Towards Open Science: The Case for a Decentralized Autonomous Academic Endorsement System

b8d5ad9d974a44e7e2882f986467f4d3*
blockchain-aes@protonmail.com

Abstract

The current system of scholarly communication is based on tradition, and does not correspond to the requirements of modern research.

The dissemination of scientific results is mostly done in the form of conventional articles in scientific journals, and has not evolved with research practice.

In this paper, we propose a system of academic endorsement based on blockchain technology that is decoupled from the publication process, which will allow expeditious appraisal of all kinds of scientific output in a transparent manner without relying on any central authority.

Introduction

Scientific output is traditionally disseminated in the form of articles in scientific journals. It is then given value by peers and funders based on in which journal it is published, e.g. by the Journal Impact Factor, and by counting the number of other works citing the paper. In recent years, other metrics of scientific impact have appeared, but they are rarely used for decisions by funders and recruitment committees.

There are many problems with the current state of affairs, including

cost Scientific output is to a large extent controlled by a profit-driven publishing industry that provide little added value. In fact, many scientific journals only consist of collections of papers produced by public funds, refereed for free by the scientific community. The role of the journal is then simply to provide a publishing platform, organize the refereeing process and make editorial decisions. In spite of this, scientists are expected to relinquish copyright for their articles and pay the journal for publishing their work. In addition to this, many journals charge the scientific community for accessing the articles, (unless exuberant Open Access fees are payed by the authors), thereby effectively preventing access from academics at universities without a journal subscription, and from the public. Furthermore, these so-called paywalls hinder meta-analytics, and drive scientists to resort to services of questionable legality, such as SciHub[2].

metrics In spite of common belief, the merit of an article is not automatically high because it is published in a prestigious journal. The Journal Impact Factor (JIF) is often used by funding agencies to rank ap-

*As our proposal aims to make parts of the scientific publishing industry obsolete, we have chosen to publish this proposal under a *nom de plume* in order to minimize the risk of adverse effects (e.g. unfavourable editorial decisions, or stern letters to our employers[1]). The authors declare that they have no competing interests.

plicants, in spite of the questionable value of this metric.[3, 4, 5, 6, 7].

control Given the influence editorial decisions can have on scientific careers, in particular for young scientists, publishers and editors are bestowed an undue power. The "cult of the journal" is detrimental to scientific progress[8]. In fact, the entire system of peer reviewing comes with a considerable risk of preventing outstanding discoveries to be published[9, 10].

delays Scientific projects often take years from start to publication. Consequently, there is an inherent time lag in using citations to appraise scientific work.

publication bias There are very small incentives to publish negative results and studies confirming previous results, as this kind of work, while important for furthering science, is less likely to garner citations in the future.

non-publications It is difficult to be rewarded for non-traditional output, e.g. data sets and scientific software.

While several of the deficiencies outlined above are being addressed in various projects and organizations, in particular new ways of scientific dissemination, a key feature that is missing in most of these initiatives is the possibility to receive merit in other ways than citations. Novel metrics for scientific impact are often based on journal publications[11], or more oriented towards providing reading suggestions[12, 13, 14].

The short-comings of current evaluation systems are well-known in the scientific community[3]; the *San Francisco Declaration on Research Assessment*[15] has more than 10^4 signatures at the time of writing.

Proposal: an academic endorsement system

The purpose of evaluating research output is to guide scientists, funders, recruiters in making different kinds of decisions; what articles are worth spending time reading, how to fund the best research, which scientists are most likely to produce important results. It should be possible to identify high-quality research and performant researchers without waiting for citation data, as that is a slow process.

In this communication, we propose an academic endorsement system (AES) with a form of currency, academic endorsement points (AEP), which scientists can use to endorse research output. Each scientist is then (possibly periodically) credited with AEP to reward scientific work that he/she finds worthy of endorsement. The amount of AEP each scientist is credited is based on the amount of AEP received for previous work. The total amount of AEP given to a research object can then be used as a metric for its value. The amount of AEP given to a scientist can be used as a measure of his/her impact.

While impact and importance of scientific work is not amenable to be quantified as simple numbers – metrics should always be analyzed in a context, the advantages for such a system are many-fold:

- Any kind of scientific output could be endorsed, as long as there is a persistent identifier for the research object. This would facilitate attributing value to non-traditional publications (e.g. arxive documents, open referee reports, blog posts, data sets, software, etc.).

- Provided there are clear links to the authors (e.g. as part of the PID metadata), they would be credited AEP from endorsements by their peers.

- With enough uptake, the value of new results will become apparent much faster than with citation metrics.

- Scientists whose output has been endorsed to a high degree will have more AEP to use for endorsements, and thus have a larger influence in the community.

Transparency and decentralization by using blockchain technology

The proposed system of endorsement would need to be carefully designed in order to minimize opportunities to game the system to gain undue advantages. It would also be better served by not having a single organization controlling it. This is why we propose to use blockchain technology as the underlying infrastructure for the AES.

Blockchain technology is perhaps most well-known for its use in crypto currencies, e.g. bitcoin. However, in recent years, the technology has evolved and is now being proposed for different kind of point systems, tracking ownerships, educational records[16], smart contracts, decentralized name resolution[17] and even for generating persistent identifiers[18].

Briefly, blockchain technology allows for distributed verifications of transactions. Transactions of tokens (e.g. crypto currency, votes, points) can take place between accounts. In addition to accounts controlled by users of the system (externally owned accounts, using the terminology of the etherium platform[19]), accounts can also be governed by predefined rules – so-called smart contracts. By using smart contracts, it is thus possible to construct a system of transactions with its own set of rules that, once constructed and deployed, can operate autonomously, exempt from any form of control by a central authority. These constructs, known as distributed autonomous organizations (DAOs), are currently being explored for e.g. governance systems and venture capital funds[20].

In the proposed AES, each scientist would then have an EOA, and every digital research object would have a smart contract attached to it. An endorsement would be a transaction of AEP from an EOA to a scientific object, where the amount of AEP transferred – limited by the endorsers current balance – and would reflect the importance the endorser is attributing the work. EOA:s would thus only be able to transfer merit points to research objects (i.e. scientific output, not scientists can be credited). Conversely, research objects (smart contracts) would only transfer AEP to scientists.

The main advantages for using blockchains to track academic endorsements are that the system can then be autonomous, and have complete transparency. The distributed ledger model will allow consumers of this information to only take endorsements from a subset of users (i.e. trusted scientists) into account, if they so wish – thereby providing means to circumvent attempts of gaming the AES. This filtering could be based on the amount of AEP received, but also by identifying the persons attached to the accounts, i.e. allowing scientists to follow what authorities in their field endorse (and not only what they cite). In addition, an endorsement system that is decoupled from *where* scientific objects are published/made available, will ameliorate the unsound dependency on the scientific publishing industry. Finally, the wealth of information from such a system would allow for interesting analytics on scientific progress.

A prerequisite for the AES is to have unique identifiers of research objects as well as of researchers. In order to bootstrap the AES, the former could be built upon existing identifiers, e.g. the doi system[21], which is already used for articles, data sets and even software. The latter could be e.g. Open Researcher Id (ORCID)[22]. It would even be possible to boot-

strap the system by crediting initial users with a pre-defined amount of AEP. The final requirement is an infrastructure where transactions - based on the current rules - can be recorded and verified. This could be constructed as a DAO on the ethereum blockchain application platform[19, 23], but there are also other alternatives (e.g. Openchain[24]).

The basic prerequisites would need to be complemented by an ecosystem of tools to facilitate endorsements, viz. social media buttons at article pages, and tools to analyze and visualize AEP transactions and account balances.

For a functional AES, there are many additional details to be discussed, e.g. how AEP is distributed when there are multiple authors, how to handle retractions and scientific fraud, the possibilities of different endorsement flavours (e.g. novelty, quality), whether scientists who contribute to the system by crediting scientific work should be rewarded in order to incentivize its use, counteracting tit-for-tat schemes and nepotism, the question of interest rates on the AEP, etc.

Discussion

In this paper we argue that a new way of giving merit to scientific results will accelerate scientific progress, and at the same time decrease the scientific communitys dependence on the publishing industry, which will free up funds to research. The solution that we propose – an academic endorsement system built on blockchain technology, could leverage existing digital infrastructures, and would only need modest resources to realize. The major challenges are achieving consensus for devising the AES, and ensuring uptake by the scientific community.

The purpose of this communication is to present the concept of a decentralized AES as a starting point for further discussions. There are several fora where this discussion could take place; the OECD Directorate for Science, Technology and Innovation[25] have a strong record of furthering Open Science, as has the European Union Directorate-General for Research and Innovation[26]. On the grass-roots level, FORCE11 was formed with the aim "to bring about a change in modern scholarly communications through the effective use of information technology"[27], and the Research Data Alliance[28] is a cross-disciplinary organization which has backing from many funding organizations as well as technical expertise among its members. Other organizations and projects include[1] the W3C Research Object for Scholarly Communication (ROSC) Community Group[29], OpenBlockchain[30], CODATA[31], Pasteur4OA[32], researchobject.org[33], ePIC[34], FAIRDOM[35], the Digital Curation Centre[36] and the European Open Science Cloud[37][2]

Once these ideas have been scrutinized, discussed and improved, we believe that the best way forward is to convince funders about how an AES could improve research in general, and gain commitments from some large funding agencies to fund the development of a pilot system, and subsequently evaluate its usefulness in ranking funding applications.

A final word of caution: the scientific publishing industry will no doubt oppose any development that threaten their influence and profit margins[3]; their control of major communication channels combined with their lobbying experience will make this an uphill battle.

[1] Apologies if stakeholders are missing due to the authors involuntary ignorance.

[2] On a side note, the EOSC is proposing to award *cloud coins* to be used by scientists when accessing IT resources – this concept would also be suited for cryptocurrency technology.

[3] This is not out of malice, it is simply their responsibility towards their shareholders.

Hopefully, science – with the help of academic integrity and new technology – will prevail.

References

[1] *Letter from Association of American Publishers*. URL: https://dl.dropboxusercontent.com/u/51751685/misc/ThomasAllen_Letter.pdf (visited on 08/10/2016).

[2] *Sci-Hub*. URL: http://sci-hub.cc/.

[3] Colin Steele, Linda Butler, and Danny Kingsley. "The publishing imperative: the pervasive influence of publication metrics". In: *Learned Publishing* 19.4 (2006), pp. 277–290. ISSN: 1741-4857. DOI: 10.1087/095315106778690751. URL: http://dx.doi.org/10.1087/095315106778690751.

[4] P. O. Seglen. "Why the impact factor of journals should not be used for evaluating research". In: *BMJ* 314.7079 (Feb. 1997), pp. 498–502.

[5] P. A. Lawrence. "The mismeasurement of science". In: *Curr. Biol.* 17.15 (Aug. 2007), R583–585.

[6] P. A. Lawrence. "The Last 50 Years: Mismeasurement and Mismanagement Are Impeding Scientific Research". In: *Curr. Top. Dev. Biol.* 116 (2016), pp. 617–631.

[7] T. C. Ha, S. B. Tan, and K. C. Soo. "The journal impact factor: too much of an impact?" In: *Ann. Acad. Med. Singap.* 35.12 (Dec. 2006), pp. 911–916.

[8] P. A. Lawrence. "The politics of publication". In: *Nature* 422.6929 (Mar. 2003), pp. 259–261.

[9] K. Siler, K. Lee, and L. Bero. "Measuring the effectiveness of scientific gatekeeping". In: *Proc. Natl. Acad. Sci. U.S.A.* 112.2 (Jan. 2015), pp. 360–365.

[10] *Nope! 8 Rejected Papers That Won the Nobel Prize*. URL: https://www.authorea.com/users/8850/articles/117724/ (visited on 08/12/2016).

[11] Carl Bergstrom. "Eigenfactor: Measuring the value and prestige of scholarly journals". In: *College & Research Libraries News* 68.5 (2007), pp. 314–316. eprint: http://crln.acrl.org/content/68/5/314.full.pdf+html. URL: http://crln.acrl.org/content/68/5/314.short.

[12] *Altmetric*. URL: https://www.altmetric.com/.

[13] *Mendeley*. URL: https://www.mendeley.com/.

[14] *Authorea*. URL: https://www.authorea.com/.

[15] *San Francisco Declaration on Research Assessment*. URL: http://www.ascb.org/dora/ (visited on 08/12/2016).

[16] *Blockchains and the Web Position Paper, A W3C Workshop on Distributed Ledgers on the Web*. URL: https://www.w3.org/2016/04/blockchain-workshop/interest/third.html (visited on 08/11/2016).

[17] *Namecoin*. URL: https://bit.namecoin.org/.

[18] L. Bolikowski, A. Nowiski, and W. Sylwestrzak. "A System for Distributed Minting and Management of Persistent Identifiers". In: *The International Journal of Digital Curation* 10.1 (2015), pp. 280–286. DOI: 10.2218/ijdc.v10i1.368.

[19] *Ethereum*. URL: https://ethereum.org/.

[20] *The DAO*. URL: https://daohub.org/.

[21] *DOI*. URL: http://www.doi.org/.

[22] *ORCID*. URL: https://orcid.org.

[23] *Ethereum White Paper*. URL: https://github.com/ethereum/wiki/wiki/White-Paper (visited on 08/11/2016).

[24] *Openchain*. URL: https://www.openchain.org/.

[25] *OECD Directorate for Science, Technology and Innovation*. URL: http://www.oecd.org/sti/.

[26] *EU Directorate-General for Research and Innovation*. URL: http://ec.europa.eu/research/index.cfm?pg=dg.

[27] *FORCE11*. URL: https://force11.org.

[28] *Research Data Alliance*. URL: https://rd-alliance.org/.

[29] *W3C Research Object for Scholarly Communication Community Group*. URL: https://www.w3.org/community/rosc/.

[30] *OpenBlockchain*. URL: http://blockchain.open.ac.uk/.

[31] *CODATA*. URL: http://www.codata.org/.

[32] *PASTEUR4OA*. URL: http://www.pasteur4oa.eu/.

[33] *researchobject.org*. URL: http://researchobject.org.

[34] *ePIC*. URL: http://www.epforum.eu/.

[35] *FAIR-dom*. URL: http://fair-dom.org.

[36] *The Digital Curation Centre*. URL: http://www.dcc.ac.uk/.

[37] *EOSC*. URL: http://ec.europa.eu/research/openscience/index.cfm?pg=open-science-cloud.