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Responsible Blockchain: STEADI Principles and the Actor-Network Theory-based Development Methodology (ANT-RDM)

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ABSTRACT

This monograph provides a comprehensive analysis of the challenges and controversies associated with blockchain technology. It identifies technical challenges such as scalability, security, privacy, and interoperability, as well as business and adoption challenges, and the social, economic, ethical, and environmental controversies present in current blockchain systems. We argue that responsible blockchain development is key to overcoming these challenges and achieving mass adoption. This monograph defines Responsible Blockchain and introduces the STEADI principles (sustainable, transparent, ethical, adaptive, decentralized, and inclusive) for responsible blockchain development. Additionally, it presents the Actor-Network Theory-based Responsible Development Methodology (ANT-RDM) for blockchains, which includes the steps of problematization, interessement, enrollment, and mobilization.

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1

Introduction

Bitcoin, introduced by Satoshi Nakamoto in 2008, marked the inception of the first peer-to-peer currency (Nakamoto, 2008). Since its inception, many other cryptocurrencies have been introduced and have gained significant traction. As of the end of 2022, it is estimated that the number of cryptocurrency owners grew to 425 million worldwide (Crypto.com, 2022). Although Nakamoto's original paper mentioned a "chain of blocks," the term "blockchain" itself did not appear in the 2008 white paper. Instead, "blockchain" evolved as a loose umbrella term (Narayanan and Clark, 2017) within the cryptocurrency community to describe a suite of technologies—including decentralized ledgers, linked timestamping, Merkle trees, consensus mechanisms, and public keys as identities—that underpin Bitcoin. These technologies have been recognized for their potential to revolutionize various sectors such as manufacturing, construction, healthcare, finance, insurance, supply chain, agriculture, academic publishing, energy, resource management, and legal systems (Haq *et al.*, 2023), overcoming challenges related to information sharing, traceability, and operational efficiency.

Despite the significant interest and hype about cryptocurrencies and blockchains, more than 10 years since their inception, they have

still not become everyday technologies for consumers (AlShamsi *et al.*, 2022). This technology still faces many technical challenges, such as scalability, security, privacy, interoperability, and energy consumption, as well as business adoption challenges, social, ethical, environmental, and regulatory controversies. We argue that responsible blockchain development is the key to overcoming these challenges and achieving mass adoption.

Responsible Blockchain Definition In this monograph, we define responsible blockchain as a socio-technical system that fosters sustainable, transparent, ethical, adaptive, decentralized, and inclusive practices among diverse participants to promote a dynamic equilibrium of interests for its long-term viability. The participants include human actors such as developers, users, regulatory entities, and non-human actors such as computer hardware, software, protocols, policies, and the environment.

This monograph will provide a comprehensive analysis of the challenges and controversies of blockchain technology, identify the technical challenges such as scalability, security, privacy, and interoperability, and also the business and adoption challenges, and social, economic, ethical, and environmental controversies within current blockchain systems. The monograph will then introduce the STEADI principles (sustainable, transparent, ethical, adaptive, decentralized, and inclusive) aimed at fostering responsible blockchain development, grounded in Actor-Network Theory. Additionally, this monograph presents the Actor-Network Theory-based Responsible Development Methodology (ANT-RDM) for blockchain technology, incorporating the stages of problematization, interessement, enrollment, and mobilization.

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