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RESEARCH ARTICLE

The Impact of Algorithmic Technology on Labour Rights and Interests in the Context of Digitisation

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Abstract

The ever-changing algorithmic technology is empowering the development of the digital economy in a comprehensive way, promoting the rapid improvement of labour efficiency and creating opportunities for the free and comprehensive development of human beings. On the one hand, algorithmic technology can efficiently break down information barriers, optimise resource allocation in depth and greatly improve the efficiency of labour management, thus playing a positive role in promoting the development of digital labour. On the other hand, it has also shaped a pattern of interactive games among multiple actors, including platform enterprises, consumers and workers, which places workers in a passive and vulnerable position and in turn results in infringements of their legitimate rights and interests, such as the right to social security, the right to appeal, the right to remuneration for labour, the right to autonomy, the right to rest and the right to health. In this regard, we should accelerate the construction of an algorithmic system that balances efficiency and fairness, promote joint action by multiple actors to strengthen accurate regulation of algorithms, strengthen education in algorithmic ethics and construct a more humane algorithmic system, so as to optimise algorithmic governance strategies in respect of technology, regulation and education and thereby improve the system for protecting workers' rights and interests in the digital age.

Keywords: digitisation; algorithmic technology; labour rights and interests

1 Introduction and literature review

An algorithm is a series of clearly defined, finite operational steps or instructions adopted in solving a problem or achieving a particular goal, usually executed by a computer or by a person; algorithms play a vital part in the development of the digital economy and in digital labour management. As the core technology of the digital age, algorithmic technology can mine, process and analyse massive quantities of data and extract valuable information from them, giving enterprises powerful support in improving the efficiency and precision of decision-making; it can record and evaluate digital workers' performance in every dimension, allocate tasks according to their efficiency and capacity, and determine their income levels. Platform enterprises today rely on algorithmic technology to link the capital market, the consumer market and the labour market closely together, and on that basis have absorbed a vast number of flexibly employed workers; drawing on the capacity of algorithmic technology to respond precisely to demand, allocate resources efficiently and supply finely grained decisions, they have achieved innovative development. As digitalisation accelerates, algorithmic technology has been applied widely in recruitment, task allocation, resource scheduling, route navigation, time management, performance appraisal and promotion, profoundly changing labour relations, the form of labour and the mode of labour management. Through such covert and finely engineered strategies as "incomplete labour relations", the "algorithmic black box", "consumer rating and feedback mechanisms" and "gamified competitive incentives", however, platform enterprises have built an unequal relationship among enterprise, consumer and worker that leaves workers passively subject to the "soft compulsion" of algorithmic technology, so that many of their labour rights and interests — the right to social security, the right to consultation and appeal, the right to remuneration, the right to autonomy, the right to rest and the right to health — are infringed, posing a new challenge to the protection of workers' basic rights and interests in the digital age. It is therefore of great importance to examine how algorithmic technology will affect the labour process and workers' rights and interests against the background of digitisation, and how precise governance of algorithms can be achieved so that algorithms genuinely empower workers in the new era.

Scholarship on the impact of algorithmic technology on labour rights and interests in the digital age has so far proceeded along five lines. The first concerns the breaking of traditional labour relations once algorithmic technology intervenes, and

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the series of labour-rights problems caused by the blurring of the employment relationship. Presenting themselves in the capacity of providers of algorithmic technology as "market intermediaries", platform enterprises break the traditional "subordinate" labour relationship: internet platforms seldom conclude formal labour contracts with workers but instead form a "de-labour-relationised" model of flexible employment, which gives rise to problems with workers' rights and interests (Yan Zehua, 2023[1]). New forms of employment typified by "platform plus participant" have dealt a great shock to traditional employment: multi-party employment, online task crowdsourcing, online on-demand matching and platform-based self-employment have transformed labour-economic relations and produced a differentiated pattern of interest distribution (Han Wenlong and Tang Xiang, 2024[2]). An ambiguous "incomplete labour relationship" has formed between platform and worker, one characterised by weak subordination, weak organisation and weak stability, which the traditional "dichotomous" system of labour-rights protection, the labour-relations-linked collective bargaining mechanism and the social insurance system can hardly protect effectively (Hu Lei, 2022[3]). The second line focuses on social security for workers in the new forms of employment. Workers in the new business forms face severe risks of occupational displacement, occupational injury, illness and old age (Xi Heng, 2021[4]). At present China's flexibly employed population shows low overall coverage of work-injury insurance, many contributors but few beneficiaries, a high participation rate in low-risk occupations alongside a low rate in high-risk ones, and a large insurance fund surplus (Wang Xiaoyu, 2024[5]). Labour departments should accordingly require platform enterprises to conclude formal contracting agreements with contractors of good repute, check periodically on the implementation of labour contracts and labour protection, bring the whole flexibly employed population within the scope of occupational-injury protection, and improve the design of basic old-age and basic medical insurance (Zhao Qing, 2024[6]). The third line examines the damage the "algorithmic black box" does to workers' basic rights and interests. The "algorithmic black box" provides space and conditions for the covert operation of power: the concealment and high technicality of algorithms make it easy for them to escape the scope of regulation, and through such modes as classification, screening and prioritisation they acquire the power to construct audience perception and form a covert compulsory force (Zhang Aijun and Li Yuan, 2019[7]). Some platforms use the "algorithmic black box" to raise commission rates in disguise, so that workers cannot obtain the remuneration due to them and interest distribution becomes uneven (Wu Shuai et al., 2024[8]). The fourth line examines the infringement of workers' autonomy by algorithmic surveillance. By granting consumers a god's-eye view of the whole, the algorithmic systems of food-delivery platforms increase consumers' control over and foresight of delivery work, adding considerable pressure on riders and greatly reducing the flexibility of delivery (Chen Long, 2020[9]). The algorithmic power of platforms occupies a monopolistic position and produces inequality between platform and worker: technical rationality directly dissolves the worker's subjectivity, while the conversion of the platform worker's value into computable data, turning the social person into a digital person, is technical rationality dissolving the worker's subjectivity indirectly (Wei Guangping, 2023[10]). Using algorithms and other new technologies, internet platforms have built a threefold and three-dimensional monitoring mechanism of trigger-based networked surveillance, assembly-line drilling and "force-feeding" inspection, thereby completing the control and exploitation of digital workers (Xie Xiaoqin, 2024[11]). The fifth line examines how algorithmic systems use trans-spatiotemporal control, points-and-tier systems and gamified incentives to induce workers to work overtime, damaging their right to rest and their right to health. Through algorithmic systems that transcend time and space, capital covertly extends labour control into leisure time and even into time needed for physical recovery: the employer need not be present to achieve dual control over the worker's activity in physical space and in virtual space (Wang Liyun and Wang Baozhu, 2024[12]). Lured by the reward and points mechanisms set up by platforms, "digital gig workers" throw themselves "voluntarily" into competition and take orders without pay of their own accord; they appear to have won the right to free labour, but in reality they are compelled under algorithmic regulation to raise the intensity of their labour (Yan Kunru and Li Yi, 2023[13]). Platforms have established gamified incentive mechanisms through their algorithmic systems, rolling out various reward and subsidy schemes and periodically updating a "order-king leaderboard", using material and spiritual rewards to spur workers to "take three or five more orders", so that they fall into self-imposed overwork (Deng Zhiping, 2021[14]).

In recent years the Party and the state have given close attention to protecting the rights and interests of workers in the new forms of employment. The *Decision of the Central Committee of the Communist Party of China on Further Comprehensively Deepening Reform and Advancing Chinese-Style Modernisation*, for instance, proposes such measures as "improving the social insurance system for flexibly employed persons, rural migrant workers and persons in new forms of employment, and expanding the coverage of unemployment, work-injury and maternity insurance". Protecting labour rights and interests in the algorithmic age concerns not only workers' wellbeing but also the sustainable development of the economy and the progress of social civilisation; it is an important part of improving social governance and is of far-reaching significance for promoting harmony and stability in contemporary society. This article focuses on questions of labour rights and interests against the background of digitisation: it offers a systematic analysis of the positive role of algorithmic technology embedded in the labour process, examines in depth the internal mechanisms by which algorithmic technology

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gives rise to problems of labour rights and interests, and on that basis proposes targeted strategies of algorithmic governance for protecting labour rights and interests, so as to provide theoretical support and practical reference for improving the system that safeguards labour rights and interests in the digital age.

2 The positive role of algorithmic technology embedded in the labour process

2.1 Algorithmic technology breaks down information barriers efficiently

Through the collection, screening, analysis and processing of massive data and the intelligent matching of supply and demand information, algorithmic technology helps enterprises, consumers and workers break down information barriers, and has made an important contribution to raising market transparency, alleviating information asymmetry in the market and promoting sound competition in the field of the digital economy. First, algorithmic systems can optimise information matching and make personalised information recommendations to enterprises and individuals. Intelligent algorithms turn human behaviour into data: people need only move about on a digital platform or in an area connected to an algorithmic system to leave a digital "footprint", and these "footprints" are recorded and stored as data — the "raw material" on which algorithms run. By comprehensively analysing historical behaviour, preference and demand data for enterprises and workers, algorithmic systems can carry out precise and efficient information matching. Enterprises can obtain optimal solutions under complex constraints and recruit employees whose skills, experience and education fit the post, while workers can quickly obtain information on the positions they desire, reducing the time cost of searching for information. Second, algorithmic systems can help platforms extract valuable market data, industry trends, user demand and labour conditions by analysing and processing big data, so that platforms can formulate effective strategic decisions in line with market trends. Algorithms can track the digital activity of platform users, analyse their personality, interests and demand tendencies from big data, form a "data profile" and thereby supply personalised goods and services; algorithms can moreover extract and analyse the various data generated by digital workers in the labour process, and so optimise the standard of labour remuneration and give the platform an advantageous position in competition (Xiao Feng and Hu Yueqing, 2024[15]). Third, algorithmic systems can strengthen information sharing and collaboration and make digital labour proceed more smoothly. On the one hand, algorithms can organise and summarise information from different channels and provide enterprises and workers with a clear view of it; on the other hand, some algorithmic systems integrate such collaborative functions as instant messaging and file sharing, which help to break the "information cocoons" of the various actors and effectively improve labour efficiency.

2.2 Algorithmic technology optimises resource allocation in depth

Data play a core role in algorithmic systems. As the link and intermediary in the circulation of economic factors, data can dynamically connect the various actors and factors in the flow of people, goods and capital, achieving an optimal allocation of resources and to some degree avoiding mismatches in the proportion and structure of factors (Ma Yan and Chen Yao, 2023[16]). Through data-driven operation, intelligent decision-making and dynamic optimisation, algorithmic technology continually reshapes the underlying logic of resource allocation and drives the transformation of social resources from "experience-led" to "algorithm-led". First, algorithms can allocate work tasks automatically and intelligently. On the one hand, an algorithm can automatically allocate work to the most suitable worker according to the worker's age, skills, experience and efficiency together with the requirements and characteristics of the task; on the other hand, it can dynamically adjust the worker's tasks according to real-time changes in the labour setting, resource utilisation and customer demand. Through optimal time planning and task allocation, algorithms can help workers complete as much work as possible in as short a time as possible, greatly improving performance and generating profit for the enterprise at the highest efficiency. Second, algorithmic systems have powerful capacities for data analysis and prediction: by mining and analysing historical data they can predict the future balance of supply and demand in labour resources with reasonable accuracy, helping enterprises to prepare in advance and allocate labour resources rationally, so avoiding waste or shortage. Third, algorithms can provide personalised matching of work resources according to workers' individual preferences, needs and working habits. This plainly helps to raise workers' sense of wellbeing and to stimulate their subjectivity and creativity.

2.3 Algorithmic technology greatly improves the efficiency of labour management

The intelligent algorithm is one of the most important means of production in the digital age: acting as an invisible manager controlling the entire labour process, through efficient task allocation, real-time tracking of labour data, dynamic pricing, performance appraisal and ranking, and targeted information push, it greatly improves the efficiency of labour management. Algorithmic control resting on big data takes Max Weber's principle of rationalisation to its limit, realising the principles of high efficiency, calculability, predictability and controllability across every dimension, throughout the whole process,

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seamlessly and precisely (Wu Jing, 2022[17]). First, data-tracking algorithms and machine-learning algorithms can supervise and manage the whole labour process efficiently. On the one hand, throughout the labour process data-tracking algorithms closely control the worker's state of labour and the use of means of production; on the other hand, machine-learning algorithms can continually optimise the ratio of the technical composition of capital and the structure of the workforce so as to improve regulatory efficiency and save costs (Yang Shanqi and Liu Yan, 2021[18]). Second, algorithms play a pivotal part in labour performance appraisal and evaluation, helping enterprises to build a visualised and precise meritocratic management. At the appraisal stage algorithms record the worker's state, customer evaluations and work efficiency in standardised form, and grade and rank workers so as to promote competition among them (Yang Shanqi and Liu Yan, 2021[18]). By precisely quantifying and analysing the various work data of workers, algorithms can reduce interference from such factors as the preferences and moods of the enterprise or its managers and measure the worker's value more comprehensively and objectively by combining multidimensional information on performance, customer feedback and innovative contribution. Moreover, details of the worker's working state, efficiency in executing tasks, behavioural patterns and even personal mood swings are all converted by algorithms into data that can be referenced and used; algorithmic systems can therefore track the trajectory of a worker's skills and performance, build a comprehensive "profile" of the worker, help the enterprise adjust its talent-management strategy quickly, and by identifying the worker's latent problems and capacity bottlenecks help the worker improve efficiency and plan future work better. Finally, algorithms can carry out intelligent dynamic pricing of labour, helping enterprises to "reduce costs and increase efficiency". Dynamic pricing algorithms can, according to the state of supply and demand in the labour market, predict accurately the minimum wage a worker will accept in different regions and periods, and adjust the enterprise's own labour costs accordingly (Yang Shanqi and Liu Yan, 2021[18]).

3 The internal mechanisms by which algorithmic technology gives rise to problems of labour rights and interests

Algorithmic technology is not value-neutral but reflects the intentions and preferences of its designers and users. Once designers and users over-emphasise the "efficiency logic" of algorithms and neglect the "logic of the person", a series of problems with labour rights and interests is bound to follow. Intelligent algorithms not only help enterprises to establish meritocratic management and greatly improve their economic returns but also drive the formation of a pattern of interactive games among multiple actors — platform enterprises, consumers and workers. In this pattern, however, workers are on the whole in a passive and weak position, and their labour rights and interests — the right to social security, the right to consultation and appeal, economic returns, career development, the right to autonomy, the right to rest and the right to health — are damaged to some degree.

3.1 Labour-rights problems arising from the unreasonable application of algorithmic technology by platform enterprises

3.1.1 The blurring of the employment relationship damages workers' right to social security

Ever-changing digital technology has driven the rapid growth of the gig economy, breaking the relatively stable traditional labour relationship and making flexible employment widespread, so that the clear subordinate relationship between worker and employer has been weakened. Platform enterprises that control algorithmic systems regard themselves as playing the role of intermediary between worker and consumer: the consumer pays, the worker provides the service, and the platform does not intervene in the service agreement between the two nor prescribe the worker's hours or workplace, but merely uses algorithms to provide information on market supply and demand and to monitor performance of the agreement as a reliable intermediary. Sheltering behind their algorithmic systems, platforms have in this way abstracted themselves out of the traditional labour relationship (Yan Zehua, 2023[1]). Algorithmic management technology decomposes the labour process into many task modules and places workers flexibly at the various task nodes in line with changing actual demand and resource supply. Because this mode of labour is uncertain, short-term and flexible, workers and platform enterprises often no longer stand in a clear employment relationship but are defined as "independent contractors": their subordination to the employer in personality, economic and organisational terms is no longer evident, and many workers have not even concluded a clear employment contract with the employer. Although the worker's status is relatively independent, in practice the worker must still follow a series of algorithmic rules laid down by the platform and accept the task allocation and performance appraisal of the algorithmic system, so forming a relation of "covert subordination". Algorithmic technology has developed a new type of labour relationship and improved the efficiency, flexibility and autonomy of labour, but the blurring of the subordinate relationship has also brought many employment disputes and new problems of labour rights and interests, of which damage to the right to social security is the most prominent. While using algorithmic technology to reduce labour costs, platform enterprises also outsource or simply ignore responsibility for such social

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security as maternity, medical, work-injury and unemployment protection; workers lack adequate institutional support when facing uncertainty or occupational risk, and so encounter difficulties in claiming benefits, narrow coverage and low levels of protection when participating in basic social insurance. Platform enterprises use algorithmic technology to control the labour process precisely and, through route optimisation and dynamic scheduling, reduce the safety hazards workers face in complex settings. Many enterprises, however, are unwilling to bear the cost of protecting rights and interests that an employment relationship generates, and therefore use algorithmic technology to recast the labour relationship as a data-driven, de-employed, indirectly hired mode of cooperation, in which the service relationship among platform enterprise, outsourcing agency and worker is often hard to identify clearly. As dispatched workers, part-timers, outsourced workers, crowdsourced workers or the self-employed, workers in flexible employment face low thresholds for entering and leaving the industry and work by taking orders on their own initiative, with no clear employer and a hard-to-define duty of employment; they may even lack a lawful and compliant labour contract, and so often cannot be effectively protected by labour law and related statutes. In such high-risk industries as food delivery, express delivery and ride-hailing, the risks of occupational injury — traffic accidents, physical injury and occupational disease — are built into the algorithmic system as "costs" to be avoided as far as possible rather than as basic risks to be protected against. The blurring of the employment relationship enables platform enterprises to transfer labour risk to workers themselves in the guise of "technology intermediary" or "lessor", thereby weakening or even evading the legal obligations they should bear in respect of occupational-injury protection. A 2022 survey by the Jinan survey team of the National Bureau of Statistics showed that in the Jinan area only 13.8 per cent of employers paid work-injury insurance for food-delivery riders, while riders who had themselves and whose colleagues had all been free of accidents, notwithstanding the pressure of delivery deadlines, accounted for only 39 per cent (Liu Ping et al., 2023[19]). This shows that improving the mechanism protecting workers' rights and interests, promoting high-quality development of the gig economy and clarifying the labour employment relationship are of the first importance.

3.1.2 The "algorithmic black box" obstructs effective consultation and appeal by workers

In traditional bureaucratic management, a worker's performance appraisal rests mainly on a superior's assessment of a subordinate or on mutual assessment among colleagues, so the evaluation criteria are usually easy to understand and strongly personalised. In the digital age, however, internet platforms have gradually replaced traditional physical organisations as the new vehicle of production activity, and intelligent algorithms have replaced the managers of the traditional bureaucracy in appraising employee performance: with the aid of large-model technology, intelligent algorithms can, through continuous machine learning and interaction with both capital and labour, bypass the capital side's own determination and autonomously settle on the optimal appraisal strategy, forming a de-personalised appraisal system (Wu Shuai et al., 2024[8]). Although this shift has improved the efficiency of labour management, it also enables platform enterprises to make and exploit opaque algorithmic rules: to ignore the value created by a worker's individual labour time, depress the worker's commission rate, raise appraisal standards and work intensity and apply a strict system of penalties, thereby deeply affecting the worker's actual income and extracting more surplus value. Although the results of algorithmic appraisal can directly affect a worker's task allocation and income, monopoly platforms hold pricing power and discursive power firmly in their hands and often plead trade secrets in refusing to disclose the algorithm's specific rules, operating principles and decision process, manufacturing an "algorithmic black box" so that workers can hardly ascertain the scoring rules of the algorithmic system and the weights of its various indicators. Some platform enterprises do provide complaint and feedback channels, but the "algorithmic black box" is often made up of large numbers of interwoven mathematical and statistical models in which the relation between input and output is complex and non-linear, and which are markedly opaque, closed and complex; and since workers generally lack a basic knowledge of algorithms, they find it very hard to understand accurately the process by which the algorithm operates and the basis and logic of its decisions, so that they face serious information asymmetry in labour disputes. When confronted with unfair pay or unreasonable penalties, therefore, workers often lack the capacity to bargain collectively and cannot lodge a targeted and reasoned appeal against a disputed appraisal result, and so cannot effectively defend their labour rights and interests. In short, the "algorithmic black box" greatly increases the cost of communication between platform enterprises and workers and aggravates the difficulty workers face in consulting and appealing when their rights and interests are infringed.

3.2 Labour-rights problems arising from unequal interaction between consumers and workers under biased algorithmic rules

3.2.1 Under unfair consumer evaluations, workers' economic returns and career development suffer

To maximise economic returns, many platform enterprises lay down "consumer-first" algorithmic rules: the indicators the algorithmic system values — quality of service, attitude of service, complaints and suggestions, five-star ratings — are all

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markedly biased towards the consumer, which leaves workers without the discursive power they ought to have and in an extremely passive position. Digital capital uses algorithmic technology to construct a digital reputation mechanism resting chiefly on user scoring and customer evaluation, outsourcing to consumers the employee-appraisal function that should be borne by the human resources department, so that consumers and the algorithmic system together play the role of "manager" (Huang Zaisheng, 2022[20]). By virtue of their "final say in evaluation", consumers occupy an advantageous position in their interaction with workers, while platforms often do not adequately examine whether a consumer's evaluation reflects objective fact, and consumers often need not answer for their evaluations or remarks. This quality of non-liability in the feedback and evaluation mechanism exposes workers to the risk of economic loss and other damage to their rights and interests through unfair, one-sided or even maliciously low consumer ratings. In fact, a consumer's evaluation and satisfaction do not necessarily reflect truthfully the worker's quality of service or performance: the rating may be affected by personal mood, personal preferences and needs, previous experience, incidental circumstances in the course of service, problems with product quality and many other factors, so that the worker suffers unfair penalties which in turn affect income and promotion prospects. Once consumers' subjective evaluations have been incorporated by the algorithmic system into the worker's performance appraisal, the platform on the one hand fails to verify and examine the objectivity of the evaluation results and ignores the worker's actual performance and its reasons in complex working situations, and on the other hand lacks any mechanism for correcting and adjusting the results of that appraisal and provides workers with no smooth and effective channel of appeal. Some workers are consequently unable to obtain reasonable remuneration, and their paths of career development are blocked.

3.2.2 Under the joint monitoring mechanism of platform and consumer, workers' autonomy suffers

In the digital age algorithmic technology is widely used in the interaction between consumers and workers to ensure that consumers receive a high-quality service experience, but it also neglects the worker's position as a subject. Because consumers enter into a close interactive relationship with workers through the labour-evaluation mechanism in the algorithmic system, and their ratings largely determine the worker's chances of receiving orders and their income level, the worker's decisions and conduct at work are subject to enormous external pressure from consumers. On the basis of consumer feedback, each of the worker's tasks is broken down by the algorithm into specific operational steps and standardised procedures. Although the standardisation of the labour process improves the efficiency and quality of service, it also restricts the worker's right to choose the content, method and steps of the work autonomously and narrows the room for applying personal experience, exercising creative thinking and solving problems flexibly. Workers' individual differences, particular circumstances and needs are also often ignored, so that they are driven to exhaust themselves in meeting consumers' demands. The standardised evaluation system of algorithms tends to stress consumer-side indicators that can be quantified — clicks, sales volume, satisfaction — while making light of worker-side factors that are hard to quantify, such as capacity for innovation, adaptability and independent decision-making; one-sided evaluation criteria suppress workers' subjectivity and creativity in their work. The consumer rating mechanism forces workers to cultivate various "soft skills" and social dispositions and to deal warily with customers who act as third-party "managers": faced with consumers of every kind and every changing mood, they must expend great ingenuity on emotional labour in its various forms in exchange for a consumer's "five-star rating" (Huang Zaisheng, 2022[20]). Smiling service, forms of blessing, tone of voice, warmth of manner and the display of particular emotions have become an important part of the algorithmic evaluation system, and workers must at all times "high-quality" cater to consumers in emotional expression and interaction, which greatly restricts their autonomy and also constitutes a "third-party exploitation" of the worker. Online streamers, for example, must often conceal their true feelings and continually adjust their emotional state to meet audience expectations and enliven the atmosphere of the live-streaming room if they are to maintain their traffic. They must at all times attend to the management of facial expression, posture, wording, tone and mode of interaction, long performing another "persona", disciplining themselves, commodifying themselves and objectifying themselves for the sake of click-through and sales figures; emotional labour thus stripped from the self has produced occupational burnout and mental-health problems in many streamers.

3.3 Labour-rights problems arising from excessive competition among workers under algorithmic inducement mechanisms

3.3.1 The right to rest is infringed under "self-exploitation" competition

Through precise data monitoring and real-time performance evaluation, the algorithmic system can continually optimise work arrangements and impel workers to raise their efficiency, but it also aggravates competition among workers. Algorithms under capital's control use the pressure of high-standard appraisal, differentiated distribution of income and promotion prospects, and the inducement of generous performance bonuses to make workers believe that "anything is

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possible", and so to turn them into "go-getting" meritocratic individuals who inscribe the desire to maximise performance deep in their consciousness and throw themselves into the tense "involution" of the workplace. Individuals are indeed often obliged to expend more effort and time if they are to stand out at work, but when that effort passes the bounds of reason and degenerates into irrational self-consumption and mutual consumption, it produces the unreasonable competition of "self-exploitation". In an ever harsher competitive environment many workers actively extend their working hours in order to hold their advantageous position, giving up recreation, social life and even time with their families, choosing frequent overtime, working weekends without rest or handling work matters outside working hours, so that rest and leave come to be regarded by them as "dispensable" rather than as the worker's most basic right. One social survey reports that nearly half of workers in the new forms of employment work more than 40 hours a week, that nearly 40 per cent of them work one to two times the standard hours, that nearly 8 per cent work two to three times the standard hours, and that a few work even more than three times the standard (Mo Rong, 2024[21]). "Self-exploiting" competition exists not only in such labour-intensive industries as logistics, food delivery and ride-hailing but also among highly skilled workers. In some internet platform enterprises, algorithms manage software engineers by combining carrot and stick, that is, by combining flexible management measures with a strict evaluation system. Although the enterprise does not compel overtime, these engineers face the innovation anxiety and fierce performance contest produced by a demanding algorithmic evaluation system, and bear the enormous pressure generated by difficult promotion and the "age-35 crisis". They therefore throw themselves "proactively" into an ever-accelerating "labour race", often working day and night at the risk of "death from overwork": many work more than ten hours a day and eighty hours a week, frequently give up public holidays and leisure, and find normal rest a luxury.

3.3.2 The right to health is infringed under the "speed-up game" mechanism

In industries that depend heavily on algorithms for work allocation and performance evaluation, competitive pressure among workers has evolved into a broad pressure to survive and to advance, endangering workers' right to health. As algorithmic technology becomes ever more the dominant force in the labour process, the worker's replaceability is greatly increased, so that workers neglect their own normal physical and psychological needs in pursuit of higher performance ratings and income and fall into the trap of vicious competition. Food-delivery platforms use algorithms to design a rider hierarchy tied directly to performance, turning the dull labour of delivery into a "speed-up game" that is tense and exciting, full of challenge and variables and concealing unknown surprises. Each time a rider is successfully promoted, they receive a new title, new entitlements or the corresponding new equipment and points; the platform moreover sets up leaderboards for daily, weekly and monthly delivery volumes, and station managers periodically push individual delivery rankings into work groups to promote internal competition (Sun Ping, 2024[22]). The hierarchy and leaderboards tied directly to "privileges" fire riders' enthusiasm for competing with one another: the appearance of objective fairness created by "more work, more pay", the ever-growing material desires encouraged by instant rewards, the pride of "holding one's fortune in one's own hands" and the glory of becoming a distinguished competitor together make many riders gradually addicted to the "over-quota delivery game" of pursuing "faster, more, harder". The positive feedback that hard work brings reinforces some riders' "consent" to delivery labour and their psychological dependence on it, and leads them to seek self-recognition through more desperate work. Algorithmic rules deftly cater to workers' desire for self-mastery, for standing out in fierce competition, for earning more and for confirming their own worth, and so impel them, while tacitly accepting the platform's various rules, to throw themselves into the melee of the "order-rush game". To win in fierce competition and take higher returns, workers may take on tasks beyond what they can bear regardless of physical fatigue, constantly pushing the limits of performance, working hours and labour intensity while paying no attention to protecting their own health; overwork and irregular eating and sleeping readily bring on such occupational diseases as sports injuries, cardiovascular disease and stomach complaints. At the same time a persistently high-pressure environment poses a latent threat to workers' mental health. Unreasonable competition has bred a group of over-"positive" workers addicted to an alienated sense of self-realisation, and has also left many workers in psychological fatigue, emotional standardisation and hollow burnout, gradually losing their sense of belonging at work and even "quitting in spirit" while still on the job. "Hyperactivity" at work may lead to an extremely passive mode of conduct, provoking bewilderment, anxiety and depression in workers.

4 Algorithmic governance strategies for protecting workers' rights and interests in the digital age

4.1 The technical dimension: constructing an algorithmic system that balances efficiency and fairness

Platform enterprises are the subjects that design and apply algorithmic systems, and their design philosophy and mode of application bear directly on workers' income levels and working conditions. If an algorithm pursues capital appreciation and the maximisation of economic returns to excess while neglecting protection of workers' basic rights and interests, this will be detrimental to the enterprise's healthy long-term development. We should therefore attach importance to putting people

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first, construct an algorithmic system that balances efficiency and fairness, create a sound interaction among algorithm, platform enterprise and worker, and strive to balance the interests of platform enterprise and worker so that both benefit. First, core design principles of fairness and justice, transparency and explainability should be established at the algorithm-design stage, so as to prevent algorithmic systems from pursuing efficiency and profit one-sidedly. Algorithmic performance-appraisal standards such as task completion volume, online rate, punctuality rate and positive-rating rate should be set reasonably, labour intensity determined scientifically, and time-management algorithms, work-allocation algorithms, employee-promotion algorithms and other algorithms closely related to labour rights improved in accordance with the requirement that they be both efficient and humane. Enterprises should of their own accord refuse to use such means as the algorithmic black box and algorithmic hegemony to reduce employees' basic pay, commission rates and bonuses unilaterally or to apply excessively harsh penalties. Second, the algorithmic decision mechanism should be optimised in depth, ensuring that the algorithm fully respects and protects people's rights and needs while improving work efficiency. Platforms should accelerate algorithmic disclosure, set up dedicated areas for algorithmic publicity, and invite users, employees and relevant experts to discuss jointly the basic principles and operating mechanisms of their algorithms. Full account should be taken of individual differences and needs: more flexible schemes of work should be provided according to the worker's working hours, state of health, task complexity and individual capacity for service; and performance appraisal should analyse specific problems specifically, avoiding excessive reliance on such quantitative indicators as hours worked, task volume, punctuality rate and consumer evaluation. Finally, the algorithm's capacity for dynamic adjustment and its capacity for innovation should be strengthened. Algorithmic rules need to be adjusted dynamically in line with changes in labour conditions, a sound system for data monitoring and analysis built, the effects and impact of algorithmic decisions tracked closely, and algorithmic parameters and decision mechanisms optimised in good time according to feedback from workers and consumers. Technological innovation should be strengthened, with the efficient allocation of resources and the reduction of labour intensity as its goals, and algorithmic iteration advanced continuously, so that the algorithm genuinely empowers and builds up the worker.

4.2 The regulatory dimension: multi-party co-governance and stronger precise regulation of algorithms

Stronger precise regulation of algorithms is the necessary path to safeguarding workers' basic rights and interests. Co-governance by legislatures, regulators, social organisations and workers, together with dynamic regulation in step with the latest development of algorithmic technology, is needed to achieve comprehensive and effective protection of workers' rights and interests. First, regulators should require and guide platform enterprises to clarify the employment relationship and their principal responsibility, and prevent enterprises from disguising themselves as "technology-intermediary companies" by exploiting the algorithm's screening effect in order to evade the social security obligations they owe workers. Employers should be required to clarify labour relations along the dimensions of personal subordination, economic subordination and organisational subordination; as for workers "not wholly conforming to the situation in which a labour relationship is established", lawful and compliant service contracts, contracting agreements or written service agreements should be concluded with them, the rights and obligations of both parties reasonably specified, and such social insurance as work-injury insurance and employer's liability insurance taken out for them, so providing them with the most basic social security. Second, legislatures need to speed up the formulation and improvement of laws and regulations on algorithmic regulation and, through legislative means, set reasonable "traffic lights" for the business management of platform enterprises. For the use of the algorithmic black box, algorithmic hegemony, algorithmic discrimination, algorithmic manipulation and other means to infringe labour rights and interests, and for the use of algorithms to set unreasonable performance-appraisal standards or to induce workers, through performance leaderboards or high-tier "privileges" offered frequently, into self-exploitation and excessive competition, more deterrent penalties should be laid down. The algorithm filing system and the system of subsequent algorithm assessment should be improved, the mechanism of tiered and classified algorithmic regulation refined, and for algorithmic systems involving the right to labour remuneration, the right to rest and the right to health and other basic labour rights, strict review should be required of such links as data collection, variable selection, operating logic and output results. Third, multi-party participation of all sectors of society in the precise governance of algorithms should be promoted. Regulators and industry associations may require platform enterprises to explain publicly the basic principles and logic of their algorithms, their data selection, their decision process and their intended purpose, and may join with third-party assessment bodies to carry out professional review of the fairness, lawfulness, transparency and accuracy of algorithms. Attractive incentives should be put in place to encourage the public and social organisations to submit opinions and suggestions on algorithmic rules through open channels, and manual review should be conducted periodically so as to strengthen supervision by public opinion. A system for real-time feedback of employees' opinions should be established, allowing workers to appeal against malicious complaints or unfair evaluations by consumers, with the circumstances investigated, verified, screened and handled, so that employees can put forward suggestions for improvement in good time regarding unreasonable algorithmic rules and decisions. Finally, a dynamic

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regulatory system that keeps pace with the times should be built quickly. Regulators should keep abreast of the development of algorithmic technology, continually improve their own technical capacity, and conduct comprehensive review and supervision of newly developed and applied algorithms periodically. They should maintain cooperation with technology enterprises and research institutions to develop jointly intelligent systems capable of real-time monitoring and efficient analysis of algorithmic behaviour, discover and handle the latest typical cases of algorithmic infringement in good time, and provide early warning and assessment of potential risks.

4.3 The educational dimension: strengthening education in algorithmic ethics and promoting algorithmic beneficence

Strengthening education in algorithmic ethics for algorithm developers and users, and guiding them to instil the correct value orientation into the design, application and subsequent management of algorithms so as to promote algorithms that are upward-looking and beneficent, is a necessary path to achieving efficient governance of algorithms and responding to problems of workers' rights and interests. Concentrated education and training may be provided periodically within enterprises for the practitioners concerned, disseminating the following ethical principles to that group. First, all labour subjects must be treated equally: workers must not be given discriminatory treatment on the basis of an "algorithmic profile", nor have their right to know deprived or their basic labour rights infringed. Second, algorithms must not be used — through algorithmic evaluation, "algorithmic games" or information cocoons — to subject workers to improper psychological manipulation, endanger their mental health or plunge them into an alienated state of work. Third, the worker's subjectivity and uniqueness must be respected: workers should not be reduced simply to data or treated as instruments, nor subjected to panoptic algorithmic surveillance of their work and life or to interference in their autonomous labour and creative activity; in making decisions by algorithm the humanistic principle must be upheld, and the worker's personal dignity must not be harmed. General courses in algorithmic ethics may be offered to the relevant disciplines at universities, explaining in detail through concrete cases of algorithmic ethics such specific principles as the principle of doing no harm, the principle of responsibility and the principle of beneficence; interactive methods of teaching such as group discussion and role-play may be used to simulate algorithm design and ethical assessment, combining theoretical teaching with practical operation so that students understand how to apply the principles of algorithmic ethics in practice and future practitioners form a correct outlook on professional ethics. Work at the grassroots level should be deepened, and the popularisation of algorithmic ethics accelerated through online courses, new-media publicity, community lectures and seminars, so as to foster a sound social atmosphere in which the whole of society attends to and learns about algorithmic ethics.

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