SODIMA
Social Dialogue for the Future of Manufacturing

Position paper

Organization, skills and social dialogue: towards digital manufacturing

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SoDiMa – Social Dialogue for the future of Manufacturing

Digitalization and automation in the manufacturing sector are among the most important challenges for the social partners representing companies and workers. Trade unions and employers' associations are facing today a difficult and rapid transition (due to Internet of Things, Big Data, Collaborative Robotics, 3D Printing, Artificial Intelligence) which must be governed so that it does not generate the loss of millions of jobs, as several studies have predicted.

The objective of the parties must be to reconcile the protection of work with that of greater competitiveness and productivity for companies. This is why new skills, training and work organization are as fundamental as urgent aspects to deal with. Yet these are elements that cannot be achieved unilaterally by any of the parties involved.

For this reason, the SoDiMa project sets out to put social dialogue at the center of the transition towards the manufacture of the future and wants to do it right at the European level, by strengthening the Sectoral Social Dialogue Committee on Metal Industry answering to the challenges of the EU document. A new start for social dialogue, its activities and its visibility with new and innovative results and activities. The reinforcement of the Committee and the involvement of countries with different maturation levels of digital manufacturing will favor the exchange of good practices and the development of guidelines that can help individual states to increase both business innovation levels and workers' skills.

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This position paper was conceived at a time when the changes introduced by the pandemic were not on the horizon of companies, workers and governments. At the same time, however, it became increasingly clear, in the past months, that many of the challenges that the pandemic has thrown us are deeply connected with several transformations already in place. Some of these major transformations include widespread digitalization and the organizational impact of the massive introduction of remote working around the world.

In fact, we know that before the pandemic, there were few companies (especially large ones) in which remote work was widespread, whether in the form of teleworking or what is commonly referred to as 'smart work'. Especially in the manufacturing sectors, in which the great centrality of manual work, and more generally, of the shop floor as the main place of production processes limited the use of remote work (and with it the opportunities it can bring in terms of work organization). The new needs generated by the pandemic has instead led many companies to introduce remote work for those for whom it was possible, but we know that often this has not been accompanied by real changes in the ways of organizing work, apart from the spatial dimension, especially because of the rapidity and the emergency nature of these changes. Companies and

workers already involved in adopting and discovering new ways to organize work found themselves readily adaptable, while others faced more difficulties. It is therefore necessary to be wary of the assertions stating that the mere spread of remote work in recent months has contributed, almost automatically, to modernizing the organization of work. On the contrary, there is still a long way to go in order to coordinate three dimensions: technology, skills, and organization. The coordination of these three dimensions looks at the worker (whether blue-collar, white-collar, manager, or other) as the central figure around which to build models that can reconcile productivity, efficiency and higher degrees of autonomy and responsibility. One of the great challenges that the pandemic has reminded us is that we need a work organization that can change easily in order to adapt to a productive environment and, in general, to a highly flexible economy. This includes overcoming some principles of the Taylorist model of the early twentieth century to make people and processes more equipped to adapt to unexpected events and a changing demand, in which the role of the consumer (that' very unpredictable) is increasingly central. For this reason, we believe that the contents and results of the SoDiMa project, within which this document is part, are not only important, but also very actual in this particular phase of the history.

It is recognized by plenty of studies, starting with the theorists of the socio-technical paradigm in the nineteen-seventies, that technologies without organization risk translating into a great promise that does not bring the desired results. The possibility of producing customized goods and adapting processes according to the data that is produced and analyzed requires an organizational model in which the division of labor isn't conceived as an extreme fragmentation of tasks, but rather the enabling of changeable jobs and roles that, through the skills possessed by those worker involved in them, are able to respond to environmental stimuli. This therefore means intervening on the hierarchical structures within the company, which must not lead to an ungovernable anarchy but rather to a more horizontal distribution model of responsibilities in order to reduce the bureaucratization of decision-making processes that excessively tighten organizations. To do this, models must be introduced in which, in the face of greater responsibility by the workers, ways can be identified to ensure greater transparency and information flow to them, so as to allow a better exercise of their role within complex processes. This leads to a way of working in which worked hours remain an important tool but not the only way to determine wages, as still happens in most of the companies. A reward system, therefore, that makes wages and productivity interact more, but within a clear organizational model and with all of the tools and methods that make it truly efficient and functional.

The last aspect of legacy left by the pandemic months, probably the most important, is that of the relationship between time, space and organization. Considering the fact that manufacturing companies do not have the possibility of a widespread diffusion of remote work, what has recently emerged is that the major limit to it for companies and workers is not the technological availability, but the absence of new efficient organizational models not based only upon the physical presence of the workers. These require a mature discussion on the relationship between space and time of work, that also takes into account the potential of technologies in the manufacturing sector. The knot of remote working is organization. The peculiarities of individual companies (type of employees, seniority, trade union relations, work-life balance needs, etc.) are a fundamental element in deciding whether and how much to apply this remote working tool, which is not APPLICABILE TO everyone.

1) Work organization for the digital manufacturing, challenges and methods

What has been said thus far brings us to understand that, on the one hand, it is not possible to push the problems made visible by the pandemic to the background, because they are largely due to the organization of work in digital

manufacturing rather that to the emergency. On the other hand, we cannot imagine understanding, analyzing, and governing these problems as if they were totally contingent and not instead inserted within a wider set of structural needs generated by the set of transformations that are not only technological (but also demographic, environmental, etc.), as summarized in a broader concept of "Fourth Industrial Revolution".

Let's start by saying that it is difficult to find a company that has not faced the organizational challenge that the Covid-19 emergency has brought about. For years there has been a discussion, sometimes in an abstract way, of adapting organizations to the needs of flexibility that came from the outside scenarios and stimuli. But in this situation, this need for control has taken on even more urgent characteristics that have put businesses and workers to a severe test. This can also be seen as one of the positive aspects, if we can use this term, of the crisis we are experiencing because it has forced us to review some key points of the organization of work that has constituted objective limits to the processes of innovation of production models.

The reference, in particular, is to the strong presence of Taylorist organizational logics, which have emerged well (as obstacles) in the face of the attempt to introduce modern forms of remote work to manage the emergency. Attempts to introduce remote work have resulted in the simple moving of work performance from within the boundaries of the company building into the workers' homes, without, i.e., concrete boundaries in terms of autonomy with respect to working times. The boundaries are blurred and there is a persistence of the still dominant logic of constant control and monitoring of work activities. The pandemic led to companies and workers encountering the organizational and even psychological upheaval due to the switch to remote work, for the first time. This has caused a disorientation deriving from no longer recognizing the physical boundaries in which one is used to carrying out the work performance. Borders that are far from being only material, generate bewilderment and loss of reference points in relationships, hierarchies, times, and working methods. This has made it clear that organizational changes are something much deeper and more complex than the introduction of digitization processes for certain tasks, as can happen through remote work.

And here it emerges strongly that if the Taylorist organizational logics once had their own justification in the ownership by the employer of the means of production (mainly machines), and its consequent prerogative to make them work in the places and times he wanted, today all this seems at least anachronistic for an increasing share of workers

and companies, especially through digitization. The alibi of the technological impossibility of dissolving the space-time boundaries of work was quickly put into crisis by the fact that companies have been able to relocate a very large part of the tasks to the homes of workers, and also that the machines themselves, and therefore physical production processes, can increasingly be governed from a distance. The challenge for the post-pandemic phase, however, is to make this mere physical moving a true organizational revolution. They key here is precisely linked to the permanence of a corporate and union culture which is refractory to abandoning Taylorist structures, because they are still conceived as the only guarantee of an effective organization that is able to manage people and processes.

On the contrary, however, today the changing demand of the markets, and the increasingly invasive role of the consumer in business decisions and international competition, requires much more streamlined and participatory processes than those guaranteed by the hierarchical chains and the very wide division of labor of companies in the twentieth century. In this perspective, greater autonomy and involvement of workers in the organization of their work would be a consequence of the awareness of the need for greater fluidity, co-responsibility and flexibility.

The goal, especially in modern companies, is to reconcile an efficient production model with high levels of productivity with the satisfaction and well-being of its employees, as well as a positive and collaborative business climate. The scenario of digital manufacturing is an opportunity to innovate organizational models, and at the same time, new organizational models are an important tool to accompany a rethinking of business models.
But the organization of work cannot be imagined and designed without a very close link with the business model of the company and with the specific production carried out.

The link between organization and production systems can be clarified with a historical example. Fordist production, characterized by a very high level of standardization (i.e. for Ford's Model T was available in all colors "as long as it is black") and the presence of the assembly line, required a model of work organization like the Taylorist one which was based on the extreme fragmentation of workers' tasks, limited individual autonomy, and single use of the physical strength of the worker without interest in the intellectual component. In a Fordist system, this organization of work made it possible to calculate and organize production efficiently, precisely controlling the actions of collaborators and evaluating their productivity. This also allowed companies to pay high wages, given by the increase in

productivity allowed by this organizational model, and gave those who produced more the opportunity to receive a greater salary.

Beyond the historical judgments and limits that much literature has highlighted, Fordism and Taylorism have been a successful attempt to reconcile the efficiency of the production system and the needs of collaborators through an original form of work organization. It is precisely with the crisis of this model that the first organizational studies have begun to develop that relate the organization of work and the levels of innovation within companies. In fact, Fordism was a model that, at least in the West, characterized production in all manufacturing sectors, but with the changes that have occurred since the 1970s (the oil crisis, saturation of internal markets after more than thirty years of the postwar period, new technologies, etc.) the model of Fordism had to be rethought. So many different theories arose, starting from the attempt to apply the Toyota Production System organizational model and Lean Production, which are adapted according to the needs of the national contexts. The relationship between new organizational practices and innovation is expressed in several chapters, which we can summarize as follows:

- **New organizational and HR management practices**: the reference is to the so-called High Performance Work Practices (HPWP) implemented by companies in order to improve the efficiency of workers and in order to increase their collaboration and individual performance with the aim of a return in terms of profits and productivity. Examples include teamwork, job rotation, and individual variable pay based on performance.

- **Training**: this refers to the presence of both on-the-job and external training courses for the purpose of greater alignment between the individual skills of collaborators and production process technologies, as well as an expansion of the specific tasks of the worker. In particular, the provision of on-the-job training takes place more effectively through the application of organizational methods based on problem solving and teamwork.

- **Time management and workplaces**: i.e. the introduction of new models of hourly flexibility, which derogate from the traditional 7/8 hours per day in order to allow both greater freedom for the worker and greater freedom for companies, which increasingly find themselves working in a climate of strong international competition and with consumers who require individualized products with consequences on processes. More recently, through the possibilities offered by remote control technologies and cloud-based

servers, management systems have been introduced for the place of work performance other than those in the workplace.

- **Outsourcing**: understood not only as the use of external resources by leveraging the so-called "numerical flexibility" in particular periods but, in a modern sense, as an open human resource management model that is not only focused on core collaborators. This model includes the creation of business networks and therefore the sharing of highly professional workers (especially for SMEs that cannot afford ad hoc recruitment), the use of university researchers or researchers from research centers or modern platforms digital (the so-called gig-economy) in which there are professional freelancers able to respond to specific needs.

Eurofound research shows how the presence of workers with access to training courses, variable remuneration tools and flexibility schemes in the management of working times leads to an increase in innovation levels of 9%. Similarly, the presence of ways of organizing work based on consultation of workers for improving processes can increase these levels by 8%. Furthermore, the same research shows how the very presence of these forms of organization and employee involvement increases the probability of investments in innovation driven by

them. For example, if a company introduces innovative forms of personnel management, these can enable it to invest in technology by virtue of the fact that its work organization system will be able to manage them better. In the context of digital manufacturing, the new organizational models can therefore be a tool capable of accompanying, encouraging and increasing innovation processes.

The foregoing concerns in particular innovation and the improvement of performance, but there are also links between new forms of work organization and worker well-being. In fact, it is the European Commission that, in the Europe 2020 Strategy, defines true innovation as "sustainable and inclusive". Eurofound research itself demonstrates, in the light of empirical surveys in various European countries, that where innovative HR Management practices are developed, workers' well-being levels are higher. In particular, it is those forms of organization that are based on mutual trust that alone manage to increase the level of well-being by 7 points.

Man with the machine

Some studies have then advanced hypotheses of concrete application of models of complementarity between technologies that identify the paradigm of digital manufacturing. In particular, the concept of Operator 4.0 was developed, as "a smart and skilled operator who performs not only -" cooperative work" with

robots - but also - "work aided" by machines as and if needed - by means of human cyber-physical systems, advanced human-machine interaction technologies and adaptive automation towards "human-automation symbiosis work systems".

The goal would be to "create trusting and interaction-based relationships between humans and machines, making possible for those smart factories to capitalize not only on smart machines' strengths and capabilities, but also empower their 'smart operators' with new skills and gadgets to fully capitalize on the opportunities being created by Industry 4.0 technologies".

This could happen through different systems, in particular through a particular declination of Cyber Physical Systems in terms of human cyber-physical production system (H-CPPS) intended as "a work system that improves the skills of operators through a dynamic interaction between men and machines". In physical and virtual worlds by means of "intelligent" man-machine interfaces. This takes the form of various hypothetical hybrid figures, think, for example, of the augmented operator who uses augmented reality technology to enrich the work environment with data, sounds, images, and graphics that can contribute to a better execution of the performance in terms of both experience and productivity.

Therefore, new ways of cooperating between man and machine are outlined within the paradigm of digital manufacturing. It is possible to see how processes develop in different production realities which, contrary to what happened only a few years ago, combine two different types of intelligence in place: that of the worker and that of the machine. On the one hand, a creative intelligence capable of reacting to the stimuli of changing and unpredictable environments, and on the other hand, a computational intelligence that would be impossible for human minds, which is based on the ability to analyze and process data capable of providing indications for actions and activities. No longer is it a passive use of the machine by the worker, who understood the machine as a fundamental tool to facilitate his work (but at the very end a blind tool), but more an active and proactive use that can enhance the two intelligences. It is therefore not just a matter of changes in working methods but of a new way of understanding the role of the worker within production processes and of conceiving his relationship with all the step of the processes. This rethinking can be qualified as an overcoming of the merely executive role of the worker typical of the Fordist paradigm due to the introduction of a different relationship with machines, i.e., a relationship which, while remaining ultimately functional, is enriched with elements of complexity that make it necessary to total involve

people in their cognitive dimension. This is combined with a reduction in manual and physical workloads, made possible precisely by the introduction of machinery capable of carrying out activities previously carried out by man.

However, this scenario of change also poses some critical elements that must be taken into consideration. In fact, what has been described so far presupposes a conception of the relationship between man and complementary machine within which the role of the worker maintains a prominent and creative role, albeit in dialogue with a mechanical intelligence.

On the contrary, this concept could be canceled in favor of a substantial submission of the role of the worker to that of the machines, acting solely as controller or executor. Without involving dystopian scenarios, it would be enough simply to conceive automation processes as merely functional to business models that still works with the principles of mass production to create organizations in which workers, who would clearly decrease even from a quantitative point of view, are placed side by side with machines for carrying out those small tasks which they are unable to perform but which they themselves coordinate the workers in doing. This could increase the levels of alienation of the workers who would see their role no longer only, as in Fordism,

subordinated to the orders and directives of a superior, but of a superior who is a machine. A further critical point, also linked to the concept underlying the modeling of production processes, could be linked to the use of the machines with which the workers perform their duties which could act as a tool for controlling and monitoring their performance, generating a profoundly different climate from that described above. It therefore emerges that the impact of digital manufacturing on work, and in particular on the man-machine relationship, is not predefined but can acquire different forms and natures depending on the concept of work that the company will want to apply and, above all, depending on the business model that it will develop, as the more complicated it is and looks towards product customization, man and machine will require greater complementarity. On the contrary, if we opt, and it would be necessary to evaluate the long-term sustainability of this choice, for a simple intensification of mass production through technological automation, the man-machine relationship will qualify in a distinctly different way.

The new man-machine relationship shown above, as well as having an impact on the types of skills necessary to govern it and on the tasks necessary to implement it, is combined with a rethinking of production processes, their times, their organization, and the coordination of various human and technological resources. From this

is derived one of the main sets of qualitative impacts of digital manufacturing, which is relating to the methods of organizing work and the skills necessary to implement them.

The case for high performance work practices

It is possible to read this impact by focusing on the so-called, already mentioned, *high performance work practices* that are a set of work methods and work organization that respond above all to the needs of new business models characterized by strong flexibility and product customization. These can be divided into three groups:

- Practices that involve greater employee involvement than traditional models.

- Practices aimed at building skills and encouraging the motivation of workers and their skills.

- Industrial relations practices that help build trust, loyalty and identity with the company.

As seen, unpredictability and complexity emerge among the main features of the business models enabled by digital manufacturing. In these models, the role of the consumer is in fact central so that it contributes to making organizations more permeable to external stimuli and inputs. The latter, if not managed with adequate flexibility, risk generating a misalignment between market needs and company responses. Product customization is not just a topic of technical innovation of processes and products but above all an innovation of the organization, and in particular of the organization of work. In recent years, the belief that there is no specific model that allows companies to deal with uncertainty and complexity, but that there is a set of practices that, depending on the needs of organizations, can be applied, has become established in organizational theory.

There are several definitions of these practices. A common trait can be found in the fact that they refer to a vision that attributes a growing role to the consumer, places emphasis on the differentiation of products and services, increasingly customized to individual needs, and takes the form of a horizontal diffusion of leadership within the organization.

The practices are therefore designed to generate decentralized decision-making processes, so that decisions concerning the consumer's needs are taken as close as possible to him, so that they can be quickly modified if necessary. The goal is to generate an active involvement of collaborators who deal with individual projects, to spread their trust in their abilities, by virtue of spaces for decision-making autonomy, however, aligned with corporate objectives. Concretely, the practices can be divided into different macro-areas:

- **Practices which involve a great involvement of workers and which aim to activate**: semi-autonomous teams of workers, problem solving teams, continuous improvement teams, responsibility for work quality, job rotation, evaluation, suggestion boards, surveys and internal focus groups.

- **Practices aimed at building skills and encouraging the motivation of workers and their skills:** examples include performance and skills tests, psychometric tests, responsibility-sharing practices, individual development plans, wages and skills connections, team bonuses, salary and productivity links.

- **Industrial relations practices that help build trust, loyalty and identity with the company**: examples are the presence of formal procedures for the resolution of disputes, revision of salary levels, and moments of meeting to discuss work issues.

This classification can be extended and adapted according to the types of companies, their needs and the organizational maturity of the workers and their skills. However, the use of these work practices is not to be understood sporadically, but must be inserted within a socio-technical system that reads with the same lens the technological elements and the contribution that groups and people within the company can give in their relationships.

In the context of digital manufacturing, high performance work practices are a fundamental element, although certainly not conceived and born within this context. This is due to the fact that they constitute tools for building a non-hierarchical work organization in which decision-making processes take place in a decentralized way to adapt better and sooner to constant changes. In fact, if the processes are faster, by virtue of the central role of the consumer and customized products, an organizational model that encourages the autonomy of workers and teams is necessary, that empowers these teams with respect to company objectives, rather than with respect to methods operational to obtain them. Autonomous or semi-autonomous work groups, job rotation and the development of multi-skilled workers can therefore only be functional within a more comprehensive organizational model animated by the principles of high-performance work practices.

These practices make it possible to reconcile two different types of objectives. One the one hand, organizational objectives of efficiency, flexibility and process optimization through the introduction of practices that encourage organizational structures capable of adapting to technological potential. For example, if a new integrated production line is introduced through the Internet of Things, capable of connecting to inputs from the supply chain, new

organizational models are required that are able to ensure flexibility of response by workers to these inputs.

Furthermore, they make it possible to achieve a set of work quality and employee enhancement goals. In fact, the listed practices contribute to placing workers' initiative at the center of the value creation processes, in line with the objectives set by the company. This helps in the enhancement of individual skills and their full use, in the decrease in the levels of employee turnover and related costs, and in triggering practices of continuous improvement and professional updating.

If, for example, the relationship with a specific customer is entrusted to the responsibility of a team, which, by managing its workload independently, will be pushed on the one hand to identify original working methods that enhance its internal skills. On the other hand, the same autonomy can contribute to improving the quality of work because it can guarantee margins of decision on times and activities. All within a production environment that will therefore be able to fully benefit from the contribution of the new technologies introduced, achieving economic goals of productivity, competitiveness and profitability as much as possible in line with what was expected upstream of the investment made.

There are some characteristics that contribute and others that hinder the spread of high-performance work practices. Firstly, especially for SMEs, the introductory phase of these new practices may be too burdensome. In fact, rethinking the organization of work by introducing innovative practices leads to results in the medium-to-long term and it is therefore necessary to use those legislative and fiscal tools (such as tax relief for productivity agreements) that can reduce the economic weight of new organizational models. A second element regarding possible obstacles is given by the average age of workers, which could negatively affect the request for adaptation of habitual behavior to a new organizational model. In this sense, a slow transition is preferable, involving above all younger workers, inserting a greater number of workers that are positive towards change. A third element then concerns the level of skills present in companies: the use of these practices is simpler and more immediate when it involves highly qualified profiles with respect to which it is possible to apply logics of responsibility and autonomy.

As already pointed out, the reference to high performance work practices may seem dated, as a set of practices observed since the first half of the nineties within some particularly innovative companies. Indicating them as a key element in changing work in digital manufacturing however, means recognizing how they have become today, despite their variety and diversity, an

essential tool for organizing work within scenarios of very high flexibility and changing demand.

Therefore, they no longer acquire that character of exceptionality, often connected to enlightened and visionary entrepreneurs, but that of necessity, thus going to profoundly change the way they work. It is indeed the normalization and widespread diffusion of some embryonic changes already observed in the Eighties, and which today new technologies, and above all, new business models made necessary.

Finally, the topic of high-performance work practices is not to be confined to the purely organizational sphere as it also has a strong impact on the issue of skills, understood especially ad soft skills. In fact, a pre-condition for being able to apply these practices is to have workers who possess certain skills: from the ability to work in a team to communication skills, from proactivity to knowing how to work towards objectives, etc. Recognizing this close link is particularly important in managing the transition between organizational models of the past and those that best match with digital manufacturing as a concrete case that demonstrates how mechanical transitions between different conceptions of worker involvement cannot exist. Inserting new organizational models that are based on an active role of human resources without these possessing the soft skills necessary to accompany

them often means starting processes that will not give the desired results because they exclude, in a purely organizational vision, the relationships between people and technology.

2) New skills for digital manufacturing, how to spread them?

If it is true that the paradigm of digital manufacturing is enabled in the first place by the presence of innovation and technology, it clearly emerges that the constant updating of the skills of the workers who are and will find themselves managing, governing and using them is a central element for its implementation. The role of training and the presence of training activities and projects within companies can therefore no longer be understood, as it often was in the past as a plus of some virtuous realities, but becomes a key to the development, productivity and competitiveness of the company, regardless of its size. This also has profound implications within the labor market in which the actors of the social dialogue find themselves operating. In fact, the renewal and evolution of technologies and their applications in companies increases the levels of flexibility and with them the risk of changes in the employment structure. At the same time, it makes it more difficult to relocate workers who are victims of crises and corporate failures in the absence of professional retraining policies, a particularly worrying scenario if we think of the employment impacts of

the economic crisis that followed the outbreak of Covid-19.

The need for constant updating therefore requires the development of training strategies that are aligned with the production processes and that develop alongside them as much as possible. From this point of view, the on-the-job training model is a method that is particularly responsive to the needs of companies that want to invest continuously in innovation. By on-the-job training we mean the training carried out directly in the company, using the company as a training place with the aim of improving the technical professional skills, soft skills and with them the organizational model. During the months of lockdown, training activities have seen a strong strengthening of the forms of distance learning, which still require more strengthening to address workers in a learning process that is not merely theoretical but also practical and operational. And in this, new technologies and in particular the use of virtual reality, are particularly promising, as we will see below.

When we talk about on-the-job training, we refer to a way of training that does not take place through traditional teaching (e.g., the frontal lesson in the classroom), but is carried out through a "doing to learn" method, which identifies in experience and in practice, the training moment par excellence, within non-formal learning

contexts, such as the company, both in classroom and laboratory moments and, above all, during the work itself. It is a training methodology that allows companies and workers to derive mutual benefits. The companies are able to organize and initiate training processes within the workplace that have as their object the problems and needs of the individual company, while the workers have the opportunity to increase their skills and therefore their value in the labor market, as well as having potential positive impacts on wages. In fact, one of the elements characterizing on-the-job training is that it is constructed of training activities carried out directly by the members of the company, whether they are the managers of the areas, the workers with more experience, the team leaders, or other figures, identified with the external support of those who can contribute to the planning of these activities.

Briefly, the actors involved in on-the-job training can be traced back to several broad categories:

- Trainers who plan, implement, and deliver training activities by coordinating with each other.

- The companies which are primarily responsible for the decision to start on the job training programs and to coordinate them through figures such as the managers of human resources, training and research

and development, coordinating with the production managers, whilst training during the production processes themselves. Secondly, they are responsible for identifying tutors and trainers within the population of their collaborators.

- Institutional actors such as trade union representatives (corporate and non-corporate), employers' representatives, local, national and international institutions, who can contribute to supporting training activities through support in the organization, in favoring coordination and agreement between the parties or even by financing such projects.

- Training centers or universities, which can support in-building training projects in line with the professional needs of companies.

- The main beneficiaries of the training activities, i.e., the workers, who must be identified according to criteria aimed at filling training needs. These based on the needs of the company, the composition of the workforce according to age, professional classification, skills already acquired, role and tasks in the company, performance, belonging to a team, etc.

Therefore, the importance of identifying the best trainers within the availability of the workforce emerges. It is necessary to first identify who is able to best perform a certain task that is

considered to be the subject of training, but this is not enough. In fact, an important element concerns the aptitude for transferring information and skills, that is, the ability to be a teacher and tutor of other people. On this front there are no objective characteristics, although usually the older workers have this attitude more, since they fear less the risk of replacement by those who are training (this risk is perceived as greater by a worker with an average seniority). Other figures more inclined to provide on-the-job training are team leaders, who have already had the opportunity to be selected precisely for their soft skills in communication and knowledge transfer. Finally, another way of identifying trainers is that of a matching between the figures to be trained in relation to some tasks and others who possess skills in this regard but at the same time cover different roles and responsibilities, since this can reduce the risks of opportunism. On-the-job training can therefore be based on a redefinition of the role of the head of the area, extending it to an educational and teacher function of some collaborators of who previously only had an organizational responsibility.

In regards to the development and provision of on-the-job training courses, there cannot be a strategy that works for all companies. In fact, the effectiveness of the training action is higher the more that it develops, beginning with an analysis of the context of the company and its needs.

It will thus be possible to put into practice different activities, combined temporally in order to build a path that leads from the starting situation to the maturation of new skills, but above all, also through an ex post evaluation action, to establish a training method that can be continuous in time. Among the activities that fall within these paths, we can identify some main ones:

- **Tutoring**: this is an activity that aims to build bridges between training and the concrete experience of work through individual or collective workshops, especially where classroom training is also provided, to facilitate the transfer of skills and their internalization.

- **Mentoring**: this is training and teaching by an experienced worker towards a younger worker or in any case with a lower level of skills. It can take place directly during work, or consistently during working hours within moments of dialogue and exchange of information.

- **Coaching**: is the activity in which a manager leads and promotes the development of skills of other less experienced workers and / or with lower responsibilities and roles. This can be done through meetings and working groups to help elaborate the training courses, helping to grasp their value for the individual collaborator.

- **Teamworking**: training activity that includes the principles of tutoring, mentoring, and coaching within operational work units led by a team leader, who works according to the logic of sharing information, continuous improvement, and the pursuit of a common goal.

The context of digital manufacturing innovates the idea of on-the-job training not so much in the activities as in the objectives that they must pursue. It is not just a matter of training to update and align technical skills with the technology available, but of building training processes that help collaborators develop an idea of the overall production process and learn the links between the different phases in experience, in order to develop the fundamental competence of knowing how to anticipate problems and knowing who to refer to when they arise. Indeed, the complexity of the digital manufacturing environment requires employees to be aware not only of the tasks entrusted to them, but of the entire flow of activities that flows within the company (and, in part, also of that in the supply chain). This awareness is more easily matured through on-the-job training activities that show the links present through experience, rather than through external training that can be reduced to a mere theoretical transfer of notions.

Training through augmented reality

The use of augmented reality aims to try to overcome these limits and the first results of its use seem to confirm its positive contribution. Indeed, according to a Columbia University research, workers supported by augmented reality in learning processes take 53% less time than others to complete a new activity. But how can this new way of training be realized?

Firstly, suitable tools are needed. These can be digital devices such as tablets, smartphones, or other devices that support augmented reality technology. Imagine a class of workers who must learn to use new machinery with complex characteristics, present in only two units within the company and which, if damaged during training, would cause significant economic damage to the company. By using augmented reality for training, workers will be provided, for example, with a tablet in which an application connected to the machinery to be introduced will be installed on the devices and reproduced in three dimensions, as if they were in front of the machinery and its interface themselves. The worker can thus explore the different components of the machinery, simulate switching on, switching off and changing settings by touching the screen. The trainer thus has at his disposal a class that relates in real time with the machinery and can illustrate its operation, proceeding step by step to a verification by the workers who use the tablet to carry out the activities that, without it, would remain theoretical or read from an instruction manual. Teaching will thus be based on visual and experiential communication (albeit digital) and not on oral and / or textual communication which is less effective. The modalities can be different: instructions through animations, a voice guide that shows how to carry out the activities, writings and indications that appear on the screen, etc. Furthermore, an activity of this type could be carried out remotely at different establishments of the same group that were to install the same machinery, using only one trainer, or at home.

With workers who have already participated in training courses using augmented reality, it will then be possible to imagine training moments that do not require the trainer and will take place only through the support of the tablet and the installed application, which will illustrate the steps operating the machinery. After each step that is considered fundamental, moments of verification can be introduced, without which it is not possible to continue in the training course.

This form of training is particularly important for workers who are not familiar with digital technologies. In fact, through this training method, they do not only learn to use new machinery but are induced to measure themselves

with a digitized environment and production, thus developing transversal skills fundamental for digital manufacturing.

A final aspect to underline concerns the monitoring of the effectiveness of training. This is a fundamental element in the context of digital manufacturing because it is able to ensure that training has a concrete effect on processes and truly accompanies innovation. Through the data that the machines produce, which can be related to the skills of the individual worker (which can also be reconstructed using devices used by the individual worker) it is possible to verify to what extent the technical skills acquired are functional to the processes, and investigate where and what still does not work to improve training or adapt the worker's duties.

3) The role of social dialogue

What can be the way and the tools to achieve the results and start the processes illustrated thus far? The hypothesis of this document is that social dialogue can play a central role as a way of dealing with problems and challenges that starts from putting people who often have different goals at the same table in order to reach common points and evolve their positions, by trying, and with the art of compromise, to develop paths and strategies together. We believe that the particular historical moment we are experiencing requires an even greater role of social dialogue than in the past for several

reasons. Let's quickly analyze two levels, the first being the company level that develops the social dialogue in the dimension of industrial relations within the firm, and the second being at the national and European level.

Company level

First, the consequences of the pandemic on the stability of markets and consumption, and therefore on production, but also the need to rethink the organization to contain infections, has had impacts that were difficult to manage unilaterally. Such epochal and unpredictable shocks can fuel conflicts and obstacles if not governed through a positive exercise of industrial relations by trying to find common interests and goals of the actors in order to protect human capital and business. Both within the phase of reorganization, were linked to the pandemic emergency and in that of managing the impressive economic crisis that followed. Protecting employment levels means protecting human capital on which important resources have been invested and not wasting it. To do this, social dialogue is a way of meeting to identify those common points of balance between interests that can lead to this end, such as the Great Recession taught us.

Social dialogue seems, in general, to be the best method for the design and governance of the technological transformations that are at the center of the interest of this document. In fact, we know that

the information asymmetry within highly innovative realities is growing, with workers possessing increasingly sophisticated skills that are essential for the proper functioning of processes. At the same time, due to the deep skill mismatch that characterizes a lot of European countries, also thanks to the difficulties of school systems in being updated with technological evolution, workers learn an important part of their skills right in the workplace. Skills that empower their profile and that can allow them to move within the labor market. For this reason, since the interest in training and professional retraining is shared by companies and workers, social dialogue can become a tool that contributes to the construction of practices, projects, and monitoring of training itself. This considering the peculiarities of the various industrial relations systems that in the different countries regulate the relations between State and social actors through collective agreements, laws, or other tools and roles.

A similar issue arises in relation to the organizational changes that are leading many companies towards forms of horizontal integration less subject to what have now become the constraints of Fordist and Taylorist models. This means the development of logics of autonomy and responsibility, and therefore of trust, are at higher levels than in the past. So that this does not translate into an excessive polarization between workers (autonomy) and the

company (data monitoring, through what is known as *workforce analytics*), with the information asymmetries that also in this case would generate disorganization and the impossibility of a correct management of the processes. Social dialogue can be a positive tool when understood as the exercise, at the company level, of practices of sharing information, transparency up to experimentation of co-planning of organizational innovations, rethinking of roles, duties, and professionalism.

National and European level

Then there is the national and supranational level which is the one most traditionally connected to the idea of social dialogue. The months of the pandemic saw an important role for social dialogue in crisis management, as well as now in the planning phase of economic recovery. At this level, the actors of social dialogue should help to mark the urgency of a political-institutional agenda that can accompany the new needs within companies and in the territories. This through the promotion of initiatives aimed at not impeding local and company processes, identifying however the boundaries that do not cause them to translate into loss of protection for workers, or weakening of companies in the reference markets. Translated, this means providing policies that support the retraining of workers, continuous training, the dissemination of a corporate culture that is based

on the monitoring of professional needs, and support for introducing new organizational models. Social dialogue plays a central role in this because if it also can involve the public actor, it can contribute to bringing the different needs and changes that occur in business and local realities to the national and supranational level. These are transformations that the actors at higher levels often struggle to grasp or grasp only in a theoretical dimension.