HYBRIDISATION BETWEEN LIVING AND WORKING ENVIRONMENT: EVOLUTION OF PREVENTION AND PROTECTION MEASURES IN RELATION TO POPULATION IMPOVERISHMENT AND THE CENTRAL ROLE OF WORKERS [1]

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Abstract. The Italian National Institute of Statistics (Istat), a public research institute and the main producer of official statistics, has faced the transformations caused by the increasing spread of remote work, accelerated by the pandemic. The aim of this study is to analyse the hybridisation between living and working environment, exploring the implications of work flexibility, the new requirements for adapting prevention and protection measures as well as the socio-economic impacts on workers' well-being. A multidisciplinary approach has been adopted to carry out this analysis, integrating statistical and regulatory aspects with working conditions assessments. To examine strengths, weaknesses, opportunities, and threats associated with the adoption of hybrid work it has been used a SWOT analysis. Sources include anonymised data from health surveillance visits at Istat, Inail surveys on sector specific occupational accidents and diseases, as well as academic studies on new organisational models and on the impact of economic and social inequalities. The study highlights the evolution of the concept of the "workplace" that now can be applied to domestic and shared spaces, requiring the implementation of new prevention and protection measures to ensure workers' safety, health, and well-being. The analysis assesses the risk of disparities in access to technology and optimal working conditions, which could contribute to increased mental workload and work-related stress. The extension of prevention measures to home environments, the promotion of a culture of prevention that incorporate healthy lifestyles, and the enhancement of training on the risks associated with agile work are some of the strategies proposed to mitigate these effects. Finally, the study underlines the need for inclusive policies to reduce gender, territorial, economic, and cultural inequalities, reinforcing the central role of workers in the transition towards more flexible and sustainable work models.

1. Introduction

The National Institute of Statistics is the main scientific, autonomous institution that produces official statistics. Following the inevitable transition to remote working due to the pandemic (Camisasca *et al.*, 2023a), the Institute has faced a central issue in the current scientific and professional debate on different forms of

[1] This article is the result of the common contribution of all and, therefore, the individual contribution is considered equal and equivalent to that of the other co-authors. The authors' points of view expressed in the article do not necessarily reflect the official opinions of the National Institute of Statistics - Istat.

work flexibility. What began as an experiment before the pandemic emergency has become a necessity that has involved millions of workers (Klaser *et al.*, 2023). In accordance with Title III of the CCNL (National Collective Labour Agreement) for the Education and Research sector 2019-2021, the organisational choices of the Institute have been oriented towards the implementation of remote working, leading to a «*workplace*» concept evolution. The increasing use of remote work with new working methods changes the traditional separation between professional environment and private life and redefine boundaries, habits, and interaction. As work changes, it is essential to achieve a new balance between living and working environments, organising both areas while respecting safety and health regulations (Camisasca *et al.*, 2025). This study aims to analyse the interconnection between these aspects and to explore how the increasing hybridisation between work and private life influences individual behaviours and the very concept of workplace. The evolution of working models requires a new approach to the organisation of lifestyles, promoting strategies that can balance productivity and well-being (Dentini, 2025). Economic, social, and technological transformations act as catalysts for this change. Another crucial aspect concerns productivity, recent studies emphasise both the opportunities and the challenges linked to hybrid work. Barrero *et al.* (2023) show how remote work has evolved into a structural feature of the labour market with measurable effects on productivity and organisational performance. Lee (2023) highlights the broader economic and social changes generated by remote work. Although this paper does not directly measure productivity, acknowledging this issue allows for a more comprehensive understanding of hybrid work as a multidimensional phenomenon.

It is crucial to distinguish between the pandemic phase (2020–2021), when remote working was imposed as an emergency prevention measure and therefore not the result of an individual or organisational choice, and the post-pandemic phase (2022–2024), when hybrid work gradually became institutionalised and workers could choose how to perform their work. This difference strongly affects the assessment of its long-term sustainability.

2. Materials and methods

Legislative Decree 81/08 [2] defines workplace as "*any environment intended to accommodate workstations, located within the company or production unit, as well as any other place accessible to the worker in the course of their work*" and emphasizes the health, safety, and suitability of spaces with the aim of preventing risks and ensuring the workers' well-being.

[2] Italian Legislative Decree of 9 April 2008 n. 81. Text coordinated concerning the protection of health and safety in the workplace.

Table 1 - *Organisational features and prevention measures for a traditional office vs. remote working.*

Aspect	Traditional Office	Remote Working	Prevention Measures
Safety	Direct monitoring of working conditions.	Difficulty in implementing safety conditions at home. Particularly in poorer or socially and economically disadvantaged contexts.	Enhance training and workers' awareness.
Ergonomics	Workstations designed according to legal standards.	Makeshift risk and non-ergonomic workstations, particularly in poorer or socially and economically disadvantaged contexts.	Enhance training and workers' awareness
Health and Well-being	Access to services (e.g., canteens, relaxation areas) with moderate stress risk conditions.	Increased risk of stress, isolation, and sedentary behaviour.	Promote healthy lifestyles and prevention.
Training	In-person sessions with direct supervision.	Distance learning, often asynchronous.	Introduce interactive online courses and periodic discussion sessions.
Supervision	Direct hierarchical control.	Greater trust and autonomy required with increased responsibilities.	Adopt non-invasive system of monitoring and feedback sessions.
Work-Life Interaction	Established and fixed schedules and travels.	Flexibility, but risk of overlapping schedules. Burden from family and personal factors. Work-life balance. Reduction in commuting.	Set clear work-life boundaries and defined hours for work and private life (establish availability times to facilitate collaboration with the team).
Techno-stress	Greater opportunity of carrying out other activities.	Need for advanced technologies. Excessive connection times. Including breaks during disconnection moments.	Impose breaks and promote mindful use of technologies.

Source: Istat, Internal documents.

In recent years, the concept of «*workplace*» has evolved, moving from a traditional physical space to a more fluid and virtual dimension. With the rise of remote working, the traditional model of workspace, separated from the personal sphere, has expanded to include new environments, such as home (smart working), coworking spaces, and even outdoor locations. This change has required the application of safety standards to non-traditional contexts as well. It is essential that the worker choses workplaces that meet the minimum safety requirements, including ergonomics, adequate lighting, and appropriate spaces and workstations. Working in non-company environments requires the redefinition of responsibilities, the

extension of risk assessment, and the adoption of appropriate behaviours to ensure safety and productivity. While this transformation offers greater flexibility, it can also accentuate disparities between workers, in relation to the access to technologies, adaptability or specific economic and social conditions. Furthermore, new challenges have to be faced, such as the management of work-related stress (Camisasca *et al.*, 2023b) and social isolation, through prevention measures and support strategies. Thus, it is fundamental to identify and reduce new potential risks and hazards to ensure well-being at work. Nowadays, workplace is an integrated ecosystem that combines physical and digital spaces, fostering continuous interaction between technology, human relations, and well-being. The evolution of this concept, guided by Legislative Decree 81/08, requires an innovative and dynamic approach capable of harmonising safety, flexibility, and quality of life in different work contexts. Table 1 shows a comparison between some organisational characteristics and prevention measures that can be applied both to a traditional office and to remote working. Although the analysis is based on Istat data, the trends observed are consistent with INAIL national surveys and with the international scenario. Therefore, while the outcomes cannot be automatically generalised to all work contexts, they provide useful insights for other public institutions and private organisations facing similar organisational and health and safety challenges.

2.1. SWOT analysis about the hybridisation between living and working environment

The SWOT analysis on the hybridisation between living and working environments (Table 2) examines the Strengths, Weaknesses, Opportunities, and Threats, separating the internal and external organisation features and distinguishing the aspects that can facilitate or hinder the goals achievement. Strengths include, e.g., greater flexibility and a better work-life balance, less commuting by minimising daily travel to and from work, greater schedule autonomy and possibility to personalise one's own work environment. Nevertheless, when agile working is excessive some Weaknesses can emerge as the isolation risk, reduced social interaction due to the lack of in-presence events important for strengthening team spirit, difficult risks monitoring, and the possible overlap between personal and professional spheres. Furthermore, the sense of belonging to the organisation and the connection with colleagues can be compromised, reducing team cohesion and work involvement. Talking about the Opportunities, hybrid work is a real asset and allows for a reorganisation of working methods, offering greater autonomy in activities and time management. This is made possible by the adoption of new technologies, the spaces organisation designed to improve worker's well-being, and the promotion of smart working as an organisational model. An additional advantage is the reduction of company costs, thanks to a less need for physical spaces and travels reducing

environmental impact. Finally, the analysis highlights the Threats linked to the adoption of hybrid work, such as the risk of economic impoverishment, i.e., the negative impact that excessive remote work could have on the economy or specific categories of workers, the increase in mental burden for workers, as well as inequalities in access to technologies and telecommunication networks.

Table 2 - *SWOT analysis of the hybridisation between living and working environments.*

	Internal origin (features of the organisation)	External origin (features of the environment)
Helpful to achieving the objective	**Strengths** ▪ Greater flexibility and work-life balance ▪ Reduction in commuting ▪ Greater autonomy in time management ▪ Opportunity to personalise the work environment	**Opportunities** ▪ Reorganisation of work with different ways of working ▪ Implementation of new technologies ▪ Adaptation of spaces for well-being ▪ Promotion of remote work as the standard ▪ Opportunity to reduce business costs (offices, transportation)
Harmful to achieving the objective	**Weaknesses** ▪ Risk of social isolation ▪ Greater difficulty in monitoring risks ▪ Risk of overlap between personal life and work ▪ Workers feel less connection to the organisation and colleagues, with a reduced sense of company belonging	**Threats** ▪ Economic impoverishment ▪ Increased mental workload for workers ▪ Disparities in access to technology and telecommunications networks ▪ Risk of increased inequalities among workers (e.g., some roles requiring physical presence create disparities between those who can benefit from flexibility and those who cannot); economic differences.

Source: Istat, Internal documents.

Not everyone has the resources to bear the additional costs associated with remote work, such as electricity, connection and equipment, nor do they receive allowances to cover them. Furthermore, the flexibility offered by hybrid work could accentuate the disparities between those who can benefit from smart working and those who are bound to physical presence, with economic and professional inequalities. At a macroeconomic level, changes in consumer behaviour, for example, a reduction in purchases in urban centres, could have negative repercussions on specific geographical areas and economic sectors. It is essential to adopt specific strategies to maximise the benefits of hybrid work, while mitigating its risks, such as interventions aimed at fostering a sense of belonging, improving workplaces safety and ergonomics, and ensuring equitable access to technologies for the hybridisation of work sustainable and effective.

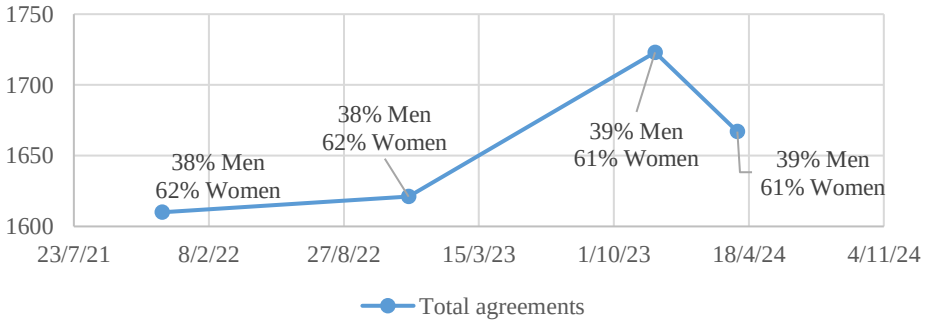
3. Convergence of prevention measures between life and work

According to Law No. 81/2017, Article 18, smart working helps workers to have a better work-life balance and, at the same time, promotes growth. This definition emphasises organisational flexibility, the will of the parties involved, and the use of technological tools that allow remote work (e.g., laptops, tablets, smartphones, etc.). Before the lockdown, Istat tried out agile work that then, during the pandemic, became the primary prevention measure. Agile working has been regulated and structured with the ordinary management - National Collective Labour Agreement 2019-2021 (May-December 2024). As of April 15, 2024, out of approximately 2.000 Istat employees, 1.667 agile working individual agreements have been signed (gender distribution: men=39% and women=61%) [3]. The principle of prevalence regulates work organisation: 51% of working days in-person and 49% in agile work. Furthermore, there are two different profiles of agile working:

1. ordinary agile working: up to a maximum of 20 days on a bi-monthly basis for all employees;
2. enhanced agile working: up to a maximum of 24 days on a bi-monthly basis for employees who document serious, urgent, and otherwise irreconcilable personal or family health situations, including the distance from the workplace.

Figure 1 shows the trend in the total number of individual agreements signed at Istat in the post-pandemic period, from the second half of 2021 to 2024.

Figure 1 – *Number of individual agreements signed in the post-pandemic at Istat.*



Source: Istat, Internal data processing.

A stable growth is observed until January 2024, followed by a decline in the subsequent months. This evolution requires the adoption of appropriate measures to ensure workers' health, safety, and well-being even at home:

[3] LIMITI C., SOLA G., 2024. Agile Working at the National Institute of Statistics. Proceedings CNS15.

- extension of prevention measures to home environment: ensure correct ergonomics, adequate lighting, availability of a first aid kit, and protocols for the proper use of electrical equipment. It is essential that workers take care of their own safety, health, and mental well-being;
- promotion of a healthy lifestyle: encourage regular breaks, a routine of physical exercise, and a balanced time management between private life and work. It is essential to respect the agreed work schedule and adopt habits that promote well-being;
- awareness of common hazards at home and at work and emergency procedures: provide guidelines for the organisation of home spaces and protocols for managing critical situations (fires, short circuits, domestic accidents), with easily accessible emergency numbers.

4. Impact on health, safety and accidents

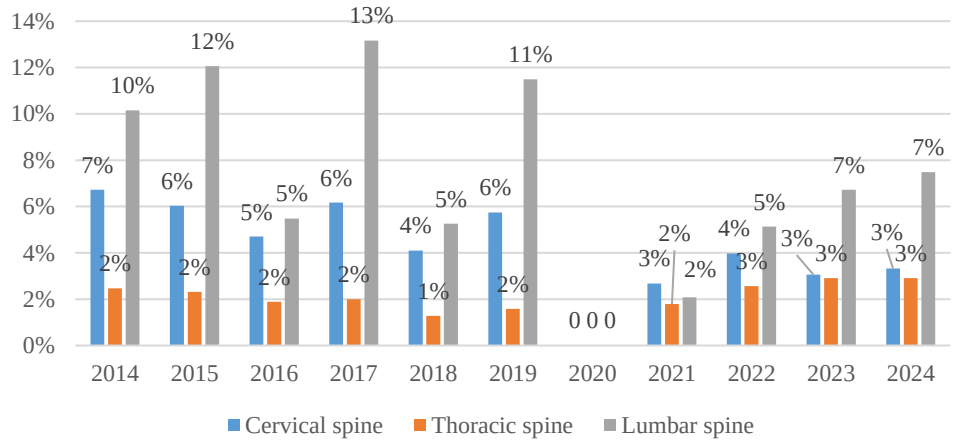
According to INAIL, in the first 11 months of 2024, 543.039 accidents were filed (+0.1% compared to November 2023 and -16,7% compared to the same period in 2022). The increase concerns exclusively commuting accidents. At national level, in the first nine months of 2024, there was a reduction in workplace accidents[4], from 363.064 in 2023 to 361.804 in 2024 (-0,3%), while commuting accidents, i.e., those occurring during the trips between home and work, increased from 67.765 to 71.198 (+5.1%). In the first nine months of 2024, occupational diseases[5] amounted to 65.333, with an increase of 22,0% compared to 2023. The largest increases concern musculoskeletal diseases, followed by those of the nervous system and ear. There is also an increase of tumours and respiratory diseases. Regarding «*domestic accidents*», there is no univocal definition in the National Prevention Plan (PNP) 2020-25[6]. Law No. 493/1999, "*Rules for the protection of health in homes and the establishment of insurance against domestic accidents*" is the regulatory reference. Istat, within the "Multipurpose surveys on Households - Aspects of daily life", defines a domestic accident as *an accidental event that compromises health and occurs within the home or its appurtenances (balconies, garden, garage, stairs, etc.)*.

4.1. Istat data for the period 2014-2024

Figure 2 shows the percentage distribution of musculoskeletal disorders on the total number of individuals monitored in Istat.

[4] https://dati.inail.it/portale/it/tabelle/tabelle-infortuni-sul-lavoro-con-cadenza-mensile.html
[5] https://dati.inail.it/portale/it/tabelle/tabelle-malattie-professionali-con-cadenza-mensile.html
[6] National Prevention Plan 2020-2025. Ministry of Health, Directorate General for Health Prevention. https://www.salute.gov.it/imgs/C_17_notizie_5029_0_file.pdf

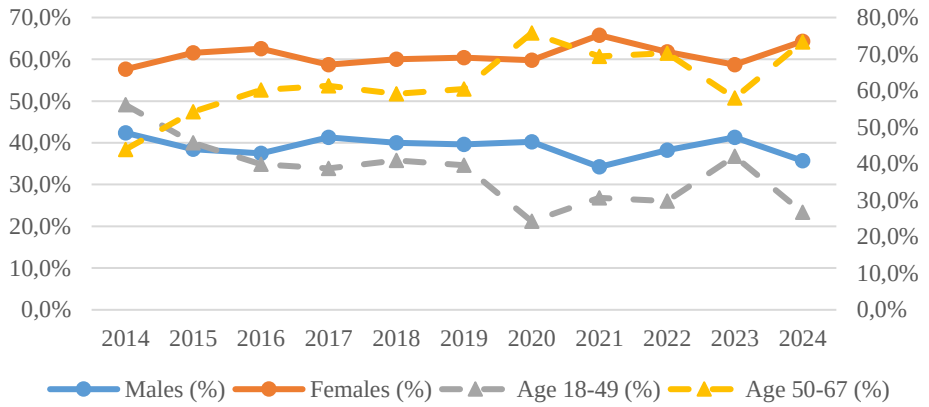
Figure 2 – *Percentage distribution of musculoskeletal disorders on the total number of individuals monitored in Istat.*



Source: Istat, Internal data processing.

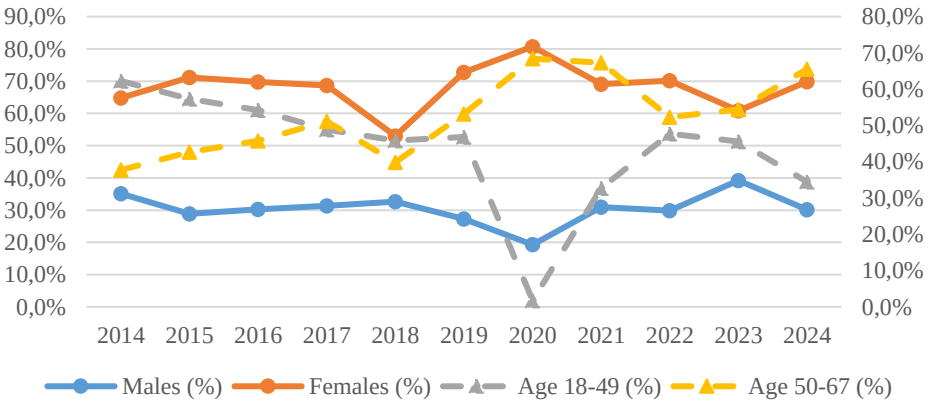
The cervical spine disorders have significantly decreased, from 7% in 2014 to 3% in 2024. Although the absolute number of cases fluctuates, the ratio of reported cases to the monitored population continuously decreases. The lumbar spine disorders are more variable, with peaks of 13% (2017) and drops to 2% (2021). Year 2021 marks a general contraction in all pathologies, with very low percentages. The thoracic spine is the least affected, with values between 1% and 3%. In the 2022-2024 period, the lumbar spine diso1rders values remain between 5% and 7%. Figure 3 shows the percentage of monitored Istat workers, divided by gender and age. The male percentage fluctuates between 30% and 42%, while female percentage represents the majority, with values between 58% and 70%. From 2017 onwards, there is a widening gap between men and women, with more women subjected to monitoring due to the greater female working population. In 2014, the monitored individuals were evenly distributed between the 18-49 age group (56,1%) and the 50-67 age group (43,9%). Since 2016, the percentage of the 50-67 age group has steadily increased, exceeding 60% in 2022 and reaching 73% in 2024. This trend suggests a progressive ageing of the monitored working population. Figure 4 shows the percentage of individuals considered fit for work with limitations, divided by gender and age; as highlighted before, from 2014 to 2024, women have prevailed (values always above 60% and peaks over 70% in the years 2015, 2016, 2019, and 2020). The male percentage has remained lower, between 19% and 39%. In 2020, 80,7% of workers considered fit for work with limitations were women, although the Covid-19 pandemic influenced surveillance activities.

Figure 3 – *Percentage of the number of monitored individuals, divided by gender and age.*



Source: Istat, Internal data processing.

Figure 4 – *Percentage of the number of individuals deemed fit with limitations, divided by gender and age.*

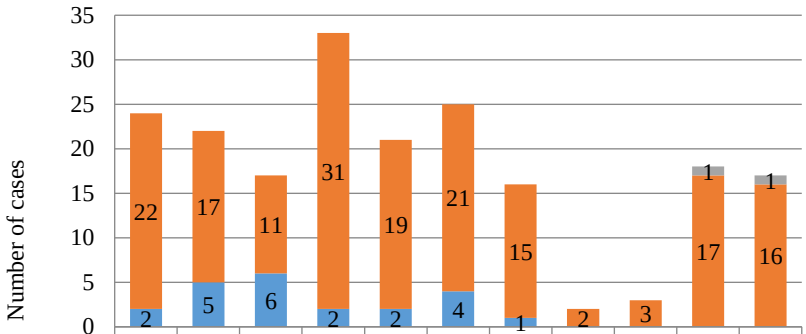


Source: Istat, Internal data processing.

In 2023, the male percentage reached 39,2%, but in 2024 it dropped again to 30,2%. In 2014, most of those considered fit with limitations belonged to the 18-49 age group (62,3%), while 37,7% were in the 50-67 age group. In the following years, the percentage of the 18-49 age group has decreased, while that of the 50-67 age group has increased, reversing the ratio from 2017 onwards. In 2024, 65,5% of workers considered fit with limitations were over 50, confirming the trend of an ageing working population with restrictions. Figure 5 shows accidents data recorded

at Istat from 2014 to 2024. Workplace accidents had low values in the period 2014-2019 (with a maximum of 6 cases in 2016). From 2020, these episodes have dropped to zero, following the pandemic, the increased attention to safety, and the spread of agile working. However, with the gradual return to in-person work, commuting accidents are emerging again.

Figure 5 – *Trend of work-related accidents in Istat by categories from 2014 to 2024.*



	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Agile work										1	1
Commuting	22	17	11	31	19	21	15	2	3	17	16
Workplace-related	2	5	6	2	2	4	1	0	0	0	0

Source: Istat, Internal data processing.

Between 2014 and 2019, the trend of commuting accidents showed fluctuations, with a peak in 2017 (31 cases). Starting from 2020, it can be observed a drastic decrease in commuting accidents that hit historical low in 2021 (2 cases), attributable to lockdowns and smart working. There was a rise in the 2023-2024 biennium (17-16 cases), signalling a gradual return to work mobility. Agile working remains the area with the fewest accidents, although individual cases occurred in 2023 and 2024, demonstrating that also remote work can present, even if rarely, safety-related risks. Variations in the percentages should be interpreted with caution, as the analysis is purely descriptive with no control of potential confounding factors (such as age, health status, etc.). Consequently, data cannot be read as evidence of causal relationships but rather as indicative trends for further investigation.

5. Inclusion, well-being and safety policies for sustainable work

The evolution of the world of work requires inclusive policies to reduce gender, territorial, and economic inequalities, strengthening the role of workers in the transition towards more flexible and sustainable models. Disparities in access to healthcare, education, and technology widen the social gap, making investments

essential to ensure equity and opportunities. The 2030 Agenda (Goal 10) promotes inclusion as a tool to reduce these inequalities. According to the World Health Organization, *health is a state of complete physical, mental, and social well-being* and it is essential for productivity and quality of life. Healthy lifestyles promotion, smoking reduction, and corporate welfare are fundamental to preventing chronic diseases and improving working conditions. With the increasing median age of the workforce, prevention becomes a priority to ensure active and healthy ageing. Training is crucial for health and safety and should be introduced from an early stage in schools. Recent regulations, such as the Directive of 14 January 2025[7] and the legislation on agile working for SMEs, highlight the need for collaboration between workers and employers. Training is not just an obligation but a strategic opportunity to enhance skills and improve services. In Istat, the strengthening of safety policies has been achieved also through an integrated management of health and safety objectives in the PIAO (Integrated Plan of Activity and Organisation) and in the Risk Management, reinforcing the organisational structure and making prevention policies more efficient. The adoption of more focused strategies makes it possible to protect workers and to optimised risk management.

6. Final considerations

Health and safety in living and working environments are influenced by socio-economic, territorial, technological, and regulatory factors. The development of prevention and protection measures is essential in a context where the boundaries between private life and work are becoming increasingly thinner. The study highlights the following key aspects: the decrease in workplace injuries is offset by a rise in commuting accidents, drawing attention to the need for safe mobility policies; prevention is crucial, from home safety to workplace training; socio-economic and territorial inequalities limit access to training, technology, and healthcare, making inclusive policies essential; digital innovation and AI enhance prevention and personalised care. Moreover, the productivity dimension should not be neglected, remote work is not only a matter of individual choice or organisational flexibility but also a structural factor influencing economic performance and competitiveness (Barrero *et al.*, 2023; Lee, 2023). Finally, new regulations strengthen training and safety, actively involving both workers and employers. Regulatory developments must ensure a dynamic and inclusive approach to safety.

[7] Directive of the Minister for Public Administration of 14.01.2025. Valuing People and Creating Public Value through Training. Principles, Objectives and Tools. https://www.funzionepubblica.gov.it/sites/funzionepubblica.gov.it/files/Direttiva_MinistroPA_14.01.2025_formazione.pdf

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