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Policy Paper

Improving Working Conditions in German Warehouse Logistics –

Challenges & Policy Options in the Context of Technological Change

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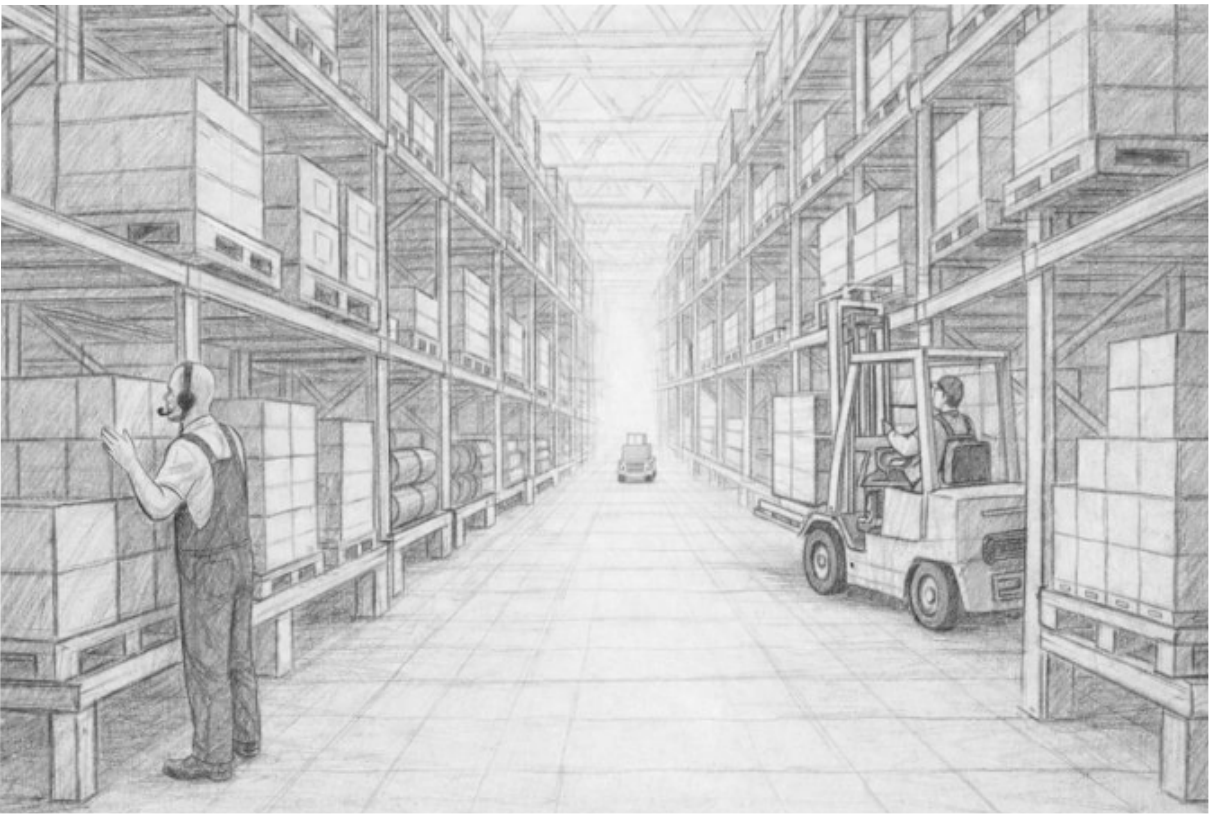

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The following report draws on 48 interviews with workers, works council representatives, and managers in German warehouse facilities. It was developed within the framework of the *Humans in Digital Logistics (HuLog)* project, funded by ERA-CHANSE between 2022 and 2025 (Grant Agreement No. 101004509). The findings and recommendations presented here were discussed in two stakeholder meetings. Participants in these meetings included representatives of works councils, employer associations, local authorities, labour agencies, health and safety experts, and the Federal Ministry of Labour and Social Affairs.

We would like to thank Prof. Markus Helfen, whose empirical contributions and expertise were invaluable to this report, as well as Monika Maslany for her excellent assistance.

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Executive Summary

Warehouses are vital links in German and European supply chains. Yet the sector faces persistent and growing pressure to cut costs and deliver faster, while struggling with low wages, high staff turnover, and fragmented employment relations. To remain viable in the long term, German warehousing requires significant investment in technology and workforce development. However, increasingly short-term warehouse leases have become a major obstacle to any long-term investment. With targeted reforms, necessary investments and worker-centred adoption of new technologies, labour fluctuations could be reduced, subcontracting limited, and wages raised, lifting the German warehouse sector to a higher standard.

A sector shaped by cost pressure, low wages, high fluctuation, and poor social partnership

Warehousing's volatile demand and structural cost pressure translate into low wages, unstable jobs, fragmented employment relations, and weak worker representation. Entry pay often lies just above the statutory minimum wage, and only a small minority of warehouses are covered by collective agreements, leaving sector wages well below the nationwide median. The sector continues to rely heavily on migrant workers, many of whom leave as soon as they can, as reflected in high mover-out rates and frequent workforce churn. At the same time, warehousing makes extensive use of agency work and subcontracting, with agency workers accounting for a sizeable share of the workforce and their proportion rising sharply during peak seasons. Only a small share of warehouses have works councils, and fragmented employment structures make co-determination difficult to establish and maintain. These dynamics reinforce one another and create a vicious circle: low wages drive turnover; high turnover undermines worker organisation; weak industrial relations keep wages low; and employers respond to demand volatility by deepening a core–periphery staffing model instead of investing in long-term employment relationships.

Table 1. Key takeaways: The German warehousing sector

Takeaways	Indicators	Sources
Logistics and warehousing employ a large workforce	Transportation and storage: 2.06 million employed Warehousing and support activities: 626,700 Warehousing and storage: 90,900	Eurostat (2024a)
Pay levels are relatively low	Median wage/month: €3,253 (€760 below national median) Gender pay gap: €311/month	BA (2024a)
Weak industrial relations	Collective bargaining coverage: 12% Works councils in warehouses: 10%	IAB (2024)
High labour turnover and reliance on agency work	16% mover-out-rate (leave the sector/year) Agency workers in logistics (2024): 192,000 (highest across all sectors)	BA (2024b)
Persistent underinvestment and digitalisation gaps	Investment rate (TNCA): 23rd in EU-27 Investment rate machinery & equipment: 19th in EU-27 Ranks below the EU average in sectoral digital intensity	Eurostat (2024b)
Short-term leasing constraints investment	Typical warehouse lease duration has decreased: 2–4 years Crisis-driven uncertainty reinforces short-termism	Field work

Note. TNCA stands for tangible non-current assets. For short-term leases see also market reports (e.g. Colliers 2025).

Short-termism: A barrier to improving working conditions and technology investments

German warehouses suffer from structural underinvestment in automation, digital systems, and workforce development. Despite clear needs for investment Germany ranks far below EU-27 averages of investment rates into warehouses' machinery and equipment and tangible assets. The key driver of underinvestment is that leases between warehouse providers and client companies have become much shorter: leases now typically run for two to four years, compared with eight to ten years in the past, making major investments in robotics, conveyor systems, or modern infrastructure economically risky. As a result, many employers rely on cheap manual labour, agency work, and subcontracting to handle fluctuating demand. Under these conditions, technological adoption is geared towards cost cutting rather than improving job quality.

Technological change in warehousing: Ambivalent effects on workers

Against the backdrop of short-term contracts and cost-driven investment, our fieldwork found that technological change has ambivalent effects on warehouse workers. On the one hand, new technologies can reduce physical strain, improve forecasts of demand for goods and labour, and deliver efficiency gains that can reduce work intensity. On the other hand, they can intensify monitoring and reduce worker autonomy, increase monotony and stress, and accelerate the replacement of labour without adequate upskilling. The effects of technological change depend on how new systems are implemented; a worker-centred approach to technology adoption makes positive outcomes more likely. Yet workers and works councils are rarely involved early in investment decisions, even though difficulties in implementation often arise precisely from a lack of practical insights from those on the shop floor.

Recommendations for policymakers

Reforming warehousing is essential both to secure fair working conditions and to safeguard the long-term functioning of European supply chains. Policymakers could first strengthen enforcement of existing labour standards by increasing the frequency of inspections by customs and labour authorities, especially in injury-prone inbound and outbound operations. They could also raise wages and expand collective bargaining coverage by linking public-procurement rules to compliance with collective agreements. In addition, policymakers could curb excessive subcontracting, drawing on successful precedents from the meat-processing sector, and support training, language acquisition, and workplace integration measures to stabilise the workforce. Finally, advancing EU-level rules on subcontracting and backing initiatives such as the *Quality Jobs Roadmap* would help reduce precarious employment and align standards across member states.

Recommendations for social partners

Employers could involve works councils earlier in technology decisions, use digitalisation to reduce physical strain, and invest in stable employment, upskilling, and career paths. Unions could work to limit outsourcing that undermines collective standards and prioritise establishing works councils in warehouses to build durable representation structures.

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1. Introduction

Warehousing plays a critical role in logistics. As logistics hubs, warehouses are integral to German and European supply chains. The sector has expanded in recent years due to the growth of e-commerce, just-in-time deliveries, and the growing need for resilient supply chains in response to multiple crises. The industry is a key player across European economies, with around 10.4 million people employed in the logistics sector across the EU's 27 member states and 392,000 in warehousing specifically (Eurostat 2024a).

Germany is Europe's leading logistics hub, connecting essential trade routes across the continent. It has by far the largest logistics market in Europe, with a total volume of €327 billion, followed by France with €183 billion (Klaus et al. 2024, 23-32). The German market handles 42.9 tons of goods per resident each year – 19% more than the EU average – and has the continent's highest warehouse-handling expenditure at €98 billion per year (Klaus et al. 2024, 26-46). This substantial transport, storage, and delivery of goods and services depends on the labour of millions of workers: Germany's logistics workforce totals over 2 million people (4% of national employment), with at least 80,916 workers employed in warehousing (Eurostat 2024a).[1]

At the same time, the sector faces high cost pressures and strict time constraints. In the value chain of European goods and services, warehouse logistics is often among the first areas targeted for cost cutting, with low wages systematically embedded in cost-competitive strategies. Logistics, including warehousing, is primarily viewed as instrumental for other industries, reflecting the relatively low status of the sector.[2] Warehousing's low public recognition contrasts sharply with its growing importance for reliable supply chains. This was particularly evident during the Covid-19 pandemic when e-commerce and home deliveries surged, and logistics workers were classified as essential workers. Yet awareness of their role has since diminished, and warehouses remain 'black boxes', with the workforce and their working conditions largely hidden from public view.

Technological advancements create opportunities to improve working conditions in warehousing and are key to overcoming logistical bottlenecks. Increasing geopolitical tensions, trade conflicts, and global competition for critical materials have made well-functioning warehouses crucial for resilient supply chains. Robotics, digitalisation, AI, and data-driven algorithmic management can support this resilience by streamlining logistical processes in warehousing and improving profitability. Yet these technologies are also profoundly transforming working and employment conditions in warehousing, with ambivalent effects. For workers, new technologies can reduce physical strain but may also introduce stricter (algorithmic) oversight and increase time- and performance-related pressures. For employers, technological innovation can help address labour shortages through automation and process optimisation but can also entail high investment costs and disrupt well-established logistical operations.

[1] Employment figures vary across data sources due to differences in sectoral classification and worker coverage. These figures should therefore be interpreted as proxies, as actual employment is likely underestimated due to the sector's heavy reliance on agency work (around 192,000 workers in 2024) and subcontracting (BA 2025). All sources consistently indicate that employment in German warehouse logistics is substantial.

[2] See for instance the influential Draghi report, where logistical optimisation is portrayed as a means of boosting competitiveness and productivity for key industries such as the automotive (p. 143) and security (p. 207) sectors.

2. Working conditions in the German logistics sector

2.1 Workforce

Germany employs more than 2 million people in the logistics sector, representing around 4% of total employment, including approximately 81,000 workers in warehousing (Eurostat 2024a).[3] The warehouse workforce is highly diverse. Warehouses have a high share of employees with a migration background, averaging around 38-40% (Statistisches Bundesamt, 2020; interviews). Many workers originate from eastern European countries such as Poland, Romania, Bulgaria, and Ukraine, as well as from Syria and Turkey. The composition of migrant groups varies regionally: the share of eastern European workers tends to be highest in eastern Germany and lower in western and southern areas. Workers who have migrated to Germany more recently often depend on continued employment to maintain their residence permit, placing them in particularly vulnerable and weak bargaining positions. The warehouse workforce is additionally marked by a notable gender imbalance, with approximately 80% men and 20% women (BA 2024a).

It is common for warehouse staff not to share a single working language. In one large warehouse we visited during our field study, workers came from 40 different countries. This linguistic and cultural diversity can complicate work processes, as communication barriers increase the likelihood of workflow disruptions and heighten the risk of injuries. Technology can help reduce language barriers by allowing devices such as tablets and scanners to be programmed in multiple languages or by using number- and colour-based systems in the picking process.

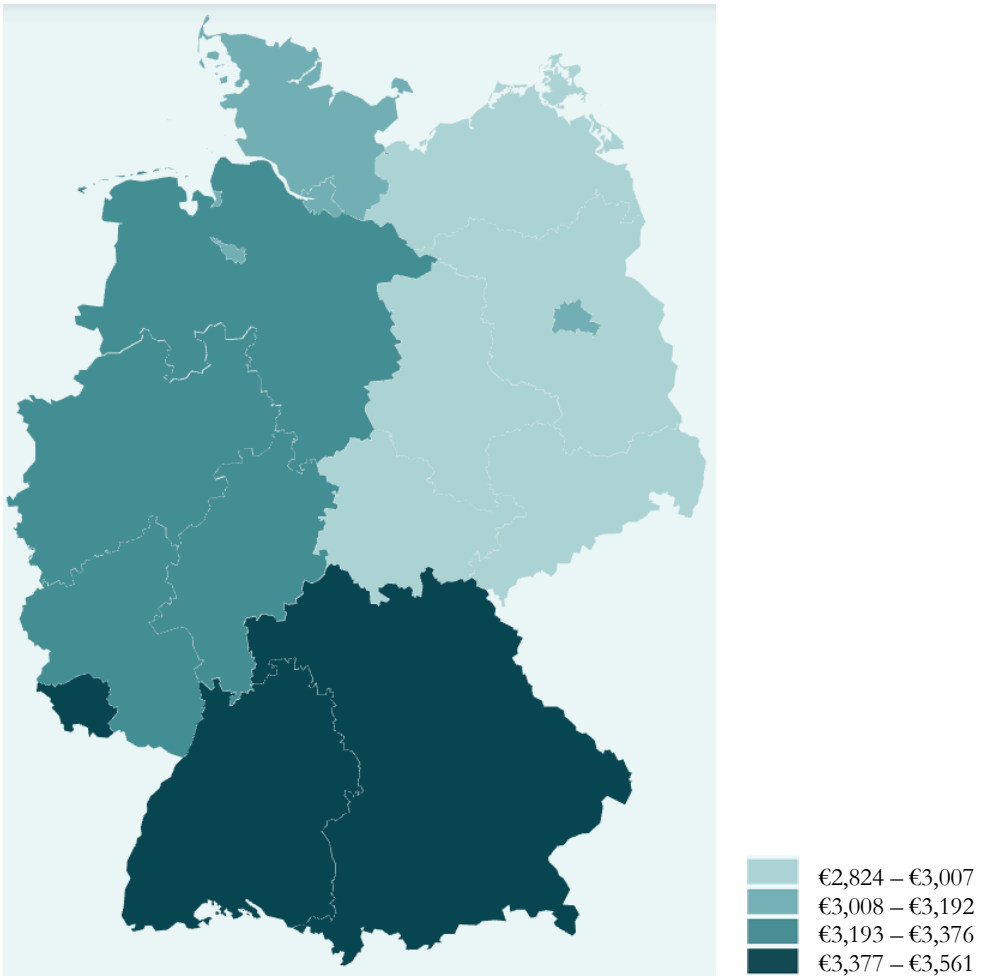
Warehousing logistics often provides a first entry point into the German labour market for many workers. Those on the shop floor typically lack formally recognised qualifications. Career progression within warehouses is nevertheless common. Shop floor pickers can advance to shift or team leader roles and, in some cases, move into lower management or works council positions.

2.2 Low wages

The warehousing sector is characterised by comparatively low wages. Entry-level pay typically lies just above the statutory minimum wage. Collective bargaining coverage is limited, reaching only 12% in the sector compared with a nationwide rate of 49%. Nonetheless, around 40% of workers receive wages that are aligned (*angelehnt*) with the major collective agreements in the sector (IAB 2024). For example, DHL warehouses across Germany reference the collective agreement negotiated between DHL and ver.di in Hamburg, which serves as an important benchmark for the wider warehousing industry. In recent years, wages in the sector have risen noticeably. As of 2024, the median monthly gross income of warehouse workers is €3,253 (BA 2024a), representing an average increase of €159 since 2023. The BA wage statistics refer to qualified warehouse operatives (*Fachlagerist*) and therefore reflect pay levels for formally trained workers; non-qualified warehouse workers typically earn significantly less (see Karusseit 2025). Substantial regional differences in remuneration persist across the German federal states (see Figure 1).

[3] Throughout this report, logistics corresponds to the Eurostat NACE sector Transport and Storage (H), while warehousing denotes the sub-sector Warehousing and Storage (H521) (Eurostat, 2024a).

Figure 1. Regional variation in median monthly income of warehouse workers (DE)



Source. Federal Employment Agency (BA, 2024a)

Wages are lowest in the eastern German federal states and highest in southern Germany, reflecting broader regional wage patterns across the country. A substantial gender pay gap persists in the warehousing sector: women earn an average of €2,987 per month, compared with €3,298 for men. While wages tend to rise with tenure, opportunities for wage progression remain limited for workers engaged in shop-floor tasks such as picking. Due to the low wages paid in this sector, some workers at the lower end of the pay scale rely on additional state support, such as housing benefits, to supplement their income.

2.3 High fluctuations and labour shortages

Low wages are the main driver of the persistent and widespread labour shortages in the warehousing sector. Many workers switch employers and move to other warehouses where they can earn slightly higher wages. Most remain within the sector but seek positions that offer better pay and more stable employment prospects. During our fieldwork, one experienced manager reported that, in extreme cases of high fluctuation, more than half of a warehouse's workforce turned over within two years. Such high levels of fluctuation disrupt operational processes and place additional pressure on remaining staff, who are often required to work overtime to compensate for understaffing, which intensifies stress and increases workloads.

Table 2 shows that warehousing serves as an entry point into the labour market for many workers. The mover-out share (MOS) of 67% in 2023 means that around two thirds of new jobs in the sector are taken up by people who were previously unemployed or employed in other sectors. The MOS is significantly higher than the value for the total economy (53%) and is structurally high in the warehousing sector, with a five-year average of 61%.

Table 2. Labour mobility indicators in warehousing, agency work, and the total economy (DE)

	Job change rate (%)		Mover-out share (%)		Mover-out rate (%)	
	2023	2019-2023	2023	2019-2023	2023	2019-2023
Total economy	26	26	53	53	14	14
Warehousing & storage	23	26	67	61	16	16
Agency work	101	107	57	55	64	66

Notes. Job change rate = (number of employment changes in the sector in a year ÷ average employment stock in the sector) ×100
mover-out share = (number of movers-out from origin sector ÷ all begun employment entries from origin sector) ×100
mover-out rate = (number of movers-out from origin sector in a year ÷ average employment stock in the sector) ×100
Source. Federal Employment Agency (BA 2024b)

At the same time, the table does not suggest exceptionally high labour market fluctuation within warehousing itself, since both the job change rate, capturing overall mobility, and the mover-out rate, capturing exits from the sector, are close to aggregate-economy values. However, warehousing and logistics rely heavily on agency work: with around 192,000 agency workers, no other sector depends as strongly on agency labour as warehousing and logistics, both in absolute and in relative terms (BA 2025). Agency work is reported separately and is therefore not reflected in the warehousing figures, even though it displays an extremely high job change rate and a high mover-out rate. Fieldwork interviews support this picture and indicate that fluctuation in warehousing is largely driven by cost pressures, agency workers, and volatile demand for temporary labour.

Employers face growing difficulties in filling vacancies, and persistent labour shortages raise recruitment costs while increasing pressure to either improve wages or invest in automation. Yet strong cost pressures constrain firms' capacity to do either at scale. In the context of demographic ageing and widespread labour shortages, persistently low wages will continue to undermine retention in warehousing. Sustained wage growth is therefore essential to strengthen employee commitment and to support more stable industrial relations, including the conditions for long-term investment. Because labour costs account for a large share of operating expenses and warehousing is often treated as a cost buffer within supply chains, wage suppression remains structurally embedded in business models. As a result, high turnover and labour shortages pose increasing risks not only to warehouse operations but also to the resilience of European supply chains.

> "Labour shortages and fluctuations are one of the most pressing issues in the sector. As soon as a warehouse in the region offers fifty cents more per hour, a large part of the workforce is gone". (manager)

> "I don't mind the work, but the biggest issue is the income. I can barely make ends meet with a full-time job. The main reason why people leave [the warehouse] are the low wages." (worker)

3. Employment conditions in the German warehousing sector

Employment conditions are significantly affected by employer fragmentation, understood here as the practice whereby workers within a given warehouse perform the same or similar tasks but are employed by different employers. This fragmentation of employers reflects the heavy reliance on agency work and subcontracting, which in turn is used to meet fluctuating demand for goods and labour within warehouses.[4]

3.1 Fragmentation of employment contracts

Non-standard forms of employment are omnipresent in warehouses. Interviewed experts confirmed that the share of non-permanent staff is at around 50% and potentially even higher during peak times.

> "In our warehouse it's around 50% permanent workers, 25% temporary workers, and 25% agency workers. […] Employers use employees as flexibly as possible. Agency workers can be de-registered or requested on a daily basis. If an agency worker falls ill, they're not paid, but a replacement must be provided." (works council representative)

Among non-permanent forms of work, such as agency work and subcontracting, the latter poses particular risks because it diffuses liability and responsibility during work processes. Subcontracting is particularly common in loading and unloading trucks – tasks that also produce the highest injury rates (BAuA 2023, 10). According to information provided by representatives from Germany's national health agency, these high injury rates are closely linked to fragmented liability and responsibility structures. Common issues include subcontracting firms failing to adhere to basic safety standards and lacking experience in warehouse-specific procedures, such as handling particular materials.

Employers emphasise that subcontracting and other forms of fragmented labour supply are a response to highly fluctuating demand in warehouse logistics (DSLV 2025). High cost and time pressures in the sector encourage practices that adjust labour supply to short-term demand. During peak (e-)commerce seasons such as Black Friday and Christmas, demand for warehouse workers increases substantially. Employers and their associations argue that they cannot keep the number of workers required for such peaks employed throughout the year, making subcontracting necessary. However, subcontracting is also used outside peak seasons, suggesting that it serves primarily to reduce labour costs rather than simply to align labour supply with demand. While agency work is generally sufficient to cover seasonal fluctuations, employers supplement agency workers with subcontracting because agency labour becomes more expensive during peak periods.

The fluctuating demand for goods therefore translates into fluctuating demand for workers in warehouses. Peak seasons markedly exacerbate existing labour shortages. As a result, agency workers are in high demand and often earn higher wages than permanently employed staff during peak months, which creates tensions within the workforce. In one warehouse visited for this study, for example, the works council annulled an existing works agreement (*Betriebsvereinbarung*) on the

[4] In the academic literature, this pattern of employer fragmentation is often described as the fissurization of the workplace (see Weil 2019).

use of agency labour in order to safeguard workers' interests and to prevent a further expansion of agency work.

> "We terminated a works agreement to protect our own workforce. The agreement stipulated that only 15% of the workforce could be agency workers. However, as the core workforce became increasingly convinced that agency workers were displacing their own colleagues, we terminated the works agreement. We have informed the employer that if we cannot find another solution, we will treat every single assignment of temporary workers in accordance with Section 99 of the Works Constitution Act. This means that it will be treated as a recruitment process, which involves a great deal of effort." (works council representative)

This example illustrates how works councils can use the Works Constitution Act to influence the distribution of employment contracts in workers' interests. Nevertheless, employers argue that they must rely on temporary, agency, and subcontracted labour to remain competitive in warehouse logistics. As warehouse providers compete for clients in an extremely price-sensitive marketplace, they seek to contain wage growth through the strategic use of fragmented employment contracts. These employment structures make it more difficult to establish works councils, which helps explain their relative scarcity in the warehousing sector. Because a shared employer is a prerequisite for effective works councils, such fragmentation also hinders improvements in job quality and working conditions.

> "Employee retention and turnover have become so high that half of the workforce is replaced within two and a half years. The idea of a stable workforce that grows over the years is gone. This naturally makes it very difficult to organise co-determination. If I have a more stable workforce, then workers are also more likely to be interested in appropriate representation of their interests, and then workers have a different lever." (works council representative)

3.2. Shift structures

Managers organise working hours to align labour supply with volatile levels of demand while keeping permanent staffing costs low. Digital systems increasingly support this approach. Workforce-planning tools linked to warehouse management and transport systems translate demand signals into shift schedules in near real time. Time-management systems (for example, Chronos) are commonly used in warehouses. Managers can use them to record working hours, presence and absence, overtime, and even smoking or toilet breaks across the whole company.

Detailed data analysis enables managers to forecast labour demand at shift and task level and then match supply by assigning workers to shifts and tasks through online platforms. The core workforce – that is, permanent employees – is typically the first to receive access to shifts, with agency workers and subcontractors used to fill remaining gaps. However, this also fuels high labour turnover, increases reliance on agency work, and reinforces the unsustainable system of industrial relations in warehousing. Flexible shift structures and short notification times for workers are enabled by technology, but primarily reflect the volatile demand that is common in many B2C (and increasingly B2B) warehousing operations. In warehouses where demand for goods is stable and predictable throughout the year, the share of non-permanent employees tends to be lower and industrial relations more stable.

3.3 Unrewarded education and limited upskilling

Warehousing is a sector that relies heavily on untrained workers, and a significant share of the workforce has no formal qualification. Vocational training for warehouse workers is often not a financially attractive option. Formally trained workers earn only marginally more than untrained workers despite completing three years of training, so there is effectively no education bonus in warehouses. During vocational training, earnings are typically close to the statutory minimum, set at €682 per month for first-year trainees in 2025. There is, however, some variation in training-related pay depending on the position of the warehouse in the value chain. Where warehouses remain integrated into manufacturing production – rather than being outsourced to reduce costs – and fall under collective agreements negotiated by IG Metall or IGBCE, trainees receive more attractive allowances. Yet the widespread outsourcing of warehouse logistics as a cost-saving strategy ultimately results in lower pay for trainees.

> "I believe that there are very few, if any, other professional fields in which those who have completed training have no economic advantage whatsoever." (worker)

Automation and digitalisation are changing skill requirements in warehouses. Robotics, semi-automated processes and algorithmic management can create a need for upskilling, while digital technologies such as scanners and voice-activated picking can standardise work processes and reduce both technical skill and language requirements. Where upskilling is required, firms tend to invest in their employees as a retention strategy. However, due to persistent cost pressures, performing more complex tasks or taking on additional responsibilities does not generally result in substantial wage increases on the shop floor. This produces a disconnect between levels of education and remuneration in warehouse operations. Given the physically and mentally demanding nature of the work, both employers and workers argue that the occupation itself warrants substantially higher wages, irrespective of educational background.

Digitalisation also reshapes on-the-job training needs. Workers must learn to use new technologies and operate semi-automated machinery, and as these technologies become more central to warehouse operations, continuous training is essential to maintain both efficiency and safety. Employers' willingness to invest in their workforce, however, also depends on the duration of client contracts for a given warehouse location. Where contract durations are short and the future of a site is uncertain, employers are more reluctant to invest in training. Longer contract durations, by contrast, increase the likelihood of investment in upskilling and in the long-term retention of workers.

> "The demands placed on employees are increasing with advancing digitalisation and technological change." (manager)

> "Employers need to do much more, for example in terms of further training and language courses, in order to achieve minimum standards and prevent accidents wherever possible."
> (works council representative)

4. Social partnership in the German warehousing sector

Collective bargaining coverage in the warehousing sector, at just 12%, is low and only around 10% of warehouses enjoy works council representation (IAB 2024). As a result, the sector does not resemble Germany's traditional model of social partnership.

Table 3 shows that Germany occupies a middle position in terms of the share of employees working in SMEs compared with the five EU countries with the largest economies and major logistics and warehousing markets after Germany (Klaus et al. 2024). In Germany, 42% of all warehouse workers are employed in 1,702 SMEs, while 58% work in only 57 large warehouse enterprises. By contrast, market concentration is significantly higher in Spain, France and Poland, where 70-80% of warehouse workers are employed in large companies.

Table 3. Firm size and employment shares in warehousing and storage (2024)

	Number of enterprises		Share of employees	
	SMEs	Large	SMEs	Large
Italy	1,522	15	63% (14,414)	37% (8,467)
Netherlands	1,315	19	53% (12,199)	47% (10,629)
Germany	1,702	57	42% (33,659)	58% (47,257)
Spain	1,803	21	30% (16,501)	70% (38,131)
France	1,973	23	27% (11,464)	73% (30,275)
Poland	1,745	21	20% (13,604)	80% (53,103)

Source. Eurostat (2024a)

The employer landscape in German warehouse logistics varies considerably. One reason for the limited presence of social-partnership institutions is that the sector consists of a large number of small and medium-sized warehouses with relatively few employees (see Table 3). Alongside major global players such as DHL, Kühne & Nagel, Dachser, and Amazon, many SMEs operate warehouses. In larger facilities, the presence of trade unions, the application of collective agreements and the establishment of works councils are more likely, and firm-level working conditions are more often subject to co-determination.[5]

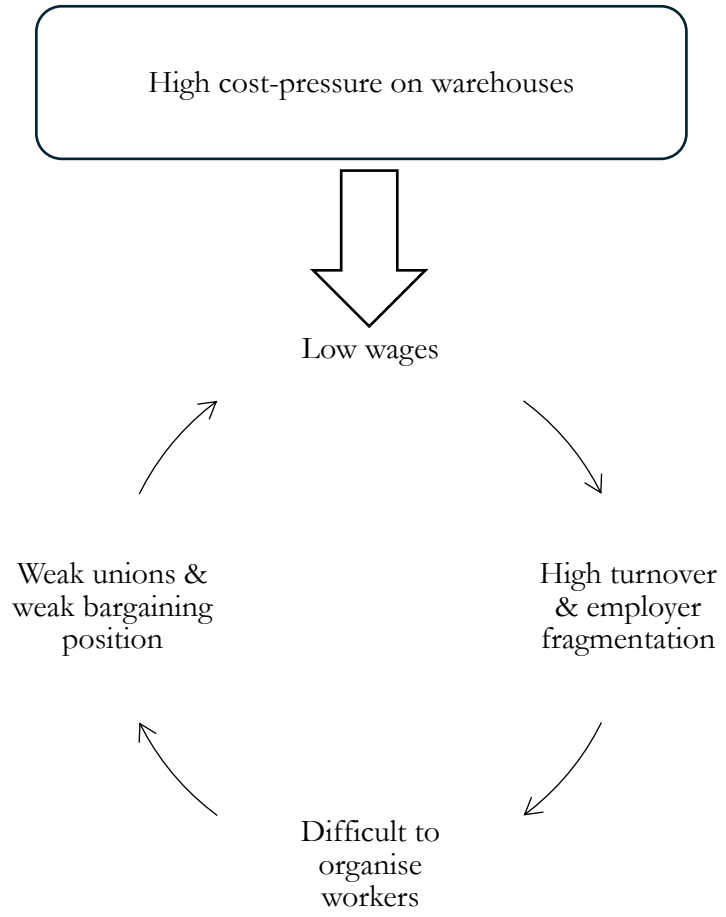
Employers tend to advocate greater flexibility in working hours, shift arrangements and wage structures, often pointing to competitive pressures and labour shortages. Employee representatives, by contrast, resist further deregulation and prioritise safeguarding standard working hours and preventing excessive workloads. Despite workers' relatively strong bargaining position in the context of persistent labour shortages, employers generally still wield greater power than organised labour. High turnover, language barriers, and the deliberately fragmented employment status of a heterogeneous workforce all complicate collective organising. As a result, the most common way for workers to express dissatisfaction is to 'bargain with their feet', that is, to leave their employer. While widespread labour shortages and recent wage increases suggest that

[5] The willingness of large firms to foster social partnership varies considerably: while some cooperate with unions and support co-determination, others have resisted the establishment of works councils or collective representation.

unfilled vacancies have strengthened workers' position, the sector continues to be characterised by institutionally asymmetric industrial relations.

The sector is caught in a vicious circle. Intense cost pressures in a highly price-sensitive market exert downward pressure on wages; persistent low wages, in turn, fuel labour shortages and high turnover. Employers respond by fragmenting the workforce to match fluctuating labour demand and to contain wage costs. High turnover and workforce fragmentation undermine collective organisation on the shop floor, resulting in weak union presence and a fragile bargaining position for workers. Substantial wage increases are therefore difficult to achieve, reinforcing the cycle of low pay. Breaking out of this dynamic is challenging, given the persistent cost pressures on the demand side (see Figure 2).

Figure 2. The vicious circle of low wages



Source. Own illustration

But workers can still signal their dissatisfaction by seeking jobs elsewhere, and widespread labour shortages increase the pressure on employers to improve wages. Given demographic ageing and the German warehousing sector already facing severe labour shortages in a stagnant economy, this pressure to recruit and retain staff will intensify further once economic conditions improve. These dynamics encourage employers to adopt technologies that automate warehouse processes, both to mitigate labour shortages and to retain their workforce by easing physical demands and improving working conditions.

> "In light of the continuing decline in the number of skilled workers, companies who offer poor work and employment conditions will be less successful because people won't want to work for them." (manager)

Working and employment conditions, as well as the technological standard of operations, vary considerably across warehouses. This variation reflects warehousing's embeddedness in all major value and supply chains, from Germany's dominant industrial and manufacturing sectors to chemicals, retail and food logistics. Depending on the type of goods stored and transported, warehouses face different technical and regulatory requirements. Some products require controlled temperatures, such as unbroken cold chains to ensure food safety, while others demand enhanced security measures due to the storage of high-value materials. The characteristics of the stored goods and the associated processes therefore largely determine the technological configuration of a warehouse.

Despite this diversity, the sector is characterised by comparatively poor working and employment conditions and by sustained underinvestment in modern technologies. Yet certain contextual factors increase the likelihood that firms will improve working conditions and invest in technological upgrades. The following sections on technological change and investment in warehousing examine these factors in detail and explain why such variation persists across the sector.

5. Technological change in warehouses

The most widespread technological developments in warehouses include the introduction of sophisticated, data-driven Warehouse Management Systems (WMS) and the ongoing shift from person-to-goods to goods-to-person technologies.[6] Conveyor belts, for instance, can transport goods directly to workers, and various robotic technologies can be used either to bring goods to them or to guide workers towards the product (see illustrations B, C, and D).

Illustration A. Warehouse Management System (WMS)

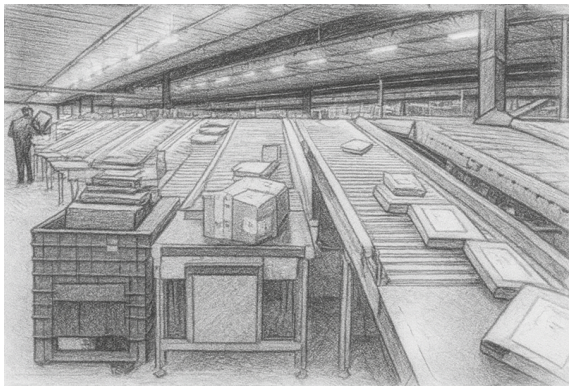


Illustration B. Conveyor belt

The Warehouse Management System (WMS) processes and coordinates all operational data within a warehouse. It is the central technological infrastructure that organises inbound and outbound flows, manages inventory, and determines labour demand and supply. WMS can be synchronised

[6] For a more comprehensive overview of technological developments in warehousing, see, for instance, Boysen, De Koster and Weidinger (2019).

with various software tools, including time-management systems. Managers work with the WMS daily and use it to schedule shift structures and allocate tasks.

Advances in data analytics have made today's WMS increasingly sophisticated, enabling the forecasting of order volumes, the optimisation of workflows and the tailoring of processes to fluctuating conditions. WMS can also be used for performance monitoring, although data-protection regulations in Germany theoretically limit detailed individual-level tracking.

> "The WMS is used to create transparency in the operational area and increase productivity. It was very important to us that WMS cannot be used for individual performance tracking. But managers do have access to this data and may use it, not explicitly but implicitly, to evaluate employees. This means that short-term employees may lose their jobs due to performance measurements."
> (works council representative)

The picking process is typically carried out using scanners, tablets and pick-by-voice systems (see illustration C). These tools streamline the picking process and can help reduce language barriers by relying on colour and number systems. The picked items are then fed back into the WMS, allowing managers to monitor the performance of a given shift on an hourly or daily basis using picking ratios.

Illustration C. Pick-by-voice and scanner

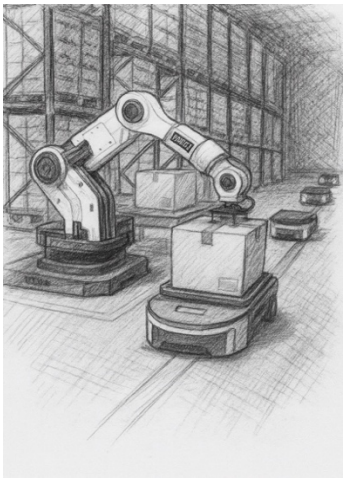


Illustration D. Robotic technologies

5.1 Ambivalent effects of technological change on warehouse work

Technological changes are not inherently beneficial or detrimental for warehouse workers; their effects depend on how they are implemented. WMS and the algorithmic management they enable can negatively affect job quality by reducing autonomy, increasing monotony, elevating stress levels and reinforcing reliance on non-permanent employment or short-notice shift changes. At the same time, these systems can generate efficiency gains, reduce physical strain and improve the allocation of working hours through more accurate forecasting. The impact of modern WMS on working conditions, and of technological change more broadly, is therefore mixed and ultimately depends on how employers deploy and manage these technologies. Robotic technologies can automate tasks such as truck unloading and offer considerable potential for eliminating physically demanding work (see illustration D). However, they may also replace tasks previously performed by workers

and can lead to job losses. Investing in a modern conveyor system can reduce walking distances and thereby lessen physical strain for workers. At the same time, shorter task cycles may increase monotony and contribute to higher mental strain.

Workers have little influence over which technologies are introduced or how these technologies will shape their daily work. Large-scale investments often require substantial restructuring of warehouse processes, and our fieldwork indicates that the transition to new systems frequently disrupts workflows and takes considerably longer than anticipated. Involving workers at earlier stages of technological decision-making would therefore be beneficial. Their practical knowledge enables them to identify bottlenecks in existing processes and can facilitate smoother and faster adoption.

> "Especially in the first few months, we noticed that this interface between robots, WMS and employees was very difficult and didn't work properly. It's much more complex than you might imagine beforehand. The assumption that such sophisticated systems can be introduced quickly and then just work is often disappointed." (manager)

Once managers invest, technology adoption is more likely to benefit workers if works councils are consulted in investment decisions and workers' perspectives are incorporated into the adoption process. Given that only 10% of warehouses have a works council (IAB 2024), such consulting of affected workers is rare. Instead, investment decisions are based on simple cost-benefit calculations. Even in warehouses with a works council, involvement in decision-making regarding investments in technology usually occurs only after management has already decided what to procure.

> "We're not involved in technology planning from the outset. Concrete plans are presented to us and then haggled over in negotiation committees to determine how far they're acceptable. This is at odds with the Works Council Constitution Act, which stipulates early and comprehensive involvement of works councils." (works council representative)

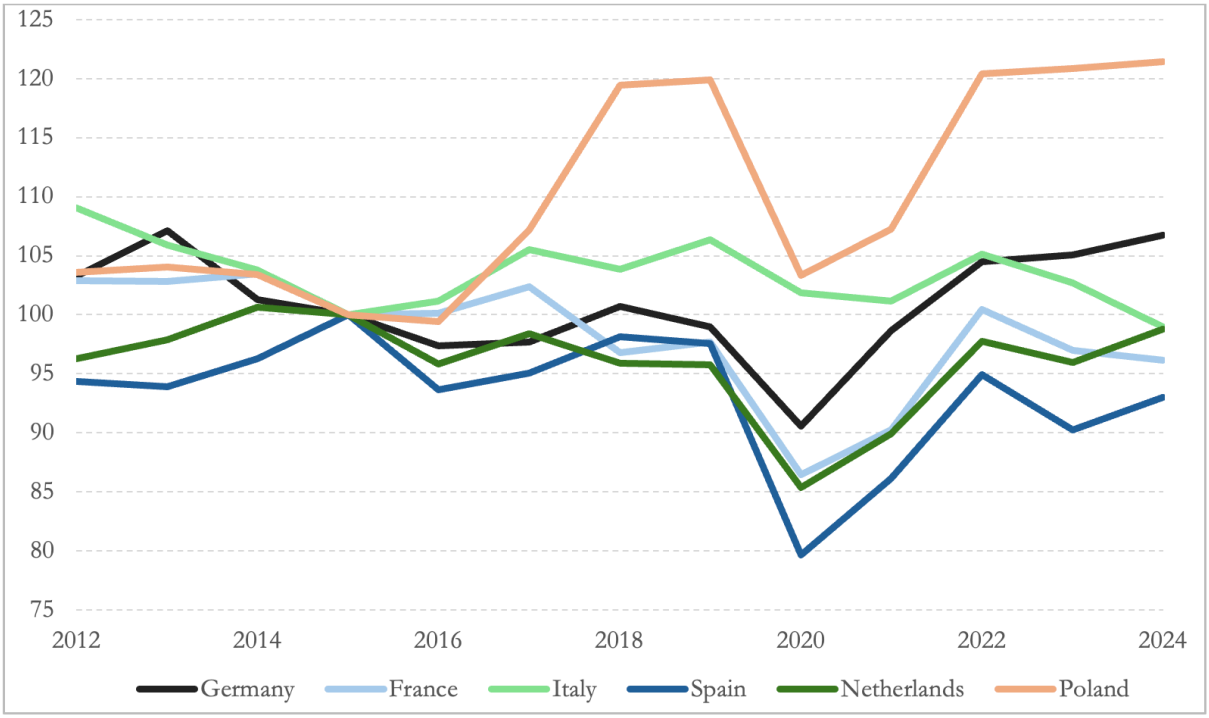
5.2 Social partners' responses to technological change

Workers and works councils often adopt a context-dependent and ambivalent stance towards technological change. When new technologies improve work processes and reduce physical strain in ways that benefit employees and the workplace atmosphere, they are generally supported. When technological changes are expected to result in substantial layoffs, works councils tend to oppose them.

For employers, investments in digitalisation and automation ultimately need to translate into higher (labour) productivity. However, large-scale productivity gains in warehousing are difficult to achieve and typically require substantial and costly investments. Figure 3 shows only modest growth in labour productivity per hour worked in Germany's transportation and storage sector. Indexed to 2015 = 100, productivity in 2024 is around 7% higher than in 2015, while the peak was already reached in 2013, suggesting that productivity gains have remained limited despite ongoing technological investment. Although the indicator covers the entire transportation and storage sector – of which warehousing is only one component – it nevertheless provides a useful proxy for productivity developments in warehousing and is consistent with our fieldwork findings from

the warehouses visited. The relatively flat productivity trend points to continued reliance on labour inputs, rather than strong labour-saving effects from digitalisation or automation in warehousing.

Figure 3. Productivity per hour worked in transportation and storage, selected EU countries (2012–2024, 2015 = 100)



Source. Own illustration based on Eurostat (2025a)

The comparison with Poland highlights the importance of starting conditions. In countries where technological standards were historically lower, the scope for productivity gains from investment is larger. Poland's labour productivity per hour worked in transportation and storage is more than 20% higher in 2024 than in 2015, indicating substantial catch-up effects driven by technology adoption and structural modernisation. Overall, the figure suggests that in mature logistics markets such as Germany, further productivity gains in warehousing are likely to be incremental rather than transformative, reinforcing the importance of labour availability, skills and working conditions alongside continued investment in technology.

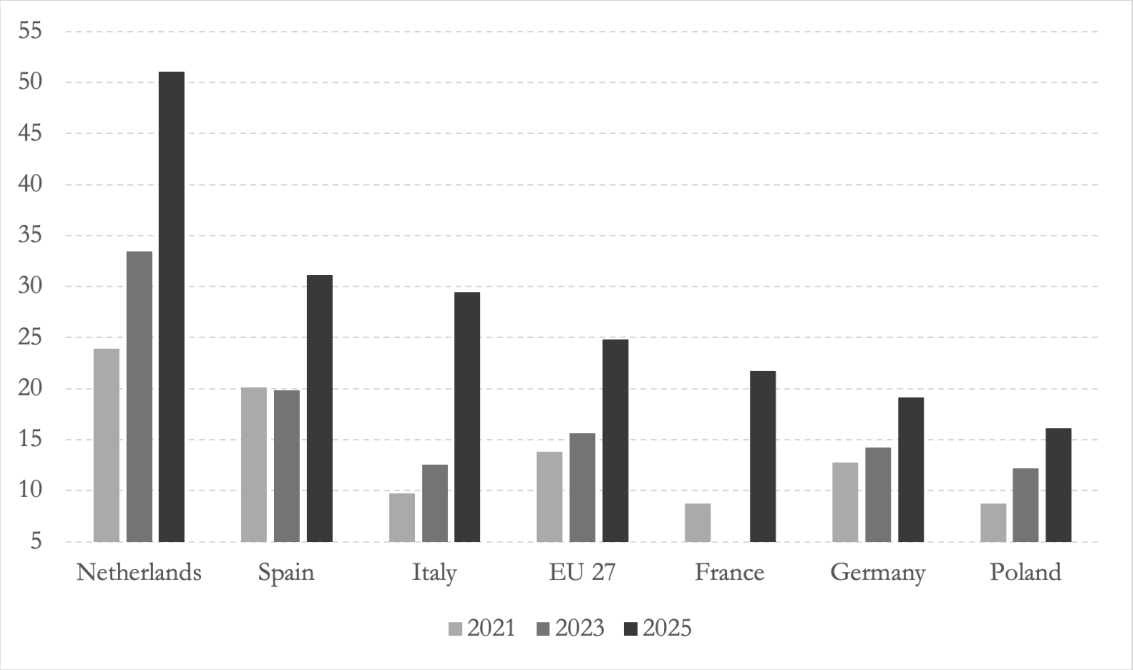
6. Investment needs and their constraints in German warehouses

Overall, German warehouses face significant investment needs. These range from basic improvements in warehouse infrastructure, such as better insulation, more efficient cooling and heating systems and upgraded sanitary facilities, to investments in new machinery, robotics, and enhanced warehouse management systems (WMS) for process optimisation. Most importantly, there is a pressing need to invest in warehouse workers themselves through language training, opportunities for upskilling and long-term strategies to strengthen workforce retention.

6.1 Digitalisation gaps and low investment rates

Figure 4 shows the share of enterprises with high or very high digital intensity in transportation and storage across the six largest EU economies, highlighting that Germany has substantial investment needs in warehousing digitalisation.

Figure 4. Share of enterprises with high or very high digital intensity in transportation and storage, selected EU countries (2021–2025)

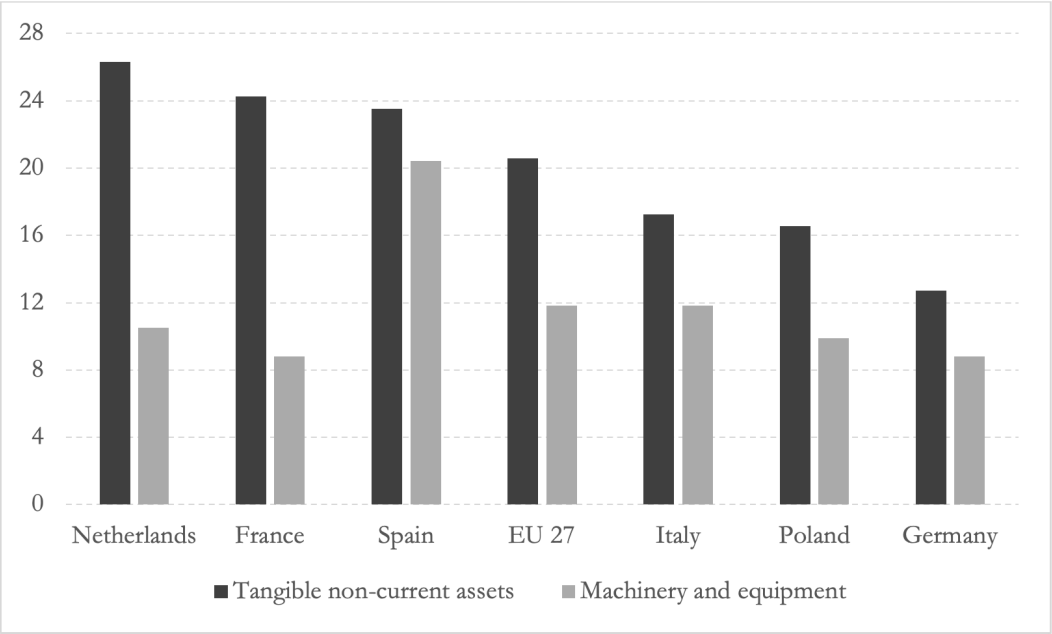


Source. Own illustration based on Eurostat (2025b)
Note. Percentages shown; data for France 2023 are missing

While Germany has increased the share of digitally advanced firms from around 13% in 2021 to about 19% in 2025, it still lags clearly behind leading countries such as the Netherlands, where more than half of enterprises (51%) reach a high or very high level of digital intensity, as well as behind the EU-27 average of 25%. Although the indicator covers the entire transportation and storage sector, it is informative for warehousing, which is among the more digitally intensive segments due to widespread WMS use, data integration, and growing automation. The relatively low share of digitally advanced enterprises therefore points to significant unrealised potential for digital investment in German warehousing.

Figure 5 shows that investment rates in German warehousing are remarkably low, despite substantial investment needs. Germany records the lowest investment rates among the six major EU economies and lies below the EU-27 average in both indicators: investment in tangible non-current assets (23rd out of 27 countries) and in machinery and equipment (19th). The investment rate in tangible non-current assets measures the share of value added reinvested in physical assets such as vehicles, technology and office equipment. The investment rate for machinery and equipment captures reinvestment specifically in these assets, and Germany's persistently low values suggest that underinvestment is a structural feature of the sector. Digital intensity is therefore unlikely to increase markedly over the next years, leaving warehouse workers exposed to physically strenuous working conditions in the short to medium term.

Figure 5. Investment rates in warehousing and logistics (%), selected EU countries



Source. Eurostat (2024b)

Taken together, the evidence suggests that Germany's logistics sector is undergoing digitalisation, but at a slower pace than key European peers. Limited productivity gains are linked not only to technological complexity but also to delayed or insufficient investment and weak co-determination in investment decisions, whose structural and institutional causes are examined below.

6.2 Short contract duration as the key investment constraint

The main investment constraint in warehouses is the short duration of warehouse contracts. Warehouses are often rented by a client company from a host provider, with lease periods tied to the client's (regional) business case. It has become increasingly common for clients to rent warehouses for short periods, often as little as two years, which discourages firms from making major investments in warehouse technologies or even basic improvements such as insulation. This, in turn, leads to structural underinvestment, as successive clients use facilities only temporarily and avoid substantial upgrades.

Expert interviews indicate that this underinvestment increases the likelihood of outdated technologies and physically strenuous work, while exacerbating labour turnover and discouraging the development of stable employment relationships.

> "Everything related to digitalisation and technology always depends on how customer relationships are structured. Unfortunately, short-term contracts [of warehouses] are becoming increasingly common. Short-term contracts mean that investments in technology are not made because they're not worthwhile from a cost–benefit perspective." (works council representative)

> "If you have a ten-year contract, then it's of course easier to invest in automation and in all sorts of things. If you have a two-year contract, investments don't bring enough benefits in the short term." (manager)

In the context of labour shortages, employers are more inclined to invest in technologies that automate logistical processes and reduce labour demand. Firms with substantial capital, greenfield sites and a long-term business case are more likely to make significant technology investments, and employment relationships in such contexts tend to be more stable and sustainable. By contrast, where firms lack sufficient capital or a credible long-term business case, shortages are more often managed through greater reliance on agency work and subcontracting. The resulting fragmentation of employment relationships exacerbates workforce fluctuations and undermines the social integration of an often highly heterogeneous workforce.

> "We invested in those robots to support workers by reducing their walking distance at work and to also reduce labour demand overall. […] I love automation. But I love simple automation which supports workers by reducing hard and difficult tasks or monotonous processes. Robotics are for me an example which reduces monotony and improves quality. (manager)

6.3 Open- and closed-book contracts

Beyond contract length, the type of contract between warehousing service providers and their clients also shapes investment decisions. Two models dominate the sector: open-book contracts and closed-book contracts, which differ markedly in their implications for investment and co-determination.

In an open-book contract, the client guarantees the provider a fixed return, typically between 4% and 7%, and receives full access to the provider's financial records. As a result, every major investment decision must be approved by both firms, which significantly limits the scope for long-term investments. This arrangement also makes firm-level co-determination more difficult, as workers are only a secondary concern for clients who do not employ them directly.

> "In an open-book contract, I have almost zero room to manoeuvre. Because at the end of the day I'm a service provider. And the client wants to have the final say regarding all major decisions." (manager)

> "The customer assumes all costs and then guarantees a margin. However, this means that all costs always go through the customer's desk, and they wonder what the benefits are in terms of productivity. Workers are only a secondary concern, as the customer is not their direct employer. This applies to all investments and therefore also to technological and digital change." (works council representative)

By contrast, in a closed-book contract the client purchases a service from the provider without gaining detailed insight into how that service is delivered. This gives the warehouse provider greater discretion to make investment decisions with limited or no consultation of the client. Closed-book contracts therefore increase the likelihood that providers will consult works councils and are generally more conducive to sustainable industrial relations.

> "Closed-book contracts offer employees much more scope for co-determination, because they actually have the opportunity to negotiate directly with the employer and reach agreements, rather than a supposed third party having any say in the matter." (works council representative)

During periods of economic stagnation or downturn, however, closed-book contracts become less common, and open-book contracts spread because they allow clients to share risk and maintain relationships despite lower demand. This shift further constrains providers' room for manoeuvre in making long-term investments in technology and working conditions.

> "We had a closed-book contract but because of reduced demand volume we're temporarily switching to an open-book contract. If demand is down, and business of the client reduced, open-book contracts are the option to find a common ground and keep working together." (manager)

While contract type is important, the length of contracts remains the most salient factor shaping investment behaviour and the stability of industrial relations in warehousing. Given persistent economic stagnation in Germany and recurring crises, short contracts of two to three years are likely to become the new standard, reinforcing short-termism and making long-term technological investment more difficult. A clear tension emerges between the service provider's need for long term investments, driven by labour shortages and persistent cost and time pressures, and the trend toward short contract durations on the client side. This tension is a central reason why large-scale warehouse automation is unlikely to materialise across regions in the coming years.

6.4 Limited potential for large-scale automation

> "Managers only spend money if sufficiently long contracts justify these investments. With short contracts, it's clear that manual labour is still cheaper than automation and digitalisation. As long as warehouse contracts last only for one to three years, no six- or seven-figure sums will be invested in automation." (works council representative)

In light of AI, advances in robotics technology, and a general streamlining of processes through digitalisation, a key option to reduce reliance on labour and fragmented employment relationships is to invest in large-scale automation. However, investment in automation is costly for employers. For instance, in the US a leading supply chain company has invested 10 million US dollars in robotics to fully automate truck unloading at its large-scale greenfield site in Georgia (Crowe, 2022). Such investments can benefit both workers and employers by eliminating physically strenuous unloading work and easing labour shortages through automation.

However, it is unrealistic to expect that automation of processes will result in the reduction of labour needed in German warehouses in the near-term future. Only companies with substantial capital, long-term business cases, and access to greenfield sites are likely to invest in large-scale automation. For other companies investments are too costly, or existing operations in brownfield sites would need to be disrupted or re-tailored in ways that enable automation. In light of Germany's more fragmented warehouse landscape, characterised by many SMEs and a relatively low share of greenfield sites, large-scale automation across regions is unlikely.

> "Contract durations in contract logistics [i.e. warehousing] will continue to shorten. There will be fewer ten-year or eight-year contracts as in the past, but more two-, three- and four-year contracts. We will have to create more automation solutions that are standardised and modular, because we're in a rapidly changing world of work. This means that I have to make automation and IT so modular that I can use as much of it as possible with two or three customers, because only then will it pay off." (manager)

Short-term warehouse leases undermine the viability of customer-specific automation, which typically requires long-term contracts. Service providers therefore seek to standardise automation strategies by developing modular solutions that can be deployed across warehouses and clients. These investments demand substantial capital and are largely accessible only to major industry players, which test new systems and roll them out across their warehouse networks. Small and medium-sized enterprises can follow only if such standardised solutions become financially viable for them, and many cannot match the investment levels of large competitors. This reinforces the growth of large providers and further constrains SMEs' ability to secure contracts and offer competitive wages. It also underscores how price competition, contract duration, investment strategies and working conditions are closely intertwined.

7. Recommendations: Lifting the warehousing sector to higher standards

> "It was positive that logistics was perceived as systemically important during Covid. However, in terms of societal value, there is a profound lack of appreciation for the sector. Appreciation has deteriorated over recent decades, and persistent cost pressures in logistics have further undermined public recognition. Policymakers need to act and improve standards." (manager)

7.1 For policymakers: Reducing subcontracting and improving labour standards

The warehousing sector requires targeted policy action to raise overall standards and substantially improve working conditions. Persistent cost pressure contributes to unsustainable working and industrial relations. Injury rates remain comparatively high, labour turnover prevents the long-term integration of a heterogeneous workforce, and low wages shift costs onto the state through social security top-ups. Policymakers across parties therefore have an interest in improving conditions in the sector.

Strengthen enforcement of existing labour standards

Before introducing new legislation, policymakers should prioritise ensuring compliance with existing rules. Labour inspections in warehouse logistics remain infrequent, and both employers and workers expressed limited trust in policymakers' commitment to enforcing current standards. Strengthening oversight is a necessary first step towards rebuilding credibility. National labour authorities – including customs offices and labour inspection bodies such as the state's accident-insurance institutions – should be equipped to conduct regular inspections. This is particularly important for inbound and outbound operations, which are frequently subcontracted and where the risk of injuries during the loading and unloading of trucks is highest (BAuA 2023).

> "I would like to see customs carry out inspections here more often than just every four years. And also weed out the black sheep in the industry. And if they [i.e. those who do not adhere to labour standards] are foreign entrepreneurs, customs needs to better ensure that they're no longer allowed to pursue their trade in Germany." (manager)

Raise wages and strengthen collective bargaining

Raising wages is a key lever for tackling labour shortages and improving job quality. Expanding collective bargaining coverage would help stabilise employment and reduce turnover. The planned German Tariftreuegesetz (Public Procurement and Tariff Compliance Act), currently under review, provides an important opportunity: by linking public procurement to collective agreement coverage, policymakers can incentivise employers to adopt collectively negotiated wage standards. Higher wages would also enhance worker retention, thereby strengthening firm-level co-determination and facilitating worker-centred technology adoption.

Restrict subcontracting and limit agency work

Extensive subcontracting remains one of the most significant drivers of poor working and employment conditions. Experts identify subcontracting as a major contributor to high injury rates, particularly during the loading and unloading of trucks (BAuA 2023, 10). Subcontracting blurs employer responsibility and fragments the workforce, resulting in uneven standards of (social) protection. Germany's recent restriction of subcontracting in the meat industry offers a relevant precedent. Following the ban, working conditions in the meat-processing sector notably improved (see Kärcher and Walser, 2025). These reforms were only put in place after Covid-19

outbreaks had moved the issue onto the political agenda, illustrating that public attention and political salience often catalyse regulatory change.

Although warehousing lacks similar visibility, policymakers should act proactively. Heavy reliance on subcontracting and persistently high turnover signal a structurally unsustainable business model. Limiting subcontracting and fostering stable industrial relations – rooted in the principles of German social partnership – is crucial for ensuring the long-term viability of the sector.

Agency work also contributes to fragmented employment structures, yet large-scale restrictions are unrealistic because warehouse operations rely on agency labour to meet peak demand. Policy should therefore prioritise restricting subcontracting while allowing employers to continue using agency workers during seasonal peaks. At the same time, policymakers could introduce caps on the proportion of agency workers permitted in a single warehouse to prevent excessive reliance on temporary staff. Subcontracting, however, remains the more pressing challenge and should be addressed first.

Advance EU-level regulation of employer fragmentation

At the EU level, the Quality Jobs Roadmap aims to improve working conditions and curb fragmented employment, including excessive subcontracting (European Commission 2025). Although employer organisations have expressed concerns, we recommend supporting these initiatives. EU-wide regulation of fragmented employment practices could raise standards across the continent and limit opportunities for operators to take advantage of regulatory differences across jurisdictions. Moreover, concerns about capital flight are overstated. Germany's logistics sector is so substantial that it cannot simply be absorbed by neighbouring countries such as Poland. Improving working conditions and productivity in German warehouses would set a benchmark for the European sector. Coordinated EU-level regulation creates a level playing field and increases the likelihood of higher warehousing standards.

7.2 For employers: Promoting stable employment through technological change

To harness the benefits of technological change in warehouses while avoiding harmful consequences, employers should adopt a worker-centred approach to technology. This means involving employees in investment decisions, in the adoption of new systems and in the assessment of their impact on workflows and working conditions. Workers are not only affected by technological change; they also have practical know-how for improving processes and ensuring that technology supports, rather than undermines, job quality. Including their perspectives at each stage of technological change therefore benefits both employees and employers.

At present, workers have only limited means to influence these developments, and decisions about whether and how to invest in technology are usually guided by employers' cost–benefit considerations. In firms without works councils, technologies are often introduced without systematic consultation of workers, which increases the risk that systems are poorly designed, worsen working conditions and contribute to higher labour turnover. Breaking this self-reinforcing cycle requires stabilising employment and retaining workers over the long term, which in turn makes worker-centred technology adoption more feasible and supports more sustainable employment relations in warehouses.

Employers can facilitate this by providing mandatory training and upskilling opportunities that help workers adjust to new technologies and by rewarding trained workers with higher pay and clearer career prospects. Investing in skills and remuneration can reduce labour shortages and is often less costly than the continual recruitment expenses associated with high turnover. Offering language courses, broader skills development and information on labour rights, laws and institutions also becomes more viable when employment is stable, and this is particularly important given the large share of migrant workers in warehouse logistics, whose sustainable social integration depends on time, continuity and strong regional ties.

7.3 For unions: Increasing solidarity across the entire value chain

The underlying cause of poor employment and working conditions in warehouse logistics lies in the persistent pressure to reduce costs along the value chains of many products. Across sectors ranging from e-commerce to established industrial branches such as manufacturing, firms seek to cut their logistical expenses to stay competitive. One common strategy is the outsourcing and subcontracting of core logistical operations to avoid paying workers on the basis of collective bargaining outcomes agreed across a sector. This practice contributes to low wages, high turnover, and unstable industrial relations throughout the warehousing sector.

Trade unions could play a central role in improving working and employment conditions by strengthening solidarity across entire value chains. When manufacturing firms outsource warehousing to reduce production costs while simultaneously paying their core factory workforce wages in line with collective agreements, it fragments responsibility and undermines solidarity among workers. Unions in strong industrial sectors have the potential to call out such outsourcing practices and to include limits on subcontracting in their collective bargaining agendas. Allowing outsourcing and subcontracting on a large scale in value chains where trade unions have traditionally shaped working conditions weakens unions' position over time. It undermines their public credibility when high wage standards are defended for some workers and very low standards persist for others within the same value chain. This trend is particularly concerning given the recent weakening of national legislation that aims to ensure higher standards across supply and value chains. In this context, it becomes even more important that unions articulate strong positions in favour of sector-wide standards.

In addition, unions need to be more proactive in supporting the establishment of works councils in warehouses. With only about 10% of warehouses having a works council, firm-level employee representation remains very limited. All major unions should therefore develop strategies for strengthening social partnership within the warehouses that are part of their respective sectors. Although establishing effective co-determination is challenging given high workforce turnover, fragmented employment contracts, and employers' continuous quest for cost reductions, it remains the central task for unions.

References

BAuA. (2023). *Statistik – Arbeitsunfallgeschehen 2023*. https://publikationen.dguv.de/widgets/pdf/download/article/4990

Betriebsverfassungsgesetz. (n.d.). In *Gesetze im Internet*. Bundesministerium der Justiz und für Verbraucherschutz. https://www.gesetze-im-internet.de/betrvg/

Boysen, N., De Koster, R., & Weidinger, F. (2019). Warehousing in the e-commerce era: A survey. *European Journal of Operational Research*, *277*(2), 396-411.

Bundesagentur für Arbeit. (2024a). *Fachlagerist/in | Entgeltatlas*. Bundesagentur für Arbeit. https://web.arbeitsagentur.de/entgeltatlas/beruf/27538

Bundesagentur für Arbeit. (2024b). *Branchenwechsel von Beschäftigten* (Methodenbericht). Statistik/Arbeitsmarktberichterstattung. Nürnberg. Retrieved from: https://statistik.arbeitsagentur.de/DE/Statischer-Content/Grundlagen/Methodik-Qualitaet/Methodenberichte/Beschaeftigungsstatistik/Generische-Publikationen/Methodenbericht-Branchenwechsel.pdf?__blob=publicationFile

Bundesagentur für Arbeit. (2025). *Beschäftigung von Leiharbeitnehmenden* (Tabellen, Produkt-ID 1919; Stichtag: 31. Dezember 2024). Statistik/Arbeitsmarktberichterstattung.

Colliers. (2025). City Survey Q3 2025. *Chapter 2.2. Industrial- and logistics: On the road to recovery. https://citysurvey.colliers.de/en/*

Crowe, S. (2022). NFI deploying Boston Dynamics' Stretch robot in $10M deal. *The Robot Report*. https://www.therobotreport.com/nfi-deploying-boston-dynamics-stretch-robot-in-10m-deal/

DSLV. (2025). *Feedback from: DSLV Bundesverband Spedition und Logistik e. V.* https://ec.europa.eu/info/law/better-regulation/have-your-say/initiatives/14707-Quality-Jobs-Roadmap/F3585812_en

European Commission. (2024). *The future of European competitiveness: Part A*. https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en

European Commission. (2025). *Communication from the Commission to the European Parliament, The Council, The European Economic and Social Committee and the Committee of the Regions. Quality Jobs Roadmap*. https://employment-social-affairs.ec.europa.eu/document/download/82975aa7-bdd6-4a64-b3e3-82433901f8f7_en?filename=Quality-Jobs-Roadmap_Communication_2025.pdf

Eurostat. (2024a). *Structural business statistics database. Enterprise statistics by size class and NACE Rev. 2 activity (from 2021 onwards)*. Retrieved from: *https://ec.europa.eu/eurostat/databrowser/view/sbs_sc_ovw__custom_19725240/default/table*

Eurostat. (2024b). *Structural business statistics database. Enterprises by detailed NACE Rev. 2 activity and special aggregates*. Retrieved from: https://ec.europa.eu/eurostat/databrowser/view/sbs_ovw_act__custom_19706167/default/table?page=time:2023

Eurostat. (2025a). *Labour productivity and unit labour costs by industry (nama_10_lp_a21)*. Retrieved from: https://ec.europa.eu/eurostat/databrowser/view/nama_10_lp_a21__custom_19509392/default/table

Eurostat. (2025b). *Digital intensity by NACE activity (isoc_e_diin2)*. Retrieved from https://ec.europa.eu/eurostat/databrowser/view/isoc_e_diin2/default/table?lang=en&category=isoc.isoc

IAB. (2024). *IAB-Betriebspanel (IAB-BP) 1993-2023*. https://fdz.iab.de/unsere-datenprodukte/betriebsdaten/iab-betriebspanel/

Kärcher, A., & Walser, M. (2025). Durchsetzung von Arbeitsrecht-das Arbeitsschutzkontrollgesetz als Modell? Verfassungs-und europarechtliche Fragen mit besonderer Berücksichtigung des Direktanstellungsgebots. *HSI-Schriftenreihe*, *54*.

Karusseit, L.-M. (2025). *Gehälter in der Lagerlogistik: aktuelle Zahlen und Einblicke*. Even Logistics. Retrieved from https://www.even-logistics.com/blog/gehaelter-in-der-lagerlogistik

Klaus, P., Leicht, R., Wojtech, A., & Blum, R. (2024). Top 100 in European Transport and Logistics Services 2024/2025. Fraunhofer IIS.

Statistisches Bundesamt. (2020). *Bevölkerung mit Migrationshintergrund 2019 um 2,1 % gewachsen: Schwächster Anstieg seit 2011*. Statistisches Bundesamt. https://www.destatis.de/DE/Presse/Pressemitteilungen/2020/07/PD20_279_12511.html

Weil, D. (2019). Understanding the present and future of work in the fissured workplace context. *RSF: The Russell Sage Foundation Journal of the Social Sciences*, *5*(5), 147-165.