D. Lombardi, ,

**Blockchain Grammars for validating the design process**

Keywords: Blockchain, Shape Grammar, Design Validation, Smart Contracts, Design Collaboration

This paper develops the Blockchain Grammars concept providing various scenarios that validate the Decentralised Autonomous Organisation (DAO) Mechanism as a platform for design collaboration. Within a fast-developing context of internet-based applications fostering the potential of connecting people and expertise, DAOs and Blockchain (BC) are explored as tools for embedding both participated design processes and the traceability of the decision-makers.

Blockchain Grammars are shape grammars implemented on a DAO, where multiple grammarists propose one or more grammars, using the underlying blockchain technology of the DAO to record each entry with a unique hash and incentivise participants to evaluate and elaborate new ones. At the same time, an implemented reputation-based system helps to structure the governance of the DAO itself with the scope of promoting both quality and participation.

In order to display the interaction of DAO and BC in a design context we have set up a DAO as part of the research, and we framed its application in the high-density context of a Chinese city, producing various shape grammars for the design of residential towers. The presented grammars have been structured to optimise the density of housing and provide functional apartment layouts to be evaluated against regulated environmental factors.

We further simulate a decision process taking place within the DAO with the aim of selecting the best option among the proposed ones, relying on the reputation granted to users and on the recording system of the BC.

We have validated the process of decision making via the governance system allowed by the DAO, and concurrently developed the infrastructure connection between a shape grammar system on parametric software and the smart contracts embedded on a DAO.

In terms of the structure of the research, the paper presents in sequence the DAO we have set up, its governance and reputation system, the design and application of the grammars through the DAO, the voting of grammarists through the DAO to select the best grammar, and the connection between the parametric environment of Rhinoceros/Grasshopper and the DAO.

The paper showcases a robust workflow integrating cutting-edge parametric design tools with the novel BC technology applied as a mean for fostering collaboration while also securing financial transaction via the smart contracts.

The presented approach provides the framework for a shift in the Architecture industry, providing a further step in the line of research that connects decentralisation and design value.

XXXXX , XXXX, 2019, XXXXXX, Caadria 2019

XXXXX, XXXXX, XXXXX, 2019, eCAADe, 2019

XXXXX. 2013. ‘XXXXXX. *Zhang J., Sun C. (Eds) Global Design and Local Materialization. CAAD Futures 2013. XXXXXXXXXXXXXXXXXXXXXXXXX, Vol 369. Springer,* xxx-xxx.

Duarte, Jose Pinto. 2005. ‘Towards the Mass Customization of Housing: The Grammar of Siza’s Houses at Malagueira’. *Environment and Planning B: Planning and Design* 32:347–80.

Economou, A. 2001. ‘Four Algebraic Structures in Design’. In *Proceedings of the Twenty First Annual Conference of the Association for Computer-Aided Design in Architecture*, 192–201. ACADIA.

Grasl, Thomas. 2012. ‘Transformational Palladians’. *Environment and Planning B: Planning and Design* 39 (1):83–95.

Knight, T. 2003a. ‘Computing with Ambiguity’. *Environment and Planning B: Planning and Design* 30.

Knight, T. 2003b. ‘Computing with Emergence’. *Environment and Planning B: Planning and Design* 30.

Stiny, George, and Lionel March. 1981a. ‘Design Machines’. *Environment and Planning B: Planning and Design* 8 (3):245–55.

Wortmann, T. Stuffs, R. 2018. ‘Algorithmic complexity of shape grammar implementation’ Artificial Intelligence for Engineering Design, Analysis and Manufacturing, vol. 32. Special issue 2.