The construction commons
A new institutional economics perspective on collaborative project resources

Hall, Daniel M.; Bonanomi, Marcella; Hunhevicz, Jens

DOI
10.1201/9781003379553-7

Publication date
2024

Document Version
Final published version

Published in
Routledge Handbook of Collaboration in Construction

Citation (APA)
Hall, D. M., Bonanomi, M., & Hunhevicz, J. (2024). The construction commons: A new institutional economics perspective on collaborative project resources. In S. Moradi, K. Kähkönen, L. Koskela, O. J. Klakegg, & K. Aaltonen (Eds.), *Routledge Handbook of Collaboration in Construction* (pp. 49-60). Routledge - Taylor & Francis Group. https://doi.org/10.1201/9781003379553-7

5
THE CONSTRUCTION COMMONS

A new institutional economics perspective on collaborative project resources

Daniel M. Hall, Marcella M.M. Bonanomi, and Jens Hunhevicz

5.1 Introduction

Effective collaboration is essential in construction. In addition to organizational science, anthropology, and law frameworks (see Chapters 2–4), a robust economic framework is needed for coordinating and incentivizing participants. The prevailing economic collaboration paradigm in construction scholarship is, however, limited, favoring classical market and hierarchical models. Construction economic collaboration often assumes one of these models, and then uses game theory to predict economic interactions. Yet, game theory's limitations—its static nature, the overemphasis on rationality, neglect of transaction costs, and disregard for institutional contexts—suggest that a broader economic lens is necessary.

Specifically, this chapter embraces the nuanced insights of new institutional economics to propose the 'construction commons' as an innovative economic collaboration model for construction. The construction commons comprise a shared financial resource pool, pluralistic stakeholder decision-making, and collective financial outcomes (Hall and Bonanomi 2021). To govern the construction commons, we can learn from existing principles derived from local communities to sustain long-enduring common pool resource scenarios.

This chapter proceeds by first introducing new institutional economics and its relevance to construction management. We then introduce the work of Elinor Ostrom, correlating her theories with the operational dynamics of a construction projects. A case study of an Integrated Project Delivery (IPD) project in Vancouver exemplifies the practical application of the construction commons. The chapter concludes with a short discussion and futuristic outlook on the potential integration of blockchain technology as a governance tool for the construction commons.

5.2 Background

5.2.1 New institutional economics

Building on traditional economic theory, new institutional economics emphasizes the roles of social, legal, and institutional frameworks within economic interactions. It recognizes institutions as the foundational 'rules of the game' in society—both formal, such as laws and regulations, and

DOI: 10.1201/9781003379553-7

informal, like social norms and conventions. These institutions are critical in shaping interactions and outcomes (North 1991, Ménard and Shirley 2005).

New institutional economics also looks at transaction costs, which are the costs associated with the exchange of goods and services. Transaction costs can be thought of as ‘hidden’ costs. They include costs of gathering information, negotiating, and enforcing contracts (Williamson 1989, 2010). Recognizing such costs, new institutional economics advocates for the idea of relational contracting. Relational contracting is a contract theory approach that prioritizes the ongoing relationship between parties over strict contractual terms, allowing for trust-based flexibility and adaptability to changing conditions (Macneil 1999). It emphasizes long-term cooperation, shared goals, and informal resolution of disputes, recognizing the limitations of foresight and information (i.e., the bounded rationality of stakeholders). Relational contracting has been suggested as a particularly effective method for complex, long-duration projects like construction, where collaboration and alignment of interests are crucial for success (Henisz *et al.* 2012).

Many construction management and project management scholars have already pointed out the intersection of new institutional economics and project management (Levitt 2011, Yung 2015), project governance (Henisz *et al.* 2012) and global project teams (Mahalingam and Levitt 2007). One highly relevant example is the recent development of IPD. IPD is a collaborative project delivery model that originated in North America, characterized by a multiparty contract that unites design and construction firms to share financial risks and rewards. This approach fosters a pluralistic organizational setting where participants jointly manage resources, decision-making, and outcomes, shifting away from traditional project delivery models (Hall and Scott 2019). In addition to IPD, scholars have also shown how some of the concepts of new institutional economics are relevant to managing some of the key challenges of megaprojects (Gil and Pinto 2018, Brunet and Cohendet 2022, Gil 2022, Mahalingam 2022, Walker *et al.* 2022).

One more helpful theory, which is independent from new institutional economics, for the construction commons is stewardship theory. Stewardship theory suggests that individuals in organizations are more likely to act in ways that support the organization’s collective goals, rather than pursuing their own self-interests (Davis *et al.* 2018). When applied to construction projects, stewardship theory suggests that empowering team members—rather than just setting up safeguards and monitoring the supply chain—leads to better overall utility for the project. This approach fosters a governance structure based on mutual trust, enhancing the project’s long-term performance (Ahola 2023).

5.2.2 The limitations of game theory

Game theory is the study of strategic decision-making. The history of economics for collaboration can be traced back to the emergence of the field of game theory in the mid-20th century. Game theory analyzes strategic interactions by modeling the decisions of rational agents, who anticipate the actions of others and choose their strategies based on maximizing their own payoffs within a defined set of rules. This approach provides a framework for understanding the incentives and strategies of different actors in a collaborative setting. It has been widely used to analyze the behavior of individuals and groups in social and economic settings, also in the construction industry (Eissa *et al.* 2021).

To understand economic cooperation, construction management scholars overwhelmingly utilize game theory as a mathematical method. According to a recent review, 87 academic papers over the past twenty years have applied game theory to various aspects of construction economics, including modeling incentives, resolving conflicts, negotiating, distributing cooperative gains, managing and supervising projects, developing cooperation and trust, handling construction bids, and allocating risks (Eissa *et al.* 2021).

We should clarify, we do not think there is something wrong with using game theory; it is often also a helpful tool for new institutional economics. Despite the rigor and insights provided by these studies, it is important to recognize that game theory is not the sole, nor necessarily the most suitable, framework for understanding economic collaboration within the construction industry.

Instead, we argue the problem has been an over-reliance on game theory, with little consideration of its limitations when applied to construction economics. We note the following problems with application of game theory in construction:

- Rationality assumption: Game theory often assumes rational, utility-maximizing agents. As anyone working on a construction site knows, decisions are seldom fully rational. Stakeholders instead have bounded rationality and cognitive limitations that can greatly affect decision-making, something often ignored in standard game theoretical models.
- Institutional context: Within the construction industry, the institutional setting (i.e., the laws, norms and professional identities) can be crucial for understanding expectations, behaviors, and outcomes. Game theory typically abstracts away from these settings.
- Dynamic nature: Construction projects are inherently dynamic, evolving over time. Many game theory models are static, providing a snapshot in time. Although evolutionary game theory can explain how players can learn over time, Eissa *et al.* (2021) found only ten examples out of the 87 studies that use this approach.
- Transaction costs: Game theory focuses on payoffs and strategies, but it often ignores transaction costs. Construction projects are complex endeavors with high levels of information asymmetry. This complexity can arise from various sources, including contractual relationships, risk management, and communication strategies among stakeholders (Ceric 2014).
- Social factors: Game theory's quantitative bias can overlook the qualitative, social norms, and trust factors essential to decision-making. For example, despite numerous attempts to derive the 'optimal' revenue sharing among IPD participants (Han 2019, Teng *et al.* 2019), the negotiation process among IPD participants around revenue sharing is arguably more critical to project success than the precise distribution of payoffs.

5.2.3 Governing the commons

The term 'Tragedy of the Commons,' coined in the 1960s by Hardin, illustrates how individual pursuits, if unchecked, can collectively exhaust communal resources, harming the entire group. The classic example is a group of cattle herders who might each allow their cows to overgraze a shared pasture, resulting in downward resource availability until the pasture is destroyed. This concept applies to both natural resources, like water, land, or forests (Ostrom 2015), and constructed resources such as communal parking spaces or collaborative online platforms.

What can be done to govern the commons? In the past, economic scholars used game theory to illustrate that the commons would inevitably lead to an outcome that is suboptimal for everyone. The resulting implications for policy makers was that local communities should not be trusted to manage their own resources, and that centralized control by the government would be the only long-term solution to protect the commons (Ostrom, 2010).

It turns out, this view was wrong. Elinor Ostrom's work, for which she won the Nobel Prize in Economics, challenged the conventional wisdom about the commons. She suggested that under the right conditions, communities can successfully manage shared resources without external

Table 5.1 The Ostrom Principles for effective governance of common pool resource scenarios

Principle number	Description	Short summary
1	Clearly Defined Boundaries	Identify who has access and where resources are.
2	Local Adaptation of Rules	Customize rules to fit local conditions.
3	Collective Decision-Making	Include resource users in decisions.
4	Monitoring	Regularly check resource condition and user behavior.
5	Graduated Sanctions	Implement penalties that escalate for rule violations.
6	Dispute Resolution Mechanisms	Provide affordable and accessible ways to resolve conflicts.
7	Minimal Recognition of Rights to Organize	Ensure external authorities respect the community's right to self-govern.
8	Nested Enterprises for Larger Systems	For larger systems, organize governance in multiple layers.

Adapted from Ostrom (2015).

regulation. She provided empirical evidence that local governance systems are often more effective at stewardship and sustainable resource management than central government control, effectively defying the 'Tragedy of the Commons' paradigm. In her work, Ostrom identifies eight core principles for effective governance of the commons, which are summarized in Table 5.1.

5.3 The construction commons

Inspired by Ostrom's work, we suggest that in the right conditions, construction projects can also be understood economically as a shared 'commons' (Hall and Bonanomi 2021). In this conceptualization, we understand the construction budget as a shared project resource, which must be shared across multiple stakeholders—architects, engineers, contractors, and clients—and their associated project tasks.

The construction commons occurs when three antecedents are true. First, the participants must agree to the concept of a shared financial resource pool. For example, when IPD project participants sign a multi-party contract, these resources become contractually available for all signatory parties. Terms like 'contingency pool,' 'profit pool,' and 'incentive pool' are commonly used to describe the collective financial resources earmarked for the project, thereby encouraging a sense of shared ownership.

Second, in the construction commons model, decision-making is a collaborative process, distributed across a range of stakeholders rather than a centralized project manager. This marks a departure from traditional top-down approaches and encourages collective ownership of outcomes. This method involves extensive discussions among all parties to achieve consensus and coordinate efforts, thereby promoting transparency and shared responsibility in project governance.

Third, the construction commons requires that parties have a shared destiny where they share together in the financial risks and rewards. The governance structure can be calibrated to manage not just the initial allocation of resources but also their eventual appropriation (i.e., use) by various stakeholders. In the end, the project must fairly distribute the overall project reward.

The concept of the construction commons can be likened to a common grazing field, where the project's budget is the pasture available to all. Various firms engage with this budget to execute distinct segments of the project, much like herders use specific areas of the field for grazing. During the design phase, firms decide which portions of the budget they will utilize, akin to selecting grazing spots, but the actual expenditure, similar to the grazing, occurs during construction. Once a budget segment is used, it's no longer available, just as grazed land can't sustain more livestock. The leading firms in the project, who have signed the multi-party contract, are the primary users of this budget, directly incurring costs or subcontracting parts of their work. The project's sponsor, who acts as the owner of the pasture, defines the initial budgetary limits, and aims for its optimal use for collective benefit. This sponsor delegates experienced firms to manage and preserve the budget's integrity, ensuring equitable usage. These firms, serving roles analogous to project managers and team leads, are tasked with preventing budget overruns to maintain fiscal balance throughout the project.

While the shared pasture analogy is useful in explaining the construction commons concept, it has its limits. Unlike a pasture, which is maintained for ongoing use over many years, a construction project has a definitive endpoint where any well-managed budget surplus is distributed as a reward upon completion. Nonetheless, this comparison serves to illustrate the principles behind collaborative resource management in construction.

To effectively implement Ostrom's principles for governing common resources, we suggest projects begin with well-defined rules for participation and resource distribution—consistent with Ostrom's first principle. This clarity from the outset ensures that all participants are aware of their responsibilities and the scope of shared assets, which reduces the likelihood of confusion and conflicts, streamlining the collaborative process. Next, projects should design collective-choice arrangements that allow stakeholders to participate in rulemaking, enabling a democratic form of governance. This not only empowers participants but also ensures that the rules are more aligned with the ground realities of the project. Such a governance model is agile, allowing for changes and adaptations as the project evolves, which is essential for dealing with the complexities and uncertainties inherent in construction projects. During project execution, stakeholders should openly share information and use local monitoring strategies to keep track of resource utilization and project progress. This increases accountability and allows for early identification and mitigation of issues.

5.4 The construction commons in practice

The East Vancouver Integrated Health and Social Housing complex is a public IPD project located in Vancouver, Canada. Interestingly, the project is being developed through the cooperation of three owners: British Columbia Housing, Vancouver Coastal Health, and the City of Vancouver. It is the first IPD project in British Columbia and one of the first public IPD projects in Canada.

The project began in October 2018 and is planned to be completed in 2026, with a total approved cost to-date of 109 million Canadian dollars (79 million US dollars). The complex will cover an entire city block and have a threefold functional layout, including: (1) a withdrawal management center, (2) social housing, and (3) a social enterprise space for Indigenous healing and wellness. British Columbia Housing is the project lead developer and in charge of the social housing units, the City of Vancouver is the landowner and will operate the social enterprise space, and Vancouver Coastal Health will operate the withdrawal management center. In addition to the three owners, the project team includes numerous firms. At the time of the project validation phase (2019), the project had included 14 firms within its boundaries, including the three owners; architectural, construction, structural, electrical, and mechanical engineering consultants; and the wall and ceiling, roofing and cladding, glass, mechanical, and electrical sub-trades.

The second author observed the project team in 2019 during the period referred to as the validation phase. The validation phase of IPD is when the project team evaluates the project's feasibility, goals, and constraints. During this phase, the team collaboratively examines the project's scope, budget, and schedule to ensure they align with the owner's objectives and expectations. By the end of the validation phase, all parties should have a clear understanding of the project's objectives, potential challenges, and the necessary resources. At this point, the resources that belong to the construction commons are identified and separated from the larger ecosystem of possible resources. Together, the project sponsor and project team collectively define which specific aspects of project scope and budget are considered part of the construction commons and which are not.

Over a period of three months, the second author conducted over 80 hours of ethnographic, non-participant observations to observe how the project team worked together in a co-located 'big room' space. In addition, she conducted 12 semi-structured interviews and a series of surveys asking the participants to reflect on their management practices related to the IPD project. Further details about the case and the methodology used can be found in Bonanomi *et al.* (2020).

Within the case study, we observe four different examples of Ostrom's principles being operationalized to govern the IPD project: 'nested enterprises', 'monitoring', 'recognition of rights to organize' and 'graduated sanctions.'

5.4.1 Nested enterprises

Nested enterprises explain how the governance activities of IPD projects are self-organized into multiple layers of hierarchy using a nested enterprise design. The project team in the case study has elected to organize itself into three layers of management: (1) Project Implementation Teams (PITs), (2) the Project Management Team (PMT), and (3) the Senior Management Team (SMT). While membership might be assigned based on seniority within a single firm, the number of teams and the number of participants are collectively decided by the other team members themselves.

In this case, the self-organized 'nested enterprise' includes nine PITs, one PMT, and one SMT. Each of the nine PITs—architectural, structural, mechanical, electrical, envelope, owners, constructability, communications, and BIM/sustainability—represents a small, multidisciplinary operative team with participants from many different firms. Each PIT is also assigned a specific working area within the project co-location space, also known as 'Big Room'. They sit together in their PIT teams, not with the members of their own firm. Each PIT appoints a 'PIT Captain' who is responsible for reporting out during the weekly meetings. These PIT Captains have been given specific project responsibilities and authority but for the most part lack traditional hierarchical authority. The other PIT members are employed by different firms, and there is no specific contract that specifies obligations within each PIT team.

At the next level, the PMT plays an administrative role, making the tough decisions, and monitoring financials. It includes seven members: the three owners, the architect, the contractor, the electrical engineering consultant, and the mechanical sub-trade. Finally, at the highest level, the SMT deals with dispute resolution, conducts contract negotiations, and resolves questions of scope change. It is composed of 14 members, 1 C-level executive from each of the 14 parties that signed the IPD agreement.

5.4.2 Monitoring the users

The monitoring design principle emphasizes the need for regular oversight of resource conditions and user behaviors to ensure sustainable use. This involves the establishment of accountable and effective monitoring systems, often executed by community members or external parties, to quickly detect rule violations and mitigate potential overuse or misuse of the resources. Within the case study, we observed that many activities, which IPD literature often characterizes as collaboration, are less about collaboration and more about collective monitoring. For example, during the plenary meetings within the co-location space (i.e., the 'Big Room meetings'), each PIT must publicly report out to the entire team its performance. This is done based on a two-week planning board that was committed during the previous meeting. The PIT captain must state which tasks have been done, and importantly which tasks still need to be completed. It is also the opportunity to clarify with the other teams what is needed to complete delinquent tasks. Then again, each PIT declares the work that is going to be accomplished in the next two upcoming weeks. This is done publicly in a way that all other participants can read it on the wall. The PIT is now accountable to complete these new tasks in the upcoming two weeks (Figure 5.1).

In addition, to monitor the team's perceptions and expectations, the team conducts a 'Plus and Delta' exercise. Each project participant suggests a 'Plus', something that is going and/or went well, and a 'Delta', something that is not going and/or did not go well and needs improvement. The team then discusses all together the Plus and Deltas previously identified. This is occasionally supplemented with anonymous online surveys that assess team's performance throughout the project development.

5.4.3 Graduated sanctions

Although we did not observe specific legal or financial sanctioning of project participants, we did observe low levels of social sanctioning. This occurred as a result of the above monitoring activities. A metric known as the 'planned percentage complete' is kept, to show the number of promised

Figure 5.1 Big Room meeting.

tasks that are actually completed. This metric is recalculated every two weeks and publicly available within the Big Room. The collective and transparent report-out of each PIT's performance during the weekly meeting(s) within the 'Big Room' motivates project participants to perform as expected and to conform to the agreement's conditions.

It is expected that in the case of repeated poor performance, the project team might need to increase the sanctioning penalty. For example, individual team members might be removed from the project, or in the case of low performance by an entire firm, that firm could be removed from the commons and replaced with an alternative firm.

5.5 Implications for theory and practice

The construction commons model offers several advantages. Viewing projects through the lens of a commons allows for a sense of collective ownership and shared responsibility among participants. Decentralized governance structures can aid in managing project complexity by empowering local decision-making, which enables faster, more adaptable responses to specific challenges. Decentralization also enhances project resilience by dispersing authority, reducing bottlenecks, and allowing for solutions better tailored to immediate and localized needs.

However, the construction commons has some challenges. Collaborative projects, just like common natural resources like pastures, can suffer from overuse, leading to decreased returns for all involved. The 'tragedy of the project' arises when stakeholders excessively draw from the budget, just like the herders could overgraze in the pasture (Hall and Bonanomi 2021). This overuse could also occur with taking too much time in the schedule or too much of the physical space required for production alone. Furthermore, project managers need to look out for the 'free-riders' who might benefit from the project payoff without contributing as much as others. As we see in the case study, the operationalization of Ostrom's governance principles can help address these issues, but further research is needed to understand how to mitigate these issues.

From a theoretical lens, we find that the construction commons align with stewardship theory. Stewardship theory suggests that within organizations, individuals will prioritize collective goals over personal interests, especially when given autonomy (Ahola 2023). This perspective counters the traditional emphasis on self-interest as the primary driver of economic behavior, as posited by game theory. Under the construction commons, project managers—or 'project stewards'—are envisioned to act in the project's best interest, with the understanding that their personal success is intertwined with the project's success. This reconceptualization of roles and authority champions a cooperative culture, where the collective achievement of project goals becomes the shared mission of all team members. Stewardship theory offers a holistic perspective for more sustainable and equitable system outcomes, one that would be a welcome contrast to the hyper-competitive and adversarial nature of construction projects today.

Furthermore, the construction commons might help bridge the gap between production economics and new institutional economics. Koskela (2017) identifies the disconnect between organizational theory and production practices as a major and historical oversight in management research, with pointed critiques to the relevance of transaction cost theory to explain production. The construction commons places emphasis on managing for the long-term production health of the project commons. New institutional economics suggests that the definition, distribution, and enforcement of property rights influence resource allocation and production. The corresponding organizational structure is built for the purpose of nurturing a robust production system rather than merely optimizing information exchange and communication. Decision-making is driven by the long-term viability of the project, and rewards are thoughtfully distributed based on each participant's contribution and assumed risks in the process of production.

5.6 Future outlook: toward a digital construction commons

As the world becomes increasingly distributed and digitalized, how then might the construction commons evolve? The IPD case illustrates how the construction commons can be governed through intentional approaches to communication, exchange, and collaboration to enable inter-organizational trust. However, these situations are not always possible. For example, it might not be feasible (e.g., COVID-19 pandemic) or economical (e.g., high project overheads) for projects to co-locate in a collective Big Room.

We suggest that blockchain technologies can be a helpful tool for scaling and governing real-world commons, especially with respect to novel and digital approaches to project collaboration. The main idea is to understand blockchain technology as a facilitator for new types of economic governance using its unique characteristics: immutability of transactions, transparency of the transaction history, and peer-to-peer transactions without middlemen. Blockchain technology was first introduced with the Bitcoin blockchain as a digital electronic cash system (Nakamoto 2008) capable of facilitating trusted monetary transactions over the Internet with negligible transaction costs and without a trusted third party (Catalini and Gans 2020). The technology has evolved, and newer blockchains often support programmable transaction interaction through smart contracts to encode economic workflows or create new value representations with tokens that can be transferred on the network. There is enormous potential to use smart contracts to create new economic systems (Davidson *et al.* 2018, Miscione *et al.* 2019, Voshmgir and Zargham 2020), such as novel decentralized systems that can govern collective project behavior.

The use of cryptoeconomic coordination on the blockchain for the economic governance of Common Pool Resource (CPR) scenarios has been referred to as the 'crypto commons.' The crypto commons describes a set of blockchain-based market mechanisms and economic incentives that aim to reward contributions to the public good (Maples 2018, Crypto Commons Association 2021). Such an approach has been found to be promising by various scholars for scaling real-world CPR scenarios while avoiding the tragedy of the commons (Bollier 2015, Fritsch *et al.* 2021, Rozas *et al.* 2021b,a, Papadimitropoulos 2022). By encoding Ostrom's principles in smart contracts, the "networked governance [of the crypto commons could] allow new types of value creation with crypto assets rather than shares of stock, contributors rather than employees, and decentralized collaboration rather than centralized ownership" (Maples 2018).

We have conducted some very early work to describe how such novel forms of economic mechanisms could create value for construction project governance through more decentralized, bottom-up approaches (Hunhevicz *et al.* 2022a). The crypto commons could become the organizational structure for decentralized project delivery models, emphasizing collective action, monetary and non-monetary values, and micro-exchanges (Hall *et al.* 2022). While the theoretical alignment and potential is there, the question remains as to what mechanisms are needed to realize decentralized project delivery on the crypto commons. Hunhevicz et al. (2022b) reviewed and summarized proposed cryptoeconomic mechanisms from the literature, and then proposed individual and system applications of them to the governance of collaborative project deliveries. The idea is to form an organization on the crypto commons around a shared resource pool represented on the blockchain, governed, and coordinated by selected cryptoeconomic mechanisms (Table 5.2). Key ideas include the use of blockchain addresses and tokens to represent and define the boundaries of

Table 5.2 Blockchain mechanisms for project delivery on the crypto commons

OP	*Description*	*Crypto commons mechanisms*
1	Clearly Defined Boundaries	Identity and rights are based on blockchain addresses and tokens, as well as tokenization of resource pools.
2	Local Adaptation of Rules	Decentralized finance and markets can be tailored to local project needs. In addition, smart contracts can be used to formalize resource allocation rules, such as risk and reward sharing.
3	Collective Decision-Making	Decentralized proposal and voting platforms can ensure collective decision making based on a coded distribution of power.
4	Monitoring	The transparent record of transactions ensures trusted stakeholder interactions, monitoring, certification, and rapid response to events. Smart legal contracts and peer-review mechanisms enforce transparent and fair processes.
5	Graduated Sanctions	Self-enforcement of token-based sanctions with smart contracts and social sanctions through transaction transparency.
6	Dispute Resolution Mechanisms	Smart contract-based mini courts for quick dispute resolution.
7	Minimal Recognition of Rights to Organize	Smart contracts ensure that powerful parties cannot impose collective choice and conflict resolution on their own.
8	Nested Enterprises for Larger Systems	Smart contracts coordinate decision making between organizational levels.

Adapted from Hunhevicz *et al.* (2022b).

both resources and appropriators. The use of blockchain allows for some unique features, such as allowing not only humans to participate in project delivery but also machine agents to contribute to various project tasks, such as bidding, signing work packages, accessing resources, and being directly compensated for their work. Tokenized project resources can also enable transparent definition of resources, allowing more accessible and shared ownership, exchange and trading, as well as digital management of one or even multiple resource pools with distinct appropriation and payoff functions. Since all transactions, identities of project participants, and resources are transparent on the blockchain, the system can be easily monitored, and fast bottom-up system response can be realized by encoding system properties and nested hierarchies in smart contracts. For example, smart contracts could encode rules on how resources can be appropriated, how decisions are made through transparent decentralized voting systems, how non-compliance with system rules is enforced, e.g., by banning certain addresses, losing financial or reputational tokens, or decreasing the value of tokens, or how disputes should be resolved.

Interestingly, many of these applications are not entirely new, but have been proposed individually by other research as promising for construction. The idea of a crypto commons for decentralized project delivery provides an overarching conceptual and systems perspective that connects many of these use cases. However, a digital construction commons is mostly theoretical at this point. A better understanding is needed of how individual and combined cryptoeconomic mechanisms can help shape the future of decentralized construction project collaboration, and how to overcome system design challenges and implementation barriers in the specific context of the construction industry. A growing number of blockchain-based real-world examples that suddenly enable anonymous and global coordination at scale could serve as further inspiration and practical evidence (e.g., City DAO, Constitution DAO, and LexDAO).

5.7 Conclusion

Overall, this book chapter offers an alternative view on economic collaboration in construction projects. We suggest that new institutional economics, and particularly the work of Elinor Ostrom, is an essential framework to understand construction projects as dynamic, evolutionary, and collective endeavors. The construction commons is a novel perspective on collaborative economics, one that does not rely on market forces or hierarchical coercion, but instead thrives on collective coordination and shared destiny. The case study of the East Vancouver Integrated Health and Social Housing complex suggests that the idea of a construction commons is perhaps not so radical, but instead is already operationalized in the governance structures of today's collaborative projects. We illustrate practical examples of governance mechanisms for the construction commons such as nested enterprises, monitoring, and graduated sanctions. As we look toward a more decentralized and digital project future, we briefly suggest that blockchain offers a compelling governance technology to scale the construction commons, although more research is needed in this field.

References

Ahola, T., 2023. Classic perspectives on project governance: Transaction cost economics, agency theory, and stewardship theory. In Ralf Müller, Shankar Sankaran, and Nathalie Drouin (Eds.), *Research Handbook on the Governance of Projects* (31–41). Edward Elgar Publishing. https://www.e-elgar.com/shop/gbp/research-handbook-on-the-governance-of-projects-9781802208061.html

Bollier, D., 2015. The Blockchain: A Promising New Infrastructure for Online Commons. Retrieved November 27, 2023 (https://www.bollier.org/blog/blockchain-promising-new-infrastructure-online-commons).

Bonanomi, M. M., Hall, D. M., and Staub-French, S., 2020. Governing integrated project delivery as a common pool resource scenario: What management practices and impact on project participants? In *18th Annual Engineering Project Organization Conference (EPOC)*.

Brunet, M., and Cohendet, P., 2022. Transforming construction: heterarchical megaproject ecologies and the management of innovation. *Construction Management and Economics*, 40(11–12), 973–986.

Catalini, C., and Gans, J. S., 2020. Some simple economics of the blockchain. *Communications of the ACM*, 63, 80–90.

Ceric, A., 2014. Strategies for minimizing information asymmetries in construction projects: Project managers' perceptions. *Journal of Business Economics and Management*, 15(3), 424–440.

Crypto Commons Association, 2021. Crypto Commons.

Davidson, S., De Filippi, P., and Potts, J., 2018. Blockchains and the economic institutions of capitalism. *Journal of Institutional Economics*, 14(4), 639–658. doi: 10.1017/S1744137417000200.

Davis, J. H., Schoorman, F. D., and Donaldson, L., 2018. Toward a stewardship theory of management. In Alan E. Singer (Ed.), *Business Ethics and Strategy, Volumes I and II* (473–500). Routledge. https://www.taylorfrancis.com/books/edit/10.4324/9781315261102/business-ethics-strategy-volumes-ii-alan-singer?refId=67e24485-451b-48b3-9c56-d517aa967241&context=ubx

Eissa, R., Eid, M. S., and Elbeltagi, E., 2021. Current applications of game theory in construction engineering and management research: A social network analysis approach. *Journal of Construction Engineering and Management*, 147(7), 04021066. doi: 10.1061/(ASCE)CO.1943-7862.0002085.

Fritsch, F., Emmett, J., Friedman, E., Kranjc, R., Manski, S., Zargham, M., and Bauwens, M., 2021. Challenges and approaches to scaling the global commons. *Frontiers in Blockchain*, 4, 1–16.

Gil, N., 2022. Megaprojects: A meandering journey towards a theory of purpose, value creation and value distribution. *Construction Management and Economics*, 40(7–8), 562–584.

Gil, N., and Pinto, J. K., 2018. Polycentric organizing and performance: A contingency model and evidence from megaproject planning in the UK. *Research Policy*, 47(4), 717–734.

Hall, D. M., and Bonanomi, M. M., 2021. Governing collaborative project delivery as a common-pool resource scenario. *Project Management Journal*, 52(3), 250–263.

Hall, D. M., and Scott, W. R., 2019. Early stages in the institutionalization of integrated project delivery. *Project Management Journal*, 50(2), 128–143.

Hall, D. M., Hunhevicz, J., and Bonanomi, M. M., 2022. Blockchain governance for integrated project delivery 4.0. In Vicente A. González, Farook Hamzeh, and Luis Fernando Alarcón (Eds.), *Lean Construction*

4.0 (288–305). Routledge. https://www.taylorfrancis.com/books/edit/10.1201/9781003150930/lean-construction-4-0-vicente-gonz%C3%A1lez-farook-hamzeh-luis-fernando-alarc%C3%B3n?refId=5fc08f36-c945-4063-b1f1-8c7b822efe7d&context=ubx

Han, J., Rapoport, A., and Fong, P. S., 2019. Incentive structures in multi-partner project teams. *Engineering, Construction and Architectural Management,* 27(1), 49–65.

Henisz, W. J., Levitt, R. E., and Scott, W. R., 2012. Toward a unified theory of project governance: Economic, sociological and psychological supports for relational contracting. *Engineering Project Organization Journal*, 2(1–2), 37–55. doi: 10.1080/21573727.2011.637552.

Hunhevicz, J. J., Brasey, P. A., Bonanomi, M. M., Hall, D. M., and Fischer, M. 2022b. Applications of blockchain for the governance of integrated project delivery: A crypto commons approach. arXiv preprint arXiv:2207.07002.

Hunhevicz, J., Dounas, T., and Hall, D. M., 2022a. The promise of blockchain for the construction industry: A governance lens. In Theodoros Dounas and Davide Lombardi (Eds.), *Blockchain for Construction* (5–33). Singapore: Springer Nature Singapore. https://link.springer.com/book/10.1007/978-981-19-3759-0

Koskela, L., 2017. Why is management research irrelevant? *Construction Management and Economics*, 35(1–2), 4–23.

Levitt, R. E., 2011. Towards project management 2.0. *Engineering Project Organization Journal*, 1(3), 197–210.

Macneil, I. R., 1999. Relational contract theory: Challenges and queries. *Northwestern University Law Review*, 94, 877.

Mahalingam, A., 2022. How institutional intermediaries handle institutional complexity in vanguard megaproject settings. *International Journal of Project Management*, 40(4), 320–331.

Mahalingam, A., and Levitt, R. E., 2007. Institutional theory as a framework for analyzing conflicts on global projects. *Journal of Construction Engineering and Management*, 133(7), 517–528.

Maples, M. J., 2018. Crypto Commons.

Ménard, C., and Shirley, M. M. (Eds.), 2005. *Handbook of New Institutional Economics* (Vol. 9). Dordrecht: Springer.

Miscione, G., Goerke, T., Klein, S., Schwabe, G., and Ziolkowski, R., 2019. Hanseatic governance: understanding blockchain as organizational technology. In *Fortieth International Conference on Information Systems*, Munich, 15 December 2019–18 December 2019, Blockchain as Organizational Technology. https://doi.org/10.5167/uzh-177370

Nakamoto, S., 2008. *Bitcoin: A Peer-to-Peer Electronic Cash System*. www.bitcoin.org

North, D. C., 1991. Institutions. *Journal of Economic Perspectives*, 5(1), 97–112.

Ostrom, E., 2015. *Governing the Commons: The Evolution of Institutions for Collective Action*. United Kingdom: Cambridge University Press.

Papadimitropoulos, V., 2022. *Blockchain and the Commons*. 1st ed. London: Routledge.

Rozas, D., Tenorio-Fornés, A., Díaz-Molina, S., and Hassan, S., 2021a. When ostrom meets blockchain: Exploring the potentials of blockchain for commons governance. *SAGE Open*, 11, 215824402110025.

Rozas, D., Tenorio-Fornés, A., and Hassan, S., 2021b. Analysis of the potentials of blockchain for the governance of global digital commons. *Frontiers in Blockchain*, 4, 15.

Teng, Y., Li, X., Wu, P., and Wang, X., 2019. Using cooperative game theory to determine profit distribution in IPD projects. *International Journal of Construction Management*, 19(1), 32–45.

Voshmgir, S., and Zargham, M., 2020. Foundations of cryptoeconomic systems.

Walker, D. H., Vaz Serra, P., and Love, P. E., 2022. Improved reliability in planning large-scale infrastructure project delivery through Alliancing. *International Journal of Managing Projects in Business*, 15(5), 721–741.

Williamson, O. E., 1989. Transaction cost economics. In Richard Schmalensee and Robert Willig (Eds.), *Handbook of Industrial Organization* (Vol. 1, 135–182). Elsevier. https://www.sciencedirect.com/handbook/handbook-of-industrial-organization/vol/1/suppl/C

Williamson, O. E., 2010. Transaction cost economics: The natural progression. *American Economic Review*, 100(3), 673–690.

Yung, P., 2015. A new institutional economic theory of project management. *Journal of Business Economics and Management*, 16(1), 228–243.