Available online at www.sciencedirect.com

ScienceDirect

Procedia Engineering 196 (2017) 638 – 645

Procedia Engineering

www.elsevier.com/locate/procedia

Creative Construction Conference 2017, CCC 2017, 19-22 June 2017, Primosten, Croatia

Potentials of Blockchain Technology for Construction Management

Žiga Turk[a,*] and Robert Klinc[b]

[a]*Professor, University of Ljubljana, Faculty of Civil and Geodetic Engineering, 1000 Ljubljana, Slovenia*
[b]*Ph.D., University of Ljubljana, Faculty of Civil and Geodetic Engineering, 1000 Ljubljana, Slovenia*

Abstract

Blockchain technology enables distributed, encrypted and secure logging of digital transactions. It is the underlying technology of Bitcoin and other cryptocurrencies. Blockchain is expected to revolutionize computing in several areas, particularly where centralization was unnatural and privacy was important. In the paper, we present research on where and how this technology could be useful in the construction industry. The work is based on the study of literature on open issues that exist in construction process management. These are than matched to the capabilities of blockchain.

We are motivated by the fact that construction projects involve a dynamic grouping of several companies. We study the degree to which the relationships among them are hierarchical or peer-to-peer and note that particularly in information intensive phases, centralization of information management was necessary because of technology. When using un-constraining technology, communication patterns among participants show a peer-to-peer nature of the relationships. In such environment, blockchain can provide a trustworthy infrastructure for information management during all building life-cycle stages. Even if building information modelling (BIM) is used, which assumes a centralized building information model, there is a role for blockchain to manage information on who did what and when and thus provide a basis for any legal arguments that might occur. On the construction site blockchain can improve the reliability and trustworthiness of construction logbooks, works performed and material quantities recorded. In the facility maintenance phase, blockchain's main potential is the secure storage of sensor data which are sensitive to privacy.

We conclude that blockchain provides solutions to many current problems in construction information management. However, it is more likely that it will be built into generic IT infrastructure on top of which construction applications are built, rather than used directly by authors of construction related software. It has a potential to make construction processes less centralized which opens needs for research in that direction.

Keywords: blockchain, building information modelling, building information management, information systems, intellectual property rights, construction contracts, trust

* Corresponding author. Tel.: +386 1476 8622.
E-mail address: ziga.turk@fgg.uni-lj.si

Peer-review under responsibility of the scientific committee of the Creative Construction Conference 2017
doi:10.1016/j.proeng.2017.08.052

1. Introduction

Construction has always been a collaborative process involving a larger or smaller group of participants. Throughout history, communication technology has a significant impact on the relationships among those involved [1].

Before on-paper documents and drawings became standard, the designing, planning, and constructing work was organized around a master builder. Paper documentation enabled the first wave of specialization and consequently fragmentation of professions, businesses and processes. Companies specialized either into information processes (such as designing and planning) or material processes (such as construction, maintenance, and demolition). Information processes took place in firms and consultancies that were held together by a flow of paper documents that were created collaboratively by people working closely together. The information was exchanged by other firms typically as rather large and complete documents – such as conceptual design, basic design, detailed design or tender documentation. The authorship and intellectual property of such documents was very clear. Information with legal significance passed the boundaries of a business rather infrequently, were properly signed and the medium – paper – made possible alternations very visible.

Today, digital technology is allowing even greater specialization which results on one hand on the greater sum of knowledge deployed, better quality and safety and higher productivity. But on the other, it is also causing more fragmentation. Since the end of the master builder era, construction has been organized in what recently became known as the "Hollywood business model" [2] of economy. For each movie project a unique set of contributors is assembled to work together and are dismantled at the end of the project. In construction, this set of contributors have been companies but this is changing due to digital communication. Companies are getting smaller and individual consultants are having bigger roles, just as is the case in the Hollywood movie business. The information exchanges across organizational and legal boundaries of companies are much more frequent than before.

The processes of planning and design are today almost entirely digitalized with information being shared and exchanged in a digital format. In recent years, an increasing share of all information is managed by building information modelling (BIM) technology. BIM is changing the entire AEC industry and disrupting the building processes. What used to be a problem of modeling of buildings is now understood as a problem of managing building information [3].

It is important to note that building information management is the management of legally significant information that can be used in case of disputes and litigation among the numerous and fine-grained contributors to the process. Several authors have identified these legal issues as barriers to BIM technology adoption. Arensman and Ozbek [4] warned on legal uncertainty associated with BIM. Redmond et al. [5] identified legal and security issues as a main obstacle to using cloud platform for BIM. Thomas [6] claims these are:

- who owns the model;
- who has modification rights;
- who has distribution rights;
- who has liability for changes or errors;
- how to manage copyright protection;
- how to protect digital intellectual property.

There are also other legal and organizational concerns such as who owns the datasets, who pays for the datasets, who is responsible for the accuracy and correctness. They present a challenge for BIM implementation and identify legal barriers and model ownership management as barriers of BIM adoption by owners and facility managers [7]. Foster [8] identified the following barriers to BIM adoption:

- difficulties in assigning responsibilities and liabilities,
- collaborative nature of the design process,
- risk allocation,
- blending of roles and responsibilities by BIM,
- privity and third party reliance,
- distributed design decisions by third parties,