DOI: 10.21564/2414–990X.166.312167

DAO-Based Society-In-The-Loop Model: Redesigning Society-In-The-Loop Framework to Concrete Social Dialogue Key Measurement for Platform Workers

Tanel Kerikmäe*
Tallinn University of Technology,
Tallinn, Estonia
**e-mail: tanel.kerikmae@taltech.ee*
Şaban İbrahim Göksal
Tallinn University of Technology,
Tallinn, Estonia
Archil Chochia
Tallinn University of Technology,
Tallinn, Estonia

Abstract
The advancements in Information Communication Technologies (ICT) have caused widespread adoption of immersive technologies throughout society. Among these, artificial intelligence (AI) is the most popular, increasingly integrated into various business practices. The capacity of this technology to process large volumes of data has made it indispensable for businesses, driving efficiency and innovation across sectors. Despite the benefits of these technologies, AI technology often compromises employee rights due to biased automated decision-making and pervasive monitoring processes. In response, the European Commission took a decisive step to protect platform workers with its proposal for the Directive on Improving Working Conditions in Platform Work (2021/0414 COD). This directive aims to ensure fairness, transparency, and accountability within digital labour platforms by introducing four crucial measures designed to counteract biased decision-making and intrusive monitoring in its algorithmic management chapter. However, one of these measures "social dialogue" remains abstract. This paper proposes a blockchain-based AI feedback loop model: DAO-based Society-In-The-Loop (DAO-SITL) Model to concrete this key measurement by redesigning the Society-In-The-Loop (SITL) framework through Decentralized Autonomous Organizations (DAO) governance approach.

Keywords: automated decision-making; decentralized autonomous organizations; digital labour platforms; platform workers; social dialogue.

Модель суспільства в циклі на основі ДАО: переробка структури суспільства в циклі з метою конкретизації ключового вимірювання соціального діалогу для працівників платформи

Танел Керікмяе*
Талліннський технологічний університет,
Таллінн, Естонія
**e-mail: tanel.kerikmae@taltech.ee*
Шабан Ібрагім Гьоксал
Талліннський технологічний університет,
Таллінн, Естонія
Арчіл Чочія
Талліннський технологічний університет,
Таллінн, Естонія

Анотація
Розвиток інформаційно-комунікаційних технологій (ІКТ) спричинив широке впровадження імерсивних технологій у суспільстві. Серед них найпопулярнішим є штучний інтелект (ШІ), що дедалі більше інтегрується в різні бізнес-практики. Здатність цієї технології обробляти великі обсяги даних зробила її незамінною для бізнесу, сприяючи ефективності та інноваціям у різних секторах. Та попри переваги цих технологій, ШІ часто порушує права працівників через упереджене автоматизоване прийняття рішень і всеохопні процеси моніторингу. У відповідь Європейська комісія зробила рішучий крок, щоб захистити працівників платформи, подавши пропозицію щодо Директиви про покращення умов праці під час роботи на платформі (2021/0414 COD). Ця директива спрямована на забезпечення чесності, прозорості та підзвітності в рамках цифрових платформ праці шляхом запровадження чотирьох важливих заходів, спрямованих на протидію упередженому прийняттю рішень і нав'язливому моніторингу в розділі алгоритмічного керування. Проте один із цих заходів – «соціальний діалог» залишається абстрактним. У цій статті пропонується модель циклу зворотного зв'язку ШІ на основі блокчейну: модель суспільства в циклі на основі ДАО (DAO-SITL) для конкретизації цього ключового показника шляхом переробки структури суспільства в циклі (SITL) за допомогою підходу до управління через децентралізовані автономні організації (DAO).

Ключові слова: автоматизоване прийняття рішень; децентралізовані автономні організації; цифрові робочі платформи; працівники платформи; соціальний діалог.

Introduction

Improvements in information and communication technologies (ICT), especially artificial intelligence (AI), have transformed various sectors, employment models,

and operational practices [1–4]. One notable example is the digital labour platform, which employs "platform workers" that emphasizes flexibility and the integration of technology [5]. These platforms extensively utilize machine learning (ML) algorithms to analyse large volumes of data gathered from both workers and customers [6, pp. 904-905; 7, pp. 170-176]. However, these algorithms also introduce significant challenges for platform workers through biased automated decision-making and invasive monitoring practices. These practices often create power imbalances that disproportionately benefit platform owners and service requesters, granting them more control and oversight than the workers themselves [6, pp. 905-910]. Moreover, these systems can perpetuate discrimination, as inherent biases in the data or the design of the algorithms adversely affect marginalized groups [7, pp. 176-196]. In response, the European Commission's Proposal for the Directive on Improving Working Conditions in Platform Work (2021/0414 COD) marks a significant step forward in safeguarding the rights of platform workers on digital labour platforms [8-9].

The directive specifically aims to ensure fairness, transparency and accountability in these mechanisms, so its algorithmic management chapter introduces four crucial measures: transparency (Article 6), human monitoring (Article 7), human review (Article 8), and social dialogue (Article 9). This paper focuses on social dialogue (Article 9), this measure fosters a participatory approach to algorithmic management, thereby bolstering worker participation in AI governance [9, p. 17-38]. However, the ambition of social dialogue to involve broader societal groups in the AI governance process presents practical challenges defined as remaining abstract [10, p. 905; 11, p. 537-541; 12, pp. 795-796; 13, pp. 2-3]. Thus, this paper introduces the DAO-SITL model, which concretes the key measurement by redesigning the SITL framework within the approach of DAO governance. Although, the SITL framework, designed by Iyad Rahwan in 2018, proposes a solution to this challenge [14], it is still abstract for the practical application [15].

Rahwan introduces SITL framework by employing social contract theory to embed societal values into AI development and ensure ethical operations conforming to human expectations. This framework, built on consensus mechanisms and feedback loops, integrates collective AI governance akin to democratic processes, where societal groups reconcile values and distribute AI benefits and costs. By incorporating adaptive learning, the SITL facilitates continuous realignment of AI systems with evolving societal standards, balancing trade-offs like security and privacy. Despite its innovative approach to embedding collective ethics in AI, the framework still remains abstract because Rahwan originally designed this framework primarily to highlight the importance of

collective AI governance and democratized automated decision-making and monitoring processes [14]. DAO is a governance approach through rules encoded into smart contracts, which are automatically executed on blockchain. DAOs operate independently of any central authority, utilizing these smart contracts to facilitate decision-making and governance processes, thereby enabling a decentralized management structure [16]. By redesigning the SITL framework through the DAO governance approach, its practical applicability can be enhanced. This method uses the decentralized nature of DAOs for collective AI governance and democratized automated decision-making and monitoring processes, ensuring that the decision-making processes are not only inclusive of all stakeholders but also transparent and free from central manipulation.

The next section describes the background of the directive, particularly its algorithmic management chapter and social dialogue. The third section introduces the SITL framework and DAO governance approach. The fourth section presents the DAO-SITL Model and elucidates the improvements on the SITL framework. The last section concludes the findings, highlighting the contributions of this paper.

Results and Discussion

The Background of Regulating Digital Labor Platforms: Safeguarding Platform Workers' Rights in the Age of AI

The evolution of social rights for workers has undergone significant transformation, initially triggered by early 20th-century mechanization [17]. Organizations like the International Labour Organization (ILO) established in 1919, along with the creation of works councils, are significantly important in promoting humane working conditions and worker representation [18]. Notable developments include the Community Charter of Fundamental Social Rights of Workers in 1989 and the EU Charter of Fundamental Rights in 2000, which reinforced workers' rights to information, consultation, and participation [19; 20]. However, the recent technological advancements in the early 21st-century, especially the improvements in AI technology, have reshaped the landscape of sectors, employment models and practices along with presenting new challenges and rights for workers. One emerging sector is digital labour platforms that employ platform workers. They employ machine learning (ML) algorithms to thoroughly process vast amounts of data gathered from both workers and customers [21]. The objectives of these algorithms are multifaceted: they aim to optimize worker allocation, performance, and evaluation [22]; analyse market trends [23]; forecast demand [24]; enhance the efficiency of service delivery [25]; and dynamically adjust service costs in response to real-time fluctuations in

demand and supply [26]. These platforms also pose significant challenges, as they may infringe upon the fundamental rights of platform workers through biased automated decision-making and invasive monitoring mechanisms [6, pp. 904-905; 7, pp. 170-176].

These mechanisms frequently lead to power imbalances disproportionately empowering platform owners and service requesters with enhanced control and oversight compared to platform workers. This dynamic poses a critical challenge to the rights of platform workers, as algorithmic systems are capable of unilaterally modifying contractual terms, fostering disparities in information, and implementing strict monitoring and feedback procedures [27]. Moreover, these mechanisms perpetuate discrimination as biases inherent in the data or the algorithms' designs significantly disadvantage marginalized groups. These biases manifest as fewer job opportunities, longer waiting periods between assignments, and consistently lower earnings for affected workers [28]. In response to these challenges, the European Commission has proposed the Directive on Improving Working Conditions in Platform Work (2021/0414 COD), marking a significant step toward safeguarding the social rights of platform workers [9]. This directive is designed to promote fairness, transparency, and accountability in digital labour platforms. It introduces four crucial measures in the section on algorithmic management: transparency (Article 6), human oversight (Article 7), human review (Article 8), social dialogue (Article 9) for digital platforms and these are rights for platform workers. Article 6 requires that digital labour platforms clearly inform workers about how automated decision-making and monitoring systems are used and their key characteristics, impacting workers' conditions [9, pp. 16, 35-36]. Under Article 7, digital platforms must ensure that trained and competent staff oversee these automated processes to safeguard the physical and mental well-being of platform workers, promoting a fair application of AI technologies in the workplace [9, pp. 16, 36-37]. Article 8 stipulates that digital labour platforms must offer workers the chance to obtain clarifications and, if necessary, challenge automated decisions and monitoring via human intermediaries. This ensures a strong system for addressing grievances and correcting errors, thus protecting worker rights in environments shaped by AI [9, pp. 17, 37-38]. Finally, social dialogue (Article 9) mandates that digital labour platforms actively engage with platform workers or their representatives when making significant decisions regarding the implementation or major modifications of automated decision-making and monitoring systems. This measure fosters a collaborative approach to algorithmic management, significantly increasing worker participation in the automated decision-making and monitoring processes [9, pp. 17-38].

This directive is not the first legislative source at the European Union (EU) level to address social dialogue within an AI regulatory framework. At the European level, when examining the formal institutions [29, pp. 119-120] developed for trustworthy AI, the EU Ethics Guidelines for Trustworthy AI which proposes trustworthy AI concept at the EU level, emphasizes the importance of social dialogue for trustworthiness of AI [30]. This emphasizes that collaborative engagement and democratic involvement in AI governance with a wide range of stakeholders can enhance trustworthiness of AI [31]. According to Clifford et al. [32] social dialogue is an important tool for responding to the mechanistic working conditions of platform work, facilitating an exchange of views, and promoting an understanding and contestation of automated decision- making and monitoring processes. This dialogue is seen as a key step in the development of data rights that enable democratic involvement in decisions under modern industrial conditions.

State of Art in Integrating Societal Values in AI: The Society-In-The-Loop Framework and Decentralized Autonomous Organization Governance Approaches

In the evolving landscape of AI, integrating societal interaction into AI governance loop has become critical to ensure that AI development aligns with ethical standards and public expectations. This section delves into two approaches that exemplify or have potential to exemplify this integration: the SITL framework [14] and the DAO Governance Approach. Both approaches have capacity to represent innovative attempts to merge AI governance loop with sociopolitical insights, aiming to create automated decision-making and monitoring processes in AI systems that are democratic [15; 33]. This section will first explore the SITL framework by detailing its components, describing the operational flow, and evaluating its strengths and weaknesses. Subsequently, the discussion will shift to the DAO Governance Approach, examining its structural elements, operational mechanisms, and assessing its advantages and limitations.

Society-In-The-Loop

Rahwan [14] introduces a sociotechnical framework based on social contract theory [34] to incorporate societal feedback into AI development by advocating for an "algorithmic social contract", which involves terms and rules agreed upon by human stakeholders and enforced by algorithms to ensure AI systems align with societal values and expectations. SITL framework merges human-in-the-loop (HITL) a human feedback mechanism that integrates human judgment into AI processes to enhance accuracy and ethical considerations, with AI applications [35]. It positions a consensus mechanism as a key component that

involves society in making collective decisions about the value trade-offs in AI, such as balancing in societal values. It also includes negotiating the distribution of AI's benefits and costs among stakeholders. This process reflects democratic governance by allowing public opinion to guide voting and collective decision-making, thus aligning closely with the principle of human-centeredness, a core aspect of trustworthy AI.

The framework operates in a loop, starting by sending the outputs from the AI application to a consensus mechanism. Here, 'society,' depicted through various stakeholder groups, is tasked with resolving contradictions and reconciling differing values while considering the gains and losses involved. This process includes tasks like assessing and determining the ethical limits of AI-powered surveillance in public safety contexts. The outputs derived from the collective inputs, which contribute to the formation of the algorithmic social contract, are sent back to the original AI system. This establishes a feedback loop that is essential for retraining and realigning the AI with current societal values. This adaptive learning process involves the AI system making iterative adjustments based on new information and shifting societal norms, thereby ensuring that its decisions are ethically robust and reflective of a broad, shared consensus.

The SITL framework is valuable because it democratizes AI decision making process, ensuring that automated processes evolve also through a broad, inclusive dialogue involving multiple societal stakeholders. By integrating the consensus mechanism directly into AI systems, it facilitates collective decision-making that represents diverse perspectives and needs. This helps balance the distribution of AI's benefits and burdens across society but also promotes transparency and accountability. It adheres to the trustworthy AI characteristic of human-centeredness by placing societal values and ethical considerations at the forefront of technological advancement [15].

The weakness of the SITL framework is that it remains primarily sociotechnical in nature, without offering a direct pathway as a system design to deployment or integration within existing AI systems. It focuses on the social and ethical aspects of AI, emphasizing stakeholder agreement and societal norms without detailing the technical mechanisms required for actual implementation in AI programming or system design. This can limit its direct applicability in technical environments where concrete algorithms and coding practices need to be developed and adjusted based on the framework's principles. Therefore, while SITL is innovative in proposing how society can engage with AI development, it stops short of providing the technical specifications needed to operationalize these ideas within the technology itself.

The purpose of this paper is to redesign the SITL framework through a DAO governance approach, aiming to transform its sociotechnical concepts into concrete technical implementations within AI systems. By using blockchain technology as an infrastructure [36], the redesigned framework uses smart contracts, decentralized consensus mechanisms, and token-based incentives to enforce the algorithmic social contracts. This approach ensures that these contracts are transparent and tamper-proof [37]. The integration of DAO components such as automated governance protocols and token economies can facilitate more efficient and scalable decision-making processes, effectively embedding collective societal values directly into the operational core of AI systems. By trusting blockchain technology's practical applicability [38], this revitalized framework is designed to easily operationalize the SITL principles by providing the necessary technical architecture, thus bridging the gap between sociotechnical aspirations and practical, actionable AI feedback mechanism.

Decentralized Autonomous Organization Governance Approach

The DAO Governance approach is a decentralized governance method using smart contracts on the public blockchain to facilitate automated governance while requiring human interaction for decision-making processes. This method supports functionalities like democratic management and protective mechanisms against majority dominance, specifically allowing minority stakeholders to split and form new DAOs to safeguard their interests [16]. The components of this governance approach are blockchain system, smart contract and decentralized decision-making mechanism. Blockchain system refers to a distributed system that records a ledger of transactions or a history of changes to the system state. The ledger is usually hard to tamper with, which enhances security but also makes it difficult to perform desirable changes, such as pruning the history or compacting the ledger [39]. Smart contract is a computer program that executes predefined conditions automatically on a blockchain platform, facilitating trusted transactions and agreements across various parties without the need for central authority [40]. And decentralized decision-making mechanism refers to the automated governance process in DAOs, where decision-making is distributed among participants via coded rules on the blockchain, allowing for autonomous execution without central oversight [41].

The operational workflow of a DAO begins with the proposal mechanism, where members may submit proposals for various tasks or initiatives. These proposals generally detail the activities to be undertaken in exchange for organizational resources. Once a proposal is submitted, it undergoes a democratic voting process where all members, whose voting power often correlates with their holdings

of governance tokens, can cast their votes. The integration of smart contracts ensures that these proposals and votes are executed autonomously, maintaining transparency and adherence to predefined rules without the need for central oversight. Upon approval, the smart contracts facilitate the automatic allocation of resources and the implementation of decisions, effectively managing the DAO's operations. This autonomous and decentralized decision-making process not only fosters a democratic management environment but also minimizes the risks associated with central control, allowing for a more secure and resilient organizational structure [42].

The DAO governance approach is valuable because of its practical applicability; this approach is applicable in various domains where decentralized management and resource allocation are crucial. For example, DAOs can be effectively applied in crypto fund governance [43], project funding [44], community governance [45], and even in corporate decision-making environments [46]. This flexibility allows for adaptation in non-profit organizations [47], grassroots initiatives [48], and innovation incubators where stakeholders can participate actively and transparently in the decision-making processes. Furthermore, the inherent transparency and security of blockchain technology make DAOs particularly appealing in sectors that require strict governance standards and accountability, such as in public administration [49] and sustainable development projects [50]. By using the advantages of smart contracts and decentralized mechanisms, DAOs promise to revolutionize traditional governance models and offer a scalable, efficient, and more democratic alternative for various organizational forms. This practical applicability aspect of the DAO governance approach is also valuable to concrete the SITL framework by redesigning through this approach.

The DAO governance approach has found applications significantly in various domains, yet its potential in facilitating collective and democratized automated decision-making and monitoring processes remains underestimated. This represents a gap in the current deployment of DAOs, where the emphasis has primarily been on governance in financial and organizational contexts. This paper proposes a novel application of DAO governance approach by redesigning the SITL framework to integrate these decentralized mechanisms into AI governance. By doing so, it aims to bridge the research gap, promoting DAO's capabilities to foster a more democratized AI development through wide societal interaction. This approach extends the reach of DAO governance and also concretes the SITL framework to practically embed societal values into AI systems.

The DAO-based Society-In-The-Loop (DAO-SITL) Model

The DAO-SITL Model is an AI feedback loop model that concretes the socio-technical SITL framework by integrating the DAO governance approach. This

model uses the decentralized, autonomous nature of DAOs to incorporate societal feedback practically into AI governance processes, ensuring a democratic automated decision-making and monitoring processes. By utilizing smart contracts under blockchain ecosystem, the DAO-SITL Model facilitates secure, autonomous and immutable consensus mechanisms, allowing for real-time adaptation of AI systems to reflect societal values and norms. Thanks to the features of blockchain technology, this approach not only democratizes AI governance but also enhances trustworthiness of AI, making the systems aligned with the several key requirements of trustworthy AI [15].

The Components of the DAO-SITL Model

The DAO-SITL Model consists of two mechanisms as illustrated in *Figure 1*. The first mechanism is the HITL Mechanism, which integrates the AI System and the Human Controller as components. The second is the DAO-based Consensus Mechanism, it includes the Smart Contracts (SCs), the Proposal, the Stakeholders and the Governance Tokens as components.

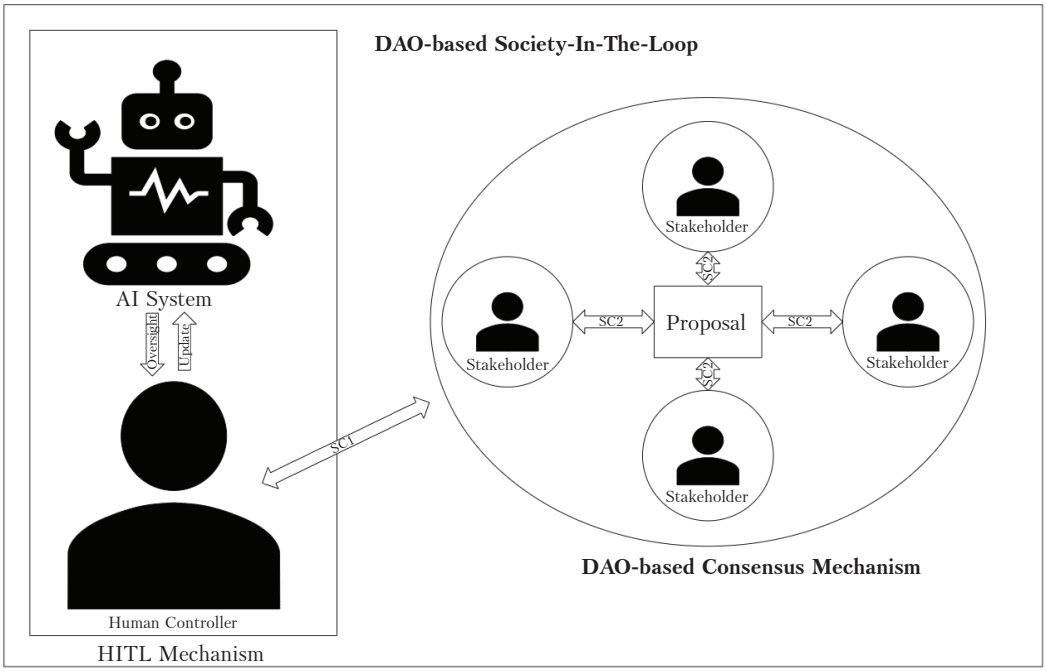

Figure 1. DAO-based Society-In-The-Loop Model

In the context of the DAO-SITL Model, the AI System is a network of algorithms and computational processes that autonomously execute automated decision-making and monitoring practices such as optimizing the allocation, performance,

and evaluation of workers; analysing market trends; predicting demand; enhancing service delivery efficiency; and adjusting the cost of services based on real-time demand and supply conditions [51]. The Human Controller is a role that refers to the direct involvement and integration of human judgment and decision-making in the operational loop of an AI system. It provides real-time inputs, corrections, and feedback to the system, which helps in refining the model's performance, enhancing its decision-making capabilities, and ensuring that the outputs are aligned with human values and expectations [52]. SC is a computer program that allows to automate the actions on the blockchain platform [40] and in the context of DAO, SC runs on peer-to-peer networks, integrating governance and decision-making rules [53]. Specifically, the SC1 is programmed to channel the proposal from Human Controllers to the DAO-based Consensus Mechanisms, thereby initiating a structured process to gather societal feedback from stakeholders. Feedback is collected via the SC2, which is tasked with managing the voting process. The Proposal is typically defined as a formal suggestion or plan, submitted by any member or designated party within the DAO, aimed at initiating a specific action or series of actions [47]. And in the context of the DAO-SITL model, it is the AI System's outcome in the form of formally submitted suggestion by the Human Reviewer to collect the Stakeholders' feedback. The stakeholders are the end users, in this paper, for social dialogue, they are platform workers or their representatives. Finally, the Governance Tokens are digital assets that confer voting rights and governance privileges within a DAO, enabling holders to influence decisions and policy implementations [54].

The Workflow of the DAO-SITL Model

The workflow of the DAO-SITL Model began when the AI System generates an output, as shown in *Figure 2*. Following this output generation, the Human Controller receives the output and starts the reviewing process. During this review, the Human Controller assesses the output and determines its alignment with expected standards and societal values. This assessment is important as it initiates the subsequent stages of the DAO-based Consensus Mechanism because the Human Controller will generate the proposal according to this output. This proposal is comprised entirely of the AI System's output and the potential feedback options which will be chosen by the stakeholders through a structured voting mechanism. This feedback process is crucial as the Stakeholders will express their insights. The Proposal is then formally submitted to the DAO-based Consensus Mechanism via the SC1 where it is opened for discussion and voting by the Stakeholders. Through the decentralized and transparent nature of the DAO, each Stakeholder has the ability to review the proposal, contribute their insights, and cast their vote via the SC2. This ensures that the decision-making

process reflects a collective consensus. The SC2 will facilitate this process by managing the voting logistics, ensuring that all votes are recorded and tallied accurately and securely on the blockchain. This is the difference between the SC1 and the SC2.

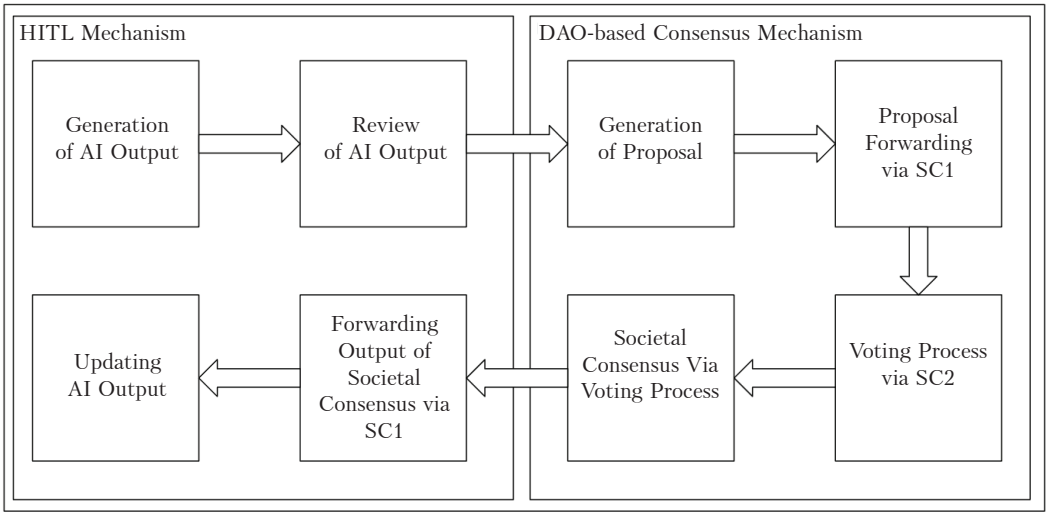

Figure 2. The Workflow of the DAO-SITL Model

The Human Controller and the Stakeholders will have access to these two different SCs via the different Governance Tokens according to their different roles. The Human Controller possesses Governance Tokens that only allow them to submit proposals within the DAO-based Consensus Mechanism, while the Stakeholders' Governance Tokens are specifically designated for voting purposes.

The Conformity of the DAO-SITL Model to Ensure Social Dialogue

The DAO-SITL Model operationalizes social dialogue by providing a platform that enables collective engagement of platform workers and their representatives in automated decision-making and monitoring processes. This is achieved through the integration of the DAO governance model into the SITL framework, ensuring that all stakeholders have a voice in shaping the outputs of AI systems. The novelty of the model is the DAO-based Consensus Mechanism, which allows all relevant stakeholders to participate in AI governance processes practically. By using the decentralized nature of blockchain technology, the mechanism ensures that the consensus reached is secure and representative of a collective societal will. This mechanism promotes an equitable distribution of power among stakeholders, particularly enhancing the agency of platform workers and their representatives who are often marginalized in traditional models of algorithmic governance.

In the mechanism, the Stakeholders receive the AI System's output and potential feedback as a multiple choice in the Proposal and they vote. The voting process is critical as it allows platform workers or their representatives to actively participate in shaping the decision-making of AI systems, ensuring that their voices are heard and considered in automated processes. The results of the voting then inform the AI System to adjust or maintain its operations according to the collective feedback. This continual feedback loop not only aligns AI practices with the actual needs and values of society but also strengthens the trust and reliability of AI systems in digital labour platforms.

Conclusion

The increasing integration of AI in various sectors has altered the operational practices of business. Digital labour platforms employ machine learning algorithms to process and analyse large data volumes, but this operational practice causes challenges such as biased automated decision-making and invasive automated monitoring mechanisms, often to the detriment of platform workers. The European Commission's proposed directive on improving platform work conditions aims to address these challenges by ensuring fairness, transparency and accountability during automated decision-making and monitoring practices so it introduces four crucial measures in its algorithmic management chapter. However, one of these measures *"social dialogue"* remains abstract, this paper highlighted the challenges of implementing it and proposes the DAO-SITL by redesigning the SITL framework through the DAO governance approach.

The DAO-SITL Model transforms the abstract concept of social dialogue into a concrete operational practice. By using DAO governance approach within the SITL framework, it ensures that AI governance is democratic and collective with stakeholders' participation, thereby addressing the challenges posed by traditional AI systems. This model utilizes blockchain technology to provide a secure and immutable voting system, enabling real-time stakeholder feedback that is accurately integrated into automated decision-making and monitoring processes. The incorporation of Human Controllers and structured voting processes ensures that AI decisions are continuously aligned with the expectations and needs of society, particularly benefiting platform workers by giving them a significant voice in AI decision-making.

While the DAO-SITL model offers a platform for democratizing AI governance with platform workers' participation through blockchain technology, future research opportunities abound in how blockchain technology and its applications can be more effectively utilized to democratize AI governance processes and increase trustworthiness of AI. Blockchain's potential to securely and

transparently manage stakeholder interactions in AI governance processes offers a promising avenue for ensuring that AI governance is inclusive of diverse stakeholder voices. While the DAO governance approach is used in this paper, it is not the only blockchain application. Designing and developing Decentralized Applications (DApps) that are user-centric is important, as it provides stakeholders with a clear and understandable interface for interacting with AI. Moreover, the capacity of SCs to automate processes [55, pp. 232-237] and the ability to tailor to specific operational needs highlight the significant roles they play. Along with these applications, he features, alongside the inherent transparency and robustness of blockchain technology are essential for enhancing the trustworthiness of AI as well.

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Tanel Kerikmäe
Ph.D., Professor
Department of Law, Tallinn University of Technology
19086, 5 Ehitajate tee, Tallinn Estonia
e-mail: tanel.kerikmae@taltech.ee
ORCID 0000-0002-5972-827X

Şaban İbrahim Göksal
MA in Law, Early Stage Researcher
Department of Law, Tallinn University of Technology
19086, 5 Ehitajate tee, Tallinn Estonia
e-mail: sagoks @taltech.ee
ORCID 0009-0002-6253-9389

Archil Chochia
Ph.D., Senior Researcher
Department of Law, Tallinn University of Technology
19086, 5 Ehitajate tee, Tallinn Estonia
e-mail: archil.chochia@taltech.ee
ORCID 0000-0003-4821-297X

Танел Керікмяе
доктор філософії в галузі права, професор
юридичний факультет, Талліннський технологічний університет
19086, вул. Будівельників, 5, Таллінн, Естонія
e-mail: tanel.kerikmae@taltech.ee
ORCID 0000-0002-5972-827X

Шабан Ібрагім Гьоксал
магістр права, дослідник
юридичний факультет, Талліннський технологічний університет
19086, вул. Будівельників, 5, Таллінн, Естонія
e-mail: sagoks @taltech.ee
ORCID 0009-0002-6253-9389

Арчіл Чочія
доктор філософії, старший дослідник
юридичний факультет, Талліннський технологічний університет
19086, вул. Будівельників, 5, Таллінн, Естонія
e-mail: archil.chochia@taltech.ee
ORCID 0000-0003-4821-297X

Suggested Citation: Kerikmäe, T., Göksal, Ş.İ., & Chochia, A. (2024). DAO-Based Society-In-The-Loop Model: Redesigning Society-In-The-Loop Framework to Concrete Social Dialogue Key Measurement for Platform Workers. *Problems of Legality*, 166, 237-255. https://doi.org/10.21564/2414-990X.166.312167.

Статтю подано / Submitted: 23.07.2024
Доопрацьовано / Revised: 29.08.2024
Схвалено до друку / Accepted: 31.10.2024
Опубліковано / Published: 01.11.2024