BARMETAL

Digitalization, Automatization and Decarbonization: Opportunity for Strengthening Collective Bargaining in the Metal Sector

Italy Policy Report

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Introduction

This report is meant to assess the status and evolution of the processes of **digitalisation, automation and decarbonisation, called DAD (digitalisation-automation-decarbonisation) in the Italian automotive industry**. The ultimate scope of the report is to assess the effects of the DAD process in bargaining and social dialogue, the primary interest of this research being on the effects that DAD exercises upon workers, trade unions and their bargaining processes.

The analysis of the three processes altogether derives from the fact that the industry is at the same time crossed by a preceding wave of automation and digitalisation, the so-called Industry 4.0 phase, which started approximately in 2016-2017 and is still unfolding. More recently, it has been coupled with the so called decarbonisation phase as well as pushed by the growing concerns about the climate crisis. The combination of such transformations have ultimately led the industry toward a deep reconfiguration in terms of actors and value chain articulations, products, and production processes. As such, the three forces might be interlinked among them, pushing toward a unique pattern of rearticulation of the industry, or alternatively, exercising different pressures and tensions according to the actors involved, the role and position of the country under study in the value chain generation and distribution as well as the status of advancement and implementation of regulations. The effects might also reverberate from macro to micro levels and are deeply shaped by the institutional conditions of the country under study. Therefore, to assess the unfolding of the effects of DAD it is important to distinguish some realms of investigation which might help us in defining the arenas, and together the boundaries, of such transitions.

In this report, we identify the following areas of analysis: labour market trends and conditions before the advent of DAD with reference to the automotive sector (Section 1), particularly looking at the process of deindustrialisation in the Southern Europe and the process of industrialisation in Eastern Europe; the conditions and evolutions of the industrial relation systems (Section 2), the articulation of DAD at the macro level in the institutional agenda (Section 3), at the industry level (Section 4), and at the workplace level to spot DAD “at work” (Section 5).

The ultimate outcome of the report is to understand the extent to which social dialogue in its diverse forms of implementation is currently invested by new agenda settings and new forms of negotiation vis-à-vis DAD, our findings are presented in Section 6. To develop the report, we draw upon a mixed method approach, combining quantitative indicators, academic literature, industry reports and systematic interviews conducted with actors involved/informed at different levels of the social dialogue process, from national, to industry, to workplace level ones. In addition, cross parallelisation and validation of the research outcomes have been conducted to harmonise the results.

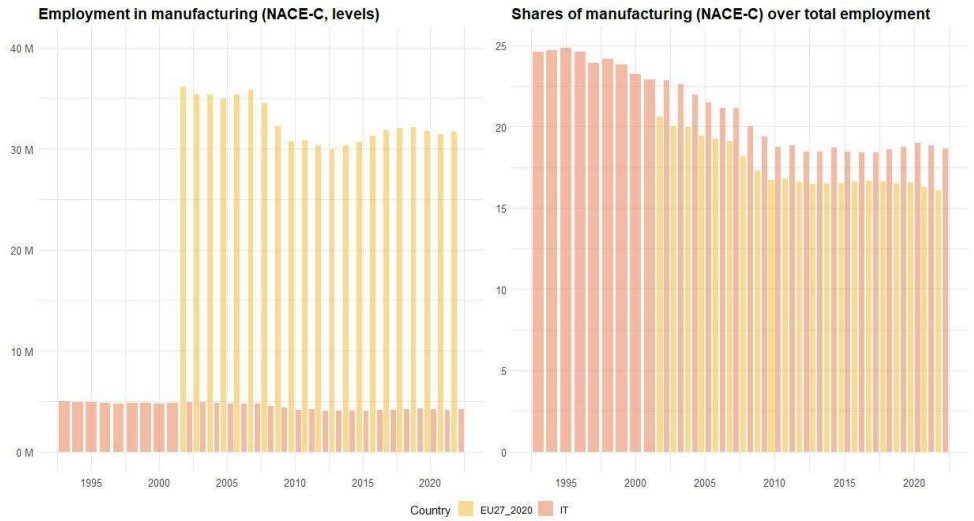
1. National and sectoral labour market situation

In this Section, we start from the presentation of the national and sectoral labour market status in order to give an account of the preconditions of the system before the advent of DAD. The left panel of Figure 1 shows the levels of employment in manufacturing (NACE-C) and the share of manufacturing employment over total national employment (right panel)

for Italy from 1993 to 2022, and, as a benchmark, the European Union (27 countries) average from 2002 to 2022.[1] The total employment in manufacturing in Italy amounted to around 5 million workers at the beginning of the period, corresponding to 13% of total European employment in manufacturing[2]. Since 2007, the number of workers has been decreasing but stabilised around 4.1 million workers by 2022. Such a decrease during the Great Recession period is common to the European Union, whose average of employment in manufacturing is characterised by a weak increase after 2015. Within the country, the share of employment in manufacturing over total employment decreased from 25% at the beginning to 18% at the end of the period, generally 2% higher than the European average over the same time span, however both follow a decreasing trend.

Decomposing the metal sector, Figure 2 shows the share of employment in the manufacturing of basic metals (NACE-C24, top-left panel), of fabricated metal products, except machinery and equipment (NACE-C25, top-right panel) and of motor vehicles, trailers and semi-trailers (NACE-C29, bottom-left panel) of employment in manufacturing (NACE-C), both for Italy and the European Union average. The share in manufacturing of basic metals (NACE-C24) for Italy increased from 2.5% to 4.6% of Italian manufacturing, always slightly higher than the European average. The manufacturing of fabricated metal products (NACE-C25) provides the highest share for Italy of the three sectors under analysis, around 13% and always higher than the European average corresponding to 9-10% of employment in manufacturing. The shares of manufacturing in motor vehicles, trailers and semi-trailers (NACE-C29) range between 3.3 and 5.6%, with a stable trend around 5% between 2004 and 2020, while the European average has increased from 2002 to 2015, when it reached 10%. The European average decreased to 9.4 percent in 2022. A similar decrease for the Italian share is evident during 2022. The stable trend of the Italian employment share in the automotive industry in the last decades with respect to the increasing trend of the European average suggests a delocalisation movement of the industry.

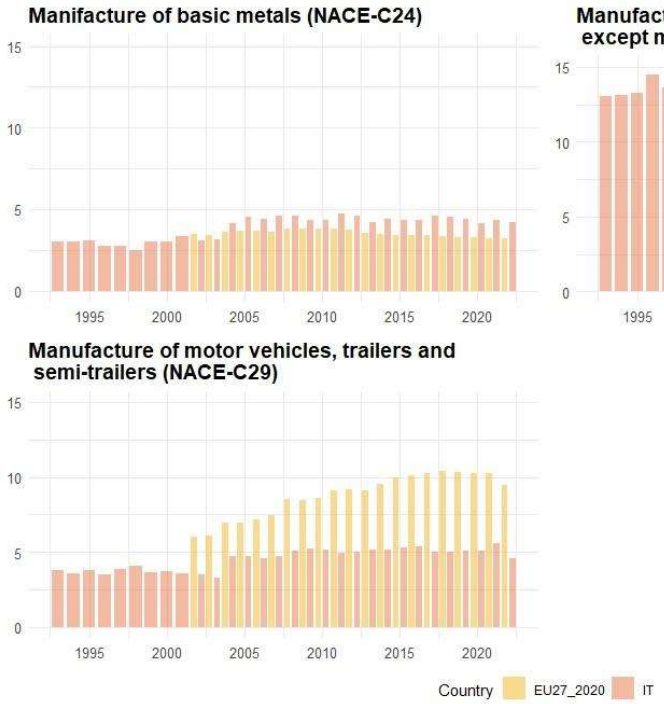
Figure 1. Levels and share of employment in manufacturing (NACE-C) in Italy and the European Union (27 countries) average, annual data from 1993 to 2022



Data Source: Labour Force Survey, EUROSTAT

1 Differences of time period are due to lack of data from 1993 for the European average. The European Union average refers to the 27 countries aggregation, preferable to the other average available referring to the Euro area, 20 countries.

Figure 2. Share of employment in the manufacturing of basic metals (NACE-C24), fabricated metal products, except machinery and equipment (NACE-C25); motor vehicles, trailers and semi-trailers (NACE-C29) over total employment in manufacturing (NACE-C) for Italy and the European Union (27 countries) average, annual data from 1993 to 2022



Data Source: Labour Force Survey, EUROSTAT.

2. Insight into industrial relations

2.1. Industrial relations context and actors

Italian industrial relations are based on a multi-tier voluntary collective bargaining system founded on the principles of a representative pluralism on both the trade union and employer sides (Pedersini, 2019, pp. 340-41). Traditionally, the system is scarcely institutionalised and relies mainly on social partners' mutual recognition and self-regulation (*ibid.*). State intervention is minimal and the autonomy of the bargaining parties is in principle unrestrained by law at the various bargaining levels (Dorigatti and Pedersini, 2021). There is no mechanism for the legal extension of multi-employer agreements but, whenever mobilised, case law has usually adopted the minimum wages established in sectoral contracts as the benchmark to assess the appropriateness of set wages in case of dispute (Pedersini, 2019). Consequently, the OECD and AIAS consider the extensions of collective agreements to non-organised employers as being virtually automatic in the country and estimate the bargaining coverage rate near 100% (OECD and AIAS, 2021). However, such a number is an overestimation when compared to results from company-level surveys (Deidda *et al.*, 2023).

There are three major trade union confederations in the country (CGIL, CISL and UIL) with distinct political and organisational traditions that have, however, faded over time (Pedersini, 2019, pp. 341, 343). In the metal industry, the sectoral unions belonging to the confederations of Fiom-CGIL, Fim-CISL, Uilm-UIL are by far the most representative. Alongside these, there

are numerous “independent” unions, the most important of which are the FISMIC, a company union of the former FCA group, the UGLM, a sectoral federation of the conservative-corporatist UGL union, and the USB, a rank-and-file and radical left-wing union.

On the employers’ side, the most representative association is *Confindustria*, which is present in the metalworking sector with its branches *Federmeccanica* and *Assistal*, which respectively associate metalworking and technological equipment supply and installation companies. Confindustria can be considered a “general organisation”, since it represents companies of all sizes and from all sectors and has “historically played a dominant role in the representation system of employers’ interests” (Dorigatti and Pedersini, 2021). There are other employer associations specialised in representing employers on a sector-specific basis (such as in retail, personal services and tourism industries) or on a company type basis (such as small and medium-sized firms, or craft businesses) (*ibid*.).

Regarding trade union membership, self-reported data from the three largest confederations indicate more than 11 million members among active and retired workers (Perdersini, 2019). After peaking during the 1970s following the major workers’ mobilisations, the unionisation rate gradually declined, only to rise slightly in the years following the economic crisis – in part due to a significant reduction in employment (Dorigatti and Pedersini, 2021) – and finally settling at around 32-33% in recent years (OECD/AIAS ICTWSS, 2023). On the employers’ side and according to Inapp data, the membership of firms in employers’ organisations has steadily declined over the last 10 years, from 49.8% in 2010 to 39% in 2018, a decline that is reflected in the share of workers employed in associated firms, decreasing from 66.8% in 2010 to 61.7% in 2018 (Morocco and Polli, 2022). In the manufacturing sector, however, companies maintain a strong membership in employer associations (55.5%) and a high employer density (74.7%) (*ibid*.), while the number of members of the three largest unions in the metalworking industry after remaining constant at 650,000 between 1998 and 2014, declined to 617,000 in 2018 (Bordogna, 2021).

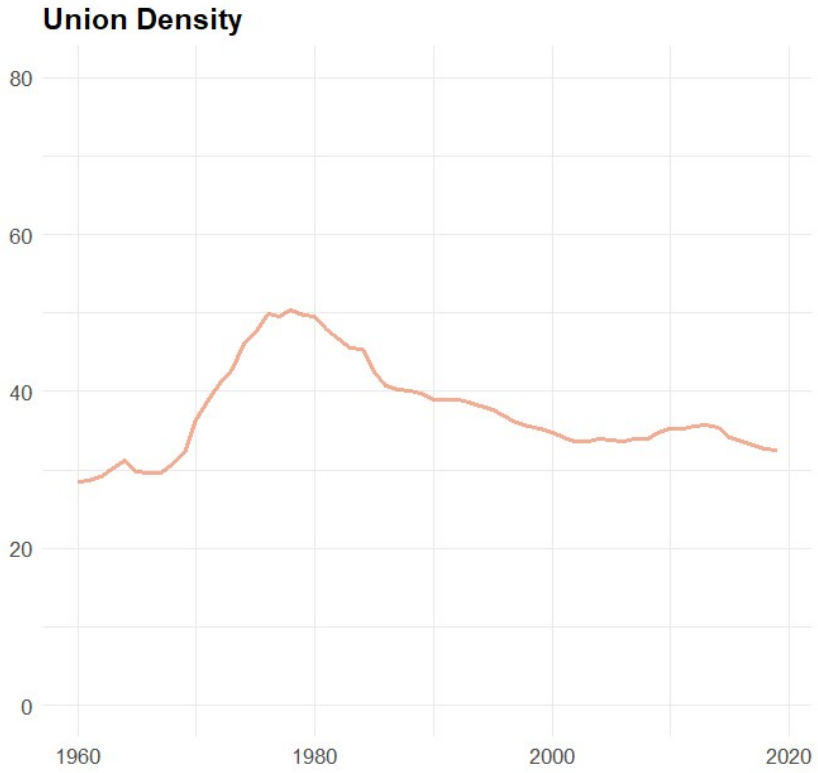
Synthetic indicators are presented in Table 1 and Figure 3.

Table 1. Italian Average Values.

	2018-2020
Employer Organisation Density*	61.7%
Bargaining Coverage Rate	98%
Bargaining Level	3

*Data retrieved from IRL-INAPP

Figure 3. Union Density in Italy



Although the decline in trade union membership has been contained over the last decade, the power and influence of trade unions has waned considerably in the political sphere (Dorigatti and Pedersini, 2021). Almost all recent governments, in fact, with the exception of those that had to manage the Covid-19 crisis, have renounced concertation with social partners, preferring to exclude trade unions from public policy-making (Pulignano *et al.*, 2018).

2.2. Collective bargaining system

The Italian collective bargaining system is structured on three levels, differentiated by roles and competences. The inter-confederal and interprofessional level regulates representation, negotiation and renewal procedures. At this level, agreements between the three main trade union confederations and the general employer association define the overall regulatory framework of the system ensuring its coordination (Dorigatti and Pedersini, 2021). The industry level maintains a pivotal role in the substantive regulation of employment relations (*ibid*.). The agreements concluded at this level by the sectoral trade union federations and the corresponding employer associations regulate various topics, including information and consultation rights, minimum wage rates, job classification, working time, recruitment and termination, non-standard employment, and training (*ibid*.). The inter-confederal agreement of April 15, 2009 stipulates that collective labour agreements have a duration of three years.

This collective bargaining system faces two particular difficulties at present. On the one hand, there has been a general erosion of real wages over the last three decades (Cetrulo *et al.*, 2023) as a result of the economic crisis. This has been compounded by the rise of an in-work poverty phenomenon, since despite the extension system mentioned above, a significant

percentage of workers are paid below the minimums set in sectoral agreements (Garnero, 2018). Faced with this situation, collective bargaining at the sectoral level has shown little capacity to produce wage increases, in the absence of minimum wage legislation, towards which trade unions, traditionally sceptical, have only recently shown openness (Dorigatti and Pedersini, 2021). In addition, there has been a proliferation of so-called 'independent' (i.e. detached from the main organisations) trade unions and employers' associations, that are accused of signing agreements that are defined as 'pirate', since they reduce the quantity and quality of the protections established in the main sectoral agreements. The significance of this phenomenon is demonstrated by the intense growth of industrial agreements recorded in recent years: from 580 in 2013 to more than 1000 in 2023.[3]

In the manufacturing sector, the most important collective agreement is the *CCNL Metalmeccanico*, signed by *Federmeccanica*, *Assistal*, Fiom-CGIL, Fim-CISL, Uilm-UIL, covering about 1.5 million workers (Fim-CISL, 2023a). The main topics of this agreement are: relations with lower bargaining levels with increasing space left to the possibility of derogation on contractual institutions with the exception of minimum wages; wages, in particular by including the possibility of indirect forms of remuneration (welfare benefits); working hours, in particular by allowing and then consolidating from 2010 onwards increasing hourly flexibility; the regulation of fixed-term contracts and temporary work, where there has been a substantial ratification of legislative provisions liberalising their use without including additional forms of protection; the job classification system, reformed in the last agreement of 2021 since being established in 1973 (Dorigatti and Rinaldini, 2023).

Other collective agreements are also applied in the sector, mainly concerning small and craft enterprises. The most important of these are the *CCNL* for small and medium-sized industrial and manufacturing firms in the metalworking sector, signed by the three major trade union federations with *Unionmeccanica* and *Confapi*, and concerning about 420,000 workers employed in about 40,000 firms, as well as the *CCNL* for the artisans in the Mechanics Area, signed with three employer associations (*CNA*, *Confartigianato* and *Claai*) and concerning about 500,000 workers employed in 130,000 firms (Fim-CISL, 2023b, 2023c). Expiring in 2022, the latter contract has not yet been renewed. Other sectoral contracts are only signed by some trade unions and minor employer associations or concern specific productive sub-sectors.

In the last 25 years, there has been a progressive union division in the metalworking sector, which has led to the signing of so-called “separate industry agreements”, i.e. not signed by the largest metalworking union in terms of number of members, the Fiom-CGIL. Of the last 10 metalworking national collective labour agreements, four have been concluded without the signature of the latter, and the unity between the metalworkers’ unions, a constituent element of industrial relations in the sector throughout the 1970s and 1980s, has only been found in the last two agreements signed in 2016 and 2021 (Dorigatti and Rinaldini, 2022).

The Fiat industrial reorganisation matter has been the main element of tension in industrial relations in the manufacturing sector over the last decade. On the one hand, it has sharpened union divisions between a collaborative side towards the company’s restructuring plans (Fim-CISL, Uilm-UIL and Fismic) and an opposing side represented by the Fiom-CGIL who refused the approval of those plans and the stipulation of the CCSL, while initially even ousted from the representative bodies in the plants. On the other hand, the exit of the most important group in the sector from the national collective bargaining system raised concerns for the

3 https://www.rivistailmulino.it/a/il-salario-minimo-tra-giustizia-sociale-ed-efficienza-produttiva

survival of the sector's national collective agreement, for fear that other companies might follow Fiat's example. To date, this has not occurred, even if some big companies, such as Luxottica and Marcegaglia have followed FCA's example (Dorigatti and Pedersini, 2021).

As a result of the industrial reorganisation dispute at Fiat in 2010 and 2011, in fact, the companies of the former FCA-CNH group left *Confindustria* and withdrew from the national metalworking agreement. Therefore, a "specific collective agreement" negotiated at group level applies in these companies. This agreement regulates matters that are typical of sectoral agreements (such as salary, union rights, and qualification system, regulation of employment relations) and also includes subjects covered by decentralised bargaining (see below).

2.3. Decentralised collective bargaining and employee representation

With regards to decentralised collective bargaining, the tripartite agreement of July 23, 1993 established a criterion of specialisation between the sectoral level and the decentralised/company level, assigning to the latter the task of distributing productivity gains through the bargaining of variable pay related to company or site performance. The tripartite agreement of January 22, 2009 confirmed this scenario, but also provided the possibility of opening clauses agreed at sectoral level, allowing the renegotiation of some contractual topics at the company level. This model of 'organised decentralisation' was undermined by a legislative provision taken by the last Berlusconi government in 2011 that allowed decentralised agreements to derogate national contracts and even, within certain limits, legal provisions without the need for coordination with higher bargaining levels (Dorigatti and Pedersini, 2021).

The 1993 agreement had the aim of incentivising decentralised bargaining, a goal that has, however, only been partially achieved. The spread of decentralised bargaining in fact appears to be generally correlated with the size of the organisation and the propensity to bargaining increases as does the firm size (CNEL, 2022, Deidda *et al.*, 2023). According to the latest ISTAT-CNEL survey available (2012-13), only 17.5% of firms between 10 and 49 employees were covered by a form of decentralised agreement, while this percentage rose to 38.5% of firms between 50 and 199 employees, and even to 60.5% and 69.1% of firms between 200 and 499 employees and 500 or more employees respectively (CNEL-ISTAT, 2016). Second level bargaining is more diffused in industries where the average firm size is larger, such as chemicals, and lower in industries populated by small enterprises, such as textiles (CNEL, 2022). In this context, the manufacturing sector is slightly above average, with 25% of the enterprises covered by decentralised collective bargaining, a figure which, however, rises to 75.6% of firms in the range between 200 and 499 employees and to 86% of firms with more than 500 employees.

Workplace representation in Italy follows the single channel model, which combines the functions of employee representation and union structure. It can have two configurations:

a) the RSA (Union Company Representation), established by the Workers' Statute in 1970, are union representation structures, without bargaining power, but with information and union rights;

b) the RSU (Unitary Union Representation), established by the interconfederal agreement of July 23, 1993, signed by the government, Confindustria, CGIL, CISL and UIL, are employee representation bodies who represent all workers regardless of their union membership and are elected – on union lists – by all the employees at the

establishment level. They have the right to bargain collectively at the company level and to be informed and consulted.

Both the RSA and the RSU can be established only in workplaces with more than 15 employees. Overall, today RSAs are present in 11.8% of companies, while RSUs are present in 12.1% (CNEL-ISTAT, 2016). Although they are not mutually incompatible, these structures rarely overlap. The purpose of setting up the RSU, in fact, was to facilitate company bargaining, by bringing all trade unions together under one single structure (Pedersini, 2019). To date, the diffusion of RSUs is limited especially to those sectors where labour relations are more difficult, such as social and personal services, or market services. In the manufacturing sector, however, RSUs are much more widespread (21.4% of firms) and RSAs are present in 13.3% of cases (they are found, for instance, in the companies of the Stellantis group, precisely because of the difficult labour relations in the latter).

In addition to RSAs and RSUs, the law stipulates that workplaces with more than 15 employees workers have the right to elect employee safety representatives (RLS). These representatives have the function of monitoring and stimulating compliance with the rules on employee safety by the employer. In workplaces with fewer than 15 employees, these representatives are appointed by trade unions on a territorial basis. In Italy, there is no legislative provision on employee representation on company boards. Nonetheless, there are some experiences in this field, limited, however, to the banking sector and municipal companies (ETUI, 2016).

Despite the difficulties highlighted, company bargaining is a key element of Italian industrial relations and can be a driver of innovation in employment practices, through the negotiation of sometimes very advanced solutions (Dorigatti and Pedersini, 2021). The performance-related salary has certainly been the most bargained institute, even if, according to critics, its real link with company results has remained weak (Ponzellini, 2017). In the 2010s, agreements on firm restructuring and on the use of social shock absorbers had an increasing weight, while more recent years have witnessed a rise in the negotiation of indirect salary in the form of benefits and corporate welfare (Dorigatti and Pedersini, 2021). In contrast, work organisation and technological innovation have long remained in the background with the exception of agreements on working time flexibility coinciding with a renewal of the matter with respect to Industry 4.0 (Cirillo *et al.*, 2023).

While company bargaining in the metalworking sector follows the same trend lines, it also shows some of the most advanced experiments in the field. In some company cases, often confined to specific regions (Emilia-Romagna, Lombardy), there has been a strengthening of participatory labour relations, based on tools such as the 'joint commissions' since the 1990's (Carrieri, 2021; Ponzellini, 2017). These mixed bodies act as a forum for consultation between the company and the trade union on various topics (monitoring productivity indicators, work organisation, working time, and training etc.) and appears to be aimed at enhancing company performance, within a framework inspired by "co-management" type arrangements (Cetrulo and Moro, 2021). However, these tools remain quite limited in their scope and diffusion.

3. D-A-D and its effects

The automotive sector is undergoing a deep restructuring process. The delocalisation of production to integrated peripheries, the technological and environmental challenges of the digitalisation, automation and decarbonisation of the sector (Krzywdzinski, 2019; Pavlinek,

2020). Between 1991 and 2017, core countries have been subject to a large downsizing of automotive production. Italy is the country that has suffered the deepest decline (-56%), followed by France (-49%), and Sweden (-24%), partially because of the offshoring of assembly (Pavlinek, 2020).

The overall dynamics of the sector is primarily affected by the ongoing dissolution of the main national car producer and employer absorber, namely ex-Fiat, now Stellantis. The lack of investments by the previous corporate structures in the last decade (ex-FIAT then FCA) together with the lack of industrial strategies of the Italian government as well as increasing outsourcing resulted in the reduction of cars production and employment (Balcet and Ietto-Gillies, 2019, Cresti and Virgillito, 2022).

According to an interview conducted with an expert of the field, the group has undertaken a clear strategic choice of exclusively maintaining the production of high-end vehicles in Italy and discarding the production of mass car products. Such a corporate strategy is conducting the group toward the progressive dismantling of other production lines. On top of that, the management of the transition towards electric production is expected to further resize employment and production in the Italian plants. Today, the Italian production of Stellantis accounts only for 5% of total group production around the world employing around 50 thousand workers in the country across 12 plants. The corporation has already asked for voluntary redundancies of 15,000 workers to manage the transition towards electric production (Bubbico, 2023).

Together with the progressive decline in the production of cars (from around 1,500,000 vehicles in the late 1990s to 473,000 in 2022), the production in the Italian automotive sector has become progressively specialised in the supply of components during the last three decades (Source ANFIA)[4]. According to the same interviewed expert, such a specialisation strategy has protected employment and production from the ex-Fiat dissolution, as the supply chain partly separated from the ex-Italian OEM, at least for some players with a diversified portfolio of clients and products. However, many plants, especially in Southern Italy are sole providers of Stellantis and thus subject to the decrease in production volumes of the group (Bubbico, 2023). Overall, Italian GVC specialisation is quite weak and dependent from an external core to activate internal production, while the production of components is under the threat of further delocalisation to low labour cost countries (Cresti *et al.*, 2023). Given such conditions, with the shift to electrification, a possible stop of the production of the cars is envisaged.

Potential job reallocations are claimed to be achieved by investing in the employability of the workforce in new emerging productions, such as the production of batteries. So far, European OEMs have mainly imported battery components from Asia assembly[5] and Asian manufacturers have only invested in the European assembly of battery components (Pardi, 2022). In the case of Italy, Stellantis plant in Termoli is expected to be converted into a

4 ANFIA Data on recent trends in production: https://www.to.camcom.it/sites/default/files/studi-statistica/Slide_Osservatorio_Auto_2023_ANFIA.pdf ; https://www.to.camcom.it/sites/default/files/studi-statistica/Osservatorio_Auto_2023_Rapporto.pdf

5 Gigafactories in Europe expected to produce batteries in the next future are Northvolt, Sweden (for more details see: https://northvolt.com/manufacturing/) and Volkswagen Group, who is planning to build six gigafactories in Europe (for more details see: https://www.volkswagen-group.com/en/strategy-15955?query=).

gigafactory in joint venture,[6] however, it is still producing combustion engines (Bubbico, 2023) and no clear sign of conversation has so far been visible.

Given the status of the sector, the institutional response in Italy emerges as weak and untimely. A Board of coordination between social actors and the national government ("*Tavolo Sviluppo automotive*") to increase the competitiveness of the sector was only established in November 2023 according to ANFIA (*Associazione Nazionale Filiera Industria Automobilistica*). In the meanwhile, trade unions have requested a comprehensive industrial policy plan on public and ecological mobility from 2020 onwards.[7] However, a coordinated social dialogue institutional setting is missing, with scattered and non-coordinated initiatives proposed by the single actors without a clear coordinated plan to face DAD.

With reference to Digitalisation and Automation, the main policy intervention has been the National Plan on Industry 4.0. The policy dates back to 2017 and was renewed in the following years aimed at spurring private investments in digital technologies. A more recent version of the plan is "*Transizione 4.0*"[8] with 13 billion euros funded by the National Recovery and Resilience Plan. The plan was however mainly based on fiscal deductions, credits to investment in new capital goods, tangible and intangible assets. The impact has been limited on company decisions and sectoral technological upgrading as the majority of firms used the public fundings to invest in ICT security rather than advanced digital technologies. In addition, firms investing in Industry 4.0 technologies were already planning to do so, and rather than allowing for a national upgrading it, favoured already high-specialised production workplaces located in the North of the country (Cirillo *et al.*, 2021).

In a similar vein, policy interventions for the decarbonisation process of the automotive sector have been targeting the transition mainly by tax exemptions and purchasing bonuses[9], rather than through the implementation of European regulations charging infrastructures and NRRP objectives. The Italian NRRP allocates €740 million to reach the goal of 31,500 public fast-charging points by 2030 (and 6 million electric vehicles), 3,64 billion for the renewal of bus fleets and green trains.[10] However, the NRRP does not envisage ad-hoc policies to guide the development of the technological and organisational transformation of the automotive sector, nor to tackle the employment effects of the transition. In fact, the relation between produced cars and new registrations in Italy in 2022 stand at 36.9%, while

6 Stellantis is building three gigafactories, one in Italy, one in France and one in Germany, by the joint venture with Total Energy and Mercedes-Ben. The gigafactory in France has been inaugurated in Billy-Berclau Douvrain in France the 30th of May 2023. More details can be found here: https://www.stellantis.com/en/news/press-releases/2023/may/stellantis-electrification-transition-in-full-swing-with-first-acc-battery-gigafactory-inaugurated-in-france

7 National event organized by metalworkers trade union to discuss the future of the automotive sector in 2020: https://sbilanciamoci.info/la-giusta-transizione-per-la-mobilita-sostenibile/

8 "*Transizione 4.0*" Italian Plan available at: https://www.mimit.gov.it/it/transizione40

9 Details are available on the International Energy Agency (IEA) website:
On the green mobility bonus: https://www.iea.org/policies/11499-green-mobility-bonus?country=Italy;
On the Ecobonus (subsidy for low-emission vehicles): https://www.iea.org/policies/6789-ecobonus-subsidy-for-low-emission-vehicles?country=Italy; https://www.iea.org/policies/8555-bonus-malus?country=Italy

10 Source *Osservatorio Nazionale Automotive*, available at:
https://www.anfia.it/allegati_contenuti/DOC/323_STUDIO%20OSSERVATORIO%20AUTOMOTIVE_BENCHMARK%20INTERNAZIONALE%202023.PDF

in Germany at 125%,[11] the clear sign of a lagging position of the country vis-à-vis the benchmark producer. A timid switch to hybrid and electric productions is coupled by the request for voluntary redundancies of Stellantis and even the closure of many plants in the supply chains as in the case of Magneti Marelli in Emilia Romagna (Cetrulo *et al.*, 2023).

In 2022, the law "*DL Energia*" (legge n.34/2022) has activated the "Automotive Fund 2022-2030"[12], allocating 8.7 billion until 2030 – 650 million in 2022-2024, and 1 billion each year from 2023 and 2030 for purchasing bonuses and investments for the development of an innovative and sustainable automotive production. In particular, 50 million in 2022 and 350 million euros each year from 2023 to 2030 are allocated on the "Development Contracts" ("*Contratti di sviluppo*") for the 70% on "Innovation Agreements" ("*Accordi per l'innovazione*") related to the transition of the automotive sector for the 30%

A broader plan for decarbonisation is the National Integrated Plan on Energy and Climate (PNIEC)[13] which will be approved by June 2024. The plan has been elaborated by the Ministry of the Economic Development, the Ministry of Environment and Land and Sea Protection and the Ministry of Infrastructure and Transport and it envisages the reduction of emissions in non-Emission and Trade System sectors by 43,7% by 2030 with respect to 2005; energy efficiency and security by the diversification of supply sources and optimisation of infrastructures and natural gas production; the empowerment of the internal energy market (electricity interconnection) and investment in research and innovation to increase national competitiveness. However, the plan lacks long-term measures to reach these goals and according to environmental associations is still relying on natural gas.[14]

Other policies in place relate to hydrogen strategy, both financed via the NRRP resources (as the conversion of disused industrial areas into hydrogen hubs)[15] and different alternative funding. In 2023 the Ministry of Transport allocated 24 million for the acquisition of hydrogen power trains and 276 million euros for the establishment of at least 10 plants for the refuelling of hydrogen along at least six rail lines by 2026.[16] Investments at the current stage still haven't materialised.

11 In 2022, Italy has produced 486,111 cars and registered 1,316,702 cars, while Germany 3,332,609 and 2,651,357 respectively. Source: ACEA https://www.acea.auto/files/ACEA-Pocket-Guide-2023-2024.pdf#page=88

12 Source IEA: https://www.iea.org/policies/16482-automotive-fund-2022-2030. For more details see the site of the Ministry of Entreprises and Made in Italy: https://www.mimit.gov.it/it/notizie-stampa/nuovi-incentivi-per-auto-non-inquinanti; and the ANFIA report referred to above.

13 PNIEC available at: https://www.mase.gov.it/sites/default/files/archivio/pniec_finale_17012020.pdf

14 Declaration of national ecological associations on the national policy of decarbonisation: https://www.legambiente.it/wp-content/uploads/2021/03/PNRR-Associazioni-su-decarbonizzazione.pdf

15 Source IEA: https://www.iea.org/policies/16985-converting-disused-industrial-areas-into-hydrogen-hub; for more details about the NRRP see: https://www.iea.org/policies/13577-national-recovery-and-resilience-plan-m2c2-renewable-energy-hydrogen-grid-and-sustainable-mobility ; https://www.italiadomani.gov.it/content/sogei-ng/it/en/home.html

16 Source IEA https://www.iea.org/policies/17400-green-hydrogen-production-for-rail-transport; for more details see the Ministry of Infrastructures and Transport website: https://www.mit.gov.it/comunicazione/news/trasporto-ferroviario-assegnati-300-milioni-per-realizzazione-impianti-per

Table 2. Italian national policy on D-A-D

Digitalisation-Automation	**National Plan on Industry 4.0** (2017)-**Transizione 4.0** (funded through PNRR)**:** ➢ Mainly based on credits to investment in new capital goods, tangible and intangible assets; ➢ ICT security instead of advanced digital technologies.
Decarbonisation	**National Integrated Plan on Energy and Climate** (to be approved by June 2024): ➢ Decarbonisation (-43,7% greenhouse emissions in non-ETS sectors by 2030); ➢ Energy efficiency and security (diversification of supply sources and optimisation of infrastructures and natural gas production); ➢ Empowerment of the internal energy market; ➢ Investment in research and innovation to spur national competitiveness. ⚠ Lack of long-term measures to reach these goals and excessive reliance on natural gas according to environmental associations. ⚠

4. Sectoral relevance of DAD – responses via collective bargaining

The national collective agreement (NCA hereafter) of metalworkers has been signed on the 5th of February 2021 by the sectoral employers' associations – *Federmeccanica* and *Assistal* – and the three main metalworkers' trade unions – Fiom-CGIL, Fim-CISL, Uilm-UIL. The agreement covers more than 1,5 million workers and will be in force until June 2024. In the Italian context, it represents one of the most relevant national collective agreements both because of its extensive coverage and its political role in the history of industrial relations (Bordogna, 2021).

Negotiations have lasted around 1.5 years with several moments of conflict. A four-hour national strike was called by the three trade unions in November 2020 in response to Federmeccanica's proposal of adjusting pay-scales to the inflation (near to zero during the negotiations) while granting room for wage bargaining to firm-level agreements only. On the contrary, trade unions were asking for a more significant pay rise on national pay scales to restore metalworker purchasing power in a context of structural wage stagnation (ISTAT, 2022).

The agreement provides indeed a wage increase of 112 euro on average over its period of validity, not far from the initial demand of trade unions. This amount, which is indeed much higher than the inflation adjustment, is explicitly presented as a provision adopted because of the new occupational classification. Trade unions were able to link the reform on occupational classifications, endorsed by employer associations with their own claims on pay-rise without triggering a more controversial discussion on wage setting and appropriate bargaining channels as defined by previous agreements (in particular by the "*Patto per la fabbrica*'' in 2018). Moreover, an important provision that turned out to be particularly effective in protecting worker bargaining power against the unexpected inflation spike has been the introduction in this NCA of a "safeguard clause". This clause establishes that each year by the month of June, the pay scales defined by the agreement will be adjusted based on the actual inflation as measured by IPCA net of energy imported goods (Pianta, 2023). This

clause is meant to partly counterbalance the historical weakness in the capacity to protect wages from inflation erosion, due to the IPCA indexation process introduced in 2009 that excludes energy costs from the calculation (Maccarrone, 2023).

However, the novelties introduced by the NCA do not regard only wages, but also a new occupational classification system replacing the one introduced in 1973 (the so-called "*inquadramento unico*" due to the introduction of a unique classification for blue-collars, white-collars and managers). This reform has been hailed as an important step by all social actors, spurred by the necessity of accounting for the structural transformations of the sector, the recognition of new job profiles emerging in the labour market, and the requirement of digital competences for the entire workforce. Moreover, the new classification has substituted the old taxonomy based on 8 levels (from 1 to 8) and 2 intermediate levels (3S and 5S) with a scheme of 9 levels based on 4 occupational domains: 1) operational roles (D1 and D2); 2) specific technical roles (C1, C2, C3); 3 specialist and management roles (B1, B2, B3); 4) innovation and change management roles (A1). Each domain has a specific description of roles rather than tasks ("*declaratorie*"), declined across the different levels based on multiple criteria that relate not only to the degree of autonomy/hierarchical responsibility and technical specific competence (already included in the previous classification), but also to the endowment of soft skills, polyvalence, multi-functionality and propensity towards continuous improvement. Several issues remain unclear, such as the effective mobility across different roles and the risk of an increasing individualisation of the job relation (Dorigatti and Rinaldini, 2023). Nevertheless, the concrete application of this reform is still under way and a national joint commission has been established by the NCA to manage the transition towards the new system.

Historically, in the management of the digital transition first and in the ecological transition later, trade unions were only consulted through the instrument of technical or crisis boards, but were not involved in the planning and definition of public policies. Despite the fact that trade unions have promoted their vision on issues such as Industry 4.0, presenting their specific plans and working with the employer organisations on an industrial relations reform pact (called the 'Factory Pact') signed in February 2018, with the aim of steering industrial relations towards a participatory approach deemed necessary to address and implement technological transformation processes (Gasparri and Tassinari, 2020).

Turning to the latest NCA, the main provisions addressing the adoption and diffusion of new technologies are mainly contained in the section of the agreement devoted to industrial relations. A national joint observatory is granted with the mandate of carrying out some analyses on social, productive and economic sectoral dynamics related in particular to organisational change and the diffusion of Industry 4.0. technologies. Specific information rights are granted to trade unions present in companies with at least 50 workers in case of substantial production changes concerning the adoption of new technologies and the work organisation models. Moreover, when discussing a continuous training of workers, a certain emphasis is put on the crucial role that learning has in allowing workers to deal with the challenges related to technological innovations and the consequent transformation of work for what concerns digital skills. For example, a specific program ("*@pprendo*") is devoted to apprenticeships to ascertain and develop apprentices' digital competences while territorial commissions are promoted to develop specific collaborations with Universities and Competence Centres. Reference to digital technologies is also made with respect to the employment of female workers as one of the goals of the joint commissions on equal

opportunity (to be established in firms with more than 1000 workers) is to favour female employment in specific job profiles characterised by the use of new technologies. While the digital revolution is addressed in different sections of the NCA mainly linked to industrial relations, training and worker competences, no clear provision is found on the challenges posed by the just transition. Only one direct reference to ecological issues is advanced on the trade unions' right to be informed about the environmental impact of investment choices related to the establishment of new plants or the enlargement of old ones.

5. Case studies

The empirical analysis aims at detecting what is the role played by trade unions in the bargaining over the introduction of new technological artefacts, reorganisation processes and strategies linked to digitalisation and automation, and in addition to uncover the negotiation process over decarbonisation. While the former transformation (D-A) largely impacts upon the work organisation within the plant, reshaping the internal architecture and division of labour of the workplace, the latter (-D) so far mainly refers to the rearticulation of the final products. Our empirical enquiry relies on semi-structured interviews carried out in two plants both operating in the automotive sector. These productive facilities are differently positioned along the value chain. Case study 1, in fact, refers to a component manufacturing plant and a Tier 1 supplier located in Tuscany, while case study 2 refers to a high-end car manufacturer in Emilia-Romagna. Interviews have been carried out with union representatives, operators and foremen, as well as production, process and R&D engineers, covering both clerks' and managers' positions, and finally R&D and plant managers.

The two cases represent heterogeneous examples with respect to different criteria, as explained below.

(i) Degree of digitalisation and automation of the production lines – Case study 1 where automation and digitalisation are diffused but with a localised approach in the strategic implementation of new technological advancement, with respect to different departments and processes, vis-à-vis Case study 2 which is instead characterised by a high degree of digitalisation and automation technologies along the entire workplace.

(ii) Development of new products in relation to the decarbonisation process – where Case study 1 produces components for internal combustion engines (ICEs) and whose productive paths with respect to the decarbonisation transition are still undefined, while Case study 2 has started a gradual conversion toward hybrid products, albeit without a fully planned strategy of complete product electrification.

(iii) Workplace industrial relations – where in Case study 1 the industrial relations model emerges as more passive vis-à-vis digitalisation and automation, but able to propose some strategic actions to face the risk of mass redundancies recently experienced because of the transition towards BEVs production, while in Case study 2 workers' and trade unions' representatives play an active and crucial role in bargaining the introduction of D-A while less attention has been devoted so far to decarbonisation paths.

5.1. Case study 1

5.1.1. Brief history of the plant – Providing the context

Case study 1 refers to the Italian subsidiary of a company created in 2019 as a spin-off dedicated to e-mobility of a MNC involved in the production of various parts and components for the automotive industry. The plant develops and produces injectors for ICEs and it is one of the main suppliers of the key European and non-European OEMs. The history of this firm goes back to 1987, when a large MNC established an R&D lab for the development of an electro-injector in Tuscany. The area was considered strategic, endowed with skills and know-how due to the presence of universities and locally established automotive companies. The production started in 1992, while in 2009 the firm was acquired by a new MNC.

The plant has just overcome a prolonged crisis period which began in 2019 with the announcement a transition strategy towards e-mobility undergone by the parent MNC accompanied by a redundancy plan for 750 employees over the entire workforce of around 1000 workers in the following few years. This was part of a more general closure plan that included all subsidiaries active in the production of combustion components, with about 30,000 potential redundancies involving many sites of the MNC. The selected case represents an archetypal example of how supply chains manufacturing activities are, severely affected by the decarbonisation process when producing parts and components specific for ICE vehicles.

At the time of the fieldwork, the acquisition of this plant by a new multinational group that develops and manufactures components for electric and hydrogen vehicles was about to be finalised. The new ownership took an interest in the Tuscan plant to manufacture injectors for internal combustion engines, since the so-called brown trajectory is expected to coexist with the decarbonised trajectory in the near future. The firm will supply injectors especially for non-European markets, while starting to develop injectors for hydrogen vehicles and to expand into businesses other than private car mobility.

The firm has about one thousand employees, a small percentage of which are outsourced and are employed by the company to respond to peaks in demand. The firm is characterised by a low turnover (1%), being considered a good employer in the region. The plant mostly works on a continuous cycle, three shifts of 480 minutes, while production may stop for only some products. Union members are well over 40% of the entire workforce.

It presents a positive synergy with local institutions and universities and has developed collaborations with other local firms at the scope of R&D projects, electrification or hydrogen solutions. The Regional government seems to have played an important role during the transition phase towards the new ownership to avoid 750 redundancies.

In the following we shall present the results of the semi-structured interviews that have been conducted according to the scheme presented in the Technical Appendix, distinguishing the perspectives of managers, workers, and union representatives on the processes of digitalisation, automation, and decarbonisation at the workplace level.

5.1.2. The managerial and technical-professional perspective on digitalisation, automation, decarbonisation

The technical-professional perspective of this case study is provided by engineers holding managerial positions. Their main activities relate to R&D, process, product, and industrial engineering. Their pivotal tasks are data analysis, by the use of engineering and statistical software, and the coordination and organisation of teams of engineers and technical workers.

Over time, the introduction of new technologies, the increase of product complexity as well as the product-client and destination-client portfolio have determined an increasing complexity and transformation of the work organisation. The main technological and organisational changes derive from the firm's Industry 4.0 (I4.0) strategy. The I4.0 technologies introduced in the plant are Automated Guided Vehicles (AGVs) and collaborative robots (cobots) implemented on top of an already quite advanced degree of automation of production lines. Being products and processes quite interlinked, different vintages of assembly lines are present in the plant, corresponding to the respective products. The main driver of the I4.0 strategy is cost efficiency and the need to be competitive on the market. According to the interviews conducted, such competitiveness is achieved by the increase in the general level of skills over the whole production process, together with a progressive substitution of manual tasks in low value-added phases with automated processes. Harsh competition also occurs towards "sister" plants under the same MNC. For instance, the introduction of cobots has reduced the production costs so as to avoid the delocalisation of the fuel rail department to a plant in the Czech Republic that is closer to the final assemblers and records lower labour costs.

With reference to automation, cobots were introduced starting from 2017. Currently, they perform semi-automatic operations characterised by a low cycle time (below 10 seconds) and high-precision tasks. Production lines were planned with the cobots from the start, as introducing the right level of automation decreases debugs and time wastage. From a managerial perspective, the higher initial level of automation would also contain the risk of conflict with workers, because it would limit the need for technological replacement of the workforce at a later stage. Such a localised strategy of automation adoption is the footprint of the attitude toward digitalisation and automation of this plant. The introduction of AGVs – in the production area first, between the warehouse and the production area after – has implied the reorganisation of production lines in order to have enough space with an efficient and clean layout. The interviewees state that lean manufacturing methods have been crucial for the implementation of I4.0, to optimise production processes first, with the plant to later be automated. For instance, warehouse locations have a rational layout that follows material and worker flows, needed for the adoption and efficient use of AGVs.

The main digitalisation-related innovation has been the creation of a *business data warehouse* through the implementation of a Manufacturing Execution System (MES). Data availability, the speed of computation for data analysis and the level of integration of data have been improved: the machines can pursue quality controls with respect to the production process criteria by integrating different instruments of the MES (i.e., production program, data loaded through barcodes, etc.). Another digital tool that has been developed is a software to recognize flaws in the injector performance. The increase in digitalisation had no particular impact on worker tasks, as worker interaction with the MES is limited to the control of production parameters.

The introduction of digital technologies was accompanied by the implementation of the '5S best in class' method (Sort, Straighten, Shine, Standardise, and Sustain) derived from lean manufacturing. This system was applied to all departments, not only in production but also in management, with the aim of creating routine mechanisms aimed at process optimisation. The driver of digitalisation is in fact the continuous improvement of the production processes, by eliminating waste within the processes (MUDAs), according to a classic lean manufacturing approach. AI image recognition and AI algorithms have been recently applied to identify and to predict wear and tear of components, data and text mining, data simulation and analysis. However, its use is quite localised in some specific phases of the assembly line.

One of the organisational changes has been the creation of the Chief Digital Officer (CDO), in charge of digitalisation, I4.0 technologies development and adoption, and the coordination of a team of software engineers. To improve autonomy of the plant in the programming of highly automated production lines, a maintenance area software has been established and some qualified employees have been trained to become software specialists. Each department has a digital lean coach who communicates to the digital chief officer's team the improvement that needs to be addressed by a bottom-up approach within a first level strategy defined by a steering committee. Each technological change is preceded by the coaching of the "Education and Training" unit. Management claims that this strategy can improve employee acceptance of new digital standards and technologies thanks to the direct involvement of workers. Nevertheless, worker involvement is limited to cases where the coach can benefit from operators' tacit knowledge for the purpose of the creation of new standards.

According to the interviewees, the introduction of cobots and AGVs have rather transformed routinised work more than substituting it. Manual low value-added tasks have been replaced, thus operator work is more concentrated in higher value-added tasks. Workers whose tasks have been substituted have been reallocated within the plant. However, the increase in production has not been matched by a proportional increase in employment – meaning a general improvement in plant efficiency – and some positions are expected to be completely replaced to cope with the high labour costs. In general, internal redeployment is facilitated by the high level of job rotation within departments, which has been largely implemented to meet production flexibility needs. The firm has pushed on an internal training strategy on the required skills, as with the CDO, promoting internal labour market and the limited hiring of new personnel. For managerial and professional figures such as R&D, process and product engineers, the labour process has changed with respect to the higher availability of data and data analysis. For administrative figures, software saves time for them to do their "actual job". Such thoughtful and widespread technological adoption seems to be the outcome of the interaction of corporate culture, managerial strategy and capabilities.

Before the takeover of the firm by the new MNC, the local management, in agreement with the trade union, developed a plan to convert the plant to the production of components for BEVs. The aim was to convince the parent company to change its decision to close the plant and instead to include it in its transition strategy towards electric mobility. According to the interviewees, the conversion of the plant would have implied a reorganisation of the production lines and the production would have been set to initial low volumes. The main challenges would have been the shift to the production of BEVs components that are not yet standardised as much as injector production is. Currently, the firm is also developing a prototype of an injector for hydrogen, and it is willing to develop engine components for

hydrogen and alternative fuels, also accessing institutional funds (e.g. from the National Recovery Plan and other regional funds). Although Despite the huge R&D efforts on electrification of the main OEMs to which the company is related, the interviewees state that these players have shown some interest in exploring different injection solutions as with e-fuels. A new carbon neutral market niche could be developed, given structural problems common to many players to undertake the electrification strategy.

Management reports of having good dialogue with union representatives. Nevertheless, the latter are only passively informed of the introduction of new technologies. Collective bargaining at the plant level does not deal directly with technological innovation, but only indirectly with respect to investment plans. Employee involvement schemes are the usual devices related to lean production systems and HPWPs, such as the 5S tag system by which workers can signal and provide suggestions to change standards or to improve procedures, verbally or via digital tools. Team meetings with workers about quality and safety are organised but not on a fixed schedule.

5.1.3. The worker perspective on digitalisation, automation, decarbonisation

The interviewed workers are shift-supervisors from different departments of the plant: the fuel-rail, the clear room and the components production. On the production lines of the fuel-rail department, the shift-supervisor oversees 10 lines with 5 operators on average and cobots for each line; in the clear room he shift supervisor oversees 3 main lines and other smaller ones with 16 operators and 3 maintenance workers; the component department is supervised by two shift-supervisors, since it comprehends a main area and two smaller ones, each shift leader oversees around 25 workers and 35 machines, while each operator controls two machines, three if there is a cobot.

The introduction of new technologies has helped workers in their daily tasks, however they still need time to adapt to new standards of new machines and to the complexity of new products. The main difficulty at first was to understand and fix errors, given also the fact that they received limited support. The cobots allow workers to avoid high-precision manual tasks, however the presence of nebulised oil may create problems with the cobots' cameras and sensors; AGVs replace operators in moving materials to production lines, but initially did not work well due to the lack of space for AGVs to move properly. AGVs are helpful especially for workers in the fuel rail department, where they wear specific clothing that must avoid contact with the outside and needs to be removed in order to acquire materials.

Automation processes were mainly targeted at assembly operations in order to reduce cycle times and sources of possible damage and breakdowns resulting from manual operations. When the lines were partially automated, they had on average three machines and five workers on each line during each shift. Automation has increased the number of machines overseen by each operator and surplus workers were redistributed among the various shifts. Automation and digitalisation processes have had an impact on worker tasks by reducing the manual component of their work, which is now limited to the technologically-assisted servicing of machinery, and by increasing the cognitive component related to the control of machinery and production parameters. For shift-supervisors, staff management and paperwork has increased. The plant's workforce is also subjected to a regime of very high internal job flexibility, and can shift from one workstation/department to another.

Thanks to union agreements, the plant's workers are all hired at the third level of the national collective agreement and then quickly move up to the fourth. While this form of egalitarianism allows plant operators to have higher salaries than the industry average, it does not allow adequate forms of career progression for the most qualified workers. However, vertical professional mobility within the plant is possible and any vacancies are communicated through a career map. The evaluation of workers takes place once a year and is discussed in dialogue with shift supervisors, if necessary. Workers can suggest improvements in production line organisation and machine standards, but no reward is offered.

The workers' perspective on the decarbonisation process is clearly linked to the long-standing threat of closure and mass redundancies at the plant. Together with their union representatives, workers mobilised at the announcement of the restructuring plan in 2019 with almost all of them going on strike for four consecutive days. The takeover of the factory by the new multinational made it possible to guarantee employment continuity in the medium term, while abandoning the plan to convert the plant. Although many are convinced that there is still a future for combustion engine production, uncertainties remain about the long-term future of the factory.

5.1.4. The union perspective on digitalisation, automation, decarbonisation

Within the factory, the most representative trade union is Fiom-CGIL, which elects most union delegates and has the largest number of members. However, other unions are also present in the plant, although they play a lesser role in the labour relations system.

The strength and degree of maturity of labour relations and social dialogue in the plant are quite consolidated. Over the last 25 years, management and trade unions have negotiated on a wide variety of issues (wages, working hours, recruitment, improvements in competitiveness and productivity, parental and medical leave, guarantees for precarious workers, etc.). Nonetheless, the union has shown that it can occasionally turn to more adversarial relations, leveraging the support it enjoys among the plant's workforce and its proven ability to mobilise workers in case of need. This threat is particularly credible in the eyes of the management, especially since production interruptions are particularly burdensome in a lean management. All the interviewees stress the effort of the local organisation to develop *inclusive* collective bargaining, defending and representing the interests of temporary workers or employees in outsourced activities (such as logistics, cleaning, canteen, etc). One of the clearest demonstrations of this tension towards a general involvement of the workforce employed in the plant is the possibility of electing trade union representatives from temporary or outsourced workers. While on the one hand the union is committed to building internal solidarity, seeking, for example, to negotiate pathways for the progressive stabilisation of precarious workers, on the other it manifests a corporatist attitude, taking care that worker demands are compatible with the profitability of the company and the efficiency of the plant. Nevertheless, there is a general interest in pursuing trade union democracy and worker participation in the definition of bargaining platforms, as is the tradition of the majority union within the plant.

The union is intensely involved in bargaining over working hours, pay systems (mainly wages, performance bonuses, and worker contractual qualification levels), as well as welfare benefits and leave schemes for medical examinations or to allow workers with children and relatives to care for them beyond the normal contractual leave. One of the union's main

achievements is the reduction of working hours while maintaining the wage level, thanks to the introduction of one or two additional teams in the shift system. In fact, this plant is one of the few in the national panorama that in case of peak demand can produce on a continuous cycle with a shift system organised with 4 or 5 teams. However, this reduction was achieved by using part of the individual annual paid leaves. Not all negotiations involve formal bargaining but are the result of an ongoing and fruitful dialogue with local management. In addition, at the time of the interviews, the union representatives, aware of the forthcoming change of ownership, managed to pressure for the stabilisation of 20 agency workers to cope with the expected workforce turnover.

Maintaining employment levels and possibly increasing them is also at the centre of trade union negotiation activity. This aspect is linked with technological development in two ways. On the one hand, the introduction of automation (mainly cobots and AGVs) has certainly made it possible to achieve the same production volumes with considerably less employees (in certain lines passing from 30 to 5-6 operators). On the other hand, it allowed a given level of cost competitiveness to be maintained, finally preventing the relocation of some production lines in plants located in Eastern European countries, thus avoiding redundancies. On the contrary, the assignment of new lines to the Tuscan production site and the introduction of a new team in the shifts allowed for an increase in the workforce.

The main technological changes took place from 2010-2011 with the early version of Industry 4.0 plans. However, digital tools have been present at the production site since the early 2000s for warehouse and order management (in this respect, they refer to SAP). Union representatives state that there is no room for *ex-ante* negotiations on the introduction of new technologies, reorganisation of production lines and changes in production volumes, although the union is constantly informed about these changes through continuous exchanges with management. However, once informed of technological changes, union representatives closely monitor safety and ergonomic aspects. One of the union representatives interviewed, who is also one of the employee representatives for safety ("*Rappresentate dei Lavoratori per la Sicurezza*", RLS), reports that such monitoring is useful for identifying potential risks and implementing improvement actions. Finally, although technology does not fall within the scope of firm-level formal collective bargaining, there are spaces for informal negotiations on the use of technology, through which union representatives seek to ensure, for example, that digital devices are not used for performance monitoring. The union representatives, for instance, aware of the control risk arising from the use of digital devices such as shop-floor software, have reached a verbal agreement with management that information collected by such software cannot be used against workers. However, no formal agreement on the issue was negotiated.

During the last few years of turmoil over successive changes in ownership and crises related to the transition to e-mobility, the local union was able to establish a relationship with local and regional institutions. This allowed the signing of a Memorandum of Understanding with the Region of Tuscany and the assignment, by the Minister of Economic Development, of the status of 'area of complex crisis' to the territory of the town where the plant is located. This status facilitates the provision of social benefits and public contributions for the financing of new industrial plans. Moreover, the convergence with local political institutions, urged by the union, enabled the allocation of funding for the training of about a hundred mechanical engineers on electrification-related topics by the nearby university.

However, it should be noted that all these initiatives were ultimately not conclusive in preventing mass redundancies, which were only avoided thanks to the takeover of the plant by a new MNC in 2023. However, it cannot be ruled out that the union's efforts, in particular to obtain 'area of complex crisis' status, could have played some role in facilitating this takeover.

Finally, one of the union representatives interviewed is also a member of the European Works Council (EWC). According to him, the EWC meetings were useful in exchanging information with union representatives from other European sister factories on working hours, wage levels and tax regimes, to calibrate local demands. They also represented opportunities for questioning representatives of the parent company. This union representative tried to promote a joint collective action at EWC level to obtain more information on the company's strategies regarding the transition to e-mobility and to counter the restructuring plan, but the attempt failed. No demands or claims could be solved by the parent company, and this weakened the purpose of the council. At the same time, no joint action was taken by the union representatives of the various plants even when the parent company presented its restructuring plan, which envisaged 30,000 redundancies worldwide due to the abandonment of production for internal combustion engines.

5.2. Case study 2

5.2.1. Brief history of the plant – Providing the context

Case Study 2 refers to a high-end car manufacturer, a historic firm founded in 1963 in the region of Emilia-Romagna, where both the headquarter and the only production plant have been established since then. The firm was bought by a multinational OEM in 1998 and actually employs 2100 workers. Currently, there are also 600 interim employees working in the plant, and more than a half of them will be employed by the firm within a few months, as stated by the new collective agreement signed in January 2024. Furthermore, there are another 1000 outsourced workers employed in the plant (such as 400 employees at the logistic company located within the firm premises).

The firm is characterised by highly developed industrial relations while the rate of worker unionisation has historically been around 90% for blue-collar workers and 15% for white-collar workers. Those employed in the outsourced logistics company are also unionised and in recent years have started a process of collective bargaining.

The firm is on the technological frontier for what concerns the adoption of Industry 4.0 technologies. In the last two decades, it has been subject to a major technological and productive transformation. Production volumes have increased considerably, also thanks to the production of the first super-sport SUV starting from 2017. From a dimensional point of view, the plant has been expanding with the creation of new buildings devoted to production, logistics and administrative activities. The workforce has increased, moving from around 800 workers in 2014 to 2100 in 2023, with a balanced composition between blue- and white-collar workers.

In 2023, the first plug-in-hybrid vehicle was launched and it is the first step of a gradual transition to the decarbonisation of production. The target is to move to a fully hybrid production by 2030 together with the introduction of the first BEV model in 2028. However, no unique electrification strategy has been planned. The firm stays open to different technological solutions, such as alternative fuels. Over time, the transition will take into

account CO2 emissions related to the product life cycle, not only emissions from the use of the product.

5.2.2. The managerial and technical-professional perspective on digitalisation, automation, decarbonisation

The managerial and technical-professional perspective of this case study is provided by coordinators of R&D teams, with electronic and aeronautical engineering background and experience with electric components, engines and powertrain; department heads, who manage the production line, together with operator training and coordination.

The firm produces three products, launched in 2014, 2017 and 2023 respectively. Wireless AGVs move the car from one station to the next at the end of the takt-time, while other AGVs move materials and components to the workstations. The main organisational changes occurred with the setup of the new production line in 2017. Differently from the previous lines which were fixed on the ground, the new workstations are characterised by equipment and robots hanging from the ceiling to allow for modularity and flexibility. Secondly, in 2017 an integrated Manufacturing Execution System (MES) was introduced and developed. Before 2017, there was one computerised shop-floor management system for each productive area, thus six/seven systems overall, with data circulating mainly on paper, screens in each workstation to guide operators, but without integration across the different systems.

The MES is the main digital technology developed in the last few years by the firm, integrating all communication systems and allowing a higher availability of data. More software has been developed for the prototype phase of the R&D area. According to the department head interviewed, MES is more user friendly than the previous systems. The company has followed a gradual process of adoption and implementation of MES, starting with a more restricted use of the system, and progressively enlarging the domains of applications to give workers the time to get used to the new technology. For reasons of safety and standard compliance, the firm is legally obliged to mention that all operations planned by the MES have been executed. The MES collects all kinds of information related to the production process, to assure the traceability of all operations pursued on each vehicle and by each machine. Any incorrect operation is recorded as a flaw. Even though through the MES it could be possible to have a detailed overview of the work of operators, information concerning individual worker performance and productivity are not object of analysis thanks to both institutional regulations and a firm-level collective agreement that explicitly rules out any form of worker surveillance. The latest product launched in 2023 is a plug-in-hybrid car. The production line is flexible, the vehicle moves on an AGV from each station to the next at the end of the takt time. The line is completely digitalised and connected to the MES. The necessity of introducing a new hybrid model has pushed the R&D department towards a process of organisational change. The interactions of the R&D department with production, quality and pre-series departments have been intensified. Cross-disciplinary figures have been established to act between the project management and the R&D internal development.

At the same time, one aspect emerging from the interviews is that electrification increases the weight of cars by about 400-500 kilos due to a large cooling system for the batteries and components, also due to the powertrain complexity. This raises some doubts about the effective *greenness* of this type of vehicle. Digital test simulation tools are helping to manage the product complexity, nevertheless digitalisation is claimed to be necessary regardless of electrification: a more intense use of software, a higher degree of integration and

interconnection across components, and new requirements for cyber and safety security are present in new vehicles irrespective of electrification.

The management of high-voltage parts within the car brings the necessity of new requirements that were not in place in the manufacturing of ICE cars. To reduce safety risks related to the electro-conductivity of some components, several novelties in the production process have been introduced. For instance, if a vehicle needs reworking, employees need to be trained on how to disassemble the vehicle under complete safety. Furthermore, an expert from the Plan of Security and Coordination ("*Piano Sicurezza e Coordinamento*") must be called to secure the car any time a rework is needed. The training of workers involved in the production of the hybrid vehicle has focused on functional safety with the high-voltage of the electric engines, other than the assembly of new components in the front room of the car.

Because of the increased complexity of the production of the hybrid vehicle and of the rising production volume of the entire range of products, employment has grown both on the R&D and on the production side. For instance, in 2017 each workstation of the assembly line had no more than two workers, while the addition of the hybrid car will require one additional operator in the new hybrid assembly line. The employment demand has been met by training internal employees on hybrid development and production, on the capabilities of dealing with suppliers of electric components and internalising R&D activities, previously outsourced to external consulting. External figures have been hired to bring some specific, hard to find skills.

For what concerns the potential impact of the hybrid production on the composition of the supply chain, the interviewees report that among the electric components and technologies required, they are not currently experiencing significant differences. Nevertheless, they believe that the quality of components is decreasing because of the lower know-how of suppliers shifting from ICE to electric components. Moreover, the turnover across producers of components is high because of the high uncertainty with respect to market regulations and consequent redirection of technological development. Despite such transformations of the supply chain, the geography is not changing. Suppliers are manly European, for batteries as well, except for the cells that can only be assembled by European suppliers while being produced globally,as for magnets that are produced mainly in China.

The union is strongly present in the technical-professional departments of the firm. For instance, R&D engineers cover the role of union representatives. Negotiation issues specifically related to this departments are somewhat different from the ones concerning production. In the R&D department, the focus is on promoting higher work flexibility, capability recognition, efficient tools and team size to achieve targets demanded by the firm.

5.2.3. The worker perspective on digitalisation, automation, decarbonisation

The workers interviewed are from the finishing department, where they check the cars before delivery. The workforce in this department has strong experience in quality control which is performed manually with the aid of specific tools. The takt-time has evolved, together with the increasing production volumes and the innovations in the sphere of work organisation and technology. The department has also gradually moved to MES, as in the case of the assembly line. In general, a process of reduction in the takt-time has been observed. For instance, a worker with several years of seniority states that when entering into the plant the takt-time was 50-60 minutes, with one operator checking the interior and

another checking the exterior of the car, whereas now, it's just 19 minutes. Nevertheless, from the worker interviews, it has emerged that the takt-time started to be reduced before the introduction of the MES, not because of any other new technology, but rather because of the higher production volume. As a result of new increases in production volumes, workers expect the takt-time to be further lowered to 15 minutes.

In each workstation related to the 2017 and 2023 production lines, operators log into the MES by means of an electronic bracelet. Thus, they access their work file and activate all equipment for the functions established by the MES. In this respect, the MES has simplified operator work. The older production line envisaged traceability of operations and standards only at the end of the line of the finished car, thus workers needed to know each operation extremely well as they had no serial guideline in each workstation, as in the case of the MES assembly line. Consequently, with the introduction of the MES, the labour process has become more standardised with the risk of being less cognitive.

MES also represents an important learning tool, as different training activities are performed through it. In fact, workers identified as trainers can log into the system with a new incoming worker for a training period of two weeks. After this training on the job, which includes the assembly of about 150 cars, the new worker performs an online training course and if passed, will be qualified to work autonomously with the support of the MES.

5.2.4. The union perspective on digitalisation, automation, decarbonisation

Within the factory, the most representative trade union is Fiom-CGIL, which collected 97% of the votes in the last union elections (2021), consequently electing all union representatives. Almost all union members in the factory belong to this union as well. Also in this case, we are dealing with a company with extremely developed and deep-rooted labour relations, where bargaining between the union and management takes place almost across the board, touching on a wide variety of topics, which are discussed not only in negotiations for the renewal of the company-level collective agreement, but also in specific bilateral joint commissions in which management and union exchange views on an ongoing basis.

Collective bargaining and social dialogue are particularly developed on the topic of technological innovation. Union representatives are able to negotiate new investment plans and, as mentioned above, have been successful in placing contractual limits on the use of new technologies for performance monitoring. For instance, the MES has been developed by a team including union representatives in different capacities. As a result, the union has been able to shape the technology from the very conception phase, avoiding surveillance risks and ensuring a high degree of transparency with respect to the use of the data collected. Nevertheless, with the introduction of these innovations, some union representatives note that working rhythms have been intensified, even if the average takt-time remains well above the industry standards.

Concerning health and safety, it is worth recalling that the bilateral commission on health and safety has been one of the first commissions introduced in the company in the early 2010s, together with the one devoted to work organisation, time and methods. Indeed, several bilateral commissions have been established in the company in the last two decades as participatory institutional tools and meet regularly to discuss and introduce specific measures on each domain of interest (work organisation, health and safety, training and job titles, performance premia, canteen).

Another aspect that emerges from the interviews with union representatives is the focus on the need to improve employee training. This is why in the last years union representatives have advocated the establishment of a "quality" school, providing internal training to workers in order to be moved to the quality department. Unfortunately, the latter proved to be ineffective, and many workers failed to pass the examination (the reasons for this failure are still unclear).

Concerning the decarbonisation process that is affecting the entire automotive sector, some union representatives show a cautious perspective on the radical nature of such transition. While recognising the need to create ecologically sustainable products and productive processes, they emphasise the need, on the one hand, to defend employment in the sector, and, on the other hand, to look at the entire production cycle of electric/hybrid cars in order to assess their true ecological sustainability.

Finally, in January 2024, the new firm-level collective agreement was signed by social partners after several months of bargaining. This agreement introduces important arrangements concerning working time that will lead, on average, to a reduction of 22 working days per year. According to union representatives, this measure will ensure an improvement of working conditions and a better work-life balance. The agreement also includes several provisions on wage increase and performance premia, together with the recruitment of 500 permanent workers between July 2023 and December 2026, the establishment of a bilateral commission concerning outsourced services and an expansion of individual worker rights such as parental leave, and specific measures against violence at work, etc.

Despite such an extensive collective bargaining, worker representatives appear quite passive with respect to corporate decisions on the decarbonisation path. The shift to electrification does not seem to constitute a matter for negotiation differently from the Industry 4.0 strategy and the introduction of new technologies more generally. The lack of such interest is perhaps due to the widespread opinion, also shared by many of the technical-professional figures interviewed, that the electrification strategy is inherently limited in terms of the type of production carried out in the plant, and that other solutions should be explored

The main results of the case studies are summarised below.

Table 3. Main results of case studies

Case-Study 1 *Automotive components manufacturer*	**Case-Study 2** *High-end car manufacturer*
Digitalisation-Automation: introduction of new technologies	**Digitalisation-Automation:** introduction of new technologies
➢ **Ex-ante**: no room for negotiation, union representatives are only informed by established practice and continuous exchange with management.	➢ **Ex-ante**: strong bargaining power, MES has been co-developed by a union representative; gradual adaptation to MES functioning.
➢ **Ex-post:** monitoring of safety and ergonomic aspects, detecting potential risks and suggesting improvement actions; digitally collected data cannot be used against workers (verbal agreement).	➢ **Ex-post:** monitoring of safety and ergonomic aspects, detecting potential risks and suggesting improvement actions; digital technologies cannot be used for surveillance purposes (formal agreement).

Decarbonisation	Decarbonisation
➢ Risk of plant closure due to the parent company's transition to electric mobility production. After 4 years, acquisition by a multinational company interested in pursuing the ICE injector business; ➢ Developing prototypes of injectors for hydrogen vehicles; ➢ Strong union role in avoiding mass redundancies.	➢ Transition to hybrid vehicle production but still no full electrification strategy. No negotiation with union representatives on this matter; ➢ Hybridisation of the car makes the process more complex and also more exposed to electrocution risks for workers; ➢ Acquisition of new external professional figures linked to electrification.

6. Findings

According to this report, the following series of findings have emerged.

- DAD processes actually pose new challenges to the automotive sector at various levels of analysis, from macro, to sectoral, to micro-ones. Such challenges involve many realms that go from country level production capacity, industry level positioning in the external market, workplace level transformation due to processes of restructuring, as well as closures or orientation versus the new decarbonisation paradigms.
- DAD processes are not necessarily coupled: while automation and digitalisation of workplaces represent a necessary process of internal upgrading to remain competitive into the market, decarbonisation is completely reshaping the industry because of supply chain rearticulation, and the necessity to develop new products and to gain both new clients and new suppliers.
- National level policies on automation and digitisation have been mostly oriented to favour already established players in the market and were meant to provide fiscal deduction and credit to foster investments.
- Decarbonisation policies for the automotive sector are not clearly defined, together with the lack of a strong orientation toward public mobility.
- The erosion of investment plans and new product design of the most important player in the Italian automotive industry, Stellantis is crystallising the positioning of Italy as mostly a country of Tier 1 and Tier 2 suppliers, closing the production of final cars if not for the segment of premium.
- Trade unions have embraced strategies to negotiate digitalisation and automation which however look to be quite timid vis-à-vis the main risk associated with work intensification and saturation.
- The new metal-worker agreement goes in the direction of rearticulating hierarchical levels in terms of roles assumed in the work process (technical, operational, relation) with the attempt to incorporate the transformation of skills and functions executed by workers because of the digital transition.
- Attention to training schemes from trade unionists has been paid at all levels of negotiation, while the lack of action is spotted with respect to the possibility to ex-

ante define the boundary of use of the technology, apart from limiting individual control.

- Decarbonisation is currently the subject of neither bargaining nor other forms of social dialogues at all levels of interaction. No macro-level plan is identified with reference to what must be produced in the context of the just transition. So far, the switch toward hybrid vehicles has been done mostly to remain competitive in the market rather than to achieve actual decarbonisation goals.
- The need for new job profiles with competences on data analytics, software management and electrical engineering has emerged and is faced by both practices of internal labour market with processes of reskilling and external hiring of new categories.

The analysis has put forward a series of interconnected risks related to the DAD processes. In particular, productive national asymmetries may be deepened by countries' heterogeneity in capabilities to address the digitalisation, automation and decarbonisation challenges and in the public intervention path. The core vs periphery structure of the automotive sector may be exacerbated. While low value-added labour-intensive assembly activities and the supply of Tier1 and Tier2components are concentrated in the periphery, high value-added and innovative activities are located in plants close to the OEMs headquarters in core countries. With reference to Italy, given the increasing specialisation in the production and supply of components, the dissolution of ex-Fiat and the weak institutional response to the challenges of the sector's restructuring, Italy risks being at the periphery in digitalisation, automation, and decarbonisation processes.

As stated by Bubbico (2023), despite the availability of skills in R&D activities in the Italian Stellantis plants, reorganisation processes seem to be favouring R&D departments in France and in the US due to the delay of R&D for electric production in the last years by the FCA. Similarly, Magneti Marelli was the only Italian supplier of components to play a crucial role at the international level, while today it has lost its positioning with the sale of some of its business units to the American financial fund KKR in 2018 and the consequent employment reduction. Magneti Marelli has moved investments in the electrification of production previously planned to be in Bari to a plant in Germany, while at same time, Bosch is closing the plant in Bari (with the risk of 620 redundancies and no conversion plan) while investing in the hydrogen and electric strategy outside of Italy (Bubbico, 2023).

The NRRP has represented a new push to face the restructuring of the sector. However, the Italian NRRP is based on an incentive scheme and horizontal industrial policy perspective without any direct public intervention to achieve productivity and employment growth. At the same time, the lack of industrial policies previous to the NRRP may undermine its efficacy, while positive externalities and possible synergies from past interventions may have reinforced the NRRP if in place. The lack of innovation and of suitable labour policy interventions may force the Italian automotive industry to lag and to be subject to the shortcomings of the automation and decarbonisation of the sector.

Given such panorama, propose a coordinated EU level industrial policy in the automotive sector which should at the same time work at the scope of rebalancing EU internal productive capacity, softening asymmetries along GVCs, and at the scope of pursuing a just transition. In this respect, the direct involvement of trade unions to shape such industrial policy is pivotal, because the latter represent a true agent of change whenever actually mobilised in the

workplace. Trade unions should be able to directly plan and propose strategies to assess what must be produced and how. In addition, without an integrated perspective on mobility beyond a private one, the goal of CO2 emission reduction cannot be reached. At this scope, trade unions should also be actively engaged in discussion and social dialogue schemes on public mobility.

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8. Technical Appendix

8.1 Interviews for each Case-Study

Case-Study 1	**Case-Study 2**
11 interviews	*9 interviews*
• Technical-professional workers & Managers (n. 6): 1. CEO 2. Human Resources Manager 3. Focus Factory Manager 4. Head of RD-engineering department 5. Head of Production Group department 6. Chief Digital Officer	• Technical-professional workers & Managers (n. 2): 1. RD-coordinator of electric components 2. Assembly-line coordinator
• Union representatives (n. 2): 1. Line operator, union representative 2. FMEA specialist, union representative 3. Former line operator and union representative, now full-time union official	• Union representatives (n. 4): 1. Manufacturing Engineering employee, union representative 2. RD engineer, union representative 3. Line operator, union representative 4. Line operator, union representative and employee representative for safety
• Workers (n. 3): 1. Shift leader 2. Shift leader 3. Shift leader	• Workers (n. 3): 1. Team leader 2. Line operator 3. Line operator