

## CONFERENCE PROCEEDINGS

## 6<sup>th</sup> Blockchain International Scientific Conference 19 April 2024, ISC2024, Singapore

### 1. The nature of DAO

Sinclair Davidson FBBA, RMIT University, Australia

Category: Oral Presentation

#### Abstract

Just as economics Nobel Laureate Ronald Coase famously asked, 'Why do firms exist?', this project asks, 'Why do DAOs exist?'. Blockchain technology overcomes transactional trust issues through decentralisation and the provision of a tamper-proof and transparent ledger. It does not, however, resolve governance trust issues. 'Who does what, to whose satisfaction?' remain open and important questions in DAOs just as they do in any and every other organisation. This paper forms part of a project that sets out to establish an intellectually coherent, consistent, and academically robust theoretical framework that locates DAOs within a theory of organisation that can then be used by both practitioners and policy makers. The practical outcomes of this research will include a theory of DAOs; a set of testable hypotheses based on those principles; and a set of recommendations to DAO users and policy makers.

**Keywords:** *Decentralised Autonomous Organisation, Organisation costs, Open Source, Property Rights*

**JEL Classification:** D23, D71, D86, L22, L86

### 2. Decentralised Finance (DeFi) in 2034: Impact on Financial Services and Needed Competencies for its Professionals

Daniel Liebau, Erasmus University, The Netherlands

Category: Oral Presentation

#### Abstract

The significance of blockchain-based Decentralized Finance, or DeFi, is rising. In late 2021, crypto-native actors pushed total value locked (TVL), a common measure for the size of this market, above USD 150 billion. The ability to swap digital assets against each other and to give borrowers access to capital without intermediaries, only using smart contracts, were decentralized innovations. Then, these unregulated markets collapsed to ca. USD 40 billion in TVL after the bank run on the Terra LUNA network. But regulators worldwide, including MAS in Singapore, started investigating DeFi primitives and how to use them to resolve some of the critical issues in current Finance. Even the Bank of International Settlements (bis) investigated to understand related risks. It is, therefore, timely to ask what capabilities will be needed by finance professionals and their organizations of any size to remain competitive a decade from now – in 2034. I collect unique survey data amongst participants of my executive education course titled "Decentralized Finance (DeFi): A New Financial Ecosystem" to understand required competencies as they are perceived by experienced financial services professionals in (investment) banks, asset managers, insurers, and regulators. Research results are relevant for policymakers and talent development leaders alike.

**Keywords:** *Blockchain, Decentralized Finance, Innovation, Technology Change, Competencies*

**JEL Classification:** G1, J2, O3, L1

### 3. Navigating Cryptocurrencies' Next Frontier: The Revolution Towards Decentralizing Physical Infrastructure

Jincheng Zheng, Chongwu Xia, Swee-Won Lo, David Lee Kuo Chuen - Singapore University of Social Sciences

Category: Oral Presentation

#### Abstract

Decentralized Physical Infrastructure Networks (DePIN) integrates blockchain, cryptocurrencies, and the Internet of Things (IoT) to develop traditional industries and the new digital economy. This article outlines DePIN's concept, mechanisms, applications, and future trends, as well as current noteworthy challenges. The LASIC principle is used to measure the feasibility of DePIN, offering valuable insights to investors and practitioners in the assessment of a sustainable business model within the DePIN ecosystem. This article also compares various public blockchains that are used as the DePIN settlement layer and proposes the criterias for cultivating a prosperous DePIN ecosystem.

**Keywords:** *Decentralised Autonomous Organisation, Organisation costs, Open Source, Property Rights*

**JEL Classification:** D23, D71, D86, L22, L86

## 4. Token Classification Framework By Consideration Of Origins Of Value And Mechanisms Of Manifestation Thereof

Vasily D Sumanov, Simon Polanski, *PowerPool, Cyprus*

Category: Oral Presentation

### Abstract

This paper presents the original Value Capturing Theory (VCT) for digital assets (tokens) study and classification, focusing on the intrinsic value of tokens and acknowledging the significance of demand-side considerations. Traditional classification frameworks overlook these aspects, often assessing tokens based on a wide range of properties without positing a hierarchical structure. In contrast, the VCT introduces a novel framework that classifies tokens based on their value-creating roles in coordinating agent behavior and the primary pathways through which value is realized in the system. In particular, a hierarchical three-level model is developed, wherein a token is attributed several origins of value, and interacting origins of value are grouped by a common pathway they are realized through (termed the Value-Capturing Mechanism). Specific technical implementations of these pathways are recognized. In addition, a method of systematic token design is proposed, and criteria for recognizing novel Value-Capturing Mechanisms are given. Application of the novel framework is demonstrated for both token design for a model system and the decomposition of an extant token according to its origins of value and Value-capturing Mechanisms.

**Keywords:** *classification framework, token value, value-capturing mechanisms, origins of value, token engineering*

**JEL Classification:** *D46*

## 5. Architectural Design of a Blockchain-Powered Carbon Trading System: A Case Study of the South African Carbon Market

Timileyin P Abiodun, *University of Johannesburg, South Africa*

Category: Oral Presentation

### Abstract

To achieve carbon neutrality by 2050 and reduce greenhouse gas emissions to a range of 350 to 420 megatons of carbon dioxide equivalent, South Africa introduced a carbon taxation system in June 2019. However, in just three years, it has become evident that the system faces significant challenges, with less than 6% of the estimated tax returns reaching the government. This issue raises concerns about possible corruption and manipulation within the system. To address these challenges, this study presents a comprehensive framework for a carbon trading and taxation system, leveraging blockchain technology. The unique perspective of designing this framework from the government's perspective ensures efficient monitoring and oversight. Notably, the proposed system operates automatically, eliminating the need for third-party intermediaries. This study also identifies a crucial research gap and lays the foundation for future studies. It plans to empirically implement the system as a decentralised application (dApps) using the Ethereum blockchain network, complemented by ReactJs for the user interface, Node-Red to interface with IoT sensors, and Provable to authenticate and validate data that is being injected into the blockchain network. In summary, this research aims to address the shortcomings of the current carbon taxation system in South Africa through a novel, government-centric approach powered by blockchain technology. The proposed system's potential to enhance transparency and efficiency justifies further exploration in future studies.

**Keywords:** *Blockchain, Blockchain Technology, South Africa, Greenhouse Gas, Carbon Taxation, Carbon Market, Carbon Trading System, Carbon Finance, Carbon Footprint.*

## 6. Some Simple Institutional Cryptoeconomics of Shared Security

Darcy W.E. Allen, Chris Berg, Sinclair Davidson, *RMIT Blockchain Innovation Hub, RMIT University, Australia*

Category: Oral Presentation

### Abstract

Security is an economic good that is costly to produce. Entrepreneurial blockchain communities face a 'make or buy' decision to acquire that security. Many complex factors determine whether a project either (1) makes security (e.g. bearing the setup and maintenance costs of a validator set) or (2) buys security from another blockchain or service provider (e.g. a larger blockchain with more economic weight). In recent years several prominent shared security models have emerged including Interchain Security in Cosmos, Eigenlayer in Ethereum, Babylon for Bitcoin and Parachains in Polkadot. These models involve the purchase of security over a blockchain's organisational boundary, with different contracting structures. In this context, this paper outlines some simple institutional cryptoeconomics of shared security models. We apply institutional economics theory to dissect shared security models, identifying potential contracting hazards that stem from contract incompleteness, asymmetric information and asset specific investments. By applying existing understandings of contract theory to the frontiers of shared security, this paper informs the design of more robust and sustainable shared security models in blockchain ecosystems.

**Keywords:** *Shared Security, Institutional Economics, Incomplete Contracting, Blockchain Governance*

## 7. Towards Confidential Chatbots: A Scalable Decentralized Federated Learning Framework

Hongxu Su<sup>1</sup>, Cheng Xiang<sup>1</sup> and Bharath Ramesh<sup>2</sup>

<sup>1</sup>National University of Singapore - <sup>2</sup>Western Sydney University

Category: Oral Presentation

### Abstract

The development of cutting-edge large language models like ChatGPT has sparked global interest in the transformative potential of chatbots to automate language tasks. However, alongside the remarkable advancements in natural language processing, concerns about user privacy and data security have become prominent challenges that need immediate attention. In response to these critical concerns, this paper presents a novel approach that addresses the privacy and security issues in chatbot applications. We propose a scalable and privacy-preserving framework for chatbot systems by leveraging the power of decentralized federated learning (DFL) and secure multi-party computation (SMPC). Our DFL framework leverages blockchain smart contracts for participant selection, orchestrating the training process on user data while keeping the data local, and model distribution. After each round of local training by the participants, the blockchain network securely aggregates the model updates using SMPC, ensuring that participants' raw model parameters are not exposed to others. Iterative training rounds are executed through the blockchain network, with participants updating the model collaboratively using SMPC. Experiments show that our approach achieves comparable performance to centralized models while offering significant improvements in privacy and security. This paper presents a novel solution to privacy and security challenges in chatbots and we hope our approach will foster trust and encourage broader adoption of chatbot technology with privacy at the forefront.

**Keywords:** *Privacy-Preserving Learning, Decentralized Federated Learning, Tiny Language Models (TinyLMs), Secure Multi-party Computation (SMPC), Blockchain Technology*

**JEL Classification:** C88 - *Other Computer Software - Our paper discusses the development or application of specific software related to chatbots.*

## 8. Empowering Families in the Genomic Era: A Decentralized Data Trust Approach for Ethical Genomics Management

Daniel Uribe, *GenoBank.io*<sup>TM</sup>, USA

Category: Oral Presentation

### Abstract

The field of genomics is at a pivotal juncture, facing challenges in data privacy and the ethical handling of genetic information. Existing genomic data management systems often lack transparency, are inefficient, and do not comply with stringent data protection laws like GDPR or CCPA. Addressing these issues, we propose an innovative AI-governed web3 Genomics Data Family Trust framework, rooted in the principles of DeSci (Decentralized Science). Utilizing the ERC721 standard on EVM-compatible chains, such as the Avalanche C-Chain, our system embeds BioNFTs (Ricardian Contracts) in compliance with local data laws. This approach ensures enhanced transparency and traceability, bolstered by security through client-side encrypted GenoVaults. Additionally, BioWallets enable effective management of genomic assets, with AI oversight ensuring governance standards.

A critical aim of this decentralized trust is to foster integration with AI platforms like BioGPT and other advanced GPT and LLMs. This integration supports the acceleration of genomics and clinical data interpretation, consistent with initiatives like FDA 3060 (a) (Clinical Decision Support Software). By embracing DeSci, the platform not only empowers individuals and families with control and secure sharing of their genomic data but also facilitates their participation in groundbreaking genomic research. The adaptability of the system to various genomic data management scenarios underscores its potential to transform genomic research, aligning with the ethos of Decentralized Science to promote open, transparent, and collaborative scientific inquiry.

**Keywords:** *DeSci, Genomics, Data Privacy, AI Governance, BioNFTs, Smart Contracts, ERC721, GDPR, CCPA, BioGPT, FDA 3060(a), DeSci, Web3, BioDAO, LabNFT, BioWallet, Biosamples*

**JEL Classification:** C88 - K24, O34, I18

## 9. Assessing the readiness for blockchain technology in the South African public sector

Beatah Sibanda, *North-West University, South Africa*

Category: Oral Presentation

### Abstract

The rise in recent technological developments through the Fourth Industrial Revolution has impacted how businesses and governments globally operate, requiring a shift in strategies and governance systems. These technological advances have altered production, management, and governance systems, allowing businesses and governments to respond with agile and complex approaches. A study into one of these technologies reveals that blockchain could enhance the effectiveness and efficiency of operations in the public sector through its transparency-enhancing measures. While governments globally have adopted or are considering blockchain, South Africa still needs to catch up. This study assessed the readiness of the South African public sector to adopt blockchain technology. The population for the study comprised officials in 15 provincial departments in Gauteng province, South Africa. The study adopted a sequential-exploratory approach using the QUAL-QUANT design. If blockchain has the potential to enhance transparency and accountability in the public sector, it is worth assessing if South Africa is ready to accept this technology by obtaining the perceptions of those charged with governance. Although the study's findings suggest that blockchain could be instrumental in improving public sector governance, South Africa may need more time to accept blockchain technology as several deterrents that could hinder adoption were identified, such as resistance to change, change management, and outdated infrastructure. These could, however, be mitigated by skills development and training and the acquisition of the appropriate infrastructure to support blockchain. The study proposes a framework for adopting blockchain technology in the South African public sector to enhance good governance.

**Keywords:** *Auditor-General South Africa, Blockchain technology; corporate governance; accountability; transparency; public sector.*

**JEL Classification:** *H1*

## 10. Models Of Crypto Projects And Their Properties

Oleksandr Letychevskyi, *Heriot-Watt University Edinburgh, Scotland*

Category: Oral Presentation

### Abstract

The research concerns the general abstract model of the crypto project. The algorithmic components of the crypto project, which are defined in the smart contract and their varieties for different services, are highlighted. Typical algorithms for such services as a cryptocurrency exchange, services related to the Internet of Things, education, Internet services and trade are considered. In addition to the algorithmic components, the market component that depends on the external environment, the influence of various external factors, such as the actions of other companies, the statements of celebrities, changes in sales and purchases depending on price changes, is investigated. To predict the scenario of the crypto project, the types of neural networks are considered, which are also included as a component of the crypto project model. Taking into account the algorithmic and market component of the crypto project, the properties of reliability, equilibrium, impossibility of centralization and resistance to malicious actions are investigated. This study is a generalization of the experience of formalization of token economy projects and is an important stage for the creation of a system of analysis and prediction of crypto project scenarios. The presentation will also include demonstrations and comparisons of software systems used in similar analytical studies, including the platform created by the author and his team.

**Keywords:** *smart contract, algebraic modelling, token economy, economical equilibrium, formal methods, neuron networks*

**JEL Classification:** *C680*