Blockchain in building logistics: emerging knowledge, and related actors in Sweden

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AIM OF THIS STUDY

Consider the emerging potential of the implementation of blockchain technology for a new digital business model for construction logistics, where the material and economic flows are integrated, and

investigate the main constellations of building logistics actors in Sweden, along with the related capabilities for the implementation for such a new digital business model
WHAT IS BLOCKCHAIN?

From a social interaction perspective:

• A team technology fostering collaboration to solve business challenges
• Peer-to-peer system for value transaction
• Digital ledger: append-only, shared, decentralized
• Reduced need for in-between verification
• New entries reflected on all database replicants hosted in ledger nodes
• Each “block” stores a finite set of transactions- and system-related data; then blocks are connected in a fixed order
BLOCKCHAIN IN CONSTRUCTION

- Research on related knowledge and implementation relatively new (Penzes, 2018)
- Application systems and solutions generally not yet technologically and commercially mature (Gerber & Nguyen, 2019; Nguyen et al. 2019)
- Research mainly discretized into:
  - Holistic efforts on understanding and implementing blockchain
  - Dedicated efforts on integration of blockchain with distinct fields
BLOCKCHAIN IN CONSTRUCTION LOGISTICS

• Especially regarding construction logistics → no investigation on utilizing blockchain for the integration of the respective material and economic flows

• Potential benefits of such an integration through blockchain:
  o Better overview of construction production and supply chain
  o Enhancing currently problematic transactions
  o Enhancing delivery + quality management of on-site deliverables
  o Aiding in stakeholder collaboration through decentralization
  o Assisting in project constructability optimization
  o Creating monetary and qualitative value for the stakeholders
INTEGRATING MATERIAL + ECONOMIC FLOWS IN CONSTRUCTION LOGISTICS THROUGH BLOCKCHAIN

• Creating monetary and qualitative value for stakeholders → value proposition of a new digital business model

• Investigation on: different digital building logistics constellations of companies and economic flows in Sweden, and the way their operation can be facilitated with the implementation of blockchain

• Theoretical approach: sociomateriality (Orlikowski 2016, Buser and Carlsson 2017)
A SOCIOMATERIAL TAKE ON BLOCKCHAIN

• **Sociomateriality**: a sociotechnical approach emphasizing the way digital technologies are co-shaped with practices

• Social and material aspects of digital technologies: inseparable

• Blockchain in building logistics and supply chain management cannot be understood separately from the relative processes and their practical realization
CONSTELLATIONS OF DIGITAL BUILDING LOGISTICS IN SWEDEN

• Sweden: Intensive construction activity

• Complex coordination processes → logistics-related issues:
  o Delayed deliveries
  o Complicated supply chain coordination
  o Low productivity

• There are different constellations for digital building logistics – with a potential for integration with blockchain
CONSTELLATIONS OF DIGITAL BUILDING LOGISTICS IN SWEDEN

Three main sociomaterially identified constellations:

1. **Large contractors** integrating building logistics internally *(typical case)*

2. **Independent third-party building logistics consultants** employed by clients

3. **Third-party players** (e.g. construction equipment suppliers or industrialized housing suppliers), offering digital building logistics solutions
LARGE CONTRACTORS
INTERNALIZING BUILDING LOGISTICS

• Economic flow:
  o Passes through the different accounting systems of the clients and the contractors
  o Ledgers organized according to each actor's business practice – rarely structured commonly

• Transition to a digital business model utilizing blockchain for building logistics with integrated material and economic flows:
  o Generalized, decentralized and common digital ledger used by all related actors → the discrepancy in the utilization of different accounting systems significantly mitigated
  o Normalization due to the append-only aspect of the block creation, and the immutability of the chain itself → facilitating the decentralization in the relative processes
INDEPENDENT BUILDING LOGISTICS CONSULTANTS

• Economic flow: at present, often organized in parallel to the model of the large contractors internalizing logistics

• Transition to a digital business model utilizing blockchain for building logistics with integrated material and economic flows:
  
  o Facilitating agility in integrating: (i) the logistics planning and flow control system, and (ii) the material registration, placement and installation
  
  o Ameliorating still existing hindrances in consultants’ efforts (e.g. delivery failure, unprecise data retrieval, delays, intra-systemic inefficient flows and data transfer)
  
  o Resolving ambiguities in the economic flow – consultants still have to justify the value-for-money for their services when coordinating the to-be-paid invoices after finished deliveries and/or works
3rd PARTY ACTORS OFFERING DIGITAL BUILDING LOGISTICS SERVICES

• Economic flow: decentralized

• Transition to a digital business model utilizing blockchain for building logistics with integrated material and economic flows:
  o Furtherly streamlining the decentralized economic flow of on-site planning (already "flattened" to ease on-site congestion)
  o Furtherly streamlining the multiple material flows connected to the differently designated site areas and access points
DISCUSSION

• Building logistics in Sweden → possible field of blockchain implementation

• Different constellations with different business models:
  o Different modes of collaboration between the participants in a blockchain network
  o **Different sociotechnical solutions involving characteristic distributions of power**, rather than just technical choices among rationally discernible models

• Operational frameworks dependent on knowledge exchange, but also a political game
DISCUSSION

• Blockchain security issues (and the need for mutual trust):
  o Internal trust among participants in a blockchain network, where there is reduced control, should be cultivated – however, this is difficult
  o Autonomy-control paradox (Bader and Kaiser 2017, Zuboff 2019)
  o Possible solution: setting up a permissioned system and following a series of procedures to protect the blockchain network from external threat, but also internal instabilities

• Blockchain integration issues:
  o Technical interoperability
  o Changes in the work practices and organization of the participants

• Blockchain technology introduction issues:
  o First, as an add-on to an information infrastructure consisting of different accounting, project and site planning, and quality and access control systems
  o Then, common standards, not only for building components, but also for the ledger structuring, should be possibly adopted
CONCLUSIONS

• Blockchain: emerging technology with potential for the construction sector
• Relative present systems immature
• Disintegration of material and economic flows in construction logistics and supply chain management: major issue → integration could be facilitated through blockchain
• Each of the three main sociotechnical building logistics constellations in the Swedish context is characterized by its own challenges and power structure
• Implementing blockchain in the constellations entails negotiations, and requires tackling of security, integration, and technology introduction issues
• Cross-fertilization of blockchain with the IoT, machine learning, digital twin, automated vehicles, augmented reality, and other digital technologies → possible
THANK YOU FOR YOUR ATTENTION!

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