A Blockchain-based Scientific Publishing Platform

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Abstract—**Out casting, sharing, and publishing the collected knowledge, experiences, and outputs of scientific works, regardless of being empirical or purely theoretical, has always been one of the key assets of human evolution. However, on one hand, re-usability of published work depends on accessibility, and, on the other hand, om the correctness of published work. Studies on the traditional scientific publishing platforms reveal many deficits with those systems, which had been addressed with the proposed blockchain-based solution called Eureka. Eureka enables high quality reviews of tthe published work, while incentivizing authors and reviewers to participate in this decentralized, open, and public scientific publishing platform.**

I. Introduction

From thousands of years ago, where humans started to draw images on the cave walls, until today, where computers and Internet have opened new paradigms to human's life, sharing the knowledge and experience have been constantly the main appliance for keeping and improving the knowledge, believes, experiences, and results of the investigations and explorations. Human evolution would not be possible without learning from each other, and in this millennium, one of the main groups of mechanisms in sharing the knowledge especially in academic life is electrical Scientific Publications Systems (SPS).

Electrical publications provide access to millions of scientific documents from journals, books, protocols, and reference works [15], [12], [18]. Even though the publication systems seem to be successful, current studies show that these systems face several challenges and deficits. Scientific publishing is facing challenges, such as :

Problem 1 - Low incentives to publish negative results: Current scientific publishing culture is not supporting unsuccessful trials to be published. For this reason, it is intuitively common to experience the same failure by different researchers after dedicating considerable amount of time, energy, and cost as they could not attain any information with the current publishing systems about that previous and the same unsuccessful experience of researchers in the same field. Here the problem might be the low probability of failed experiences to be published in current SPS which basically leaves no incentive for scientist to bare the effort for documenting and publishing the steps and the failed results.

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Problem 2 - No credit for contribution: Observations on the publishing process in current SPS, indicate that the contribution of reviewers and authors are neglected. On the one hand, unfortunately within the current SPS publishers expect the experts of a field to dedicate a considerable amount of time for reviewing an article with no reward. On the other hand, publishers may ask authors to pay for publishing their documented work and results, and universities are asked to pay subscription fees for accessing the scientific publishing articles. Surprisingly, who have done the real work need to pay! Even more surprising is that most of the reviewers are not being credited properly (*i.e.,* not paid) for the time and effort they invest for evaluation of an article by current SPS.

Problem 3 - Lack of reusability of published works According to a survey of 1500 scientists conducted by the science journal Nature [17], more than 70% have been unable to reproduce another scientist's experiments. Even more worrying, over 50% of those surveyed were unable to reproduce their own experiments. As a result, much time and billions of dollars are wasted pursuing drug candidates which have already been found in unpublished research not to be effective. This is what is known as the 'reproducibility' crisis. It is estimated that in the US alone, pharmaceutical companies waste $28 billion annually on irreproducible life sciences research. The top ten biopharma companies spent $63 billion on Research Development in 2016.

To overcome these problems, this work here presents a scientific publishing platform named "Eureka". The Eureka platform has a novel incentive model within the publishing process to ensure quality research. Authors and academic institutions will be able to publish open-access research while reviewers will be directly paid. With Eureka research is timestamped and added to the blockchain. The reviewing is performed later and submitted to the smart contract. By using a blockchain-based system, the Eureka platform is a highly efficient, rapid, and scalable, token-based incentive mechanism that reduces the overhead in the current SPS. The potential use cases for the Eureka are substantial and global.

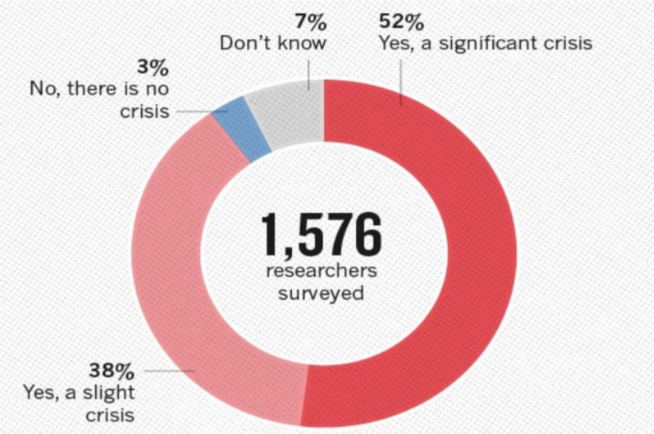

Fig. 1: Reproducibility Crises [17]

II. Related work

This section covers the related proposed works in the scientific publishing area by indicating the determined solutions by each approach. Orvium [2] aims to integrate blockchain-technology into the management of scholarly publications' life cycles and the associated data for creating an open-science platform. Developing time lines and plans for Orivium's platform according to the the published white paper [2] implies that the proposed system is following the developing processes by the end of 2019. The Orvium platform will be characterized by instantaneous proof-of-existence, where manuscripts will be available from the moment they are submitted to the platform and thus promoting, open-science. Furthermore, copyright and licenses will be owned and transferable by authors, where authors themselves will have the control of their own work. In Orvium transparent peer reviews are considered, where the research community will determine the validity and soundness of the research.

Regarding the publication aspect of a manuscript, Orvium will allow the community to create and manage customized journals. These journals will follow a Decentralized Autonomous Organization (DAO) [4] approach. Each stakeholder involved in the process of publishing science, will be able to initiate his own Decentralized Autonomous Journals (DAJ) and define its set of governance rules.

In the same field, the "Blockchain for Science" [1] is an organization that wants to use blockchain technology for connecting all research devices and distributing research money anonymously creating a new living knowledge network. This organization wants to promote blockchain technology for connecting all research devices and distributing research money anonymously creating a new living knowledge network. Its core focus is put on a collaborative thinktank for blockchain science-related projects by bringing together people interested in that field. This thinktank is already composed of many people interested in science and blockchain applications (many members coming from the projects presented above), who are cooperating and co-writing together the Open Living DOC [5]. This document can be viewed as a sort of universal and shared whitepaper which collects ideas and opinions from a consortium of people who constantly tries to find new attractive opportunities for combining blockchain and science.

In this respect, ScienceRoot [3] is a blockchain-based ecosystem that wants to create a social media scientific network organized by decentralized publishing mechanisms. The goal in ScienceRoot is to create an ecosystem where anyone in the community will be able to discuss research ideas, collaborate and publish their work through a common transparent platform. In order to create such an open-access collaborative platform, they aim at integrating blockchain technology and the Interplanetary File System (IPFS) [7] as the underlying technology.

ScienceRoot is planned to consist of a Marketplace and a set of shared repositories, which can be seen as an ever-growing database of scientific information. In addition, its planned in ScienceRoot to create a blockchain-based funding and job platform. Such a platform, will consist of a centralized portal where peers from all around the world will be able to offer many grants for different fields. The portal will be open for national or international funding organizations with the main goal to offer funding options for scientific projects.

Regarding funding research projects, DEIP [6] is a decentralized research platform entirely governed by the scientific community. Indeed, DEIP aims to create an ecosystem for scientific work activities where the value of each discovery will be assessed and ensured by the experts community. Each research project will be fairly rewarded regardless of its final result if the correspondent experts in that field will acknowledge its significance and impact [11]. Furthermore, since the DEIP ecosystem is mainly driven by the scientific community, it will promote cooperation in many scientific areas and collaboration between different research groups, where all researches will be assessed from the point of view of their significance and quality.

In addition to that, DEIP core's focus will be put on the funding mechanisms for diverse scientific projects. DEIP plans to create the DEIP protocol to adapt to increasing budgets for distribution across science-activities depending on total number of researches at the platform [11]. Researchers on DEIP could potentially receive funding by other stakeholders for either getting profit from initial investments or for satisfying the research curiosity (since the majority of the platform members are scientists themselves). The long-term vision of DEIP is to stay absolutely free for its users and to ensure operability by means of a protocol and its underlying economic incentives. Similarly to all other related project presented above, DEIP will also promote open-science, i.e. all research and discoveries within the ecosystem will be accessible by anyone.

Investigations done on each of the introduced related work in this section, reveal that most of the claimed functionalities of these platforms are still under progress and not yet available fully. Despite sharing a common view of employing blockchains towards decentralized approaches, all the mentioned works here cover common but at the same time different use cases with deviations with respect to the level of centralization, employed incentive methods, stakeholders, goals, and generality of the design.

III. Design

To address the problems of traditional SPS, and to ease the processes involved in publishing research and experience outputs, this work here introduces a novel scientific publishing platform *i.e.*, Eureka. Eureka is designed to serve in the most possible generic way for all kind of researchers and scientific works. Eureka has designed to use a public blockchain to bring the public accessibility and trust to the whole operation.

The designed platform consists of 6 steps as presented in the Figure Design. In Eureka, Step 1 describes the scenario where an author submits an article calling a public function in the Smart Contract (SC). Afterwards, the paid amount for the submission is split and locked within the SC. That amount will be afterwards used for recompensing all parties involved in the processing cycle of that submitted article.

Step 2, is characterized by the presence of a convenience layer. The convenience layer can be viewed as a combination of internal infrastructure (a MongoDB, a Node.js server and a private Ethereum node) provided by Eureka, which is constantly listening to the deployed SC. Once a new event gets triggered within the SC (*e.g.,* the submission of a new article), the convenience layer recognizes it and informs the concerned stakeholders with the help of an email service provider. Step 2 consists of informing a set of reviewers that a new article has been submitted. The convenience layer will select an adequate list of reviewers from those that have been added in the SC.

In Step 3, reviewers can submit their review by calling a public function in the SC. The numeric rating will be stored on the blockchain, while the raw review text will be kept in the convenience layer. Once the convenience layer gets triggered, *i.e.*, the minimum amount of reviews for starting the peer-review process has been reached, the editor as well the second-reviewers (in case of non-editor-approved reviewers are allowed) are notified. When they state that the submitted reviews are sensible and consistent, the reviewers get rewarded with Eureka tokens (*i.e.,* EKA). In case of more cycles in the peer-reviewing process, the compensation will be paid at the end of it.

Step 4 consists of informing the author about the collected reviews in step 3. In the case of a resubmission, no additional fee has to be paid (however, the gas transactions costs will be paid by the author).

Step 5 is the last step before the publication. The editor at the end of the peer-reviewing process has to approve the manuscript. After the approval, she/he gets also compensated with EKA tokens.

Last step –step 6–, includes the remuneration for referenced authors.

A. Erueka Token (EKA) – Generic Reward and Incentive Design

Crypto-Tokens are well-known assets in the crypto space and are usually identified as a subset of the huge Cryptocurrency family. While a cryptocurrency is a standard currency for making or receiving payments on a blockchain, crypto tokens are a special kind of virtual representation of a particular asset or utility, that reside on their own blockchains [9], [20].

Usually, tokens can be classified into two main categories:

1. Utility Tokens

As the word itself states, utility tokens represent a sort of ”digital coupon” which can be used for accessing a particular service or product in a crypto ecosystem (*e.g.,* Eureka). Usually, users operating with such tokens will be rewarded for their contribution in that particular system. In this sense, utility tokens empower the participants therein.

2. Security Tokens

Security tokens can be viewed as a digital company's share and in the norm are more designed as an investment. Indeed, they give the holder an ownership right (normally, also dividends are included and paid out). However, security tokens imply more strict federal regulations, limiting investors participation and the trading possibility.

As mentioned in the previous Sections, one of the well-documented challenges in the current SPS is the absence of fair contributions for those stakeholders who were involved during the editorial assessment and peer-reviewing process. Indeed, authors, editors, and reviewers currently get almost no direct compensation for the scholarly work that they perform in publishing and reviewing. The high cost to publish peer-reviewed research means researchers have a barrier to publish and share knowledge with society and the scientific community. To tackle these issues, Eureka exploits blockchain technology to create a new incentive mechanism in the academic industry: the reward system and EKA utility tokens.

The reward system in Eureka is designed as follows:

1. Revelation

The time-stamping of single observations as an incentive since this gives the author immediate ownership rights, and ensures scientists' and researchers' discoveries are tamper-proof.

2. Evaluation

Eureka will make use of crowd-sourced reviewers to get consensus-oriented evaluations of work, instead of being restricted to one or two reviewers, as is common practice. In doing so, each peer in the world could be part of the peer-reviewing process of a certain manuscript and thus get rewarded for his/her work with EKA tokens.

3. Worth Assignment

The Eureka platform's crowd-sourced scoring system will provide researchers as well as publishers a new metric that can be used to evaluate articles. Since the ratings for scientific work are stored on the blockchain, the scores can be transferred (*e.g.,* to another journal) and the peer-reviewing process must not be performed twice.

4. Award

Referenced authors, editors and reviewers will be rewarded for

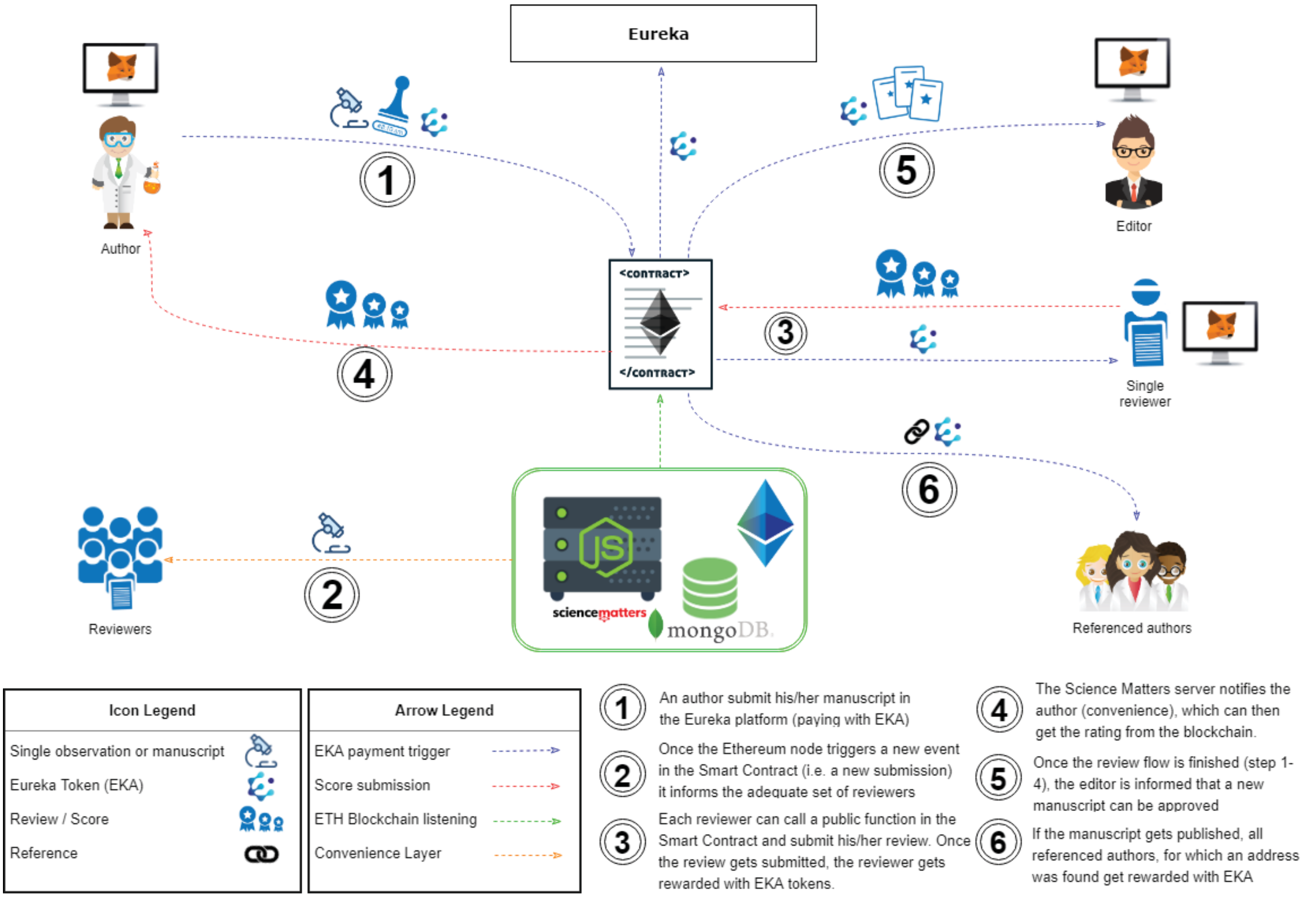

Fig. 2: Overall Transaction Flow [17]

their operations within the Eureka ecosystem with EKA tokens coming from the amount paid for the submission. Referenced authors, will get tokens once an editor approved a specific manuscript, reviewers will be rewarded when their submitted reviews have been accepted by the editor and/or by second-reviewers. The editor's contribution will arrive at the end of the editorial assessment process.

5. Replication

Since a part of the amount paid for the submission will get locked and allocated in the SC in case of invalidation, other authors will have the incentive to replicate existing studies. Researchers that contradict the study will get compensated with EKA tokens. This ensures the reproducibility of findings and minimizes wasteful time and financial spending.

6. Data Analytics

With the help of well-known text-mining techniques, Eureka will extrapolate the main topic of an article and thus automatically assign a set of reviewers which are experts in that field. In doing so, reviewers with different backgrounds and coming from different fields will have the incentive to join the Eureka community as reviewers.

The awarding system applied to the transactions between stakeholders shown in Figure 2, are based on the EKA tokens (*cf.*, Figure 3), which are used for the following set of actions:

- Submitting articles for review
- Proving ownership of observations by timestamping them
- Upvoting and downvoting articles with EKA micropayments
- Voting for awards and prizes
- Paying the submission fee, which includes a fee for operating costs and a variable fee to reward two or more peer reviewers
- Automatically connecting peer reviewers with manuscript submissions transferring
- Reward ratings from peer reviewers internally and externally
- Rewarding peer reviewers, authors and funding agencies for citations and for Having exceptional reward ratings
- Research funding using smart contracts: automatically release funds for studies,
- Peer review once conditions have been met
- Token pledges, awards, and prizes contributed by organizations for scientists and researchers to reach set milestones and help solve society's problems

- Crowdfunding from the general public to directly pay scientists around the world to conduct research studies on the Eureka platform into under-researched diseases and ailments

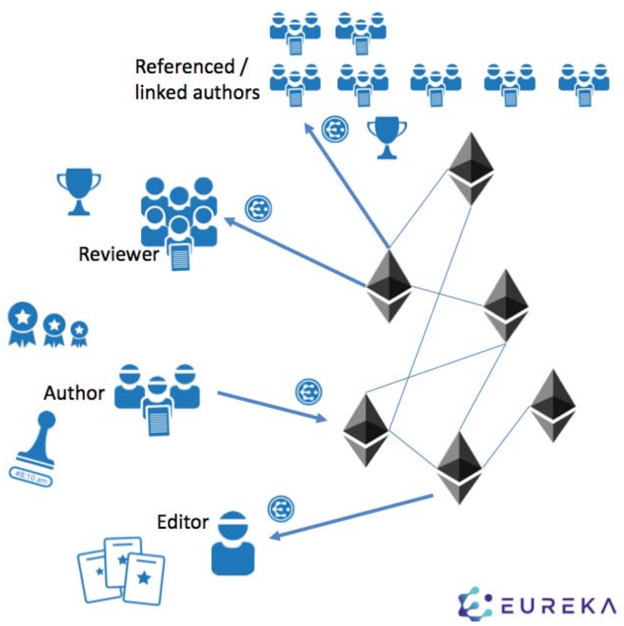

Fig. 3: Eureka's Token-based Reward System

IV. Implementation

Eureka Implementation is composed of three main components of front-end, back-end, and Smart Contracts which connects Eureka to the Ethereum Blockchain (cf. Figure imp). These components are explained as follows in this section.

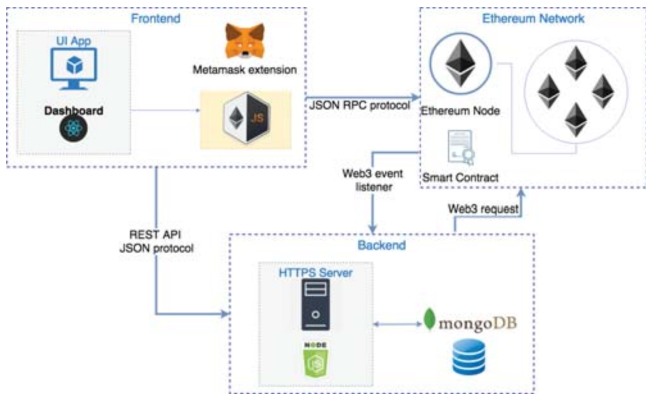

Fig. 4: Eureka Platform Architecture [17]

A. Back-end

In Eureka, a Node.js application is provided in order to manage our Database, off-chain interactions with our frontend and render methods. However, all interactions with the blockchain take place on the client side using the methods provided by the web3.js Javascript API. This is more secure since the user does not need to give the control of his/her private keys to the service provider and all interactions with his/her wallet are administered on the client side.

B. Front-end

Decentralized Application (Dapp): A decentralized app is implemented to act as an interface for interacting with the Ethereum blockchain directly. Using web technologies, an easy-to-use interface which supports seamless blockchain/off-chain interaction is be provided. For submitting manuscripts (external URL of the manuscript and hash) to the smart contract, a user-friendly interface using Dapp browsers like Mist or MetaMask is provided. To not lose manuscripts if the external URL were inaccessible, Eureka caches the manuscript on its servers. Thus, a submission will be only accepted if the paper is accessible during submission. The external URL can be a pre-print service or a personal website.

C. Ethereum Connection and Smart Contracts

The developed Smart Contract of Eureka is abstracted in Figure SC while the source code can be accessed in [14]. Using the standard web3.js Javascript API which implements the generic JSON RPC specification giving a convenient interface for the RPC methods, the Dapp can be accessed using a regular web browser with an extension such as MetaMask or a desktop client such as Mist Wallet. For example, the Metamask extension exposes the web3.js API by an injected web3 object that can easily be accessed using Javascript using asynchronous methods calls. Thanks to the flourishing Ethereum ecosystem, the mobile experience with clients such as Toshi is also decent and constantly improving. Using these browsers, users can interact with the blockchain while never having to communicate with Eureka servers.

Eureka Token Contract Implementation:
The Eureka Token Contract is an ERC-20 token [13]. ERC-20 is a standard for implementing smart contracts on the Ethereum blockchain. The Eureka token Contract also contains parts of more extending smart contract standards which are all sub-standards of the ERC-20 token. In Eureka a special transferAndCall token interface is implemented, which deviates slightly from the ERC-677 token [19], [8]. TransferAndCall method is implemented in such a generic way that the method which wants to be called can be specified as a method parameter (cf. Listing code:transferAndCall).

```
// ERC677 functionality
function transferAndCall(address _to, uint256 _value, uint8 _rewardType, bytes4 _methodName, bytes _args) public returns (bool) {

  require(mintingDone == true);
  require(transfer(_to, _value, _rewardType));

  emit Transfer(msg.sender, _to, _value, _methodName, _args);

  // call receiver
  if (Utils.isContract(_to)) {
    require(_to.call(_methodName, msg.sender, _value, _args));
```

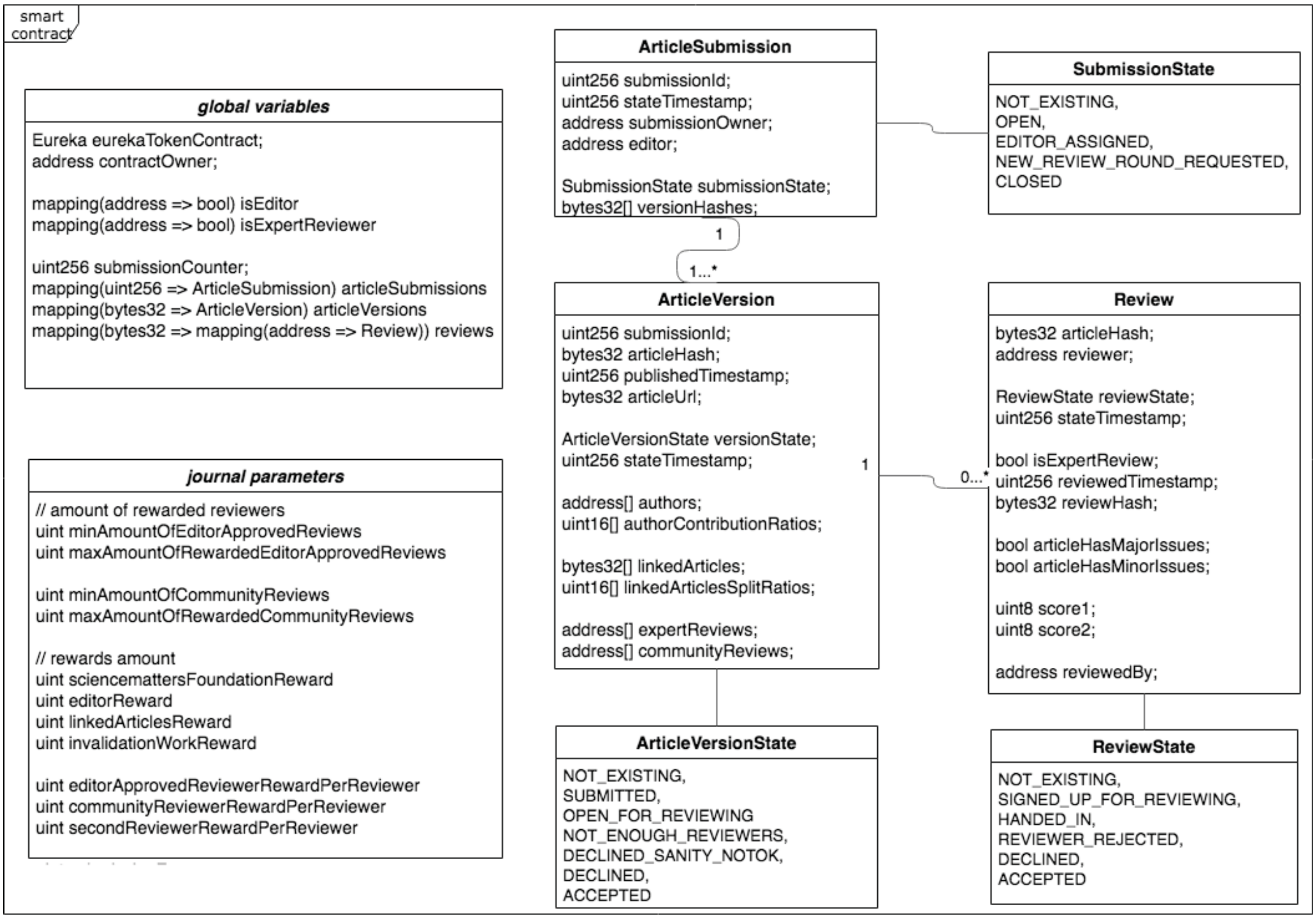

Fig. 5: Eureka Smart Contract Components [17]

```
  }
  return true;
}
```

Listing 1: The generic transferAndCall method of the Eureka token contract

The Eureka Token Contract also implements the ERC-865 interface. It represents the implementation of a delegated transfer method which results in a so-called tranferPreSigned method (cf. Listing code:transferPreSigned). It is the pre-requisite for the payment service which allows paying the transaction costs (gas) in EKA tokens instead of Ether.

In Eureka not only the standard ERC-865 [16], [10] token is extended by implementing a delegated transfer method, but also, a delegated transferAndCall method is provided (transferAndCallPreSigned) to assure that the user can call every method after transferring without having Ether in his/her wallet.

```
function transferPreSigned(bytes _signature,
    address _to, uint256 _value, uint256 _fee,
    uint256 _nonce, uint8 _fromType) public
    returns (bool) {

  require(signatures[_signature] == false);

  bytes32 hashedTx = Utils.
      transferPreSignedHashing(address(this), _to
      , _value, _fee, _nonce);
  address from = Utils.recover(hashedTx,
      _signature);
  require(from != address(0));

  doTransfer(from, _to, _value, _fee, msg.sender,
       _fromType);
  signatures[_signature] = true;

  emit Transfer(from, _to, _value);
  emit Transfer(from, msg.sender, _fee);
  emit TransferPreSigned(from, _to, msg.sender,
      _value, _fee);
  return true;
}
```

Listing 2: The transferPreSigned method which is implemented by the ERC-685 token standard interface

V. The Token-based Use Cases Perspective

After explaining the Eureka platform regarding the implementation aspects in previous section, in this section Eureka's operation flow as a generic scientific publishing system is explained considering the three main use-cases of:

1) Authors/ Institutions/ Universities/ Funding agencies, buying tokens and paying for the reviewing and rating
2) Reviewers/ Editors getting tokens for the reviewing/editing jobs
3) Authors of cited (linked) or replication papers getting tokens
As explained in the Design Section, these three use cases require a set of actions that are explained stepwise as follows:

Author tending to publish a paper:
Eureka users are responsible for their accounts wallets, and the ETH and EKA tokens in them. Eureka doesn't manage users' wallets in any case. The user has MetaMask installed and enough Eureka tokens and Ethers on his/her selected address. A website with a URL field or upload area is shown. The user can set his/her email and a previous submission transaction (in case of resubmission). The user can also specify the minimum amount of reviewers. The higher the minimum amount of reviewers, the more expensive the submission gets. Once the user filled in these amount, uploads or sets a URL, the submission can be done.

Preparing the submission:
After a submission check is being done on the client(*i.e.,* Author owns enough tokens), parsing of reference authors, and the results are shown to the user. The user then has the ability to add more referenced author addresses or a linked author for confirmation/invalidation. The eligible referenced authors are checked by the editor (*e.g.,* already Eureka published authors). The format of these authors need to be specified, but can look as follows: "eureka:0x8aF94De2c676BAa741d347C448cA132c073Ee1f5" (lower-upper case is a checksum). Thus, a reference in a manuscript needs to have this information, *e.g.,* "Thomas Bocek [eureka:0x8aF94De2c676BAa741d347C448cA132c073Ee1f5], David Hausheer, Reinhard Riedl, Burkhard Stiller: Introducing CPU Time as a Scarce Resource in P2P Systems ; IFI Technical Report, No. 0, January 2006".

Web3js Calls Smart Contract submitManuscript() function:
After the client-side check, the user submits the review via the Eureka smart contract. If the user chose to upload the file, before submission, the paper is uploaded, and replaced by a Eureka URL. The user will be forwarded to a dashboard, where he can check the status of submission.

$=> transaction_{id}$

Front-end polls ETH in background for latest papers for user - reads the published journal [which is free]:
The backend listens to a specific Eureka-journal contract (cf. Fig SC) and updates the dashboard accordingly. Once a new submission is registered, the submitter gets an email as well as the editor. Reviewers in Eureka platform have access to the new submission repository and they are able to choose the paper they like to review. Eureka announces review possibilities publicly and anybody with Eureka tokens can participate in the review process.

Receive tokens for reviewing
The reviewer has an option for rating (drow-down 1-5) and free text. Once the review is finished in a timely manner, the rating is stored in the smart contract, the text is send to the backend. Optionally, the editor may define a staking fee to prevent late reviews. Once the minimum number of required reviews have arrived, the editor and optionally the author need to agree for the payout to the reviewers to prevent bogus reviews. Also the editor approves within the same transaction the rating, which gets stored in the journal contract. If a manuscript gets rejected, then the author can resubmit with a submission ID. Everything will be publicly recorded.

Receive Tokens as A Cited/Linked Author
A manuscript submission has the address of cited authors (eureka:0x123456789AbcDef). Each time a new manuscript is accepted, a percentage of tokens are transferred to those cited authors. It has to be distinguished between cited and linked author. Cited authors are typically mentioned in related work. However, only a fraction of the cited authors will have an author address in the beginning, making it attractive for early movers. A linked author is only one, whose work is either been confirmed or invalidate. A linked author then also gets a percentage of the original authors, with decreasing percentage the higher the indirection.

A part of the submission fee is held back for a certain amount of time (*e.g.,* , one year), for those authors to invalidate the research. If after e.g., one year more invalidating research was published than confirming, the fee is paid to the invalidating authors. In the simplest case, if one invalidating research was submitted, the fee held back during the submission is paid to the invalidating author, otherwise these held back tokens are send back to the original author.

VI. Summary and Conclusions

The academic publishing industry is facing well-documented serious challenges from current models for scholarly publishing. The limitations detected in the process of publishing science are constantly affecting the scientific progress and thus having significant negative implications for the entire society. Since science is continuously changing our life day by day, the importance to change the oligarchic process of publishing science has answered the bell for new potential approaches and solutions.

In this sense, blockchain-based solutions have been taken into consideration as suitable options for addressing the well-documented problem identified by the absence of fair credit contributions for the main stakeholders involved in the editorial and peer-reviewing process in publishing science. In fact, such blockchain-based solutions do have the capacity to breathe life into new token-based incentive mechanisms which can be fully or partially self-regulated. Those new ecosystems aim at improving the absence of rewards by decentralizing the decision-making process in the academic publishing industry.

In this respect, Eureka has been presented in this work as a viable blockchain-based alternative to the current model. The approach presented, rewards all parties involved in the process of science publishing using the Eureka token (EKA), determining the fuel of the Eureka ecosystem. Eureka uses

Ethereum as main infrastructure for creating its own digital asset. Furthermore, Eureka exploits the characteristics of a public blockchain for improving transparency and giving the possibility to each peer in the world to contribute and at the same time be fairly rewarded. Within the Eureka ecosystem the amount paid in EKA for submitting a manuscript or a single observation is split and kept locked within a SC.

In the second step, it is proportionally and fairly distributed among those stakeholders who contributed to the process leading to an article's publication. In this aspect, through SCs reviewers are being rewarded for their time and effort. With such a token-based incentive, Eureka avoids the well-known problem where reviewers do not allocate sufficient hours to properly assess the quality of the research. Similarly, to reviewers, editors who carry out the quality control of each research are being automatically paid at the end of the editorial assessment process. In addition, referenced authors who indirectly contributed to a certain study, are also rewarded once the document is approved by the editor.

Regarding the decisions taken for system design, infrastructure, and implementation related aspects, Eureka is built on the basis of three main components. A front-end component which exposes an interface for interacting with the Ethereum blockchain, a convenience layer which is constantly listening to the SC, and the SC itself. The entire architecture of Eureka relies on state-of-arts Web technologies. Since all interactions with the blockchain takes place on the client side, it is more secure since no third parties will be involved in the process of storing public/private-key pairs. Eureka not just creates new incentives for all scientific actors, but it also increments transparency and efficiency in the academic industry. Eureka's main goal to reach a scientific publishing platform as a fully self-regulated ecosystem has been achieved via the entire decision-making process getting driven by the scientific community. However, having just SCs as regulatory authorities in science publishing is still an ambitious concept.

To detect malicious contributors and contradicting studies, which had been compensated with EKA tokens, a contradicting study needs to be peer-reviewed. For the compensation of EKA, the the publisher needs to specify which other publishing contracts are accepted in case there is a contradiction. So, only this publisher itself or other reputable publisher can accept contraction with automatic payout. Any other submission to "malicious" publications needs to be manually reviewed and accepted by the respective editor.

Future work foresees further evaluations and a complete real world implementation.

REFERENCES

[1] Blockchain for Science: Reproducible Results Through Openness to Scientific Self Correction. https://www.blockchainforscience.com, [Last accessed Dec 4, 2019].

[2] Orvium: The Open Source and Decentralized Framework for Managing Scholarly Publications Life Cycles and The Associated Data. https://orvium.io, [Last accessed Dec 4, 2019].

[3] ScienceRoot. https://scienceroot.com, [Last accessed Dec 4, 2019].

[4] What is DAO? https://blockchainhub.net/dao-decentralized-autonomous-organization/, [Last accessed Dec 4, 2019].

[5] Blockchain for Open Science – The Living Document. https://www.blockchainforscience.com/2017/02/23/blockchain-for-open-science-the-living-document/, [Last accessed Dec 5, 2019].

[6] Building a New Home for Science. https://deip.world/, [Last accessed Dec 5, 2019].

[7] IPFS is The Distributed Web. https://ipfs.io/, [Last accessed Dec 5, 2019].

[8] Alexander Culum. Token ERC Comparison for Fungible Tokens. http://blockchainers.org/index.php/tag/erc-677/, [Last accessed Dec 21, 2019].

[9] Aziz. Coins, Tokens, and Altcoins, What is The Difference? https://masterthecrypto.com/differences-between-cryptocurrency-coins-and-tokens/, [Last accessed Dec 21, 2019].

[10] Bhaskar. ERC865: A Case for More User-friendly Tokens. https://medium.com/coinmonks/erc865-a-case-for-more-user-friendly-tokens-eb68e62a986, [Last accessed Dec 21, 2019].

[11] deip.world. DEIP: Decentralized Research Platform. [Last accessed March 15, 2019].

[12] Elsvier. Empowering Knowledge. https://www.elsevier.com/.

[13] Ethereum Wiki. ERC20 Token Standard. https://theethereum.wiki/w/index.php/ERC20_Token_Standard, [Last accessed Dec 21, 2019].

[14] Eureka Scientific Publishing Platform. Eureka Smart Contract Source Code. https://github.com/eureka-blockchain-solutions/eureka-token-contract/blob/master/src/test/resources/Eureka.sol.

[15] IEEE Explore. IEEE Explore Digital Library. https://ieeexplore.ieee.org/Xplore/home.jsp.

[16] Ludovic Galabro. ERC865: Pay Transfers in Tokens Instead of Gas, in One Transaction #865. https://github.com/ethereum/EIPs/issues/865, [Last accessed Dec 21, 2019].

[17] Monya Baker. 1,500 scientists Lift The Lid on Reproducibility. https://www.nature.com/news/1-500-scientists-lift-the-lid-on-reproducibility-1.19970, [Last accessed March 15, 2019].

[18] Springer Link. Providing Researchers With Access to Millions of Scientific Documents from Journals, Books, Series, Protocols and Reference Works. https://link.springer.com/.

[19] Stieve Ellis. ERC: TransferAndCall Token Standard #677. https://github.com/ethereum/EIPs/issues/677, [Last accessed Dec 21, 2019].

[20] StrategicCoins. ICO 101: Utility Tokens vs. Security Tokens. https://strategiccoin.com/ico-101-utility-tokens-vs-security-tokens/, [Last accessed Dec 21, 2019].