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Ethical issues around crowdwork: How can blockchain technology help?

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Abstract

Crowdwork involves paid work organised through online platforms. As a relatively new form of employment, a range of issues have emerged around work practices and contractual arrangements between the three parties: task requesters, crowdworkers, and platform owners. In this paper we examine some of the issues associated with workers' experience of crowdwork that have been raised in recent years. We then outline how the affordances offered by another emerging technology, blockchain, could be used to address some of those issues. Based on a conceptual, scenario-based exercise, we argue that there is considerable potential for blockchain technology to manage the transaction-based aspects of crowdwork processes and contractual arrangements to make them fairer and more transparent, but without necessarily incurring excessive overhead costs. However, despite the claimed "democratizing" effect of blockchain, some structural issues associated with managing work are not likely to be improved by blockchain-based solutions.

Keywords: Crowdwork, ethics, contracts, blockchain

1 Introduction

Crowdwork appears to offer opportunities for accessing skills required by organisations flexibly and cost effectively. The benefits of crowdwork for businesses have been pointed out in a number of recent studies (Prpić et al. 2015; Thuan et al. 2016). These have found that crowdwork can increase flexibility and lower costs. However, there is also a 'dark side' to crowdwork. Major crowdwork sites, such as Amazon's Mechanical Turk (AMT) platform[1], have been the subject of extensive criticism with regard to the labour practices they enable (Ettlinger 2016; Silberman and Irani 2016). 'Turkers', as the community of regular workers who derive some or all of their income from performing tasks on AMT, have complained of low wages, poor responsiveness to questions or disputes, unclear task descriptions, and requesters (those who set the tasks) rejecting work without due cause or adequate explanation (Silberman and Irani 2016).

Protection against unethical practices is one of the reasons we have laws governing work. In response to concerns about worker security and working conditions, many national and international bodies developed labour laws including (for example) protections against child labour[2], or more contested laws such as those governing the minimum wage. Recently, technology innovations are creating, inter alia, opportunities for new labour practices. There is a risk that crowdwork can become the modern digital equivalent of a sweatshop, trading mainly in insecure, low-paid, digital piece work[3]. To counter this, in some countries, crowdworkers are starting to establish unions, and establish rating systems for crowdwork platforms and issuers (Silberman and Irani 2016). The authors acknowledge that fair-practice in the workcontext[4] needs to be a negotiation between all parties, including employers, employees, and other stakeholders including outsourcers and contractors. However, for this initial study, we concentrate on issues associated with crowd**workers**.

Interestingly, another emerging technology – blockchain – offers the opportunities to restructure aspects of crowdwork to make the processes more ethical and transparent. In this conceptual and scenario-based paper, we examine working conditions associated with crowdwork and the potential for blockchain-based technologies to manage these issues.

The design of technologies has been argued to contain embedded values (Sclove 1995). Since workers in some contexts can now be largely "managed" by software, we believe the academic community has an important role to play in initiating dialogue about the risks and mitigation strategies of these new management models. We believe we should aim to lead thinking about the values embedded in technologies for managing the changing workcontext, rather than simply studying the problems that arise post-hoc. In this context, scenario-based research has been found to be valuable for producing interesting, challenging and forward-looking insights (Ramireza et al. 2015).

2 Background Literature

2.1 Crowdwork

Crowdwork is a subset of a wider phenomenon known as crowdsourcing, a term coined in 2006 to describe the phenomenon whereby "a function once performed by employees [is outsourced] to an undefined (and generally large) network of people in the form of an open call'' (Howe 2006, p.1). Since then, understanding of the types, nature and roles of crowdsourcing have advanced rapidly. Crowds may be used for voting, to source ideas and innovations, and to perform tasks. These include both tasks that were at one time carried out by employees, and tasks that probably would never have been carried out at all in the absence of a crowd platform. The tasks may be paid or unpaid, and highly skilled, or minimally skilled. The focus of this paper is paid crowdwork, which can be carried out at a number of different levels. Larger, more complex, pieces of work that require specific skills, for example, developing a research paper, a piece of business writing, or a video, are often described as 'macro-tasks'. However, a large proportion of paid crowdwork falls into the category of micro-tasking. Micro-tasking is a specific sort of crowdwork that involves dividing a larger piece of work into many very small, repeatable pieces. Typically (but not always) these do not require any specific skills to complete, and individual tasks can be completed very quickly (within minutes). Micro-tasking is organised with a 'crowd' of workers, requesters, and a platform provider who connects the crowd of workers with those seeking crowdwork.

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[1] https://www.mturk.com
[2] For example, The International Labour Organization Convention concerning Minimum Age for Admission to Employment
[3] In piece work, the worker gets paid based on the number of "pieces" or work they complete. Each piece is worth a certain amount.
[4] We use the term "workcontext" to capture the intersection of place, task, and employment terms and conditions in which work is carried out, as crowdwork is generally not associated with a single 'workplace'.

The 'crowd' are generally considered to be independent contractors by the platform owner, not employees (Felstiner 2011). There are a number of platforms available for organising micro-tasking, including CrowdFlower and Microtask. The earliest and still largest crowd-sourcing platform, and therefore one of the most-studied, is AMT. Macro-tasking works similarly, but is based around larger pieces of work that typically require some level of skill. Popular macro tasks are coding, software testing, usability testing, translations and graphic design. Many are targeted towards specific market niches or with specific value propositions, for example Mylittlejob[5], which is based in Germany and concentrates on students looking for short term work.

2.2 The relationship between the parties involved in crowdwork

There are generally at least three parties involved in crowdwork, the platform, the requester, and the worker. There is some variation as to the extent to which the terms of service are set: 1) at the platform level, where all requesters and workers using that platform must use the same terms of service; and 2) at the individual requester level, who determines task requirements and constraints, as well as the rate of pay. Felstiner (2011) notes that AMT is more than just a "glorified job listing service", nor is it a "passive middleman in a supply chain", nor does it fall under the concepts of sub-contracting, outsourcing of services, or temporary staffing. It has a direct contractual role with the other two parties (its "Terms of Service"). Thus AMT designates crowdworkers as independent contractors, and "sets all the ground rules regarding qualifications for work, supervision, payment, dispute resolution, and access to the platform." (p.151). The requesters and workers have no facility available to negotiate their own contract, yet if there are disputes, AMT tend not to get involved. Felstiner goes on to say:

"*In high-volume crowdsourcing, the prospect of a sequence of hundreds or thousands of independent contracts, lasting a few minutes apiece and producing pennies in compensation, seems slightly ridiculous. But as with any independent contractor designation, the impact is serious. The posture of the law towards nearly every aspect of the employment relationship depends on that threshold classification. Independent contractors are not covered under the Fair Labor Standards Act (FLSA), the National Labor Relations Act (NLRA), Title VII of the Civil Rights Act and related anti-discrimination legislation, the Family Medical Leave Act (FMLA), the Occupational Safety and Health Act (OSHA), or other similar federal statutes*." (p.170).

The implications are considerable, as in the event that crowdwork becomes a more dominant model for obtaining work, **and if** the independent contractor designation remains unchallenged, this would effectively remove these protections from a large segment of the workforce. This risk is part of the motivation for our study. To avoid unnecessarily complicating the discussion, we acknowledge that workcontext issues can arise with either the platform or the requester (or both), depending on the exact configuration of each platform.

2.3 Blockchain

Blockchain technology can be conceptualised as a fully distributed database of transactions, which consists of 'chains' of timestamped and cryptographically verified 'blocks' of data. The notion of a chain of blocks gained traction in the Internet community when Nakamoto (2008) introduced it as a critical component of the cyber currency Bitcoin, a peer-to-peer electronic cash system. Subsequently, the underlying technology which supported Bitcoin became known as 'Blockchain' and was recognised as an enabler of new applications beyond Bitcoin, sometimes referred to as 'the trust protocol' and 'the internet of value' (e.g., Tapscott and Tapscott 2016). Applications of blockchain have expanded far beyond cryptocurrencies. Swan (2015) describes the development of Blockchain according to its application domains: currencies and payment systems (Blockchain 1.0), contracts in relation to economic, market, and financial applications (Blockchain 2.0) and applications beyond currency, finance, and markets, particularly in the areas of government, health, science, literacy, culture, and art (Blockchain 3.0). Blockchain is often described broadly as a distributed ledger to record and verify transactions between parties related to asset ownership and transfer or, more broadly, any kind of value (e.g., Beck and Müller-Bloch 2017; Brakeville and Perepa 2016; Iansiti and Lakhani 2017). Iansiti and Lakhani (2017) define five basic characteristics of Blockchain technology: (1) distributed database, 2) peer-to-peer communication, 3) transparency with pseudonymity, (4) irreversibility of records, and (5) computational logic that can be tied to transactions. To these we add: 6) trust mechanism, and 7) networked integrity.

<u>Distributed database (with peer-to peer communication):</u> Blockchain transactions are fully distributed – every node associated with the blockchain has a historical record of every transaction since the

[5] https://www.mylittlejob.com/

beginning of the chain. No single party can shut the system down (Tapscott and Tapscott 2016). Communication occurs peer-to-peer, not through a central node or authority (Iansiti and Lakhani 2017). We define the distributed database concept as: power to post transactions, and create blocks across a peer-to-peer network with no single point of control. Note that this does not necessarily mean that every node contains a full copy of everything associated with the transaction. For example, a blockchain might create a record that a movie had been streamed so that royalties can be paid, this does not necessarily mean that an entire copy of the movie itself would be associated with every transaction and distributed to every node on the blockchain each time a related transaction is posted.

Transparency with pseudonymity: Each node on a blockchain is identified by an alphanumeric address. Every transaction on the blockchain is associated with an address and is visible to every other node. This means that transactions are fully transparent but the user's identity can be hidden, unless the user chooses to disclose it (Iansiti and Lakhani 2017).

Irreversibility of records: The essence of the blockchain is the cryptographic hash that validates transactions and allows transactions to be verified and blocks of transactions to be closed off and added to the chain. The hash of each transaction is added to the block hash, and the hash of the block is added to the next block. This provides an irreversible 'chain'. In Bitcoin, the hash value calculated must also be smaller than current cut-off point determined by the network, known as 'the difficulty', in order for a new block to be accepted. This means that millions of candidate hash values will be calculated, but very few of them will meet 'the difficulty'. Therefore enormous computing power is required to continuously generate candidate hash values. Payment in Bitcoins recognises the computing effort that has gone into producing a block, and is known as payment based on 'proof of work'[6]. In a public ledger (we return to the differences between public and private ledgers shortly) – anyone with computing power available can register, post transactions and if they choose to, join in attempting to solve blocks (bitcoin 'mining'). We define irreversibility of transactions as: Transactions, once entered, cannot be altered or updated as they are cryptographically linked to all other transactions.

Smart contracts (computational logic that can be tied to transactions): Since the blockchain is entirely digital it has the properties of other digital objects, including programmability (Yoo et al. 2010). This means that transactions on the blockchain can be triggered by rules, algorithms and computational logic. Smart contracts can be seen as cryptographic 'boxes' that contain value and only unlock it if certain conditions are met" (Buterin 2014).

Trust mechanism: Based on the 'irreversibility of transaction records' functionality described above, blockchains also provide a cryptographically assured and distributed trust mechanism for all transactions. Swan (2015) sees the blockchain as the main technological innovation of Bitcoin because it creates a so-called 'trustless[7]' proof mechanism of all the transactions on the network. We define the trust mechanism as: Trust in transactions that is intrinsic to the transactions and the network itself, not extrinsic.

Networked integrity: "Safety measures are embedded in the network with no single point of failure, and they provide not only confidentiality, but also authenticity and nonrepudiation to all activity." (Tapscott and Tapscott 2016, p.39). We define networked integrity as: confidentiality, authenticity and non-repudiation provided at the network level.

As an emerging technology, blockchain is still evolving. Some of the newer developments are related to private and hybrid blockchains, and intersecting chains.

Public, private and hybrid blockchains: Blockchain technology is also being utilised in private ledgers. Private ledgers use some central control to manage who has permission to create transactions on the ledger. In a fully private ledger, write-permissions are monitored by a central locus of decision-making. Read-permissions are either public or restricted (Buterin 2014). A private blockchain can be considered as a permissioned ledger, where the identity of the nodes (members) on the blockchain are known (to the permissioning authority, at least, though not necessarily to each other). Hybrid models are also possible, also described as 'consortium blockchains' (Buterin 2014), and they are composed of a mixture of low-trust (i.e. public blockchains) and the single, permissioned entity model (i.e. private blockchains. Transactions in private and hybrid blockchains can be validated using a number of alternative mechanisms, 'proof of stake' (PoS) and 'proof of authority' (PoA). Validators are a group of accounts/nodes that are allowed to participate in the consensus; they validate the transactions and

[6] There are also mechanisms for paying contributors who do not solve a block, see for example (ref)
[7] This term can result in confusion. In the blockchain context, it means that trust is embedded in the blockchain itself, and no recourse is required to additional trust mechanisms external to the system, hence the term "trustless"

blocks. For PoW the validators are miners who get rewarded for their effort, for PoS the validators are those that with an (economic) stake who can get penalised, for PoA the validators are those that are explicitly authorised.

Note these principles remain true for private and hybrid blockchains once a *node or entity is added to the network*. Private and hybrid chains have gatekeepers which typically control 'right to post' into the network, so control over *entry* to the network may be vested in a specific party. The network's governance structure may also control the nature and rules governing transactions. Therefore it is not inherent in private or hybrid blockchains that the rights of all parties will be equally represented. For example an educational institution might include, as one of its terms that the entire academic transcript of student would be available to legitimate requesters, including any failed papers. What *is* inherent is that the network will consistently follow whatever rules are agreed upon for its configuration.

Cross-chain protocols for transactions involving intersecting chains: Selecting a public or private chain, and associated validation mechanisms, may limit the business applications of blockchain. For example, most people would agree that only credentialed medical practitioners should be able to add to their medical records, or that educational qualifications should only be added by recognised institutions. These suggest an important role for hybrid chains where write access (the ability to create records) is controlled. However, a person applying for a higher level crowdwork assignment might need their credentials for that assignment checked by the crowdwork platform (read access). An ideal solution would permit multiple parallel blockchains to interoperate and exchange transactions with each other while retaining their own security and integrity. However, this is very difficult to manage in a proof-of-work context. How can the 'cross-chain' transactions be recognised and rewarded? Protocols and software are beginning to emerge for managing interblock transactions and exchanges. One such example is the Cosmos Hub, which is an inter-blockchain communication (IBC) protocol. Exchanges are carried out between blockchains (called 'zones') using tokens. Inter-zone token transfers go through the Cosmos Hub, which keeps track of the total amount of tokens held by each zone. The hub serves the function of isolating each zone from the others, and preserving the integrity of each. New zones (blockchains) can be connected to the hub, making it extensible to add future new blockchain-based applications.

3 Crowdworker Workcontext Management

Workcontext laws, guidelines and codes of conduct originate broadly within the domain of business ethics, based on values of fairness, exchange and acceptable conduct. They are enforced via labour laws. Labour laws may form an important part of political campaigns, and may be considered to broadly reflect the social contract regarding the terms and conditions governing work that are considered acceptable to the citizens of a country at a point in time. We note that workcontext laws vary considerably between nations. It is widely recognised that new forms of employment are testing the boundaries of current workcontext laws in many countries. Stone (2006) offers an extensive analysis of some of the issues as they are currently being experienced in the USA, including retirement security, health and safety protections, and employment discrimination. Labour laws have not entirely caught up with crowdworking. Workcontext issues have been identified in academic literature, on crowdworker forums, and in crowdworker advocacy sites.

3.1 The Basic Processes of Crowdwork: Amazon Mechanical Turk (AMT)

The most-studied crowdwork platform is AMT, so we use AMT's processes as a proxy for the basic processes involved in managing crowdwork. It has been estimated that there are more than half a million workers registered with AMT, although not all of them are active[8]. The basic process used to request and sign-up for work is as follows. Requesters break their requirements down into micro-tasks, called on AMT 'HITs' or 'human intelligence tasks'. The individual micro-tasks are divided into groups (assignments) made up of a set of equivalent tasks (for example, photo-tagging). The groups are posted on the AMT platform, with a title, description of the requester, and the reward. The requester transfers sufficient money, in advance, to AMT to cover both worker payments and AMT's commission (a minimum of 20% of the money paid to workers, at the time of writing). One form of quality assurance for requesters is to include each micro-task in several different groups, so they get multiple results for the same task. Sometimes requesters will also specify specific skills which workers must have. Workers search assignments, and decide which ones to accept. They then carry out the work. The requester collates all the completed assignments and evaluates them. Based on the evaluation, requesters approve

[8] http://www.pewinternet.org/2016/07/11/the-size-of-the-mechanical-turk-marketplace/

or reject each assignment completed by a worker. Importantly, this decision is at the discretion of the requester, and only accepted assignments are paid for. Assignments must be accepted or rejected within the timeframe specified in the listing. If they are not explicitly rejected they are eventually considered to be accepted. For accepted assignments, the worker automatically receives the agreed payment via the AMT platform, and AMT receives their commission. Over time, a worker's reputation, based on the number of accepted and rejected pieces of work they have submitted, is maintained by AMT and made available to requesters seeking high-quality workers. AMT, notably, take little interest in disputes over assignments, and the discretion available to the requester leaves many to believe that the power balance is deliberately tilted in the requester's favour, and AMT are complicit in this (Silberman and Irani 2016).

3.2 Crowdworker Advocacy

Unsurprisingly, support and advocacy communities for crowdworkers are beginning to emerge. 'Turkers' have supported each other in various forums almost since the inception of AMT[9]. For example, requester reputations, based on characteristics like whether or not they offer good pay rates, accept reasonable quality work, and provide clear instructions for tasks, are not maintained by AMT. In response, researchers Lilly Irani and M. Six Silberman developed software (Turkopticon) to enable workers to maintain their own requester reputation system (Irani and Silberman 2013). Turkopticon[10] has been operating as a portal of resources for Turkers.

Originating in Europe, a consortium of organisations prepared a white paper (the Frankfurt Paper on Platform-Based Work [11]) outlining principles for fair, equitable and transparent crowdwork. In the absence of a large body of academic research, we have used crowdworkers' advocacy site Faircrowd.work, in combination with research on AMT, to profile crowdworkers' employment concerns on the basis that a worker's advocacy site would provide a reasonable proxy for the viewpoint of crowdworkers. The focus on the European market, with its tradition of unionisation and more collaborative relationships between workers and employers[12], also gave us confidence that this site is likely to surface a representative range of issues. Faircrowd.work[13] offers advice and information ("did you know there are unions for crowdworkers?"); and reviews and ratings in a variety of categories for a range of crowdwork platforms operating mainly in the European market.

3.3 Summary of Task and Worker-Related Issues

3.3.1 Task related

Unsurprisingly, given the central nature of the task for micro and macro task workers, there are issues associated with task management, including clarity, acceptance of completed work, and variations to the task. These issues are inter-related.

Contractual clarity and variations: Unclear contracts can occur when, for example, the requester is relatively inexperienced, and provides a task description that is vague or ambiguous (Felstiner 2011; Silberman and Irani 2016). This makes it difficult for the crowdworker to understand exactly what is required, and increases the likelihood that the worker will need to communicate with the requester, or that the work will eventually be rejected if the task cannot be clarified. There is also a possibility that a variation to the task request will be required, especially for macro-tasks. Faircrowd.work include "changes to the terms of service" as one of the dimensions they evaluate for each platform. We define this issue as: the clarity of the contract and the terms and conditions under which the task can be modified.

Warranty and rejected work: This is the source of a great deal of friction for AMT workers. Currently, the requester is able to reject submitted work (including declining payment) at their discretion. Reasons why work submitted by a Worker is rejected by the Requester, as described by Silberman and Irani (2016) and Felstiner (2011), fall into a number of categories. 1) The worker did not provide quality work, either because they tried in good faith, but did not succeed, or because they did not genuinely attempt to meet the task requirements or quality standards. This could be because they hoped that a sub-standard task might still be accepted and paid for. 2) Lack of conceptual clarity around the task requirements (as above). 3) Sometimes, the worker may decide there is too much to do to complete the

[9] See for example http://turkernation.com/; http://www.mturkforum.com/;
[10] https://turkopticon.ucsd.edu/
[11] https://www.igmetall.de/docs_20161214_Frankfurt_Paper_on_Platform_Based_Work_EN_b939ef89f7e5f3a639cd6a1a930feffd8f55cecb.pdf
[12] https://www.worker-participation.eu/National-Industrial-Relations/Compare-Countries
[13] http://faircrowd.work/

task based on the time or payment offered. In all of these situations, the worker may submit work that is incomplete, poorly done, or rushed, or may simply abandon the task. All of these count (in terms of the workers reputation) as rejected work. Sometimes even quality work is rejected. This can occur when automated software evaluates the completed work and makes a mistake, or when the requester rejects work to avoid having to pay for it, despite knowing that it is acceptable. If work is rejected, AMT does not get paid their commission. Apart from that, there are relatively few consequences or impacts for AMT, who have a track record of having a very 'hands off' approach to disputes. There is a field where requesters are obliged to enter a reason for rejection, but the requirement is not policed and can be met by just entering a single character. By contrast, the European, largely macrotasking platforms evaluated by Faircrowd.work, are rated on their approach to 'warranty', which is the commitment to returning work for correction before work is rejected or payment withheld. While not all platforms are well rated in this respect, there is a general acceptance that spurious rejection of work is an unacceptable practice. We define this issue as: Fair management of quality, so that workers have a chance to correct work that is initially not accepted, and requesters cannot spuriously reject work without reason or to avoid payment.

Payment: This is closely related to the issue of warranty and rejected work, as rejected work is not paid for. Slow payment is generally not an issue on AMT as the reward is automatically paid after a certain period of time, however, the requester may be slow to accept/reject, thereby delaying payment even though they can use the work immediately. Faircrowd.work provide worker ratings for each platform on pay, broken down into rates, pay ranges, and non-payment experiences. The 'terms of service' checklist for each platform that is evaluated, covers the ability to refuse payment. We define this issue as: Fair pay rates and prompt payment.

Communication: As part of their policy enforcement and guidelines for good practice, AMT encourages Workers and Requesters to communicate with each other and with AMT, where problems occur. In practice, however, this has proved consistently problematic. Requesters are not required to respond, and often don't. Similarly, any complaints from Workers relating to perceived unfair rejections of work or lack of explanations from Requesters for rejections receive minimal or no response (Felstiner 2011; Silberman and Irani 2016). Faircrowd.work allows workers to rate platforms[14] on 'communication' which includes the ability to communicate with management, clients and other workers. Any prohibitions on communication are also noted. We define this issue as: The extent to which communication with the requester, the end client (if different), and co-workers is permitted or encouraged.

Task ethics: There have also been issues with the AMT platform issuing tasks that are not ethical – for example paying workers to vote in competitions, promote products, services or opinions, or violate intellectual property rights (Felstiner 2011; Silberman and Irani 2016). Faircrowd.work allows workers to rate platforms according to the type of tasks, including whether they were demeaning, dangerous or ethically questionable. We define this issue as: The extent to which the task is demeaning or incurs physical or psychological risks

3.3.2 Worker related

Task issues aggregate to issues associated with workers reputations, which in turn affect their ability to obtain further work. Since crowd platforms are very public forums, privacy is also a potential issue (Durward et al. 2016).

Privacy and identity management: AMT collects a considerable amount of personal data about workers during registration, including full name, email & physical address, as well as information used to help requesters seeking workers who fall within a certain domain (constraints, for example, based on age, employment status or income). Data is also collected and stored through the use of cookies, as well as personal information from 'other' (unspecified) sources. AMT does provide a 'Privacy Notice' on their website, and although they indicate that "we are not in the business of selling it to others", there are nevertheless a range of situations where the information may be 'shared', including with requesters, and what those entities may do with the data. We define this issue as: Preservation of worker privacy so that identity details are not disclosed to the network (relevant details such as credentials may be exposed).

Reputation management: Work that is not completed or not accepted on AMT affects the reputation of the worker, regardless of the reason why the problem occurred. Since a worker's rating is essential to their ability to obtain future work, and to gain increased status, this has a direct effect on their ability to

[14] AMT by contrast tends to be a very disengaged platform, so issues are not resolved at platform level but devolve to individual workers and requesters.

work. We define this issue as: Fair maintenance of reputation management records, so that worker reputations cannot be damaged by spurious actions of requesters, including the usefulness, fairness, respectfulness, and timeliness of evaluations. Faircrowd.work includes evaluation (the usefulness, fairness, respectfulness and timeliness of worker evaluations) as an important rating criteria for platforms. We do not examine requester-related issues at this time, but we note that many issues are inter-related. For example, a reliable reputation management system for requesters might influence whether a worker would accept a job.

3.4 Scenario

Jim wants to carry out a 2-week long user interface evaluation assignment issued on a specialised crowd platform for user interface design and testing. This particular platform uses blockchain-based smart contracts to manage the assignments. The assignment sounds interesting and asks for evaluation techniques Jim is familiar with. The issuer has a good reputation in the blockchain managed reputation system. The pay rate is a fixed price for the job and looks acceptable considering Jim will be able to work from home and will get some savings in commuting costs. In order to bid for the assignment, Jim receives a request to release his formal credentials in user interface design, his reputation on the site, and his country of residence and tax status. Jim agrees to the request to validate his university degree and subsequent industry training courses – fortunately all the institutions he studied with participate in one of the credential management chains used by the crowd site[15]. Jim doesn't have a reputation yet, so the smart contract asks him if he will consent to taking a short test which will take about 30 minutes. If he passes and is awarded the job, a small additional fee will be added to his contract fee. If he does not pass the test he will receive nothing, and will not be awarded the job. Jim takes the test, passes, and is awarded the assignment.

Transactions for accepting the test, taking the test, and passing the test are all recorded on the crowdwork platform blockchain. If he failed the test, that would be recorded too. Whether the test attempt was publically recorded against his alias, or was a transaction that issuers could ask for or Jim could choose to make visible, would be a policy matter for the crowd site. After one week he is less than half way through. He contacts the issuer to dispute the time estimate. The issuer responds that they are using multiple testers, the others are more experienced and faster. The dispute is settled in favour of the requester. Jim works longer hours than he expected, but completes the assignment. His work is evaluated and compared with the other testers who have also been assigned the same interface to evaluate. For one of the use-cases he evaluated, the two other evaluators both identify several issues that Jim did not identify. Although Jim's work was not poor enough to be rejected, he does not receive a perfect score for that use case, and he receives a 4.5/5-star reputation rating for the job, and receives full payment.

The contract is able to automatically exchange information with Jim's bank's blockchain(s), and to verify his tax status on the tax office blockchain, so payment is made including tax deduction. Jim gives the requester a good rating in most categories. They were responsive and fair, but he still nurtures a suspicion that they deliberately underestimated the time required for the job. The dispute exchange is also recorded as a series of transactions associated with the contract. The extent to which this is able to be publicly viewed is also a policy matter for the crowd platform. There needs to be a balance between transparency and privacy (even though identities are disguised with aliases). The smart contract has interacted using an IBC exchange protocol with a qualifications validation blockchain, and a bank and tax blockchain. It has recorded transactions on the crowd platform blockchain(s) for accepting the test, sitting the test, passing the test, accepting the assignment, disputing the time estimate, resolving the dispute, evaluating and accepting the work, Jim's rating from the requester, the requester's rating from Jim.

4 Using Blockchain to Address Crowdwork Workcontext Management Issues

4.1 Task Related

<u>Contractual clarity and variations</u>: Blockchain technologies will not assist in making sure that a contract for work is clear in the first-place or in removing the need for contract variations. However, **irreversibility** and **networked integrity** mean that any contract variation, once published, will be visible to the network, irreversible, and applied equally. In our scenario, if Jim's query has resulted in a

[15] Various examples are emerging, for example, VIVA's introduces POETS (Proof of Educational Transcript System).

variation to the contract, it would have been applied to the other workers as well. **Smart contracts** are also likely to result in increased conceptual clarity, as the terms of the contract need to be programmable.

Warranty and rejected work: Blockchain technology could assist with many of the issues associated with rejected work. Although this would depend on the terms that are programmed into the **smart contract**, blockchain technology could potentially provide an audit trail of the history of all transactions associated with a piece of work, including opening it, evaluating it, scoring it, accepting (or rejecting) it, and generating payment. It could also potentially record any subsequent accesses (if, for example, the requester opened the work with a view to using it without accepting/paying for it), and ensure timely payment by generating payment as soon as the work is accepted. This would address many of the areas of friction in the AMT process (assuming the governance of the site included a responsibility to make these transactions visible to the network). In Jim's case, records would be created of the score he was awarded for each of his use-cases, including being notified that he was not aligned with the two other testers for one use case. This could enable him to improve his work in the future, and in any event makes the evaluation and warranty of the work fully **transparent**. The **trust mechanism** would ensure that these transactions were assured, auditable, and **irreversible. Networked integrity** provides assurance against loss or damage to any part of the work or the contract. However, for larger pieces of work, the **distributed** nature of the database could make replicating the entire task details across every node in the network (as opposed to simply recording transactions associated with the task) unwieldy.

Payment: As well as the **smart contract** functionality that ensured that timely and accurate payment was generated as soon as work was accepted, there is potential for many of the financial and tax headaches associated with crowdwork to be managed by **cross-chain protocols.** This functionality is not yet mature. A possible payment scenario could include: Jim's tax number and tax status are verified by the crowdwork chain using an IBC protocol to contact a hybrid public-records blockchain managed by the tax department in Jim's country of residence, and his payment is released. Based on the tax status returned from the tax department, appropriate deductions (for example, for tax or superannuation) are made from Jim's payment, and **trusted, irreversible** records of those transactions are recorded on his tax blockchain which he can refer to at any time. Using IBC protocol again, a transaction for the balance to be paid to Jim is generated via his bank's blockchain. This could be extended further. For example, a smart contract on the tax office blockchain could review income and tax payment records at the end of each financial year and calculate tax refunds. The potential for reducing the stress and effort required by workers, employers, and public agencies in managing the overheads associated with short-term crowdwork assignments is enormous and thus-far, largely unrealised. The **fully distributed, peer-to-peer** characteristics of blockchain are likely to be a potentially limiting factor on the storage or large volumes of complex transactions as these would need to be replicated across the nodes in the network.

Communication: As with payments, rules governing communication can be embedded in **smart contracts**, and records showing communication has taken place can be treated as 'transactions', with the properties of **trust** and **irreversibility.**

Task ethics: It is not clear that blockchain technology could control whether the tasks issued were ethical. It is possible that **irreversibility** and **networked integrity** would make tasks easier to audit by regulatory bodies. However, in principle, tasks issued on AMT are stored digitally and therefore auditable. Overtime, favourable audits would contribute to the requester's reputation

4.2 Worker Related

Privacy and identity management: This is a major area of potential contribution that blockchain technology can make to crowdwork, particularly in conjunction with **hybrid chains** using **cross-chain protocols**. **Transparency with pseudonymity** means that workers can be identified by a number and do not need to reveal their full identity in order to confirm their credentials, past work history, and reputation record. This could protect workers against all kinds of unconscious bias, based on (for example) being female, disabled, or having a clearly 'foreign' name. On the requesters' side, 'CV fraud' or 'CV-inflation' would be almost impossible as CV transaction entries could be **transparent, trusted** and **irreversible**. Claimed credentials could be verified and **trusted** using **cross-chain protocols** to **hybrid chains** managed by educational institutions or industry bodies. Records of training completed could also be **trusted.** In combination with reputation records generated from completed jobs, in combination these capabilities would greatly reduce the complexity and risk of managing a crowd-based workforce, as well as providing workers with a **trusted** and **irreversible** work history in conjunction with anonymity and privacy based on **pseudonymity.**

Reputation management: The capabilities above roll up into much more **trusted** and equitable reputation management systems. At present, workers reputations are tied to the platform on which they have the majority of their experience. Interblockchain communication might allow transfer of reputation records. While the functionalities we describe offer the possibility of reducing unnecessary and spurious risks to workers reputations such as those inherent in the AMT process, there are many complexities. It is likely that reputation management systems would need to be fairly sophisticated if they were to replace current HR processes such as reference checking. There are many imponderables associated with this possible future. For example, there may be things that workers would legitimately prefer not to be **transparent** about. Would workers be anxious about raising questions if they knew each question would create a communication record? Might too many communication records create a negative impression? Would a history of attempting and failing skill tests then taking training be perceived negatively or positively by requesters? Might different crowdwork blockchains include different terms of service regarding how much information was transparent and required transaction records to be posted to the network? There is a great deal of judgement required by both workers and requesters in answering these kind of questions, and it is judgement of a rather different kind to that required when attending a job interview.

5 Discussion and Conclusions

These issues provide many challenges for the future of work. On the one hand, 'piece work' – digital or otherwise, is becoming more common, with 'zero hour contracts' being introduced in low paid retail areas, and many jobs that have been traditionally recognised as professions, such as nursing, teaching, and web design, are increasingly casualised. Skilled jobs, as well as unskilled jobs, are beginning to appear in crowdwork platforms. On the other hand, tolerance by workers and the general public for exploitative crowdwork practices is decreasing, more so in some countries than others. We expect that there will be considerable diversity in workforce models, both between and within countries and labour markets. We are not so bold as to make predictions as to how these will develop, or how regulated they will be.

The major contribution of our paper is to show that blockchain technology enables new ways of managing some of the workcontext issues associated with crowdwork. The discretion afforded to requesters currently by AMT could be greatly reduced. Overall, applying blockchain technologies to the functionality offered by sites such as Faircrowd.work could make crowdwork more democratised, more equitable, more transparent, and with less power held by brokers and the requesters. Unconscious biases against certain classes of employees could be eliminated. Claiming (and checking) reputations, credentials and work history could be automated and, more importantly, trusted, reducing many hiring overheads and allowing crowdwork to be used in increasingly skilled contexts. Even issues like tax and superannuation for crowdworkers could be managed. It does not take much imagination to project these trends into very large potential changes in the management of work-places.

The greatest contributions relate to the contractual and transactional aspects of work – deciding what constitutes reasonable terms in the first place remains a social and political process. For example blockchain-based smart contracts could manage contracts based on different pay-rates and tax-rates depending on country of residence; in reality, workers from low-wage countries may be prevented from bidding for work in high-wage countries, as happens with AMT at present. It is also arguable the extent to which complete transparency is necessary or required. Blockchain technology may permit an irreversible record of every communication between worker and requester to be created and distributed to every node on the network, but it is not clear that this is necessary or desirable. Therefore the decision as to what constitutes a 'blockchain worthy' transaction record will also still be a social process. In private or hybrid chains, while transactions on the network will be subject to the general properties of blockchain transactions, that does not mean that anyone will have entry to the network. Some private networks may be very tightly controlled. It is easy to imagine that people with records on a hypothetical 'Harvard' blockchain may have access to opportunities that others will not. There is nothing inherently democratising about blockchain technology that will address these sorts of inequalities.

Blockchain technology offers considerable potential for supporting new processes and practices for managing crowdwork in a way that affords some workcontext protections for workers without incurring excessive overhead costs. While our scenarios are speculative, it is not the technology, but the social processes and social accords that limit their realisation at present. It is essential that these issues are debated, so that new, ethical workcontext management approached can be developed that leverage new technologies such as blockchain to cushion some of the potentially negative effects of highly casualised crowdwork.

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