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The BitViews project | Camillo Lamanna and Manfredi La Manna



The fundamental problem blocking open access and how to overcome it: the BitViews project

In our view the fundamental obstacle to open access (OA) is the lack of any incentive-based mechanism that unbundles authors' accepted manuscripts (AMs) from articles (VoRs). The former can be seen as the public good that ought to be openly accessible, whereas the latter is owned by publishers and rightly paywall-restricted. We propose one such mechanism to overcome this obstacle: BitViews. BitViews is a blockchain-based application that aims to revolutionize the OA publishing ecosystem. Currently, the main academic currency of value is the citation. There have been attempts in the past to create a second currency whose measure is the online usage of research materials (e.g. PIRUS). However, these have failed due to two problems. Firstly, it has been impossible to find a single agency willing to co-ordinate and fund the validation and collation of global online usage data. Secondly, online usage metrics have lacked transparency in how they filter non-human online activity. BitViews is a novel solution which uses blockchain technology to bypass both problems: online AMS usage will be recorded on a public, distributed ledger, obviating the need for a central responsible agency, and the rules governing activity-filtering will be part of the open-source BitViews blockchain application, creating complete transparency. Once online AMS usage has measurable value, researchers will be incentivized to promote and disseminate AMs. This will fundamentally re-orient the academic publishing ecosystem. A key feature of BitViews is that its success (or failure) is wholly and exclusively in the hands of the worldwide community of university and research libraries, as we suggest that it ought to be financed by *conditional* crowdfunding, whereby the *actual* financial commitment of each contributing library depends on the *total* amount raised. If the financing target is not reached, then all contributions are returned in full and if the target is over-fulfilled, then the surplus is returned pro rata.

Keywords

Open access; scholarly communication; academic publishing; blockchain



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A personal (re)introduction

Consider the following scenario: in 2003 a researcher active in the field of academic publishing and open access (OA) fell into an 'OA coma' (defined as total inability to read, listen to, or engage in anything related to scholarly communication) that lasted for over 15 years. Finally waking up in 2018 and surveying the OA field, what would his reaction be to the changes that had taken place in the intervening years?¹

2 In two words: deep disappointment. What used to be called ‘the serials crisis’ is now the ‘unsustainable subscription model’, the oligopolistic structure in the academic publishing market is now even more concentrated,² the emphasis on OA has shifted from self-archiving non-peer-reviewed preprints to depositing peer-reviewed accepted manuscripts (AMs) in institutional repositories (IRs), but the amount of research hidden behind paywalls is still substantial. At a fundamental level, little has changed, in spite of millions of working hours and millions of pounds having been spent in an effort to move academic publishing to a more rational structure.³

The reason for this lack of progress is both patently obvious and surprisingly underplayed. This article has the ambitious aim of stating the substantive problem that has beset academic publishing for the last 25 years or so and suggesting a simple, cost-effective and immediate solution.

‘the amount of research hidden behind paywalls is still substantial’

The fundamental reason why the academic journal market is intrinsically flawed

Simplifying to the extreme, consider the workflow that starts with the submission of a paper to a journal and ends with the author’s accepted manuscript (AM). The labour expended throughout this process is by academics and for academics with no monetary reward.⁴ If the AM were to be deposited in an OA institutional repository (IR), it would become a public good freely available to anyone interested in the paper’s subject matter. In our opinion, the main objective of OA would have been achieved.

The next stage of the process is the transition from AM to published article, which is undertaken by the publisher who can reasonably expect a return for the value that is *added* to AMs (e.g., metadata tagging, HTML, PIDs, etc.).⁵ There is much confusion in the literature and among librarians and publishers about what additional value publishers contribute after the (basic) AM has been reviewed, produced as a PDF and hosted on IRs. The critical distinction here is for *whose* benefit the additional value has been produced: for example, how many of the 96 things that, according to Kent Anderson, publishers do, actually relate to value to the academy as opposed to value to the publishers’ shareholders?⁶ Alternatively, we could ask how much libraries would be prepared to pay for online/print journal subscriptions if the entire content were available (in AM format) on OA IRs.

The fundamental point at the very core of the OA debate is that if these two objects – the AM and the published article – could be unbundled,⁷ most of the problems currently plaguing academic publishing would be solved: the AMs would provide OA to knowledge and the published article would be paid for by anyone interested in the additional services that it provides over and above the AM content.

The source of the persistent crisis in academic publishing lies in the fact that publishers bundle (i.e. combine) *both* the AM *and* the article into a single commodity and charge users not only for the additional value of the article (as they are entitled to do), but also for the AM content, even though they have contributed little to its production.⁸ Seen in this light, it is no exaggeration to conclude that the OA movement has achieved very little in the last 20 years or so.

‘if ... the AM and the published article could be unbundled, most of the problems currently plaguing academic publishing would be solved’

Some promoters of OA point to the switch from a subscription model to article processing charges (APCs) as evidence of progress towards a wider diffusion of knowledge. This is a misconception. As long as APCs are set by publishers as an alternative way of charging for the combined AM plus article commodity, the same unsustainable economic model will persist, whereby libraries (i.e., ultimately, taxpayers) provide a large subsidy to the shareholders of commercial publishers, with the additional inefficiency due to researchers from poorly-endowed institutions being put at a disadvantage when submitting their research to APC-based journals.

3 The very concept of ‘article processing charges’ reflects the lack of appreciation of the substantial difference between AMs and articles (versions of record [VoRs]).⁹ With very few exceptions the labour expended throughout the peer-review process is not undertaken for financial gain, but instead either on a reciprocal gift exchange basis – for referees – or for peer esteem and recognition – for editors. Virtually the whole workflow from initial submission through to refereeing, revision and, finally, to decision is performed online with little cost other than the time expended by authors, referees and editors (for which no monetary reward is expected).¹⁰ It can be said that irrespective of whether journals are funded by subscription or by APCs, the *effective* cost of producing (basic) AMs is so insignificant that it can be neglected.¹¹

If it is accepted that the target of OA is the *content* of AMs and not the *packaging* surrounding it, it follows that the establishment of APC-funded OA journals by itself does not solve the problem of unbundling AMs and articles. It is interesting to note that if a magic wand could be waved and all subscription-funded non-OA journals could be turned overnight to APC-funded OA publications, the saving in subscriptions charges for libraries worldwide (estimated in 2008 to be £2.91bn¹²) would be completely offset by a virtually identical increase in APC costs (£2.92bn), thereby swapping the current ‘unsustainable subscriptions crisis’ for an ‘unsustainable APC crisis’.

In the early days of OA advocacy, the emphasis was on encouraging academics to self-archive their preprints, now called authors’ original manuscripts (AOs), a solution supported most vociferously by Stevan Harnad. In spite of being ‘a good idea’, generalized self-archiving did not happen (apart from in some disciplines, notably particle physics using ArXiv). Nowadays academics are prompted to deposit their AMs in IRs and, again, in spite of this being an ‘even better idea’ – in so far as AMs are peer reviewed, unlike authors’ AOs – it seems that the (quality-adjusted) take-up is disappointing.

‘all subscription-funded non-OA journals could be turned overnight to APC-funded OA publications’

To state the obvious, the reason why both ‘good ideas’ have failed to become standard practice is the *lack of individual incentives*. The average academic whose paper has finally been accepted for publication can justifiably consider their job successfully completed: their academic reputation and esteem have been increased to the extent to which the publishing journal is regarded by their peers and the currency in which their standing is measured is the number of *citations*, i.e. a metric attached to the article (and not to the AM). Why should they bother to deposit their AM on an IR? What direct benefits would accrue to them? Or, more generally, what is the value of an AM once the paper is published as an article? As long as the main metric for measuring research impact is the citation count (either directly or indirectly via the higher reputation of higher impact factor journals), the *added* value of AMs compared to articles is likely to remain low, as the path from depositing an AM on an IR to the article gathering more citations has at least two substantial obstacles.

The first roadblock is discovery: depositing an AM provides no guarantee of discovery. Unlike journal publishers, who have a strong incentive (and commensurate resources) to increase the citation count of the articles in their journals (because the citation-driven impact factor is an important determinant of journal pricing), no equivalent systemic¹³ incentive motivates the resource-poor, overworked custodians of IRs to increase the visibility of the AMs they store.

The second obstacle is the poor read-to-citation conversion rate for AMs: if I wish to cite a piece of research and I have access to the paywalled article, I am far more likely to have discovered the article rather than the AM, whereas accessing the AM but not the article prevents me from citing the latter (other than as a generic reference).

The idea that unbundling AMs and articles offers the key to unlocking the persistent stalemate in OA is not novel and has been restated recently by Toby Green.¹⁴ The fundamental difference between Green’s approach and ours resides in the identity of the player(s) who can turn the key: in Green’s view, ‘only one actor is needed to start this process of unbundling: the publisher. In making a basic, legal version free for anyone to

4 read, gratis OA is achieved at a stroke'. In our view, to expect large multinationals in an oligopolistic market¹⁵ to ditch the economic model that allows them to earn substantial supernormal profits is an example of unwarranted optimism.

Our conclusion is different: in the journal publishing ecosystem, the object of OA – the knowledge contained in the AM (produced, reviewed, corrected and produced by academics for no direct financial reward) – currently has no value to the author(s) when divorced from the published article, managed and owned by profit-seeking oligopolistic publishers. This is the ultimate reason why the unbundling of AMs and articles (VoRs) cannot be achieved under the current system of academic journal publishing. As soon as the problem is posed in these terms, its solution becomes apparent: for the unbundling to be feasible, AMs must have a *value independent from* articles. We cannot expect the publisher to be the actor who starts this process. Our approach is more subtle: our main contention is that a substantive contribution to the process of endowing AMs with independent value comes from supplementing citations as the currency of academic esteem with a parallel channel: aggregating, validating and counting online usage of AMs.

'the unbundling of AMs and articles (VoRs) cannot be achieved under the current system of academic journal publishing'

The case for and against views and downloads

Why should views/downloads be given any academic credibility?

Downloading or accessing the full text of a paper because the title sounded interesting is no guarantee that it can have any meaningful impact – having looked at it I can decide it was irrelevant, outdated, wrong, etc. But even if this problem could be magically solved, an even more basic objection could be raised: only research that is valuable ought to be rewarded, not research that is popular. Here one could insert the inevitable reference to PLoS' third most downloaded article ('Fellatio by Fruit Bats Prolongs Copulation Time'¹⁶) to drive this point home. One should not forget that such objections to measuring online usage – for example, that a download does not entail actual use, let alone impact – apply equally to citations.¹⁷ The limitations of online usage of AMs as useful raw material to measure non-citation impact are well known and well appreciated by librarians.¹⁸ What is less appreciated is that however substantial the criticisms of views and downloads as meaningful impact measures may be, the critical issue is no longer *whether* data on online usage ought to be collected, aggregated and disseminated, but rather *who* ought to be in charge of the process – the academic community or commercial publishers? We believe that views and downloads data ought to be treated as a prime example of *open data* (data that can be freely used, shared and built-on by anyone, anywhere, for any purpose), whereas most commercial publishers consider online access data as a *private commodity*. We cannot find a starker example of the difference between commercial publishers and (concerned) librarians on the treatment of data than the case of usage data reports. These are data generated by *library* users when they access journals their *library* has purchased. One might reasonably assume that such data belonged to the library concerned. Alas, such an assumption is unwarranted, as detailed, for example, in section 2.4 of the standard Elsevier journal subscription contract:¹⁹

'Elsevier will make usage data reports on the Subscriber's usage available to the librarians/administrators employed by the Subscriber for **internal use only**. Such reports may be accessed by vendors or other third parties **only with permission of Elsevier** and for the purpose of usage analysis of the Subscriber.'

We surmise that the many librarians who subscribe to and support the concept of open data instead of accepting the above confidentiality clause would be prepared to follow the example of the University of California libraries, who insist on treating *their own* usage data as open and have modified section 2.4 to:

'The Subscriber reserves the right to collect, analyze, and make results of such analysis available to both internal and external constituencies of usage data compiled by Elsevier and made available to the Subscriber.'

5 It should come as no surprise that commercial publishers have long since perceived the *market* value of online access data and have been busy acquiring companies that manage the process (e.g. Elsevier's purchases of Atira/PURE [August 2012], bepress [August 2017], Plum Analytics [February 2017], Aries [August 2018]) or collect OA material (e.g. Elsevier's purchase of SSRN [May 2016]).

In conclusion, online usage data are being collected with increasing vigour, not by librarians who would do so for the benefit of the academic community and the public at large, but by commercial publishers for the benefit of their shareholders. Far from being a dangerous development that should be managed and contained by librarians rather than exploited by corporations, online usage data could not only make an indirect, but extremely powerful, contribution to achieving universal OA to scientific, scholarly and medical peer-reviewed papers, but also could redirect research efforts in a way that would reduce the knowledge gap between high-income and low/middle-income countries.²⁰

'online usage data are being collected with increasing vigour ... by commercial publishers for the benefit of their shareholders'

We argue our case with reference to a specific discipline – emergency medicine – and a specific geographical area – Africa – but the argument can be generalized to many other disciplines and regions.²¹

In our example, an organization (a medical charity or a research council) is interested in assessing the impact on Africa of a set of clinical research articles. Currently, it will have no choice but to resort to some citation-based metric, even though citations are extremely poor proxies for measuring impact on any geographical region.²² Two options are available: either the location of the author being cited or the location of the author doing the citing. The drawbacks of both options are obvious. Any article authored by a non-Africa-based academic has by definition no impact on African readership according to the first option and, according to the second option, a necessary condition for any African-based citers is the authorship of an article. Taking emergency medicine as an example, one finds that 26 African countries (covering over 200 million people) in the last five years have produced *no* academic articles in this field. It follows that any citation-based metric would record no impact whatsoever in any of these countries – a highly unlikely conclusion. One would expect a significant number of (non-academic) clinicians involved in emergency medicine to have read, and to have been affected by, academic articles in their field, although no trace of the resulting impact was left.

The problem here goes well beyond the failure to record the impact of articles that are read but not cited. After all, citations do not save lives, clinical practice affected by exposure to academic clinical articles does. We argue that the failure to record non-citation impact may be of little significance as far as the *dissemination of existing* knowledge is concerned, but it has nefarious effects on the *production of new* knowledge. This is a point that seems to have been neglected by supporters of OA who rightly stress the inequity produced by paywalls. When researchers in, say, Africa cannot learn from the latest developments in whichever discipline they are interested in, not only are their lives diminished, but also the international research community is deprived of the potential contributions that these researchers could have made had it not been for the knowledge apartheid enforced by paywalls. Much less emphasis is placed on the inequality indirectly generated by the lack of metrics for non-citation impact.²³

'failure to record non-citation impact ... has nefarious effects on the *production of new* knowledge'

This latter point may merit some further explanation. Suppose you are a first-world researcher motivated by both the desire of peer recognition and esteem and the willingness to enhance the quality of life for at least some of your fellow human beings. Under the current system of academic publishing, you are forced to choose between advancing your academic standing or carrying out welfare-improving research. The reason for this invidious situation is simple: if your research has the greatest impact in countries with low publication rates, your academic reputation (as measured by citations) is not improved even if your research is read widely and changes lives for the better. Notice also how the recommended switch from subscriptions to APCs makes no difference to the

6 scenario described above: admittedly, if your publication is now OA, it will reach a wider audience, but, *as long as non-citation impact is not measured*, your academic recognition will not be improved and your citation count will remain low.

This is a well-known problem, yet why have no solutions been put forward? It is a recurring theme in this paper that proper attention ought to be paid to developing new and more effective incentives. Who would benefit from, and who would be negatively impacted by, a re-balancing of academic rewards that gave more weight to non-citation impact?

As a suggestive exercise we have analysed one specific discipline (emergency medicine) for one specific region (Africa) for the period 2014 to mid-2019, by counting all articles by at least one author with an African affiliation as recorded in the Scopus/SciVal database.²⁴ We have removed all articles in languages other than English and French and all journals with fewer than four qualifying articles in the period. The following two tables show the top ten rankings according to views and then according to citations (OA journals in bold; E stands for published by Elsevier).

'proper attention ought to be paid to developing new and more effective incentives'

Scopus source title	Total views	Total citations	Total articles	Mean views	Mean citations	Rank by citation	Rank by views
<i>Resuscitation</i> (E)	297	409	15	19.8	27.3	1	3
<i>World Journal of Emergency Surgery</i>	2117	553	35	60.5	15.8	2	1
<i>Shock</i>	90	68	7	12.9	9.7	3	9
<i>Annals of Emergency Medicine</i> (E)	93	61	7	13.3	8.7	4	8
<i>Injury</i> (E)	1120	619	104	10.8	6	5	16
<i>Burns</i> (E)	909	394	82	11.1	4.8	6	14
<i>Internal and Emergency Medicine</i>	57	26	6	9.5	4.3	7	17
<i>Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine</i>	76	22	6	12.7	3.7	8	10
<i>Academic Emergency Medicine</i>	123	36	10	12.3	3.6	9	13
<i>International Journal of Emergency Medicine</i>	571	66	20	28.6	3.3	10	2

Table 1. Top ten journals in emergency medicine ranked by citations

Scopus source title	Total views	Total citations	Total articles	Mean views	Mean citations	Rank by views	Rank by citation
<i>World Journal of Emergency Surgery</i>	2117	553	35	60.5	15.8	1	2
<i>International Journal of Emergency Medicine</i>	571	66	20	28.6	3.3	2	10
<i>Resuscitation</i> (E)	297	409	15	19.8	27.3	3	1
<i>International Journal of Emergency Management</i>	100	4	6	16.7	0.7	4	27
<i>Prehospital and Disaster Medicine</i>	308	45	21	14.7	2.1	5	18
<i>BMC Emergency Medicine</i>	525	102	38	13.8	2.7	6	14
<i>Journal of Emergencies, Trauma and Shock</i>	95	16	7	13.6	2.3	7	17
<i>Annals of Emergency Medicine</i> (E)	93	61	7	13.3	8.7	8	4
<i>Shock</i>	90	68	7	12.9	9.7	9	3
<i>Scandinavian Journal of Trauma, Resuscitation and Emergency Medicine</i>	76	22	6	12.7	3.7	10	8

Table 2. Top ten journals in emergency medicine ranked by views

7 If citations are replaced by online views/downloads, top-tier journals see their rankings drop precipitously: *Injury, Burns, and Internal and Emergency Medicine* drop from 5th, 6th and 7th to 16th, 14th and 17th, respectively. Conversely, when measuring views instead of citations, the *International Journal of Emergency Medicine* (an OA title, part of Springer Nature's *BioMed Central*), the *International Journal of Emergency Management, Prehospital and Disaster Medicine, BMC Emergency Medicine* (OA) and *Journal of Emergencies, Trauma and Shock* (OA) are catapulted from 10th, 27th, 18th, 14th and 17th place to 2nd, 4th, 5th, 6th and 7th, respectively. Our contention here is not to supplant existing (citation-based) journal rankings with a new order, but to suggest that greater transparency regarding usage would allow libraries to make more informed purchasing decisions, researchers to identify outlets that would facilitate their work being viewed/downloaded, and readers to discover material that is relevant to their context.

Highly profitable commercial publishers are unlikely to push for more views-based impact measures. OA journals (whose articles can be viewed without the obstacle of expensive paywalls) would definitely gain from views/downloads being given more weight, but they lack the clout (and the resources) to endow online views/downloads with the academic recognition required to make authors undertake impactful research.

'greater transparency regarding usage would allow libraries to make more informed purchasing decisions'

The conclusion reached so far is that if AMs are to be unbundled from articles, then they ought to be given independent value based on their advantage over articles in terms of wider reach. Value implies comparison, but how can AMs be compared unless online usage is measured, aggregated, validated and disseminated?

Why can online usage data not be aggregated, validated and disseminated?

The instructive answer to the above question is provided by the fate of the Publisher and Institutional Repository Usage Statistics (PIRUS) project.²⁵ In a nutshell, the PIRUS project aimed at collecting all online usage data generated by UK IRs and publishers' servers, validating them using COUNTER criteria, and making the resulting cleaned-up data available to all stakeholders. The very idea that publishers would support a mechanism that creates value for AMs (an object they should not own) and that they would be willing to release, for free, usage data (that they do own) rather than to attempt to monetize them shows the importance of assessing *economic incentives* when designing a project as ambitious as PIRUS.

The proximate reason given for the failure of PIRUS was that "PIRUS proposed the establishment of a global central clearing house (CCH) to deliver such a service. Unfortunately, it became clear from a survey conducted at the end of the project that the majority of publishers were not, largely for economic reasons, yet ready to implement or participate in such a service."²⁶

The moral of this sad tale is that if online usage data are ever to be aggregated, validated and disseminated, it must be through a mechanism that firstly acknowledges the powerful disincentive of commercial publishers to support any initiative that enhances the value of AMs and, secondly, does not rely on a global central clearing house to collect the data.²⁷

A new way of aggregating online usage data: BitViews

There is a feasible low-cost solution to the technical problem that beset PIRUS: rather than having a central clearing house with which each repository interacts – in other words, a hub-and-spoke model – a blockchain can be used to distribute the work across repositories, aggregate usage from different sources and ensure conformance with COUNTER standards without needing a central body.

We have described elsewhere²⁸ the basic features of such a solution, which we call BitViews.²⁹ In summary, participating repositories constitute the 'nodes' of the network; over a fixed time period (*t*), all nodes send their (encrypted) raw usage data (including the DOI

of material accessed, time-stamp, and requesting IP address) to a single, randomly-selected node which collates the activity into a block for time t and applies agreed-upon open source rules (e.g. COUNTER criteria) to filter out non-human activity, double-clicks, and so on. A second randomly-selected node verifies that COUNTER criteria have been applied correctly and, if so, the block is added to the chain. The process is then repeated, generating a validated, COUNTER-conformant blockchain of online usage with no central clearing house. While formal COUNTER compliance requires independent audit, BitViews instead offers an open-access ledger and transparent, 'smart contract'³⁰-type rules for counting online usage; in this way, both product (ledger) and process (rules) are open to full public scrutiny.

An example might be that on 10 October 2018, a researcher from Sydney, Australia, wished to view article A published in the *African Journal of Emergency Medicine* from ScienceDirect, so the researcher's computer would send Elsevier a request for the full text (see Figure 1).

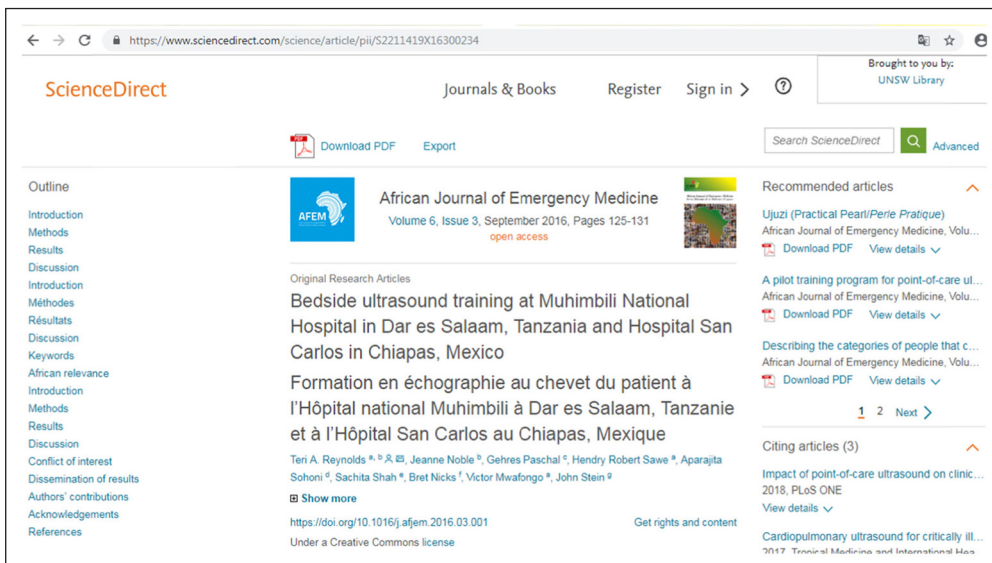


Figure 1. A typical online access web page

Now Elsevier³¹ would have researcher A's IP address, the article's DOI and the time of the request: the where, the what and the when. This proposed usage event is sent to the collating nodes, its COUNTER compliance is verified and, if compliant, it is added to the ledger as:

DOI: 0.1016/j.afjem.10000000; **Location:** Sydney, Australia; **Timestamp:** 10.10.2018.

Notice that neither the IP address nor the precise time is recorded, protecting researchers' privacy. The workflow chart for BitViews looks as follows (see Figure 2).

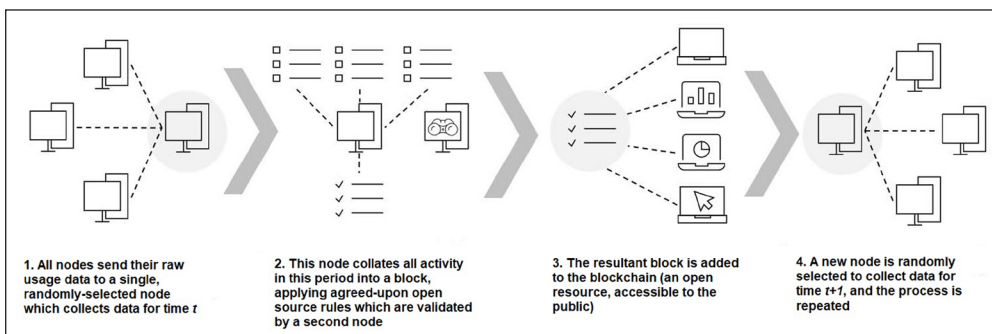


Figure 2. A typical BitViews flowchart

What BitViews produces is, essentially, a table of usage events, a public ledger that can be searched and analysed by anyone, anywhere, at no cost. By providing aggregated and validated online usage data, BitViews would furnish researchers with the raw materials to analyse not only the geographical reach of individual papers and journals but also the dynamics of such reach. For example, the number of instances where an article's

9 DOI appears on the blockchain is that article's usage count.³² It would also be simple to establish an article's usage by country. Similarly, searching the ledger for "10.1016/j.afjem", in African countries, in 2017 would give the continent-level usage statistics for the *African Journal of Emergency Medicine* in that year. The value that BitViews adds relative to individually-collected IR data is threefold: usage statistics are calculated transparently and consistently,³³ they are collated across platforms and they are accessible in a single OA ledger. It is easy to see that although BitViews can collect and validate online usage data irrespective of whether the item accessed is an AM or the published article, BitViews has the potential to be a game-changer as far as the value of AM is concerned.

BitViews as a game-changing nudge

If BitViews were merely an efficient and cheap new way of aggregating online access data for scholarly, scientific and medical peer-reviewed papers, it would represent just another tiny step forward towards academia reclaiming ownership of its data and using them for the benefit of all. But this aim, laudable as it may be, it is *not* the ultimate objective of the BitViews project. By providing a subtle 'nudge' to authors of peer-reviewed articles, BitViews aims to create a *parallel channel* for academic recognition and esteem by counting, validating and disseminating data on where, when and how often AMs specifically are viewed by readers on a worldwide basis. The argument is strikingly simple: as soon as peer recognition and esteem depend (also) on usage, it is in each researcher's *individual* interest to ensure maximum visibility, which can be achieved most efficiently by depositing AMs in IRs, free from the shackles of readership-decimating paywalls.

BitViews can satisfy the demand for non-citation impact analysis, and it is easy to foresee that funding bodies, promotion committees and the academy in general will consider validated online access data as part of their assessment of research impact. Notice the virtuosity of this circle: the provision of aggregated, validated, publicly available online access data allows any institution interested in assessing research impact to make use of such data. This in turn creates a hitherto absent incentive for authors of peer-reviewed papers to ensure that they reach the widest audience of readers, which is best achieved by making AMs as widely available as possible, i.e., by depositing them on paywall-free IRs. This in turn creates more data on online access and the circle continues indefinitely. Then BitViews would have achieved its ultimate goal – to create an ecosystem that maximizes the amount of peer-reviewed OA research.

BitViews: the obstacles ahead

It would be the height of naivety to assume that a project like BitViews would not encounter formidable obstacles in its path to universal OA to scholarly, scientific and medical research. Identifying both the sources of opposition and the forces to defeat them is the key for success. The obstacles facing BitViews can be grouped in two main categories: internal and external, the former related to BitViews as a piece of technology, the latter related to BitViews as an economic and social construct.

The core technology of BitViews is, unsurprisingly, blockchain: a very secure technology finding applications across industries. Undoubtedly, there are difficulties to be worked on: integration with COUNTER, making BitViews a plug-and-play application working with the various platforms used by IRs, etc. The inevitable comparison with Bitcoin could be easily misinterpreted. Whereas under Bitcoin, anyone can check the validity of a proposed transaction, under BitViews only a selected few reputable repositories are allowed to add transactions to the ledger (under a consortium blockchain arrangement). As a result, BitViews dispenses

'usage statistics are calculated transparently and ... collated across platforms and they are accessible in a single OA ledger'

'funding bodies, promotion committees and the academy ... will consider validated online access data as part of their assessment of research impact'

'its ultimate goal – to create an ecosystem that maximizes the amount of peer-reviewed OA research'

10 completely with computationally intensive ‘mining’, a feature that makes Bitcoin extraordinarily wasteful in terms of computation and energy consumption. It is also worth mentioning that even though publishers and IRs see millions of accesses per year, if stored on a well-designed database, the storage requirements should be very manageable – probably around 1GB to store 10 million views. We estimate that if each ‘node’, or IR, were to store the entire BitViews blockchain locally, storage requirements would amount to less than US\$50.

As far as the external obstacles to the success of BitViews are concerned, they come from two separate camps, one very obvious – commercial publishers – the other, very surprising – well-intentioned librarians.

The same reasons that made leading publishers sink the PIRUS initiative apply even more to BitViews. If successful, BitViews will turn proprietary online access data currently owned by commercial publishers into open data, freely available to anyone. By reducing the role of peer-reviewed articles (owned by oligopolistic corporations) to purveyors of citations, by stripping them of their unwarranted function as disseminators of research, and by increasing the value of peer-reviewed AMs (a public good freely available to anybody) as carriers of scientific and scholarly knowledge, BitViews could make a contribution to correcting the persistent market failure in scholarly communication and finally unbundle AMs from articles. It seems realistic to expect commercial publishers not to join BitViews with their platforms, at least initially. Would this non-participation not sink BitViews as it did for PIRUS? We think not – and for two main reasons.

‘BitViews will turn proprietary online access data currently owned by commercial publishers into open data’

First, online access data produced by commercial publishers are available. Even when they are validated through the COUNTER system, publisher-supplied viewing data have an in-built bias towards accommodating practices that artificially increase the volume of views (as shown conclusively by Bergstrom³⁴). Nevertheless, when potentially tainted publisher-produced online access data are compared with COUNTER-conformant bias-free data provided by BitViews, all sorts of adjustments can be made, exposing systematic biases, aggregating ‘clean’ BitViews data with de-biased publishers’ data, etc.

Second, we expect that in the medium term the initial refusal by commercial publishers to join the network of BitViews-compliant repositories will come under increasing pressure from both librarians and academic authors. It would be very surprising if libraries refused to follow the University of California’s good example of treating online access data to articles as open data and not the publishers’ own property, to be shielded from public scrutiny. We can foresee a healthier environment where in order to obtain validated data on online access to peer-reviewed articles, interested parties will have to rely less and less on proprietary platforms such as Scopus/SciVal. Academic authors, too, can be expected to object to publishers limiting the availability of aggregated data on the non-citation impact of their articles in the new landscape where views/downloads scores are relevant factors in assessing impact and therefore peer recognition and esteem.

‘we regard the attitude of the international librarian community as possibly the most challenging obstacle to the success of ... BitViews’

Counter-intuitively and surprisingly, we regard the attitude of the international librarian community as possibly the most challenging obstacle to the success of the BitViews project. Far from criticizing the aims of BitViews or finding serious faults in the concept, the reception by librarians has been almost unanimously positive when we have presented the project at conferences and workshops as well as through personal communications. How can the generous welcome by librarians be an impediment to BitViews? The reason is rather subtle. The consensus amongst librarians is that BitViews is ‘a good idea’ and the last thing BitViews needs is to be considered ‘a good idea’. The proliferation of ‘good ideas’ is one of the main reasons why the last 20 years or so have seen slow progress in the good idea par excellence – OA. If the substantial and deep-rooted inefficiency of the current academic publishing market is to be removed, the academy has to focus on clear and specific

11 *solutions*. The difference between ideas and solutions is not a matter of semantics: ideas are for debate, solutions are for implementation. Ideas can always be improved, extended and refined; solutions are binary – either they work or they do not. The very concept of cost-benefit analysis is not applicable to ideas, but is fundamental to assess solutions. Ideas can be produced locally, whereas solutions often require multi-agent, multinational co-ordination.

The arguments and evidence that we have produced so far in this article confine the BitViews concept to the category of ‘good idea’, whereas we wish to propose it to the librarian community as a ‘good-enough solution’.

BitViews is not a ‘good idea’ – it is a viable solution

We estimate that the cost of producing a turn-key software application that utilizes blockchain technology to create a public ledger of online usage data within a timescale of 18 months is £250,000. Although the cost of BitViews compared to direct costs of journal subscriptions is vanishingly small, it is still large enough to prevent any single institution from undertaking the project on its own. With no single funder available, the free-rider monster raises its ugly head, with every interested party (i.e. university and research libraries) expecting everyone else to contribute. The dispersion of potential contributors can be turned – we surmise – from an obstacle to an opportunity by a suitable combination of transparency and online technology. We suggest that BitViews be funded by its potential users (university and research libraries) via a new form of crowdfunding, which we call *conditional crowdfunding*.³⁵

Under conditional crowdfunding, the financial commitments undertaken by contributors are conditional in the sense that the effective amount of money to be disbursed depends on the *total* amount raised. Specifically, if the total amount falls short of the £250,000 target, all contributions will be returned and the project will be closed. If the total amount raised exceeds the £250,000 target, the surplus will be returned pro-rata to each contributor. It can be seen that this scheme provides a simple remedy to the problem both of pessimistic potential contributors who, expecting the project to fail, choose not to contribute at all and of over-optimistic contributors who, expecting the project to raise more than its target, reduce their own contributions. In order to introduce an element of fairness in the presence of potential contributors with vastly different economic resources at their disposal, we suggest that libraries make a (conditional) contribution equivalent to 0.05% of their annual journal subscription charges.³⁶

‘We suggest that BitViews be funded by its potential users (university and research libraries) via ... *conditional crowdfunding*’

In order to avoid a war-of-attribution scenario (where every player waits for others to move first), the crowdfunding window will be open for a limited period of three months from February to May 2020. Permission will be requested from contributors to publicize their participation in the project (but not the amounts contributed). We expect leading libraries to support BitViews and we hope that this will encourage others to follow suit.³⁷

Needless to say, the entire project will uphold the highest standards of openness and transparency. The BitViews website will track every step in the development of the project (with the software application being open source) and all expenses will be itemized and published. As soon as BitViews becomes active, two key performance indicators will be used to track the progress of the BitViews: 1) the number of institutions using the BitViews application and 2) the number of unique documents and unique usage events recorded on the distributed ledger. These metrics will be tracked and displayed on the BitViews website, along with specific targets for growth at six- and 12-months post-deployment.

We believe that this crowdfunding exercise will be beneficial to the OA movement, irrespective of whether the funding target is attained or not. If successful, the BitViews template could be used for other similar initiatives that are currently beset by co-ordination problems. But even if the crowdfunding attempt were to fail, it could nevertheless stimulate

- 12 a long overdue debate on reforming academic publishing by taking active steps and not be setting up yet another committee/commission/research unit. Libraries who failed to support the project would have to justify their stance: which aspects of BitViews did they object to or thought would not work? which other projects did they believe offered better cost-effectiveness than BitViews and why?

Tentative conclusion

We wish to conclude on a positive note. We are confident that most librarians and unbiased policymakers would agree that unbundling AMs and published articles does provide the basis for sustainable OA to all scholarly, scientific and medical peer-reviewed research. The crux of the issue is how to achieve this. We discard the suggestion that a prime mover for change would come from the (commercial) publishing industry. Our analysis suggests if AMs were given value independent from published articles, then the beneficiaries of this newly created value would have a strong incentive to buy into the system. The direct beneficiaries are academic authors themselves who, under the mechanism we have described in this paper, would add a parallel channel of peer recognition and esteem based on the number, location and dynamics of online usage of AMs. BitViews simply provides the technology for aggregating, validating and disseminating online usage data. Instead of relying on Christmas-voting turkeys/publishers as the main actors who set in motion AM/article unbundling, the BitViews project is predicated on the assumptions that librarians worldwide are willing to take concrete steps to initiate the unbundling process. This is not to absolve academic authors of their responsibility (complicity?) in the slow progress of OA. The main reasons for targeting libraries as agents of change are that, compared to academics, they are counted in (a few) thousands rather than in hundreds of thousands and that they are far more well-disposed to reform the academic journal publishing system than citation-focused authors. The BitViews project is predicated on the goodwill of libraries worldwide, and the use of conditional crowdfunding is meant to alleviate the worst features of the free-rider problem by providing a simple mechanism to spread fairly the (relatively) small set-up cost of BitViews.

'The BitViews project is predicated on the goodwill of libraries worldwide'

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Abbreviations and Acronyms

A list of the abbreviations and acronyms used in this and other *Insights* articles can be accessed here – click on the URL below and then select the 'full list of industry A&As' link: <http://www.uksg.org/publications#aa>

Competing interests

The BitViews concept was devised by the authors and M La Manna is the director of the BitViews project.

References and notes

1. The scenario is not hypothetical: one of the authors was one of the signatories of the 2001 Budapest Open Access Initiative and the organizer of the ELSSS project (2000–2004).
2. Vincent Larivière, Stefanie Haustein, and Philippe Mongeon, "The Oligopoly of Academic Publishers in the Digital Era," *PLOS ONE*, 10(6): 20 June 2015, e0127502, DOI: <https://doi.org/10.1371/journal.pone.0127502> (accessed 11 October 2019).
3. This is not to deny that there has been a large increase in the volume of articles that can be accessed without subscription or that new OA journals have not entered the market. See, for example, Heather Piwowar et al., "The state of OA: a large-scale analysis of the prevalence and impact of Open Access articles," *PeerJ*, vol. 6 e4375. 13 Feb. 2018, DOI: <https://doi.org/10.7717/peerj.4375> (accessed 11 October 2019), but the bulk of 'established' journals are still paywalled.
4. Admittedly, some editors are paid honoraria and/or expenses (sometimes as an incentive not to defect to alternative publishing models), but these costs pale into insignificance compared to the billions of pounds paid annually by libraries and authors as subscriptions and APCs (see note 8 below).
5. In some cases, aggrieved authors may argue that the value of their own camera-ready AM is reduced by the introduction of misprints by underpaid proofreaders!
6. Kent Anderson, "96 things that publishers do" (updated 2016 edition), *The Scholarly Kitchen*, 1 February 2016, <https://scholarlykitchen.sspnet.org/2016/02/01/guest-post-kent-anderson-updated-96-things-publishers-do-2016-edition/> (accessed 11 October 2019);

Quantifying even broad categories of post-AM costs appears to be very difficult. Searching RELX's 184-page 2018 annual report for 'marketing expenses' yields zero results, *RELX Annual Report and Financial Statements 2018*, <https://www.relx.com/-/media/Files/R/RELX-Group/documents/reports/annual-reports/2018-annual-report.pdf> (accessed 11 October 2019). RELX is the corporation owning Elsevier, among many other companies. How much of the £1.191 **billion** reported in 2018 by RELX as 'distribution and selling costs' benefits authors and readers?

7. On the 'Big Deal' as an example of bundling, see Theodore C. Bergstrom et al., "Evaluating big deal journal bundles," *Proceedings of the National Academy of Sciences*, 111(26), 16 June 2014, DOI: <https://doi.org/10.1073/pnas.1403006111> (accessed 11 October 2019).
The meaning of unbundling in our article is germane to the decoupling of academic book publishing as described by S.A. Hill ("Decoupling the academic book", *Learned Publishing*, 31(S1), 6 September 2018, <https://onlinelibrary.wiley.com/doi/full/10.1002/leap.1201> [accessed 14 October 2019]) and similar to Toby Green's "We've failed: Pirate black open access is trumping green and gold and we must change our approach," *Learned Publishing*, 30(4), October 2017, DOI: <https://doi.org/10.1002/leap.1116> (accessed 11 October 2019), with substantial differences explained above in the article.
8. Publishers can claim that the activity of organizing peer review is critical to the production of an accepted article, but the cost of setting up a peer-review system (which can be organized as semi-automatic) is a sunk cost, not a recurring cost. We can easily imagine that if the organization (and set-up cost) of journal peer review were to be transferred from publishers to academic departments/centres, the universities concerned would compete for the prestige associated with hosting a respected journal. Again, any attempt to quantify what publishers call 'pre-publication costs' is frustrated by the opacity of their annual reports. For example, the RELX 2018 report mentioned above (reference 6) states: 'pre-publication costs are stated at the lower of cost, including appropriate attributable overhead, and estimated net realisable value. Such costs typically comprise direct internal labour costs and externally commissioned editorial and other fees. Pre-publication costs, representing costs incurred in the origination of content prior to publication, are expensed systematically reflecting the expected sales profile over the estimated economic lives of the related products, generally up to five years'. We note that in 2018 pre-publication costs amounted to £171m against revenues of £7,492m, i.e., to less than 0.023%. On the basis of these illustrative figures, our contention that pre-publication costs are *relatively* insignificant and non-recurring (and hence not to be included in the final price) seems reasonable.
9. We are aware that there are discipline-specific differences in what constitutes an AM.
10. We are simplifying somewhat here: there other non-labour costs, such as the hosting of articles, but these are largely of the sunk-cost variety and comparatively small and thus could be sustained by academic/charitable funders.
11. Notice the stress on *effective* cost: this refers to the minimum cost at which AMs can be produced, not the actual cost, which can be inflated by 'gold-plating'. The simple reason why profit-seeking publishers may wish to incur unnecessary costs is that their pricing model is essentially a mark-up on costs.
12. If journal subscriptions were replaced by APCs '... subscriptions paid by academic libraries globally would fall by £2.91bn. But these savings would be offset by an increase of £2.92bn in the charges that the academic and research institutions of which they are a part (or their funders) would have to meet in author-side publication fees', Cambridge Economic Policy Associates, *Activities, costs and funding flows in the scholarly communications system in the UK* (Research Information Network Summary Report 2008), 8; Ralf Schimmer, Kai Karin Geschuhn, and Andreas Vogler, "Disrupting the subscription journals' business model for the necessary large-scale transformation to open access," (2015), DOI: <https://doi.org/10.17617/1.3> (accessed 11 October 2019) make the point that current subscription charges would be more than sufficient to cover the costs of article processing, a not altogether surprising finding, especially in view of the 30%–40% profit margin included in subscription charges. It should also be pointed out that the paper does not consider the issue of the large back catalogue that would still remain largely paywalled.
13. This is not to deny that the library profession is built on people who believe in access to knowledge and in doing everything they can to connect users with information. The evidence shows that this pool of goodwill is not sufficient to overcome the systemic mismatch of incentives.
14. Green, "We've failed".
15. Larivière, Haustein, and Mongeon, "*The Oligopoly of Academic Publishers*".
16. Min Tan et al., "Fellatio by Fruit Bats Prolongs Copulation Time," *PLOS ONE*, 28 October 2009, 4(10): e7595, DOI: <https://doi.org/10.1371/journal.pone.0007595> (accessed 11 October 2019).
17. Juan Gorraiz, Christian Gumpenberger, and Christian Schögl, "Usage versus citation behaviours in four subject areas," *Scientometrics*, 101(2), November 2014, DOI: <https://doi.org/10.1007/s11192-014-1271-1> (accessed 14 October 2019).
18. See, for example, Johan Bollen and Herbert Van de Sompel, "Usage impact factor: The effects of sample characteristics on usage-based impact metrics," *Journal of the American Society for Information Science and Technology* 59 no. 1 (2007): 136–49, <https://onlinelibrary.wiley.com/doi/full/10.1002/asi.20746> (accessed 28 October 2019), DOI: <https://doi.org/10.1002/asi.20746>
19. See Ted Bergstrom, Richard Uhrig, and Kristin Antelman, "Looking under the COUNTER for overcounted downloads," UC Santa Barbara: Department of Economics, 2018, <https://escholarship.org/uc/item/Ovf2k2p0> p. 1 (accessed 14 October 2019); and Ted Bergstrom, "Do download reports reliably measure journal usage? Trusting the fox to count your hens?," UC Santa Barbara: Department of Economics, March 2018, <https://escholarship.org/uc/item/2cd2h7vt> (accessed 14 October 2019).
20. The Springer Nature's report (Mithu Lucraft, Hélène Draux, and John Walker, "Assessing the open access effect for hybrid journals," June 2018, <https://doi.org/10.6084/m9.figshare.6396290> [accessed 14 October 2019]) provides data to support the unsurprising conclusion that open access content receives more views/usage than restricted content.
21. See Camillo Lamanna and Stevan Bruijns, "Measuring regional impact: The case for bigger data," *Learned Publishing*, 31(4) October 2018, <https://onlinelibrary.wiley.com/doi/full/10.1002/leap.1183> (accessed 14 October 2019), DOI: <https://doi.org/10.1002/leap.1183>
22. While it is recognized that Altmetrics can offer geographical insights into impact, its measure may be skewed by differing social media activity patterns globally (Cameron Neylon, Michelle Willmers, and Thomas King, "Rethinking Impact: Applying Altmetrics to Southern African Research," *Scholarly Communication in Africa Programme*, Paper 1, January 2014, pp. 1–20, <https://pdfs.semanticscholar.org/ee96/d67a9ce474247de9824da43fe44349fc4ce0.pdf> [accessed 14 October 2019]).
23. Stevan Bruijns and Camillo Lamanna, "Rethinking Impact: Applying Altmetrics to Southern African Research," *ecancermedicalscience*, 12, ed78, 29 January 2018, <https://pdfs.semanticscholar.org/ee96/d67a9ce474247de9824da43fe44349fc4ce0.pdf> (accessed 14 October 2019).

24. We are aware of the pitfalls of Elsevier-supplied viewing data: they are not transparently validated and, more generally, the data contain far too much noise to extract a meaningful signal. For example, the most cited article (with 298 citations) contains resuscitation guidelines and it has apparently been viewed only 131 times.
25. PIRUS, *Developing a global standard to enable the recording, reporting and consolidation of online usage statistics for individual journal articles hosted by institutional repositories, publishers and other entities (Publisher Metadata and Interoperability Projects 3) Final Report*, January 2009, https://irus.jisc.ac.uk/about/pirus2/pirus_finalreport.pdf (accessed 14 October 2019).
26. Ross MacIntyre et al., "Measuring the usage of repositories via a national standards-based aggregation service: IRUS-UK," in *New Avenues for Electronic Publishing in the Age of Infinite Collections and Citizen Science: Scale, Openness and Trust: Proceedings of the 19th International Conference on Electronic Publishing*, eds. Schmidt B, Dobrev M (Amsterdam, Netherlands: IOS Press, 2015), 85, <https://pdfs.semanticscholar.org/9235/f5e88705411088588bf0116b7c729fd0c122.pdf> (accessed 14 October 2019), p. 3.
27. It should be noted that the recent Crossref-led Distributed Usage Logging project differs substantially from BitViews in both aims and scope. (For a recent account see Jeffrey G. Coghill, "Distributed Usage Logging: What to Consider," *Journal of Electronic Resources in Medical Libraries*, 16(2) June 2019, DOI: <https://doi.org/10.1080/15424065.2019.1638870> [accessed 14 October 2019].) The differences are best encapsulated in the DUL mission statement: "This initiative, driven by the DUL working group, is exploring how to provide a *private* peer-to-peer channel for the secure exchange and processing of COUNTER-compliant *private* usage records from hosting platforms to publishers." "Publishers are unable to demonstrate the full value of their content to library customers. They are also unable to provide authors with a full picture of usage of their articles. Because use is distributed, institutions do not have a complete picture of usage when making *purchasing* decisions." [italics added] <https://www.crossref.org/community/project-dul/>. The main motivation of the DUL initiative appears to be the desire to establish a closer link between online usage and pricing of published articles.
28. Camillo Lamanna and Manfredi La Manna, "BitView: Using Blockchain Technology to Validate and Diffuse Global Usage Data for Academic Publications," in: *Maturity and Innovation in Digital Libraries*, eds. Milena Dobrev, Annika Hinze, Maja Žumer (ICADL, 2018), part of the *Lecture Notes in Computer Science* series, vol. 11279. Springer. DOI: https://doi.org/10.1007/978-3-030-04257-8_28 (accessed 14 October 2019).
29. Notice that our use of blockchain technology is completely different from Phil Davis' suggestion of using it as an authentication tool. See Phil Davis, "Bitcoin: A Solution to Publisher Authentication and Usage Accounting," *The Scholarly Kitchen*, 1 June 2016, <https://scholarlykitchen.sspnet.org/2016/06/01/bitcoin-a-solution-to-publisher-authentication-and-usage-accounting/> (accessed 14 October 2019).
30. Pierluigi Cuccuru, "Beyond bitcoin: an early overview on smart contracts", *International Journal of Law and Information Technology*, 25(3), Autumn 2017, DOI: <https://doi.org/10.1093/ijlit/eax003> (accessed 26 October 2019).
31. We address later the issue of whether publishers such as Elsevier would join the BitViews consortium. The above example applies if 'IR' is substituted for 'Elsevier'.
32. While we recognize that adoption of DOIs has not been universal, it has increased significantly in the past decade and the majority of material published in peer-reviewed journals has an associated DOI (Christophe Boudry and Ghislaine Chartron, "Availability of digital object identifiers in publications archived by PubMed," *Scientometrics*, 10: 1453 (2017), DOI: <https://doi.org/10.1007/s11192-016-2225-6> (accessed 14 October 2019).
33. It has been estimated that the *majority* of IR 'usage' is due to non-human activity (Patrick O'Brien et al., "RAMP – the Repository Analytics and Metrics Portal," *Library Hi Tech*, 35(1), 2017, DOI: <https://doi.org/10.1108/LHT-11-2016-0122> [accessed 14 October 2019]). A single, transparent set of filtering criteria is essential to make IR usage statistics valid and comparable.
34. Bergstrom, "Do download reports reliably measure journal usage?"
35. The term 'conditional crowdfunding' is sometimes used in the fundraising community to mean "conditional on the funded project/person undertaking (or refraining from undertaking) a given action", for example, fundraising for a Congressional candidate but only if a certain cause (e.g., gun control, reproductive rights, etc.) is supported. Instead we use it to mean that the supporters' financial commitment is conditional *both* on the attainment of the target (sometimes called 'threshold crowdfunding') *and* on the total amount committed (with any surplus returned on a pro rata basis).
36. The suggested contribution is meant to establish a link between a library's budget and its participation in the project.
37. It should be stressed that libraries' initial contributions are not binding financial commitments to the project, but merely an indication of the *maximum* amount each library is willing to contribute to the development of the BitViews application. If the fundraising target is reached and once the total amount of *maximum* contributions is known, each contributor will be invoiced for a pre-order payment (expected to be lower than its maximum willingness to pay).

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