

# ScienceMiles

## Digital Currency for Researchers

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### ABSTRACT

Peer-reviewing is a community-driven activity where volunteer researchers assess the work of other researchers. Peer-reviewing is an important and time-consuming activity that has very little recognition. This lack of incentive may lead to poor-quality reviews and frustration from researchers. In this paper, we envision ScienceMiles, a Blockchain-based platform to manage the incentivization of peer-reviewers through a crypto-currency.

### CCS CONCEPTS

• **Networks** → **Peer-to-peer protocols**; • **Social and professional topics** → **Information system economics**;

### KEYWORDS

Blockchain; ScienceMiles; Peer-review; Academic Publishing; Incentive

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## 1 INTRODUCTION

Researchers spend their valuable time in a number of activities like peer-reviewing, and chairing and participating in workshops and conferences. Such activities support the wider research community but are rarely acknowledged by it. Peer-reviewing is an example of such activity when researchers spend extra time out of their busy work schedules, to read and review the scientific work of other researchers. They take the responsibility for having suitable knowledge of the presented research and assessing its scientific

quality. Researchers' activities are neither acknowledged publicly nor incentivized. Adding peer-reviewing efforts to a CV is a coarse measure that does not take into account review quality and only benefits junior researchers.

To recognize, acknowledge and incentivize the efforts of researchers, we present the idea of *ScienceMiles*, a crypto-currency for incentivizing peer-reviewing. Researchers would earn *ScienceMiles* every time they review a research object and would then be able to spend them, either by offering them as *bounty* to other researchers to incentivize reviews of their own research objects or exchange them for perks in conferences and journals they attend, e.g., a discount on registration (in a similar style to frequent flyer miles). A Distributed Ledger serves a two-fold purpose in this scenario: first, it provides a decentralized way of executing *ScienceMiles* transactions; second, it makes reviews both immutable and tamper-free.

In combination with an Open Review Process, this would foster healthy criticism, scrutiny and quality control of peer-reviews. This model would encourage researchers to submit their thorough and constructive reviews in a timely fashion. This platform would be an attempt to make peer-reviewers' contributions quantifiable in a trustworthy fashion. Rewarding researchers for their reviews would encourage peer-reviewers to write constructive, fair, useful and unbiased reviews.

The remainder of the paper is structured as follow: Section 2 provides a literature review on peer-review patterns and incentives. Section 3 provides an overview of the *ScienceMiles* System. Impacts and challenges are discussed in section 4, followed by conclusion.

## 2 LITERATURE REVIEW

This section discusses about peer-review patterns, incentives for peer-reviews and blockchain technology.

### 2.1 Peer Review Patterns

Peer reviewing practice follows a number of patterns. For instance, in [4], case studies of six peer review patterns were presented.

- (i) *Simple* - when authors of a publication and reviewers are paired together;
- (ii) *Round Robin* - when participants are grouped and each participant reviews the work of others in the group;

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- (iii) *Group Activity* - when a third party reviews the work of a group of authors;
- (iv) *Group Review* - when a group of authors review the efforts of their group individually;
- (v) *Committee Review* - also known as "Conference committee stage of peer review", when a group of reviewers produce one review about different artefacts;
- (vi) *Multiplicity* - When publications from multiple authors are independently reviewed by multiple reviewers.

A Blockchain-based incentive model can be applied using any of the above review patterns. However, different variables depending upon the process type, would have to be taken into account.

## 2.2 Open Review

The Open Review Process has been instantiated in a number of ways including [5]:

- (i) *The Submitted manuscript* is available online as a discussion paper;
- (ii) *Reviewer names* are publicly available at the time of publication of reviews;
- (iii) *Access to review reports* are available publicly;
- (iv) *The review reports* are available publicly including the authors;
- (v) *Accepted vs. rejected papers* review reports are made available.

## 2.3 Incentive

There have been several approaches to incentivising reviewing, some of which are listed in table 1 below. Hauser [2] suggests that a reviewer who submits reviews after the deadline should be punished and their next publications (as a first author, in the same journal) would be delayed by twice the length of their delay. Researchers submitting their reviews before the deadline would be rewarded by journals as their manuscripts would be sent for reviews as soon as they are received and pushing them high up in the publication queue if accepted. Hauser further suggests, if habitual late-reviewers stick to their habit, another week delay should be added as a top-up. This model was proposed to fix what Hauser calls the *broken* review process where wrongdoers are not punished by editors [2].

Gropp [1] asked if peer-review is properly incentivized, and if peer-reviewers are being asked to evaluate the right things? Gropp suggested an incentive model to filter out the good peer-reviewers (e.g., timely, responsive and thorough) and then put their names into a research funds lottery.

*The Winnower* is a platform that publishes post-publication peer-reviews and is exploring incentivizing peer-reviewers to highlight their work by elevating the review report to the level of an original research publication [5]. The Winnower platform is intended to be integrated with the Zenodo<sup>1</sup> repository that holds Open Science publications[5].

*ReviewerCredits*<sup>2</sup> came up with an idea to give credit to peer-reviewers. Peer-reviewers would have to contact *ReviewerCredits* which would contact the journal concerned for verification. After

receiving verification, a peer-reviewer's profile is credited with *ReviewerCredits*. This, however, is a manual and centralized approach to add reputation to the peer-reviewers' profile, where *ReviewerCredits* acts as a trusted third-party.

Existing approaches to incentivize peer-reviewers are based on centralized and manual systems requiring trust in third parties. Apart from the idea of a lottery fund for researchers, these models offer no real-world value incentives.

We present a model based on blockchain that would reward peer-reviewers and authors for submitting high-quality reviews. The immutability of the distributed ledgers would not allow abuse of the system or alteration of the record data in the database. In contrast with existing approaches, our approach offers increased benefits as outlined in Section: 3.

## 2.4 Blockchain

Blockchain has emerged as a disruptive technology in recent times. It offers the features of distributed, immutable and tamper-proof data [7]. The already developed peer-reviewing systems are centralized and controlled by the publishing organizations. By implementing a system based on blockchain, a pool of public profiles of researchers (peer-reviewers) can be built along with a mechanism to incentivize them for their peer-reviewing efforts and contributions.

## 3 THE SCIENCEMILES SYSTEM

Figure 1 explains the flowchart of the process that starts when authors submit their article to a conference. The management of the conference typically sends that article to peers familiar with that area of research. Peers then examine that article and write their recommendations for the work presented in that article, along with the opinions on it, suggested improvements, and recommendations as to whether to accept or reject the article for publication.

Written peer-reviews and decisions are then made public by the conference so that researchers can comment on and criticize the reviews. A certain number of *ScienceMiles* would be given to the peer-reviewer for submitting a review. Their share would be increased by ratings for the constructiveness of their review. Similarly, someone who criticizes or comments on reviews would also be incentivized for their contribution. This gamification would encourage readers to reflect on and evaluate both their own reviews and those of others, and pave the path for increased dialogue to be explored.

### 3.1 Peer-review system on Blockchain

By deploying an Open Review system on blockchain, we can enrich the current methods of peer-reviewing with the benefits of blockchain. In this section, we list the benefits of building an Open Review system on top of blockchain.

- **Recognition** - Reviewers will be recognized based on their publicly available peer-reviews. With the implementation of Open Reviews on the Blockchain, the recognition and reward would be permanent and immutable. Researchers would have their public profile showing statistical analysis of their peer-reviews and rewards. These *ScienceMiles* are the acknowledgement by the research community, for contributions to the research community.

<sup>1</sup><https://zenodo.org>

<sup>2</sup><https://www.reviewercredits.com/>

**Table 1: Comparison of incentive models**

Approach	Punishment Model	Incentive Model
Hauser [2]	Reviewer's article in editorial limbo for a certain period. (even if peer-reviewers refuse to review)	Reviewers' articles in priority queue for publication, if accepted.
Gropp [1]	No	Filter good peer-reviewers and put them in to a lottery fund
ReviewerCredit <sup>+</sup>	No	Credit awards for peer-reviewers' profiles as reputation indicators.
ScienceMiles	No	Digital Currency, to be spent on other platforms, as well as measured as reputation.

- **Activities for research community** - By participating in the public platforms, authors, peer-reviewers and commentators will be entitled to be awarded *ScienceMiles*. The best peer-reviewers of the year per conference can also be awarded to researchers using *ScienceMiles*. The system will keep the record of *ScienceMiles* awarded to a peer-reviewer and the number of miles they spend.
- **Preventing abuse** - Publication records are valuable for academic careers, which can induce reasons for people to game the system. The availability of incentives may increase the motivation to do so. This model can help in preventing possible abuse of authority over a peer-reviews database by making use of the openness of the system and immutability of data provided by blockchains.
- **Less bias** - Peer-reviews and comments about them are publicly available as well as immutable, so reviewers are incentivised to come up with a valid and clear stance about the article, thus reducing the bias in the peer-reviewing process if any.
- **Selection** - All journals maintain a database of peer-reviewers and their history [2]. Blockchain offers a distinct feature of data distribution, that data is spread across the network, and thus the database of peer-reviewers is shared with everyone in the network. With the process of Open Reviews, and incentives in the form of *ScienceMiles*, editors can easily filter out the most competent peer-reviewers for future events. This filtration will be carried out on genuine unchangeable data available to everyone in the network.
- **More discussion - More knowledge** - The gamification of earning *ScienceMiles* will encourage researchers and communities to participate more in discussions around peer-reviews. Researchers will have increased motivation to contribute to peer-reviewing activity, which will enrich the on-going discussions and ideas about the quality of research and peer-review.

Initially, consortium members would create accounts for workshops, conferences and journals designated for minting the coins (*ScienceMiles*) on blockchain. The management of these accounts and their allowed operations need to be investigated and outlined.

Collectively, these benefits promote timely, unbiased and well-thought-out peer-reviews, which will therefore improve the overall quality of scientific output.

## 4 CHALLENGES

In this section we are going to focus on the impacts this system would have on the peer-reviewing process.

### 4.1 Communal impact and acceptability

With the emergence of Blockchain and hundreds of multiple cryptocurrencies, many people still have no idea about how digital currencies work. It will be an interesting study to observe researchers' interest in the acceptability and usage of *ScienceMiles*. Further development and deployment of the *ScienceMiles* approach would enable the study of the reaction of researchers to a crypto-currency dedicated for scholarly purposes. Would this play an influential role in motivating researchers in their approach to peer-review? The public profiles would have their peer-reviews and number of *ScienceMiles* aggregated through their peer-reviewing activity. Would having peer-reviews and number of *ScienceMiles* on researchers' public profiles be helpful in portraying community contributions alongside scientific publications?

Another benefit of peer-review data being published on a Blockchain platform would be to enable the study of further deep research questions of peer-review statistics about conferences, publishing organizations, institutions and individual researchers.

### 4.2 Open and closed reviews

The design and implementation would demand further investigation into the impacts of openness and closedness of peer-reviews. At this moment, the design focuses on Open reviews, however, blind and double blind reviews will be taken into consideration in future.

### 4.3 Linked Data

This would comprise a large dataset and thus would be available for other applications to be integrated with. An important research question would be to investigate the impact of using Linked data of peer-reviews and reward system on blockchain.

### 4.4 Trading - ScienceMiles as monetary entity

Crypto-currencies are yet in their infancy to be accepted by major e-commerce platforms. They have shown an exponential growth recently [3]. However, many people are unaware of digital currencies. There are deep practical and ideological issues to be addressed while trading currencies on external platforms, as explained by Sharples [6]. We would have to come up with a function of equivalence between *ScienceMiles* and items of real-world value. Similarly, we would have to consider the precise levels of reward for various community activities, such as submitting a review or commenting or rating on a review.

Another interesting challenge would be to come up with a list of possible rewards other than paying for the conference fee and priority queue at conference venue.

As this model suggests a bounty program for peer-reviewers, it would be an insightful question to explore that how such bounty

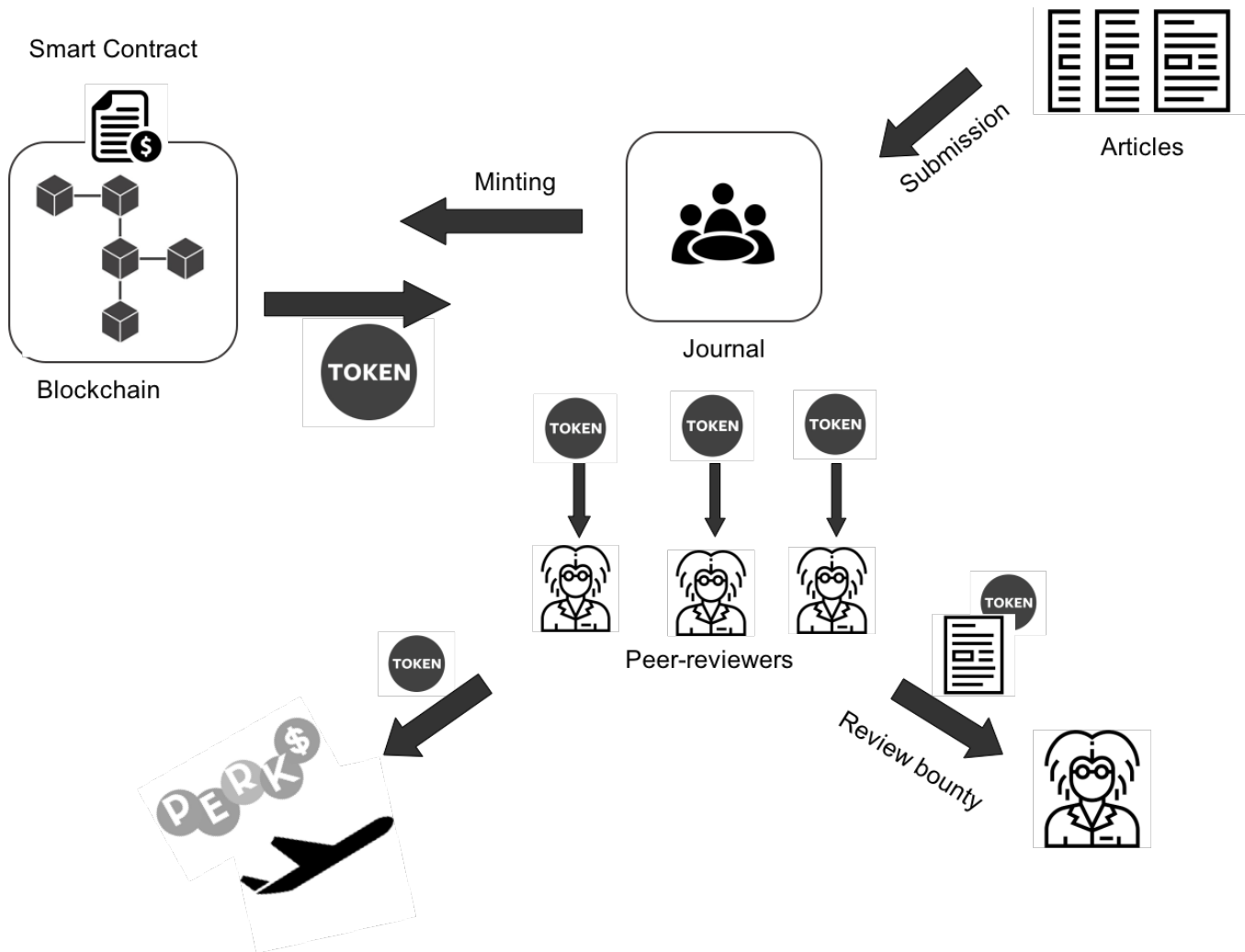


Figure 1: Peer-Reviewers Recognition System

transfer would impact on peer-reviewers when they receive the crypto-currency but their reputations are not incremented.

A further question relates to the process of minting new ScienceMiles. In crypto-currencies like Bitcoin, they are minted as a reward for miners. As the concept of miner does not exist as part of ScienceMiles, they would need to be created on a per-conference basis. We would investigate the use of smart-contract-based token systems on platforms such as Ethereum to implement this.

#### 4.5 Underlying Blockchain platform

ScienceMiles can be implemented on top of a public Blockchain (like Ethereum [8]), however, that would mean that every time a transaction of ScienceMiles is triggered, a fee needs to be paid to the platform, leading to the question: who pays the fee?. Alternatively, ScienceMiles can be implemented on a *Consortium Blockchain*, where the verifying nodes are run by research institutions that do so on the basis of providing a trusted environment for peer-reviewing, taking care that the size and makeup of such a

consortium be diverse and large enough to maintain independence of blockchain contents and security. In this case, an interesting research question is: which permissioned-blockchain protocol is the most appropriate for the particular case of ScienceMiles? Ethereum<sup>4</sup> platform will be used for deployment of ScienceMiles Smart Contracts. To avoid the computational cost, and save transaction time, we would focus on adopting non-computational methods, unlike PoW (Proof of Work) [8], for minting coins.

#### 5 CONCLUSION

We have proposed the *ScienceMiles* model for incentivising and gamifying the process of scholarly peer-review, in order to motivate researchers to submit timely, unbiased, relevant and constructive reviews of others' work, and to recognise and reward individual contributions to scholarly communities. In combination with an open review process, this model has the potential to make a positive

<sup>4</sup><https://www.ethereum.org/>

difference to the academic publishing process and the quality of resulting work, and we intend to study the effects of its introduction on the review process. In future, *ScienceMiles* may go beyond the scope of research to other domains in which non-incentivised peer-reviewing takes place.

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