



# The poverty of ethical AI: impact sourcing and AI supply chains

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## Abstract

Impact sourcing is the practice of employing socio-economically disadvantaged individuals at business process outsourcing centres to reduce poverty and create secure jobs. One of the pioneers of impact sourcing is Sama, a training-data company that focuses on annotating data for artificial intelligence (AI) systems and claims to support an ethical AI supply chain through its business operations. Drawing on fieldwork undertaken at three of Sama's East African delivery centres in Kenya and Uganda and follow-up online interviews, this article interrogates Sama's claims regarding the benefits of its impact sourcing model. Our analysis reveals alarming accounts of low wages, insecure work, a tightly disciplined labour management process, gender-based exploitation and harassment and a system designed to extract value from low-paid workers to produce profits for investors. We argue that competitive market-based dynamics generate a powerful force that pushes such companies towards limiting the actual social impact of their business model in favour of ensuring higher profit margins. This force can be resisted, but only through countervailing measures such as pressure from organised workers, civil society, or regulation. These findings have broad implications related to working conditions for low-wage data annotators across the sector and cast doubt on the ethical nature of AI products that rely on this form of AI data work.

**Keywords** Artificial intelligence · Supply chains · Impact sourcing · Ethical AI

## 1 Introduction

The current flood of new AI-driven products across a range of services has raised questions about the safety and ethics of the rapidly growing AI industry (Taylor and Hern 2023; Morley et al. 2023). Critics have analysed the supply chain of AI systems and have uncovered social and environmental concerns about how AI systems are produced (Crawford 2021; Dauvergne 2022; Miceli and Posada 2022). One key aspect of this supply chain is a hidden army of AI data workers who perform the behind-the-scenes work of preparing datasets used to train the machine learning algorithms that

power AI products (Anwar and Graham 2020; Irani 2015; Miceli and Posada 2022; Tubaro et al. 2020). Much of the seemingly automated nature of AI products designed to reduce work and make our lives easier remains hugely reliant on a large human workforce that operates out of sight (Graham and Anwar 2019; Gray and Suri 2019). These AI data workers perform a variety of tasks including collecting, annotating, curating, and verifying datasets that serve as training data for AI systems (Miceli and Posada 2022). Studies have estimated that around 80% of project time for the development of AI systems consists of this type of data work (Cognilytica Research 2019). There is also no immediate sign that this work will be automated away, as it remains a necessary and structural component of AI systems (Tubaro and Casilli 2019).

Following the recent plea to locate labour in infrastructural geographies (Stokes and De Coss-Corzo 2023), this article focuses on the working conditions of data workers within global production networks of AI (Aloisi 2022; Howcroft and Bergvall-Kåreborn 2019; Jones and Muldoon 2022). In the media, the employment status and working conditions of 'gig workers' including microworkers on digital platforms undertaking data annotation and content

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moderation work has achieved high visibility (Berg et al. 2018; De Stefano 2016; Graham et al. 2017; Graham and Anwar 2019). Another important form of data work is that undertaken by employees of business process outsourcing (BPO) centres in which AI companies outsource their AI data work to an external provider who performs the work according to instructions set by the company (Click and Duening 2004; Miceli and Posada 2022). Now that most of the world's population is connected to the Internet, BPO companies find it ever-easier to serve clients—who are primarily located in high-income countries—based on the labour of workers who are primarily located in low- and middle-income countries (Graham 2015). One of the largest BPOs in East Africa, Sama, a training-data company that focuses on annotating data for AI systems, was the subject of significant negative media attention after an investigation revealed that Sama workers fulfilling content moderation contracts were paid less than \$2 an hour, had suffered significant trauma as a result of their work, and had subsequently been victimised for attempting to form a trade union (Perrigo 2023a). Over 150 of these workers have since agreed to form a trade union to help improve pay and working conditions in the sector (Perrigo 2023a).

The negative spotlight on Sama is surprising given that the company claims to be an 'ethical AI' company that has developed an innovative model of 'impact sourcing,' which aims to empower workers and create positive social impact in their communities (Sama 2023a). The practice of impact sourcing has been pioneered by Sama, founded by its then-CEO Leila Janah in 2008 as a non-profit with the mission of 'giving work' to disadvantaged individuals who had difficulty accessing the traditional employment market (Carmel et al. 2016; TEDx 2010). Janah made it her life's mission to combat the effects of poverty by leveraging her connections in the US tech world to create job opportunities for low-income individuals in the Global South through outsourcing digital work to Sama delivery centres (Janah 2017). Sama has since transitioned to become a for-profit company, but still claims to be a social enterprise and mission-driven company that believes in providing dignified work, paying workers living wages, and helping to reduce poverty and empower women. In their own words, "Sama is driving an ethical AI supply chain that meaningfully improves employment and income outcomes for those with the greatest barriers to work" (Sama 2023a). Sama also champions 'ethical AI' through working with organisations, such as the Partnership on Artificial Intelligence, the Ethical AI Governance Group, and the Haas Center for Equity, Gender and Leadership (Sama 2023a).

This article draws on fieldwork undertaken with AI data workers at three of Sama's East African delivery centres in Kenya and Uganda in April and May 2023. This research was conducted as part of Fairwork, an action-research

project that exists to highlight the best and worst examples of how new technologies are being used in the workplace. The fieldwork involved interviews with workers and management, observation of production floors and facilities, presentations from management, and analysis of company documents provided by Sama. We also conducted follow-up interviews with a smaller sample of workers based on the initial interviews, specifically on issues of harassment and gender discrimination. Based on this fieldwork, we examine the realities of impact sourcing in the data annotation industry and the extent to which it contributes to an ethical AI supply chain. Our analysis from our initial fieldwork revealed alarming accounts of low wages, insecure work, a tightly disciplined labour management process, gender-based exploitation and harassment, and a system designed to extract value from low-paid workers to produce profits for venture capital investors. We discovered that the company leveraged a brand of 'ethical AI' to help attract investors, clients and corporate staff, while maintaining substandard working conditions at its East African delivery centres. Although Sama had taken steps towards creating decent working conditions for its employees, on closer inspection, some of these measures were ineffective or overshadowed by more harmful aspects of its business model and its system of labour management.

However, this is not the end of the story. Fairwork's research methodology involves conducting desk research on the company, conducting fieldwork with workers and also approaching company management for interviews. Management interviews open up a dialogue through which the company can agree to implement changes based on Fairwork's findings and in accordance with Fairwork principles. This is what we refer to as Fairwork's action-research methodology: it aims not only to study, but also initiate change in the digitally mediated workplaces. In line with this methodology, after the presentation of preliminary results, Sama made numerous changes that we detail at the end of the article. The following evidence presents what we found as part of our research at the company prior to any changes made in response to our findings.

These findings have broad implications for our understanding of the social impacts of AI. As AI systems become increasingly integrated into everyday life, the working conditions of AI data workers directly involved in their production should be of critical concern due to the growing size and importance of this form of digital labour. Previous studies have highlighted the precarity and low pay of microworkers on digital platforms who lack employment contracts, job security, and decent wages (Berg et al. 2018; Graham and Ferrari 2022; Howcroft and Bergvall-Kåreborn 2019; Woodcock and Graham 2019). However, as AI companies require higher quality data annotation and have more complex tasks, an increasing amount of this work is shifting away from those platforms and towards

more specialised BPOs which can guarantee greater accuracy and efficiency (Schmidt 2019). As a result, studies such as this one which interrogate working conditions in the BPO sector and AI companies' claims of contributing to an ethical supply chain are much needed.

An important implication of these findings is how degraded working conditions impact AI products further down the supply chain. If these are the conditions of workers annotating data for some of the largest companies in the world, this calls into question the ethical nature of a whole range of AI services currently enjoyed by consumers. Sama (2023c) claims to have worked with 25% of Fortune 500 companies, including Google, Walmart, Ford, Microsoft, and eBay. In addition, all companies with AI products require their data annotated and the cost and labour-intensive nature of this process results in the majority of these tasks being outsourced to external providers (Tubaro and Casilli 2019). Although this labour is often swept under the rug in AI companies' PR campaigns, a wide variety of AI products are implicated in the substandard working conditions of workers at BPO delivery centres.

Theoretically, the article points to an underlying tension in any social impact business model: between the profitability of the company, and the desire to have positive social impacts. Our case study indicates that competitive market-based dynamics generate a powerful force that pushes companies towards limiting the actual social impact of their business models in favour of ensuring higher profit margins. This force can be resisted, but only through countervailing measures such as pressure from organised workers, civil society, or regulation. The fungibility of much BPO work, traded in a planetary market in which small differences in unit cost can move contracts from one side of the world to the other, leaves BPO suppliers with relatively little room to manoeuvre. There is a small amount of space in the market for a more ethical model that might offer longer contracts, higher wages, and more benefits, but this imposes costs on the firm that renders it less competitive and limits the return to its investors. Our analysis of the structural economic model of data annotation outsourcing points to the importance of client-side action either from the requester company often based in the Global North or through laws requiring compliance with minimum standards from a company's suppliers. In the absence of such pressures, the market dynamics of the global data annotation sector result in a race to the bottom on pay and conditions, leaving workers vulnerable to exploitation and abuse.

## 2 AI supply chains and impact sourcing

AI systems are much lauded as having the capacity to automate mundane tasks and augment the speed and capacity of existing human practices. Although much research has

focussed on ethical issues related to the outcomes of AI systems (Floridi 2019; Hagendorff 2020; Jobin et al. 2019), another key consideration is the ethics of how AI systems are produced. There is a growing literature examining the production of AI systems which interrogates the environmental resources, human labour, and other factors of production that are needed to make the seemingly automated services of AI systems possible (Crawford 2021; Dauvergne 2022). Interrogating the supply chains of AI is an increasingly important task, since many critical aspects of AI systems rely on global production networks that operate outside the boundaries of any single company (Tubaro et al. 2020).

Supply chain transparency concerns a company disclosing information to the public about upstream operations related to how their products are made (Sodhi and Tang 2019). AI companies pursuing environmental, social, and governance (ESG) goals are under pressure to critically assess the social and environmental costs of producing AI tools (Dauvergne 2022). This can include setting benchmarks for suppliers related to employment relations, working conditions, and environmental practices (Kannothra et al. 2018). While disclosure of information about the supply chain of products is becoming increasingly popular with many companies, there are currently few regulatory requirements for AI companies to disclose any information concerning the provenance of their datasets or other critical infrastructure related to AI systems (Bender et al. 2021; Gebru et al. 2021; Marshall et al. 2015). For example, after having first provided basic information about the datasets on which ChatGPT was trained, in their latest model of Chat GPT-4, OpenAI has offered no information related to the datasets used to train the system, its environmental impact, specific aspects of its hardware, or how it was created (Vincent 2023).

Theorists of 'digital colonialism' have argued that technology companies in the US seek to exercise control over populations in the Global South by creating new forms of dependence through their ownership over digital tools and platforms (Avila 2020; Kwet 2019; Vesna 2023). This developed out of a broad scholarship that showed how technology embodies particular values which shape how we engage with it and perceive the world through using it (Fischbach et al. 2023; Hollanek 2023). Renata Avila defines digital colonialism as "the deployment of imperial power over a vast number of people, which takes the form of rules, designs, languages, cultures and belief systems serving the interests of dominant powers" (Avila 2020: 1). This form of power extends both to how AI is produced through supply chains which follow older colonial patterns of subordination and the extraction of resources and labour in addition to how AI is deployed. Michael Kwet (2019) understands digital colonialism as a "structural form of domination" exercised through "three core pillars of the digital ecosystem: software, hardware, and network connectivity." In particular,

Kwet focuses on the education environment, analysing how Big Tech companies seek to place their products in classrooms in the Global South to create dependencies at the same time as biasing the local tech ecosystems towards the company's software.

One important aspect of the AI supply chain is the human labour required to prepare and verify the datasets used by machine learning algorithms (Miceli and Posada 2022; Newlands 2021; Tubaro et al. 2020). AI companies exercise a great deal of power over the conditions under which these data work occurs through their sourcing decisions in relation to datasets. Due to a growing body of research that highlights the precarious working conditions of data workers, global civil society groups such as the Partnership on Artificial Intelligence have called for AI companies to meaningfully improve working conditions through their business practices (Partnership on AI 2021). More specifically, in the report 'Responsible Sourcing of Data Enrichment Services', they have called on AI companies to ethically select data enrichment providers, design and assign tasks with workers' interests in mind, define payment terms and pricing appropriately, conduct quality assurance, and establish direct communication with workers (Partnership on AI 2021).

AI companies, such as Sama and Cloudfactory, have adopted an impact sourcing model to contribute to an ethical AI supply chain (Cloudfactory 2023; Sama 2023a). The possibility for impact sourcing emerged with the rise of BPOs and the expansion of communications infrastructure between the world's rich and poor (Graham and Anwar 2019). The BPO sector first emerged in the US and Europe in response to competitive pressures to restructure business processes to increase efficiency by outsourcing work tasks to external providers within lower wage areas of national economies (Davis 2009). By the early 2000s, the growth in communication technology allowed much of this work to be offshored to an even cheaper workforce located in countries such as India and the Philippines, which opened a global marketplace for BPO services (Graham 2015; Mann and Graham 2016; Peck 2017). The spread of the Internet enabled new employment opportunities to reach poorer segments of the world's labour markets and new businesses to leverage their competitive advantage in accessing cheap labour and a knowledge base in ICT (Graham and Ferrari 2022). India, in particular, experienced a rapid growth of its information technology outsourcing, which convinced a number of leading international institutions that the development of an outsourcing industry provided an important gateway for economic development and poverty reduction (Lacity et al. 2011).

Impact sourcing evolved in the late 2000s as business process outsourcing began to intersect with corporate social responsibility and the practice of hiring marginalised individuals was pitched as a means of reducing poverty and boosting economic development (Gino and Staats 2012).

The movement has been driven by powerful global institutions such as the Rockefeller Foundation which funded a number of reports and conferences on the topic and promoted impact sourcing through its Digital Jobs Africa Initiative (Avasant 2012; Bulloch and Long 2012; The Monitor Group and The Rockefeller Foundation 2011). The Rockefeller Foundation (2011: 2) defines impact sourcing as "employing people at the bottom of the base of the pyramid, with limited opportunity for sustainable employment, as principal workers in business process outsourcing (BPO) centres to provide high-quality, information-based services to domestic and international clients". This draws on C. K. Prahalad's idea of the economic opportunities that lie in the poorest socio-economic group who live on less than \$2.50 a day, but who represent an untapped potential for global capital (Prahalad 2004).

Impact sourcing has long been associated with microwork and small digital tasks, such as data annotation and verification. Gino and Staats (2012: 95) describe impact sourcing as a practice in which one can "hire and train people at the bottom of the pyramid to execute digital tasks like transcribing audio files and editing product databases". They refer to impact sourcing as the 'microwork solution', emphasising that relatively low-skill digital tasks can be performed by a distributed workforce that could open employment opportunities to lift disadvantaged individuals out of poverty. Impact sourcing emerged as a market-based poverty reduction strategy that intersected with the fields of social entrepreneurship and social investment.

One of the principal reasons for impact sourcing's popularity in the business world is that it is a profitable option for clients seeking to outsource work. These impact sourcing companies leverage the fact that they are well placed to take on short-term and intermittent work that might be unattractive to traditional BPOs, but which can be performed by 'base-of-the-pyramid' service providers at a low cost. The popularity of impact sourcing relies on the fact that these companies can still compete against traditional BPOs with low cost and high-quality work. A survey conducted by Accenture indicated that for outsourcing clients, cost and quality remained the highest priorities, with corporate social responsibility objectives appearing as secondary goals (Bulloch and Long 2012). At the same time, impact sourcing promises to achieve multiple corporate goals: reduce labour and operating costs, while also positively impacting a company's ESG objectives and increasing employee retention and loyalty. It can also help improve a company's brand through the company widely advertising how impact sourcing positively impacts local communities (The Monitor Group and The Rockefeller Foundation 2011).

Sama played a key role in the development of impact sourcing through its founder, Leila Janah who worked with the Rockefeller Foundation to develop the theoretical

foundations of the idea in the late 2000s (Janah 2017: 70). Janah (2017: 69) saw how “the outsourcing industry had generated billions of dollars for a few wealthy businessmen” and she asked, “what if I started a company that inverted the outsourcing concept and used it to generate a few more dollars for the billions of people at the bottom of the pyramid?”. In her book, *Give Work: Reversing Poverty one Job at a Time*, Janah (2017: 70) defines impact sourcing as “a subset of outsourcing that focuses specifically on giving work opportunities to the poorest of the poor—women and youth living in rural areas, slums, or anywhere of high unemployment”. She originally conceived of a for-profit two-sided market for outsourcing work she called ‘Market for Change’ but later revised her idea to create a non-profit and called it Samasource, with *Sama* meaning ‘equal’ or ‘fair’ in Sanskrit (Janah 2017: 101). She considered that rather than funding expensive aid programs, the most effective way of helping the world’s poor was to give dignified, secure and living-wage work that would provide a long-term resource to lift people out of poverty. Although Janah passed away in 2020, Sama claims to continue her mission as an ethical AI company that seeks to promote positive social change through impact sourcing. In this sense, Sama provides an important test case for the effectiveness of impact sourcing and its ability to fulfil its social mission.

### 3 Sama as a case study

This study draws on data from a qualitative research project that took place in April and May 2023 involving fieldwork at three of Sama’s BPO delivery centres in Nairobi, Kenya and Gulu, Uganda. One of the authors of this paper also conducted previous research at Sama in 2017 during an earlier stage of the company’s development, while it remained a non-profit. Sama (2023a, b, c) is a training-data company founded in 2008 which specialises in training data for AI systems and has between 2000 and 4000 employees at their East African delivery centres at any given time.

Two of these centres are located in Nairobi nearby a large cluster of BPOs in Africa’s ‘Silicon Savannah,’ in a city with very high youth unemployment but a highly educated English-speaking population (Mallonee 2018). A third centre visited during the fieldwork was located in Gulu in Northern Uganda, a city with a population of roughly 200,000 in which Sama is one of the largest formal employers. Although the company undertakes a limited amount of other work, its primary focus is on producing training data for computer vision systems—how computers can be taught to read and understand content from images and videos, which can assist with the automation of human tasks. Sama is an important case study for the interrogation of the claims of impact sourcing and ethical AI, because it is one

of the largest and most well-known BPOs in the AI industry in East Africa and is also a relatively high-profile case, with recent media attention due to the poor working conditions of its content moderators for Meta as well as the ongoing court case against them (Kimeu 2023; Perrigo 2023b).

We were invited to conduct a case study of Sama by members of Sama’s senior management team who were engaged in the Global Partnership for Artificial Intelligence. After conducting a global consultation to create a set of ‘AI for Fair Work’ principles in 2022, we began 2023 with the goal of conducting case studies to test the suitability of these principles for analysing the fairness of AI in the workplace. Sama volunteered to be one of our case studies, and they provided assistance in setting up interviews with workers and managers, giving us presentations on Sama’s work, sharing some internal company documents, and helping us to visit slums and villages where Sama employees lived in the local community.

Data collected at Sama’s three delivery centres included workplace observation of employees on the production floors, tours of the facilities, and 46 semi-structured interviews with workers and management. Most of the interviews were arranged by the company who invited workers to participate and arranged for the interviews to be conducted in its meeting rooms. We advised the company we wished to interview a broadly representative sample that included workers of different genders, who worked different roles within the company and who performed day and night shifts. We are unaware of any additional criteria used by the company in determining which workers to contact. Some workers we interviewed informed us they had been personally invited by management to participate in the interviews. These workers included workers at a variety of levels, including junior associates who performed data annotation work, quality analysts, team leaders, and senior delivery managers in charge of up to hundreds of workers and who would liaise with external clients.

In addition, we also gathered data via semi-structured interviews with an external sample of current and previous Sama employees (including workers who were still eligible to be offered new contracts, workers made redundant from the Meta content moderation team, and those whose contracts were not renewed during attempts at forming a union). This sample was organised independent of Sama (and, indeed, we did not reveal the identities of any of the workers with whom we spoke to Sama management) and allowed us to cross-reference our results across multiple data sources. We also undertook follow-up interviews with a smaller sample of workers, specifically on issues gender-based exploitation in the workplace.

Interviews lasted between 45 and 75 min and consisted of questions which covered issues such as their workflows, how they performed their tasks, their knowledge of the projects,

workplace discipline, expectations of management, how they felt about their work, managerial structures, and key performance indicators. All interviews were recorded, transcribed, and analysed. Participants were all anonymised with any identifying information removed from the transcripts. Transcripts were analysed using inductive thematic analysis focussing on prominent themes related to the claims Sama made regarding impact sourcing and the benefits it provided workers (Given 2008; Silverman 2010). The characteristics of interviewees in our sample are provided in Table 1.

## 4 Assessing Sama's impact

Sama's vision is "to pioneer new technologies and business methods that harness the power of markets for social good, leveling the playing field for those who do not share equally in the benefits of human progress" (Sama 2023b). It seeks to achieve this vision by providing data annotation solutions to clients through an ethical AI approach which employs marginalised individuals who have lived below the poverty line and/or who lacked access to formal employment opportunities. There are several important claims that Sama makes about the effects of its impact sourcing.

First, Sama claims to empower its workers by offering a living wage and providing them with training for a future career. The first aspect of this claim is based on the assertion that the company pays its employees a living wage and that members of its workforce experience an average  $3.6\times$  increase in their earnings when they join Sama. Sama also advertises the positive impact it has on local communities and claims that its research has found that employment at Sama directly

benefits dependents of its workers. Furthermore, Sama argues that it provides career advancement within the company with certifications for associates to be promoted to leadership roles and a commitment to upskilling its own employees and hiring from within. Sama also sees itself as a bridge employer, offering individuals training and job skills to pursue their future career. This includes an internal learning management system (SamaU) which provides a set of training, in addition to other opportunities to learn CV writing, interviewing, and presentation skills.

Second, in its efforts to empower its employees through work, Sama seeks to provide secure, dignified work and a stable income to pursue their personal goals and support their families. As part of this commitment to decent work, employees can access well-being services in the company with a dedicated team of coaches of both genders with accreditation in counselling and which can engage in preventive and curative therapy in relation to work and personal issues.

Third, Sama claims to invest specifically in women, with female employees making up over 50% of its entry-level workforce and receiving benefits, such as new parent leave, lactation rooms for nursing mothers, and equal pay for equal work. In the following, we assess each of these specific claims based on evidence gathered in our fieldwork at the company. We conclude with a reflection on who benefits from the international division of digital labour established through this system of impact sourcing.

Fourth, Sama claims to use four 'impact proxies' in deciding who to employ in its associate roles: prior earnings, previous employment, educational opportunities, and neighbourhood/socio-economic status. It claims to engage in purposeful hiring in prioritising applicants who have never worked in the formal economy, who were unemployed or underemployed and who lived below the poverty line before joining the company. To measure whether Sama is reaching the right target population with its employment practices, it administers a baseline survey when employees enter the company and keeps track of these metrics across its entire workforce.

Finally, before we compare Sama's conditions, it is worth noting that evidence from workers within the firm indicates that Sama is among the better employers in the industry and that while our research team did not collect systematic evidence from other firms, anecdotal evidence from workers we interviewed indicates that conditions are similar if not worse at other companies in the region, a perspective backed up by studies of other BPOs.

### 4.1 Economic empowerment through a living-wage job

Sama seeks to empower workers by paying them a living wage that would not only lift individuals out of poverty,

**Table 1** Characteristics of the sample

Gender	
Male	26
Female	20
Age	
18–25	4
26–35	34
36–45	8
46+	0
Nationality	
Kenyan	19
Ugandan	17
Other	10
Education	
Secondary	7
College	9
Bachelor	23
Master	7
Total participants	46

but also enable them to support their family. The idea of ‘giving work’ as a method of poverty reduction is a core commitment of the company and one of the founding principles established by Leila Janah. Previous studies have shown that the company has a positive economic impact on its employees. Researchers from the Massachusetts Institute of Technology conducted a 3 year randomised controlled trial from 2017 to 2020 and found that individuals who received training and a job with Sama received 40% higher average earnings than those who did not over the course of 3 years (Atkin et al. 2021). In Kenya and Uganda where youth unemployment is relatively high, Sama offers vital economic opportunities in the formal job market where even a low-wage job can lead to a considerable improvement in an individual’s income and quality of life.

The company employs the Anker methodology for estimating a living wage, a robust method supported by organisations such as the International Labour Organization and the Global Living Wage Coalition (Anker 2011; GLWC 2023). This method defines a living wage as “remuneration received for a standard work week by a worker in a particular place sufficient to afford a decent standard of living for the worker and her or his family” (GLWC 2023). This is calculated based on how much a worker living in different geographical areas should be paid based on considerations of the price of “food, water, housing, education, health care, transport, clothing, and other essential needs, including provision for unexpected events” (GLWC 2023). Sama conducts a living wage audit each year. After calculating a figure based on an up-to-date analysis of these factors, the Sama impact team then compares this to other benchmarks established by living-wage organisations to ensure a rough compatibility of their figures.

In the Kenya offices, Sama’s living-wage recommendation for 2022 was 27,469 KES (\$200.88) per month. In Uganda, the recommendation was 819,495 UGX (\$220.44) in Gulu and 877,072 UGX (\$235.93) in Kampala. Due to the rising cost of living, wages struggled to keep up with essential costs for fuel, food, and education. In Kenya, the company calculated that the living wage increased by 14.3% in 2022. A member of Sama’s impact team explained how they determine the figure then “share that with I think a lot of folks who are maybe on the executive team and on payroll... and that’s kind of where I leave it off”.

Evidence from interview data and from payslips independently verified by our research team indicated that at the time of interviews, not all employees were paid the living wage calculated by Sama’s impact team as their base salary. One associate we interviewed in Kenya showed us a pay slip for 23,805 KES (\$173.28) for their base income. A second associate reported earning 28,000 KES (\$204.76) (above Sama’s living wage), while another reported “newcomers start on 20,000 KES (\$146.26)”. Of the Ugandan employees

we spoke to on the lowest pay scale, reports ranged from 620,000 UGX (\$167.40) to 740,000 UGX (\$199.06), 751,000 UGX (\$202.02) and 800,000 UGX (\$215.20) as their base income, all below Sama’s recommended living wage.

When asked about a possible gap between the living-wage calculations of the company and what its employees were actually taking home, one senior employee responded, “it doesn’t surprise me”. They continued: “I think that’s been on a personal level part of what I have struggled with: this is a business. There are business decisions to be made and there’s a reason for maybe going a little bit below what our exercise says might be a living wage. There is some flexibility in the numbers. ... I think the company has some flexibility and likes to use that flexibility to maybe pay a little bit below”. Yet, this apparent flexibility appears to contradict Sama’s own marketing material, which claims not that it strives to pay a living wage when it is economically feasible, but that it is a minimum standard of the company.

At the same time, the employee did not want to discount the real economic benefits that Sama brought to the community: “I don’t think it completely calls it [Sama’s impact] into question. I think the company’s impact is still there. But I do think what I maybe attribute it to is a marketing strategy that any company would use to promote itself and say these things”. A senior manager of the company stated that “we treat it [the living wage] as a benchmark... our goal is to have as much of our population as possible at that living wage benchmark”. This manager noted that the company does “achieve 100% when you consider base plus benefits... their average bonuses... or performance incentives”. When the company did not meet this benchmark, this failure was partly attributed to high inflation, which raised the cost of living.

The interviews suggest that salaries at Sama are not low in comparison to other BPOs in East Africa. One senior manager estimated that wages at Sama were roughly 10–15% above the market rate for the BPO sector. Another reported that the company’s goal was to pay 20% above market rates for entry-level positions. Indeed, workers who had been at other BPOs suggested that Sama was among the better employers of those available in the sector. Some workers reported the dramatic effect their wages had on their quality of life, enabling them to pursue education, purchase small assets, pay off their debt, and support their families. Individuals who obtained jobs at Sama often became a support figure for others in their family including their parents and siblings. In comparison to many other jobs that were available to them, the salary offered by Sama was considerably better.

However, other workers we interviewed complained that their wages were not sufficient to meet their daily needs: “The salary we earn is barely supportive. I have a family, and

its growing. I'm unable to do a lot with my salary". Another associate complained, "the pay is too low if you compare it to what we do. ... [the associates] are just working because there are no other opportunities". Some workers were forced to take out high-interest loans to cover their expenses: "So you take out loans, because the wages are too low ... like last month, I had a loan of 300,000 UGX (\$81.00). So basically, when I receive my salary, like this month, it all goes into paying loans". Yet another commented, "I've been a street kid for two years, not having anything, finding a way to feed myself, I'm glad to be here. But if I was told I had a better opportunity, I wouldn't hesitate to leave this place". While the salary offered by Sama was more than what workers would earn in the informal economy, it was viewed by many workers as very low and inadequate to meet their basic needs.

Furthermore, Sama claims to be a 'bridging employer' that provides the first step for marginalised individuals into formal employment. In her 2017 book, Leila Janah (2017: 74) stated that employees at Sama "often stay only a little more than a year". Yet by the time we conducted our interviews in 2023, Sama management claimed that although their target was for people to stay 3–4 years, the reality was that employees were often staying longer than five. One issue here is whether Sama are preparing their employees for future employment. Workers confirmed that Sama did offer a range of options on SamaU, a learning platform that focussed on digital skills, such as work management programs, Excel, and other digital literacy programs. There were also career fairs and mentorship for some staff that would help them with CV writing, interviews and presentation skills. However, despite these services offered by Sama, recently, it had not been very successful in placing its staff in better paid external jobs and had for some time not undertaken surveys of their alumni to gather data on this point. On the one hand, several workers stated that data annotation skills were essentially non-transferable and would only be useful at other data annotation firms. On the other hand, many workers believed the soft skills they had learnt, such as communication and presentation skills, office management, and digital skills, were transferable and could be leveraged for future opportunities. The main issue faced by all workers was that these external work opportunities were few and far between.

## 4.2 Job quality and job security

Another important factor in assessing the value of impact sourcing relates to the quality and security of the jobs that Sama provides. Sama claims to promote the UN's eighth Sustainable Development Goal, 'Decent Work and Economic Growth', which includes supporting "full and productive employment and decent work for all" (The UN 2023).

It was on this metric that our data revealed Sama fell far below reasonable expectations of what constitutes decent work. The average worker reported working long hours with stressful performance targets, a strict labour management regime, short-term contracts, and the danger of not having their contract renewed if they failed to meet their targets or complained about their work or the management.

In their presentation to us, senior management reported that "most employees might be on a yearly contract which gets renewed", but most workers we spoke to reported to be on either 1- or 3-month contracts, with some as short as 1 week. In one interview conducted on a Friday, a researcher asked a participant when their current one-month contract ended: "actually, next week I don't have a contract, so that's one of the things that's causing me a lot of stress. You don't know your fate, you can come back tomorrow, and they tell you, you don't have a contract". The interviewer asked what would happen if the participant was not offered more work immediately. The participant paused, then said very softly: "that's one of the things that I don't even want to think about, because you have so many people that depend on you".

If Sama did not have a lot of work on or needed to ramp down one of its projects, it would place workers 'on the bench', which meant that they would not be paid and would need to wait for Sama to find another project for them. Workers reported waiting on the bench without income for months at a time. One senior employee reported feeling uncomfortable with what they were offering workers:

"It wasn't clear to me, especially with the narrative when I joined the team, which was 'we provide full-time employment. We are a great alternative to this gig economy, short-term, you work for a little bit and you hop between jobs.' That's what it was sold as, so I was very surprised to learn about the contract system... especially when we are marketing and touting ourselves as full-time employment. Well, if you dig into it, we are essentially just contracting people. It's not full-time employment. ... Although we say you're on the bench, you are still a Sama employee, you're the first one Sama will go to, but it's not the same."

Almost all workers we interviewed reported feeling insecure and fearful about the prospects of losing their job. "People are scared of being on the bench", reported one worker, "they are under a lot of stress to do the work... some people might skip lunch, they work extra overtime... when ramp downs come, they don't want to be on the list that gets cut." Another witnessed a group of workers who had been sent to the bench: "Some of them left and they were crying. They didn't know what's next after this. And these are people, I don't think they have other ways of surviving out there".

Employees worked 10-h days (with 1 h of breaks) 5 days a week with some Saturday work expected during busy

periods. Employees would arrive at 7:40 AM often following a 1–2-h journey from their houses which tended to be a long way from the office. They would then start work at 8:00 AM and pause only for one 20-min tea break and a 40-min lunch break until their departure at 6:00 PM. Every minute at work was closely surveilled through a digital monitoring system with workers expected to meet strict performance targets. One worker noted that even their toilet break was considered to be in the 1-h lunch break, and “you just know how to manage it” (the need to use the restroom) throughout the workday; as otherwise toilet breaks would add up and they would need to stay after their shift to meet their targets.

Managers reported that the performance management system looked at attendance (are you coming in); performance (how long are you working) and quality (whether your work is accurate). Sama’s system reports whether workers are ‘productive’ (actually working), ‘idle’ which is hands off keyboard, ‘out of focus’, when you are on a different website or a different browser, or ‘on training’, ‘wellness’, ‘bathroom break’, etc. If workers failed to meet their targets during the day, team leaders could sometimes expect them to stay back an hour for unpaid work to make up the difference. If this continued throughout the week, workers reported that it was not uncommon for associates to be asked to come in for a 5-to-6 h unpaid shift on Saturday to meet their performance targets for the week. Further poor performance could lead to being placed on a performance improvement plan which could see them exit the company in 6 weeks.

“If you did not perform or improve your stats the company will not renew the contract. It is purely based on the scores”, remarked one worker. This led to a situation in which constant stress and overwork was the norm. “Physically you are tired, mentally you are tired, you are like a walking zombie”, reported another worker. Workers also commented on a culture of fear at the company around meeting targets: “if you complain of fatigue they will remind you, if the client pulls out you are out of a job”. In sum, the relatively low quality and poor security of the work calls into question the degree of impact that Sama achieves by providing this form of work to marginalised individuals.

### 4.3 Gender-based exploitation

Sama promotes itself as a model employer for women and an organisation where women can expect equal treatment and equal pay. Leila Janah (2017: 76) was a proponent of the idea that “the best kind of empowerment is cold, hard cash given directly to low-income women”. Although there were no reports of discrepancies in pay between men and women, there were several glaring examples of overt gender-based exploitation and harassment within the company. The first was related to maternity leave for women. The interview data revealed several instances of managers strategically

aiming not to renew the contracts of pregnant employees to avoid paying them 3 months of new parent leave promised by the company. One worker reported how, “in most cases they put you on the bench before your due date... they wait when [your] due date is almost clocking [then] they put you on the bench to avoid paying the maternity leave”. When asked about the prevalence of this practice among her colleagues, the worker reported it had occurred to “several friends of mine... like 5, 6 or 7 times”. The worker also alluded to instances of favouritism within the company: “it’s only when the PM’s [project manager’s] wife is pregnant that they fix you [ensure you stay employed by the company to be entitled to new parent leave]”.

Another egregious example of systemic discrimination in the company reported by interviewees was cases of male managers offering jobs to women on the condition they had sex with them. One interviewee reported that “when they apply to work here, those guys [the managers] normally tell them ‘if you won’t accept to be my girlfriend there’s no way you are going to get a job at Sama... if you want to get a job you will be my girlfriend’”. Another worker reported that managers had favourites they would try to assist in the application process: “people used to apply via email, via phone and when they come for assessment, when the managers are around and they think ‘this lady is beautiful’, they will go and approach them and tell them ‘if you want to pass and join the company you have to do A, B, C, D’—they will give you a link on how to join the company without struggling”.

For women at the company, it was reported that, “most of them have a mentality that this is the only way you have your job security by getting someone at the top... when you have someone at the top you know your job is secured”. When asked about how many managers have girlfriends among the junior associates, the worker replied, “most of them”. They continued, “it doesn’t last a month or two and then they [the managers] hook up with someone else ... no one speaks out of fear for their jobs”. Managers were reported to be in relationships with multiple women at the same time, “sometimes two, sometimes three ... some do know about each other”. Another worker at a different centre agreed that “it was widespread to many managers... [female employees] were there because of—they were forced to be their girlfriends, some of them, to give these sexual advantages”. Another worker noted that “Yeah, that’s a very common thing in Sama. Honestly, it’s just very common. So common it doesn’t even make news anymore”. They noted that one female worker got promoted three times within 6 months, due to being a manager’s favourite.

In addition to these issues, some female workers complained that there were no sanitary products provided and no washrooms for women who were menstruating. One woman complained, “we come from 7 [AM] to 6 [PM] ... you sit without taking your bath and it’s so uncomfortable. ... If

they could provide some washrooms, I know I can take my bath again and clean up”. There were also no extra breaks provided for women who were menstruating. These issues are particularly concerning due to the location of the delivery centres in countries which still have deep-rooted taboos around periods (Plan International 2022).

#### 4.4 Impact sourcing metrics

Another issue under consideration is whether Sama adheres to its commitment to engage in impact sourcing of marginalised individuals. This is because Sama envisions a significant portion of its impact to consist in hiring entry-level employees who face challenges finding full-time employment. As one senior employee explained, “we’re specifically set up in a way to be sourcing folks who are coming from disadvantaged backgrounds. So automatically, there’s kind of impact without doing anything... you really just have to measure the number of people that are getting jobs, because that in itself—because of the background of the people—is the kind of impact that the company wants to create”.

By the first quarter of 2023, Sama had impacted 65,343 people, since it was founded in 2008, including 15,083 individuals employed by the organisation, 41,157 dependents of its employees who were impacted by their income and 9312 individuals who received a short training course in digital literacy. At their Nairobi office, which contains the majority of their East African workforce, Sama reported in the first quarter of 2023 that 70% of their impact sourcing hires lived below the \$1.90 poverty line before Sama; 76% were un/underemployed; 30% faced barriers to pursuing higher education; and 59% reported living in informal settlement or a low-income neighbourhood. Sama assesses its impact on these metrics by collecting account data monthly and combining administrative data on employees with a baseline survey new entrants take upon starting at the company. These figures demonstrate a commitment to hiring employees who are from marginalised communities and who have experienced barriers to formal employment.

Sama’s hiring and onboarding process as explained by their management team also appeared to adhere to their commitments. Interested applicants for Sama’s associate program could apply online via a link. Candidates who met Sama’s impact criteria could then be selected to do a short ‘AI101’ training course which lasted for 10 days with training for 5 h per day. Applicants received a stipend of \$5 a day to cover transport and meals, while they completed the training. The curriculum of this training course consisted of digital literacy, work readiness, and a basic overview of data annotation.

The main issue our research identified with the Sama hiring process was that interview data revealed that certain managers preferred hiring graduates. Evidence for this was

stronger at the Gulu centre, where almost every individual we interviewed had a bachelor’s degree, than it was at the Nairobi one. Referring to the frequent graduate-level education of new Sama employees, one manager stated, “technically the Sama guidelines stipulate that we take lower ... but there’s a bit of a bias because those who have got degrees or a higher-level education, it’s easier to get them to turn around faster... the understanding of concepts is faster for guys who are educated”. A supervisor commented, “in the past we had entry level at Senior 4 [O-Level equivalent] ... now we only hire at least graduates for the associate level”. Another manager at the Gulu centre claimed, “something has changed... for the past year, what I’ve seen is they don’t hire people without degrees”. Their reasoning was that “it’s better to have people with degrees because right now it’s a business entity. So, you want to get on board people who have that skill who could elevate your business”. This was one moment in which a company’s business interests could potentially conflict with its desire for strong social impact as graduates were found to pick up the work more quickly, which increased the quality of outputs and reduced the amount of time spent on training. However, hiring graduates systematically biases against the spirit of impact sourcing which seeks to benefit marginalised individuals rather than those with graduate-level education.

## 5 An unequal distribution of value

Stepping back and observing the combined impact of all these issues, it is important to ask what benefit different parties receive from the impact sourcing model. Despite the issues raised above, one should not discount the genuine benefits workers receive through access to employment opportunities. Many workers we interviewed were thankful for their jobs and saw them as a lifeline in an otherwise difficult job market. It provided them with a source of relatively stable income which they used to support themselves and their families. Employment with Sama had been life changing for those fortunate enough to stay at the company for a number of years. Some of these workers had through strict discipline managed to accrue savings and invest in assets and their future education. In the absence of Sama hiring marginalised individuals, some of its employees would experience challenges finding similar work. In one sense, since its founding in 2008, Sama has had a demonstrable impact on the 15,083 individuals employed by the organisation and their 41,157 dependents, which should not be overlooked.

At the same time, it is also important to highlight just how much the company benefits from its impact sourcing model. Sama is no longer a non-profit and does not hire its workforce purely for benevolent reasons. Impact sourcing makes good business sense. Through this practice, the company

gains access to a cheap and highly disciplined workforce. Sama's structural position as an employer who attempts to reach the lower end of the labour market ensures that they have a large reserve army of workers who can rapidly replace the existing workers in the company. Senior managers reported to us that at any given time, there could be around 40,000 applicants who had applied for a job, 2000 who had completed the AI101 training, and a further 1,000 'on the bench' who had already worked on Sama projects. This enabled the company to quickly ramp up and down to meet potential client needs for large numbers of workers to complete short-term projects. It was clear from our interviews that Sama's position in the labour market exercised a strong disciplining effect on workers, enabling Sama to extract extra work from them, both in terms of efficiency during their shifts, but also in unpaid overtime worked out of fear of being placed on the bench.

In addition to these direct economic benefits, the company also gained reputationally by advertising its impact sourcing to investors, clients, and potential employees. In our interactions with Sama, we observed that the philosophy and impact of the company was one of the top talking points of senior managers. "The company loves to tell its impact... whenever we promote something internally about a new initiative corporate staff are very eager to hear about it", said one corporate employee. Impact sourcing offers huge advantages to the company when it comes to attracting and retaining senior employees. One interviewee noted how, "anecdotally we have heard it's one of the major reasons we have attracted talent at the corporate level. They chose Sama because of the unique impact model". As one senior employee recounted, "that's what attracted me to the opportunity—it was knowing that, when it comes to the private sector and different companies, I hadn't heard of many companies that have this unique [impact] sourcing model". Sama's impact story also tended to be a drawcard when it came to investors: "they are very interested to know", recounted one employee, "it's one of the reasons they decided to invest in the company". For clients, on the other hand, the employee thought it was "more hit and miss": "some customers really like that, and that was the key decision, in other instances, it can be a detriment". Studies show that for clients, cost and quality are still the top two considerations and that ethical sourcing of labour is much lower down the list of priorities (Appen 2022). Some clients might have the impression that impact sourcing implies a lower quality service, an assumption that Sama and other impact sourcing companies are keen to avoid (Cloudfactory 2023).

While Leila Janah writes about founding Sama as a non-profit with modest savings from her work and a small social enterprise development prize (Janah 2017: 101), more recently as a for-profit company, Sama raised

\$14.8 M in a Series A funding round led by Ridge Ventures and \$70 M in a Series B funding round, which was led by CDPQ with participation from First Ascent Ventures and Vistara Capital Partners (Gonzalez 2021; Varsha 2019). Industry Ventures (2017) estimates that late-stage investors tend to target a 20% plus gross internal rate of return on their successful investments and have an average holding period of 6 years, which means they need to make a 3× profit on their winners to achieve their investment objectives. This means Sama will have serious obligations to make significant returns for its investors, which seem highly likely to conflict with its social impact goals.

The reality of the economic system in place at the company could be described as enabling a large transfer of value from workers at the base of the pyramid to senior managers and venture capital investors at the top. Workers who perform the valuable work of data annotation, which is the bread and butter of the service offered to clients, are paid as little as feasible to reproduce their basic existence and continue working for the company. Sama relies on a large reserve army of workers to be rapidly scaled up and down to meet the needs of clients and to generate maximum profits for investors. Senior managers in Canada and the US, however, are offered permanent positions with generous salaries that Glassdoor estimates to be above \$300 K at the director level (125× an associate's salary), with full benefit packages including medical, dental, employer matching 401 K, generous holiday and vacation policies, sabbaticals, a monthly fitness stipend and professional development opportunities (Glassdoor 2023). Of course, this is how many companies operate, but the sheer amount of value being transferred up the pyramid appears particularly striking in this case, because the philosophy espoused by the company is one of empowering workers and combating poverty.

At its worst, pursuing social impact becomes a shallow marketing exercise to promote the company, but which means little in practice in terms of how employees are treated: "it's a weird dynamic. Corporate staff loves to talk about the impact, but it surprises me how little they understand what we are doing", recounted one senior employee. Sama has a dedicated impact team that are responsible "not only to promote the company's impact internally, but also externally—blog posts, social media posts, that's what gets people's attention". But what happens when impact just becomes a communications and marketing exercise? "We can say one thing but what we are doing is actually kind of different", commented one employee, "we are touting ourselves as doing all these great things", but asked if they would consider Sama an ethical AI company, their response was: "probably not".

## 6 Conclusion: changes following our fieldwork

In addition to this research article, Fairwork also produced a report on the scoring of Sama based on our research (GPAI 2023). As a project, Fairwork evaluates the working conditions on digital labour platforms in the platform economy, and companies that use artificial intelligence in the workplace, and scores them on how well, or how poorly they do. The project has developed five principles of fair work (fair pay, fair conditions, fair contracts, fair management, and fair representation), and companies are given a score out of ten based on their adherence to these five principles. Each of the five principles are divided into two thresholds; hence, the scoring system allows a first point to be awarded corresponding to the first thresholds, and an additional second point for the second threshold. The second point can only be awarded if the first point of that principle has been awarded. The thresholds specify the evidence required for a company to receive a given point. Where no verifiable evidence is available, the company is not awarded that point. A company therefore can receive a maximum of Fairwork score of ten points.

Between August and November 2023, Sama's management team provided us with significant evidence of changes that improved their Fairwork score. After starting at a 0/10 in August based on their compliance with the Fairwork for AI principles, they were ultimately awarded 5/10 in December. Major changes included (but were not limited to) raising all associates wages to the Anker-determined living wage before bonuses, extending the standard employment contract to 12 months, developing systems to eliminate unpaid overtime, implementing a zero tolerance campaign on sexual harassment and violence, and eliminating the use of screen monitoring software. These changes address many of the issues raised during our research, and will substantially increase the fairness of work at Sama in the future (GPAI 2023). These changes and their implementation were independently verified by follow-up conversations with some of the workers we interviewed during the research. Furthermore, the changes suggest that despite being subject to competitive market-based dynamics that pressure Sama to lower costs to win business, 'ethical AI' firms can also be subject to a particular kind of counterpressure in the direction of fairer work (even if that means changing the distribution of value within the firm, or charging clients more). The struggle to achieve fairer working conditions at the firm is thus subject to competing imperatives: economic pressure to offer lower prices to clients and another set of pressures to meet legal standards, when in place, avoid negative publicity and keep workers satisfied and productive. The result, as

demonstrated by this case study, is that when pro-worker forces are absent or can be ignored by the company, pay and conditions drop and workers suffer.

If working conditions at a self-reported 'ethical' BPO could have been so dismal, this has implications for job quality across the sector. Indeed, our interviews with workers who had worked at other BPOs in the sector suggest that Sama is no outlier, and if anything, offered slightly better conditions than comparable BPOs. Sama's willingness to make significant changes following the presentation of the evidence is commendable and suggests that it strives to be a market leader in how to treat its workers and operate a data annotation company. It may also indicate the effect of its specific funding structure, with its Series B backers including a development fund and a pension fund with a strong focus on diversity and inclusion. Interviews with senior Sama management suggest that both funders are willing to accept lower gross margins and a longer return profile than traditional venture backers, which gives Sama room for manoeuvre that may not be available to the rest of the market. Our analysis calls for further examination of BPOs providing services to AI companies to confirm whether these problems persist, as we believe they do, as a structural feature across the industry.

A closer examination of this part of the AI supply chain also reveals the important role that could be played by clients in enforcing higher standards. BPOs compete in a fiercely competitive market that requires them to adhere to demands of their clients for minimum conditions for workers. Indeed, some of the positive aspects of working conditions we observed at Sama were the result of clients' specific requests. Companies committed to an ethical AI supply chain could play a more positive role in the industry by demanding a stricter adherence to dignified working conditions for data workers, and avoiding some of the contractual pressures, BPO companies then exert on the workers down the supply chain (e.g., short-term contracts, piece-rate remunerations, hyper-surveillance in the workplace, extreme time pressure for delivering outputs, and so on). Many decision-makers at different levels of the company felt compelled to enforce a particular regime of labour management, because they believed that this is what the client would demand to ensure efficiency and quality. If contracts are not delivered rapidly and to a high standard, clients drop providers and move elsewhere within the sector. Companies should adhere to existing standards set by civil society groups such as the guidelines established by the Partnership on AI or the Fairwork AI principles, among other important contributions to these debates (Partnership on AI 2021).

Finally, there is also an important role that client-side regulators could play in regulating labour conditions across clients' supply chains. One notable example of this form of regulation in action is Germany's recent Supply Chain Act

which entered into force on 1 January 2023. According to this law, companies must make reasonable efforts to monitor social and environmental risks in their own supply chains to ensure that no human rights violations occur as part of their business operations. The Act obliges companies to produce a policy statement on their human rights policies and to implement risk management and risk analysis of their supply chains. This framework also establishes fines for violations of due diligence and reporting obligations of up to 8 million euros depending on the nature and gravity of the violation. Clients and regulators can both ensure that data workers are entitled to secure, dignified and meaningful work in their contribution to the development of the latest AI products.

**Data availability** The participants of this study did not give written consent for their data to be shared publicly, so due to the sensitive nature of the research, supporting data are not available.

## Declarations

**Conflict of interest** On behalf of all authors, the corresponding author states that there is no conflict of interest.

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