AI-BASED WORKER MANAGEMENT IN AN AUTOMOTIVE PARTS MANUFACTURER IN ITALY: IMPLICATIONS FOR OCCUPATIONAL SAFETY AND HEALTH

1 Introduction

With the development of advanced and highly integrated digital technologies, new models of management have been progressively introduced in the workplace. Until now, most of the attention has been devoted to platform workers, given their new socio-economic and institutional characteristics. However, increasing evidence highlights how worker management models based on AI and algorithms have also been spreading in more traditional contexts, such as the manufacturing industry, calling for further research. In fact, rather than showing a uniform and deterministic pattern, important heterogeneities emerge concerning the deployment of these technologies and their impact, both on the production process and on job quality. The goal of this report is to provide novel evidence on such topics, through a case study of an automotive company located in Italy. Being part of a broader campaign of EU-OSHA aimed at identifying opportunities and risks behind the adoption of new worker management models, this study tries to combine the analysis of the organisational, technological and social characteristics of the firm. The main assumption is that health and safety issues do not represent separate dimensions, but rather are at the intersection of all the domains under study and need to be addressed in a comprehensive and interdependent way.

2 Methodology

Data have been gathered through the combination of multiple sources, from official documents shared by the company, field observation and interviews with workers, held both at the firm's premises and remotely. Several job profiles were covered to ensure an adequate representation of the workforce composition, from line and quality operators to workers with managerial responsibilities in the departments of production, logistics, maintenance and human resources. Additionally, external occupational safety and health (OSH) experts were also involved as key informants on the specific practices adopted by the company. Interviews followed a specific template agreed upon with EU-OSHA and were conducted both in the form of individual interviews and focus groups.

3 Business model and work organisation

Brief presentation of the company

The firm under study is a company with 49 full-time workers, located in the province of Naples, in the south of Italy. The company sells carbon-coated synchroniser rings to automotive firms, mainly original equipment manufacturers (OEMs). The ring is an important component of manual and dual-clutch gearboxes of internal combustion engines and hybrid cars, trucks, and similar vehicles. Despite a relative uncertainty in the sector due to the conversion to electric vehicles, which do not require this component, the company has been recording a stable production level, with more than 6,825,000 rings produced in 2023. The company's core production activity – the coating of synchroniser rings – is carried out through three different processes: coating the carbon and applying the glue on the ring; coating the carbon without applying the glue (already present on the carbon); molybdenum thermal spray coating of the ring. These processes show important differences. They include manual tasks performed by the operator (i.e., visual inspection after sandblasting), automated tasks performed by the machines (i.e., sandblasting, glue spraying) and tasks that can be performed alternately by the operator or the machine (alignment of the carbon strip). In fact, the degree of automation is not fixed and can be modified by the company according to production volumes and customers' requirements. The firm is part of an international group headquartered in West-Central Europe, which employs 12,704 people worldwide and is present in 38 different countries. Among the coordination mechanisms adopted at international level, a program of excellence is held every month for representatives of each local unit to discuss improvement proposals. On this occasion, best practices can be applied to different plants with the support of the firm that first introduced them.[1]

The adoption of lean organisation model and advanced technologies

An important process of renewal aimed at increasing productivity, efficiency and quality started once the company, founded in 1998, moved to its current 4000 m^2 factory in 2008, with the idea of radically changing the structure of the company's processing layout. In the context of the financial crisis, which strongly hit the automotive sector worldwide, the company was supported by a consultancy firm, expert in lean organisation models. The main goal was to move from a traditional production process, where each worker performs a single task, to integrated workstations where the worker is able to perform all tasks and produce the final good. During the initial experimental phase, the company quickly became autonomous in such a transition process. In fact, while introducing automated solutions to enhance productivity and improve working conditions, the company began to design in-house machinery and equipment tailored to its needs, to overcome the technical constraints of technologies available in the market.[2] Digital technology was also gradually introduced, mainly through the adoption of Systems, Applications and Products in Data Processing (SAP) – an enterprise resource planning software – whose user interface was developed in-house by the company's IT specialist. To ensure an easy and efficient use of SAP by the whole company (from production to administration), the implementation process actively involved workers through the collection of their suggestions.

Workers' functional flexibility, skills and training

To operate efficiently, the company relies on highly functional operators who can manage the entire process and cope with changing constraints when moving from one workstation to another. Indeed, given a certain variety in the production process, each workstation is characterised by a different set of tasks and specific matrix of competences. Consequently, a one-month training program is provided for new operators. The course includes first formal training (covering health and safety, quality, etc.) and then specific training on the job, where the operator is supported by the supervisor in performing working tasks. During this initial period, the pieces produced go under stricter quality controls. Once the zero-defect standard is reached, the operator is allowed to work autonomously.[3] To a different extent, administrative workers and managers also rotate among different roles. Such functional flexibility and internal job mobility is indeed perceived as a learning practice that enables a better understanding of the entire process and enhances a smooth interaction among departments. With respect to the adoption of the lean model, the entire workforce was actively involved in workshops and training courses, provided by the consultancy firm. Meanwhile, no specific training was devoted to digital technologies, including the more recent application of AI-based solutions to manage workers – that is, AI-based worker management (AIWM)[4] tools. Rather, a strategy of 'learning by using' was pursued by the management, as technological innovations were introduced step by step and tested directly on the line with the operators. During this transition phase, workers were indeed encouraged to share their feedback about difficulties and bottlenecks encountered in dealing with the new devices.

4 AIWM and its implications for the workforce

Adoption of AIWM

Digital technologies and AIWM are now widespread in the company, affecting all hierarchical roles and production stages. To better assess their impact, it is crucial to identify their main applications. The table below provides a synthetic overview of the tasks performed through digital technologies and AIWM, distinguishing among production, maintenance and logistics departments.

As the table below clearly shows, the main (and in some cases overlapping) areas of application of AIWM concern: **allocation of tasks, communication and information tools** (i.e., automatic daily assignment of operators' workbook via a screen device, alerts on statistics to be compiled before

[1] The company under study already provided support to other plants, given its experience with lean work organisation models.
[2] A machine designed by the company was recently installed at another plant of the group located in Italy.
[3] In terms of quality, the company records only 2.5 pieces with defects per one million products.
[4] AIWM identifies technologies that allow the totally or semi-automated management of data to take decisions concerning the workplace, both through the application of predefined rules (algorithms) and dynamic models of artificial intelligence.

starting to work and during the process); **quality and safety controls** (i.e., validation of batch packaging, control of machines temperature); **planning and maintenance design** (i.e., updated change in the production plan of specific products in case of changing requirements, alerts on preventive maintenance interventions based on breakdown frequency); **logistics management** (i.e., updated delivery of raw materials and final product picking, warehouse management and validation of batch composition).

Table 1: Main applications of digital technologies and AIWM across departments

	Production	Maintenance	Logistics
Main tasks performed through technologies (i.e., SAP, barcode scanners, sensors)	▪ Collection of data on production targets, raw materials, quality requirements, workstation productivity, etc. ▪ Provision of technical sheets and virtual configurations of products and machines present in each workstation. ▪ Communication tool for assistance and support.	▪ Communication tool for requesting maintenance intervention and assistance (classified by urgency). ▪ Collection of data on all maintenance operations (time required, workstation, type of components used, type of failure, total cost, etc.).	▪ Collection of data on available stock and raw material consumption at each workstation. ▪ Integrated collection of data on batches to be sent to customers (from raw materials used to final product) and stored internally for agile consultation. ▪ Virtual representation of the warehouse and inventory management.
Main AIWM applications	▪ Workbook assignment to operators via the monitor when they log in with their personal badge. ▪ Set-up of the workstations (after the launch of a new production order by the production manager) based on the features of each product and associated process. ▪ Preliminary checklists on quality, safety and production requirements to be validated by the operator to start working. ▪ Alert system for the collection of specific statistics on the product (on average every two hours).	▪ Preventive maintenance warning system based on optimal intervention frequency (derived from data analysis on machines failures and directly modifiable by the maintenance manager). ▪ Workstation set-up checklist (to be completed by the maintenance operator).	▪ Real-time updating of material consumption at each workstation (while the operator produces the final product, the system automatically computes the amount of material used) and generation of delivery programmes every two hours. ▪ Control and validation of the final product packaging. ▪ Generation of transport documents with complete traceability of the entire process. ▪ Automatic risk assessment in case of quality claims on other products with similar characteristics.

Source: Author’s elaboration based on workers’ interviews and field visit at the plant

5 Psychosocial and organisational factors at play in the use of AIWM

Given the extensive use of these technologies within the company, the impact on job quality needs to be assessed in a multidimensional way, considering both the different domains of job quality and the hierarchical role covered by the workers.

Autonomy, standardisation and professionalism

A first job dimension strongly impacted by these technologies is the degree of autonomy that workers exert while performing their tasks. Even though the production process is subject to strict quality controls that must be respected carefully, evidence is found of a more discretionary management of daily tasks, both in formal and informal ways. For instance, the possibility of looking at workbook assignment on the monitor without interacting with any supervisor is perceived by the operator as a form of enhanced autonomy in managing own job (i.e., checking alone the assigned work cell and related tasks), even if he knows that the decision was taken by the production manager. In the case of logistics, the availability of updated information on each workstation allows the milk-runner[5] to better organise his delivery schedule, according to the actual priorities that he faces. As for maintenance, the possibility of receiving detailed requests for assistance and the availability of stored data on previous operations and risks of breakdowns, increase the worker's self-confidence when making decisions. Generally, both middle managers and operators report a feeling of higher entitlement in performing their tasks, as the system provides a validation of their professionality. This sense of 'empowered professionalism' is also due to the perception of having a comprehensive and broader knowledge of the entire process, which becomes more standardised and methodical, and less prone to unexpected events.

Work intensification but also enrichment of tasks and upskilling

The use of digital tools and AIWM has led to an overall increase in productivity, as all workers confirm they can perform their daily tasks more quickly, with considerable time saving and enhanced efficiency. At the same time, such work intensification has also translated into an enrichment of the individual set of tasks. Given the extensive and instantaneous availability of digital data (previously stored only in paper form), as well as the ability to communicate with the rest of the company (without physically moving), workers confirm dedicating more time to other tasks. This results in an upskilling effect, especially in the case of supervisory and technical roles. Indeed, they can focus on activities less linked to the production process, but that are still crucial to fostering the innovative capabilities of the firm. For instance, while the production manager can devote more time to designing new technological solutions, the maintenance manager can provide more training to operators, while the logistics manager can more easily adapt his daily program, anticipating or postponing activities according to changing customer demands or business needs. In the case of operators, the potential risk of deskilling due to the pervasive role of AIWM seems to be counterbalanced by their direct involvement and advanced individual use of these technologies.

Data availability, control and surveillance

Data collection is continuous and covers all stages of production. For example, at the end of each shift, the production manager receives an automatically generated email, providing detailed data about final products produced per workstation, compliance with targets, an overview of any problems encountered and the solutions adopted. Previously, this data could only be collected on paper or by talking directly to the operators, with clear costs in terms of unsolved asymmetric information and time waste. The operator, when logging into the system at the start of the shift, can see on the monitor – together with a message from OSH awareness campaigns about the use of personal protective equipment (PPE), etc. – the workbook (weekly shift, workstation, specific PPE required) together with detailed information about any issues that occurred the day/shift before at the same workstation. The maintenance operator also relies extensively on data in the daily work: not only does the operator deal with on-going intervention requests, but it is possible also look at the operations made during the previous day/shift. Once a maintenance intervention is completed, information on its total cost (in terms of working time, price of components, production loss) is automatically displayed to all the workers involved. However,

[5] The milk-runner is the logistics operator in charge of delivering raw materials and picking up final products from workstations.

rather than being seen as a tool of surveillance, such intensive collection and broad availability of data is perceived as a communication channel. It becomes a tool of collective transparency that increases the sense of commitment of workers in performing their tasks efficiently. Even the emergence of unexpected bottlenecks seems to be handled more calmly by the operators, first because they feel the 'authority' of directly signaling the problem and secondly, because they know that everything is recorded by the system. Indeed, by having a comprehensive overview of the entire production process, workers feel that such data is not used to control them, but rather to increase efficiency, to support them and in this way to even improve their working conditions.

6 The implications of AIWM for OSH

Brief overview of OSH risks and management strategies

The type of production carried out in the company under study exposes the workforce to a wide array of health and safety risks. Macro hazards include the risk of explosion due to the storage and use of flammable gases (i.e., acetylene, oxygen), solvents, machine and coating oils. Occupational risks include exposure to vibration and noise (caused for instance by the sandblasters); bio-chemical risks and dust exposure (caused by the coal and molybdenum processing); accidents related to the use of automated machines (i.e., injuries, dragging damages, burns); manual handling of loads and repetition of tasks. Over time, an in-depth process of risk assessment was initiated by the company together with OSH specialists to reduce the incidence of these hazards, which are now well below the minimum legal threshold for intervention. Technological and organisational solutions were pivotal to reach this outcome. First, the creation of closed workstations, equipped with air conditioning and cleaning systems, has drastically reduced both workers' exposure to noise and the incidence of bio-chemical risks. Concerning ergonomics, several technical solutions have been introduced to lower the frequency and intensity of movements, together with a significant adoption of automation that, according to the workers, could be further implemented.

More recently, given the higher productivity recorded in the last years, an additional daily break has been scheduled to give operators more time to rest and socialise.[6] Indeed, workers usually spend most of their working time alone in closed work cells. Thus, increasing moments of interaction and collective breaks was deemed by the management as crucial to mitigate the risk of isolation and to improve workers' psychological wellbeing, especially in the presence of radical organisational and technological innovations. Indeed, the impact of AIWM on health and safety is also relevant, especially in the area of physical and mental stress, as briefly illustrated below.

AIWM and ergonomic risks

In the case of ergonomic hazards, a positive impact of AIWM is found in all departments, both because of the diminished number of physical movements needed to communicate with other colleagues and the reduced physical effort required to perform specific tasks. For instance, the possibility of opening a request for assistance from the workstation translates into an important saving of time and physical effort for the operator, since instead of exiting from the workstation and walking across the plant, the operator can continue the work. The maintenance worker also reports a decrease in physical effort, as it is now possible to reach the workstation with all the necessary tools, according to the information provided by the operator in the online request. In the case of logistics, the improvement is even larger. In fact, the milk-runner can more efficiently deliver the materials to the workstations, without having to go back to the warehouse in case of an incomplete or incorrect list. Moreover, while picking up the final product from the workstation, the operator is not required to visually check all the products' codes and to manually record them on a paper, thanks to the barcode scanning system that validates his operations and transmits the information directly to the warehouse. In addition, the packaging of deliveries for customers is less physically demanding, thanks to the availability of the virtual warehouse through which the internal composition of batches can be validated while their exact location is recorded.

[6] Apart from a 30-minute lunch break, operators have a 10-minute break every two hours. Working time is organised into morning shifts (from 7 am to 3 pm), evening shifts (from 3 pm to 11 pm), or central shifts (from 8 am to 4 pm) for coordination roles.

Cognitive stress

A better management of the time available to perform different tasks and the more efficient and autonomous handling of quality constraints and emergencies result in a general improvement of mental and cognitive wellbeing, both for managers and operators. In the case of managerial roles, the reduction in mental stress is strictly related to the capability of better dealing with unexpected problems, through preventive interventions, advanced risks assessment and immediate response. For operators, AIWM is perceived as a tool that lightens the workload, whether in the form of statistics alerts (for production), set-up checklists (for maintenance) and batch validation (for logistics). In all these applications, the worker is not asked to remember all the necessary steps, but the system reminds him what to do and ensures that everything is done in the correct way. Previously, the risk of being interrupted and consequently forgetting some tasks represented an important source of stress for the operators.

Social relations and work-life balance

In terms of social relations, the way digital tools and AIWM have been deployed in the workplace ensure that each worker can contact the rest of colleagues when needed. This fosters a sense of social involvement and better coordination. More precisely, evidence is found of a perceived reduction in the social distance across departments and hierarchical levels: an improvement in the quality of verbal interactions as they result in being ‘freed’ from the technical urgencies (handled by the system); and a general reduction in conflicts and tensions, previously due to misunderstandings and unclear communication. Important improvements are also recorded in the domain of work-life balance, both in direct and indirect ways. In the case of managerial roles, the impact is direct since the availability of detailed and updated data has facilitated the management of emergencies and unforeseen problems (i.e., the unplanned absence of a worker or machine breakdowns), drastically reducing the frequency of calls outside of working hours. In the case of operators, the effect is indirect, as the certainty of having correctly respected the entire sequence of tasks required (through the system of alerts and validation) gives the workers the serenity to focus exclusively on their private sphere once at home, without worrying about having left something unfinished.

7 Social dialogue

Industrial relations

In the company, no formal union representative body exists, although two workers have been elected internally to represent the entire workforce on specific issues, such as the definition of production bonus criteria. The company is covered by the most representative sectoral collective bargaining agreement in the automotive industry.[7]

Participatory practices

Despite the lack of trade union and firm-level bargaining, workers report a strong sense of belonging to the company. Indeed, the average tenure is 15 years, such that many operators feel to have ‘grown up’ together and tend to use the plural when talking about the history of the firm. The adoption of a lean work organisation model has been a key driver in activating this participatory mechanism, in line with the assumption that workers do not simply execute tasks, but they act as problem solvers. At this stage, digital technologies seem to further strengthen such a path. The most important and successful participatory practice is the possibility for workers to make proposals for improvements concerning any sphere of the production process. The worker can send the proposal using his personal device or through the tablet available at work. If the idea is implemented, the worker gets a monetary reward that is doubled if the improvement concerns health and safety issues.[8]

[7] We refer to the *‘Contratto Collettivo Nazionale di Lavoro per le lavoratrici e i lavoratori addetti all'industria metalmeccanica privata e alla installazione di impianti’* (National Collective Bargaining Agreement for workers in the private metalworking and plant installation industry) signed by the three national trade unions: FIOM-CGIL, UILM-UIL, FIM-CISL.

[8] The list of ideas implemented includes: the automatic bench height adjustment system; the adoption of a round disc, rather than rectangular, to allow uniform treatment of the ring surface; the automated positioning of the ring in the thermopress to reduce the risk of burns; and the distinction between a general request of assistance and a request of maintenance.

Relations with institutional stakeholders

The company is also very active in forging relationships with institutional actors on specific projects, especially concerning health, safety and managerial best practices. Among the collaborations recorded in the last years, it is worth to cite the on-going project with the ICS Maugeri on the adoption of wearable shirts aimed at detecting the most strenuous movements executed by the operators in the workstation. Increasing attention is paid to these issues, given the aging of the workforce. Another important collaboration started last year with INAIL aimed at developing best practices at the workplace, especially through the improvement of communication and the creation of periodic moments of dialogue between all the members of the company.[9]

8 Key takeaways

Several interesting conclusions can be drawn from the presentation of this case study. First, the strong **interaction between work organisation models and adoption of new technologies** (AIWMs in this case) is strongly confirmed. What is pivotal, however, concerns the virtuous circle emerging from the adoption of advanced technologies aimed at both **optimising the production process and improving working conditions**, highlighting the interdependence between the two. Putting **labour at the centre of value creation** implies, in the case of this company, a **solid commitment to health and safety goals and prevention programmes**. In fact, given the tight quality standards and the strong competition faced by the supplier company in the global automotive market, a complex strategy of **technological upgrading, learning dynamics and participatory practices** has been put in place to pursue the goal of **continuous improvement** in all spheres of the production process. In such context, a **wide and transparent collection of data**, as allowed by AIWMs, does not only increase the productivity of the entire plant, but it also **enhances a strong sense of responsibility among workers**, who feel entitled to intervene and make suggestions, while becoming **more prone to accept the pervasive use of these tools**.

Author: Armanda Cetrulo – Sant'Anna School of Advanced Studies | SSSUP · Institute of Economics.

Project management: Maurizio Curtarelli, Emmanuelle Brun – European Agency for Safety and Health at Work (EU-OSHA).

[9] The ICS Maugeri is a scientific clinical institute, while INAIL stands for National Institute for Insurance against Accidents at Work.