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SCHOLARLY JOURNALS IN BUILDING AND CIVIL ENGINEERING – THE BIG PICTURE AND CURRENT IMPACT OF OPEN ACCESS

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SUMMARY*: The publishing of scholarly peer reviewed journals has in the past 20 years moved from print to primarily digital publishing, but the subscription-based revenue model is still dominant. This means that the additional benefits of open access to all scholarly articles still remains a vision, despite some progress. A selection of 72 leading journals in building & construction was studied, in order to determine the current status in this subfield of engineering. Of the approximately 9,500 articles published yearly in these, only some 5,6 % are in the 11 full OA journals included, and a couple of percentage more are paid OA articles in hybrid journals. In most of the OA journals publishing is free for the authors. In terms of OA maturity, the field lags far behind the situation across all sciences, where at least 15 % of articles are in full OA journals. If OA is to become more important in our field, the growth is likely to come from major publishers starting new journals funded by author payments (APCs) or converting existing hybrid journals once they have reached a critical share of paid OA articles.*

KEYWORDS*: Scholarly publishing, Building and Construction, Internet, Open Access*

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1. INTRODUCTION

It is paradoxical that Tim Barners-Lee invented the World Wide Web primarily in order for researchers to share information more efficiently, yet many other branches of society have taken the web in more efficient and innovative use, than the international research community. In scholarly journal publishing technical developments have been rapid and dramatic and almost all journals are nowadays also digitally published, and articles predominantly retrieved and read electronically. But unfortunately, the socioeconomic infrastructure underpinning this is lagging far behind other media industries, not making full use of the potential available. Scholarly journal publishing is suffering from a peculiar oligopolistic situation, which together with the prevailing publication and academic evaluation cultures has resulted in strong inertia to change (Björk, 2017). Although search and retrieval of scholarly articles has improved a lot from a technical point of view, the system as a whole is far from making optimal use of the potential of the web. The time takes it from submission to publication is often over a year (this author has experienced delays of up to three years in construction journals) and even after publication the presented research results are hidden to all but subscribers. Also, access is unnecessarily limited. Hardly any Finnish researchers have for instance direct access to articles published in ASCE-journals, since these are not included in the big e-license packages from leading publishers (such as Science Direct or Springer Link) but require separate arrangements.

The relative importance of peer reviewed journal publishing differs between scientific fields. In STM fields like biomedicine the journal is the totally dominating mechanism for disseminating new scientific results. In the social sciences and humanities book chapters and full monographs are important outlets. In fields like high energy physics and economics preprint servers for early manuscript versions are important means for early dissemination. And in engineering, including computer science, conference papers provide an important outlet. The regular conferences organized by ASCE or CIB commissions provide good examples. The rest of this article will nevertheless concentrate on journal publishing, partly because much of conference publishing is not covered in systematic indexes like web of science or Scopus.

2. OPEN ACCESS AS AN ALTERNATIVE "BUSINESS MODEL"

What OA advocates saw already in the 1990s is that the obvious solution is making the scholarly record available to everyone with no access barriers whatsoever (Suber, 2012). There are several motivations for this. Firstly, research and the production of scholarly journal articles, up to the point of acceptance of a manuscript, is largely publicly funded, and thus the reporting of the results should be a public good free for anybody to access. Secondly, if all journals would convert to electronic only and OA publishing funded by charging the author side, the ensuing system would be cheaper than the current mixed paper/electronic one. Also, marketing, negotiation and invoicing costs would be lower. And lastly the impact of research on the research of others, industrial development and policymaking would increase.

Open access (OA) can be viewed from a technical or legal viewpoint. So-called free OA means essentially that anybody with Internet access can read and download a scholarly journal article, with no technical barriers whatsoever (such as subscriptions, need to register etc.). Libre OA further requires that the access is regulated by copyright statements allowing readers to do a number of things with the article, such as further sharing, data mining etc. Mostly this is done using a standard Creative Commons license, which is the case of ITcon. In Full OA journals all research articles are free, and the production of such journals can either be funded by charging authors (so-called APCs) or by by voluntary labor, subsidies from universities and scholarly societies etc. Hybrid OA journals are traditional subscription journals, which make individual articles OA provided that the authors pay an article processing charge (APC).

The above is what in the OA discourse is described as the gold route to OA (Harnad et al, 2004). In addition, copies of different stage versions of an article can often be found in different repositories on the web (green route). Within the boundaries defined by the licensing rules of the publishers, this can be done in the institutional repositories of the authors' universities, or in fields like physics and medicine in subject bases repositories like arXiv and PMC. The downside is that the publishers often allow this only after an embargo period after formal publishing, typically a year and in the social sciences often two (Laakso and Björk, 2013). In addition, social networks like ResearchGate, which don't control the legality of uploaded copies, have become popular with

authors (Van Noorden, 2014). And at the totally illegal end of the spectrum are pure pirate sites like Sci-Hub, which houses around 50 million article copies (Bohannon, 2016), (Himmelstein et al, 2018).

3. JOURNAL PUBLISHING IN BUILDING & CONSTRUCTION

The current situation in the building & construction domain is characterized by a large number of thematically overlapping journals, many of which have rather small yearly volumes. Five commercial publishers share the market (Elsevier, Springer, Wiley, Taylor & Francis and Emerald) and the sixth major journal provider is the society publisher ASCE. The vast majority of the journals were founded between 1970 and 2000. Some of the journals have first been published by smaller publishers or universities but have later been acquired by these majors or are published in partnership with them.

The business of these major publishers is extremely lucrative. The operating profit levels, defined as the share of profits before taxes of the total revenues, were for instance in 2010-2012 for leading publishers Elsevier, Springer, Wiley-Blackwell and Taylor & Francis all in the range 32-42 % (Morrison, 2012).

In order to get a more precise overview of the field of construction and building an empirical study of leading journals was carried out. To this author's knowledge, no such studies have earlier been undertaken. The only articles on this area of scholarly journal publishing seem to have been case studies of individual journals, often concentrating on the country affiliation of authors, topical areas etc. (Betts and Lansley, 1993), (Lazmazaheri and Rasdorf, 1998), (Pietroforte and Aboulezz, 2005). An ITcon case study from a decade back also contained some performance comparisons with other construction IT journals (Björk and Turk, 2006).

The Scimago free web service provides useful Scopus index data about journals, which can be searched according to different classifications. The Scopus index has a more comprehensive coverage of journals than the more well-known Web of Science. In particular, it enables a comparison of the descriptive data for journals in over 200 different subject fields. Of these three subject fields: "Architecture", "Building and construction" and "civil and structural engineering" contained journals of interest for this study. The data for these three were downloaded as Excel files. The three files were merged yielding a total of 722 journals. After book series and conference proceedings were eliminated 491 peer reviewed journals remained. A feature of Scopus is also that many journals are classified in multiple categories. After eliminating double and triple occurrences in the merged Excel sheet, a list of 380 journals remained.

In terms of the number of published articles and citations received the list is highly skewed. The total article count was 35,298 and the 100 biggest journals contained 73,3 % of the articles and received 88,0 % of all citations. Furthermore, if the journals are sorted according to the total citation counts, the 100 most cited journals received 92,6 % of citations.

The journals can be sorted according to the country of the publisher. The UK (110) and the United States (93) where the leading countries, due to the location of the major international commercial publishers as well as important society publishers such as ASCE. In addition, the numbers for the Netherlands (31) and Germany (17) can largely be explained by journals published by Elsevier and Springer. All in all, 65,8 %, of the journals were published in these four countries and their combined article output was 72,7 % of articles, receiving 88,7 % of citations. China (21) had the biggest share of the remaining journals.

In order to drill down further and obtain more detailed information, a more narrow selection of journals was made. All CIB recognised and encouraged journals (27) were initially included, but two had apparently ceased publishing. In addition, roughly half of all journals published by ASCE were included (14/38). ASCE journals, the content of which were deemed out of scope (i.e. aerospace engineering) were excluded.

In addition, the Scopus Journal Metrics (https://journalmetrics.scopus.com) was used to search for the high impact journals classified in either of the three specific subject areas: Architecture, building and construction, civil and structural engineering. The Source Normalized Impact Factor (SNIP) is a better measure to compare the citation impact of journals than the more widely known JCR impact factor. This is because SNIP values take into account the quite big differences in averages per article citation rates between fields of science. All journals with above average citation rates for their fields, that is a SNIP value of 1 or higher, were included. This yielded 39 journals in addition to the CIB and ASCE journals. All in all, 72 journals were included in the final sample.

There are hundreds of scholarly journals within building and construction which were not in the sample but the scientific impact of these is peripheral and their publication volumes are generally lower. Such journals are often published by societies and universities from different regions of the world, often in other languages than English.

Table 1 shows the number of journals and articles published by publisher. The 72 journals publish around 9,500 articles per year[1]. The distribution is highly skewed with a small number of large volume journals (in particular published by Elsevier) raising the mean to 131 articles/journal, while the median is 51 articles per journal. As a result, Elsevier was the publisher of 62 % of all the articles. The biggest journals dealt with building materials. Although the number of full OA journals was eleven, they only published 525 articles (5,5 % of the total). Most of these were published by universities or societies. On the other hand, almost all subscription journals offer a hybrid OA option for authors. The 25 CIB endorsed journals published 1051 articles.

Table 1. The journals by publisher and yearly volume of articles

		journals	articles	average	median
				/journal	/journal
ASCE		14	1389	99	68
Elsevier		17	5821	342	174
Emerald		10	305	31	28
MPDI		1	120	120	120
Sage		1	28	28	28
Springer		3	343	114	49
Taylor&Francis		8	362	51	36
Techno Press		1	159	159	159
Wiley		5	351	70	69
Institutes		3	138	46	38
Universities		4	71	18	16
Societies		4	263	66	64
All publishers		**72**	**9444**	**133**	**51**
OA journals		**11**	**525**	**48**	**38**
CIB Endorsed Journals		**25**	**1051**	**42**	**29**

Checking the hybrid OA uptake in all the journals would be very resource demanding, since journals tend to have different methods for tagging such articles, and there are usually not search facilities for them. For this reason, only four journals from different publishers were checked. Journals with which ITcon readers are likely to be familiar were picked. The results are shown in table 2 below.

[1] Yearly averages where computed from the total documents sums for 2015-2017 in the Scimago service. For the 12 journals for which that data was not available, the articles in 2017 were hand counted from their websites.

Table 2. Share of hybrid OA articles in four subscription journals

Journal	Publisher	APC	total	hybrid	% -
		US$	articles	articles	share
Automation in Construction	Elsevier	2500	186	2	1,1
Construction Innovation	Emerald	2650	24	1	4,2
Computing in Civil Engineering	ASCE	1750	108	1	0,9
Construction Management and Economics	Taylor & Francis	2950	46	4	8,7

The figures are low, in line with global studies of the uptake of hybrid OA. The Figure for Construction Management and Economics could be due to the higher share of UK authors (for which there are automated institutional payment systems for APCs), but the sample is so small that it's impossible to draw any conclusions.

4. THE OA JOURNALS

Eleven of the studied journals are full OA journals. They publish yearly an estimated 525 articles, which represents 5,6 % of the total article output. It is useful to look at these as individual cases, with different histories, contexts and technical platforms.

Case Studies in Building Materials is part of Elsevier's growing portfolio of full OA journals, and was started in 2014. The aim is to publish short papers on case studies and tap into that particular market segment. The APC is low for Elsevier, only 500 USD. The article numbers are quite low, and the sister journal Case studies in Structural Engineering was cancelled in 2017.

International Journal of Concrete Structures and Materials is published by the Korea Concrete Institute and seems to have gone through a number of transformation since its launch in 1998. Prior to 2006 it was called the Journal of the Korea Concrete Institute, and then changed its name to the current "international ..". It's unclear when the journal converted to OA. Since 2012 it is published in partnership with Springer, as part of the "Springer Open" label. The APC is currently 1420 USD. Around 40 % of the authors in 2017 where from Korea.

Buildings is in contrast to the two above published by a specialized OA publisher, MPDI, which has launched over two hundred OA journals in the past ten years, covering all fields of sciences. Although the main office and origin are in Switzerland, most of the operations are located in mainline China, which explains the relatively low APCs charged for the journals, in the case of Buildings 500 USD. Buildings differs from almost all other journals in this study by it's broad scope encompassing all of building construction, and the journal has had a rapid growth in article numbers (120 in 2017 and a predicted 160 for 2018, based on the first half of the year). It comes close to the concept of a megajournal, discussed elsewhere in this article, although its peer review criteria differ.

Journal of Information Technology in Construction (ITcon) is a typical representative of the "Indie" OA journal, started by scholars who were enthusiastic about the potential of the web (Björk et al, 2017). The journal was founded in 1996 by four researchers active in the working commission W78 of CIB (Martens et al, 2003). The official publisher was at first the Royal Institute of Technology in Stockholm, where the editor-in-chief worked at that time. There was also some initial funding available to launch the journal. The technical Infrastructure was developed and is still hosted at the University of Ljubljana. At a later stage CIB became the nominal official publisher, but with no practical involvement or funding. This was in connection with a bid to become indexed by ISI, because the editorial team felt it would increase the chances of acceptance. ITcon is one of the longest surviving voluntary based OA journals, and is nowadays published using the OJS software. OJS is a widely used open source software for scholarly publishing (Edgar and Willinsky, 2010).

Electronic Journal of Structural Engineering (EJSE) is like ITcon a born-OA journal, and was founded in the year 2001. In the early days it was common to name such journals with "electronic .." upfront, to distinguish them from the traditional journals which still were paper based. There is no explicit information on the website about an official publisher, but the editor is based at the university of Melbourne. EJSE uses its own publishing software and accepts submissions by email.

Construction Economics and Building was also founded in 2001, by researchers at the University of Technology Sydney, and is nowadays published by the University Press of that University. It was earlier known known as the Australasian Journal of Construction Economics and Building, but changed to its current name in 2015.

Journal of Construction in Developing Countries is published by the University Press of the Penerbit Universiti Sains Malaysia, in cooperation with the working Commission 107 (W107) of the CIB. It evolved from the former Journal of Housing Building and Planning (founded 1996) by expanding its scope and renaming it in 2006 to its current name. Apparently, the journal started publishing in electronic form and converted to Open Access at the same time.

Revista Ingeniería de Construcción is an old journal (now in its 33rd year) published by the Pontificia Universidad Catolica de Chile. Articles are published in both Spanish and English, and the original submission can be in either language. Authors come predominantly from Spanish speaking Latin America. The journal still offers a subscription paper journal. The journal doesn't charge authors and is published using the Open Journals System (OJS). It also has a mirror site at the Latin American OA portal Scielo (Packer, 2009). It is nowadays also indexed in Web of Science due to a massive agreement Scielo has made for the better quality journals in included in its portal.

Both ***Materiales de Construcción*** and ***Informes de Construcción*** belong to the 37 scholarly journals published by the Spanish National Research Council (CSIC). Both have originally been published in paper format and still retain printed versions. The electronic version are published using OJS as the technical platform. The articles in Materiales de construction are in English, despite the Spanish name of the journal, but the authors come predominantly from Spain. In contrast Informes de Construction publish articles in Spanish. Both Journals have JCR impact factors.

The history of ***Civil Engineering and Management***, published by the Vilnius Gediminas Technical University in Lithuania, goes back to 1995. The name was changed to the current English one in 2002. Around the time that several of the university's journals were included in the ISI for indexing in 2011, the university entered into an outsourcing partnership and the journals where co-published by Taylor & Francis. In 2018 the university's own press has again taken over as publisher of the journals. The move back was preceded by a couple of years of unsuccessful discussions with Taylor & Francis about converting the journals to author-paid OA. The level of the APCs is moderate, for Civil Engineering and Management 60 Euros per page, which for most articles would translate into an APC of 600-900 Euros.

5. DISCUSSION

Our empirical data thus illustrates that around 5 % of the core literature in building & construction is published in full OA journals, and that a couple of percent more paid OA articles in hybrid OA journals can be added to that. How does this compare to the situation in sciences in general? The overall share of Scopus journal articles that are in full OA journals has gradually risen by about 1 % per annum, and is currently around 15 % (European commission, 2018). The biomedical sciences are leading the developments, and in these the vast majority of OA article are paid by APCs. The leading megajournals, such as Nature Scientific Reports and PLOS ONE each publishing over 20,000 articles per year, contribute around 3 % of Scopus articles (Wakeling et al, 2016). In addition, the Scopus share of articles in hybrid journals is around 2 %, and rising rapidly for authors from countries like the UK, Netherlands, due to new funding mechanisms (RIN, 2015).

Not to be overlooked are so-called delayed OA journals. These are normal subscription journals, which after a delay of mostly 12 month make all the content of the journals available for free. A major reason for this is that central research funders in the US (for instance the worlds largest research funder NIH) require the deposit of an OA manuscript in their PMC repository after maximum one year. Although this is not libre OA, since the Creative Commons licenses are missing, delayed OA is also very valuable. The around 500 journals that practice this are mostly in biomedicine and on average much more highly cited than journals in general. Together they add over 100,000 articles per year, representing some 5 % (Laakso and Björk, 2013). Unfortunately, such delayed OA journals are very rare among the building construction journals.

Adding up full OA journals, hybrid OA articles and delayed OA journals, close to 25 % of articles in Scopus articles are OA after a year. The comparable figure for the construction and building sector is below 10 %.

Without a very broad sample based empirical study its very difficult to measure the prevalence of green OA alternatives for construction journal articles. Most studies of scholarly journals in general have shown that there are around 10-15 % manuscript copies in institutional repositories or in the leading subject based repositories like arXiv and PMC (European commission, 2018). The numbers are currently overshadowed by the partly illegal copies to be found in Scholarly social media like Research Gate. All in all, between one third and a half of all scholarly journal articles can after a delay of a year or two be found freely on the web.

6. CONCLUSIONS

What is the outlook for the building construction field, given the current situation? It is probable that there won't be many new OA journals founded by individual scientists, nor will many additional university or society journals convert to OA. If our field would follow in the footsteps of biomedicine possible growth would thus be likely to occur via major publishers launching new OA journals or converting their subscription journals to OA (Solomon et al, 2016).

Since the vast majority of civil engineering journals are quite old and access is mainly sold as part of electronic university or consortia licenses covering all the journals of a publisher, the marginal marketing and sales costs are low for the publishers. Likewise, the cost of managing the peer review is low since this is mainly handled by academics who work more for reputation and social capital building than monetary compensation. Not to mention the peer reviewers. Hence there has been very little incentive for the publishers to start new open access journals or convert subscription ones to OA. Adding the hybrid OA option has been risk-free and done at the level of the publisher's whole portfolio, and the cost of this per journal has been negligible.

Publishers will thus only state converting journals to OA if it makes sense from a business viewpoint, hence they will require substantial publishing charges (APCs) to cover the costs. Another long-term scenario is that of some major publishers start flipping journals which are included in their package deals covering both subscriptions and APCs, once a critical share of articles in a journal become hybrid OA. This is in fact what happened to Nature Communications, which after only five years as a hybrid journal converted to full OA (Jump, 2014).

A key factor in this market place is the effort that academics contribute to the publishing process as editors and reviewers. In the current situation there are numerous rather small journals competing for their time and the whole systems is rather wasteful with this limited resource. A particularly disturbing effect are the often unnecessarily long times from submission to publication that many of us have experienced. Journals that in a healthy competitive climate would vanish due to poor service to authors or insufficient subscription income can survive, shielded by being part of the big e-licenses of the major publishers.

In sum, the development towards OA has been much slower than some of us pioneers envisaged in the 1990s (Björk and Turk, 2000), but important progress has been made in the past five years, but mainly in other research fields. Currently several major research funders, in particular in Western and Northern Europe, are tightening their requirements for open access publishing of articles financed by grants from them. At the same time separate earmarked funds for paying APCs are being set up. Such efforts, for instance plan S (Else, 2018) which has been signed by 11 national research funders, could help accelerate the transition towards OA.

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