A Business Model for Multi-Tiered Decentralized Software Frameworks: The Case of ONTOCHAIN

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Abstract. Open source licensing enables the inception of collective building of integrated decentralized software frameworks. However, when individual constituents of such a framework are built by independent companies where each of them has its own business plan, then the joint exploitation of the overall software framework becomes very complicated. In this paper, we address this problem, by studying in depth the special case of the joint exploitation of the ONTOCHAIN (OC) blockchain-based software framework that is being built by many companies, each having its own business agenda. We define the business model of OC, whereby the management and maintenance of the jointly-built platform is assumed to be undertaken by a new venture; this offers the platform for dApp (decentralized application) deployment and as a PaaS for development and testing of dApps. We study carefully the business models of all stakeholders in the OC ecosystem and analyze them as a part of the overall value network. Based on realistic revenue and cost parameter assumptions, and analyzing concurrently the business models of all stakeholders in this ecosystem, we establish that win-win outcomes are economically sustainable, provided that revenue sharing is properly coordinated.

Keywords: blockchain · incentive compatibility · economic sustainability · techno-economic analysis · open-source · revenue sharing

1 Introduction

Collectively built integrated decentralized software frameworks can emerge through open-source licensing schemes, e.g., Apache v2.0. However, the business viability of a common platform, when its individual constituents are built by independent companies or individuals with different -often conflicting- business interests, is complicated [5] and even counter-intuitive.

In this paper[1], we address this problem by studying in depth the special case of the joint exploitation of the ONTOCHAIN (OC) blockchain-based software framework[8] that is being built by a large number of individual companies, each having a different business agenda. Based on a well-founded methodology, we define the business model of OC. The management and maintenance of the OC platform is assumed to be undertaken by a new venture, which offers the

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platform for dApp deployment and as a PaaS for development and testing of dApps. Different service components and library providers on top of the OC platform are assumed to be separate stakeholders with independent business models. The interactions of the OC venture with all other stakeholders in the OC ecosystem are clearly defined in a value network. The business models of all stakeholders in the OC ecosystem have been carefully studied and analyzed. Then, by means of economic sustainability analysis based on realistic revenue and cost parameter assumptions, and based on concurrent analysis of the business models of all stakeholders in this ecosystem, we establish that win-win outcomes for all involved stakeholders in ecosystem are viable and likely to emerge. Finally, we argue that choices regarding revenue sharing in this ecosystem have to be carefully made for the economic robustness of all stakeholders involved, and thus some common understanding and coordination on the exploitation of the OC ecosystem has been found to be of utmost importance.

2 Methodology

To define, describe, select and assess the most promising business model(s) (BM) for OC, we follow the methodology, named *process modelling* [2], as follows: In step 1, market analysis concerns the overview of the global and European blockchain markets in terms of market value per region and per vertical, to overview the current stakeholders in the market, and to investigate existing business paradigms and models. Step 2 is about defining and describing a business model by means of a value network definition and a business model canvas. The value network (VN) concept originates from Michael Porter's well-known value chain concept [9], which is widely used in the business literature to describe the value producing activities of an organization. The concept has been expanded in [1] to include non-linear interactions between one or more enterprises, its customers, suppliers and strategic partners. The Business Model Canvas [7] is considered an established way for describing and visualising business models, by describing the rationale of how an organization creates, delivers and captures value. In step 3, the value network defined in step 2 is analyzed to expose all values exchanged in the interactions of the different roles. These values may include multiple revenue or cost parameters that have to be thoroughly explored. Finally, in step 4, an economic analysis is performed of the proposed business model for a certain time horizon, aiming to answer questions on the profitability of the investment, on its payback period, on its deficits, etc. based on realistic assumption on the various revenue and cost parameters found in step 3.

3 Blockchain Market Overview and Related Work

3.1 The Blockchain Market

The blockchain technology [6] is now recognized as a highly disruptive technology in various sector of the economy, such as monetary transactions, energy, mobility, logistics, supply chain, healthcare and insurance, etc. It is an open, immutable, distributed ledger that acts as a universal depository of all transactions between involved parties. Modern blockchains, as initiated by Ethereum [10], enable the specification of advanced logic and the automation of business workflows to be executed within blockchain transactions in the form of smart contracts to ensure resistance to censorship and tampering, pseudo-anonymity, fault-tolerance, resilience, and non-repudiation. The global blockchain technology market size is now exploding. According to Grand View Research[2], the global blockchain technology market size was valued at USD 3.67 billion in 2020 and it is expected to expand at a compound annual growth rate (CAGR) of 82.4% from 2021 to 2028.

3.2 Business models in blockchain

Here, we overview some of the most important business models[3] to exploit blockchain-based technological solutions.

- **Token Economy – Tokenomics:** In this business model, which is the most common one, a utility token is employed to exchange goods and services through blockchain transactions, or to perform activities in the blockchain network. The blockchain platform issues this utility token and the end-users can acquire it either in exchange of FIAT money or as rewards for performing some useful work for the network, e.g., in Ethereum (v1.0), Bitcoin, Ravencoin, etc., miners are offered tokens as incentives for validating the blockchain transactions. Moreover, kickstarting blockchains ventures often involves an initial coin offering (ICO) where a portion of the utility tokens is sold to the community for fund raising, while the rest is held by the ventures.
- **Blockchain as a service** This business model involves the provision of a platform for other businesses to use blockchain technology for doing their business. Microsoft(Azure), Amazon(AWS), IBM(BlueMix), etc. offer blockchain as a service(BaaS).
- **Development Platforms** In this business model, blockchain infrastructure is offered as a platform (i.e., libraries, IDE, etc.) for development of blockchain software, such as decentralized applications (dApps) or services, e.g., Hyperledger Fabric[3]. Contrary to the BaaS model, dApps and services cannot be deployed on top of these platforms for production purposes.
- **Blockchain-based software products** This is a business model where software companies develop blockchain solutions and then sell them to bigger companies. There is a reasonable payment upfront for the blockchain software, while support fees are usual.
- **Network fee charge** In this business model, a corporate maintains a blockchain platform with non-trivial functionality where third-party decentralized applications (dApps) can be deployed and execute. The corporate takes care

[2] https://www.grandviewresearch.com/industry-analysis/blockchain-technology-market
[3] https://101blockchains.com

of infrastructure costs as well as operational expenses for the third-party dApps to run, and charges dApp providers a (network) fee, e.g., Ethereum or Neo.

- **Blockchain Consulting:** This business model involves the provision of training for consulting services around the blockchain technology, e.g., by Deloitte, IBM or others.
- **P2P Services Exchange:** This business model is similar to that of the Network Fee Charge, in the sense that the blockchain platform is offered to third party dApps to run. However, in this case it is envisioned that in these dApps services are exchanged among end users in a P2P manner. A portion of the service fees paid by the end-users is supposed to be withheld by the blockchain platform that hosts the services.

The effect that blockchain technologies can have on each element of the business model canvas has been outlined in [4]. Blockchain can enable reach of additional customer segments, facilitate (faster) transactions with previously unreachable customers or ones that were expensive to reach. As established in [5] only few multi-tiered platforms, such as ONTOCHAIN (OC), are managed effectively, so that competing and conflicting forces are balanced and intra-competition is minimized; the governance is of key importance, i.e., involving decision rights and accountability to encourage desirable behavior in the use of the platform. In OC, we employ a hybrid business model that combines P2P services exchange and the network fees, while we strongly emphasize in achieving win-win outcomes in a fully transparent way, as explained in the following section.

4 The Business Model

ONTOCHAIN (OC) offers a technological framework for a human-centered Internet, based on decentralization of power and privacy. Furthermore, the end users are going to benefit from democratic, transparent and credible mechanisms. This project aims to achieve a common path of Semantic Web and Blockchain by delivering software for reliable, traceable and transparent ontological knowledge management. To this end, we develop a blockchain platform that will offer functionality on self-sovereign identities, credentials-based authentication, semantic annotation and storage of blockchain transactions and smart contracts, decentralized oracles, decentralized reputation systems, privacy-aware data processing, copyrights management, and more, as SDKs and APIs for innovative decentralized apps (dApps) that support our vision for more trustworthy services exchange and content handling, and more privacy-friendly, decentralized Internet where people will feel more empowered. We develop a blockchain network infrastructure on top of Ethereum that will be able to host these dApps and support the execution of their smart contracts.

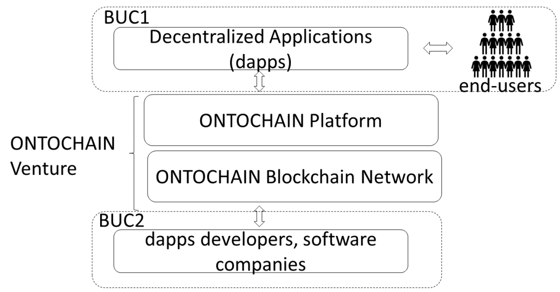
The OC software platform is being currently developed by third-party subprojects selected in the OC open calls, according to the requirements, the overall architectural design defined by the OC consortium and subject to mentoring provided by the OC core partners. The OC infrastructure (i.e., the blockchain network) is built mainly by volunteering resource contributions by OC core members and OC third-party subproject teams. While limiting ownership of blockchain nodes the OC ecosystem, as explained above, we do consider blockchain network expansion according to the computational needs of the dApps deployed on top of the OC platform, as explained in Section 7. Opening up the blockchain network to the public and the respective incentive scheme are left for future work.

Thus, so far, the creation of the initial ecosystem of OC has been funded by the EU. However, supporting the OC blockchain network in the future and sustaining its development will incur significant capital and operational expenses, e.g., for software maintenance and upgrade, for electricity, for network administration, etc. The plan is that OC in the future is run by a joint venture, hereferred to as *OC venture* created by the OC core members. OC third-party subprojects, referred to as *OC Service Components*, will be invited to sign a joint exploitation agreement for their solutions with the OC venture in mutually favorable terms. The joint exploitation agreement has to involve a procedure for governance and decision making in the OC network and may appoint a special committee for this purpose, similarly to the NEO council or the Ethereum foundation. Note that all different stakeholders in the OC ecosystem have their individual business interests and that there is no governing force dictating any business relation or coalition. Therefore, any envisioned business interaction should be incentive compatible for all involved stakeholders.

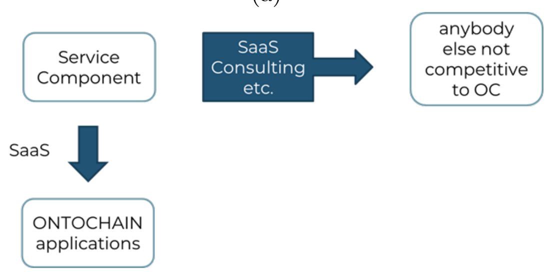
Two main business use cases (BUCs) are envisioned for the OC venture (see Fig. 1a):

- BUC1: Offering a platform for the deployment and execution of innovative dApps, which are then later exchanged among producers and consumers in a P2P manner.
- BUC2: Offering a platform for the development and testing of innovative dApps to developers and software companies.

These BUCs do not differ significantly and therefore they are considered jointly in the sequel. We will employ a combination of the P2P exchanges platform and the network fees business models described in Section 3.2. We envision that the OC platform will withhold a certain fraction of the fees of the services exchanged in the platform, provided that these services utilize the functionality and the resources of the platform. This choice is supported by the fact that the utilization of OC functionality and resources incur costs (e.g., computational, personnel, electricity, etc.) that need to be paid. Moreover, we envision that the OC ventures charges network fees for the deployment of dApps on the platform and/or the utilization of platform resources for development and testing purposes. The deployment of dApps by *dApp providers*, is associated to the allocation of scarce resources, e.g., storage, server capacity, etc., while development and testing (similar to service transactions) by *dApp developers* consume computational resources. OC Service Components are business entities that provide core functionality to the OC platform, such as privacy-aware data processing, reputation management, self-sovereign identities and so on[8]. Many have developed in the open calls of OC, but more may be developed and offered within



(a)



(b)

Fig. 1: (a) OC main BUCs, (b) Business model for an OC Service Component.

OC platform in the future. An OC Service Component may make available its services through hardware infrastructure (e.g., server nodes), additional to the OC blockchain network, which will involve capital investments. Moreover, each dApp utilizing the functionality of one or more service components will incur costs associated to the resource utilization of the respective service components. Therefore, it is envisioned that part of the total dApp service and network fees withheld by the OC platform is given to the various service components utilized by the dApp. A service component may offer its functionality to the OC platform (and subsequently to the dApp deployed on top of the latter) or any other entity that is not directly competitive to the value proposition of OC. A high-level view of the business model of a service component is depicted in Fig. 1b.

5 Value Proposition, Revenue Streams

Out of the business model canvas analysis, we will focus only on the value proposition and the revenue streams for brevity reasons. Value proposition of ONTOCHAIN (OC) can be defined in qualitative or quantitative terms. The trustworthy service/data transactions, the data/user privacy, the semantic richness of blockchain data and the trustworthiness of data and entities belong to the qualitative value proposition. The quantitative part refers to rewards for involved stakeholders, especially to service component providers and blockchain nodes, to profit prospects for dApp developers, dApp providers and investors, and to increased net benefit (i.e., utility) for end users of the dApps deployed at the OC platform. In general, it is related to the profitability and economic viability of the OC ecosystem as a whole with the profit or the prosperity exceeding the operating costs in terms of electricity consumption or otherwise, so that there is a significant return on investment (ROI) and a short payback period.

Overall, OC will follow a SaaS/PaaS business paradigm, with the following revenue streams for its constituents (i.e., OC venture, OC Service Components, OC nodes):

1. OC offers the libraries and the platform/resources for dApp developers/ dApp providers to build and deploy their services. One-off, subscription fees and/or transaction fees will be used.
2. End-users subscribe/pay per use the dApp providers for dApp transactions. Part of the transaction fee is given to OC and part is given to the different libraries/solution providers (i.e., Third-Party Service Components) that are used by the dApp. Additional fees for data employed within the dApps are paid to Data Providers.
3. OC pays blockchain nodes with gas fees for their computational resources employed in the operation of the OC platform.

6 The value network

Next, we describe the business interactions and the value exchanged among the different entities of the ONTOCHAIN (OC) ecosystem, i.e., the value network of OC depicted in Fig. 2. The *OC venture* (i) provides support, visibility and funding to *OC Service Components* (i.e., core software contributors) that invites through OC open calls; (ii) provides network and platform to *dApp Providers* for some fee to *dApp providers* and/or *dApp developers*; (iii) encapsulates Platform Components that share (part of) the value inserted into the system by *End-Users* and *dApp Providers*. The *OC Service Providers* (i) contribute pieces or service components of the OC platform in exchange of funding; (ii) may receive additional income when different dApps employ their specific components (may be subject to exclusivity agreement), which is based on the exploitation agreement with the OC platform and it can be subscription-based or usage-based. The *dApp providers* (i) offer dApps to end-users for a fee; (ii) pay the *OC venture* for hosting their apps; (iii) pay for the *OC Service Components* and the computational resources that their dApp consumes when it is offered to end-users; (iv) pay the *dApp developers* for software and support. The *dApp developers* (i) work on the development of decentralized applications and the protocols that will govern them and get paid by *dApp providers*; (ii) may offer support services to *dApp providers*; (iii) may pay the *OC venture* for accessing the libraries, computational resources or support services. The *Computing Resource Providers* (a.k.a. nodes) are (i) connected with the OC Platform; (ii) responsible for providing infrastructural support, e.g., mining and/or consensus mechanisms, for the execution of smart contracts, and for providing the computational resources to support

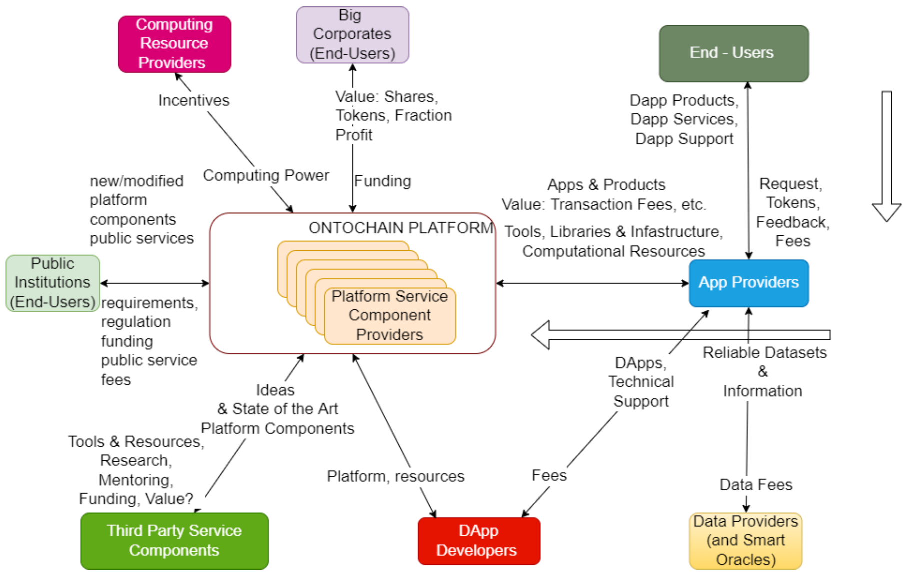


Fig. 2: The value network of OC.

the OC functionality, and they receive some incentives for these services (i.e., gas fees) in return from the OC platform. The *Data Providers* (i) provide data to *dApp providers* (and their smart contracts); (ii) might be smart oracles that provide trustworthy data or they may feed smart oracle data providers that are exterior to the OC platform or interior; (iii) get paid for the data that they provide by the end-users of dApps (directly or indirectly through *dApp providers*). Different cascades or hierarchies of data stores can be envisioned here as *Data Providers*. The *End-users* pay the *dApp providers* for the use of distributed applications. Note that *End Users* can be further distinguished in: 1) end user of a service provided by a company or a public institution; 2) end user of a P2P trading application. In the first case, end-users can pay directly or their fees to be subsidized by the company or by the public institution. Also, in trading applications (for goods or data), we may have to distinguish between sellers and buyers, although all have to pay, in cases where it makes sense that different amounts are charged to different end-user roles. *Corporate customers* or public administration customers also belong to this role and they may provide requirements and receive special services (e.g., BaaS, PaaS, SaaS, etc.) from the OC platform. The *Public Institutions* provide requirements/regulation to the OC platform. They may pay OC venture for utility services offered by the platform. The *Investors* may provide funding to OC in exchange of equities (or tokens of some form issued by the OC venture).

Economic Parameter	Value
Inflation rate	2%
Interest loan rate	5%
Credit period	5 years
Amortization period	5 years
Electricity price	0.2 €/KWh

(a)

Revenue Parameter	Value
Mean fee per dApp transaction	8 €
Avg monthly dApp transactions per user	5
Monthly fee per user per dApp	40€
dApp monthly OC hosting fee	100€
dApp deployment cost	100€

(b)

Table 1: (a) General economic parameters and (b) revenue parameters.

7 Economic Analysis

7.1 The Economic Model

We will study this business plan concurrently for the main stakeholders involved in the described value network. Global assumptions and parameters of the ONTOCHAIN (OC) ecosystem are depicted in Table 1a. We assume the lifetime of the investment is 20 years. (Note that Bitcoin is 13 years old now and it is not going anywhere soon.) The start year of the investment is 2023 and the first operational year is 2024. In compliance to the common approach for economic analysis, we assume annual general expenses equal to the 8% of the annual revenues. For realistically assessing the economic viability of the OC platform, we consider that the initial capital investment is 6 M€, which is the total OC project funding. For revenue, CAPEX and OPEX parameters of the economic analysis, we performed a market analysis regarding the average transaction fee in Ethereum[4], the Neo system and network fees[5], the real costs running a dApp at EOS blockchain[6], the dApp hosting fees[7], the blockchain dApp development costs[8] and more. The revenue parameters are described in Table 1b. The OC platform is assumed to withhold 35% of the dApp service fees paid by the end-users. We assume that each dApp employs 4 OC Service Components on the average; each of these service components is paid a fraction 12% of the service fee per dApp transaction withheld by the OC platform.

All CAPEX parameters are depicted in Table 2, while OPEX parameters are depicted in Table 3. The CAPEX for the OC venture concern platform development and infrastructure costs (in terms of full nodes) as specified above. OC blockchain network is assumed initially to have 10 full nodes (e.g., i9 8-core 3GHz, 16GB RAM, 1TB SSD). The initial number of mining nodes is assumed to be 3. We assume a hardware expansion rate of 0.01% with respect to the number of monthly dapp transactions to be processed (i.e., 1 node per 10000 monthly

[4] https://ycharts.com/indicators/ethereum_average_transaction_fee
[5] https://neo.org/
[6] https://www.linkedin.com/pulse/real-cost-running-dApp-eos-network-h%C3%A9lder-vasconcelos/?articleId=6643471577910431744
[7] https://ycharts.com/indicators/ethereum_average_transaction_fee
[8] https://oyelabs.com/blockchain-app-development-cost/

CAPEX Parameter	**Value**
dApp software development	50K €
HW cost per (mining) node (500MH/s)	7.5K €
HW cost per full OC node	3K €
Hardware cost per service component	5K €
Initial number of full OC nodes	5
EC funding for OC	6M €
dApp deployment cost (0.3 ETH)	600€
Service Component SW Development	80K €

Table 2: The CAPEX parameters.

OPEX Parameter	**Value**
Annual cost for SW licenses for OC	1000 €
Monthly power per mining node	1116 KWh
Gas fees per dApp transaction	2€
Monthly rent for placing OC / SC node	10€
dApp hosting fee per month	100€
Annual personnel Costs for SW Maintenance, Marketing and Support (per dApp)	12K €
Monthly communication (network) costs per OC / SC node	40 €
Monthly computation power consumption per OC / SC node	720 KWh
Annual Personnel Costs for SW Maintenance, Marketing and Support (per Service Component)	48K €
Annual Personnel Costs for SW Maintenance, Marketing and Support (per dApp provider)	48K €
Communication (network) costs per service component/dApp provider	600€
Annual OC personnel Costs for Software Maintenance, Marketing and Support (per dApp)	120€
Monthly rent for placing a mining node	150€
Monthly maintenance cost per mining node	200€
Data fees	0.5 €/transaction

Table 3: OPEX parameters

transactions) both for the full and for the mining nodes. The OPEX for OC concern power costs, gas fees to validation nodes, rent or other hosting fees for OC full nodes, the OC personnel costs for software maintenance, marketing and support (per dApp), the software licensing and related costs and the networking costs. For the time being, we assume that gas fees of 2 € per dApp transaction are shared among the total number of mining nodes. Regarding software licenses, the OC platform is supposed to be paying 1,000 € for various licenses annually.

The CAPEX for an OC Service Component concern software development and hardware costs for supporting the functionality of the service component, i.e., servers, networking equipment, etc. The OPEX for an OC Service Component comprises hardware expansion with respect to the number of service requests as explained above, fees for the physical placement of the hardware (per service component node), annual personnel costs for software maintenance, marketing and support, power costs and networking cost.

The CAPEX for a dApp provider concern dApp software development and one-off cost for dApp deployment at the OC platform. Concerning the OPEX costs for a dApp provider these comprise the dApp hosting fee paid to the OC platform, the annual personnel cost for software maintenance and support, and the annual marketing costs (i.e., 10K €).

The CAPEX for a dApp developer concern hardware costs for a software-development PC (i.e., 5000 €). Its OPEX comprise software licences (i.e., 300€

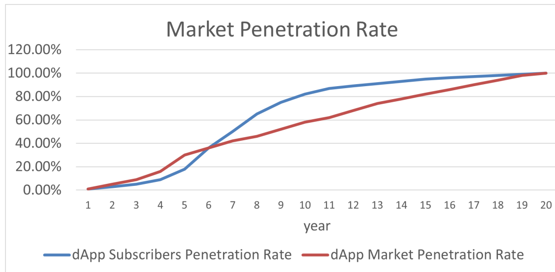


Fig. 3: Market penetration scenario.

annually), networking cost (i.e., 600€ annually) and electricity power costs (i.e., assuming 720KWh monthly electricity consumption).

The CAPEX for a data provider involves the cost for a high-end PC (i.e., 5,000 €). Depending on whether it also encapsulates the functionality of a smart oracle or not, it may also involve the development cost of a smart oracle functionality (i.e., 80,000 € as in the case of any service component). The OPEX for a data provider comprise software licenses and related costs (i.e., 1,000 €) when smart-oracle functionality is included, networking cost (i.e., 600 € annually), electricity power costs (i.e., 720 KWh monthly consumption per node at 0.2 €/KWh), and hardware scaling of 0.01% with respect to the number of transactions (as per service component). Moreover, the data provider is assumed to pay 20% of the data fees for acquiring the raw data.

Finally, the CAPEX for a mining node concern acquiring mining equipment, while the OPEX concern electricity power cost, network connectivity cost, a monthly maintenance fee and a monthly rent for hosting such a node.

7.2 Results

In this subsection, given the economic modeling of the OC ecosystem provided previously, we perform economic assessment of the sustainability of the OC ecosystem as a whole and for each stakeholder separately. The market penetration rate for the OC platform is considered as shown in Fig. 3. More specifically, the number of dApp deployed at the platform increases quasi-linearly, while the number of end-users per dApp increases in a sigmoid manner. Overall, this is considered to be a moderate market penetration scenario.

We found the payback period, the internal rate of return (IRR) and the net present value (NPV) after 20 years for all stakeholders, as illustrated in Fig. 4. Observe that the OC ecosystem turned out to be profitable for all stakeholders, although not in a similar manner. Specifically, the OC venture is found to have an NPV of 82.7M €, a long payback period of 9 years and an impressive IRR of 19.1%. Considering that a 6M € initial investment was assumed for the OC venture, this result is quite acceptable in economic terms. Moreover, the NPV for an OC Service Component was found to be 18.78M €, with a remarkable IRR

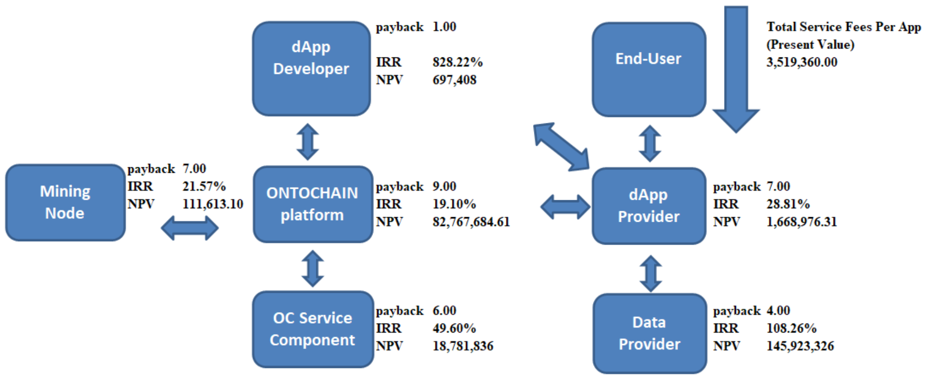


Fig. 4: The output of the joint economic analysis on top of the OC value network.

of 49.6% and a payback period of 6 years. Also, for a dApp provider we found a payback period of 7 years (with IRR 28.81%) and an NPV of 1.6 million €. A Data Provider was found to have a payback period of 4 years, an amazing IRR of 108.26% and an NPV of roughly 146M €. This result hints us that probably the raw data fees have been assumed to be too low. The dApp developer has a modest NPV of 700K €, but minimal capital investments are required with very short payback period of only 1 year. Roughly, the dApp developer is assumed to receive a salary of 50K € annually, which is an assumption to reconsider. The mining node was found to have a payback period of 7 years, an IRR of 21.5% and an NPN of 111.6K €. This economic output is clearly poor for a mining node. However, we assumed that 350 € are paid monthly for hosting and outsourcing the maintenance of the mining hardware, thus significantly reducing mining profits. Note that this is not typical as, such a small mining infrastructure, is normally hosted at the premises of a tech savvy individual that enrolls personally into maintenance. All the value is inserted into the OC ecosystem by the end-users of dApps; total service fees paid per dApp in a 20-years horizon is assumed to be 3.5 million €.

The annual net cash flow and the EBITDA for the OC venture are depicted in Fig. 5a and Fig. 5b. Observe the negative flows in the first years until the break even point on the 9th year. The annual net cash flow and the EBITDA for a OC Service Component are depicted in Fig. 5c and Fig. 5d. Observe the almost zero profit in the first 7 years, and the minimal negative flows that could be serviced by a low loan.

However, building a win-win outcome for the stakeholders of the OC ecosystem cannot be taken for granted. For example, let us assume that OC service components each demand 20% (instead of 12%) from the dApp service fees withheld by the OC platform per dApp transaction. Then, the payback period for the OC becomes prohibitively high (i.e., 17 years!), while the IRR becomes only 3.34%, which makes the OC venture not worth pursuing. At the same time, the payback period for an OC service component still remains 6 years, while IRR

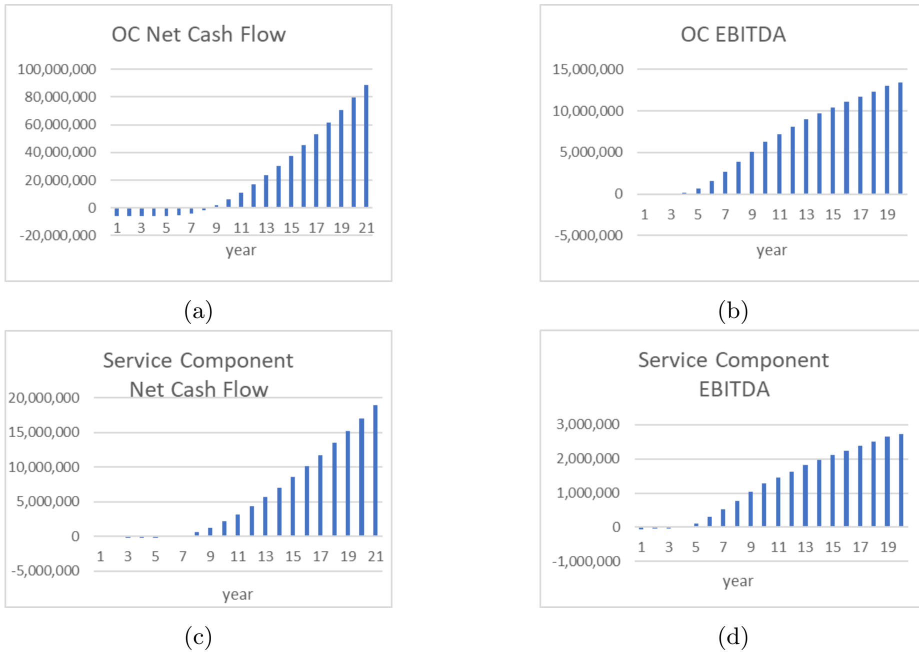


Fig. 5: (a) Net cash flow and (b) EBITDA for OC (a),(b) respectively and for Service Component (c),(d) respectively.

was already very high. Thus, a small modification in the revenue sharing scheme made the ecosystem economically unviable.

8 Conclusion

Multi-tier jointly-developed decentralized ecosystems are hard to transform to business and operate as a sustainable economy, due to conflicting incentives and lack of coordination. We considered the case of the ONTOCHAIN (OC) software ecosystem, where a venture takes over, manages and maintains the jointly-built OC platform. We carefully analyzed all stakeholders in the OC ecosystem and defined the business interactions among them. We defined the parameters of an economic model of this value network and assessed the economic viability of the OC ecosystem as a whole and for individual stakeholders. With realistic assumptions in the model parameters, we found that the OC ecosystem can be a *win-win* business for all stakeholders involved and bring high value to end-users at an affordable cost. Finally, we established that revenue sharing in this system significantly affects the economic viability of the different stakeholders. This implies that maximalistic individual strategies can be destructive for the economic sustainability of the OC ecosystem and thus unprofitable in the long run. The design of an appropriate governance model to avoid such destructive forces is a key concern for future work. Finally, we intend to design an appropriate token strategy for the sustainable development and expansion of the OC ecosystem.

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