Working Paper
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Simula Research Laboratory

A bibliometric analysis of the publication output

Dag W. Aksnes

NIFU

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Preface

This report presents a bibliometric analysis of Simula Research Laboratory. The report is an update of a similar analysis carried out in 2016. Contents from the previous report have been retained in the present version, including figures covering the preceding years. The report, which has been commissioned by Simula, is written by research professor Dag W. Aksnes.

Oslo, 01.09.2021

Vibeke Opheim
Director

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Summary

The analysis shows that Simula employees have contributed to approximately 830 publications in approved publication channels during the time-period 2016-2020. The annual production of journal and proceedings articles has been relatively stable the recent years.

The analysis shows that Simula is a major contributor to Norwegian ICT research, both in terms of number of scientific publications and R&D man-years. Simula ranks as the third largest unit of six major Norwegian departments/institutes within the area.

The proportion of publications in the most prestigious publication channels (level 2) is 23 percent in the period 2018-2020. With this, Simula ranks as number two of six Norwegian departments selected for the analysis.

Overall, Simula performs extremely well in terms of scientific impact measured through citations. Simula personnel have contributed to numerous highly cited articles. Overall, the WoS-indexed publications from the 2016-2018 period obtain a citation index of 230, which means that the articles have been cited 130 per cent more than the field normalised world average. The citation index is highest for the Communication System research area (286), and then follows Scientific Computing with a citation index of 241.

The extent of international collaboration measured through co-authorship is very high. Of the WoS indexed articles, 72 per cent had co-authors from other countries. This is clearly above the national (Norwegian) average, which is 66 per cent during the period.

1 Introduction, data & methods

The purpose of the present analysis is to give an overview of the publication output of Simula Research Laboratory. The publication analysis covers the five-year period 2016-2020. In addition, figures from the previous analysis of Simula have been included (2009-2015). Thus, several indicators cover a period of 12 years.

Simula is currently organised in five research areas and analyses are carried out for each of the research areas, in addition to analyses at an overall level. A variety of different indicators of the publication output have been included such as publication volume, publication type, citation indicators and scientific collaboration based on co-authorship.

In contrast to most other research institutes in Norway, Simula does not apply the national publication database, Cristin, for registering of the publication output. Instead, all publications and other types of research output are registered in an in-house database. This database is applied in the present study.

The Simula database is assumed to have an adequate coverage of the scientific publication output of the Simula employees. In addition, it includes data on other kinds of research output, such as lectures, talks, and reports. The coverage of the latter output dimension is, however, less systematic and is paid scant attention in the present report. It should be noted that works carried out by the Simula employees before they became affiliated with the institute, is not included in the database, at least this is the general principle. Within the scope of the present analysis, we have not been able to verify all the publications and the validity of the bibliographic data. Probably, some mistakes may occur in the registered data, for example concerning publication type and publication year. Thus, these aspects should be taken into account when interpreting the results.

Nevertheless, we have checked the completeness of the Simula database by comparing it with data retrieved from the two databases Cristin and Web of Science (where Simula has been listed as an author address). Here we identified many additional publications which have been added the analysis (see Table 2.1).

From Simula we received an extract from the database as a csv-file covering the period 2016-2020. As a part of the process, the publication data received have been further processed by NIFU. This includes deletion of duplicates,

reclassifications, standardisation of journal names, inclusion of Web of Science IDs, and publication channel levels (see below).

It should be noted that as a consequence of the reclassification carried out as part of the project, and the inclusion of missing publications, the figures in the report may differ from the ones that would appear when using the database directly. For example, the distinction between non-refereed and refereed proceedings papers has not been applied in the project (although there only is a minor number of non-refereed proceedings papers registered). Instead, these papers have been reclassified according to publication channels. Moreover, some extra publications may have been added the database after the data were extracted from the database.

2 Overall analysis

Figure 2.1 shows the number of Simula publications/records by publication type and year (2009–2020). All types of publications and other research output are included in the figure. During the period, there has been an increase in the overall volume. In particular, there was a strong growth from 2013 to 2014. In the following years the annual numbers have been relatively stable, but with a notable decrease from 2019 to 2020. The latter drop is due to a large decrease in the number of talks, a consequence of the COVID-19 pandemic.

The category for "miscellaneous" contributions (lectures, talks etc.) is the largest. If this category is excluded, the total publication output has varied from 155 (2010) to 276 (2016) during the time-period. There was a decline from 2016 to 2017. Then the output volume has been fairly stable during the period 2017–2020.

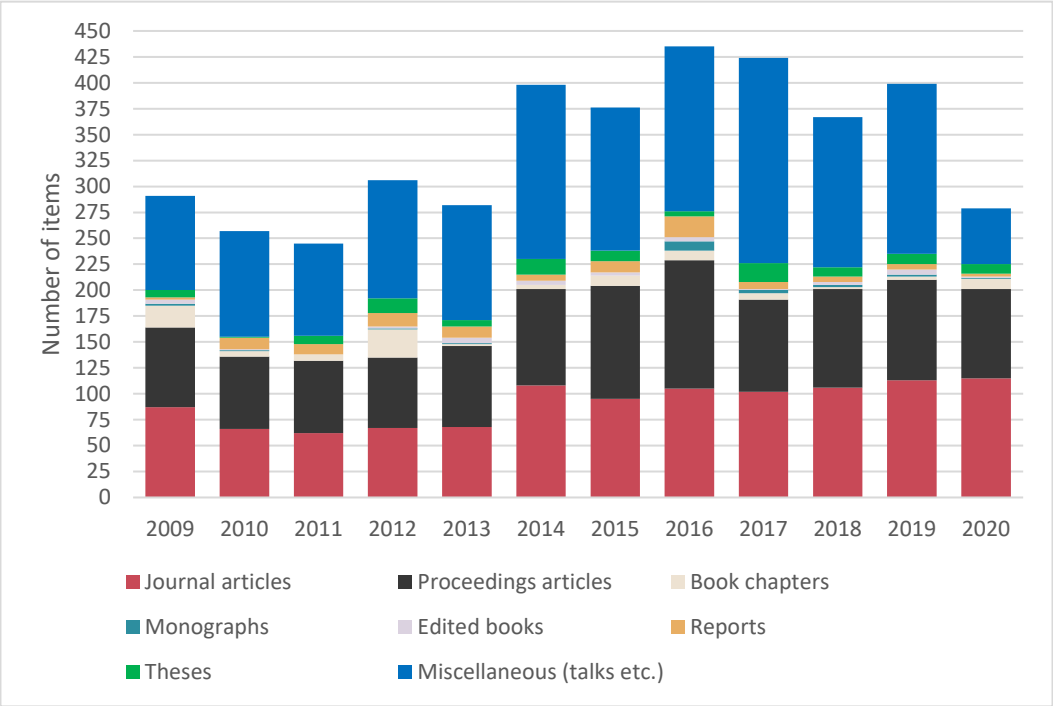

Figure 2.1 Number of publications/records by publication type and year. Simula total 2009–2020.

Figure 2.2 shows the publication output of Simula for the three largest publication types: journal articles, proceedings papers, and book chapters. As can be seen, publishing in journals and proceedings has an almost equal distribution at Simula, but the recent years the number of journal articles has been slightly higher. For both publication types, the number increased significantly from 2013 to 2016. In 2020, 115 journal articles were published and 86 proceedings articles. The number of articles in books is significantly lower and shows annual variations. In 2020, 10 book-chapters were published.

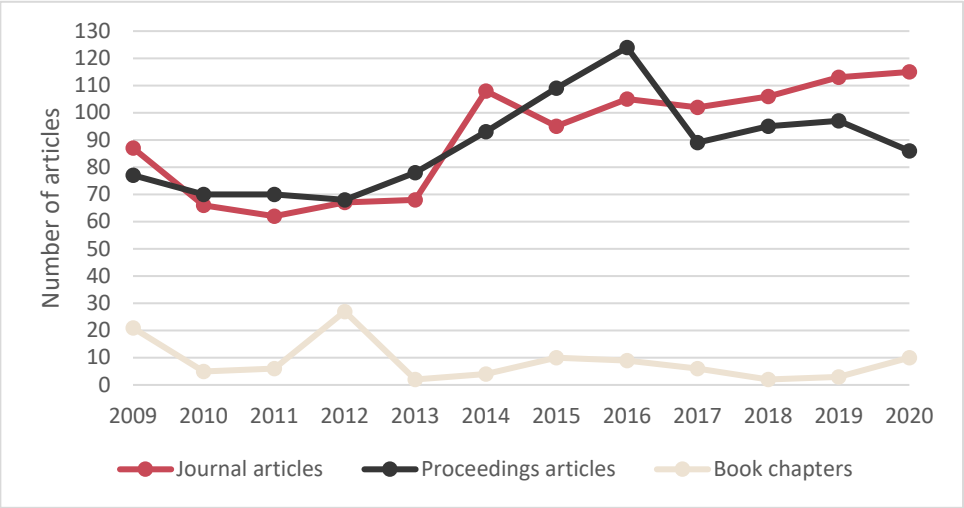

Figure 2.2 Number of publications by publication type (journal articles, proceedings papers, and book chapters) and year. Simula total 2009–2020.

The volume of the output differs significantly across the research areas of Simula. This is shown in Figure 2.3. The research area Communication System is the largest one in terms of number of items during the five-year period 2016–2020, approximately 650, followed by Scientific Computing and Software Engineering, both with more than 500. The research areas for Cryptography and Machine learning which have been more recently established, are much smaller.

In the remaining analyses of the report, we have not included the contributions in the "miscellaneous" category as this these items are of less interest from a bibliometric and research evaluation perspective.

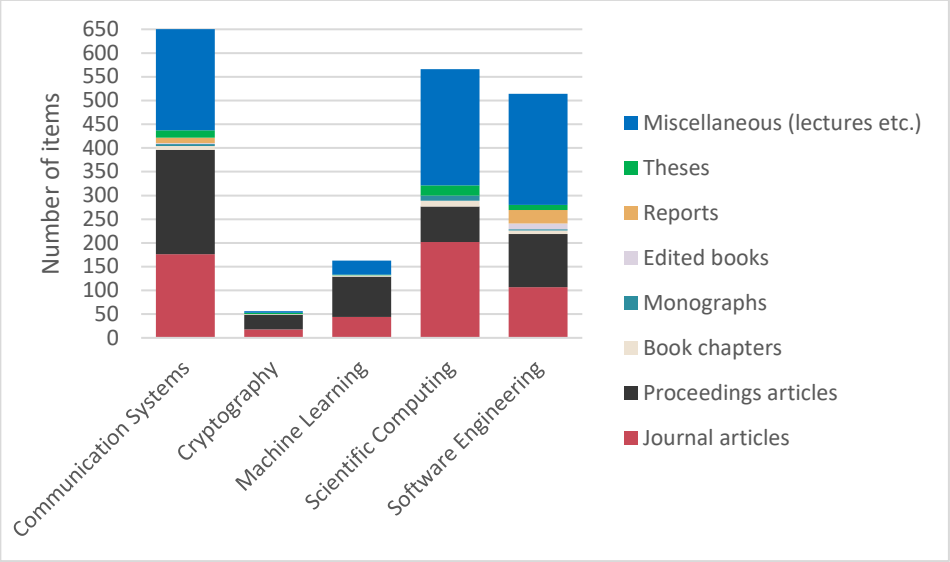

Figure 2.3 Number of publications/records by publication type and research area, total numbers for the 2016–2020 period.

Figure 2.4 shows the relative distribution of the different publication types by research areas. Scientific Computing has a publication profile where journal publishing is more important than what is the case for the four other research areas, here 63 per cent of the publication. Altogether, journal articles and proceedings articles dominate the publication output of all research areas, accounting for 78–90 percent of the publication volume. Thus, there are relatively few publications in the other categories: book chapters, monographs (single books with one or more authors), edited books, reports, and theses. The exception is Software Engineering which has a notable number of publications also in the latter categories.

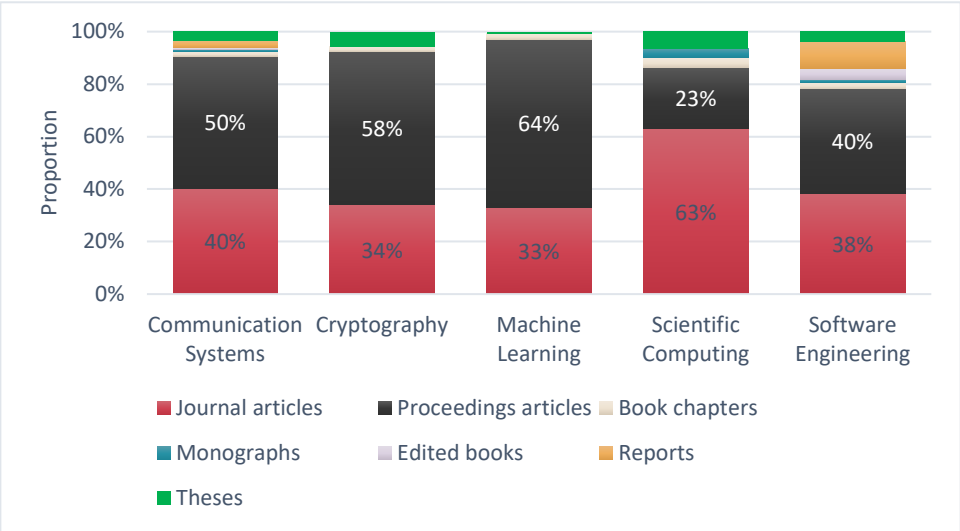

Figure 2.4 Proportion of publications by publication type and research area (total 2016–2020).

Figures 2.5a-e show the number of publications by research areas, publication type and year. For Communication System (Figure 2.5a), the number of proceedings articles has decreased significantly from 2016, while the number of journal articles has been fairly stable the recent years.

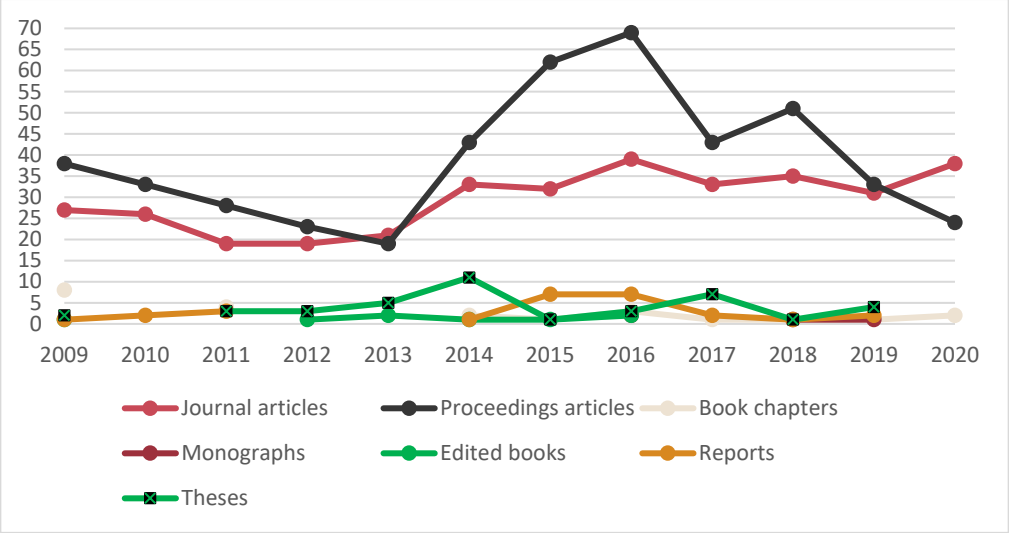

Figure 2.5a Number of publications by publication type and year. Communication System 2009–2020.

Figure 2.5b shows similar statistics for Scientific Computing. Also in this research area, the number of proceedings articles has decreased recently and there is also a minor decline in the number of journal articles.

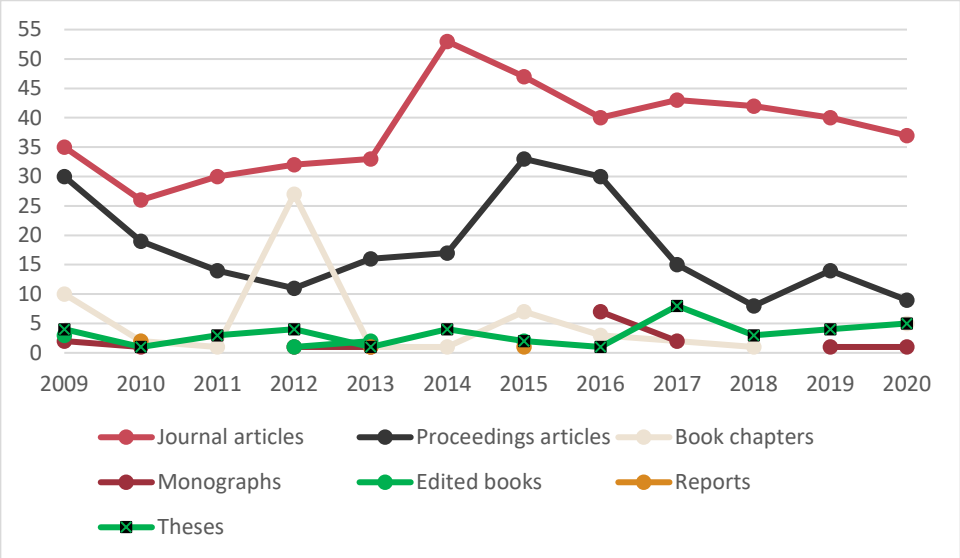

Figure 2.5b Number of publications by publication type and year. Scientific Computing

The publication numbers of the Software Engineering research area (Figure 2.5c) show a declining pattern during the 2016–2018 period while the figures have stabilized in 2019 and 2020.

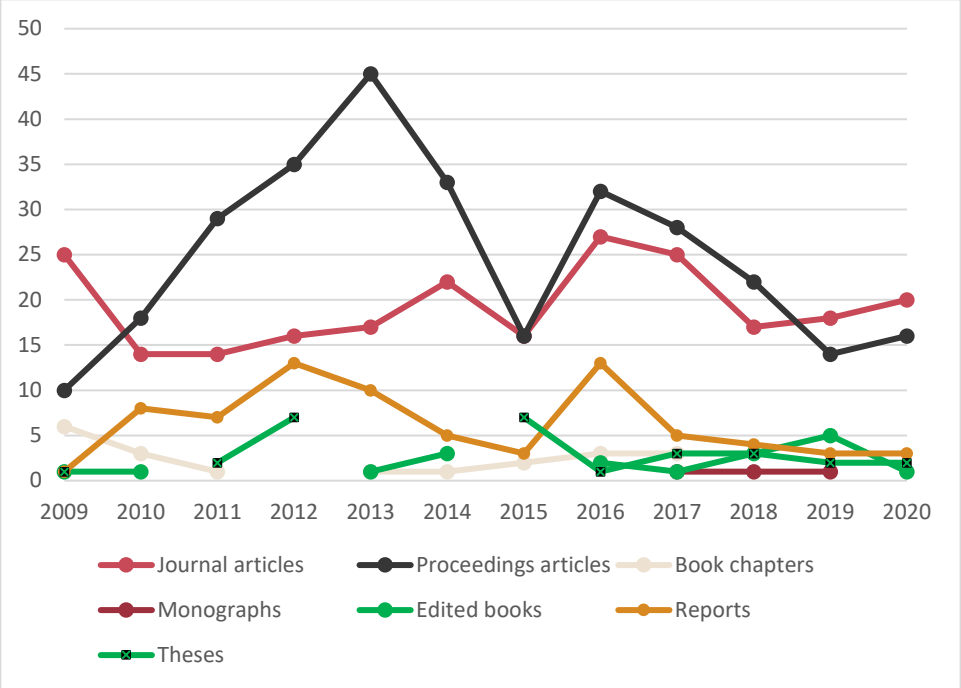

Figure 2.5c Number of publications by publication type and year. Software Engineering 2009–2020.

Figures 2.5d and e show the statistics for the Cryptography and Machine Learning research areas.

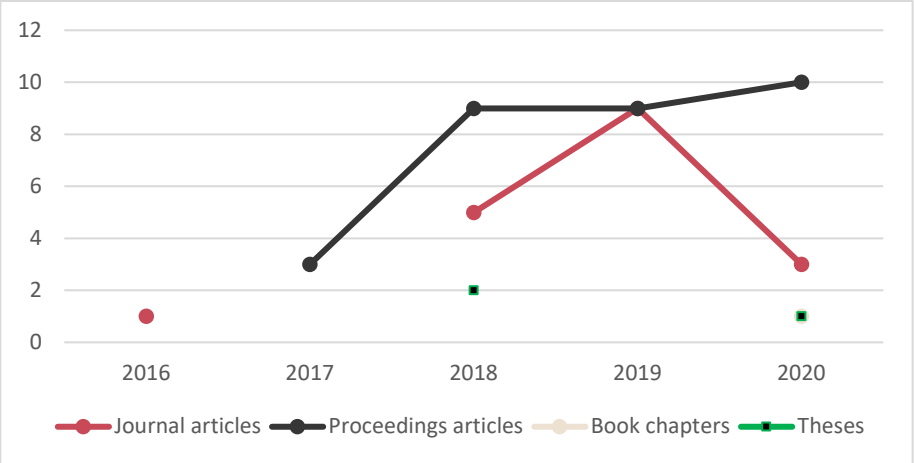

Figure 2.5d Number of publications by publication type and year. Cryptography 2016–2020.

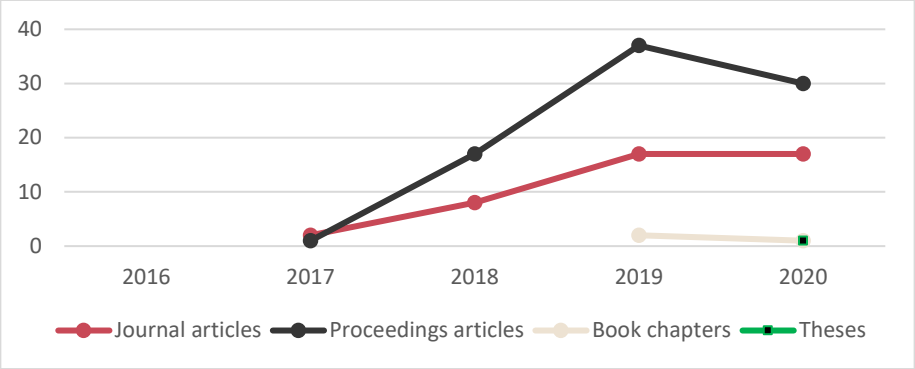

Figure 2.5e Number of publications by publication type and year. Machine Learning 2016–2020.

In Norway, publication indicators are included in a performance-based funding system of research institutes, hospitals and higher education institutions. The funding formula for publication activity includes two dimensions. First, articles in journals and series (ISSN-titles), articles in books and books/monographs (ISBN-titles) are given different weights. Moreover, publication outlets are divided into two levels in order to avoid an incentive to productivity only. The outlets given extra weight (level 2) are those defined to be the leading and most selective international journals, series and publishers (limited to about 20 per cent of the publications). In the system, only publications published in journals and by publishing houses classified as scientific/scholarly by the Norwegian Association of Higher Education Institutions (UHR) are included. The national academic councils in each discipline or field of research participate annually in determining and revising the list of approved publication channels. As part of the process, researchers may suggest publication channels for approval and nomination to level 2. These suggestions are reviewed by the national academic councils in each discipline.

In order to compare the research output of Simula with those of other Norwegian departments and institutes, we have classified each publication according to whether or not it is published in a channel included in Norwegian Register for Scientific Journals, Series and Publishers. Type of publications that will not be included in this register include proceeding papers which are not published by a scientific publishing house/scientific society. Other example are unpublished PhD-dissertations, grey literature such as reports, as well as popular science articles. Thus, the system covers publications primarily directed towards the scientific community, but not other types of research disseminations.

Table 2.1 shows the results of the analysis for the period 2016–2020. As can be seen, almost all articles in journals are published in approved channels. Also, the large majority of the proceedings articles and book chapters are published in approved channels. For the other publication types, there are none publications in approved channels. However, this may also be due to the fact that the publication

type is not approved. For example, textbooks, revised books with none or minor changes as well as editorial book publications are not approved as publication types in the system. It should also be noted that in the classification, we have not examined each publication in detail, and cases of misclassifications and doubts may occur.

As noted in Chapter 1, some additional publications which had not been registered in the Simula database, were identified from the WoS and Cristin databases. The numbers of these publications are shown in the right column of the table, these are included in the analyses.

Table 2.1 Number of records by type, approved and not approved publication channels (according to the Norwegian Register for Scientific Journals, Series and Publishers). Simula total 2016–2020.

	Approved channels/pub type	Not approved channels/pub types	Total	% in approved channels	Extra (not indexed in Simula database
Journal articles	406	30	436	93%	105
Proceedings articles	391	71	462	85%	32
Book chapters	16	0	16	100%	14
Monographs	14	2	16	88%	1
Edited books	0	14	14	0%	
Reports		40	40	0%	
Theses		51	51	0%	
Miscellaneous (talks etc.)		720	720	0%	
Total	827	928	1755		152

In Figure 2.6, we have for each research area shown the number of articles which has been published in approved channels. The figures are approximately 389 articles for Communication System, 45 for Cryptography, 120 for Machine Learning, 260 for Scientific Computing, and 200 for Software Engineering.

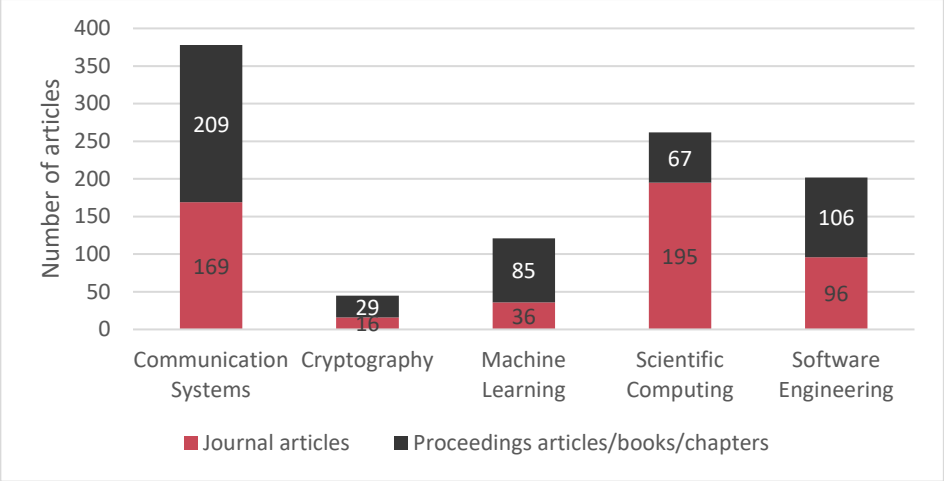

Figure 2.6. Number of approved articles by publication types and research areas (total 2016–2020).

Based on the articles in approved channels, we have calculated the number and proportion of articles in the most prestigious channels, level 2, cf. Figure 2.7. The annual numbers have been in the range of 40-50 during the recent years, an increase compared with the first part of the period analysed (2009–2013). The proportion of level 2 publications shows a slightly declining trend since 2014 but is still above the average of 20%. In 2020, 25 per cent of the publications were published at level 2. It should be noted that the level 2 publications mainly represent journal articles.

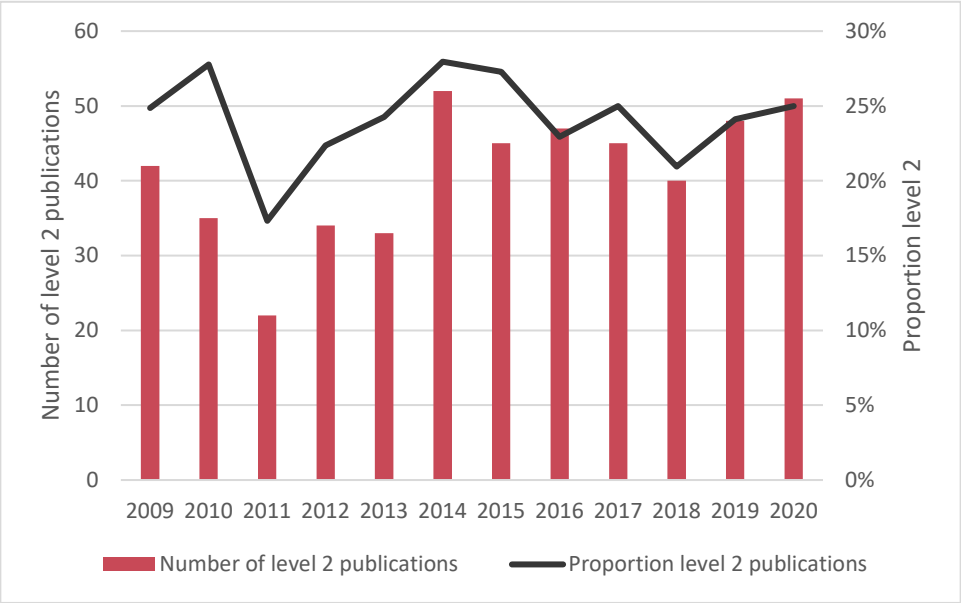

Figure 2.7. Number and proportion of level 2 publications. Simula total 2009–2020.

Based on figures for the 2016–2020 period, the proportion of level 2 publications is lowest for the Machine Learning research area (10%) and highest for the Software Engineering research area (32%), cf. Figure 2.8. Based on the premise that level 2 includes the leading and most selective international journals and publishers, high shares here indicate high ambitions when selecting journals for publication and a high quality of the research. On the other hand, it should be noted that in some subfields, particular publication patterns where level 2 publishers are few or less relevant may explain low proportions of level 2 publications. Moreover, as Simula is not part of the performance based-funding system, the institute has no specific incitement to publish in these channels or to suggest publication channels for approval and nomination to level 2. This affects the relevance of the indicator. Nevertheless, we have included indicators using the classification system because it is the common standard for measuring publication productivity in Norway.

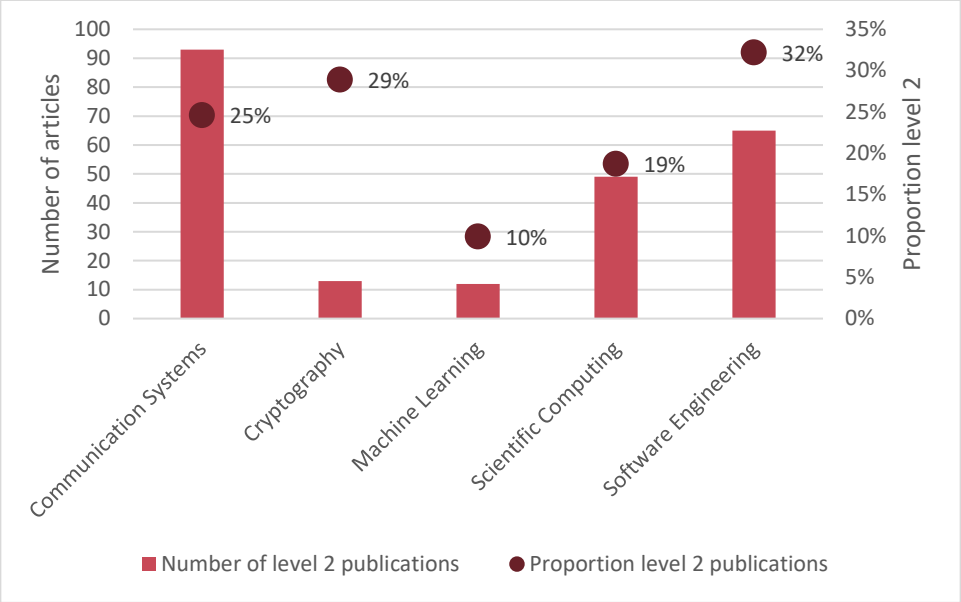

Figure 2.8. Number and proportion of level 2 publications by research area (total 2016–2020)

The publications are distributed across a large number of different journals, series and publishers. However, the frequency distribution is skewed, and some journals are more important than others are. Table 2.2 gives the publication counts for the most frequently used journals for each research area (based on the period 2016–2020). From the list of journals, one gets an impression of the overall research profile of the research areas.

Table 2.2 The most frequently used journals, number of publications by research area 2016-2020*

Research area	Journal	Level	Number of articles
Communication Systems	IEEE Internet of Things Journal	1 and 2	16
	IEEE Communications Magazine	2	11
	IEEE Transactions on Vehicular Technology	2	11
	IEEE Network	1 and 2	10
	IEEE Wireless Communications	1 and 2	9
	IEEE Access	1	8
	IEEE Transactions on Industrial Informatics	2	8
	IEEE Transactions on Smart Grid	1 and 2	6
	Computer Networks	2	4
	Computer Communications	1	3
	IEEE Computer	2	3
	IEEE Transactions on Emerging Topics in Computing	1	3
	IEEE Transactions on Intelligent Transportation Systems	1	3
	IEEE/ACM Transactions on Networking	2	3
	Multimedia Tools and Applications	1	3
	Sensors	1	3
Cryptography	IEEE Transactions on Information Theory	2	5
	IEEE Transactions on Communications	2	4
Scientific Computing	International Journal for Numerical Methods in Biomedical Engineering	1	13
	PLOS ONE	1	8
	SIAM Journal on Scientific Computing	2	7
	Journal of Open Source Software	1	6
	IEEE Transactions on Biomedical Engineering	1	5
	Biomechanics and Modeling in Mechanobiology	1	4
	Computer Methods in Biomechanics and Biomedical Engineering	1	4
	Frontiers in Physiology	1	4
	Renewable Energy	1	4
	Biophysical Journal	1	3
	Cardiovascular Engineering and Technology	1	3
	Computer Methods in Applied Mechanics and Engineering	2	3
	Journal of Computational Physics	2	3
	Scientific Reports	1	3
Software Engineering	Journal of Systems and Software	2	11
	Information and Software Technology	2	10
	IEEE Software	2	7
	Software and Systems Modeling	2	6
	Empirical Software Engineering	2	5
	Journal of Behavioral Decision Making	1 and 2	5

*) Limited to journals with at least three publications during the time-period.

In order to compare the scientific output of Simula with other relevant Norwegian departments, we have collected publication statistics for a few other units. The total number of publications for the three-year period 2018–2020 is shown in Figure 2.9. As can be seen, Simula ranks as number three in terms of publication volume of the selected units. The Department of Informatics at the University of Oslo (UiO)

is by far the largest unit, with a publication volume almost twice as large as Simula. Figure 2.9 also includes data on number of R&D work years by the selected departments. As expected, The Department of Informatics at UiO is also the largest department in terms of work years. Simula also ranks as the third largest department in terms of R&D work years. This means that Simula is a major contributor to the ICT research in Norway.

There are differences among the institutes in terms of the degree to which their R&D activities actually result in scientific publications. This is evident by comparing the publication numbers by the number of R&D work years. However, it should also be taken into consideration that the institutes are heterogeneous in terms of their R&D activities. Some institutes have a stronger focus on basic research than others, typically leading them to produce larger numbers of scientific publications. Other have a profile dominated by services and technology development where scientific publishing is less relevant. Nevertheless, Simula performs very well also in terms of productivity of scientific publications. Simula has the highest publications/staff (R&D work years) ratio of all the units included in this analysis.

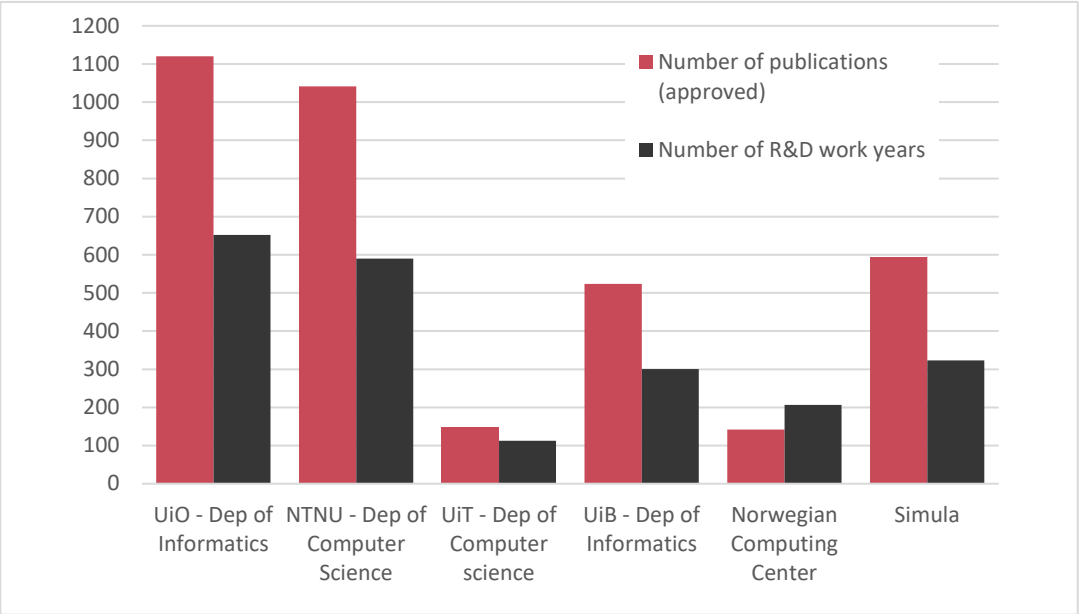

Figure 2.9. Total number of publications (approved) and total number of R&D work years for selected departments (total 2018–2020).

Source: Simula, NSD/DBH, NIFU/Nøkkeltalldatabasen. Number of R&D work years refers to number of work years by scientific personnel.

The proportion of level 2 publications for the selected units is shown in Figure 2.10 (average for the 2018–2020 publications). Here Simula ranks as number two of the departments selected for the analysis with a proportion of 23 per cent. Only the Department of Informatics at the University of Bergen (UiB) has a higher

proportion. Please note that these figures are based on publication numbers and not on author fractions (which is used in the official Norwegian publication statistics).

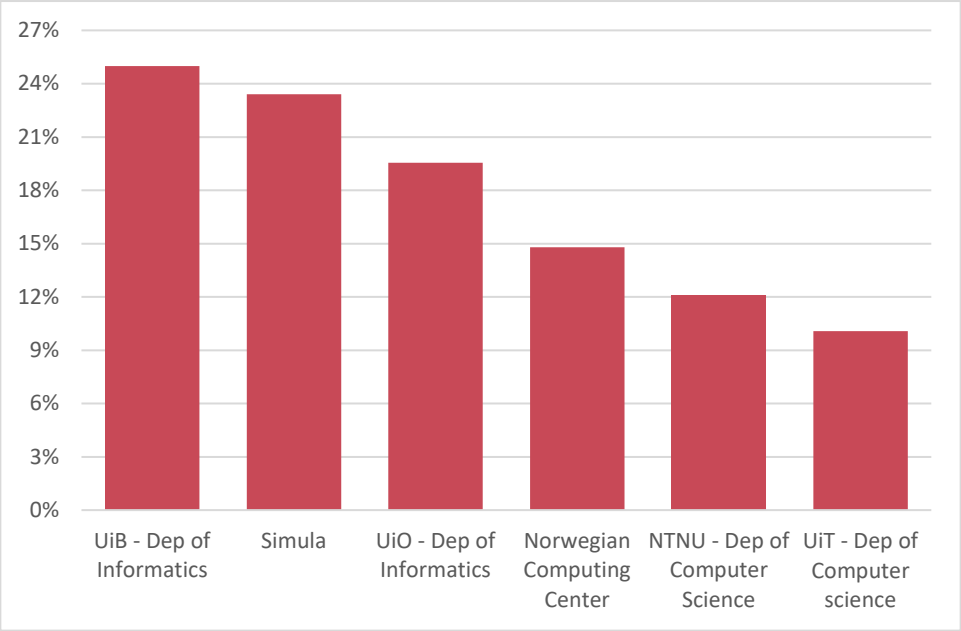

Figure 2.10. Proportion of level 2 publications for selected departments (total 2018-2020).

3 Analysis of WoS-indexed articles

In order to assess the citation frequency and collaboration pattern of Simula, we have performed an additional analysis using the Web of Science (WoS) database. The edition of WoS applied, covers the six citation indexes: Science Citation Expanded; Social Sciences Citation Index, Arts & Humanities Citation Index, Conference Proceedings Citation Index, Emerging source citation index, and the Book citation index. It should be noted that the analyses conducted in the previous edition of this report did not include the three latter indexes. Therefore, the previous analyses were based on a more limited set of the publication output of Simula, in particular it did not include articles in proceedings. Still, the coverage of the more extensive version of WoS is selective and several journals and proceedings where Simula employees have published are not indexed (see Figure 3.1, below).

We have identified the citation counts of the Simula articles which are indexed in the WoS-database. The calculation of citation indicators has been based on aggregated bibliometric statistics at country and field/subfield level. The individual articles and their citation counts represent the basis for the citation indicators. In the citation indicators we have used accumulated citation counts. The edition of WoS applied in the study, covers the period up to and including 2020. This means that for the articles published in 2016, for example, citations are counted over a 5-year period (2016-2020), while for the articles published in 2018, citations are counted over a 3-year period (or more precisely a 2–3-year period: the year of publication, 2019 and 2020). Articles from 2020 and 2019 are not included in the citation analysis, as these have not been available in the literature for a sufficiently long time to be cited. However, articles from the latter years are included in the analyses of collaboration.

In the calculation of citation indicators, Simula has been credited a fraction of the articles corresponding to the number of authors from Simula and a square root of this fraction has been calculated. This is the basis for the weight of each article in the index and corresponds to the weighting principle applied in the Norwegian publication indicator.

The average citation rate varies a lot between the different scientific disciplines. As a response, various reference standards and normalisation procedures have

been developed. The most common is the average citation rates of the field in which the particular papers have been published. In the analysis, we have used the world and Norwegian field averages for comparing the citation counts of Simula. A relative citation index is calculated as the ratio between the average citation rate of Simula's articles and the average subfield citation rate. In this way, the indicator shows whether the Simula articles are cited below or above the world and Norwegian average of the subfields in which the institute is active.

It should be emphasised that the indicators cannot replace an assessment carried out by peers. In the cases where an institute is poorly cited, one has to consider the possibility that the citation indicators in this case do not give a representative picture of the research performance. Citations have highest validity in respect to high index values. But precautions should be taken also here. For example, in some cases one highly cited researcher or one highly cited publication might strongly improve the citation record of a group or even a department. Citations mainly reflect intra-scientific use. In a field like ICT, with strong technological and applied aspects it is important to be aware of this limitation. Practical applications and use of research results will not necessarily be reflected through citation counts.

Figure 3.1 shows the number of WoS articles for the Simula research areas. As can be seen, the large majority of the journal articles are indexed in WoS. The proportion is 86 per cent but varies somewhat across the research areas.[1] For articles published in proceedings the overall proportion is 53 per cent. Thus, WoS covers a more limited part of these publications. In other words, the analyses of citations (and collaboration, below) are based on a limited part of the overall research output. Also other units within the ICT field are affected by the coverage limitation, and an analysis of WoS-publications still gives interesting information of the scientific performance.

[1] The main reason is that some journals which Simula employees have published in are not indexed in WoS. In addition, in a few cases, we have not been able to identify the articles in the WoS edition applied in the study, despite the fact that the articles have been published in indexed journals. This may be due to a lack of an indexed Simula author address in the papers.

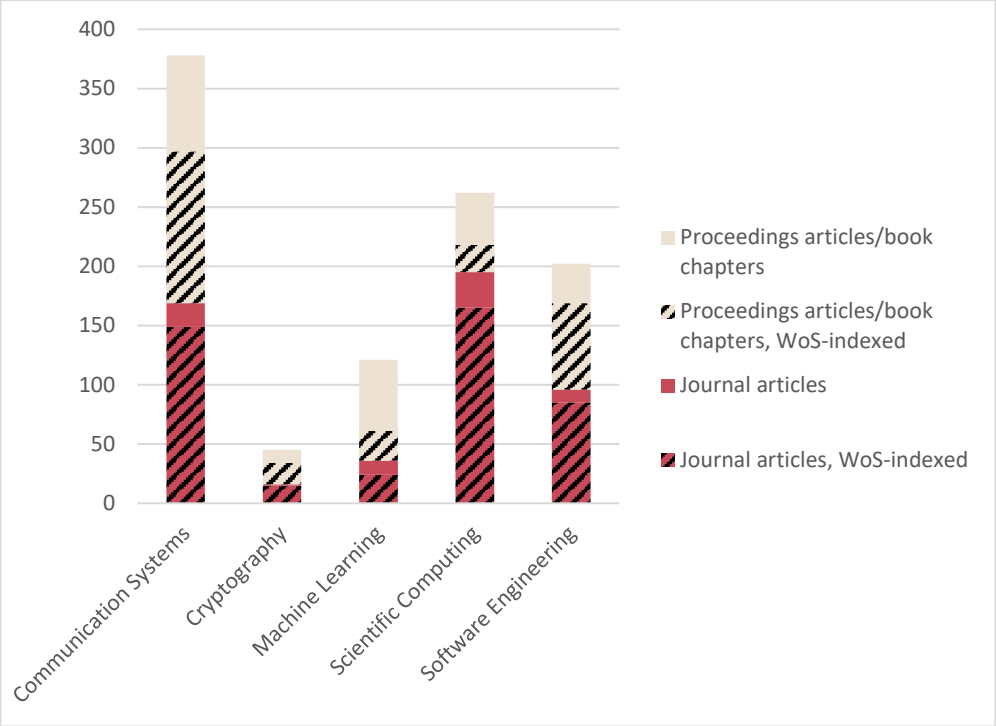

Figure 3.1 Number of articles (NVI approved) by publication types, and research areas (total 2016-2020).

Figure 3.2 shows the development of the relative citation index by publication year. In the black line, the citation counts of the Simula publications have been compared with the world average, while the red line shows similar figures where the Norwegian field average is used as baseline. Figure 3.2 also includes the results from the previous report (2009–2013) and for the year 2014 we have carried out a new supplementary citation analysis. For 2015 data are not available, therefore citations indicators are missing for this year.

As can be seen, the annual citation index shows rather large fluctuations during the period, which is not unusual in analyses like this. However, overall, the publications from the 2016–2018 period have been cited much higher than the world average. Norwegian ICT research is generally cited above the world average. Therefore, the Simula figures are lower when this average is used as baseline, but still 60 per cent above this average. Overall, Simula performs exceptionally well when it comes to the citation rates of their research publications during the period. The citation rates have also increased significantly compared with the years covered by the previous analysis (2009–2014), where the citation rates were also clearly above world average. This analysis was, however, based on a more limited part of the publication output, as explained above.

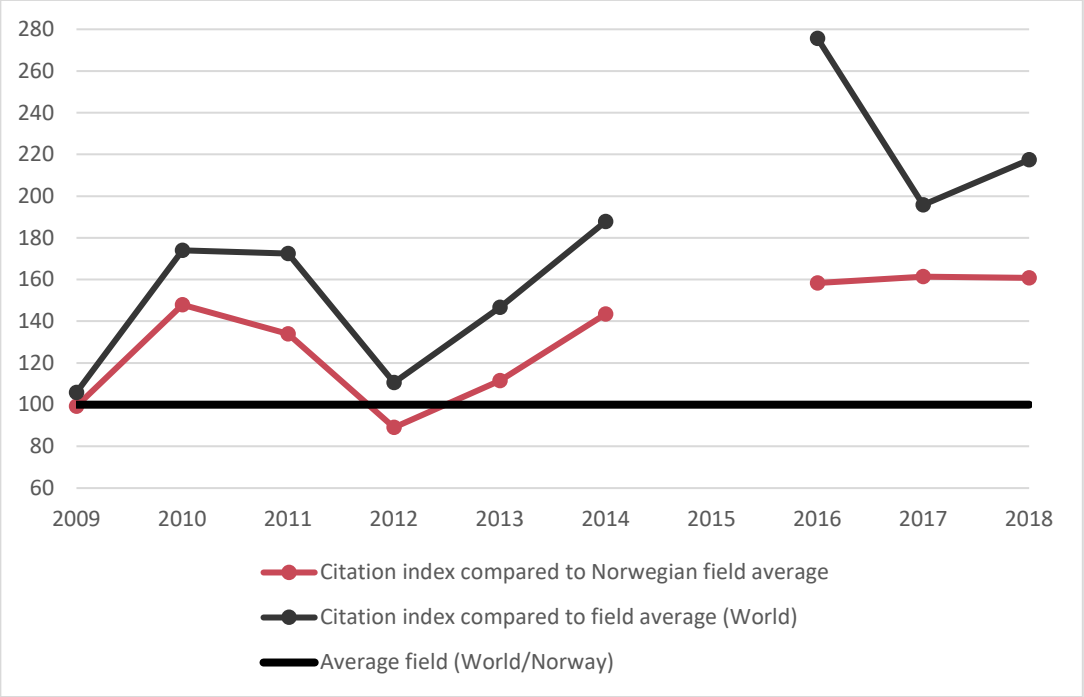

Figure 3.2 Relative citation index* Simula, compared with the field averages for Norway and the world. 2009–2018.

**) Based on annual publication windows and accumulated citations to these publications.*

Figure 3.3 shows the citation index by Simula research area, covering the entire 2016–2018 period. The citation index is highest for the Communication System research area. Compared to the world average, the citation index of the research area is 286, which means that the publications have been cited 186 per cent more than the field normalised world average. Then follows Scientific Computing with a citation index of 241. Cryptography and Software Engineering obtain the lowest indexes, but the publications are still cited clearly above the world average. Overall, the Simula publications have a citation index of 230, which also is far above the world average.

Compared with the field normalised Norwegian average, the citation indexes are lower, as expected. Overall, the Simula publications have been cited 60 per cent more than this average. The Communication System articles have been cited 113 per cent more than the comparable Norwegian average (citation index 213). Here Scientific computing has the lowest score, as the Norwegian average is very high in this area.

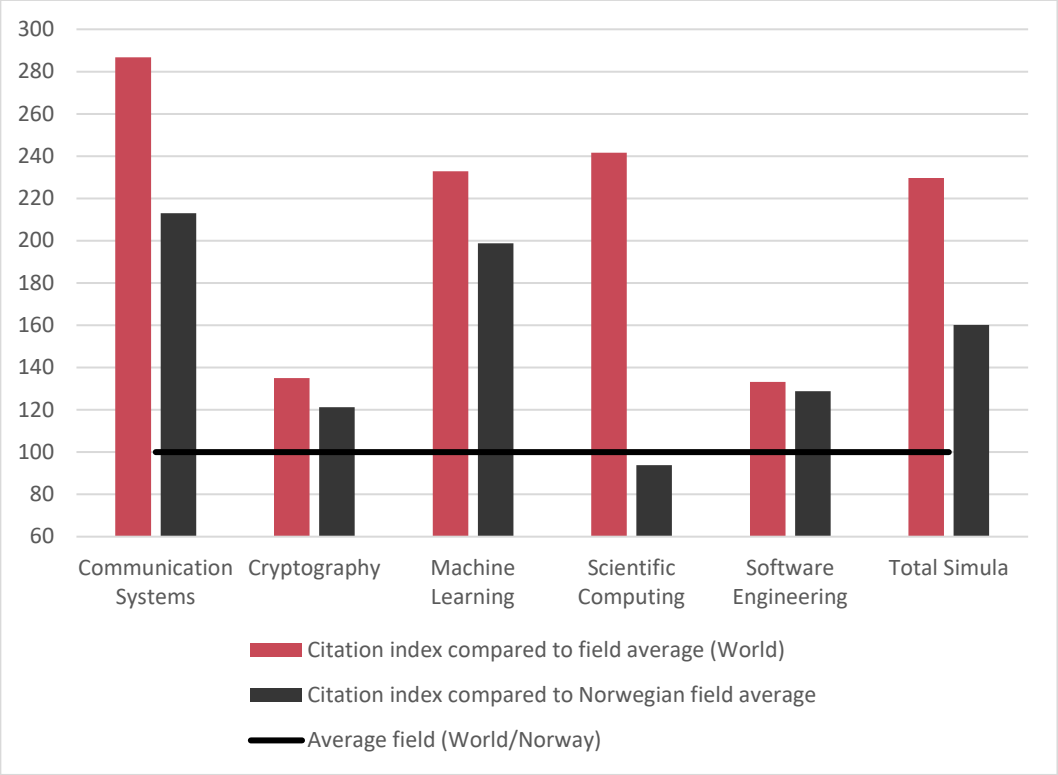

Figure 3.3 Relative citation index* by research areas (2016–2018 publications), compared with the field averages for Norway and the world.

**) Based on annual publication windows and accumulated citations to these publications.*

In order to provide further insight into the scientific profile of Simula, we have analysed the distribution of the articles at subfield levels. This is based on the classification system of WoS, where the journals have been assigned to different categories according to their content (journal-based research field delineation).

The citation index is highest for the publications classified within the WoS category Computer Science, Information Systems. Compared to the world average, the citation index is 463 and 98 of the Simula articles are classified within this subfield (Figure 3.4). Then follows Telecommunications with a citation index of 345. The citation index is lowest in Computer Science, Artificial Intelligence with 96.

The figure provides an indication of which areas the Simula research has obtained highest and lowest impact as measured by citation (for an explanation of the content of the different categories see https://mjl.clarivate.com/help-center.

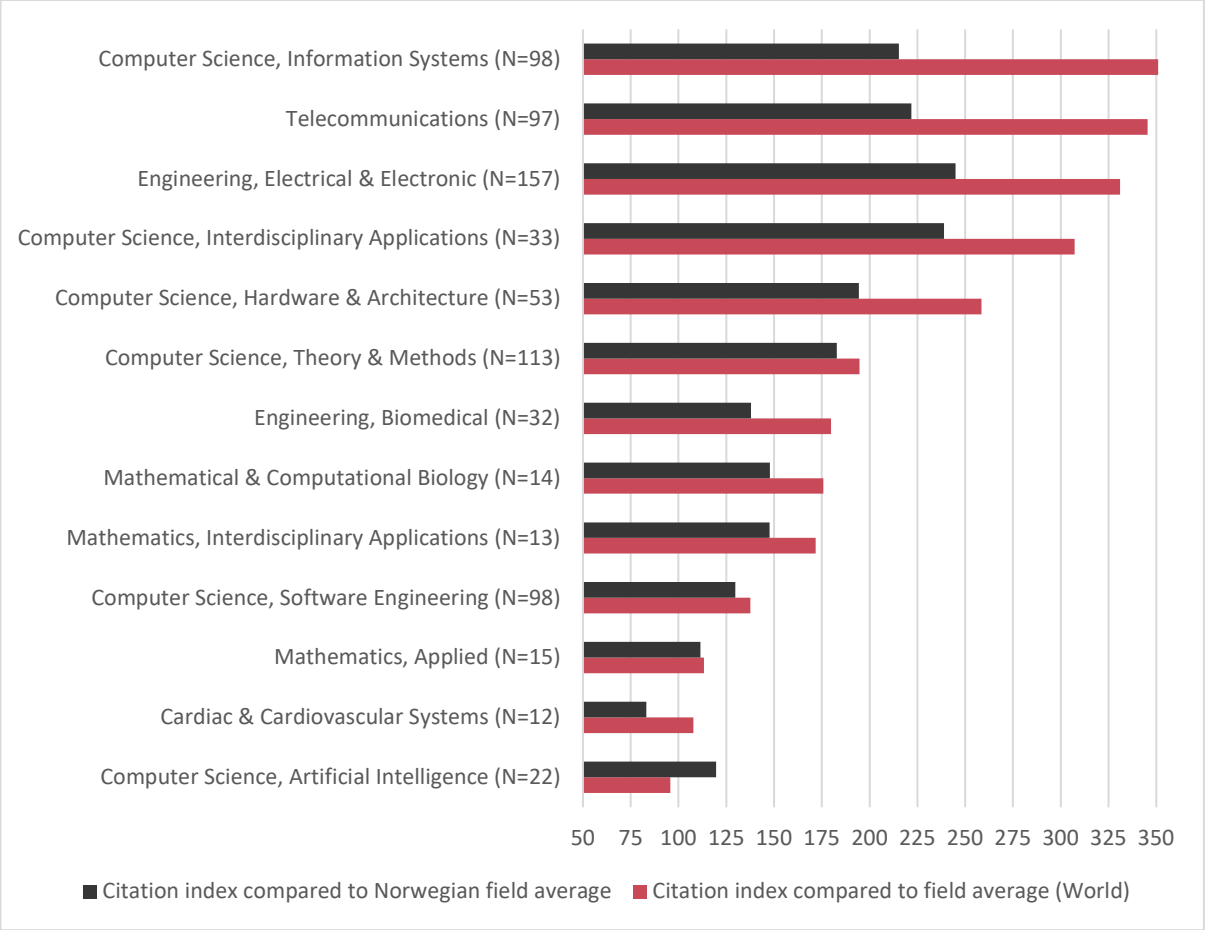

Figure 3.4 Relative citation index* by WOS categories (Simula total, 2016-2018 publications), compared with the field averages for Norway and the world.

**) Based on annual publication windows and accumulated citations to these publications.*

As the WoS-database includes data on the co-authors of the publications, we are able to analyse the collaboration profile of Simula based on co-authorship. In total, 72 per cent of the Simula articles had co-authors from other countries (total for the 2016–2020 publications). This is a minor increase compared with the previous 2009–2014 period with a proportion of 69 per cent. In other words, more than two out of three publications were internationally co-authored (Figure 3.5). This is also above the national (Norwegian) average, which is 66 per cent during the period. The proportion is highest for the Cryptography (85%) and Communication Systems (83%) research area and lowest for the Software Engineering and Machine learning research areas (54–53 %).

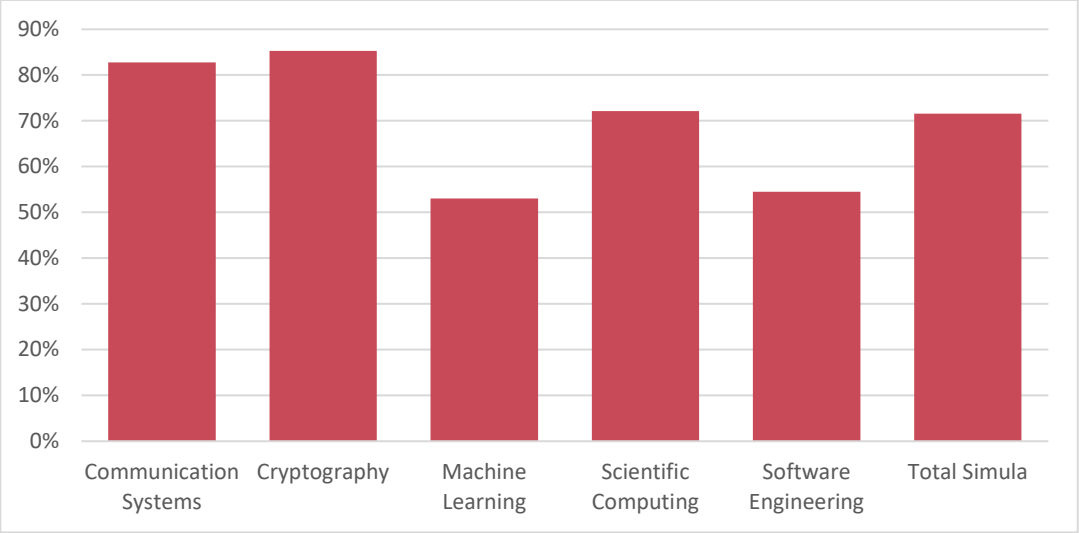

Figure 3.5 The proportion of international co-authorship by research area, 2016–2020 publications.

Which countries are the most important collaboration partners for Simula? In order to answer this question, we analysed the distribution of co-authorship. Table 3.1 shows the frequencies of co-authorship for the countries that comprise the institute's main collaboration partners in the period 2016–2020.

China is the most important collaboration partner country, and 20 per cent of the articles also had co-authors from this nation. Then follows USA with 16 %, Sweden and UK with 11 per cent.

Table 3.1 Collaboration by country. Number and proportion of the Simula article production 2016-2020 with co-authors from the respective countries.*

Country	No. articles	Proportion
PEOPLES R CHINA	142	20%
USA	111	16%
SWEDEN	78	11%
UK	80	11%
GERMANY	53	7%
ITALY	46	6%
SPAIN	45	6%
FRANCE	35	5%
AUSTRIA	30	4%
CANADA	21	3%
NETHERLANDS	18	3%
SWITZERLAND	16	2%
DENMARK	15	2%
JAPAN	15	2%
FINLAND	14	2%
GREECE	12	2%
IRELAND	11	2%
TAIWAN	11	2%

*) Only countries with more than 10 collaborative articles are shown in the table.

In Table 3.2 we have shown which foreign institutions that have the highest number of co-authored articles with Simula. On the top of the list, we find University of Electronic Science and Technology of China (UESTC) with 32 shared articles.

Table 3.2 Collaboration by foreign institutions. Number and proportion of the Simula article production 2016–2020 with co-authors from the respective institutions.*

Institution	Country	No. collaborative articles
Univ Elect Sci & Technol China	PEOPLES R CHINA	32
Guangdong Univ Technol	PEOPLES R CHINA	23
Chalmers Univ Technol	SWEDEN	19
Karlstad Univ	SWEDEN	18
Univ Oxford	UK	15
Beihang Univ	PEOPLES R CHINA	15
Beijing Univ Posts & Telecommun	PEOPLES R CHINA	14
Univ Calif San Diego	USA	14
Politecn Torino	ITALY	12
Nanjing Univ Posts & Telecommun	PEOPLES R CHINA	11
Karolinska Inst	SWEDEN	10

*) Only institutions with more than nine collaborative articles are shown in the table.

Table 3.3 shows similar figures, but for Norwegian institutions. As can be seen, a very large number of articles (341) have been co-authored with researchers affiliated with the University of Oslo. In fact, almost than half of the Simula articles also have co-authors from this institution. It should be noted, however, that people with dual affiliations (i.e. Simula and University of Oslo, Professor IIs) may list both addresses on the publications. These articles will therefore be identified as involving national collaboration in the analysis.

Table 3.3 National collaboration by institution. Number and proportion of the Simula article production 2016–2020 with co-authors from the respective institutions.

Institution	No. collaborative articles	Proportion
Univ Oslo	341	48%
Oslo Univ Hosp	42	6%
Univ Bergen	26	4%
Cancer Registry Norway	24	3%
Norwegian Univ Sci & Technol	21	3%
UIT Arctic Univ Norway	21	3%
Oslo Metropolitan Univ	21	3%
Norwegian Univ Life Sci	18	3%
Cisco Syst	17	2%

*) Only institutions with more than 15 collaborative articles re shown in the table.

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