

# Ethical issues of community-driven blockchain systems

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**Abstract**—This paper discusses the innovation and development of public-permissionless blockchain systems in the context of the triple helix model and its subsequent versions. We argue that the triple helix model fails to explain the bottom-up and community-driven innovation of this technology, which does not rely on any of the primary institutions presented in the helix models. The absence of these institutions affects the ethics of the innovation as it is left to the developers to make ethics-related design choices, which might clash with general ethical norms and values established and protected by the primary institutions. Ethical issues of public-permissionless systems are often characterized by being unaccountable and immutable, as there is no single data controller. Such design decisions can therefore have a long-term negative effect on society.

**Keywords**—*blockchain systems, blockchain ethical issues, ethical guidelines, bottom-up innovation communities*

## I. INTRODUCTION

The triple helix model (university-industry-government) [1] describes the interplay of different interests to explain how innovation occurs in an evolutionary process among three key institutions. Later, the model was extended into the quadruple model (addition of society) [2] and the quintuple helix (addition of environment) [3].

However, even with the extensions made, the helix models remain incomplete and cannot adequately explain how the evolutionary process of innovating can be explained in community-driven, bottom-up initiatives that drive new developments in the absence of the institutions mentioned in the helix models. A prominent example is blockchain protocols, such as the public-permissionless Ethereum blockchain, which is driven by open innovation communities. While these grassroots or bottom-up community movements have illustrated that they can innovate in a decentralized way and without well-defined institutions, they also raise questions regarding the norms and values embedded in disruptive technologies such as blockchain systems, which can create unforeseen ethical issues [4]. In the absence of the checks and balances of institutions driving innovation in a context of a knowledge-based normative societal framework, communities innovating in a decentralized fashion may embed norms and values in blockchain systems that violate ethical norms permanently, as blockchain systems are designed to be immutable and hard or impossible to change, once deployed [5]. Because of the immutability of blockchain systems, these ethical issues must be addressed in the innovation and design phase to ensure that the values engraved in these systems align with society's values.

In this paper, we discuss the innovation and development of public-permissionless blockchain systems in the context of the helix models and how bottom-up co-creation of blockchain systems can cause long-term negative effects on society.

Our paper is organized as follows: after briefly contextualizing our research, we discuss how community-developed public-permissionless blockchain systems fit with the helix models and, in particular, how they become misaligned on ethical matters. We then discuss how the primary institutions presented by the triple helix model could influence community-driven innovation and guide the development of blockchain systems. Even though blockchain communities have proven that innovation can be done without relying on primary institutions, we argue that the involvement of primary institutions in developing ethically sound and compliant blockchain systems is more urgent than ever. We conclude the paper with a few further remarks.

## II. ETHICAL GUIDELINES FOR BLOCKCHAIN SYSTEMS

The paper is based on ongoing work in the Expert Group on Blockchain Ethics (EGBE), mandated by the European Blockchain Partnership (EBP), to define ethical guidelines for blockchain systems. The EBP ethical guidelines will primarily be aimed at private-

permissioned blockchain systems, such as the European Blockchain Service Infrastructure (EBSI).<sup>1</sup> However, the EGBE also provides useful insights into ethical issues of public-permissionless blockchain systems due to the distinctive blockchain characteristics such as decentralization, transparency, auditability, and immutability that apply to any—permissioned or permissionless, private, or public—blockchain system [6]. The EGBE consists of experts in blockchain technology, computer ethics, philosophy, and law. The expert group is mapping ethical issues specifically related to blockchain technology against ethical norms and principles followed by the European Union. In this paper, some insights derived from the work in the EGBE served as a point of departure to shed light on the relationship between ethical implications of bottom-up community-driven innovation and the theorizing derived from the helix innovation models, using public-permissionless blockchain systems as an illustrative example.

### III. COMMUNITY-DRIVEN INNOVATION

In the triple helix model, innovation is understood as the development of new inventions and arrangements between institutional entities, such as the collaboration between policymakers, academics, and businesspeople creating conditions for innovation [1]. Here, universities, industries, and governments are presented as primary institutions intertwined in co-creating ethically sound and robust conditions for innovation. However, the creation and development of public-permissionless systems have occurred without the involvement of any primary institution described in the helix models. An example is Bitcoin, which was created without any primary institution or trusted third party [7], or Ethereum, which is maintained and developed by a decentralized community of developers [5]. Opposite to the original version of the triple helix and the extended versions of the helix since introduced, disruptive innovation seems to no longer require primary institutions. In fact, contrary to the defined roles in the helix models, innovation, and development of public-permissionless blockchain systems are based on open communities of developers that develop and maintain the protocol layer [8]. Developers collaborate in loosely coupled groups and networks where they build on the work of others and maintain the blockchain protocol, sometimes without knowing the identity of the other nodes they are co-creating with [9]. The helix models do not explain this way of innovating and developing technology, as they do not describe how innovation can be done bottom-up by decentralized communities, that defy the traditional understanding of (legal, economic, and ethical) authority.

This bottom-up, community-driven way of innovating and developing technology can create unforeseen ethical dilemmas and issues, especially in the context of a disruptive technology like blockchain, which can facilitate the creation of innovations without involving primary institutions [8]. If the stakeholders co-creating public-permissionless blockchain systems are not working from the same moral stance, they might unintentionally create a system that violates the general ethical principles that the Western democracies rely upon which are based on respect for human dignity and -rights and environmental considerations, among others.

An example is Augur, an Ethereum-based peer-to-peer protocol that can be used to create prediction markets where people can place bets on future events. The Augur protocol was created to ensure global accessibility, low fees, and to avoid insider trading. However, in 2018, Augur effectively turned into an assassination prediction market, as people started betting on the death of people, e.g., Donald Trump [10]. As the system is immutable and based on decentralized applications, it was not possible to delete or censor the bets. The openness and immutability of the protocol, which was considered an improvement over centralized prediction markets, made it impossible for the developers of the Augur protocol to address the issue, as they do not control what markets and bets people chose to create [10]. This is an example of how blockchain-based applications can create immutable ethical issues with no accountability as there is no single data controller.

On the other side, blockchain communities illustrate that it is possible to address problems and solve them collectively. For instance, environmental concerns in the Ethereum community led to a change in the protocol layer where proof of stake was chosen as a consensus mechanism instead of proof of work. The transition from proof of work to proof of stake was indeed driven and executed by the developers and users who harbored a growing concern regarding the unsustainable and ethically questionable, high-energy consumption [11]. Environmental considerations can be turned into design choices by an open community of developers and no longer require to be pushed forward by regulators or enforced by society. This focus on the environment of blockchain clashes with the role of the environment within the global innovation helix, where environmental concerns have to be pushed forward by primary institutions.

However, even though the Ethereum community has proven that it can organize itself to address ethical issues, such as energy consumption, we still argue that ethical guidelines are needed to ensure that moral values are being considered from the very early stage. Without ethical guidelines to ensure that stakeholders are working from the same ethical premise, the values engraved in blockchain systems risk being inherent, random, ill-defined, incomplete, or in violation of the values of society. Some communities openly express that they are not interested in being compliant with the values of society: “Our code is free for all to use, worldwide. We don’t much care if you don’t approve of the software we write. We know that software can’t be destroyed and that a widely dispersed system can’t be shut down” [12]. If blockchain communities define ethical guidelines for themselves, conflicts of interest may arise, as they might not be interested in limiting themselves. Leaving blockchain communities to draft their own ethical rules could lead to another (widely criticized) ethics-washing practice and might compromise their quality. Furthermore, as developers in blockchain communities do not always know the identity of each other, they cannot be certain that they share moral values. Creating a common understanding of moral values is a game-changer as moral values can be seen as a boundary object that can “[...] have different meanings in different social worlds, but their structure is common enough to more than one world to make them recognizable

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<sup>1</sup> More about EBSI, see <https://ec.europa.eu/digital-building-blocks/wikis/display/EBSI/Home>

[...]” [13]. Ethical guidelines are needed to bind the blockchain stakeholders to a common goal in the innovation- and development phase to ensure ethically sound and robust blockchain networks that are in line with society’s values.

In this context, the boundary object of moral values is being approached bottom-up by developers and top-down [14] by the Expert Group on Blockchain Ethics as we are currently defining ethical guidelines. In other words, whereas we are trying to frame these guidelines within the realm of ethical theories, the developers identify their ethics outside these theories. As public-permissionless blockchain systems are community-created in decentralized networks, we argue it is essential to have ethical guidelines to manage boundary objects to ensure that all stakeholders uniformly understand and share moral values. Without ethical guidelines, values such as “freedom” might be understood differently by different players and might not be in line with the overall values of society: for example, almost all would agree that the protection of individual freedom is fundamental, and yet we also agree that one person’s freedom should not be more important than another person’s which thereby establish limits to individual freedom. However, if this understanding is not inherently shared by all developers, blockchain systems could be created that enhances one person’s freedom at the expense of others.

Some would argue that blockchain communities are based on values such as freedom and transparency, as they seek to create transparent systems with no trusted third party [7] These alternative solutions and be used to disrupt untrusted or corrupt primary institutions and failed economic markets [15]. However, inherent values of freedom and transparency do not by default prevent the systems they create from being used unethically. Creating public-permissionless systems with no single controller, as a way of preventing untrusted primary institutions from misusing power, does not guarantee that the systems are only used in ethical ways. Blockchain systems might be used to disrupt primary institutions that are corrupt or act in unethical ways, but new types of ethical issues arise from these systems as there is no single data controller to be held accountable or address ethical issues as they arise. These new types of ethical issues are hard to address due to blockchain characteristics such as decentralization and immutability, which makes it very hard to place accountability and address ethical issues once they arise. We hereby argue, that even though innovation can be done without having primary institutions playing a central role, primary institutions still need to define moral values and ethically guide the development of new technology, such as public-permissionless blockchain systems.

#### IV. TRAILING STAKEHOLDERS

As we have identified in the previous section, the community-driven innovation of public-permissionless blockchain systems needs to be more efficiently described and explained in the helix models. However, even though primary institutions (universities-industry-government) have not been directly involved in creating public-permissionless blockchain systems such as Bitcoin, their influence is not to be underestimated and their experience downgraded. In the following, we present some ways that primary institutions can influence and help guide the development of blockchain systems. Universities, especially, conduct research that helps improve and evolve blockchain solutions, for example, making comparative analyses of consensus mechanisms and oracles [16, 17]. This academic research is essential when developers are co-creating blockchain solutions. The industry and government also have an important role to play, as they have the capital to invest in new blockchain projects and, as a result, can influence the direction of blockchain development. Specific use cases or blockchain applications might receive more attention from industries or governments, sparking blockchain development within these areas. When there is capital and investments within certain areas, the blockchain communities are incentivized to follow up, creating more applications to fit the need. Examples are supply chains, the shipping industry, and online banking [18, 19, 20]. Industries and governments can also use standards and regulations to limit or incentives the innovation of blockchain communities, as investors are more willing to invest in projects once the legal landscape has been defined. Governments and industry also have significant roles to play in developing private-permissioned blockchain systems. These systems do not depend on decentralized communities but create their blockchain network from known and approved stakeholders. Creating open systems that cannot be controlled is usually not in the interest of governments or industry, which is why communities mostly create these open, immutable systems. We argue that primary institutions can influence the innovation and development of public-permissionless blockchain systems and could have even more impact if they wanted to: indeed, although these systems cannot be controlled normatively, they could at least be improved ethically.

#### V. FUTURE RESEARCH

In this paper, we have discussed the dynamics between existing primary institutions of the helix model and blockchain communities in the context of moral values and ethical issues. For future research, it is relevant to investigate if disruptive technologies and community innovation can create new types of primary institutions that need to be included in the helix model.

We have also presented how ethical issues of public-permissionless systems should be addressed already in the design phase, by preventing unethical behavior. The unethical behavior enabled by blockchain systems sometimes exists in a vacuum of accountability and responsibility and can be very hard to address due to the immutability of blockchain systems. It is therefore important that research is conducted on how to place accountability of ethical issues of blockchain systems (especially public-permissionless systems), and on making risk mitigation strategies that are capable of addressing decentralized, tamper-immutable systems such as blockchain systems.

## VI. CONCLUSION

Even though decentralized communities can create disruptive blockchain systems without having primary institutions play a central role, we do not argue that primary institutions should remain passive. On the contrary, we encourage primary institutions (university-industry-government) to play a more active role in setting the stage for blockchain innovation. Open, immutable blockchain systems created to benefit users can be misused and harm society once employed, as was the case with Augur. This creates unforeseen ethical issues that can be difficult to mitigate once employed due to blockchain systems' decentralized and immutable nature. More research, guidelines, standards, and regulation are needed to address ethical issues that are characterized by being immutable and with no accountability. Primary institutions like university-industry-government hereby have a vital role in guiding blockchain communities to protect the moral values of society.

The ethical guidelines by the Expert Group on Blockchain Ethics are still a work in progress. However, we argue that they are essential in guiding not just governments and industry but, firstly and most importantly, blockchain communities. Without ethical guidelines, it is up to each blockchain community member to define the moral values they engrave in the systems. We believe that industry, governments, and society, as a whole, should engage and make policies, standards, and regulation that protects citizens and ensures that open, immutable protocols are creating benefits for society. This is especially important as blockchain technology allows communities to create public goods, such as currencies, that have the potential to disrupt and change fundamental social structures.

We have seen that it is challenging to apply the helix models of innovation to community-driven innovation, such as public-permissionless blockchain systems. Firstly, these communities can innovate without relying on the primary institutions defined in the helix model. Secondly, environmental concerns such as energy consumption, have been addressed collectively by the community, without being forced by a primary institution. However, we argue that although innovation can be done bottom-up in open communities, these communities need primary institutions to define moral values and to ethically guide the development of new technologies, such as blockchain.

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