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Navigating the Digital Age: Insights, Contributions
and Challenges from a Sociology of Work Perspective

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1. *The pervasiveness of digital technologies in the world of work*

One of the main concerns of contemporary sociology of work is the pervasiveness of digital technologies across occupations, industries, and institutional contexts. Digitalization transforms not only high-skilled or high-tech sectors; it spreads across the labor market, affecting professionals, technicians, office staff, but also low-skilled and manual workers. Empirical evidence shows that a considerable share of workers with primary education use portable digital devices in their daily activities, challenging the view that digitalization only concerns a restricted elite of knowledge workers and revealing, instead, its systemic diffusion. Recent European surveys confirm that more than four out of five workers regularly use some form of digital device in their work and that this is true not only for office-based occupations but also for sectors such as logistics, cleaning, and personal services.

The widespread adoption of digital technologies has brought with it both opportunities and risks. On the one hand, it enables new forms of flexibility, coordination, and improves productivity. The possibility to engage in remote work or hybrid arrangements, supported by digital infra-

structures, has extended autonomy for many professionals, particularly in high-skilled service sectors. On the other hand, digitalization exacerbates the fragmentation of tasks, space, and time, enhances surveillance, and increases work intensity.

Before examining the empirical evidence on the diffusion of digital technologies in work processes, it is useful to situate these developments within the broader sociological debates on how the concept of work itself is reconfigured in the digital age. A growing literature has questioned the boundaries traditionally established between production and consumption, paid and unpaid work, formal and informal activities, through notions such as digital labour, prosumption, and produsage. These perspectives highlight how value creation increasingly relies on activities that remain partially invisible or excluded from standard employment relations, blurring the distinction between work and non-work. Particularly, as Casilli and other scholars have shown, a significant share of digital value creation relies on forms of invisible, fragmented (often outsourced) and weakly recognized labour[1]. Digitalization thus entails not only technological innovation, but also processes of job reclassification and social invisibilization of work.

From this standpoint, digitalization does not simply introduce new tools into existing jobs, but contributes to a redefinition of what counts as work, who is recognized as a worker, and which forms of labour remain socially and institutionally acknowledged. Framing digitalization within these debates allows the analysis to move beyond a purely descriptive of how technology is spread and to reconnect empirical trends to core sociological questions concerning recognition, invisibility, and the social boundaries of labour.

As Eurofound's most recent survey illustrates, only a minority of European workers telework full-time (around 3%), but hybrid and occasional telework arrangements are steadily expanding and now involve almost one

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[1] Casilli, *En attendant les robots-Enquête sur le travail du clic*, Editions du Seuile, 2019; Ter Hoeven, Van Zoonen, *Flexible work designs and employee well-being: Examining the effects of resources and demands*, in *NTWE*, 2015, 30(3), pp. 237-255; Surie, Huws, *Platformization and informality: Pathways of change, alteration, and transformation*, in Surie, Huws (eds.), *Platformization and Informality: Pathways of Change, Alteration, and Transformation*, Springer International Publishing, 2023, pp. 1-12; Borghi, Peterlongo, *Hybridisation of work and the platform informal revolution*, in *RIS*, 2023, 64(2), pp. 317-344.

quarter of the workforce[2]. While such arrangements may improve work–life balance for some, they are also contributing to blur the boundaries between work and private life, due to a higher availability outside normal working hours and a greater exposure to unpaid overtime, especially for women, who bear disproportionate responsibilities for care.

The emergence of generative artificial intelligence tools has added further complexity. Despite a still uneven diffusion, around 12% of workers in Europe report using AI-based systems such as ChatGPT or image generators in their daily tasks: usage peaks above 20% in some Northern and Western Europe countries, while remaining below 5% in Southern and Eastern regions[3]. These technologies promise gains in efficiency and creativity, but also threatens of substitution of cognitive tasks and of new forms of dependency on opaque algorithmic systems. The diffusion of algorithmic management is already quite visible across sectors: about 17% of workers report that their performance is monitored by algorithmic systems, 16% that their task allocation is managed digitally, and 10% that their working hours are set automatically by a software[4]. These figures highlight how the employ of algorithmic management is no longer restricted to platform work, but has penetrated financial services, transport, logistics, manufacturing and other sectors. The most recent ILO estimates reinforce this picture by examining the exposure to generative AI across the global workforce[5]. According to the 2025 World Employment and Social Outlook report, nearly one in four workers worldwide is employed in occupations that display some degree of exposure to GenAI. Around 16.3% of workers are in roles with medium exposure, while 7.5% are in occupations where most tasks could in principle be automated by GenAI, especially in high-skilled professions such as accountants, software developers, and clerical support roles. In contrast, low and medium skill occupations remain largely shielded, with over 99% of workers facing minimal or no exposure at all[6]. These findings suggest that

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[2] Eurofound, *Living, working and COVID-19*, Publications Office of the European Union, 2024.

[3] Eurofound, *cit*.

[4] Eurofound, *cit*.

[5] ILO, *World Employment and Social Outlook: Trends 2025*, ILO Flagship Report, 16 of January 2025, website: https://www.ilo.org/publications/flagship-reports/world-employment-and-social-outlook-trends-2025.

[6] ILO, *cit*.

generative AI will not only transform cognitive work but also contribute to a restructuring of employment by skill level. While medium-skill occupations appear to be the most exposed segment (38.1% of total show some degree of exposure), the concentration of high-exposure roles is greater in high-skill employment, which foster the debate on the future of professional and knowledge work[7].

The growing pervasiveness of digital technologies across occupations, sectors, and national contexts not only demonstrates the breadth of the current technological transformation but also raises fundamental questions about its consequences for workers and employment structures. The fact that digital tools now shape the daily activities of both high-skilled professionals and low-skilled manual workers indicates that the impact is neither confined to specific segments of the labour market nor limited to narrow forms of task automation. Rather, the diffusion of digitalization penetrates deeply into the organization of work, reconfiguring rhythms, expectations, and modes of coordination. This expanding technological presence inevitably shifts the attention of scholars toward two closely intertwined issues: the first is how digital systems reshape the *quality* of work and the second refers to how they transform the *quantity* and composition of employment. In other words, once the systemic character of digitalization is recognized, the analysis must move beyond the descriptive dimension of a fast diffusion to explore its substantive effects on labour. It is precisely at this analytical juncture, where widespread adoption intersects with concerns about work intensification, autonomy, surveillance, and potential job displacement, that contemporary debates on job quality and the substitution of labour by technology reaffirm their relevance and urgency.

While a growing body of sociological literature has addressed the implications of digitalization for work and employment, this article argues that existing contributions often remain fragmented across distinct analytical traditions, focusing on either job quality, employment effects, or governance and regulation. The contribution of this article lies in proposing an integrated analytical framework that connects these strands and allows for a more systematic interpretation of digital transformation in the world of work.

Specifically, the article advances a three-dimensional analytical perspective. First, it conceptualizes digitalization as a process that simultane-

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[7] ILO, *cit.*

ously reshapes job quality and employment structures, linking debates on work intensity, autonomy, and psychosocial risks with those on task substitution and occupational change. Second, it emphasizes the institutional, sectoral, and organizational mediation of technological change, rejecting universalistic accounts and highlighting how similar technologies generate divergent outcomes across contexts. Third, it foregrounds the role of power, knowledge, and opacity in digitally mediated workplaces, showing how algorithmic systems reorganize authority, visibility, and control.

By articulating these dimensions within a unified sociological framework, the article seeks to move beyond descriptive overviews and to offer an analytical tool for interpreting current transformations of work under digitalization.

At the same time, the article adopts a thematic rather than approach-driven structure. This choice is deliberate and reflects the increasing overlap between analytical traditions that address digitalization and work. Rather than mapping contributions according to discrete theoretical schools, the article organizes the discussion around key analytical dimensions through which different approaches, including labor process theory, institutionalist perspectives, and socio-technical traditions, intersect and contribute to the understanding of the digital transformation. This thematic organization intends to facilitate the dialogue across approaches while preserving analytical coherence.

2.   *Work under digitalization: reconfiguring job quality and employment structures*

The diffusion of new technologies has re-awakened attention to the social sciences, focusing simultaneously on the transformation of work (how it is carried out, the conditions under which it unfolds, and its overall quality), and on the risks of job substitution generated by technological innovation. These two strands of inquiry are deeply connected: understanding the future of employment requires analyzing not only whether jobs will be created or destroyed, but also how technological change reshapes the quality of work itself.

For low-skilled and manual workers, digitalization is often less about autonomy and more about control. Studies on warehouse employees and delivery drivers show how wearable devices, scanners, and GPS trackers

dictate the pace and reduce the discretion in organizing tasks[8]. Algorithmic allocation of shifts and performance metrics further standardize and intensify work. Recent analyses link these practices to psychosocial risks, showing that algorithmic monitoring contributes to the loss of autonomy, increased monotony, and higher levels of work-related stress, anxiety, and burnout. Moreover, the intensification associated with digital tools often coincides with reduced clarity of roles, weak support, and heightened feelings of isolation, especially in telework and hybrid arrangements. It is not a coincidence, therefore, that the debate on job quality has been significantly revitalized in the digital era. Earlier literature concentrated on wages, contractual security, and working hours, whereas the pervasive impact of digital technologies has made job quality inseparable from technological transformations. Digitalization simultaneously promises empowerment and generates new vulnerabilities: it introduces new forms of control, subjectification, and psychosocial risks that reshape how workers experience their jobs[9]. At the same time, it compels scholars to integrate into the concept of job quality new dimensions such as algorithmic transparency, data protection, skill obsolescence, and the psychosocial consequences of technologically mediated work[10]. The literature increasingly emphasizes risks such as "technostress", social isolation, and permanent availability, illustrating how digital technologies affect not only the organization of work but also the

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[8] DELFANTI, *The warehouse. Workers and robots at Amazon*, Pluto Press, 2021; CIRILLO, RINALDINI, VIRGILLITO (eds.), *Technology and work in services: Vulnerable workers under automation and digitalisation*, Cham, Springer Nature, 2025, pp. 1-33.

[9] CARRERI, GOSETTI, POGGIO, ZANONI, *Lavoro e digitalizzazione: soggettività, controllo e qualità del lavoro nella quarta rivoluzione industriale*, in *SL*, 2020, 158, pp. 51-73.

[10] POUTANEN, KOVALAINEN, *Skills, creativity and innovation in the digital platform era: Analyzing the new reality of professions and entrepreneurship*, Routledge, 2023; KOVALAINEN, VALLAS, POUTANEN, *Theorizing work in the contemporary platform economy*, in POUTANEN, KOVALAINEN, ROUVINEN (eds.), *Digital work and the platform economy*, Routledge, 2019, pp. 31-55; ARCIDIACONO, PICCITTO, *Assessing inclusivity through job quality in digital plat-firms*, in *SIn.*, 2023, 11(4), pp. 239-250; ARCIDIACONO, PAIS, PICCITTO, *La qualità del lavoro nella platform economy: da diritto a servizio*, in *SPol.*, 2021, 8(1), pp. 75-98; PULIGNANO, GRIMSHAW, DOMECKA, VERMEERBERGEN, *Why does unpaid labour vary among digital labour platforms? Exploring socio-technical platform regimes of worker autonomy*, in *HR*, 2024, 77(9), pp. 1243-1271; WOOD, GRAHAM, LEHDONVIRTA, HJORTH, *Good gig, bad gig: autonomy and algorithmic control in the global gig economy*, in *WESoc.*, 2019, 33(1), pp. 56-75; BERG, GREEN, NURSKI, SPENCER, *Risks to job quality from digital technologies: Are industrial relations in Europe ready for the challenge?*, in *EJIR*, 2023, 29(4), pp. 347-365.

rhythms of everyday life[11]. However, as Gallie argues, trajectories of job quality remain highly contingent on institutional mediation, which explains the coexistence of optimistic, pessimistic, and institutionally grounded perspectives[12]. In this perspective AI applications may reduce monotony, enhance engagement, and improve physical safety, but they also generate intensification of effort, heightened stress, and skills mismatches if not coupled with proactive strategies of worker involvement and reskilling.

At the same time, growing attention is being directed to the risks of job substitution. The WEF Future of Jobs Report 2023 emphasizes the dual nature of technology adoption as both a source of job creation and of job destruction. More than 85% of firms surveyed across 45 economies identified new technologies as the most important driver of organizational transformation over the 2023–2027 time frame[13]. The most pervasive seem to be Digital platforms and apps (expected to be adopted by 86% of companies), followed by education and workforce technologies (81% of companies), big data and AI (around 75%)[14]. The report highlights that all technologies are expected to generate net job growth, (along with substantial disruption), with the exception of humanoid and non-humanoid robots. For instance, big data analytics, climate change mitigation technologies, and cybersecurity are seen as the strongest drivers of job creation, whereas agriculture technologies, digital platforms, and generative AI appear to be associated with significant labour-market upheaval: simultaneous job losses and gains across sectors[15]. The report foresees that 23% of jobs globally, equivalent to 152 million positions, will undergo structural transformation in the next five years, with 83 million roles displaced and 69 million new ones created[16]. This churn reflects deep transformations: clerical roles such as data entry clerks, accountants, postal service clerks, and bank tellers are expected to decline rapidly, while demand for AI and machine learning specialists, digital transformation experts, sustainability specialists, and data analysts is

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[11] Carreri, Gosetti, Poggio, Zanoni, *cit*.

[12] Gallie, *The Quality of Work in a Changing Labour Market*, in *SPA*, 2017, 51, 12, pp. 226–243.

[13] World Economic Forum, *Future of Jobs Report*, 2023, website: https://www.weforum.org/publications/the-future-of-jobs-report-2023/.

[14] World Economic Forum, *cit*.

[15] World Economic Forum, *cit*.

[16] World Economic Forum, *cit*.

expected to grow strongly. The "human-machine frontier" is shifting gradually: as of 2023, about 34% of business tasks were automated, compared to 66% still performed by humans, with further rebalancing expected in the coming years[17].

Within this framework, an intense debate has emerged on the substitution effects of new technologies, epitomized by the so-called routinization debate[18]. Mainstream labor economics, particularly in the neoclassical tradition, has long emphasized Skill-Biased Technical Change (SBTC), arguing that technological progress increases demand for high-skilled workers and entails a progressive upgrading. The subsequent Task-Biased Technical Change (RBTC) approach, while remaining firmly within the neoclassical mainstream, has argued that digital technologies primarily substitute routine tasks, both manual and cognitive, leading to the polarization of the employment structures, as mid-skill clerical and production roles shrink while both high-skill and low-skill jobs expand.

The debates on whether digital technologies create or destroy jobs continue to represent a central and unresolved issue in the literature. While RBTC approach has provided powerful insights into patterns of polarization and job displacement, subsequent research has shown that technological adoption cannot be reduced to task characteristics alone. A growing body of sociological research demonstrates that substitution and complementarity effects are deeply mediated by social, organizational, and institutional contexts. Factors such as industrial relations systems, workers' bargaining power, managerial strategies, and skill availability shape both the pace and the direction of technological adoption. As a result, the create-or-destroy dichotomy appears increasingly insufficient to capture the complex processes of job reconfiguration, recomposition, and reclassification that accompany digitalization. The contrast between these two perspectives, the neoclassical labour economics on the one side and the economic sociology

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[17] World Economic Forum, *cit*.

[18] On this topic: Autor, *The "task approach" to labor markets*, in *JLMRS*, 2013, 46, 3, pp. 185-199; Biagi, Sebastian, *Technologies and "routinization"*, in Zimmermann (eds.), *Handbook of Labor, Human Resources and Population Economics*, Springer, 2020, pp. 1-17; Autor, Dorn, *The growth of low-skill service jobs and the polarization of the US labor market*, in *AER*, 2013, 103(5), pp. 1553-1597; Goos, Manning, Salomons, *Job polarization in Europe*, in *AER*, 2009, 99(2), pp. 58-63; Acemoglu, Restrepo, *Automation and new tasks: The implications of the task content of production for labor demand*, in *JEP*, 2018, 33(2), pp. 3-30.

on the other, illustrates that conclusions about displacement or resilience are contingent upon the theoretical lens adopted: where economists often stress substitution and efficiency, sociological perspectives highlight power, inequality, and how institutions shape technological change.

These debates on job quality and labor substitution make clear that the effects of digitalization cannot be understood by examining technologies and/or tasks isolated from the broader context of work. The heterogeneous outcomes observed across occupations (ranging from intensified surveillance to expanded autonomy, from task displacement to new forms of professional specialization) underline that technological change does not unfold uniformly across the labour market. Instead, its impacts are filtered through specific organizational practices, industrial relations arrangements, and broader institutional structures. The same digital tool may enable skill upgrading in one setting while reinforcing fragmentation or precarity in another, depending on how work is organized and governed. This variability underscores a central insight of the sociology of work: technological transformations are always embedded in particular socio-economic contexts. Consequently, any effort to assess digitalization's implications must consider not only the technologies themselves, but also the institutional configurations, sectoral dynamics, and national political economies within which they are deployed.

3. *Contextualizing digitalization: organizational, sectoral and institutional variations*

Against the backdrop of an intensifying geopolitical and geo-economic conflict over technological innovation, the United States has consolidated a position of hegemonic leadership, challenged only by the rapid ascent of China. This global contest is so fraught with consequences that several scholars within the Varieties of Capitalism tradition have argued that the analytical framework itself may require rethinking or even supersession in order to account for the systemic centrality of U.S.-driven innovation dynamics[19].

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[19] Soskice, *Rethinking Varieties of Capitalism and growth theory in the ICT era*, in *RKE*, 2022, 10, n. 2, pp. 222-241.

However, while American predominance at the technological frontier appears indisputable, the ways in which technological hegemony is institutionalized, mediated, and translated into patterns of work and production vary considerably across national contexts[20]. It is precisely this divergence that underscores the importance of contextualizing the diffusion and implications of new technologies within specific institutional configurations. Parallel to this critique, other scholars have developed the so called "variegated economies" approach, which conceives capitalism not as a collection of discrete and internally coherent national models but as a dynamic and polymorphic process whose development is inherently uneven and multiscalar[21]. In contrast to the Varieties of Capitalism framework, often criticized for its narrow, firm-centric, and rationalist assumptions, in addition to its tendency to treat geographical variability as homogeneous national archetypes, the variegated economies perspective emphasizes a more differentiated and dynamic understanding of institutions. This involves recognizing how capitalist development unfolds simultaneously across different scales: at the national and regional level, through distinctive regulatory and institutional patterns; along global value chains, which structure flows of capital, labor, and knowledge; and at the firm level, where strategies and organizational forms mediate technological change. By adopting this lens, scholars seek to account for the temporal and spatial heterogeneity of capitalist trajectories, including the uneven diffusion and institutional embedding of digital technologies[22].

In other terms, the impact of digitalization cannot be understood in abstraction: platforms and AI systems operate within specific legal, economic, and social environments and comparative studies show that identical technologies can produce divergent outcomes depending on the industrial relations regime, educational systems, and societal structures in which they are embedded. The contextual variability of digitalization is particularly evident when comparing advanced economies with emerging ones. In Europe, strong labor institutions often mediate technological change, while in other regions digital platforms proliferate with minimal regulation, leading

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[20]   Soskice, *cit*.

[21]   Peck, Theodore, *Variegated capitalism*, in *PHG*, 2007, 31, 6, pp. 731-772; Peck, *Variegated economies*, Oxford University Press, 2023.

[22]   Alvarez León, *The digital economy and variegated capitalism*, in *CJC*, 2015, 40, 4, pp. 637-654.

to increased precariousness. Even within Europe, Northern countries display different trajectories from Southern or Eastern European contexts due to differences in welfare regimes, industrial relations, and skill formation systems[23].

Sectoral analysis enriches this picture. In logistics, for example, digitalization supports real-time tracking and just-in-time delivery, but also imposes strict surveillance on drivers and warehouse staff[24]. In education, digital technologies facilitate remote learning and blended teaching, yet they also exacerbate inequalities between institutions with different resources[25]. In agriculture, precision farming illustrates how digital tools reshape traditional labor practices while raising questions about data ownership and environmental sustainability[26]. In banking and telecommunications, digitalization has been associated with substantial labor substitution: the spread of ATMs in the late twentieth century and the rise of home banking services led to significant downsizing in banking, while the adoption of chatbots in call centers displaced human operators[27]. By contrast, in healthcare, digital technologies tend to reconfigure professional roles without necessarily reducing employment[28]. Similarly, in manufacturing, the evidence of job destruction linked to Industry 4.0 is mixed and declining employment is often driven by broader structural transformations and multiple contributing factors[29].

So, it is to be recognized that sectoral differences and institutional contexts shape the outcomes of technological change. Even within firms, organizational practices mediate how digitalization affects workers. This institutional, sectoral and organizational diversity demonstrates that sociological analysis cannot rely on universal models of technological impact: a

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[23] BERG, GREEN, NURSKI, SPENCER, *Risks to job quality from digital technologies: Are industrial relations in Europe ready for the challenge?*, in *EJIR*, 2023, 29, 4, pp. 347-365.

[24] CIRILLO, RINALDINI, VIRGILLITO (eds.), *cit.*

[25] WILLIAMSON, EYNON, POTTER, *Pandemic politics, pedagogies and practices: digital technologies and distance education during the coronavirus emergency*, in *LMT*, 2020, 45, 2, pp. 107-114.

[26] KLERKX, JAKKU, LABARTHE, *A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda*, in *NJAS-WJLS*, 2019, 90, p. 100315.

[27] KORNELAKIS, KIROV, THILL, *The digitalisation of service work: A comparative study of restructuring of the banking sector in the United Kingdom and Luxembourg*, in *EJIR*, 2022, 28, 3, pp. 253-272; DOELLGAST, *Strengthening social regulation in the digital economy: comparative findings from the ICT industry*, in *LInd*, 2023, 33, 1, pp. 22-38.

[28] CIRILLO, RINALDINI, VIRGILLITO (eds.), *cit.*

[29] GARIBALDO, RINALDINI, *L'operaio digitalizzato*, il Mulino, 2019.

contextual approach continues to be important and it is necessary to adopt a comparative and multi-level framework that considers how global technologies are filtered through local structures.

Taken together, these organizational, sectoral, and institutional variations reveal that digitalization is neither a uniform nor a linear process. The same technologies travel across borders and industries but are refracted through distinct regulatory landscapes, collective bargaining arrangements, managerial traditions, and societal expectations. This heterogeneity strengthens a central insight of sociological research: technological change cannot be understood outside the social structures that mediate, enable, or constrain it. What appears, at first glance, as a purely technical transformation is in fact shaped by distributive conflicts, institutional legacies, and organizational choices. It is precisely this empirical variability that exposes the limits of universal models of technological impact and invites a more critical engagement with the assumptions that often underpin public and academic narratives about digitalization.

A further limit in contemporary debates on digitalization is the tendency toward technological presentism, whereby phenomena such as artificial intelligence or platform work are portrayed as radically novel disruptions. However, many of the dynamics associated with digital technologies (including flexibilization, spatial fragmentation of labour, regulatory arbitrage, and the reallocation of tasks along global value chains) largely predate recent advances in AI. Digital technologies often operate as accelerators and coordinators of pre-existing processes. Research on global value chains and digital productions/infrastructures shows how technologies contribute to the reclassification and redistribution of work across organizational and geographical boundaries, reinforcing path-dependent trajectories of deregulation and labour segmentation[30]. From this perspective, digitalization should be understood as embedded within historically sedimented patterns of capitalist organization, rather than as a sudden break with the past.

All this ultimately brings us back to one of the foundational concerns of the sociological perspective: the rejection of technological determinism. To insist on contextualization, therefore, is to underline that the trajecto-

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[30] Tubaro, *The dual footprint of artificial intelligence: environmental and social impacts across the globe*, in *Glob.*, 2025, pp. 1-18, Tubaro, Casilli, Cornet, Le Ludec, Torres Cierpe, *Where does AI come from? A global case study across Europe, Africa, and Latin America*, in *NEP*, 2025, 30(3), pp. 359-372.

ries of digitalization are not predetermined by the inherent properties of technologies, but are contingent on the ways in which they are embedded, regulated, and contested within specific socio-economic contexts.

4.   *Challenging technological determinism*

As mentioned above, a key theoretical task for sociology of work is to resist technological determinism, that is, the tendency to attribute homogeneous and inevitable social outcomes to technological innovations. The recurring discourse of a "digital age" or "AI era" illustrates how technologies are often reified as autonomous drivers of epochal change. Such perspectives obscure the role of institutions, collective actors, and power relations in shaping work and employment. Technological determinism remains a persistent temptation, both in public discourse and within parts of the scientific community. These discourses have political implications: by portraying technological change as inevitable, they dismiss demands for regulation, redistribution, and democratic participation, ultimately delegitimizing social conflicts.

The sociology of work must instead uncover the social and political embeddedness of technologies. The design, the adoption, and the use of digital artifacts are not linear, smooth processes, but are shaped by struggles, negotiations, and institutional arrangements. Concepts such as "algorithmic control" risk mystifying managerial decisions by attributing agency to algorithms rather than to human actors who design, implement, and regulate them. Organizational and labour studies have also shown that the integration of digital technologies into work processes reconfigures managerial control rather than eliminating it. Research highlights how digital tools are embedded in existing organizational routines and power relations, producing hybrid forms of control that combine discretion and surveillance[31]. This insight is reinforced by recent scholarship that warns against the reification of digital technologies through deterministic narratives. As Joyce et al. argue, conceptual labels such as "algorithmic control" or "algorithmic surveil-

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[31]   BRUNI, TIRABENI, PITTINO, MIELE, *On the dualistic nature of power and (digital) technology in organizing processes*, in *SO*, 2020, XXII, special issue, pp. 207-219; CROUCH, *Will the gig economy prevail?*, John Wiley & Sons, 2019.

lance" risk obscuring the continuity between digital and pre-digital forms of managerial authority, attributing agency to algorithms rather than to the actors and institutions that design, deploy, and regulate them[32]. Similarly, periodizations that announce a "platform capitalism" era tend to portray technological change as rupture, overlooking the incremental, contested, and uneven character of digitalization. By focusing narrowly on spectacular technologies or on selected empirical cases, deterministic accounts miss the broader infrastructures and sociomaterial processes through which digital tools reshape labour. In this sense, resisting technological determinism means not only underlining the role of institutions and collective action, but also cultivating a more processual and contextual understanding of technological change that acknowledges its multiscalar and contested trajectories. As Social Shaping of Technology (SST) approaches have shown, innovation and diffusion always involve social mediation, reinterpretation, and resistance[33]. Orlikowski and Scott's notion of the duality of technology and the subsequent debates on sociomateriality further underscore that technological artifacts and social relations are inseparably entangled[34]. By highlighting this co-construction, sociology of work avoids both naïve optimism and dystopian fatalism.

A closely related line of critique has been developed within Labour Process Theory (LPT)[35]. Building on its longstanding focus on managerial control, consent, and the organization of labour, labour process scholars have extensively examined the implications of digital technologies for work. Recent contributions show that algorithmic management, data-driven monitoring, and digitally mediated performance evaluation often represent an intensification and reconfiguration of control, rather than a radical rupture with previous forms of work organization. Concepts such as digital Taylorism explicitly draw on the labour process tradition to emphasize continuity in managerial strategies of work intensification, standardization, and

[32] Joyce *et al.*, *New social relations of digital technology and the future of work: beyond technological determinism*, in *NTWE*, 2023, 28, 2, pp. 145-161.

[33] Mackenzie, Wajcman, *The social shaping of technology*, Open University, Buckingham, 1999.

[34] Orlikowski, Scott, *Sociomateriality: Challenging the separation of technology, work and organization*, in *AMA*, 2008, 2, 1, pp. 433-474.

[35] Braverman, *Labor and monopoly capital: The degradation of work in the twentieth century*, Monthly Review Press, 1974.

surveillance, while also acknowledging that digital technologies open new arenas of contestation within the labour process. From this perspective, digitalization does not impose predetermined outcomes, but interacts with existing power relations, organizational choices, and institutional constraints[36].

In terms of organizational theory and design, the framework of Socio-Technical systems (STS), one of the most dialogic approaches with the sociology of work, proves particularly useful: technologies are never adopted in isolation, but as part of broader ensembles that combine technical, organizational, and institutional elements[37]. The STS tradition, from the pioneering studies of Trist and Bamforth in the British coal mines to Calvin Pava's reconceptualization of knowledge work systems, emphasizes the principle of joint optimization, that is, the search for a balanced design that enables both technical efficiency and social well-being[38]. This perspective is especially relevant for contemporary debates on digitalization, since it explicitly resists the "technological imperative" that views workers and organizations as passive recipients of technological change.

Pava's work is particularly illuminating in this regard[39]. He recognized that the advent of information technologies and microprocessors required a profound rethinking of sociotechnical design. Instead of focusing solely on routine work processes, he proposed that the basic unit of analysis should be deliberations, the reflective and communicative practices through which actors confront complex, uncertain, and non-routine tasks. This reconceptualization underscores that technologies do not dictate outcomes by themselves, but interact with human agency, organizational choice, and institutional context. In this way, the sociotechnical approach highlights the possibility of disobeying the technological imperative: technologies can be designed and implemented either to reinforce forms of digital Taylorism and surveillance, or to support collaboration, learning, and participatory decision-making. Recent debates on algorithmic management and digital

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[36] GANDINI, *Labour process theory and the gig economy*, in *HRel.*, 2019, 72(6), pp. 1039-1056; BRIKEN, CHILLAS, KRZYWDZINSKI, MARKS, *The new digital workplace: How new technologies revolutionise work*, Bloomsbury Publishing, 2017.

[37] BUTERA, *Lavoro e organizzazione nella quarta rivoluzione industriale: la nuova progettazione socio-tecnica*, in *L'ind.*, 2017, 38(3), pp. 291-316.

[38] TRIST, BAMFORTH, *Some social and psychological consequences of the longwall method of coal-getting*, in *HRel.*, 1951, 4, 1, pp. 3-38; PAVA, *Managing new office technology. An organizational strategy*, Simon and Shuster, 1983.

[39] PAVA, *cit.*

control make the relevance of this insight particularly evident. The diffusion of wearable devices, data analytics, and AI-driven monitoring systems carries with it the risk of reviving the logic of Taylorism in digital form, a phenomenon that some scholars call digital Taylorism, by fragmenting tasks, intensifying monitoring, and reducing workers' discretion. STS offers a critical counterpoint by showing that such trajectories are not technologically predetermined but are organizationally chosen. Coding practices, data architectures, and algorithmic systems are not neutral infrastructures: they embody assumptions, values, and power relations that reflect managerial priorities and institutional environments. To treat algorithms as autonomous "agents" of control obscures the social decisions and design choices that underpin them.

Seen from this angle, the relevance of STS for the sociology of work lies in its capacity to illuminate how the introduction of new technologies is always mediated by organizational design choices. Whether digital tools generate intensification and alienation or, conversely, enhance autonomy and collective intelligence depends on how they are embedded in work systems. The design of digital workplaces thus involves normative choices: it can promote discretionary coalitions, collaborative deliberations, and distributed governance, or consolidate hierarchical command and control. In turbulent and uncertain environments, STS further invites us to see change not as an episodic event, but as an ongoing, dynamic process of redesign, in which technologies and organizations co-evolve.

All these perspectives provide a critical counterpoint to narratives of inevitability, opening analytical space to consider alternative paths, institutional mediation, and the role of agency in shaping the world of work. Indeed, from a theoretical perspective, challenging determinism involves recognizing the agency of social actors. Employers, managers, trade unions, policy-makers, and workers all participate in shaping how technologies are implemented and contribute to define what consequences will be. Countering the deterministic narratives about technologies is thus not only an analytical task but also a normative one, aimed at reopening political space for dialogue and negotiation. As the SST and LPT perspectives remind us, the evolution of digital capitalism is an unfinished and contested process, shaped by institutional mediation, labor-capital conflict, and the ongoing reconfiguration of social relations.

These reflections on the social dimension of technology and the critique of deterministic narratives point directly to another defining chal-

lenge of contemporary digitalization: the reconfiguration of power and knowledge within technologically mediated workplaces. If technologies are co-constructed through institutional arrangements, organizational choices, and social relations, then understanding how they reshape labor requires attention not only to their design, but also to the forms of visibility and invisibility they produce. The growing reliance on data-driven systems, AI models, and algorithmic decision-making introduces new regimes of mediated surveillance, classification, and control in which access to information becomes a central driver of inequality. In this sense, the rejection of technological determinism does not merely highlight the agency of human actors, it also compels us to examine how digital systems reorganize the distribution of and access to knowledge, authority, and accountability. It is precisely at this intersection of technology, power, and epistemic asymmetry that the issue of opacity emerges as a critical terrain for sociological analysis.

5.   *Opacity, power and knowledge in digital technologies*

The opacity of digital technologies, particularly AI and algorithmic systems, represents a critical challenge that differentiates the current wave of innovation from previous technological transformations. While earlier forms of automation were largely visible, material, and decipherable (even when complex), digital systems increasingly operate through layers of abstraction that obscure their functioning. The literature distinguishes at least three forms of opacity[40]. The first is *intrinsic complexity*: machine learning and deep learning systems often operate through models whose internal logic is difficult to interpret, even by the engineers who design them. The second is *technical illiteracy*: the absence of widespread digital and algorithmic competence among workers and citizens limits their ability to understand, monitor, or challenge automated processes. The third is *intentional opacity*: deliberate restrictions on access to data, models, and decision-making criteria imposed by corporations, which reproduce and deepen hierarchies of knowledge and power.

This last form of opacity has particularly profound implications for labor relations. In call centers, workers often remain unaware of the criteria

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[40] BURRELL, *How the machine "thinks": Understanding opacity in machine learning algorithms*, Big Data Soc., 2016, 3, 1, pp. 1-12.

by which AI systems allocate calls or assess performance, despite legal requirements for transparency[41]. In manufacturing, operators frequently perceive Manufacturing Execution Systems as "black boxes", where decisions about pacing, sequencing, or quality control appear as inscrutable outputs rather than negotiated parameters[42]. Yet empirical studies also demonstrate that opacity is not immutable: when firms provide structured training to workers and when unions gain access to algorithmic systems, opportunities emerge for co-determination in design and implementation[43]. Research on algorithmic management in logistics and platform work shows that workers' situated knowledge often contributes to improving algorithmic accuracy or correcting managerial misinterpretation[44]. These examples reveal that opacity is not technologically determined, but a socially constructed phenomenon, resulting from choices about system design, access policies, institutional constraints, and power asymmetries.

Opacity must also be understood as a *stratified* phenomenon. The distinction between intrinsic, cognitive, and intentional opacity highlights how different groups possess unequal forms of access and interpretive power. Managers, data scientists, and IT specialists may understand, or at least partially reconstruct, the functioning of algorithmic systems, while frontline workers remain in the dark[45]. At another level, multinational corporations often maintain exclusive control over proprietary algorithms and training data, whereas regulators, unions, and civil society actors face significant barriers in obtaining meaningful information[46]. This asymmetry reflects and at the same time actively reinforces existing power imbalances in workplaces and labor markets, defining who can question, negotiate, or contest algorithmic decisions.

Case studies across sectors underscore both the risks of growing opacity and the possibilities for resisting it. In some European countries, collective

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[41] Doelgast, *cit*.

[42] Godino, Junte, Molina, *Artificial intelligence and algorithmic management at work: A case study approach on the role of industrial relations in Spain*, INCODING Case Studies Reports, 2023, on line: https://ddd.uab.cat/record/290685.

[43] Garibaldo, Rinaldini, *cit*.

[44] Marrone, *Rights against the machines!: il lavoro digitale e le lotte dei rider*, Mimesis, Milano, 2021.

[45] Rinaldini, *Accesso alla tecnologia e autonomia*, in Masino (a cura di), *Autonomie nel lavoro negli anni Duemila*, TAO Digital Library, 2022, pp. 76–87.

[46] Zuboff, *The age of surveillance capitalism*, edn. Pubblic Affairs, 2019.

agreements now include clauses granting workers information rights concerning algorithmic decision-making[47]. In others, unions have negotiated participatory auditing procedures or training programs that enable workers to interpret algorithmic outputs and challenge managerial decisions when necessary. In platform work, experiments with algorithmic transparency have shown that opening access to data can empower workers to identify unfair rating practices or discriminatory allocation mechanisms. These initiatives suggest that opacity, far from being an inherent feature of digital technologies, can be politically contested, negotiated, and partially dismantled through institutional interventions.

Insights from the sociology of social movements further expand this analysis by highlighting how opacity and algorithmic control can also become focal points for collective mobilization. The literature on movement unionism and digital labour activism shows that workers and unions increasingly mobilize around issues of transparency, data access, and algorithmic governance. In digitally mediated workplaces, opacity does not only constrain workers' agency but may also trigger new forms of collective action, including coalition-building across occupational and national boundaries, hybrid forms of unionism, and transnational campaigns targeting platform governance[48]. Recent contributions emphasize that the invisibilization of labour is not only an economic issue, but also a political one, closely linked to struggles for recognition and rights. From this perspective, digitalization reshapes labour processes, along with the conditions under which work becomes visible, recognized, and collectively contested. All this suggests that algorithmic opacity can be considered a source of domination and a terrain of conflict and negotiation through which power relations can be contested[49].

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[47] HOLTGREWE, DWORSKY, *European social partners' approaches to artificial intelligence and algorithmic management*, INCODING Case Studies Reports, 2024, online: https://ddd.uab.cat/record/290690.

[48] TASSINARI, MACCARRONE, *Riders on the storm: Workplace solidarity among gig economy couriers in Italy and the UK*, in *WESoc.*, 2020, 34(1), pp. 35-54; MARRONE, *cit.*

[49] DELLA PORTA, CHESTA, CINI, *Labour conflicts in the digital age: A comparative perspective*, Policy Press, 2022; PIASNA, *Digital labour platforms and social dialogue at EU level: How new players redefine actors and their roles and what this means for collective bargaining*, in *SPA*, 2024, 58(4), pp. 568-582; HAIDAR, KEUNE, *Introduction: Work and labour relations in global platform capitalism*, in HAIDAR, KEUNE (eds.), *Work and labour relations in global platform capitalism*, Edward Elgar Publishing, 2021, pp. 1-27.

At the same time, at theoretical level, the problem of opacity invites a reconsideration of classical concepts of power and control in the sociology of work. Foucault's analyses of surveillance resonate strongly with contemporary discussions of algorithmic monitoring, yet the shift from visual to data-driven oversight introduces new dynamics that exceed traditional panoptic paradigms. The sociology of work can make a distinctive contribution by linking micro-level analyses of workplace practices with macro-level studies of regulatory frameworks, industrial relations systems, and platform governance regimes. Such a multi-scalar approach reveals that opacity is not merely a technical limitation, but a political and institutional field in which conflicts over knowledge, authority, and decision-making unfold.

6.   *Conclusion*

Digital technologies do not operate as autonomous, linear, or inevitable forces shaping the future of work. Rather, their diffusion and effects are deeply embedded within social, institutional, and organizational contexts. Despite their pervasive presence across occupations and skill and through their differentiated consequences on job quality and employment structures, digital technologies reveal themselves to be far from universal agents of transformation. Their impacts are filtered through sectoral dynamics, managerial strategies, industrial relations systems, welfare regimes, and national political economies[50]. Identical technologies can yield divergent outcomes depending on how they are designed, implemented, governed, and contested.

Within this perspective, the article has not aimed to provide a comprehensive or systematic review of an already extensive literature. Rather, it has advanced an analytical framework intended to organize and interpret the heterogeneous effects of digitalization on work and employment. By integrating three interrelated dimensions (the reconfiguration of job quality and employment structures, the institutional and organizational mediation of technological change, and the reorganization of power, knowledge, and

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[50] Lloyd, Payne, *Digitalisation, unions and 'country-effect': Does union strength at the workplace matter?*, in *JIR*, 2025, https://doi.org/10.1177/00221856251326682; Haapanala, Marx, Parolin, *Robots and unions: The moderating effect of organized labour on technological unemployment*, in *EID*, 2023, 44(3), pp. 827-852; Snell, Gekara, *Re examining technology's destruction of blue collar work*, in *NTWE*, 2023, 38(3), pp. 415-433.

opacity in digitally mediated workplaces), the article proposes a sociological lens through which current transformations of work can be more systematically captured.

Sociology of work emerges as an indispensable field for interpreting contemporary transformations. It provides conceptual tools to move beyond deterministic discourses that frame digitalization as an unstoppable, self-propelled revolution. Understanding the future of employment requires addressing both the qualitative reorganization of work and the quantitative restructuring of labor demand. The polarization of tasks, the risks of substitution associated with generative AI, and the intensification of psychosocial pressures all point to the need for an analytical framework that treats technology as a processual and contextual phenomenon. Similarly, trajectories of digitalization are far from homogeneous; instead, they are shaped by institutions, power configurations, and multi-scalar processes that produce variegated (sometimes contradictory) patterns of change.

Approaches such as the SST, LPT and STS traditions are useful to understand technologies as co-constructed through human agency, organizational design, and institutional mediation. The possibility of amplifying autonomy or reinforcing digital Taylorism is not inherent to the technology itself, but arises from socio-organizational choices and negotiations. Recognizing this co-construction allows sociology to maintain a critical stance, refusing both naïve celebrations of innovation and dystopian projections of inevitable decline.

At the same time, intrinsic, cognitive, and intentional forms of opacity characterizing AI-driven systems redistribute knowledge and authority across the labor process, creating new asymmetries between workers, managers, corporations, and regulators. These phenomena challenge the traditional understanding of power and surveillance, demanding a renewed theoretical and empirical inquiry. The sociology of work is crucial in revealing how opacity is produced or justified, how it can be resisted, and how its consequences may vary depending on the institutional setting within which digital systems are embedded.

We need of a sociology of work that is empirically grounded, theoretically ambitious, and politically attuned to workers. Technological change cannot be meaningfully analyzed without paying attention to the social conflicts, institutional arrangements, and organizational practices that shape its outcomes. Nor can it be understood without the scrutiny of the ine-

qualities it produces, intensifies, or transforms. Digitalization raises profound questions about control, autonomy, skill, surveillance, and democratic participation in the workplace; addressing them requires a discipline capable of integrating micro-level observations with macro-level structural analysis.

At the same time, all this raises crucial methodological challenges for the sociology of work. The increasing heterogeneity, fragmentation, and partial invisibility of digital labour complicate traditional empirical strategies based on standard occupational classifications, surveys, and firm-level data. One of the key challenges for the sociology of work lies in measuring digital labour, whose fragmented, informal, and platform-mediated forms often escape standard statistical tools and occupational classifications[51]. The risk is that this methodological gap perpetuates the invisibility of digital work within empirical research itself. Addressing these challenges calls for the combination of quantitative approaches with qualitative, ethnographic, and comparative methods capable of uncovering hidden forms of labour, informal practices, and workers' lived experiences. In this sense, the digital transformation of work reshapes labour processes, but also challenges the epistemological and methodological tools of sociological inquiry itself.

Also for these reasons, the sociology of work must cultivate deeper and more sustained dialogue with other disciplines. Legal scholarship contributes insights into emerging regulatory regimes and the governance of AI; political economy situates technological change within global value chains and geopolitical competition; philosophy clarifies ethical dilemmas surrounding autonomy, responsibility, and human dignity; and the arts, as illustrated by Crawford in the book *Atlas of AI*, expose the material, ecological, and symbolic infrastructures that sustain contemporary digital systems[52]. Only through this multidisciplinary collaboration can we understand the full spectrum of social relations that constitute digitalization.

Ultimately, anchoring technological change to society allows sociology not merely to interpret contemporary transformations but to intervene in shaping them. As digitalization reconfigures labor markets, reorganizes the labor process, and redistributes power and control, the sociology of work has a critical responsibility: to find and reveal the conditions under

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[51] Pais, *La platform economy: aspetti metodologici e prospettive di ricerca,* in *Polis,* 33(1), 2019, pp. 143-162.

[52] Crawford, *The atlas of AI: Power, politics, and the planetary costs of artificial intelligence*, Yale Univ. Press, 2021.

which technological innovation can support human capabilities, collective well-being, and democratic participation; And how to enhance and create such conditions. The challenge is formidable, but the stakes are equally high. In reaffirming its analytical and normative mission, sociology of work can help build pathways toward forms of digitalization that enhance, rather than erode, the conditions for a just and sustainable future of work.

Abstract

The article reflects on the diffusion of digital technologies in the world of work from the perspective of the sociology of work, questioning deterministic interpretations of technological innovation. Through an analysis of digitalization processes, artificial intelligence, and algorithmic management, the article shows how the effects of new technologies on employment and job quality are deeply mediated by institutional, sectoral, and organizational contexts. Drawing on approaches such as Social Shaping of Technology and Socio-Technical Systems, it highlights the role of collective action and governance in shaping alternative trajectories of digitalization. In conclusion, the article argues for the need for a sociological analysis capable of anchoring technological change to social relations, conflicts, and institutions, in order to orient innovation toward socially sustainable outcomes.

Keywords