Blockchain and Smart Contracts for Integrated Project Delivery: Inspiration from the Commons

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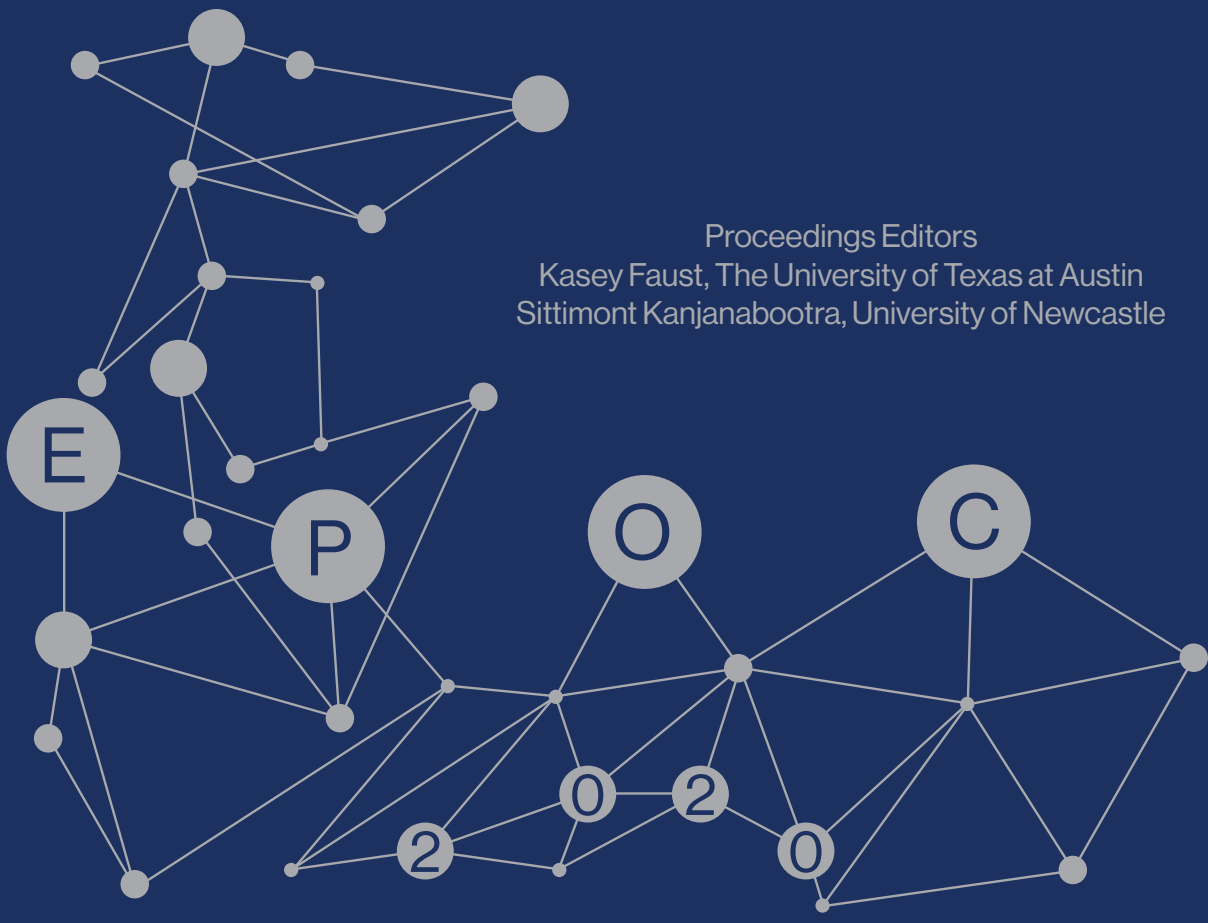

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BLOCKCHAIN AND SMART CONTRACTS FOR INTEGRATED PROJECT DELIVERY: INSPIRATION FROM THE COMMONS

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RESEARCH PURPOSE

Integrated Project Delivery (IPD) is an emerging collaborative project delivery model for the delivery of construction projects. IPD uses a shared financial pool to share risk and reward among project participants depending on the outcome of the project. IPD also emphasizes decentralized, agile, and self-organized project governance arranged by the project participants.

Blockchain is an emerging technology that enables direct peer-to-peer transactions of value and the immutable and trusted storage of data. Newer types of blockchain enable self-executing and immutable code protocols to run on top of it, so-called *smart contracts*. These smart contracts can be used to create autonomous workflows or containers of value, so-called *tokens*. The value propositions of blockchain could be useful for many proposed applications in construction (Li, Greenwood and Kassem, 2019; Jens J. Hunhevicz and Hall, 2020). Especially the possibility to build incentive systems with smart contracts and tokens in order to address human coordination challenges could also be used in collaborative construction projects (Jens Juri Hunhevicz and Hall, 2020).

This strong theoretical alignment between the objectives of IPDs and the potential benefits of blockchain has not escaped recent attention of researchers. Elghaish et al. (2020) have developed a framework and prototype using Hyperledger Fabric to apply blockchain to the existing IPD financial risk-and-reward system. However, there could be many additional opportunities to apply blockchain to collaborative project delivery models such as IPD beyond the often mentioned financial applications.

Still, it remains difficult to conceptualize and understand the opportunities to apply blockchain to IPD. There is need for future guidance to researchers that identifies how blockchain can be applied in a broader sense to IPD governance.

BRIEF RESEARCH APPROACH

In the paper, we suggest that established design principles from the governance of Common Pool Resource (CPR) scenarios is a helpful theoretical conceptualization that is particularly useful to guide future research and applications of blockchain in construction.

The paper builds upon three fundamental ideas: IPD, CPR scenario governance, and blockchain (Figure 1).

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In IPD, various governance mechanisms ensure that construction project resources are governed appropriately (Figure 1; (1)). Similarly, Ostrom (2015) defined eight principles to govern CPR in a non-hierarchical manner (Figure 1; (2)).

Hall (2017) and Bonanomi et al. (2019) proposed a connection between CPR (and the Ostrom Principles) and construction project resources, stating that there are similarities in how limited resources can be exploited in both (Figure 1; (3)).

Recently, various sources propose blockchain as a suited tool to more efficiently realize approaches for the management of CPR in line with the Ostrom principles (Figure 1, (4)). They state that blockchain has specific affordances aligned with the characteristics needed to manage CPR in a non-hierarchical, decentralized way (e.g. Rozas et al. (2018)). Moreover, first scholarship (Elghaish, Abrishami and Hosseini, 2020) highlighted the potential alignment of blokchain with IPD (Figure 1, (5).

Building from this conceptualization, the paper proposes future research directions for IPD blockchain research as guided by the design principles of CPR scenarios.

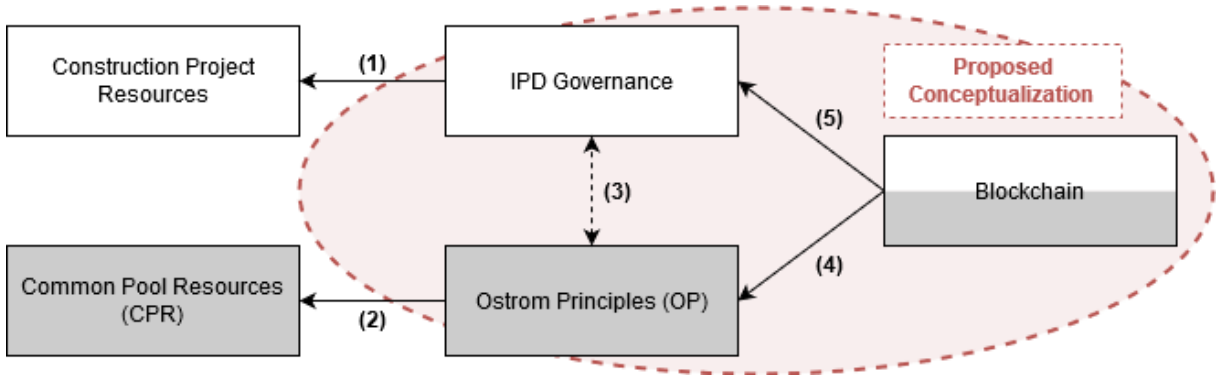

Figure 1. Schematic representation of the connections between the investigated fields and the proposed conceptualization.

KEY FINDINGS

Initial use cases of blockchain for IPD governance were summarized and the potential on how they could be applied in IPDs was investigated. The overarching future research areas are related to the digitalization of processes and the creation of incentive mechanisms. Both of them seem promising for a more efficient and sophisticated decentralized governance of IPDs. They might allow for more automation and transparency of processes, as well as incentives to align involved actors around the optimal management of project resources in line with the overall project success (**Figure 2**).

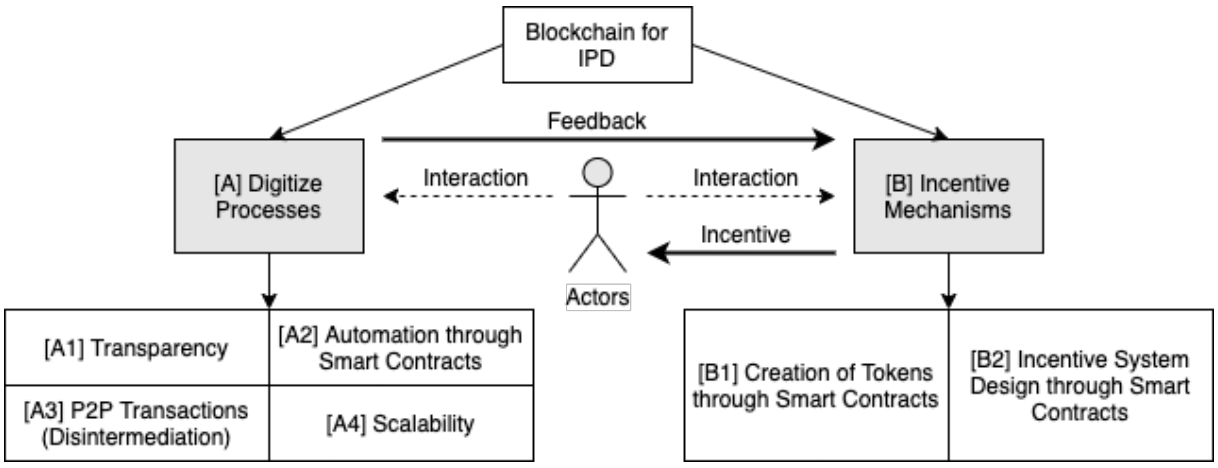

Figure 2. A simplified overview on how blockchain can be applied to IPD with two main applications: digitizing processes [A] and incentive mechanisms [B].

The paper shows that there is indeed promising alignment between blockchain for CPR and IPD. Beyond some differences of IPD and CPR related to their context, it seems that many of the proposed blockchain use cases can be transferred.

Having said that, challenges and limitations remain and are discussed. Among them are the early state of both blockchain and IPD, the difficulties in designing complex autonomous systems, and the socio-technological challenges to overcome when dealing with such new ideas.

IMPLICATIONS

Using the proposed conceptualization, there is an opportunity to understand how to best design and manage future governance and organizational structures of an IPD using blockchain. This can assist with the migration of existing IPD processes to a more automated, transparent system. It can also enable researchers to conceive of new ways for IPD to evolve, or even enable the formulation of new and future collaborative project delivery models governed through the blockchain.

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