Shō-coin: A knowledge-based economy for Life Sciences

Alexander Garcia[1[0000-0003-1238-2539]], Erick Antezana[2[0000-0002-2497-8236]], Jael Garcia[3[0000-0003-3986-0510]], Olga Giraldo[1[0000-0003-2978-8922]], Pjotr Prins[4[0000-0002-8021-9162]], Rutger Vos[5[0000-0001-9254-7318]]

[1] Universidad Politécnica de Madrid, Campus de Montegancedo, 28660 Boadilla del Monte, Madrid, Spain
agarcia@gmail.com
[2] Norwegian University of Science and Technology, Høgskoleringen 1, 7491, Trondheim, Norway.
erick.antezana@ntnu.no
[3] Universitat Jaume I, Avenida de Vicent Sos Baynat, 12071, Castello de la Plana, Spain
al278693@uji.es
[4] University Medical Center Utrecht, Heidelberglaan 100, 3584 CX Utrecht, Netherlands
j.c.p.prins@umcutrecht.nl
[5] Naturalis Biodiversity Center, Darwinweg 2, 2333 CR, Leiden, Netherlands
rutger.vos@naturalis.nl

Abstract. With the continuous creation, sharing and transformation of data resulting from Research and Development in the Life Sciences domain, provenance tracking and valorization of research outputs remain challenges. Tracing biomedical materials and associated data throughout the research life cycle requires tracking materials, methods, transformations, partial results, locations and many other facets. Research is not always carried out in one place; it is usually distributed across several laboratories. Accordingly, research outcomes of various kinds are constantly being produced, recorded, transformed and shared in a decentralized manner. In consequence, the digital continuum is very often lost for practical purposes. Moreover, the value of all the assets produced throughout the research life cycle is neglected because we assign all the value to the product that comes at the very end of the process: the scholarly publication holds all the value. We argue that distributed ledgers, Blockchain, Hyperledger and Ethereum being prominent examples, could be used to preserve the digital continuum of the experimental record as well as provide underlying technology that could help manage the value of all the assets that we produce.

Keywords: Data management, data governance, data stewardship, blockchain, traceability, acknowledgement, data decentralization, ledger, currency, award.

1 Blockchain and its application in Life Sciences

A blokchain is an immutable distributed ledger where transactions are either added or read. In plain English, a distributed ledger (DL) is a network of computers where all maintain identical copies of a database whose state is changed according to agreed-upon rules. This technology has been used in domains such as property management, identity management, electronic health records, and fintech; in general, this technology is applicable wherever keeping an accurate record of transformations over valuables living in decentralized settings is needed. Smart contracts are part of the technological

stack in DLs. Smart contracts are pieces of code stored in the DL network. They define the conditions to which all parties using these contracts agree. Thus, if required conditions are met, certain actions are executed. The combination delivers an engine for applications that can be run without the need for a trusted third party.

DLs has been successfully used as the backbone technology behind crypto currencies such as Bitcoin and Ethereum, which in such cases are the data elements tracked on the DL. Data elements can be seen as an asset that is created, shared and transformed. For our own purposes, by data elements we refer to any piece of information or activity carried out as part of a Research and Development process, for instance dataset records, journal articles, public software, conference talks, etc. They all have in common being publicly identifiable –although not necessarily open access. Data elements can be grouped together not just in the repositories containing them but also in the form of Research Objects, projects, institutions, etc. Any sort of data exchange would constitute a transaction and the DL would serve people by managing the assets and the transactions. Moreover, smart contracts attached to the assets could facilitate the generation of apps over the assets.

This technology allows us to keep the research record in a distributed manner as well as to valuate all sorts of research outcomes in an open market. Such an open market, we argue, could have its own mechanisms for valuation. Smart contracts could enact the policies of the market and make these specific for each community. A healthy economy accounts for all products because all products are traceable. Scholars attach all the value to one single object, namely the research paper. The paper, as the only holder of the value, should, in theory, make it possible for readers to understand and recreate the research being described. This is, however, not always possible. Similarly, researchers depend on a myriad of products to preserve their research assets. These products don't always communicate with each other. Over a DL, we argue, digital assets could be properly managed without disrupting the use of various technologies. By establishing protocols, third parties could offer services and goods in the market place. In this way two problems could be solved, that of preserving the digital continuum in the research record and also that of managing the value of research outcomes.

In this poster we present the overall description of the marketplace and some of the valuation mechanisms that we envision. For instance, academic papers currently hold their implicit value over time; here we allow for depreciation of value over time. Also, the value of software, databases, datasets, figures, presentations, preprints, nanopublications, etc., should be aggregated over one single metric. Such metric should work in a similar way to that of financial markets where at any given point in time values can be disaggregated in its principal components in order to get a more detailed picture.

Not all researchers do the same work, however, all researchers contribute; such contribution should be rewarded accordingly. Reputation built in this way accounts for all assets, not just for one that usually assigns attribution in an arbitrary manner. Our approach is technical; we see DLs in combination with the Interplanetary File System as a platform for preserving the integrity of the research record, thus having fully identifiable and traceable objects and transactions. We also see this platform as the underlying technology for an open market of research data; one where all things and transactions are accounted for and attribution reflects individual contributions fairly. Hence our name, *Shō-coin* (*shō*: "award" in Japanese), a knowledge-based currency. We envision a digital knowledge-based economy that improves not only traceability but also recognition.