Chapter 7
Technological and organisational innovation under Industry 4.0 – Impact on working conditions in the Italian automotive supply sector

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1. Introduction: research aims and summary of the impact on working conditions of current technologies

This chapter focuses on the main technological and organisational changes that are taking place in automotive supply companies located in Italy and the consequences these are having for working conditions.

As suppliers of parts and components to original equipment manufacturers (OEMs), these companies form part of a series of production networks which transcend national borders. The linkage with OEMs plays a decisive role, especially from the point of view of just-in-time supply practices: in this sense, organisational models (Lean Production extended throughout a fragmented production chain) as well as new technologies (Industry 4.0) are being implemented simultaneously to ensure close coordination and synchronisation within the entire production chain. Specifically, this encompasses: a) planning of production processes; b) transmission of production orders; and c) control of the progress of production in order to meet delivery dates. Furthermore, the organisation of work (i.e. working time and rhythms, workloads, etc.) is almost entirely determined by the needs of the OEMs which are requiring their suppliers to adopt particular organisational and technological tools.

At the same time, automotive supply companies located in Italy are subject to competitive pressure from companies in countries with low labour costs. Or, rather, it is the OEMs themselves who are creating this type of competition in order to lower their supply costs, putting western plants in a position of competing with plants in low labour cost countries. This is resulting in the adoption of production models by plants located in Italy based on seeking to maximise profitability through sizable increases in productivity, achieved through a particular organisation of work facilitated by applications of new technology.

These issues – and specifically the connection between Lean Production and Industry 4.0 – are playing an important role in the development of the working conditions of employees in supply companies. Explicitly, the result is a general intensification of work through a significant increase in the degree of exploitation of the workforce.

In Italy, the National Industry Plan 4.0, which has provided strong tax incentives for companies to make investments in 4.0 technologies and presented by the Italian government in 2016, was received with great enthusiasm by the larger part of public opinion, as well as by the majority of business organisations, political parties, etc.
The research programme of Fondazione Claudio Sabattini has been aimed towards developing an understanding of the specific consequences that these innovations are having for working conditions. This chapter presents the main results of our findings as regards the automotive supply sector.

Our research questions are related to:

— the interweaving of Industry 4.0 technologies and Lean Production models (Butollo et al. 2018; Sanders et al. 2016; Sony 2018; Wagner et al. 2017);
— the type of technologies, especially in information and communications technologies (ICT), that companies in this sector are implementing (Otzemel et al. 2018; Qin et al. 2016; Thoben et al. 2016; Brettel et al. 2014; Tzafestas 2018);
— what consequences these technological and organisational innovations are having for working conditions from the perspective of: work cadences and rhythms; workloads; work content; human-machine relationships; and control over the performance of work.

From the point of view of the influence on working conditions, the main results that our research has highlighted can be set out as follows.

The companies involved in our research are paying general, and serious, attention to investments in ICT. Enterprise resource planning (ERP), manufacturing execution systems (MES) and internet-based forms of connectivity are widespread and being used for the management of all aspects related to: a) the planning of activities; b) relations between suppliers and customers; c) the planning and scheduling of different stages in the production process; and d) monitoring and control.

There is no lack of investment in fixed capital (machinery, robots, plant, etc.); rather, there is a new wave of automation underway in which the greater share of investment is in products and services characterised by connectivity and ICT capabilities. Under these investments, and within the Industry 4.0 process as a whole, companies have the objective of increasing productivity with consequences for employment that are not likely to translate in the near future into redundancies and lay-offs (at least, not mass redundancies), but rather into no expansion of the workforce even though production volumes may be increasing.

Companies’ aims here are being made possible by technologies which are able to trace the beginning and the end of each single task: data relating to all operations within the production process can be recorded, collected and monitored thanks to computer systems. Furthermore, machines and plants are generating a quantity of data related both to volumes produced, the phases carried out and the processing of each batch and any problems that are limiting functionality and causing downtime (breakdowns, setting-up, controls, lack of materials, etc.). In the case of manufacturing operations, ICT tools – more specifically, the apps which are established within them – achieve this by reading barcodes connected to work orders via optical readers, personal tablets and on-board PCs embedded within a machine or a line. The barcodes indicate the work order being performed, the machines and components used and the production process being
carried out, and associate it with the ID of a particular operator. All the data obtained are immediately uploaded to the company’s information system servers via ERP or MES, and made visible in real time to the offices responsible for control and monitoring, while the MES communicates work orders directly back to each workstation.

A count of the exact time taken by a particular task is thereby commenced in which a company is able to develop a clear and precisely detailed understanding of the time taken up by the work cycle – but, of course, not only that one: the ability to record time does not only affect individual task operations but the entire production cycle (right from the acquisition of orders to the delivery of product). These cycle times are incorporated into work orders defined by engineering departments by means of the ERP software that plans the production and defines the scheduling. Indeed, a strict definition of working time is, therefore, a prerequisite for the true coordination of the various production phases.

In this way, a cycle time can be imposed within which an operator must conclude each particular task, taking it away from the knowledge and control of workers while, at the same time, allowing real-time and remote control over work performance. The constraint on workers can therefore be understood as the obligation to adapt their work rhythms and cadences to cycle times, not only concerning the speed at which a semi-finished product moves between work phases but right the way across each single phase within the production process as a whole.

Thus, these technological investments possess a clear labour-saving character: i.e. companies are benefiting from the ability to do more with less. This increase in productivity has occurred mainly under an intensification of work cadences and a marked reduction in the time assigned to machine operators for each task/operation within the wider production process. In consequence, the level of ‘saturation’, i.e. the ratio between shift working time and the quantity of work actually done during that shift, is deteriorating significantly. Working times are becoming, in many cases, extremely difficult for workers to meet, due also to the high degree of variability in workloads and production mixes (Gaddi 2018, Gaddi 2019).

This intensification of workloads (and the saturation of the work process) has, in our view, at least three causes: a) operations carried out by workers are often complementary and subordinate to those carried out by machines (since workers are conditioned by the cycle time of the machine); b) under the pretext of automating the toughest tasks, workers are now in charge of operating more than one machine at the same time; and c) workers are in charge of a number of operations – self-checking, quality control, etc. – which were previously the responsibility of others. In the context of (a), we should note in addition that the worker is becoming forced to act as a mere appendix of the machine while, furthermore, the ready appearance of data on performance in control and monitoring offices – which may be located elsewhere and even internationally – is an additional source of pressure within the workplace.

Through these control systems, companies are able to compare internal costs with prices from external suppliers: in this way, companies are able to achieve more objectives: to
calculate production costs; to calculate the cost of each worker; and to decide whether or not to outsource a certain production phase. In this way, competition between ‘internal’ and ‘external’ workers is also being created, which also adds to the pressures being put on employees.

To try to conceal these negative effects of a more highly saturated work process, companies are attempting to portray work cycle times as in some way ‘objective’, or possessed of a scientific quality determined by the technology, instead of them appearing for what they are, i.e. the social decisions of companies. This means, moreover, that they are being hidden from the perceptions of workers and, thereby, removed from formal and informal negotiation.

The same things are occurring with the use of dispatch tools in the field of maintenance/assistance/repair, etc. By combining the use of scheduling software with devices (tablets, smartphones, etc.), operators are being provided with a list of maintenance/assistance interventions to be carried out, including the time to be spent on them and with the aggravating circumstance that workers’ locations are also being recorded and controlled by the technology.

Neither is office work exempt from these operations: in addition to the classic mechanisms for recording the start and end of operations, software is capable of tracking the various ‘clicked’ functions and of checking for any errors, overlaps or repetitions, activities which have no added value, etc.

For these reasons, our contention is that Industry 4.0 technologies, in guaranteeing the minute traceability of each single operation and its progress status, are facilitating the real-time extraction of information which allows the pervasive and real-time control of the performance of each employee. We believe, therefore, that Industry 4.0 technologies are fulfilling the so-far incomplete manufacturing revolution developed under Lean Production; and that it is the coming together of both which is having the most deleterious consequences for working conditions. The ‘brilliant factory’ is just that: a powerful device for controlling workers.

This chapter is organised as follows. Following this brief introduction and summary of theme, section 2 summarises the application of Lean Production models and Industry 4.0 technologies within the sector. Section 3 introduces some essential characteristics of the contemporary Italian automotive sector; and then goes on to document the field research carried out by the Fondazione Claudio Sabattini, with a series of case studies used specifically to illustrate various themes on the influence that these models and technologies are having on the shape of the sector and on working conditions within it. Finally, section 4 provides some conclusions.
2. **Applications of Lean Production and Industry 4.0**

Lean Production, of which the production system in Toyota is the foundation, aims to increase productivity by eliminating waste, resulting in a tightly controlled production flow in which all elements, including suppliers, are strictly synchronised. Overproduction (anything which is not necessary for the following production stage) is seen as waste and should be eliminated while waiting times need to be minimised. Lead times are compared with production times, eliminating synchronisation errors, material delays, sudden queues, failures, lack of operators, tooling times, etc.

Meanwhile, Industry 4.0 factories are ‘smart’ ones in which a set of technologies - communication tools, connectivity, data collection and processing - allows to connect work tools, equipments, plants, and products so that they can communicate directly with each other and with centralized systems, at such a speed that they can do so continuously and in real time: the increase in the computerization of manufacturing systems and the use of network and ICT technologies allows to integrate and synchronize all parts of the system in an information network (Forschungsunion 2013; European Parliament 2016).

Industry 4.0 technologies are, therefore, a perfect match for the objectives of Lean Production: digital technologies can play a decisive role in shortening waiting times and contributing to a reduction in plant reset times.

Lean Production systems and Industry 4.0 technologies are used widely in automotive production, both by car manufacturers and suppliers – the latter often being compelled by the former to introduce them. In both cases, this is translating into a heavy intensification of the pace of work and of workers’ performance.

Our research has shown that applications of Lean Production and Industry 4.0 technologies are closely connected, even sharing the same ‘philosophy’. In our opinion, Industry 4.0 is not fully understandable unless we also take into account that close relationship with Lean Production. In particular, Industry 4.0 technologies facilitate the full implementation of Lean Production, overcoming the technical constraints that previously limited its application. Furthermore, it is the intertwining of these two elements that is having the most critical consequences for working conditions.

Essentially, Lean Production implies the passage from a ‘push’ to a ‘pull’ logic: whereas formerly production planning was ‘pushed’ by sales forecasts, now it is being ‘pulled’ by customer orders – i.e. from another company, or even from another department within the same one. Thus, it is orders which trigger the entire production chain. One of the pillars of Lean Production is just-in-time: if the entire production process is ‘pulled’ by customer orders, nothing must be produced upstream that is not required downstream. Each piece must be produced at the time a downstream workstation requests it through *kanban*: the visual instruments which transmit information and instructions on the materials to be supplied by storage areas – ‘picking *kanban*’ – and the components to be produced – ‘production *kanban*’. New technologies, when applied to the *kanban* system, enable the strict synchronisation of different production phases and the
management of departmental and workstation demand in real time. The entire process can be constantly monitored from the screen of any connected device.

OEMs control their suppliers even though the latter are formally responsible for their own internal processes. This translates into OEMs having a substantial degree of control over work performance.

The attached figure highlights the typical integration architecture adopted by companies in the automotive sector in Italy – the so-called ‘pyramid of automation’. The first level in this architecture is represented by enterprise resource planning, which constitutes a set of planning tools for order acquisition and processing, supply chain management, the management of human resources and the production capacity of plants, production engineering, etc. The second level is the manufacturing execution system, which performs scheduling functions, the dispatch of production orders, resource allocation, product and workforce tracking, performance analysis, production reporting, etc. The MES, starting from the general process planning generated by the ERP, deals more specifically with its scheduling and with the dispatch of production orders to each department and/or workstation. Subsequent operational levels are based on SCADA (Supervisory Control and Data Acquisition, which monitors and supervises machinery and devices on the factory floor), as well as technologies such as PLCs (Programmable Logic Controllers contained on single pieces of machinery or plant) or other, similar, tools and apps. The final level is represented by sensors and other data collection tools in the field.

![Automation pyramid](image)

Industry 4.0 technologies allow the (vertical) integration (or vertical networking) of this architecture, reducing the number of steps between decisions and system control and, hence, flattening the pyramid.

In fact, Industry 4.0 combines the digitalisation of manufacturing processes with real-time data acquisition, processed and analysed via server and edge (cloud) computing as a means of optimising industrial processes (Akerman 2018; Rojko 2017).
The whole process is started with a Data Acquisition Module, facilitating the statistical analysis of the data that has been acquired. The different nodes of the network (products, machinery, controllers, etc.) exchange information through technologies developed through IoT (Internet of Things) applications. The data acquired in this way are processed not only by cloud computing and Big Data analytics, but are also used by CPSs – Cyber Physical Systems, i.e. virtual simulation tools for physical processes. Thereafter, feedback is transmitted to PLCs, the MES and ERP to make production not only flexible but also highly reconfigurable, and the latter within a very short timescale.

This means that planning, scheduling, work order dispatch and plant operation can be continuously redefined – compelling the workforce to adapt continuously. Integration of all levels within CPS facilitates close cooperation between all departments and individual phases. In this just-in-time environment, increases in productivity are based on the strong intensification of work performance, i.e. a greater degree of labour exploitation.

This system connects the entire production cycle right from the end to the very beginning: i.e. backwards from the end of the assembly line – the point at which a customer’s production orders can be dispatched to that customer – one stage after another, workstation after workstation. From the point of view of Lean Production, this eliminates overproduction (components are supplied in the exact number in which they are required) and minimises waiting times (components get to each station at the exact moment required, and without loss of time).

Industry 4.0 technologies also provide crucial support for the full implementation of the logic of *kanban*, deployments of which are becoming progressively electronic and which make sending, receiving, recording, etc. both easier and faster. Starting from general production planning via ERP, and hence from production scheduling by times and workstations via MES, electronic *kanbans* can be generated and transmitted to connected devices embedded within each workstation. When the requests of a *kanban* have been met, the electronic recording system shows the progress in order to allow management to monitor it in real time and step in immediately when synchronisation adjustments are needed.

Respect for assigned times is central to Lean Production, in which the pace of production is determined by ‘takt time’ – the time taken up by the production of one unit of a specific output. Industry 4.0 technologies allow the real-time monitoring of takt times through connected recording devices which immediately upload data to company information systems which compare actual and planned times. In this way, takt time determines working times across all lines and at each workstation, imposing rhythms and working systems to meet the standards set by the company. They also facilitate the levelling of workstation saturation, or *heijunka*: once takt times are defined, workloads to be allocated to the various workstations are computed automatically, taking into account the availability of facilities and staff.
Strict adherence to takt time and the obsession of Lean systems with reducing lead times means that tools which are presented as aids for workers – in carrying out their assigned tasks, they do not have to ‘waste time’ in thinking, checking, verifying, etc. – or otherwise as ways of reducing operator anxiety about possible errors are thereby transformed into tools for intensifying work performance. The implications of poka-yoke (‘foolproof’) systems, which provide detailed instructions to each workstation, or automatically assign combinations of batch-machine-component codes, renders workers less and less autonomous: MES communicates with all the connected machines and guides workers through the various operations, indicating the components to be used and the sequence of operations to be carried out.

The integration between Lean Production and Industry 4.0 is also very important in terms of logistics: lines are automatically supplied by electronic kanbans, with products delivered both to the warehouse as well as to external suppliers via the same software tools and computer systems. In this case, the provision of everything needed for production directly to workstations, far from being an aid to the operator, constitutes yet another way to cancel any form of ‘waste’ in terms of ‘non value added activities’. This classification of activities into ‘value added’ and ‘non value added’ (NVAA) is another critical element of Lean Production – the former being the only activities that, in progressively transforming inputs, add value to them. In contrast, non value added activities do not directly add value to inputs and must, therefore, be compressed as far as possible since they are viewed as ‘downtime’. NVAAAs usually include all such activities connected with arranging/predisposing, searching, placing, pushing, pulling, dividing, cleaning, walking, all types of waiting, all types of stoppages, measuring, counting, controlling, sending/transferring, etc.

World Class Manufacturing (WCM) is an evolution of Lean Production and is also strongly integrated with Industry 4.0: under this approach, all operational activities and production support must be continuously improved in order to generate a flow of value added without waste and with the fewest possible losses. In other words, workers must strive for a workflow that takes place at maximum speed and at minimum cost.

WCM defines waste as leakages of value due to some kind of overproduction (stocks awaiting processing, defective parts, plants stopped as a result of failure rates, etc.); while losses are the cost of not allocating a resource to its optimal alternative use, measured as the loss of value added associated with such a misallocation – an economist would call these ‘opportunity costs’. A worker awaiting instructions, materials, equipment, the restart of an idle machine, etc. generates not only a waste but also a loss because the waiting time could, alternatively, be used to carry out activities that produce value added.

WCM assigns special importance to so-called Total Preventive Maintenance (TPM): production workers have to keep their workstations clean and tidy, perform daily maintenance of machines and equipment, etc. – all of which are non value added activities in the WCM logic. In other words, companies are assigning to production workers those activities which were previously carried out by maintenance workers. This meets a two-fold objective: a) to saturate production workers as far as possible;
and b) to ensure the correct and continuous operation of plants within the logic of a tightly-controlled flow of production.

Actual operating times depend on faults, settings, adjustments, etc., the resolution of which increases the rate of utilisation of plants as well as their performance and the quality of the final product. These three factors together – rate of utilisation, performance and product quality – determine the overall equipment effectiveness (OEE) i.e. the total efficiency of the plant. Industry 4.0 technologies allow OEE to be computed in real time and data to be transmitted to the offices which are in charge of monitoring and control. Improving these indicators also has enormous consequences for workers in terms of the monitoring of performance, the intensification of working time and the introduction of bonuses related to actual performance.

As in all Lean systems, therefore, identifying and eliminating NVAAs is crucial to WCM and its technical pillars: ‘cost deployment’; ‘focused improvement’; ‘autonomous maintenance’; and ‘workplace organisation’. In particular, the cost deployment pillar takes place in each area, identifying the losses and wastes inherent in all manufacturing processes and sub-processes, quantifying them in terms of cost and defining action programmes aimed at their reduction. For example, the cost associated with NVAAs is the number of minutes taken up by workers engaged in such activities and multiplied by their wage per minute – thus identifying these as a cost to be cut.

WCM introduces distinctions between resulting losses, which can be observed, and causal losses, the latter being the origin of the former. Total costs, therefore, can be traced back by identifying the resulting losses and summing up the corresponding causal losses. For example, a worker performing NVAAs implies lost production – which, in turn, is associated with fixed costs, the depreciation of investment items, energy costs, etc. – but also in terms of keeping downstream workers waiting: i.e. lengthening lead times and desaturating the work process, etc.

The precise quantification of all these cost items is why each workstation is required to be equipped with on-board connective devices (sensors, monitors, optical readers, etc.) capable of recording and transmitting any imperfections, irregularities or diversions of the flow. In this way, it is possible to single out any potentially disposable NVAA, which now takes on a very broad definition based on the causal chain of all the resulting losses and wastes. This is also what allows the allocation of workloads and cycle times to be presented as entirely ‘scientific’, as the result of the software processing of variables that are, by definition, objectively measured. This puts companies into a coveted and advantageous position since, where these are not questionable, this makes formal and informal negotiation on workloads, labour organisation and staffing levels increasingly hard to achieve.
3. The field research: Italian companies in the automotive supply sector

3.1 The shape of the automotive supply sector

In order to understand the practical impact of Lean Production and Industry 4.0, it is necessary to explore briefly the contemporary shape of the sector.

We should stress that the Italian automotive industry is undergoing a process of transformation characterised by an absolute drop in the production of vehicles (from 1998 to 2018: the number of vehicles produced dropped by 1.3m), accompanied by a relative rise in the production of parts and components. This implies a significant change in the structure of employment. In 1998, forty per cent of employment was devoted to parts and components and 52 per cent to final (vehicle) production; but, by 2018, these proportions had been reversed, to 53 per cent and 41 per cent respectively.

Italy is, in some respects, moving towards a production specialisation similar to that of some central and east European countries which specialise in the supply of components to western (mainly German) car manufacturers. However, Italy is characterised by higher wages, which raises doubts about the permanence of this kind of production model. In fact, two models of supply are emerging: that of countries with low labour costs (Poland, Czechia, Slovakia and Hungary), characterised by state funding and investment incentives, located close to Germany and at the service of German OEMs; and that of western countries in which the production of parts and components is still inextricably linked to the national manufacturers who absorb it. However, the disappearance of a national carmaker in Italy makes the situation in this country increasingly uncertain: if Fiat Chrysler Automobile’s production volumes are too low to absorb the parts and components produced in Italy by multinational companies, these could make drastic decisions about their Italian sites, preferring those located in other countries with lower labour costs and closer geographical proximity to final sites of assembly. Component manufacturers located in Italy are, therefore, increasingly re-orienting their production to supply foreign, in particular German and French, car manufacturers.

Furthermore, it is clear that supplier companies are being conditioned by two aspects: a subordinate position in the production chain; and competition with companies in the low-cost countries of central and eastern Europe.

As supplier companies, their production conditions are significantly determined by the OEMs which have the power to decide costs, timing and conditions. For example, they must continuously provide just-in-time supplies to OEMs, with rigid planning and scheduling of their own production processes and a strict synchronisation of internal production with both their customer(s) and their own suppliers.

Moreover, in facing up to competition from low-cost countries, they will try both to reduce production costs further, with negative consequences for wage levels; and to increase labour productivity, with negative consequences for working conditions as
regards the intensification of performance, the reduction of assigned cycle times and increases in workload saturation.

Industry 4.0 technologies and Lean Production models are the main elements that are determining working conditions in the automotive supply sector. In the next section, we highlight the close interweaving of these two elements. It should be stressed that these two elements are being applied not only at the level of an individual company, but throughout the supply chain as a whole.

3.2 Outline of the research

To highlight what is being determined by the technological and organisational transformations that we have described above, we have examined several companies operating in Italy in the automotive supply sector (see Appendix for details):

— Midac (Verona) – battery manufacturer and a tier one supplier;
— Fiamm Hitachi (Verona) – also a battery manufacturer and a tier one supplier;
— Cebi Motors (Padua) – a manufacturer of micro-motors and gearmotors, and a tier two supplier;
— Fonderie Montorso (Vicenza) – a castings manufacturer and tier three supplier;
— Magneti Marelli (Corbetta, Milan) – a manufacturer of dashboards, inverters and control units, and a tier one supplier;
— ST Microelectronics – a semiconductor manufacturer and tier one supplier.

In each company, a series of interviews were carried out with workers from different departments in order to develop our views on how the entire production cycle is being affected by these transformations. The plants involved in the research are all unionized. The interviews involved full-time union officials, shop stewards, and even simple workers who are members of Fiom Cgil (metalworkers’ union). The research, in fact, was carried out in collaboration with Fiom Cgil, which is interested in understanding the spread of Industria 4.0 in the industrial metalworking sectors and its consequences on working conditions. For each plant, in-depth interviews were carried out (from a minimum of 5 to a maximum of 15) with the figures mentioned above, each lasting about one hour. Subsequently, further analyses were carried out through the analysis of: the companies’ Industrial Plans, the investments made and planned, the layouts of the production departments (plants, machinery, lines). The analysis of these documents was followed by further in-depth analysis through interviews. A draft-report was prepared for each plant and sent to full-time union officials and shop stewards so that it could be discussed collectively (a sort of Focus Group) and then supplemented with further information and details that emerged during these meetings. At some plants it was also possible to visit the production departments, depending on whether or not the company management were willing to authorise this possibility. Interviews and factory visits took place in the second half of 2018 and during 2019.

Thus the approach to the research questions is qualitative.
In the rest of this section, analysis of our field material has been organised as follows: first of all (in section 3.3), suppliers’ relationships with their client companies have been studied to highlight how the latter’s role is decisive in determining production conditions; and then the knock-on effects of this on the network of supply companies that the suppliers have, in turn, created (since they, too, have decentralised significant parts of their production). We then focus on internal conditions in the plants from the point of view of the role played by planning and scheduling tools in determining production processes and workloads (section 3.4); and the impact these have in terms of working conditions in production lines and departments (section 3.5). The latter highlights, from our examples, that the tools of Lean Production and Industry 4.0 technologies are responsible for the deterioration in working conditions.

### 3.3 Case studies in supplier relations

This sub-section demonstrates how OEM suppliers closely control their own suppliers, creating a complex and closely integrated production network the boundaries of which may also extend internationally. Supplier companies seek to build very close relationships within their supply network in order closely to synchronise all steps. Obviously, this close level of synchronisation and control over supply conditions heavily affects the working conditions of workers in companies in the subsequent links in the chain.

The fragmentation of production is facilitated by tools that allow the continuous transmission of production orders, even several times a day (forcing workers in decentralised companies to speed up and become more flexible to meet these work orders) and, at the same time, to monitor how the supplier company is working (in respect of assigned times, production progress, etc.).

Thus, the relationship with the companies to which they are a supplier is a central preoccupation for companies in the supply chain: customers may impose on them the application both of organisational innovations (models of Lean Production, thus extended to the entire production chain) and choices of technological systems. We should recall here that, in the Lean Production mindset, it is the final customer – i.e. the OEM car manufacturer – that pulls the whole chain, in the process determining working conditions in all the downstream links. Companies in the automotive supply chain must therefore operate according to the same just-in-time principles and systems dictated by those to which they supply. Industry 4.0 made it possible to establish the main principles of work organisation (i.e. Lean Production model) throughout the entire supply chain.

In our case studies, Industry 4.0 is operating in the direction of horizontal integration:¹ i.e. the integration of different factories belonging to the same production chain. The main Industry 4.0 technologies used for this purpose are: ERP extended to the whole

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¹ As opposed to vertical integration, i.e. the integration of different functions within the same factory.
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The intensification of work performance and control over it is the direct consequence of the decisions of the car manufacturers whose demands supplier companies cannot afford to ignore otherwise they would lose supply contracts. This applies throughout the process, including tier one, tier two and tier three suppliers, and beyond. The model facilitates a substantial reduction in the possibility of trade unions to negotiate working conditions: everything is presented as fixed since it is dictated by the requirements of the customer.

Case studies: OEMs and tier one suppliers

Magneti Marelli (MM) – within its plant at Corbetta, Milan – produces dashboards, control units, inverters, etc. for manufacturers from other countries such as Germany (Porsche, Audi and Volkswagen). The way in which the car manufacturers submit their orders, and the time allotted to Magneti Marelli for supply, have a very significant impact on the organisation of work and on working conditions.

For instance, Porsche has adopted a 'herringbone' production model: the customer can configure an online order, customising the choice of car. This order is managed by a central information system which requires all the actors involved in the delivery chain to be synchronised. The MM Corbetta plant periodically receives production orders through an EDI tool called Value Added Network (a hosted service offering secure data transmission between partners). Just five days before the assembly of the car in Germany, Magneti Marelli receives an order via VAN to start production on exactly the sequence of on-board instruments which must be assembled in the Porsche plant to meet the order. Porsche’s orders, therefore, have a daily character and Magneti Marelli’s production process (and hence its workers) must adapt to them.

Another example of the closeness of tier one suppliers to OEMs can be found among the battery manufacturers. In order to meet the significant levels of coordination dictated by the just-in-time principle, planning and production phases in both Fiamm and Midac must be carefully synchronised, defined and implemented on a just-in-time basis. Battery charging programmes depend strictly on customer orders: the battery is charged only when it has to leave the factory otherwise it risks a loss of charge. This aspect obliges OEMs to provide themselves with a logistical service amongst its suppliers that is functional to production and just-in-time delivery. No delay, in fact, can be allowed: the time allotted must be strictly adhered to.

Case study: tier two suppliers

Cebi is a tier two supplier; in this way, it is subject to double pressure: the first is that from the OEM; while the second is that from the tier one supplier.

In Cebi, the acquisition of customer orders is carried out by ICT. The tier one supplier is Brose (a German firm), which now accounts for eighty per cent of Cebi’s production and for which Cebi is the only supplier. Brose makes a call based on its daily needs and
transmits this order to Cebi automatically via an EDI tool; this allows Brose to provide a daily frequency of orders and Cebi to verify the stocks and the quantities of materials which must be allocated to that customer. Cebi, in fact, operates with a deposit account at a customer plant (Consignment Stock), from which it withdraws materials daily according to its production needs. In this way, Cebi’s system works on the basis of daily flows, updating the stock requirements and planning the production needed to rebuild stock at the German plant. Through this way of managing customer orders, the organisation of production at Cebi is modulated according to Brose’s requests.

In general, the management system at Brose continually processes the flow of orders that it receives from car manufacturers before turning them over as orders to Cebi. The role of the tier one supplier can be particularly invasive: here, Brose demands that, every four hours, Cebi production operators fill in a control card in connection with the amount of production they have realised. This data is monitored both by the internal offices in Cebi and by Brose itself.

Case study: use of new technologies and organisation of the supplier network amongst tier two suppliers

Cebi is itself digitally connected with some of its suppliers. In this way, Cebi’s suppliers, before shipping materials, can provide data notifications concerning each job and the control parameters which apply (already performed and self-certified by the supplier in question). This system allows materials to arrive directly on Cebi’s production lines which, based on a ‘free pass’ model, saves testing time while also facilitating data collection.

Cebi’s programming department develops data with the aid of material requirements planning (MRP) software and sends out its supply plans on this basis. The lead time for suppliers do differ: from China it is one month; while from local network suppliers is daily: for this reason some of them having machines and processes dedicated to Cebi and which work in a continuous cycle. Supplies from faraway low-cost countries represent an element of system fragility whose effects are passed on to Cebi’s workers who have to deal with any delays by working overtime or on Saturdays (or even during holidays).

Case study: use of new technologies and organisation of the supplier network amongst tier three suppliers

In the case of Fonderie di Montorso, ‘core’ suppliers directly receive orders generated by the management software, together with a technical data sheet detailing the specifications and the cycle times which must be observed. The relationship with subcontractors is based on special methods of control by FM through the use of computer tools. By virtue of its control system, FM can outsource many stages in the production process. The management system developed by FM comprises a SAP dashboard with an ERP tool which allows the integration of external contractors in the system.

The subcontractors therefore have their own workstations equipped with PCs on which are installed the web dashboard that interfaces with the company system; in this way,
production status is displayed directly. The system was developed and supplied by FM, together with the technology and training (made by FM technicians).

FM can therefore control – in real time – the production feeds of its suppliers and also verify that they are complying with the production plan.

3.4 Impact on workers: planning and scheduling of work orders

We have seen that planning and scheduling tools constitute fundamental elements in the automation architecture aimed at maximising the productivity of the entire production process.

Once orders are acquired, they are immediately processed via ICT tools (ERP) to define production programmes. The latter, in turn, are immediately scheduled (via MES) to define the individual work orders which are transmitted to each workstation. In this way, companies are able to remove from collective bargaining both the overall production volumes (and the question of the corresponding numbers of workers needed to deal with them) and the workloads assigned to each worker. It must always be remembered that the work orders transmitted to each worker have already been defined from the point of view of the time assigned (and which is, in turn, getting tighter and tighter as a result of competition).

The purpose of the companies here is, as we have highlighted, to ‘objectify’ the assigned workloads and working times so as to make them indisputable. Regardless of the state of technological progress, the consequences for working conditions, both in terms of the intensification of pace and control of the process, are very similar.

**How process planning/scheduling translates into work orders (workloads) and performance control**

MM uses TESAR’s tools, such as MOTIS1 and MOTIS2, amounting to an integrated system for planning and controlling production. These work thanks to real-time data collection terminals directly connected to production machines. MOTIS1 constitutes software for the planning and scheduling of industrial production: it optimises the workloads of machines and workers as well as the performance and productivity of the entire company. MOTIS2 is the software for production management, data collection and monitoring (MES): this allows for the control and management of the production process, considering both the declarations of operations performed and the automatic monitoring of the production parameters of any machine/plant. Moreover, the interactive management of these declarations feeds a complete and powerful system of real-time supervision, statistics, indicators and reports.

Through these items of software, production is not only programmed but also scheduled as regards the assignments for each operator and the equipment required to carry out the workload within each shift on the basis of acquired orders, relative priorities, availability of materials and plant, etc. In this way, the organisation of production is
rigidly determined, with little room either for the autonomy of workers or for bargaining over workloads. For MM, it is also decisive that this planning/scheduling of activities is continuously monitored, thus introducing forms of control over the performance of work.

In the lines dedicated to the production of dashboards, daily production plans are indicated on work orders bearing job codes which also correspond to the operating programs of the machines and the types and quantities of products to be manufactured. Components to be inserted on electronic circuit boards are also indicated by the production plan; once they have been ‘called’ digitally, the pick-and-place machine is automatically activated to place the boards correctly. During the day, the production program may vary, requiring the resetting of the entire line to be done in the shortest possible time. All these operations are recorded. The planning of activities and their recording are two closely intertwined aspects of the organisation of work, whose integration is facilitated by the ICT tools available. In MM, the application of WCM techniques has also resulted in pressure to reduce downtime.

In STM, Industry 4.0 is being implemented as a means of guaranteeing the maximum use of the plant given that it has been the subject of sizable investment.

Within the production process, silicon is processed through different machines, following a process flow defined by the R&D department. This flow is based on infrastructure provided by Workstream (a type of MES), which provides operators with elementary information confined to the path that the batch must take. Through Workstream, operators carry out a double process: on the one hand, following automated scripts appearing on computers embedded within the machines, they move the batch between the various machines; on the other, they keep track of the work process. The set-up for each machine, identifying the particular operations to be carried out, is downloaded separately. FTP communication protocols allow the machines to access a server from which Workstream ‘picks’ the necessary recipe. Each batch is, in fact, associated with specific tooling: Workstream ‘reads’ the batch (through a barcode reader) and automatically selects the set-ups to be downloaded. The process is highly automatic: for each machine, Workstream (a) identifies and extracts the tooling set-ups associated with the batch; (b) records each operation; and (c) indicates to the operator the next step. Workstream allows the batches to be traced and processed using information contained in the barcode.

In each case, the tooling set-up is prepared by ICT engineers on the instructions of the R&D department.

This has led to the occupational de-skilling of workers: previously, they designed the re-tooling and thus knew the whole process; now, they simply load and unload the batch because many of the steps are being managed directly by the software.

**How process planning and scheduling interact with machinery and tools**

With regard to the battery companies, Midac wants to introduce between three and five new robots on top of those that already exist; currently, the machines are partially
automated but the operator is always needed for loading/unloading. Despite the
corporation stressing that robotisation will not have consequences for employment,
union officials and shop stewards highlight that even partial automation produces
some effects: it is possible to make increases in production volumes in the presence of
constant or even slightly reduced staff numbers (via the non-replacement of retiring
staff, etc.). This means that there will not be a wave of redundancies but that, if there
is an increase in production volumes, the level of employment will not correspondingly
increase: i.e. the increase in productivity is of a labour-saving character.

The battery production processes of Midac and Fiamm are very similar. The first
part relates to lead smelting and rolling, processes which are governed by a screen
displaying the production parameters. Battery fluid is prepared by a machine that
works automatically, using production data entered on a PC. The program has already
been installed on the machine: in this way, it is only run by the operator.

In Fiamm, the line is managed by a master panel and the operation of the lines tends
to be modular so that, in the event of breakdowns, only single parts need to be reset
instead of the entire line. Both in Fiamm and Midac, the communications system
between the machines is determined by a ‘master’ Programmable Logic Controller
(PLC) that controls the ‘slave’ PLCs: for example, the speed is determined by the master
potentiometer; a system that, when connected to individual PLCs, monitors whether
the machine is working or not. In Fiamm, a SAP-developed ERP tool calculates the
production volumes achieved and those that are lost in the event of machine breakdowns
and requirements for maintenance. In addition, the worker, at the beginning of each
duty, must enter a personal code on the production line and ultimately record its end.
Both these aspects are tools to control worker performance.

The final process of assembling the batteries, both in Midac and Fiamm, takes place
through different machines; the whole process is highly automated; the role of the
operators is that of the loading, control and activation of the line. The constraints on
workers, therefore, are determined by the cycle times of the machines. Each machine
has a PLC that communicates with the others; the central system that
records all the items that have been realised during the shift, allowing the company to
exercise real-time monitoring of workers’ performance.

In Cebi, the operators find out the work order at the workstation by means of reading
a barcode with an optical scanner: the PC automatically shows the volume to be
produced, the line to be used and the composition of the work team (each operator’s
ID must be inserted). The machinery is automatic, being loaded and started by the
operator through a PC embedded on the machine using a standard code (the machine
is already set according to the general planning defined earlier by ICT tools). Therefore,
the operator has only to load/unload the machinery and intervenes only in the case of
stops and for process controls. In the latest generation of machines, unloading takes
place by a robot, eliminating a work task.

A screen visible to the line supervisor collects data on operating production, making
visible the number of wastes by type. Here, a control card is filled in and entered into
the PC by an operator, who enters the numbers of good pieces, repairable pieces and those which are rejected (with reasons for the rejection) at the end of each duty. Within the most robotised department, a series of robots weld the flanges, recording and transmitting the production data automatically and in real time.

Finally, the assembly of micro-motors is also carried out using machines that work automatically; a robot provides the pieces for the first manufacturing station and then each subsequent one. In this case also, the operators only have to load/unload, start up the machines and check stops and malfunctions (through the data displayed on the monitors).

At another FM plant, in Crevalcore (Bologna), MES has been implemented: the machining centres are connected to a networked PC (and therefore to a centralised system), so that manufacturing declarations take place through log-in and log-out operations carried out by the worker who records the start and end of each duty via his or her personal ID. A scanner reads the barcode for each operation – at which point, personal ID and work order are associated so that, at any time, the operator may be identified as having been logged on to a particular machining centre – identifying the particular phase of the production and on the particular work order. At the end of the duty, the operator inserts into the ICT system data on the number of pieces processed.

Even if FM’s Vicenza plant does not yet have MES, the monitoring of production is still done in real time: the worker records the number of realised pieces on the department PC; in this way, the pieces that have been machined are visible to the ICT system as being available for the next phase. The equipment and production processes are governed by software: all operations are controlled from the point of view of relative costs through ERP; every ten minutes, via another piece of business intelligence software, the operations performed by workers and robots are monitored. The business intelligence software in question is QlikView, which is a reporting tool. It can also be used as an app and is accessible through the company network (by those authorised to access it). The equipment generates data that is collected, stored, processed and classified: in this way, reports are created and control is continuous.

3.5 Impact on workers: production lines and departments

Production planning and scheduling results in work orders being executed on the line or at workstations. Even in the practical execution of these tasks, technology has a very advanced role in determining working conditions and allowing companies to exercise control in real time. However, there are also deskilling effects. The aim of companies is to achieve the highest possible saturation of the workforce and machinery; frequently, the two things coincide because, in order to achieve the maximum saturation of machines, the rhythms of work are thereby intensified. Very often, the times assigned to workers depend on the cycle times of the software embedded in the machines or the instructions sent to them, sometimes remotely, via ICT networks. The cycle times incorporated in the machines and tools are not ‘objective’, but depend in practice on the social choices of companies to increase work saturation. Sometimes, it is the case
that the imperatives of production over-ride the times when a line should be stopped 
to check that a particular machine is functioning properly and delivering satisfactory 
product quality. This demonstrates a “formal” tension within different aspects of world 
class manufacturing that, in reality, confirms the priority order between production 
numbers and quality, but which is also to the detriment of the saturation of work.

**Condition of work and saturation of the work process are dictated 
by machines and technologies**

On the dashboard production lines at MM, the circuit board production process is 
completely automated: only the production code is entered manually and thus the 
machine (these are numerical control (NC) machines) is activated by running a program.

Usually, the first operation to be performed every day is to load the program on all the 
machines; then, for each step, the program is run for each machine: products move 
between one machine and the next on conveyors according to predetermined timings.

There is a system for collecting data generated by the operation of the machines, installed 
a few years ago, which allows the entire line to be monitored. On each line, there is a 
screen controlled by technologists from their workstations which collects production 
data for each machine and each line. This screen displays all the process information, 
including any problems and faults.

Each machine then marks out the beginning and end of each processing stage and 
carries out its operations based on the time established according to the type of product. 
The installed systems mean that it is possible to trace the entire production process and 
verify whether the cycle times have been observed.

Subsequently, the circuit boards are transported to the line where the dashboard 
assembly phase starts. Here also, it is the case that operator intervention consists only 
of inserting the board and components, while the rest is automated. It is clear that the 
work of the operators is strongly constrained by the computer programs which are 
simply run to activate automated processes that have predetermined cycle times.

The working time of workers on these lines, besides being constrained by the cycle times 
of the programs, is inevitably linked to the quantity of production to be carried out. This 
quantitative objective is conditioned by the level of operability of the machines; if a 
machine is not working properly, the cycle should be stopped to request maintenance. 
However, the imperatives of production frequently prevail over everything else. This 
consideration confirms that the application of production systems, such as WCM, 
is exclusively aimed at maximising production via a shortening of cycle times and 
regardless of the quality aspects that, formally, should represent one of the cornerstones 
of these models. In fact, the workers we interviewed stressed that, over the years, cycle 
times and rhythms have continually intensified, in particular via the elimination of all 
downtime and the intensification of work rhythms.
In MM’s power train department, the production cycle is quite similar to that of dashboard assembly. The circuit boards are not loaded manually but by robots. Part of the supply from the warehouse is automated, with two robots pulling a trolley: these move along magnetic strips and are programmed by the warehouseman to stop at the various *kanban* stations. The material is deposited and the worker takes it to carry out operations. All the production lines have *kanbans* for material storage, organised according to production sequences to try to erase as much waste time as possible.

The level of automation is very high; for example, a robot takes care of the positioning of the control units. The task of the operator is to receive the materials to be assembled, then assemble them and put them into a machine that carries out riveting, welding, electrical testing and labelling. Once these operations have been completed, the control unit returns to the worker for visual inspection and subsequent packaging. Here also, the production times are, essentially, the cycle times of the machines; the line screen shows the cycle times of the machines and these must be observed by the workers. It is also clearly the case in this department that the constraints exercised by the machinery (and the programs which run them) are crucial.

The traceability of production is guaranteed by the requirement imposed on the operator to scan the cover label (every 12 pieces) with an optical reader. In this way, when the label is read, the time spent on production is recorded.

**Saturation and possible deskilling**

In the manufacturing department of STM, the influences which technology is having on working conditions are also characterised by possible deskilling. Prior to the introduction of Workstream, the operator followed and knew all the various phases of the production cycle. Now, manufacturing phases are carried out by machines which are programmed to perform all the operations. These machines have been designed to incorporate FTP communications protocols that manage the entire download of the tooling set-ups from the server which provide the machine with its operating instructions.

On some lines, the level of automation is currently such that it is possible to operate them remotely, i.e. to launch the setting-up process directly from offices. Therefore: a) the steps that a lithographic machine must take are programmed; b) there is a double programming: of the flow, that is the sequence of machines; as well as of the processes that each single machine must carry out; and c) the programming encompasses the ability to activate each machine either from within the department (that is, on each machine) or remotely. The machines are very complex; so much so that the supplier companies have groups of workers who work permanently with STM employees at the Milan plant as only they know all the details of operation and programming.

This has strong consequences for the human-machine relationship: the machinery, in fact, operates on the basis of programs written by people who are not the operators who use them, working on the basis of logic that has no room for the understanding, and therefore the control, of STM’s workers.
**Intervention in industrial processes to achieve tightly-controlled flows of production**

In both Midac and Fiamm there are processes whose times are dictated by chemical and physical constraints (paste preparation, casting, drying, etc.). However, the companies have been intervening in all these phases to shorten the times: in Fiamm, to shorten curing times (from 15 days to 24 hours), a special oven has been installed; while, to avoid loss of time due to production changes, new machinery (auxiliary ovens) etc. have been installed. Above all, Fiamm has compressed machine times on its ironing line: the production volumes of the line have been increased from 22 metres per second to 32 by dint of speeding up machine movements with the use of inverter motors. In this way, all the machines on the line have been speeded up to make the line speed uniform: by changing the general setting of the system (on the master panel) the speed of individual machinery may be changed.

In Midac, the installation of PLCs on all equipment allows real-time signals to be sent to the maintenance department (via monitors and smartphones) to guarantee immediate intervention in the event of faults, minimise machine downtime, obtain the necessary spare parts and realise scheduled maintenance.

Meanwhile in Fiamm, in order to guarantee that the machinery is fully operational, significant pressure is exerted on maintenance technicians: they receive calls on a mobile phone and must enter every alert on Geocall. This is an ICT system that includes many functions: receiving reports directly from equipment; creating work packages to be performed with scheduled machine downtime; assigning interventions to technicians or teams based on production shifts; reporting works and opening new requests for intervention through an operational workflow; defining the check list of controls; and checking activities in real time. It is a highly automated system which allows the company to exercise a very strong form of control of the times and performance of maintenance technicians whose job is to restore operation as quickly as possible. The maintenance technician has to insert a personal ID on the PC embedded on the machine to track the start and end of activities; for each intervention, a report must be compiled that is checked by the head of department and which evaluates the time spent and the quantity/quality of the performance.

**Re-tooling machinery to reduce downtime**

In Cebi, the automated lines produce 500-550 pieces an hour; to feed these lines continuously, the flanges are welded by robots.

Thanks to the robotized welding of the flanges, these parts are supplied to the assembly line at intervals (cadencies) dictated by the operating programs of the robots, forcing the workers to adapt.

In addition, also on the assembly line there is a constraint in operation dictated by technology. The machine, once loaded, runs autonomously and its operation time is used by workers for control, restore and registration activities; primarily, however, the constraint on workers reflects the need to unload the machine because, in the absence of
this stage, the equipment would stop. In the event of a product changeover, line retooling times have been drastically reduced from 45 minutes to 15 using a PC that recalls the set-up corresponding to the new production batch. Re-tooling and maintenance have been put in the hands of the operators, increasing their workloads, and the company no longer hires maintenance technicians. Two particular elements of Lean Production are in play here: SMED (Single-Minute Exchange of Dies), which seeks to reduce plant setting times and eliminate waste; and Total Preventive Maintenance whose aim is the optimisation of capacity utilisation of the lines through the progressive reduction of unplanned extraordinary interventions.

It is also the case in Cebi, therefore, that technological and organisational innovations have led to the possibility of achieving higher production volumes with the same number of staff, whose jobs have become characterised by great flexibility and variability.

One of the main investments in connection with Industry 4.0 at Cebi concerns the wiring-up of some machines in order to have data accessible in real time via PCs or other devices, reducing time and steps. Each machine will, as a result of this greater connectivity, be able to communicate and send alerts to the person in charge of the production process so that he or she can intervene immediately, avoiding machine downtime. This will contribute to the improvement of OEE, in terms of the degree of utilisation of equipment. Some lines will be equipped with a central PC that collects data from PLCs and other devices, data which will then be passed to the MES. Other lines will have a direct PLC-network connection, with direct data transmission to the MES. In this way, the assessment of the OEE parameter is used to put the group’s plants, and therefore the workers, in competition with each other.

Effects on white collar staff

In STM’s design offices, design automation has been implemented through the use of increasingly complex design and simulation software. In particular, digital design offers much more advanced support for CAD (Computer Aided Design) than analogue design. The change in the design sector has been significant and extends to the deskilling of the designers. The design process is very complex and involves several steps; inevitably, the objective of the company is to shorten the times for these steps, and their number, as far as possible. For this reason, STM has defined a ‘process design kit’: a set of software tools that allows the automation of as much of the design as is conceivable. The definition of precise rules corresponds to the objective of minimising change to reduce costs. To achieve this goal, STM addressed its requirements to companies specialised in the supply of CAD, such as Cadence, Mentor and Synopsys which provide about ninety per cent of the tools used in design. Their software is able to count how many times a function is pressed, how many clicks are made, etc. and thus its ability to control the performance of the designers is, therefore, extremely pervasive.

STM also wants to document all the steps taken in design – which, in addition to being an extra tool for control, entails additional workload. Greater workloads and complex processes result in a highly stressful situation for workers. Moreover, STM can exert control thanks to the traceability of all its processes: when problems occur, the company
is able to identify which operators have been responsible and this is adding to the stressful climate.

Meanwhile, the designers feel less specialist and skilled than before because the software has ‘absorbed’ many of their skills.

3.6 A possible trade union bargaining agenda

The findings of this research (and other similar ones carried out in collaboration with employees organisations of Cgil, Fiom in particular), have made it possible to begin to define an agenda of bargaining issues.

First of all, the theme of information rights. The organisational and technological innovations that are applied in the plants derive from precise choices made by the management and ownership of the companies that must be communicated, in good time, to the workers and their representative organisations. The National Collective Agreement for Metalworkers provides that the management of companies with at least 50 employees must provide the trade union representatives with a series of information concerning, among others, a) the strategic choices of the companies on the production activity, b) the changes in the production system that affect the technologies adopted, the overall organization of work and the type of production; c) the outsourcing of phases of the production activity. Unfortunately, the information system that companies implement with regard to workers’ organizations often works very partially and late. The research has shown that the extent of the technological and organizational transformations that companies are implementing has such an impact on workers that it is necessary to fully implement the information rights provided by the National Collective Agreement, so as to have, in good time, useful information to negotiate with the company the actions it intends to implement.

The research revealed the need for the union to regain the opportunity to discuss work organisation. This means the possibility to discuss, in the first instance, cycle times, saturation and workloads with companies. With full-time union officials and shop stewards, objectives were discussed in relation to these issues which have become part of the union’s bargaining agenda, despite the fact that Italian companies refuse to recognise the right of the union to negotiate work organisation issues on which they claim to be able to take decisions unilaterally. Secondly, the possibility of discussing work organisation also involves bargaining on broader aspects, such as production volumes and workforce size.

Negotiation of cycle times, saturation and workloads, for example, can lead to a lower workload for each worker, thus determining the need to expand the workforce to maintain overall production volumes. This need is particularly strong in those departments where the pressure on workers is very hard.

The organisational and technological innovations implemented by companies, aimed at maximizing productivity through a greater degree of work exploitation, are also causing
problems in terms of health and safety. These problems affect both classic musculoskeletal disorders and forms of work-related stress. The Italian law obliges companies to adopt all measures to protect workers, including the respect of ergonomic principles in the design of workplaces, in the choice of production equipment and in the definition of work and production methods. The implementation of these safety measures must take place with the involvement of the trade union: in many situations, the discussion with companies on health and safety problems allows for the involvement of work organisation issues which, as said before, companies would like to determine unilaterally.

Levels of stress and pressure on workers have also worsened as a result of the use of technological systems to control work performance: trade union bargaining is trying to limit and regulate the use of these tools. This issue is not only limited to privacy but is functional to a certain model of work organisation.

Last but not least, the issues of outsourcing and production chains. In order to limit the negative consequences of these corporate strategies, CGIL has defined the objective of practising so-called «inclusive bargaining»: i.e. bargaining that also involves the workers of sub-contractor companies and supplier companies. This is a very ambitious and difficult objective, but it can no longer be postponed in the light of the concrete form taken by the industrial structure in Italy (and in Europe).

4. Conclusions

The structure of the European automotive industry is characterised by two main aspects: the production chain is highly fragmented and dispersed across different countries; but, at the same time, supplies must be sent to OEMs on a just-in-time basis, so all the stages of the entire production chain must be closely synchronised. Industry 4.0 technologies make it possible to coordinate these increasingly complex and fragmented chains, as a result of the use of ICT tools and apps that make it possible to manage and monitor all the phases of the process in real time.

Italian automotive supply chains are under pressure from two entwined phenomena: the reduction of vehicle production in Italy, which has obliged Italian suppliers to increase the volumes of components supplied to foreign car manufacturers; and the competition exercised in this area by low-cost plants in central and eastern Europe that are supplying the western European automotive industry.

Italian supplier companies are responding to this pressure by intensifying the exploitation of the workforce.

Technological (Industry 4.0) and organisational (Lean Production) innovations are closely connected and, as a result of these connections, are leading to new models of work organisation. These new models are having a serious impact on working conditions, symbolised by the intensification of the pace and rhythms of work; the saturation of workloads; the real-time control of work performance (in turn leading to workers being subjected to increased work-related stress); and often also to occupational deskilling.
A different use of technologies, i.e. to support workers rather than to establish the ground for their further exploitation, is certainly possible: but this requires trade union intervention for a different organisation of work and production. It is clear that technologies cannot be negotiated only from the point of view of their use in practice, but starting from their conception and design: only in this way will it be possible to plan interventions which are in favour of workers (Dina 1982; Noble 1979; Panzieri 1961).

References


Matteo Gaddi

The challenge of digital transformation in the automotive industry


Appendix

Overview of case studies

<table>
<thead>
<tr>
<th>Name</th>
<th>Italian employees</th>
<th>Multinational</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cebi Motors (Tier 2 supplier)</td>
<td>226</td>
<td>This company is part of Cebi Group: this is a Group headquartered in Luxemburg, with more than 3,000 worldwide employees and 11 plants in eight different Countries</td>
</tr>
<tr>
<td>Fiamm Energy Technology (Tier 1 supplier)</td>
<td>394</td>
<td>Fiamm was bought by Hitachi, so it became an Italian subsidiary of this multinational company</td>
</tr>
<tr>
<td>Midac (Tier 1 supplier)</td>
<td>485</td>
<td>Italian company with worldwide presence (this company had subsidiaries in France, Germany, UK, Sweden, Nederland, Australia)</td>
</tr>
<tr>
<td>Fonderie di Montorso (Tier 3 supplier)</td>
<td>413</td>
<td>Italian company</td>
</tr>
<tr>
<td>Magneti Marelli (Tier 1 supplier)</td>
<td>5101</td>
<td>Magneti Marelli has been sold by Fiat (FCA) to the Japanese group Calsonic Kansei: both groups (i.e. both Magneti Marelli and Calsonic Kansei) have a worldwide presence of production plants. Together they have created a company (Marelli) that has over 170 sites worldwide (production plants and research and development centers).</td>
</tr>
<tr>
<td>STMicroelectronics (Tier 1 supplier)</td>
<td>10300</td>
<td>This Group has a worldwide presence and a total of 46,000 employees. The company involved in the research is the Italian subsidiary.</td>
</tr>
</tbody>
</table>