JULY 2025
No 363

Authors
Huong Thu Nguyen
Cecilia Poggi

Coordination
Cecilia Poggi

Research papers

A Case Study of Occupational Safety and Health in Vietnam's ICT Manufacturing SMEs

ÉDITIONS AFD
AGENCE FRANÇAISE DE DÉVELOPPEMENT

Agence française de développement

Papiers de recherche

Les *Papiers de Recherche de l'AFD* ont pour but de diffuser rapidement les résultats de travaux en cours. Ils s'adressent principalement aux chercheurs, aux étudiants et au monde académique. Ils couvrent l'ensemble des sujets de travail de l'AFD : analyse économique, théorie économique, analyse des politiques publiques, sciences de l'ingénieur, sociologie, géographie et anthropologie. Une publication dans les *Papiers de Recherche de l'AFD* n'en exclut aucune autre.

Les opinions exprimées dans ce papier sont celles de son (ses) auteur(s) et ne reflètent pas nécessairement celles de l'AFD. Ce document est publié sous l'entière responsabilité de son (ses) auteur(s) ou des institutions partenaires.

Research Papers

AFD Research Papers are intended to rapidly disseminate findings of ongoing work and mainly target researchers, students and the wider academic community. They cover the full range of AFD work, including: economic analysis, economic theory, policy analysis, engineering sciences, sociology, geography and anthropology. *AFD Research Papers* and other publications are not mutually exclusive.

The opinions expressed in this paper are those of the author(s) and do not necessarily reflect the position of AFD. It is therefore published under the sole responsibility of its author(s) or its partner institutions.

A case study of Occupational Safety and Health in Vietnam's ICT Manufacturing SMEs

Authors

Huong Thu Nguyen
VNU University of Social Sciences and Humanities

Cecilia Poggi
Agence française de développement (AFD)

Coordination

Cecilia Poggi (AFD)

Abstract

Based on an extensive desk review, and key informant interviews with a range of stakeholders, this background article explores the occupational safety and health (OSH) implementation in the Information and Communication Technology (ICT) manufacturing sector, and sheds lights on perceived drivers and constraints for green transitions among relevant stakeholders. The analysis shows that OSH should not be viewed merely as a human resource management issue, but rather as integral part of firms' green transformation strategies. It explores how small and medium enterprises (SMEs) in ICT could enhance OSH by integrating sustainability into workplace practices and promoting safer, greening and inclusive SMEs' work environments.

Keywords
OSH; ICT; green transition; human resource management; SME; Vietnam

Acknowledgements
This background research is part of a larger study, entitled "The Role of Small and Medium Enterprises in Reducing Emissions and Supporting the Energy Transition in the Information and Communication Technology Manufacturing Value Chain" (C3-WP1-A2), under GEMMES Vietnam 2 (2023-2026), funded by AFD. We deeply appreciate the generous support the Board of Management of SATITECH under the Vietnam Ministry of Science and Technology have provided. We are especially grateful to all study participants in Vietnam who gave their time, knowledge and insights.

JEL Classification
J28; L26; L63; M12

Original version
English

Accepted
July 2025

Résumé

Sur la base d'un examen approfondi et d'entrevues avec des informateurs clés auprès de diverses parties prenantes, cet article explore la mise en œuvre de la sécurité et de la santé au travail (SST) dans le secteur manufacturier des technologies de l'information et de la communication (TIC), et met en lumière les contraintes perçues et les moteurs des transitions vertes parmi les parties prenantes concernées. L'analyse montre que la SST ne devrait pas être considérée simplement comme une question de gestion des ressources humaines, mais plutôt comme une partie intégrante des stratégies de transformation verte des entreprises. Il met en évidence la façon dont les petites et moyennes entreprises (PME) du secteur TIC pourraient améliorer la SST en intégrant la durabilité dans les pratiques de travail et en favorisant des environnements de travail plus sécuritaires, écologiques et inclusifs pour les PME.

Mots-clés
SST; TIC; transition verte; gestion des ressources humaines; PME; Vietnam.

Remerciements
Cette recherche fait partie d'une étude plus vaste, intitulée « The Role of Small and Medium Enterprises in Reducing Emissions and Supporting the Energy Transition in the Information and Communication Technology Manufacturing Value Chain » (C3-WP1-A2), dans le cadre du programme GEMMES Vietnam 2 (2023-2026), financée par l'AFD. Nous sommes très reconnaissantes du soutien généreux que le conseil d'administration de SATITECH, sous l'égide du ministère vietnamien des Sciences et de la Technologie, a fourni. Nous sommes particulièrement reconnaissantes à tous les participants de l'étude au Vietnam qui ont donné leur temps, leurs connaissances et leurs idées.

Classification JEL
J28; L26; L63; M12.

Version originale
Anglais

Acceptée
juillet 2025

Introduction

Globally, the transition towards a green economy and the constant pressure on the economy and environmental issues has opened up new challenges for occupational safety and health (OSH), which include potential exposure to traditional occupational risks, emerging risks from new technologies, working processes, workforce diversification and demographic changes (Lee and Nam 2017; Shabunina et al. 2017). While existing OSH research has concentrated on the impact of the fourth industrial revolution (Arana-Landín et al. 2023; Min et al. 2019), or specific sectors such as maritime (Reinhold, Järvis and Prause 2019), electric power (Song 2023), and wind energy (Wifa and Hunter 2022), there is limited focus on the Information and Communication Technology (ICT) manufacturing sector, such as those involved in the value-chains for telecommunications, consumer electronics, software, and internet sectors (used as ICT definition for the present study). This is a crucial gap, as small and medium enterprises (SMEs) typically face higher risks of occupational accidents and poorer safety performance, both abroad and in Vietnam (Croucher et al. 2013; MOLISA and ILO 2011). It may be due to lack of financial resources, management's little interest in OSH issues or awareness of the benefits of OSH good practices, inadequate employee representation, insufficient OSH inspections and limited support from occupational health services and other human resource focal points (Croucher et al. 2013). Assessing OSH compliance is thus vital for Vietnam, as few SMEs supply to foreign direct investment (FDI) enterprises or are part of global supply chains (Duc Binh 2019).

Relatedly, Vietnam, with its rapidly growing ICT sector and integration into global value chains, offers a valuable case for examining OSH within the context of green transitions. Since joining the World Trade Organization (WTO) in 2007, Vietnam's involvement in global value chains has increased significantly, making OSH a priority for both national policy and international competitiveness (National Institute for Finance 2021). The ICT sector in Vietnam has made impressive strides over the past two decades. In 2000, it accounted for only 5% of the country total exports, and by 2019, this figure had risen to 33% (Đặng 2022:95). Notably, the ICT sector has contributed significantly to the country's GDP, reaching around US$36.9 billion in 2023, with a year-on-year growth of 1.34%. The total number of employees in the sector surpassed 1.76 million in 2023, a 2.72% increase from 2022 (Le 2024). These statistics indicate that Vietnam possesses favourable conditions for developing a model of digital economy as a global ICT factory (Đặng 2022: 96). Nonetheless, OSH challenges persist, especially for ICT SMEs, which are urged to comply with the national goal of Net Zero emissions by 2050 (Socialist Republic of Vietnam 2022).

Little has been known about the OSH field in the ICT sector, as research has focused mainly on its application and labour productivity, the sector's impact on domestic economy (Đặng and Nguyễn 2021).

This background article examines barriers to compliance and how OSH practices in Vietnamese ICT SMEs can be modified to better align with green transition and sustainable development goals. The article is organised as follows: Section 1 presents the research design and methodology. Section 2 presents first the evolution of OSH legal framework in Vietnam (Section 2.1), and then it details into the specificity of OSH in the ICT manufacturing sector (Section 2.2). Section 2.3 then asks the questions of how OSH compliance is hindered and which factors are most relevant for the different stakeholders of the sector to impede or favour compliance. Section 3 concludes.

1. Research design and methodology

We set this research to investigate how OSH practices in Vietnamese ICT SMEs can be modified to better align with green transition goals. This work is based on 15 in-depth, semi-structured interviews with key stakeholders in Hanoi between December 2023 and April 2024. We managed to interview a wide range of stakeholders including national government officials from various ministries and agencies related to entrepreneurship, labour, and OHS, representatives of private ICT small and medium enterprises, and from Trade Union, United Nations agencies in Vietnam and relevant academics. Except two women, the majority of our interviewees were men, mirroring the overwhelmingly male composition of the ICT and/or OSH field. Interviews lasted about an hour, and took place in the office of interviewees, or at a café nearby their residence.

Table 1. List of stakeholders interviewed between December 2023 and April 2024

Gender	Organization
M	Vietnam National University
M	National Institute of Occupational Safety and Health
M	National Institute of Occupational Safety and Health
M	Ministry of Industry and Trade
F	Posts and Telecommunications Institute of Technology
M	Ministry of Science and Technology
M	NGO
M	ILO
M	Vietnam Academy of Social Sciences
M	Ministry of Health
F	VCCI
M	MOLISA
M	MOLISA
M	MOLISA
M	SME CEO

Source: Authors' own compilation. Note: Reponses by interviewees are codified and anonymised in the study. Acronyms: MOLISA = Ministry of Labour, Invalids, Social Affairs (ministerial title used up to 2025); VCCI = Viet Nam Chamber of Commerce and Industry; SME = Small, medium enterprise.

The analysis then develops its arguments in line with the framework of the International Labour Organization (ILO) Occupational Safety and Health in Global Supply Chains (GSC) and particularly with respect to the intervention design to improve OSH in the selected GSC (2018). This comprehensive framework aims to identify and address the drivers and constraints affecting OSH in various sectors, particularly extensive to date in agriculture and garment industries across countries.

The ILO framework emphasizes the importance of data collection, stakeholder engagement, and the development of tailored interventions to improve OSH outcomes across different stages of a supply chain. In this study, we set the scene for such dialogue in the ICT manufacturing sector, enquiring stakeholders on several value chains of the ICT manufacturing where SMEs are dominant actors. Further to that, supplementing the key informant interviews, the analysis benefited from on-site observations that took place during field visits to four selected enterprises in Hanoi and another province of Red River Delta region. The insights gathered from informal conversations with a number of enterprise managers and workers have significantly enriched our experiential and accumulated knowledge of OSH issues in the ICT manufacturing sector in Vietnam.

2. Results

2.1. Evolution of OSH National Legal Framework

In Vietnam, the 2015 OSH Law defines occupational safety as preventive measures for dangerous factors to avoid injuries or deaths to employees during the course of work, whereas occupational hygiene means preventive measures for harmful factors that cause diseases or health declining of employees during the course of work (Law No. 84/2015/QH13: Article 3, item 2; 3).

Historically, concerns about hygiene and safety for workers were taken up as early as Government Ordinance No. 29/SL dated 13/3/1947. A Decree in 1964 stipulated temporary provisions for labour protection aimed at preventing workplace accidents and protecting the health of workers and staff. Based on a State Council Ordinance issued in 1991, the National Assembly promulgated the Labour Law in 1994 providing guaranties for the rights of workers to work in safe and hygienic conditions, stressing responsibilities of employers and employees, enhancing effectiveness of state management of worker protection in preventing occupational accidents and health hazards (Nguyễn Đắc Diện 2024). The year of

1994 also marked Vietnam's ratification of both the ILO Conventions No. 155 (OSH) and No. 81 (Labour Inspection), highlighting the country's obligations to inspect OSH conditions at the workplace and to ensure compliance with OSH legal provisions. One year shortly after Vietnam ratified the ILO Convention No. 187 (Promotional OSH Framework), the national Law on OSH (No. 84/2015/QH13) was enacted in 2015, aiming at establishing coherent national policies on OSH.

Legislatively, the current OSH Law stipulates a number of requirements in terms of identifying hazards, assessing and controlling risks at the workplace, formulating an emergency response plan, providing health examinations, reporting occupational accidents and diseases, and appointing mandated focal points, and responsible institutions regarding OSH. Notably, the Law provides for concrete measures to prevent workers' exposure to occupational hazards and to control risks as well as policies on compensation for the victims. Furthermore, the Law expands OSH protection measures to cover workers in the informal sectors (i.e., without labour contracts) which accounts for 68% of the workforce in Vietnam (ILO 2023).

Another relevant OSH document is the National Program for OSH in 2021-2025 period (Resolution No. 19/NQ-CP dated 16 February 2022), which sets a number of key objectives by 2025, such as: an annual decrease of 4% in the frequency of fatal occupational accidents; an annual increase of 5% in the number of workers to be examined for occupational diseases; and 5% annual increase in the number of enterprises being subjected to workplace environmental monitoring. It is worth noticing that this national program is applied to all industries and sectors, involving state officials, employers and workers. Priority is given to industries, jobs or tasks at high risk of occupational accidents and diseases, small and medium-sized enterprises, cooperatives and craft villages. These legal provisions indicate that OSH implementation is an organisation-wide effort geared towards collective benefits such as the health and well-being of the workforce, and the business productivity, while minimizing health care expenses. As such, both employer and employee share the responsibilities in the implementation of OSH in the workplace. This idea of OSH implementation is also observed elsewhere (Surienty 2012).

In terms of current institutional mandates, the Bureau for Safe Work under Ministry of Labour, Invalids and Social Affairs (MOLISA) assumes state management functions on OSH implementation, monitoring and inspection. The Ministry of Health (MOH) is instead responsible for management of occupational hygiene and prevention of occupational diseases. Moreover, the cooperative role of Trade Union under the Vietnam General Confederation of Labour is defined in policy formulation, amendment, and legislation on OSH related rights and obligations of employees with regulatory agencies.

Notably, after its accession to the WTO, similar to China (Song 2023) Vietnam adopted the "three system certification" – a significant symbol of enterprise management modernization and a standard that enterprises must abide by. The three-system certification refers to the ISO9001, ISO14001, and ISO45001 certifications. Developed by the International Organization for Standardization (ISO), ISO9001, ISO14001, and ISO 45001 are quality, environmental, and OHS management system standards, respectively. In addition, the MOLISA issued Circular No. 36/2019/TT- BLĐTBXH providing a list of machinery, equipment, materials and substances subject to strict requirements. This list contains 105 items related to general occupational safety and military or public security occupational safety. These technical requirements incorporated in national standards and regulations on technical matters on OSH were only put in force after the Office for the Implementation of WTO Agreement on Technical Barriers to Trade reportedly had consulted with WTO partners and partners in the Free Trade Conventions of which Vietnam is a member (Hoàng Hải 2022). Through these codes of conduct and international standards, the concept of corporate social responsibility has been introduced and adapted to countries like Vietnam, moving it closer to global standards while retaining distinctive local characteristics (Nguyen, Bensemann and Kelly 2018). As such, corporate social responsibility has become mandatory in business relationships with foreign partners. Therefore, local managers must learn more socially responsible practices (Tencati, Russo and Quaglia 2008). However, existing legal provisions are not clear how these initiatives will address some of the social issues in the supply chain of ICT sector. It is critical that a transition towards a circular economy/net zero emission does not neglect its socio-economic implications.

2.2. A Glimpse of OSH in ICT Manufacturing Sector

2.2.1 Occupational Safety in ICT industry

In a broad sense, the literature on OSH risk assessment in Vietnam is rather limited to the short-term safety aspects of OSH, for instance, on accident scenarios. This reflects the traditional emphasis on work-related physical injuries elsewhere in the world (Tamers et al. 2020), and this emphasis on occupational accidents – and hence a need of safety for individual productivity and firm performance – leads to a general interpretation of occupational safety as more concerned with technical aspects of the production process, as revealed in our key informant interviews. Indeed, ISO 31000 – a standard that provides principles, a framework and a process for managing risk in any organization (ISO and UNIDO 2021; TCVN ISO 31000:2018) – also tends to focus on safety rather than health (Ji et al. 2022). Ji et al. (2023) argues that formalised risk management is effective for short-term safety

incidents, but struggles with long-term health issues, as outcomes develop gradually, involve multiple factors, and injuries may be cumulative. This is further reflected in the national mechanism of occupational safety management in which the MOLISA is mandated with the state management agency function of inspection.

From these perspectives, the national briefing report on occupational accidents issued annually by MOLISA, provides an overall picture of the situation across the country. Based on the available statistics as of 2023, fatal workplace accidents are reported to occur mostly in the sectors of construction, coal mining, mineral mining, mechanical engineering, metallurgy, construction material production, textiles, footwear, and services (MOLISA 2024). There were 7,394 workplace accidents involving 699 deaths and 1,720 injured in both the formal and informal sectors, nationwide in 2023 (MOLISA 2024). However, there was hardly any mention of the ICT sector involved in serious accidents in these annual briefings over the years. Even though the causes of most fatalities as listed in the 2023 Annual Briefing on Occupational Safety include clamping and cutting by machineries (17.32% of total accidents), or electric shocks (11.01% of total accidents), which might as well occur in the ICT manufacturing sector. Nevertheless, since available statistics are not broken down by sector, we have no way of ascertaining this.

In this study, a few interviewees indicated that ICT has lower risks of work-related fatal injuries, compared to other industries such as construction, mining, or mechanical engineering. This appears to relate to occupational problems with the culture/climate-based safety approach (Fan et al. 2020), indicating safety culture/climate in the organisation as a key antecedent of safety outcomes. Accordingly, ICT manufacturing workforce is unlikely to be exposed to occupational hazards such as in difficult and uncontrolled climate conditions, or in challenging terrains as encountered in construction and mining sectors (Gochfeld et al. 2006). A few stakeholders noted that compared to other sectors, ICT SMEs appear to be conforming better to OHS standards and regulations. Some government officers commented that many of today's design-related occupational safety concerns may not be relevant in the case of the ICT sector, pointing out that most ICT work is done indoors in relatively safe surroundings, and the nature of the work does not involve excessive physical effort on the part of the employees. In addition, apart from compliance to observe OSH standards set by GVN, most ICT firms under contracts with overseas partners in the supply chain tend to follow OSH regulations and protocols set by these partners.

> *Re. SME in supporting sector, it is less likely a big concern about OHS as they are participating in the supply chains for big international companies such as Samsung, Intel, etc. Under these international companies there are OHS compliance regulations, protocols, etc. There are social audits performed regularly. For the*

supporting sector SMEs are more likely requested by their buyers to outsource the assessment at the same institution suggested by the buyers. (G_4)

This way of explaining seems to overlook or underestimate the risk factors inherent in the production process:

There are cross-cutting issues i.e., chemicals which involve both the safety angle and occupational hygiene. (R_3)

In assessing risk factors inherent in the working environment, the authorities implement a number of measures to prevent accidents and injuries that might occur to workers, to protect them from serious health hazards and to improve workplace safety. For this study, the first author visited a number of manufacturing plants in northern Vietnam producing specific components and electrical equipment for the ICT supply chain. At these SME plants, one often sees overhead cranes that are attached to the interior structure of a building; these are operated to lift and move heavy loads the length and width of the building with high efficiency and precision. Overall, these cranes are labour saving and cost effective, while enhancing the flow of the production process. However, we noticed safety concerns in one SME related to workers performing routine tasks directly beneath an active overhead crane installation in the factory hall. The SME involved did receive an ISO45001 certification in 2017, and is an official supplier to well-known East Asian electronics companies, but this is a clear violation of the National Technical Regulation on Safe Work for Overhead, Gantry (QCVN 30:2016/BLĐTBXH), which stipulates that activities like lifting and moving heavy loads in the vicinity of ongoing work must guarantee the safety of equipment and the people involved (item No. 3.5.4.7). This is based on the principle stipulating TCVN 7549-1:2005 (ISO 124801:1997) that management is not allowed to set up work place where an overhead crane is installed, to avoid possible accidents due to mechanical or electrical mishaps and overloading. The fact that production personnel operated under such conditions might be due to limited factory space.

Another striking example of safety negligence is the absence of supervising cameras in the factory hall of some SMEs. This may be because the equipment obstructing the overhead crane rail system was removed, which included the camera system. At another SME (ISO45001 certified), a supplier to Western European and North American companies over the past decade, only a small number of workers was wearing masks when doing welding work, ignoring the warning sign. At another production unit, a number of workers did not wear cut resistant gloves when working with sharp objects, despite the warning notice posted on the wall.

During the study visits the SMEs managers, both Vietnamese, accompanied the first author. Neither seemed to be concerned about the safety aspects of their firms' operations. Symbolically, perhaps the motto "*Năng suất là tiền lương. Tiến độ là uy tín*" (productivity is salary, work progress is prestige) painted in big red letters high on the wall of the factory walls is much more eye catching, emphasizing where the priorities essentially lie, than the small notice board on safety regulations printed in small letters posted at the factory entrance.

2.2.2. Occupational Health in ICT industry

Occupational health is a core responsibility of the MOH, as evidenced by the fact that available statistics on this subject are derived from the Ministry's own sources. For instance, a report was made on the situation of occupational health among the working population in 63 provinces in the 2016-2020 period (Nguyễn Thị Thu Huyền, Lương Mai Anh, Trần Anh Thành 2021). A retrospective study based on available data indicate 2,120 cases of occupational diseases, mainly among males (91,7%), most prevalent among people above the age of 40 (78%) and those with more than 10 years on the jobs (65,7%). The most common disease is deafness due to noise (59,5%), pulmonary diseases (17,1%), and silicosis (11,9%). A more recent study (Lương Hạnh 2023) indicates that there were 114 cases receiving medical certification, accounting for 8,6% of all diagnosed cases of occupied diseases in 2022. In particular, 8 out of 34 occupational diseases were diagnosed as newly acquired. Among the most common were deafness by noise (73.2 %) and silicosis (19.1%). Branches with high rates of occupational diseases are mining, construction material manufacturing and mechanical industry, however, the number of workers in these branches who were examined for occupational diseases was low (Nguyễn Thị Thu Huyền, Lương Mai Anh, Trần Anh Thành 2021).

It is relevant to consider cultural dimensions of hygiene in the Vietnamese context. This is not to trace back the Greek origin of the term (Vandegrift et al. 2017), or its development as an academic discipline (Vincent 2005), but rather understanding how the legal definition of occupational health/hygiene shapes perceptions of risks related to hazards and harmful factors facing the ICT manufacturing industry.

Legislatively, Vietnam appears to be in line with international standards of occupational health by having defined "*vệ sinh lao động*" [occupational hygiene] as conditions or practices conducive to maintaining health and preventing disease (Law No. 84/2015/QH13, Article 3, item 3). As such, the first part of the definition tends to refer specifically to the relationship between cleanliness and the maintenance of good health, relating

entirely to the practice of medicine. Apparently, this unified form of sanitary-hygienic concept of workplace conditions is inherited from the Soviet influences, as observed in the former Soviet Union and East European countries (Dzhusupov et al. 2015; Dudarev and Odland 2013).

In practice, however, the Sino Vietnamese term "*vệ sinh*" [卫生: hygiene; sanitation] is often used to indicate a condition, or practice of cleanliness [*sạch sẽ*] or sterilization. This colloquial usage of "*vệ sinh*" seems to become increasingly conflated with actions and practices, most often concerning hand hygiene, which the World Health Organization defines as "a general term referring to any action of hand cleansing" (2009:2). On the basis of this interpretation of hygiene, a few respondents suggested a relatively low rate of sanitary-hygienic violation in the light manufacturing, which is generally considered "less problematic" (*ít vấn đề hơn*) than in heavier manufacturing. This conventional idea might be associated with the absence of ICT manufacturing sector in the list of industries inherent with high risk of labour accidents and occupational hazards as defined by Article 8, Circular No. 07/2016/TT-BLĐTBXH regarding regulations on organizing risk assessment of occupational safety and hygiene for production and business enterprises.

A notable practice of hygienic control of job conditions in ICT industry is the construction of "cleanrooms" [*phòng sạch*] to minimize the presence of contaminants, such as dust, airborne microbes, and chemical vapours, especially during the most intricate stages of semiconductor manufacturing, i.e., testing of circuits or chips, assembly and packing. This is because semiconductor materials are extremely sensitive to environmental factors until they are installed in their designated device. The cleanrooms, controlled environments are associated with ISO 14644-1:2015 (ISO 2024), which defines the classification of air cleanliness, but might not be effective in preventing or reducing ergonomic injuries and excessive work-related techno stress at workstations. Additionally, while it is acknowledged that not all processes of ICT manufacturing involve sensitive work and require this level of cleanliness control, the cost of building cleanrooms is not always affordable to most of Vietnamese SMEs, as the facilities seem to only exist in the FDI enterprises.

On the whole, Vietnam's rules and regulations of occupational health reflects the spirit of current international standards; however, the semantics of the term *vệ sinh* (hygiene) in the Vietnamese language has given rise to different interpretations, and subsequently different applications in practice. A most common understanding of *vệ sinh* as confined to physical and environmental cleanliness seems superficial, because it does not reflect the actual situations prevailing in SMEs.

Some OHS experts interviewed reveal the long-term chronic health risk in the manufacturing sector. Specifically, ICT workers are often exposed to chemicals, radiation, ergonomic hazards, and long hours of work in combination with rigid organisational structures, isolation and high levels of psychological stress. It has not been possible for us to collect data about occupational illness associated with the ICT sector, but it is clear that the foremost occupational hazards in this industry are from exposure to chemicals.

> *In the electronics industry (as part of ICT), there seems to use lots of chemicals. For instance, in step of cleaning materials for chip-making with the usage of ethanol. If being exposure for a long period of time can be harmful to the workers' health. There is another issue of bad smell/toxic chemicals from solder flux.* (interviewee R_1)

These excerpts confirm previously known health risk of chemicals in the ICT manufacturing in Vietnam (Nguyễn Thu Hà 2022), pointing out the fact that organic solvents account for a significant proportion of chemicals used in the electronics industry. Degreasers, thinners, detergents and chemical reagents are present in most manufacturing and assembly processes and stages. Among these are present isopropanol, n-butyl acetate, Freons, xylene, acetone, methanol, methoxyethanol, trichloroethane, methylene chloride, tetrachloroethylene, ethylene glycol and methyl ethyl ketone, among others. Globally, the "grey" (Plepsys 2002), or in another word, "dark side" (Osibanjo et al. 2016) of the ICT involves the usage of large amounts of often toxic materials, especially in the manufacturing of semiconductors, i.e., printed wiring boards, and cathode ray tubes. In fact, "it is one of the most chemical-intensive industries ever developed" (LaDou 2006:34). In the meantime, "many of the outdated technologies are exported to newly industrialized countries as newer technologies are installed in the more highly developed industries of Japan, the United States and Europe" (LaDou 2006:35). There is a concern about the availability and affordability of more sustainable chemicals for most developing countries, including Vietnam:

> The emerging development of the semiconductor industry has significant effects on the health of the workforce. There are certain kinds of harmful chemicals used in this sector that might be difficult to find alternatives given the high costs, and more importantly most of imported technologies to Vietnam seem to be not always the most environmental friendly. As a result, the health of workers would be highly precarious given their direct contacts with the source of harmful chemicals. (interviewee R_2)

Additionally, while the ICT sector appears to be similar to other manufacturing industries in production system, it features a unique emphasis on computer and engineering

skills, and tasks that are intellectually dynamic but physically static. Significant associations were found between prolonged standing, sitting, bending and neck, shoulder, arm, back, and leg pain facing ICT workforce across the globe (LaDou 2006):

> *Electronic manufacturing involves lots of manual component insertion, repetitive activities, especially. The manufacturing of microcircuits and microchips (microelectronics), causing visual impairment and other ergonomic issues faced by workers. Also, for Test-Mark section, it requires high levels of precision – because if there is an error found the whole load of products of the assembly line will have to be checked thoroughly, thus resulting in musculoskeletal and repetitive strain disorders among workers.* (interviewee G_5)

There is also evidence that robotics, artificial intelligence, and information technology are rapidly entering workplaces around the world and in Vietnam as well (World Bank 2018). Automation may protect workers from immediate physical hazards, but serious consequences also exist. Recent studies in other country contexts indicate that workers can be physically injured from unexpected contact with robots in manufacturing processes (Enrique et al. 2021), agricultural operations (Benos, Bechar, Bochtis 2020), or in long-term care (Vogt and König 2023). Furthermore, if they lose situational awareness, they may be unable to adequately react to hazards as it has occurred in fatal crashes involving highly automated vehicles (Tamers et al. 2020). Potential psychological harms to workers can also be anticipated from concerns about job loss or displacement due to robotic automation (Alcover et al. 2021; Nazareno and Schiff 2021). In fact, the evidence around mental health and well-being at work has grown in recent years, with a range of economic, infrastructural, socio-cultural factors cited in multiple research studies as having a negative impact on worker's mental health and well-being (Women Win and ICRW 2024; Rydstrom 2022; 2023). Taking into account these issues, a multidisciplinary approach in occupational health that goes beyond the traditional emphasis on physiological, physical harm is needed, in order to embrace emotional and psychological health as well as chronic and cumulative impacts.

2.3. Drivers and Constraints of OSH Compliance in ICT Manufacturing

We now turn to the question of how green transitions can be achieved through institutional appraisal of the drivers and constraints related to OSH practices in Vietnam. The concept of green economy and its sub-category of greening practices with respect to the enterprise behaviour are analysed jointly for the understanding of the ICT manufacturing and its potentials.

Reflections from our interviews show that ICT manufacturing entrepreneurs generally recognise the value of green transitions for meeting government commitments, while struggling to implement changes due to structural challenges such as lack of capital, skills mismatch, and the long-term nature of the transformations that would require more support from the government. There are, however, nuances on the constraints and drivers of OSH that need to be understood around green transitions, for developing short- to medium-term OSH regulatory solutions. Based on the interview insights, we identified constraints and drivers for achieving green transition features among the three types of stakeholders (workers, enterprise managers or owners, and policymakers or regulatory bodies) and four potential angles of application: (1) workforce well-being and mental health, (2) production process and work schedule, (3) management attention to OSH adherence to greening practices and inclusivity, and (4) policy evolution and regulatory practices.

2.3.1. Links to Workforce Wellbeing and Mental Health

When exploring constraints and drivers associated to OSH implementation, we notice that the health aspects emerge predominantly in the discourse. The sector is fast expanding and this implies small and frequent technological or procedural modifications applied to the production process that have direct implication on health hazards generation. For firms it may not be easy to follow all sub-regulatory frameworks within each subsector that involve both occupational health or OH issues (i.e. how a new task/mechanism or exposure to a material should be treated) and occupational safety or OS practices. Not surprisingly, workers in ICT manufacturing subsectors like electronics and microelectronics face significant health risks due to their direct exposure to harmful chemicals:

> *Chemical use in semiconductor manufacturing, like ethanol, can cause respiratory and skin problems if protective equipment is lacking.* (interviewee *G_4)*

> *Repetitive tasks like chip mounting can cause ergonomic issues, especially in manual processes.* (interviewee *G_6)*

There are also direct impacts of ICT production processes directly affecting visual and mental health:

> *In cleanroom environments, workers face risks of visual impairment due to prolonged exposure to artificial lighting and the need for high levels of precision in assembly tasks.* (interviewee *P_1)*

The intense focus required for microchip testing and inspection tasks is a known cause of eyestrain and mental fatigue. These might be exacerbated by monotonous and repetitive job functions that contribute to mental exhaustion and decreased job satisfaction, as the female civil servant noted. Moreover, although female workers in the electronics sectors are often assigned to roles like quality control considered "less risky", this categorisation overlooks the mental strain and potential chemical exposure in these positions.

As mentioned in the previous section, robotics and automation may raise psychosocial risks like stress from job insecurity). The mental load could in principle be worsen in an occupation where poorly designed job tasks, inadequate training or support, and increased sources of work-related stress may end up in creating psychosocial hazards. Nonetheless, to date psychosocial hazard identification and management are still largely overlooked in OSH regulations and training in both Vietnam and abroad (ILO 2023). This is an area still nascent in its regulation, and should be studied in relation to technological shifts that the green transition is bringing about.

Looking at managerial attention to workforce well-being, the productivity demands they experience often lead them to minimum OSH compliance, ignoring long-term health impacts. This is particularly evident in high-pressure sectors, where meeting production targets takes precedence due to strict contractual arrangements. The COVID-19 pandemic accelerated the global recognition of psychosocial risks in workplace safety and health management among enterprises (ILO 2023). However, this does not apply to the ICT manufacturing environment we analyse. A few interviewees typically noted that while the enterprise managers understand physical risks, they often overlook the mental health impacts of high-stress environments, long hours, and performance pressure. This gap in understanding can "lead to a lack of support for workers dealing with anxiety or burnout," a NGO practitioner noted. There are also considerations of unclear profitability and lack of technical expertise of health-focused implementation practices. This reluctance is evident in smaller firms, which use outdated methods, overlooking health risks for easier implementation. Moreover, gender-sensitive measures related to workers' well-being appear to be weakly applied.

> *In some companies, female workers are confined to administrative or logistic roles. (P_1)*

> *In others, female workers are assigned to repetitive and high-alert tasks in quality control that, without proper support, can affect mental well-being and lead to higher drop-outs. (G_2)*

On the regulatory side, there are a number of relevant drivers to consider for future updates. A few interviewees noted that current OSH policies are primarily focused on physical safety and lack comprehensive coverage of mental health and psychosocial risks. However, as it is a growing concern, especially as new technologies are introduced into the workplace, policymakers seem to be working on draft amendments to include mental health considerations into the OSH laws, whilst implementation is still in the early stages. As some government respondents mentioned, a future discussion over the months and years to come, identification and coverage of the broader psychosocial risks associated with tasks repetition and technological changes should be discussed in Vietnam. Thus, the inclusion of such measures would require coordination across multiple government bodies and the involvement of stakeholders like trade unions to build up guidance frameworks and OSH standards for new and emerging risks that could in turn ease enforcement and compliance.

2.3.2 Production Process and Work Schedule

Looking at production processes, a first trait that is important for updating OSH measures is the guidance around production processes that involve repetitive and high-precision tasks. For instance, in semiconductor manufacturing, workers are engaged in manual processes like die preparation and chip mounting, which are physically taxing and cause musculoskeletal disorders. The monotony and repetitiveness of these tasks could also contribute to mental fatigue and burnout, especially in environments where breaks are limited, and production quotas are prioritised. Moreover, interviewees revealed some level of concern as the young workforce is preferring more flexible and less monotonous jobs, making it challenging for ICT companies to attract young talent, with imaginable consequences for high-precision sectors. This decline in interest could in the near future affect production efficiency and lead to increased pressure on the existing workforce, further straining work conditions.

With respect to workers' schedule, factory workers often have rigid and non-flexible work schedules, which can influence their overall well-being and productivity. In sectors like ICT manufacturing, the production process is tightly controlled, and any deviation from the established timeline (e.g., due to equipment malfunction or power outages) can result in a complete reset of the production cycle, causing frustration and stress for workers, the female officer explained.

Similar and strictly associated to the health risks management difficulties highlighted above, it seems that the enterprise managers may find it difficult to balance production

efficiency with OSH compliance. The managers often prioritise short-term production goals over safety investments:

> *The managers' uncertainty about the profitability of investing in safety measures often leads to a focus on short-term production targets rather than long-term health or safety outcomes.* (P_1)

> *Small enterprises' managers often rely on outdated production technologies that are less safe and more prone to breakdowns, resulting in frequent disruptions to the production timeline. The exposure to pollutants and chemicals is also common, and the production process often involves handling hazardous materials without adequate protective gear or safety protocols.* (S_1)

Moreover, when enquired on the major constraints, a few interviewees highlighted that the implementation of greening practices in the production processes that align with both safety and environmental standards is a hard task. For example, while some managers are aware of energy-efficient technologies, they are unable to integrate these into their production lines without external support. Furthermore, in small enterprises managers may often rely on informal waste disposal methods, such as unlicensed recycling services, who do not follow proper safety protocols, and who contribute to environmental contamination and health hazards for workers handling these materials. These types of technical gaps not only affect production efficiency, they also may increase the likelihood of accidents due to inappropriate handling of machinery and/or materials.

On the regulatory side, OSH regulations are strictly enforced within industrial zones, and compliance is weaker for SMEs located outside these zones. In remote settings, limited on-site inspections allows companies to circumvent safety standards without consequence, the female officer noticed. This disparity may undermine the uniformity of OSH laws across the Vietnamese ICT value chain, and may lead to inconsistency in production safety standards across regions. High-risk production zones, such as waste recycling sites, may be particularly challenging for policymakers. These zones are known hot spots for production-related pollution and OSH violations, and the dispersed nature of these operations makes effective monitoring and enforcement difficult. The complexity of addressing these issues is compounded by the involvement of multiple stakeholders, requiring coordinated efforts across different agencies.

There is a growing recognition among policymakers of the need to integrate green production policies with OSH standards. For instance, as part of Vietnam's broader energy transition, policymakers are advocating for a more sustainable production process that

include both energy efficiency and worker safety. This approach requires creating synergies between environmental and OSH regulations, while current frameworks are not equipped to handle this dual focus, leading to implementation challenges.

What seems however to be a very promising feature in current dialogue is the awareness of sector-specific policies measures to address unique production risks in industries within the national ICT value-chain. Some respondents highlighted that policymakers are currently working on amendments to OSH Law that could include provisions for emerging sectors, aiming to create a more comprehensive regulatory environment that adapts to new production realities.

2.3.3. Management Attention to OSH Adherence to Greening Practices and Inclusivity

A number of interviewees noted that workers are rarely involved in OSH discussions, resulting in internal policies and measures not fully addressing specific workforce needs. For example, in companies where OSH focal points exist, managers often fill these roles and do not consult the workers directly impacted by safety practices. Managers' safety measures are frequently compliance-driven rather than focused on actual risk mitigation. This compliance-centric approach is prevalent because the managers view OSH as a legal requirement rather than a strategy for enhancing worker well-being and productivity. Moreover, in high-tech manufacturing sectors, including ICT, female workers are often underrepresented in core production roles (within R&D or production lines), affecting the implementation of gender-inclusive measures in practice due to the very low number among workers in the sector. Managers often deprioritise inclusivity efforts due to perceived high costs and limited returns. SMEs appear more proactive to adhere to higher degrees of OSH standards when they are part of international supply chains and subject to external audits or buyer requirements. Also, managers in small enterprises often lack structured approaches to OSH management (such as the existence of dedicated safety officers or health and safety committees), which leads to inconsistent safety practices (Vinberg 2020). This lack of structured management may result in ad-hoc approaches that are reactive rather than preventive as the 2015 OSH Law mandates. In order to avoid this tendency, more attention could be devoted to designing and testing information campaigns targeted towards entrepreneurial leadership in OSH adherence, as some applications of the Upper Echelons Theory (UET) perspective for greening practices suggest. Recent research (Ali et al. 2023) on UET in other contexts found that the personal characteristics of top managers influence strategic decisions and organizational performance, these including environmental responsibility and environmental proactive measures in business operations.

For Vietnam, it appears that if positive environmental attitude is present among top level management, there is a positive effect on choosing green production strategies, and that this effect can be positively mediated by regulatory pressure (Liem & Hien 2024). In China, an effect is found for the adoption of green innovation, via organisation learning culture that mediates the effect of entrepreneurial leadership (Ali et al. 2023).

Respondents noted that Vietnamese policymakers recognise the weak enforcement of inclusivity measures in current OH and OS policies, while are committed to improving gender and workplace inclusivity in upcoming OSH amendments. This shift could offer a more balanced framework that considers the unique needs of different worker groups and facilitate the integration across the spectrum of ICT firms of gender-sensitive practices. For instance, current OSH regulations do not adequately address gender-sensitive practices, and there is no comprehensive policy framework to promote equal opportunities in technical fields like engineering specialties within ICT. A few interviewees noted that the upcoming amendments to the OHS Law could aim to include provisions for gender diversity, particularly in male-dominated sectors where women and marginalized groups are underrepresented, and promote a more inclusive approach to safety and health regulations.

Implementing inclusive and greening OSH policies requires coordination across multiple agencies, which has proven to be a significant challenge. The study interlocutors have noted that the lack of a unified vision among different regulatory bodies leads to fragmented approaches and weak enforcement of OSH practices. A very promising avenue reported by several respondents is the inclusion of coordination resolutions in upcoming discussions about amendments, both to the OSH Law and ongoing inter-ministerial sectoral dialogues, as achieving effective implementation will require better inter-agencies collaboration.

2.3.4. Policy Evolution and Regulatory Practices

In views of regulatory practices and expected policy evolutions to accompany OSH practices in the ICT sector, interviewees explained that workers, particularly those in non-standard employment arrangements, often face challenges accessing compensation for occupational accidents due to complex reporting procedures and unclear eligibility criteria.

This issue emerged in discussions around the amendments to the Social Insurance Law, which aims to improve accessibility for workers who currently fall outside the standard employment definitions. The current framework does not sufficiently cover workers in flexible or freelance arrangements, making it difficult to access any form of OS benefits in case of injury. Furthermore, several categories of workers are unaware of their rights under existing OSH practices and social insurance law. An OSH expert noted that in small manufacturing firms, workers often do not have clear information on how to report workplace accidents or how to claim and access health benefits. This lack of awareness is exacerbated by the absence of structured communication channels between workers and the regulatory bodies, leading to underreporting of accidents and health issues.

The current OH framework in Vietnam only recognizes 35 occupational diseases, leaving many work-related health conditions uncovered. This issue is particularly relevant for workers exposed to chemicals and hazardous materials in industries like electronics and plastic waste processing. For example, health risks from long-term exposure to solvents used in microchip manufacturing are not included in the recognized list of occupational diseases, creating gaps in health coverage for affected workers.

Looking at SME managers, interviewees noted that the managers often struggle to keep up with the evolving regulatory environment, particularly when new policies are introduced without adequate guidance or support in adoption. For example, the introduction of stricter regulations for hazardous material handling under Decree No. 82/2022/ND-CP posed compliance challenges for managers unfamiliar with the technical requirements. The lack of support could result in superficial compliance rather than genuine adherence to safety practices. In the imminent future, it seems that, without tailored adoption strategies for different enterprises in the sector, parts of the ICT manufacturing value chain could become inefficient or even counterproductive with respect to the green economy objectives set nationally.

Additionally, the respondents highlighted that firm characteristics really play a role in compliance to regulations. For instance, managers in microelectronics often find that existing OSH policies do not adequately address the unique risks associated with their industry:

> *Informal microenterprises in the ICT value-chain, such as family-run businesses and household-level production units, are known to operate outside of OSH and social insurance regulations.* (B_1)

This lack of traceability of working environments may lead to unsafe working conditions and limit workers' ability to seek redress or compensation in case of accidents. Particularly when policies are targeted to match with industrial zones regulations, these may not fit well with household-level production units that are also part of this industry, where health and safety risks are different. Due to the absence of tailored measures, some respondents report that managers in small enterprises frequently perceive government support programs to favour larger companies, especially when it comes to financial assistance and technical guidance.

> *Some government programs provide incentives for the adoption of energy-efficient technologies, and their eligibility criteria are often out of reach for small enterprises.* (B_1)

Furthermore, even when managers are willing to comply with new OSH standards, financial constraints could prevent them from implementing the required measures. For instance, upgrading equipment to meet new safety standards or investing in personal protective equipment for workers can be prohibitively expensive for small businesses. As a result, compliance is often selective, focusing on the minimum requirements rather than comprehensive safety practices.

Policymakers are working to align Vietnam's OSH regulations with international standards, particularly in sectors that are part of the ICT global supply chains. The upcoming amendments to the OSH Law aim to incorporate guidelines from the ILO and other international conventions. This alignment is intended to strengthen worker protections and ensure compliance with global best practices, so implementation will require significant capacity building at both the policy and enterprise levels. Most respondents agreed that such feature will favour the operationalisation of directives for the ICT sector and, if tailored to different firm types, it could possibly become a driver for stronger competitiveness among the SMEs in the national value chain.

Nevertheless, the implementation of comprehensive OSH policies is hindered by the fragmented nature of regulatory oversight. The state's leading institution in charge of occupational safety and hygiene and environmental protection is the National Institute of Occupational Safety and Health, operating under the authority of the General Confederation of Labour, whereas MOH is responsible for the management of occupational diseases [*bệnh nghề nghiệp*], or more broadly occupational health (*sức khỏe nghề nghiệp).* This national mechanism on OHS creates overlapping jurisdictions and enforcement gaps. This lack of regulatory coordination complicates the implementation of cohesive policies that address both safety and health risks at the same time.

Recent policy efforts, such as the Resolution 28/2018 on the Social insurance Reform, have focused on expanding the categories of workers eligible for social insurance benefits. The resolution aims to include workers in flexible employment arrangements and in the informal sector, traditionally excluded from the standard social insurance schemes. This expansion is part of a broader effort to create a more inclusive social protection system, and effective implementation in the near future will require overcoming significant administrative and logistical challenges.

There is a growing interest nationally to discuss ways to integrate OSH policies with broader environmental and sustainability goals, particularly in the context of the national energy transition strategy. Policymakers are considering amendments to link OSH standards with energy efficiency and environmental protection regulations, with the final expectation of creating a more holistic approach to worker safety and environmental sustainability. However, achieving this integration will require revising existing regulations and creating new frameworks that accommodate both worker safety and environmental considerations. In addition to policy design, there seems to be a need to harmonise the future integrated OSH regulations that will be agreed. Interviewees emphasised the importance of either establishing an inter-ministerial infrastructure for shared regulation ownership or creating a clear roadmap to develop a unified regulatory framework on this topic.

3. Conclusions

The global shift towards a green economy presents new OSH challenges, including emerging risks from new technologies and production practices. Through this case study of Vietnamese ICT manufacturing sector, we shed lights on some underexplored areas where OSH updates could become a practical tool to lead SMEs towards green transitions.

Vietnam's approach offers valuable insights into how lower middle-income countries can navigate the intersection of OSH and sustainability improvements towards a green economy and this work highlights several take-aways to foster green transitions. With respect to workforce well-being and mental health, there are some clear low-hanging fruits for OSH regulatory practices with information campaigns or targeted training (of OSH officials or firms representatives) to be designed and tested. Awareness about the economic benefits of workers' retention through the promotion of well-being measures and mental health could become an effective tool, particularly to inform and interact with high-pressure ICT SMEs. Our analysis also reveals the need of engagement of trade unions and other stakeholders to identify and test implementation standards and clarify redress mechanisms

corrections to better protect workers' right to OH and OS. For instance, this could facilitate the development of OSH regulations that consider gender-specific challenges in ICT manufacturing, focusing on mental strain and chemical exposure risks faced in quality control roles, or also it could assess the inclusivity in high-specialised hiring, to decrease gender stereotypes. Moreover, our analysis confirms the need to expand the OSH framework to include health conditions specific to chemical and hazardous material exposure, where industries like electronics appear to develop more and more worker profiles susceptible to be affected.

With respect to the firms' managerial attitude, a clear finding of our study is that even for SMEs in ICT a one-size-fits-all regulatory framework approach might be outdated and could be easily modified to include more options than single provisions tailored only for industrial zones. Measures that directly tailor the promotion of regulatory incentives to facilitate green production strategies in SMEs may be very effective both at creating easier testing of greening processes among firms that would not be able to invest otherwise, and at testing behavioural interventions to encourage top managers to adopt broader environmental attitudes beyond the incentivised investment. Instruments could be applied for example for improving adoption of new safety standards or energy-efficient technologies and for upgrading safety equipment.

Across the different areas of OSH implementation, our findings call for an inter-ministerial task force to streamline OSH guidelines across different sectors, ensuring that evolving risks from new technologies and production practices are adequately addressed in policies. Our results show the potentials for strong greening impacts that could be created with a unified vision among regulatory bodies to improve OSH policy implementation and enforcement.

The country's efforts to integrate OSH with its green growth strategy demonstrate both the opportunities and challenges of pursuing sustainable development while safeguarding workers. Vietnam's experience in the ICT manufacturing sector presented here and the current policy dialogue evolution over OSH has the potential to serve as a model for other developing nations facing similar transitions.

Bibliography

Bonelli, S., Charbit, S., Kageyama, M., Woillez, M. N., Ramstein, G., Dumas, C., & Quiquet, A. (2009). Investigating the evolution of major Northern Hemisphere ice sheets during the last glacial-interglacial cycle. *Climate of the Past*, 5(3), 329-345.

Yilmaz, S. D., & Godin, A. (2024). Strongly Sustainable Development Trajectories: The Road to Social, Environmental, and Macroeconomic Stability–Introduction. International *Journal of Political Economy*, 53(1), 1-3.

ALCOVER, CARLOS-MARIA, DINA GUGLIELMI, MARCO DEPOLO, AND GRETA MAZZETTI. 2021. "Aging-and-Tech Job Vulnerability": A Proposed Framework on the Dual Impact of Aging and AI, Robotics, and Automation among Older Workers". *Organizational Psychology Review* 11 (2): 175–201.

Ali, Adnan, Xu Jiang, Afzaal Ali, and Abdul Qadeer. 2023. "A Moderated Mediation Model Linking Entrepreneurial Leadership to Green Innovation: An Upper Echelons Theory Perspective". *Creativity and Innovation Management*, 32(1): 41–57. https://doi.org/10.1111/caim.12538

Arana-Landín, Germán, Iker Laskurain-Iturbe, Mikel Iturrate, and Benat Landeta-Manzano. 2023. "Assessing the Influence of Industry 4.0 Technologies on Occupational Health and Safety". *Heliyon* 9 (3).

Benos, Lefteris, Avital Bechar, and Dionysis Bochtis. 2020. "Safety and Ergonomics in Human-Robot Interactive Agricultural Operations". *Biosystems Engineering* 200: 55–72.

Buallay, Amina and Al Marri, Meera. 2022. "Sustainability Disclosure and Its Impact on Telecommunication and Information Technology Sectors' Performance: Worldwide Evidence". *International Journal of Emergency Services* 11 (3): 379-395. *https://doi.org/10.1108/IJES-08-2021-0054*

Castillo, Manlio. 2023. *Green Jobs, Green Economy, Just Transition and Related Concepts: A Review of Definitions Developed through Intergovernmental Processes and International Organizations*. Geneva: International Labour Office.

Croucher, Richard, Blanca Stumbitz, Michael Quinlan, Ian Vickers. 2013. *Can Better Working Conditions Improve the Performance of SMEs? An International Literature Review*. International Labour Office. https://www.ilo.org/public/libdoc/ilo/2013/486238.pdf

Dudarev, AlexeyA, and Jon Øyvind Odland. 2013. "Occupational Health and Health Care in Russia and Russian Arctic: 1980–2010". *International Journal of Circumpolar Health* 72 (1): 20456.

Dzhusupov, Kenesh O., Claudio Colosio, Ramin Tabibi, and Cholpon T. Sulaimanova. 2015. "Occupational health in mountainous Kyrgyzstan". *Annals of Global Health* 81(4): 530-537.

Dang Thi Viet Duc. 2022. "Digital Economy Model in Vietnam". *VNU Journal of Science: Policy and Management Studies* 38 (2) 2588-1116. doi: https://doi.org/10.25073/2588-1116/vnupam.4345.

Dang Thi Viet Duc, Phuoc Van Nguyen. 2021. "The Nexus of ICT, Manufacturing Productivity and Economic Restructuring in Vietnam". *Journal of Asian Finance, Economics and Business* 8 (9): 0235–0247 235 doi:10.13106/jafeb.2021.vol8.no9.0235

Duc Binh. 2019. "FDI Value Hits Nearly US$31.8 Billion in Jan-Nov". *VCCI News* 12/02/2019. Vietnam Business Forum of Vietnam Chamber of Commerce and Industry (VCCI)-Investment

Enrique, Daisy Valle, João Carlos M. Druczkoski, Tânia Miranda Lima, and Fernando Charrua-Santos. 2021. "Advantages and Difficulties of Implementing Industry 4.0 Technologies for Labour

Flexibility". *Procedia Computer Science* 181: 347-352.

Eriksson, David and Göran Svensson. 2016. "The Process of Responsibility, Decoupling Point, and Disengagement of Moral and Social Responsibility in Supply Chains: Empirical Findings and Prescriptive Thoughts". *Journal of Business Ethics* 134, 281–298. https://doi.org/10.1007/s10551-014-2429-8

Fan, Di, Cherrie Jiuhua Zhu, Andrew R. Timming, Yiyi Su, Xinli Huang, and Ying Lu. 2020. "Using the Past to Map Out the Future of Occupational Health and Safety Research: Where do We Go from Here?" *The International Journal of Human Resource Management* 31 (1): 90–127.

Gochfeld, Michael, Conrad D. Volz, Joanna Burger, Stephen Jewett, Charles W. Powers, and Barry Friedlander. 2006. Developing a Health and Safety Plan for Hazardous Field Work in Remote Areas." *Journal of Occupational and Environmental Hygiene* 3 (12): 671-683.

Hoàng Hải. 2022. Hội nhập quốc tế về an toàn vệ sinh lao động: Thành công và thách thức mới - Tạp chí điện tử Nghề nghiệp và Cuộc sống 26/01/2022

International Labour Organization. 2018. *Occupational Safety and Health in Global Value Chains Starterkit. Assessment of drivers and constraints for OSH improvement in global value chains and intervention design.* Geneva : ILO.

International Labour Organization. 2013. *Proposals for the Statistical Definition and Measurement of Green Jobs*. Room Document Number 5. 19th International Conference of Labour Statisticians, Geneva: ILO.

ILO. 2023. *Occupational safety and health professionals at the workplace level: A review of qualification systems and regulatory approaches in selected countries*. Geneva: ILO.

ILO and Vision Zero Fund. 2023. *Drivers and Constraints for Occupational Safety and Health Improvements in the Viet Nam Coffee Supply Chain: Assessment Report*. Hanoi: ILO.

ISO and UNIDO. 2021. *ISO 31000:2018 - Risk Management: A Practical Guide*. ISO - ISO 31000:2018 - Risk management — A practical guide

LaDou, Joseph. 2006. "Occupational and Environmental Health Challenges in the Global Electronics Industry". In *Challenging the Chip: Labor Rights and Environmental Justice in the Global Electronics Industry*, edited by Ted Smith, David Allan Sonnenfeld, and David N. Pellow, 31-42. Temple University Press.

Le, Dahlia. 2024. *Vietnam's ICT Industry: A Dynamic Market for Foreign Investment*. Business Opportunities.

Le Duy Binh & Tran Thi Phuong. 2020. *Digital Economy and Digital Transformation in Vietnam*. Economica.

Lee, Taehee, and Hyunjeong Nam. 2017. "A Study on Green Shipping in Major Countries: In the View of Shipyards, Shipping Companies, Ports, and Policies." *The Asian Journal of Shipping and Logistics* 33 (4): 253-262.

Liem, Vo Tan and Nguyen Ngoc Hien. (2024). "The Impact of Managers' Attitudes Towards Environmental Management Accounting and Green Competitive Advantage in Vietnam Manufacturers". *Heliyon*, 10, https://doi.org/10.1016/j.heliyon.2024.e33565

Luong Hanh. 2023. "Số lao động mắc bệnh điếc nghề nghiệp do tiếng ồn tăng mạnh". *Báo Lao động* **Số lao động mắc bệnh điếc nghề nghiệp do tiếng ồn tăng mạnh** 10/4/2023. https://laodong.vn/cong-doan/so-lao-dong-mac-benh-diec-nghe-nghiep-do-tieng-on-tang-manh-1177801.ldo

Min, Jeehee, Yangwoo Kim, Sujin Lee, Tae-Won Jang, Inah Kim, and Jaechul Song. 2019. The Fourth Industrial Revolution and Its Impact on Occupational Health and Safety, Worker's Compensation and Labour Conditions". *Safety and Health at Work* 10 (4): 400-408.

MOLISA. 2024. *Thông báo tình hình tai nạn lao động năm 2023*. No. 1136/TB-BLDTBXH, 21/03/2024.

MOLISA and ILO. 2011. Kết quả Khảo sát "An toàn - Vệ sinh Lao động trong Doanh nghiệp vừa và nhỏ" Project RAS/08/07M/JPN

National Institute for Finance. 2021. *Doanh nghiệp Việt Nam tham gia vào chuỗi cung ứng toàn cầu.*

National Institute for Finance, Ministry of Finance of Vietnam. Available at: Chi tiết tin (mof.gov.vn)

Nazareno, Luísa, and Daniel S. Schiff. 2021. "The Impact of Automation and Artificial Intelligence on Worker Well-Being". *Technology in Society* 67: 101679.

Nguyễn Đắc Diện. 2024. "Vận dụng tư tưởng Hồ Chí Minh về công tác an toàn, vệ sinh lao động". *Lao động và Công đoàn Magazine* 02/06/2024 Vận dụng tư tưởng Hồ Chí Minh về công tác an toàn, vệ sinh lao động

Nguyễn Thu Hà. 2022. Quản lý an toàn, vệ sinh lao động trong ngành Điện tử_An toàn, vệ sinh lao động 03/09/2022

Nguyễn Thị Thu Huyền, Lương Mai Anh, Trần Anh Thành. 2021. "Thực trạng bệnh nghề nghiệp tại Việt Nam giai đoạn 2016 – 2020". T. 31 S. 9 Phụ bản (2021): SỐ ĐẶC BIỆT - CHUYÊN ĐỀ PHÒNG, CHỐNG BỆNH KHÔNG LÂY NHIỄM VIỆN VỆ SINH DỊCH TỄ TÂY NGUYÊN NĂM 2021 DOI: https://doi.org/10.51403/0868-2836/2021/468

Nguyen, Minh, Jo Bensemann and Stephen Kelly. 2018. "Corporate Social Responsibility (CSR) in Vietnam: A Conceptual Framework" *International Journal of Corporate Social Responsibility*, 3(9). https://doi.org/10.1186/s40991-018-0032-5

Osibanjo, Oladele, Innocent C. Nnorom, Gilbert U. Adie, Mary B. Ogundiran, Adebola A. Adeyi. 2016. "Global Management of Electronic Wastes Challenges Facing Developing and Economy-in-Transition Countries". In *Metal Sustainability: Global Challenges, Consequences, and Prospects*, edited by Reed M. Izatt, 52-84. John Wiley & Sons, Ltd.

Plepys, Andrius. 2002. "The Grey Side of ICT". *Environmental Impact Assessment Review* 22 (5): 509-523.

Reinhold, Karin, Marina Järvis, and Gunnar Prause. 2019. "Occupational Health and Safety Aspects of Green Shipping in the Baltic Sea". *Entrepreneurship and Sustainability Issues* 7 (1): 10-24.

Rydstrom, Helle. 2023. "Disrupting 'a Man's World': Gender, Technology, and Class in Vietnam's Global Heavy Industry". *Journal of the Royal Anthropological Institute* 29 (1): 163-182.

Rydstrom, Helle. 2022. "The 'Hardship' of Ordinary Crises: Gendered Precariousness and Horizons of Coping in Vietnam's Industrial Zones" *Global Discourse* 12 (3-4): 540-558.

Schulte, Paul A., George Delclos, Sarah A. Felknor, and L. Casey Chosewood. 2019. "Toward An Expanded Focus for Occupational Safety and Health: A Commentary", *International Journal of Environmental Research and Public Health* 16 (24): 4946. https://doi.org/10.3390/ijerph16244946

Social Republic of Vietnam. 2022. Decision No.896/QD-TTg approving the National Climate Change Strategy, which aims at guiding Viet Nam's climate action through 2050, dated 26/7/2022.

Song, Yu. 2023. "Integration of Occupational Health and Safety Management, Social Responsibility of Business, and Sustainability: A Stakeholder-Based Qualitative Study on China's Electric Power Industry". *SHS Web of Conferences*, 163: 02017. EDP Sciences.

Shabunina, Tamara V., Svetlana P. Shchelkina, and Dmitriy G. Rodionov. 2017. "An Innovative Approach to the Transformation of Eco-Economic Space of a Region-Based on the Green Economy Principles." *Academy of Strategic Management Journal* 16: 176.

Surienty, Lilis. 2012. "Management Practices and OSH Implementation in SMEs in Malaysia". *School of Management, USM Minden, Pulau Pinang*.

Tamers, Sara L., Jessica Streit, Rene Pana-Cryan, Tapas Ray, Laura Syron, Michael A. Flynn, Dawn Castillo, Gary Roth, Charles Geraci, Rebecca Guerin, Paul Schulte, Scott Henn, Chia-Chia Chang, Sarah Felknor, & John Howard. 2020. "Envisioning the Future of Work to Safeguard the Safety, Health, and Well-being of the Workforce: A Perspective from the CDC's National Institute for Occupational Safety and Health". Am J Ind Med. 63(12): 1065–1084. doi: 10.1002/ajim.23183

Tencati, Antonio, Angeloantonio Russo, and Victoria Quaglia. 2008. "Unintended Consequences of CSR: Protectionism and Collateral Damage in Global Supply Chains: the

Case of Vietnam". *Corporate Governance: The International Journal of Business in Society* 8 (4): 518-531.

Vandegrift, Roo, Ashley C. Bateman, Kyla N. Siemens, May Nguyen, Hannah E. Wilson, Jessica L. Green, Kevin G. Van Den Wymelenberg, and Roxana J. Hickey. 2017. "Cleanliness in Context: Reconciling Hygiene with a Modern Microbial Perspective". *Microbiome* 5: 1-12.

Vinberg, Stig. 2020. "Occupational Safety and Health Challenges in Small-Scale Enterprises". *Ind Health* 58(4): 303–305. doi: 10.2486/indhealth.58_400

Vincent, James H. 2005. "Graduate Education in Occupational Hygiene: A Rational Framework". *Annals of Occupational Hygiene* 49 (8): 649-659.

Vogt, Gabriele and Anne-Sophie L. König. 2023. "Robotic Devices and ICT in Long-Term Care in Japan: Their Potential and Limitations from a Workplace Perspective". *Contemporary Japan* 35 (2): 270-290.

Wen, Huwei, Chien-Chiang Lee and Ziyu Song. 2021."Digitalization and Environment: How Does ICT Affect Enterprise Environmental Performance?" *Environ Sci Pollut Res* 28, 54826–54841. https://doi.org/10.1007/s11356-021-14474-5

Wifa, Eddy and Tina Soliman Hunter. 2022. "Mitigating Occupational Health and Safety Risks in the Proposed Australian Offshore Wind Energy Industry: Lessons from the Safety Case Regime". *Journal of Energy & Natural Resources Law* 40 (1): 83-104.

Women Win and International Center for Research on Women. 2024. "Understanding Drivers and Prohibitors of Women Garment Workers' Mental Health & Wellbeing: NEW RESEARCH TO UNDERSTAND WOMEN'S MENTAL HEALTH IN GARMENT FACTORIES" Women-Win_Women-Garment-Workers-Mental-Health-Brief.pdf

World Bank. 2018. *Vietnam's Future Jobs: Leveraging Mega-trends for Greater Prosperity Overview*. World Bank Document

World Health Organization. 2009. *WHO Guidelines on Hand Hygiene in Health Care* (No. WHO/IER/PSP/2009/01

Agence française
de développement
5, rue Roland Barthes
75012 Paris I France
www.afd.fr

What is AFD?
Éditions Agence française de développement publishes analysis and research on sustainable development issues. Conducted with numerous partners in the Global North and South, these publications contribute to a better understanding of the challenges faced by our planet and to the implementation of concerted actions within the framework of the Sustainable Development Goals.
With a catalogue of more than 1,000 titles and an average of 80 new publications published every year, Éditions Agence française de développement promotes the dissemination of knowledge and expertise, both in AFD's own publications and through key partnerships. Discover all our publications in open access at editions.afd.fr.
Towards a world in common.

Publication Director Rémy Rioux
Editor-in-Chief Thomas Melonio

Legal deposit 3rd quarter 2025
ISSN 2492 - 2846

Graphic design MeMo, Juliegilles, D. Cazeils
Layout PUB
Printed by the AFD reprography service

To browse our publications:
https://www.afd.fr/en/ressources-accueil