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Workers' awareness context in Italian 4.0 factories*

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Abstract

The study of the co-evolution of processes of technological innovation and the resulting organisational changes has been a topic of interest since the first appearance of the idea of division of labour and specialisation in Adam Smith's works. The major phases of organisational change are in fact the result of 'waves' of technological innovations attributable to the various industrial revolutions. Nowadays, a new potential technological paradigm dubbed 'Industry 4.0' is shaping the manufacturing output of USA, Europe, and China, particularly in the automotive/engineering industry. With reference to the latter, the present research contribution aims at investigating, by means of field-work research activity, the degree of openness of the awareness context of workers and their intervention authority on the production process within three factories in the so-called Italian 'Motor Valley'. Together with state-of-the-art 4.0 technology adoption, these firms exhibit different organisational practices ranging from the Japanese Toyotism (Cesab-Toyota), to a mix of Taylorism and co-determination (Ducati), up to the example most akin to the German '*Mitbestimmung*' (Lamborghini). This technological wave is fostering the process of making the production system lean. Our findings corroborate the presence of a hybrid process of Industry 4.0 adoption, reflected into a hybrid process of workforce empowerment.

JEL classification: L23, L6, M54, O33.

Keywords: Industry 4.0, Technological Paradigms, Organisational Change, Lean Systems, Awareness Context.

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1 Introduction

It is widely recognised that the introduction of new technological paradigms is generally accompanied by organisational transformations (Nelson and Winter, 1982; Osterman, 1994). At the same time, the awareness of the workforce regarding changes that occur in the production process is considered an important condition for the full exploitation of new productive potentialities. In other words, the awareness of the subjects involved in production is linked to their authority of intervention therein. If the adoption of new technologies represents a change, to what extent and in what sense is this change perceived by the workforce within the workplace? In what way does the organisational dimension feed the increase in the awareness of change by the workforce? And in what sense does this awareness increase the ability of the subjects to intervene in the work process? The present research contribution aims at investigating the channels through which the organisational dimension feeds the awareness context and the intervention authority on behalf of the workers within three manufacturing firms located in the so-called Italian 'Motor Valley' (the industrial belt surrounding the city of Bologna) following the introduction of technological artefacts attributable to the Industry 4.0 phenomenon (hereafter I4.0).

Far from wishing to analyse the degree with which a potential 'Fourth Industrial Revolution' in the Italian manufacturing industry is underway, it is widely acknowledged that the technological conditions underlying I4.0 are (i) automation, (ii) digitalisation and (iii) interconnection (see Brynjolfsson and McAfee, 2014 and Ford, 2015, among others). These three 'basic technological conditions' can be embodied in a multiplicity of technological artefacts, such as collaborative robots, big data analytics, internet-of-things, and cloud computing. With differing degrees, forms, and purposes, the case studies analysed in this contribution are affected by the adoption of I4.0 artefacts. On the basis of this premise, and therefore of the objective introduction of technological innovations that have taken place over the last few years, the analysis is aimed at investigating the degree of awareness of workers with respect to the general change, and the ways in which awareness enables their authority of intervention within the production process.

This contribution is positioned at the intersection of the theory of organisation of firms, industrial, and innovation studies. It relies on a qualitative methodology based on field-work interviews to workers, union delegates, and middle management. The textual analysis is based on the Grounded Theory methodology; accordingly, the development of theory is constantly informed by empirical evidence. In doing so, the textual body of the interviews is first filtered and coded at different levels of abstraction, and then aggregated into higher level categories. In this respect, our research approach is mainly data-driven and bottom-up.

Our contribution proposes fresh evidence on the organisational effects induced by the adoption of I4.0 technologies and does find a pattern of general continuity in the organisational changes entailed by the latter with respect to the lean production paradigm. In a way, the I4.0 wave is fostering the making the production system lean and hardly represents a paradigm shift. In fact, the new tension toward customisation, reduction of inventories, elimination of bottlenecks, tracking of errors, intensification and saturation of working time, and in general of process and organisational innovation, constitutes a common trait of the firms under study, ascribable to the intensification of market competition and demand stagnation registered during the crisis.

Granted that pattern of continuity, our findings corroborate the presence of a hybrid process of I4.0 adoption which is reflected into a likewise hybrid process of workforce empowerment. Our results can be summarised as follows: the introduction of I4.0 artefacts has produced (i) an opening of workers' awareness context, increasing their knowledge of the firm production activity; (ii) an increase of workers' intervention authority on the production process in terms of *discretionary*

decision making, characterised by heterogeneity both among factories and among departments; (iii) the lack of a similar increase of intervention capacity in terms of *autonomy* of workers, especially regarding the possibility of establishing their own rules in the organisational and production processes. Overall, a misalignment between organisational levers meant to ‘extract’ values from workers and those meant to ‘redistribute’ value to workers strongly emerges.

The paper is organised as follows. The next [section](#) briefly discusses the main themes that intersect in this paper, namely I4.0 technology, the awareness context, and the workers’ authority of intervention. [Section 3](#) presents the three relevant organisational levers while [Section 4](#) outlines the methodology we adopt. Our results are discussed in [Sections 5 to 7](#). Finally, [Section 8](#) summarises our results and [Section 9](#) concludes.

2 Theoretical framework: awareness context, intervention authority and technology

The ultimate goal of introducing I4.0 technology within the production process is to achieve productivity gains. According to a widespread managerial rhetoric, by exploiting the possibilities offered by NATs (New Advanced Technologies, Zuboff, 1988), firms have the opportunity to become *agile* and *smart*, reducing waste, encouraging the formation of collaborative working systems, and optimising the inter-organisational relations of the so-called ‘industrial ecosystems’. This rhetoric is opposed by a reading that emphasises the risks that the pervasive digitalisation and interconnection of processes entail: strengthening concentration (of decisional power) without centralisation (of production) (Harrison, 1994); reaffirming the process of neo-Taylorisation of work through the introduction of micromanagement practices and new forms of proceduralisation (Alvesson and Sveningsson, 2003; Kärreman et al., 2002) characterised by systems of pervasive surveillance (Thompson, 2003; Zuboff, 2015).

Both perspectives emphasise the role of awareness of the technological transformations taking place on behalf of those involved. Critical perspectives focus on the relationship between the unawareness of workers invested by the Fourth Industrial Revolution and the poor ability to influence the governance of the transformations underway. In some cases, the condition of poor perception of change is led back, suggesting a certain technological determinism (Grint and Woolgar, 1997), to the ‘not very visible’ character of NATs, which might determine a poor perception of changes that are occurring in the workplace. In other cases, the workers’ awareness gap derives from the *domain geometry* in which I4.0 technology is located, which might produce a differentiated access to the knowledge of the working process. In both cases, the lack of awareness would generate a condition of ‘unaware guinea pigs’ (Morozov, 2013) that prevents the regulation and democratisation of the transformation processes linked to the introduction of NATs. Critical perspectives, however, tend to underestimate that even mainstream literature, both educational and scientific, strongly insists on increasing the awareness of workers in order to maximise exploitation of I4.0 technologies.

One of the topics on which the debate on I4.0 has focussed is on competences and tasks that the Fourth Industrial Revolution will replace with NATs, those that will survive in so far as they are compatible, and which ones will get redesigned from scratch. With respect to this, current trends still appear uncertain (Magone and Mazali, 2016), but there seems to be agreement that the full exploitation of the potential offered by NATs can not but have as a necessary condition the increase in responsibility and involvement of all the figures present along the production process. According to this strand of literature, only an increase in responsibility and involvement would be

able to generate awareness with respect to the 'sense' of the work process in which workers are inserted and to enable their intervention authority on the production process. The diffusion and increase of workers' awareness is therefore recognised as a definitive aspect also by employers.

After all, the well functioning of an organisation is not simply based on employees' obedience, but rather on

"[e]mployees taking initiative and applying all their skill and knowledge to advance the achievement of the organisation's objectives."

(Simon, 1991, p. 32)

Simon's perspective is therefore consistent with the employer's aim of opening up the workers' awareness context.

The question then arises of understanding the ways in which firms encourage, when facing the introduction of I4.0 technology, the degree of awareness of production workers and in what sense the latter are equipped with authority of intervention.

The theoretical framework on top of which the current analysis is carried out is the concept of *awareness context* of Glaser and Strauss (1964). This concept, which the two founders of the Grounded Theory (Glaser and Strauss, 1967) define as

"the total combination of what specific people, groups, organisations, communities or nations know what about a specific issue"

(Glaser and Strauss, 1964, p. 670)

allows the emancipation from the idea that the state of awareness is attributable exclusively to a psychological/individual dimension, and to shift the focus of the analysis towards the context in which the subjects are placed and themselves contribute to build. In fact, through the interactions that occur among subjects belonging to the structural unit assumed as the awareness context, the latter can exhibit differing degrees of openness and characteristics. The analysis should therefore be able to highlight the characteristics of the awareness context, the processes of interaction that allow its existence, its reproduction, and its transformation.¹ These characteristics are defined as *structural conditions* of the awareness context.

As already pointed out, according to a large portion of literature, an increase in responsibility and involvement is supposed to be able to improve workers' awareness. However, to what extent this enabling of intervention authority is to be understood in terms of increasing the *autonomy* of action of the subjects, or rather in terms of a general widening of *discretion*, is far from obvious. Although the idea that autonomy and discretion display overlapping definitions is widespread in the organisational thought (so much that they are often used as synonyms), a smaller but insightful strand of organisational literature (Albano et al., 2016; Giorgetti, 2013; Maggi, 1990, 2011) tends to distinguish the two concepts, and such distinction is integrated into the analytic framework. By discretion we mean a variable margin of action in a regulated process. The variability of discretion is therefore given by the breadth of the action space whose boundaries are however somehow already regulated. With the concept of autonomy, instead, we mean the production of own rules and

¹Glaser and Strauss identify four types of awareness context: open awareness context, closed awareness context, suspicious context, and simulation environment. The awareness context construct has found wide use in the sociology of health studies and in the analysis of interactions between patients and medical staff, and the same Glaser and Strauss lead back the emergence of this concept to the research they carried out within a hospital dedicated to the care of the terminally ill patients (Glaser and Strauss, 1965). Moreover, the authors stipulate in a seminal paper that the awareness context is a theoretical construct useful to guide the research in a variety of situations and different analytical levels (Glaser and Strauss, 1964, p. 670).

“autonomy can not be granted or attributed: it can only be affirmed or conquered.”
(translated from Maggi, 2011, p. 75)

Regulation, or the way of producing and developing the action process (e.g. a work process), is always characterised by the dialectical coexistence of *prior* rules, formal or informal rules that precede the action (pre-ordered but not predetermined), and *intrinsic* rules, contextual to the action, as well as by the coexistence of *autonomy* and *heteronomy*. The modal variability of the rules (prior/intrinsic) and the variability of the source of the rules (autonomous/heteronomous) are obviously intertwined. Prior rules can be both heteronomous and autonomous, since they can be produced by the same agent and can grant more or less discretion. Intrinsic rules, instead, can only be autonomous.

Distinguishing the two concepts of autonomy and discretion allows to contemplate situations in which the high margin of discretion of action in a regulated process is established by prevailing rules strongly characterised by heteronomy.² In other words

“confusing autonomy with discretion means, to all intents and purposes, confusing the plan of production of the rules with the plan for carrying out the action.”
(translated from *ibid.*, p. 75)

Similarly, Dosi and Marengo (2015) identify three attributes in characterising the ruler’s power: power entails the possibility of the agent (i) to define the set of actions, (ii) to veto some actions, (iii) to influence the actions or introduce a new set of actions. In this respect, from the ruled perspective, she may undergo power in different forms. Whenever she has the possibility to regulate the process by herself, this entails autonomy, as a genuine manifestation of power exerted by the ruled under the first attribute; conversely, whenever she undergoes a modification of the given set of actions that have to be performed according to prescribed rules, the ruled is affected by the third attribute of power, exerted in this case by the ruler. Discretion lies in this second case.

Fig. 1(a) shows a visual representation of autonomy. Let us consider *A*, *B*, *C*, and *D* as production phases and the solid line as the border defining the set of possible actions. When autonomy is exerted, the subject has the possibility to *modify* the border (set of actions), which might be crossed by acquiring a new external phase (*C*₁) and expelling an old one (*C*₂). Note that the exertion of autonomy allows also to define the order in which the phases are completed. In this sense autonomy is an expression of ruler’s power, because it enables the modification of the set of actions.

Fig. 1(b) shows a visual representation of discretion. Let us consider *A*, *B*, *C* as production phases and yellow circles as the individual tasks required to accomplish them. The increase of discretion entails the possibility to perform new tasks (green circles), with an expansion of the set of actions from the dashed boundary up to the solid one. Note that an increase of discretion does not allow to modify the set of actions: the border always maintains the same shape. The exertion of discretion is instead a manifestation of power underwent by the ruled, who is subject to the influence and authority of the ruler.

The distinction between these two notions appears particularly relevant to understand e.g. the principles of *autonomation* and *autoactivation*, the two pillars of the Ohnist production method, consisting in the ability of workers to detect a non-conformity, stop the process, and perform quality control. They might be considered an example of the increase of workers’ autonomy, wherein the

²It may seem paradoxical that autonomy can be established through the intrinsic regulation disregarding the discretion granted by prior rules, or that autonomy can be established via intrinsic regulation by following the tight margin of discretion through pre-defined prior rules. However, what may appear as a paradox can provide the researcher with an interpretive framework (and who has research experience knows that are not uncommon) in which subjects facing an increase of discretion on their own tasks complain a narrowing of the possibility to regulate their own work and to reorient their efforts to reduce the discretion granted (e.g. routinising some operations through intrinsic regulation).

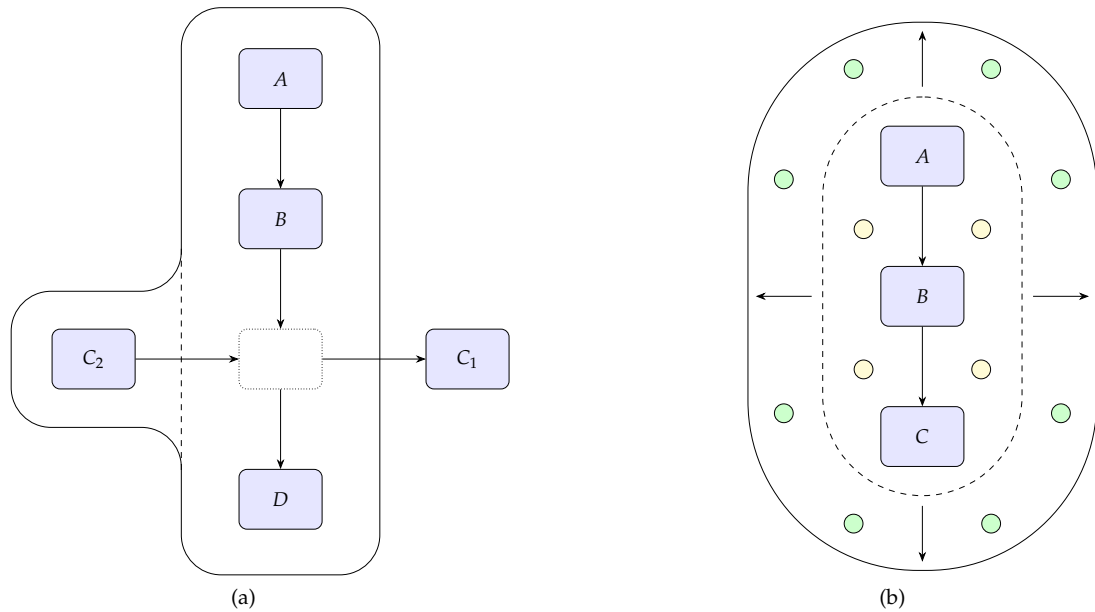


Figure 1: Graphical representation of autonomy (panel (a)) and of discretion (panel (b)).

latter are able to change the set of rules accordingly. We shall see later how the forms of workers activation put in practice in the firms under study entails chiefly an increase of discretion. Note however that in both cases an increase of the required repertoires of actions occurs (Coriat, 1991).

Finally, to characterise the nature of technology we shall adopt the *recipe* perspective: technology entails a list of ‘ingredients’, namely procedures and admissible acts required to build an artefact. A recipe always embodies a degree of codified knowledge (the ingredients) and non-codified or tacit knowledge (the non-written procedures). Together with the accomplishment of the recipe, the production of artefacts implies a process of coordination between members of the organisation. The ensemble of the recipe, the embodied knowledge required by its execution, and the coordination of members of the organisation constitutes the *organisational routines*. Organisational routines constitute therefore a *trait d’union* between technology and organisation (Dosi and Nelson, 2010).

This characterisation of technology links the design, adoption (integration) and use phases within the organisational processes (Masino, 2011). A definition of this type avoids the risks of ‘reification’ (i.e. the vision of technology as a *datum* and not a choice) and avoids the temptation to alienate technology from the organisational process, or to consider it a ‘background element’.

It follows that linking the characteristics of the awareness context, as well as the ability to intervene on the production process, to supposedly intrinsic characteristics of the technology (for example technological artefacts referable to I4.0) is misleading. Instead, of relevance is the organisational dimension in which technology is placed. On the other hand, as Landes (2003) points out, the combination of organisational/technological transformation is the core of all those socio-economic transformations of the past that historians have called ‘industrial revolutions’.

“Machines and new production techniques, by themselves, do not imply an industrial revolution. They make it possible to increase productivity and change the relationships between factors of production, with capital becoming more important than work. Now, with the term revolution, we mean a metamorphosis at both the organisational level and the means of production.”

(*ibid.*, p. 151)

3 Organisational levers

It is no coincidence that many studies identify the processes of organisational adaptation to technology I4.0 as a fundamental condition for the full exploitation of the potential of NATs; as it is no coincidence that the proposals for organisational adjustment that the various researches and analyses formulate are always oriented to increase the knowledge of the production process and the self-activation (often defined *proactivity*) of workers through the development of systems of involvement and responsibility. In other words, the premise for the opening of the awareness context and an increase in the proactivity of the subjects, is to accompany the I4.0 technologies with an organisational change, generally identified in the development of the principles of *lean production* (Womack et al., 2007). Within the literature, there exist multiple definitions of lean production, and it has been noted that the concept of 'lean' referring to organisational transformations has progressively assumed a vague and nuanced character (Arlbjørn and Freytag, 2013). With no ambition to offer an exhaustive definition, in the present paper by lean production we mean the set of organisational practices inspired by the principles of *lean thinking* (Womack and Jones, 2003), which concern both the ways in which production activities are planned and carried out, and the modes through which managerial activities are exercised (Sauter et al., 2002).

In this regard, Osterman (1994) identifies in the broader notion of *internal labour market* the set of organisational practices aimed at improving the production performance of firms by making the organisation of work flexible and streamlined, in order to promptly respond to sudden changes in orders. The notion of flexible work organisation is identified in Gittleman et al. (1998) as any departure from the traditional and hierarchical production method in which workers have a precise role. This set of practices, called *High Performance Work Practices* (HPWPs), include: self-managed work teams in which the workers self-supervise their work, presenting extensive decision-making autonomy in the event of errors or stasis of the process; problem solving groups in which the operators are directly involved in the problem solving process; job rotation, which manifests itself in the opportunity to move between the various stations and units of production; total quality management, which emphasises the role of team work; mechanisms of feedback and lean communication between the workforce. Bailey (1993) identifies three pre-conditions for the proper functioning of such practices, in particular: (i) workers must have knowledge and skills regarding the process that are not possessed by managers; (ii) workers must want to collaborate and therefore enhance their know-how; (iii) the organisation must be consistently structured to enhance the discretionary contribution of the workers involved.³ The adoption of such practices has generally been identified by the literature as a win-win game: on the one hand, the company enjoys productivity gains; on the other hand, the worker has the opportunity not only to benefit from a more flexible internal labour market, which allows easier mobility and career advancement, but also from direct participation with her own ideas to the production process. In this sense, Osterman (2000) finds that HPWP systems have seen an increase in diffusion between the 1990s and 2000, even among American companies; however, in the same period there has been a stagnant wage trend and an increase in workers' perception of insecurity of employment. Therefore, it is also important to investigate to what extent the 'gains are shared'. According to the results of Osterman (*ibid.*), the adoption

³Clearly, there are some corporate characteristics that influence the adoption and the degree of penetration of these practices. For instance, (i) the market competition level in which the firm operates, (ii) the scope of the competition, whether local or international, (iii) the type of product sold with respect to its degree of customisation, (iv) the technological complexity of the artefact in use and to what extent it requires the adoption of more or less lean practices, (v) the set of corporate values related to the structure of the properties (e.g. whether it is more family- or market-oriented) and (vi) the degree of unionisation, are all factors that influence the choice of adopting such practices. However this contribution it is not intended to carry out a comparison between companies with respect to the presence/absence of such practices, but rather to understand how such practices are perceived.

of such practices within US companies is associated with a higher probability of dismissal and no increase in wages; rather, they resulted in forms of internal restructuring implemented by firms.

The organisational dimension, therefore, is assumed as a structural condition for the opening of the awareness context and the enabling of the workers' ability to intervene in the production process. The analysis presented in the following pages focusses precisely on the characteristics of some organisational changes inspired by the principles of lean production, definable as 'organisational levers that foster the opening of the awareness context and intervention authority': (i) de-hierarchisation and development of team work; (ii) introduction of job rotation practices; (iii) introduction of assessment and career systems.

3.1 De-hierarchisation and development of teamwork

A dimension of organisational transformation often regarded as decisive for the exploitation of new technologies is that of streamlining corporate hierarchical structures. The increase in importance of the monitoring and data collection functions, the self-activation (proactivity) within the man-machine relationship, the multi-functionality and the responsibility of the operators, can only imply a strengthening of team working, and the rethinking of the hierarchical forms typical of the Taylorist organisation.

Starting from these considerations, it is considered appropriate to accompany the introduction of I4.0 technologies with lean management forms. In particular, the development of lean leadership forms is considered a central factor for a more general organisational transformation (Mann, 2009), and not by chance the functions exercised by the team leader (and in general the transformation of the functions of both the middle and the top management) represent a pillar of hierarchical restructuring, as they should allow the creation of a 'horizontal system' for the coordination of work practices, the management of workers without authoritarianism, and the development of their competences and responsibilities (Camuffo, 2017). Unlike traditional command-and-control leadership which implies the authority to order subordinates on how to intervene in the work process, lean leadership is characterised by being more focused on managing the responsibilities of operators who fall under the leadership of the leader (Shook, 2008). In accordance with this mainstream managerial literature, responsibility management should not be declined in terms of *laissez-faire* or results-only-oriented coordination, but rather as constant support for the development of problem solving skills by the operators, a strongly process-oriented coordination. This definition of leadership therefore includes practices of coaching, teaching and mentoring, the assignment and definition of responsibilities, the evaluation of results, and the definition of work programmes. In other words, lean leadership can not be simply understood in terms of top-down or bottom-up decision-making processes, but rather in terms of

"taking responsibility for making decisions already taken and implemented [by others]."
(ibid., p. 3)

For a team leader to carry out all the functions mentioned above, and thus effectively manage the team for which he is responsible, it is however necessary that she possesses specific personal characteristics in terms of values and behaviour (see the literature review contained in the Van Dun et al., 2017 article), and specific skills (typically defined in the managerial literature *transversal* or *soft* skills) (Angelis et al., 2011; Gelei et al., 2015; Pamfilie et al., 2012).

Despite the taxonomic efforts that have been put in the literature, there is still some disagreement with respect to what are the typical values and behaviours of the leaders within a lean organisation (Van Dun et al., 2017); nor is there a substantial consensus on which style of leadership (transac-

tional or transformational) guarantees greater effectiveness in a lean enterprise (Tortorella et al., 2017), and different contributions, explicitly or implicitly evoking theoretical models of situational or contingentist leadership, insist on the importance of variables referring to the hierarchical level taken into account (Camuffo and Gerli, 2012; Suresh et al., 2012; Tortorella et al., 2017), the stage of maturation of the implementation of lean principles (Emiliani and D.J., 2005; Liker and Convis, 2011), and the culture of the team members the leader is responsible of (Van Dun and Wilderom, 2012, 2016).

Furthermore, within the scientific community there is not even a significant agreement on the identification of the actual functions and coordination methods adopted by the lean leader. A number of contributions identify the reason for this in a sort of underestimation of the theme of lean leadership (see in this regard the classification of 'lean literature', Moyano-Fuentes and Sacristán-Díaz, 2012; Papadopoulou and Özbayrak, 2005), tracing back to this 'distraction' the main cause of failures recorded in the implementation of lean systems by firms (Liker and Convis, 2011). A different strand of literature tends to identify a sort of 'lack of connection' between theoretical considerations, research, and the implementation of lean leadership practices (Mann, 2009), from which it would derive, despite the modelling efforts of the implementation of lean principles, the plurality of forms that the exercise of lean leadership would take once implemented. A third chunk of literature, less inclined to interpret the non-compliance of practices to theory simply as a 'failure', tends instead to assume the variability of concrete forms of lean leadership (and in general of lean management) as an inevitable outcome of the unravelling of the organisational action, or as a predictable result of the influence of variables attributable to the context in which the company is located (the culture of the sector to which the company belongs, the culture of the territory in which the company is located, the system of present industrial relations, etc..) and/or to the firm itself (organisational culture, size, market positioning, business model, etc..). This is the case of several studies in which the lean principles, as they are formulated in the literature, and the requirements that derive from it, do not represent the model with respect to which to measure the deviation of concrete practices, but rather general guidelines of an implementation process that inevitably presents specificities. This latter approach opens up the possibility of studying idiosyncrasies, tensions, and ambiguities present in the leadership and in the modes of managing its domain (as its formal space of influence is defined) not in terms of coherence/deviation from a supposed ideal lean leadership, but as a concrete manifestation of the latter. This does not imply an underestimation of the definitions of leadership and team work proposed by *lean thinking*, as these latter represent fundamental analytical tools for the study of their empirical manifestation.

It is legitimate therefore to interpret the role of the team leader and of team working as levers of Taylorist de-hierarchisation, just as it is legitimate to highlight that the team leader, as well known, is not a hierarchical figure (Cerruti, 2015, p. 49). However, it is not possible to exclude from the empirical analysis the possibility that, through the figure of the team leader, new hierarchical forms will regenerate, nor to conclude that the latter, in case they emerge, represent a sort of deviation from a 'original lean model'. It is therefore possible, without resorting to the concept of dysfunctionality, to explain why, even though the

“figure of the team leader struggles to embody the figure of a hierarchical superior [...] a certain discomfort of the workers emerges with respect to the undefined boundaries of the position of the team leader [...] [and because] [...] the figure of the team leader turns into a sort of 'boss', that is, in a subject who exercises the role of hierarchical superior without having received formal investiture.” (translated from Corazza, 2015, p. 83)

3.2 Job rotation practices

Specialisation *vs.* rotation of the workforce in the organisation of the workplace is a well known trade-off for HR departments: while Adam Smith already emphasised the role of specialisation in favouring the accumulation of increasing returns to scale, the practice of rotation between various stations, but also between various departments, is recognised as boosting the productivity of the worker (Coşgel and Miceli, 1999). Ouchi (1981) reports the presence of permanent job rotation practices in many Japanese companies, emblematic of organisational virtuosity in both product and process innovation (Aoki and Rosenberg, 1989).

However, it is necessary to distinguish the application of these practices between the Japanese model and the American model. While in the Japanese model, although aimed at achieving lean production, job rotation systems (and in general the phenomena of participation in the production process, team working, and continuous improvement of processes) are accepted by workers on the basis of a pact according to which to the offer of their knowledge corresponds security in the working condition and improvement of wages (life-long employment, growth of salaries based on seniority, etc. . .), the same can not be said with respect to the adoption of HPWPs within American firms, in which the decision driver turns out to be the restructuring of the workforce (and not only of the organisation). These practices are accompanied both by the first wave of contingent hiring, and by the replacement of elderly labour with younger labour.

Generally speaking, the practice of job rotation turns out to be a mechanism that allows the company not only to respond to change, but also to *produce* change (Aoki, 1990). This is the result of the acquisition of knowledge by the workers not only of a single phase, but of the entire production process. This enables the individual worker to intervene in several stages of the production process, whether errors occur, or if they wish to bring improvements, transferring ideas and experience from one location to another or from a unit/department to another. Of course, the practice of job rotation is the basis of the Toyotist system, which replaces the maximisation of productivity through economy of scale exploitation with just-in-time production. In this sense, the worker inside the 'Ohno' factory must have a large set of skills (Coriat, 2001). While the worker must be multi-skilled in terms of capacity, she possesses an unusual power with respect to the Fordist method, in that she can interrupt the line in case of error. On the other hand, as claimed by Coşgel and Miceli (1999), being the job rotation a worker-initiated innovation, there must be an organisational substrate, i.e. a set of sufficient preconditions that allow the workers to value their knowledge. It is necessary that there is an organisational structure that provides for and allows the worker to participate independently in the process.⁴

The introduction of job rotation practices is attributable to two conceivable goals by the management: on the one hand, the job rotation system represents an opportunity for workers to learn the details of the production process (*employee learning*); on the other hand, it also represents a mean to reduce the degree of repetitiveness of the task being performed, and thus serves as a motivational mechanism (*employee motivation*).

Within the employee learning theory, firms benefit from the rotation of workers not only because the learning process that results enables productivity gains, but also because it makes the production process more streamlined and less dependent on the work of any single worker. It follows that in the event of a sick leave or vacation, the task of the single operator can be easily performed by someone else, increasing the overall degree of substitutability between workers.

Under the employee motivation idea, the firm benefits from motivating and making the tasks

⁴As an extreme example, Aoki and Rosenberg (1989) report how the typical Japanese firm was a coalescence of single autonomous individuals, rather than a proper organisation.

more dynamic for the so-called *plateaued* workers, whose career prospects are slim and feel 're-warded' by a continuous change of tasks. While the evidence of job rotation practices serving the purpose of employee motivation are scarce in the American literature, this is not the case for Japanese firms.

Fujimoto (2001) reports that Toyota identified a key strategy by improving the ergonomics of workers with the introduction of the *kaizen* (continuous improvement process), by including both a system of evaluation of the degree of workload, posture and ergonomics (TVAL, Toyota Verification of Assembly Line), and a series of collaborative machines (raku-raku seats, wagon carts, body-lifting mechanisms, etc. . .).

While under both these perspectives the worker is the first to benefit from job rotation practices, Ortega (2001) recognises that it is rather the management (*employer learning*) that can profit from learning whether value added is to be traced to a specific task, and hereby come to know whether some departments are more productive than others, or to a specific operator and her personal skills. Therefore, alongside job rotation practices are often added compensation schemes linked to individual performance (see the next Section).⁵ Another element of interest consists of the complementary nature of the newly implemented systems. Job rotation practices are more prevalent when teamwork mechanisms are already in place, which reduces the cost of job rotation and, at least initially, results in a possible reduction in the output and/or malfunctions within the production process.

3.3 Evaluation and career systems

The evaluation and career systems have gradually gained importance in the organisational literature. There are two instrumental factors by which their introduction affect the worker and her job performance: motivation and incentives. The attention towards the introduction of evaluation systems able to evaluate correctly the performance and the establishment of career systems in fact do lever mostly on motivational factors that would bring the worker to be more productive on the job.

As part of the organisational sociology, theories of motivation developed among others by Herzberg (1974), Maslow (1954), McGregor (1960), and Argyris (1970) at the turn of the fifties and eighties referring to a paradigm of business studies and work psychology consultancy, have identified the 'human factor' as a carrier of complexity, such that organisations are deemed liable for growth and improvement to the extent that they are able to develop and enhance their human resources. It is a paradigm shift also in the theory of business management, in that the employee from a simple officer in performing tasks and duties, becomes a key factor for business success. From that moment, the organisation is recognised as a potential place of non-adversarial co-existence of the objective dimension of the firm with the subjective dimension of the workers, who bear material and psychological needs of self-realisation. In this context, the human resource development policy to create an internal labour market is crucial to the very existence of the organisation. On the one hand, the literature has emphasised the internal mobility (the existence of career paths that allows individuals to aspire to new positions in the internal labour market) as a weakening factor for the motivational process, on the other hand, was emphasised the role of performance evaluation systems and their relationship with motivation.

The existence of career paths within firms can be approached in relation to the broader trend of

⁵Among the factors that characterise firms adopting job rotation schemes, two elements seem to be of interest: (i) younger workers tend to rotate more (providing evidence against the employee motivation and more in favour of the employee learning); (ii) firms adopting complex technologies are more likely to implement job rotation.

the theories of non-monetary incentives. In this sense, the existence of appropriate incentives has been recognised as a major factor by which an organisation is able to increase the performance of workers (Arnolds and Venter, 2007; Muchapondwa et al., 2012; Al-Nsour, 2012; Pouliakas, 2010). Non-monetary incentives are designed to reward job performance through access to so-called 'opportunities' (Ballentine et al., 2003) which can manifest themselves in greater authority, prizes, participation in company management, better working conditions, recognition of various kinds, and especially career promotions and upward mobility (Chiang and Birtch, 2008; Ellis and Pennington, 2004; Hijazi et al., 2007; Spector, 2011). According to this literature, although the motivation of the employee can not be considered to be the main determinant of job performance (Spector, 2011), it can contribute to the construction of a 'proactive' attitude and adhesion towards the organisational culture of the firm (Lawler, 1971). This perspective, which ultimately goes back to the conceptualisation of a pyramid (Maslow, 1954), identifies precisely in incentives - including the possibility of career advancement within the plant - the motivating factors that lead workers to a greater degree of involvement and improvement of performance (Hockenbury and Hockenbury, 2003). Similarly, García-Izquierdo et al. (2012) emphasise that perceptions with respect to promoting systems directly impact on the perception of organisational justice and of work motivation/satisfaction. Koch and Nafziger (2012) add that promotions are desirable as they lead us to work harder offsetting individual 'inefficiencies'. Much of the management literature argues that the implementation of a promotion system characterised by regularity and intelligibility are to be understood as a mode of satisfaction of emotional needs and motivation of individuals within the organisation

All this draws the attention of the literature also on performance evaluation systems that should result in career progression. A large part of the literature has found a convergence between career paths, motivation, and evaluation of performance in the well known theory of *goal setting* (Locke and Latham, 1990, 2012). One of its ideas is that the objective be shared, clear and precise (apart from being achievable and challenger), so that it can exert a positive influence on the motivation and in turns on the performance. Similarly, an evaluation system effective in motivating can not be separated from its intelligibility with respect to general management expectations, the criteria for evaluation of performance and achievement of objectives. Likewise, the more or less discretionary character of the evaluation can not but have an effect impact on motivation (Costa and Gianecchini, 2013). Indeed, despite the feedback can be either negative or positive, what emerges from the studies in this field is that the presence of transparent systems of evaluation tends to have a positive effect on the worker's performance

4 Research objectives and methodology

The present work aims to analyse the implementation of those that we define the three 'organisational levers opening the awareness context and intervention capacity' that accompany the introduction of technological practices related to I4.0: de-hierarchisation and teamwork, job rotation practices, and evaluation and career structures. As can be seen from the theoretical framework illustrated, the aim is not to detect deviations of the implementation of the three organisational levers from ideal models, but, assuming the unquenchable variability and indeterminacy, is to detect the features in their concrete manifestation. Rejecting the dichotomy of 'organisational levers consistent/inconsistent with ideal models' and rather focussing on their concrete manifestation allows to detect the characteristics of context awareness and the capacity for intervention of the subjects, and to avoid bringing the reasoning within a rigid functionally organicistic scheme, while

opening up the space to other interpretative paradigms. The research design flow is illustrated in Fig. 2.

This paper presents the results of an analysis based primarily on semi-structured interviews carried out in three automotive firms located in the outskirts of Bologna (Emilia-Romagna, Italy): Toyota Material Handling Manufacturing Italy SpA (formerly known as Cesab, hereafter Cesab-Toyota), Ducati Motor Holding SpA (hereafter Ducati) and Automobili Lamborghini SpA (hereafter Lamborghini). The three cases are examples of companies which borrow practices, systems, and models ranging from Japanese Toyotism (Cesab-Toyota), a mix of Taylorism and co-determination (Ducati), up to the example most similar to the experiences of German '*Mitbestimmung*' (Lamborghini). Table 1 provides a picture of the current implementation of I4.0 technology within these firms.⁶

The three case studies considered in this paper started with a series of discussion groups among researchers and union delegates of the underlying firms. The discussion groups (around 3, each consisting of about a dozen people) had the following objectives: preliminarily exploring the issues under study with union representatives; reconstructing the layout of the plant workflow; identifying the people involved in the process to be interviewed; building the relevant access channels for researchers. Access of researchers to the firm premises had been therefore mediated by trade unions. However, the construction of the theoretical sample had also been designed not to include exclusively FIOM-unionised workers, and to include workers located in different firm departments.

Subsequently, semi-structured interviews with the identified candidates were carried out. In this paper we analyse a set of 31 semi-structured interviews with workers of the three plants, distributed according to Table 2. Interviews were conducted within the establishments in areas made available by the company or by the union delegates. The interview activity was preceded by a visit to the different areas and departments of the production plant; this represented a good opportunity to directly observe some of the technological innovations and changes in work organisation. In parallel, a number of other interviews were conducted with the management of the companies and other technical figures. In total, 6 such interviews were carried out, the selection of whom varied depending on the specific characteristics of the plant. The interviews also gave us the opportunity to collect business documents and other publications that are of interest for the current research.

The collection of this material has given rise to a *corpus* of text on which, starting from the theoretical framework illustrated above, we carried out the analysis through a coding system inspired by the *Grounded Theory* (Corbin and Strauss, 1990; Glaser and Strauss, 1967). This process entailed a parallel and cross analysis (between the researchers involved) not only of the interviews, but also of the relevant literature and the material collected during the investigation, including secondary data derived from direct observation. The collected material had been in fact read and analysed in different moments of the research process, first independently by each author, then through cross dedicated comparisons during collective sessions.

Consistent with the outlined methodology, the interviews, the collection of other informational material, and the process of analysis did not follow a principle of statistical representativeness, but rather of concepts saturation. The results do not therefore aim at formulating proper causal generalisations.

⁶The study of these three companies is part of a larger research programme (started in 2016 and still in progress) of the Claudio Sabattini Foundation, commissioned by FIOM-CGIL (one of the leading Italian trade unions) and involving researchers from several universities and research institutes. The main purpose is to understand the main changes concerning the organisation of work and working conditions that occurred in recent years with the introduction of technological practices related to I4.0. In line with the general objectives and methodology of the research programme, we decided, supported by experts, union leaders, and other scholars in the field, to select a few engineering firms considered to be particularly advanced on a technological level. These companies, called 'focal firms', will give rise to case studies within the present research.

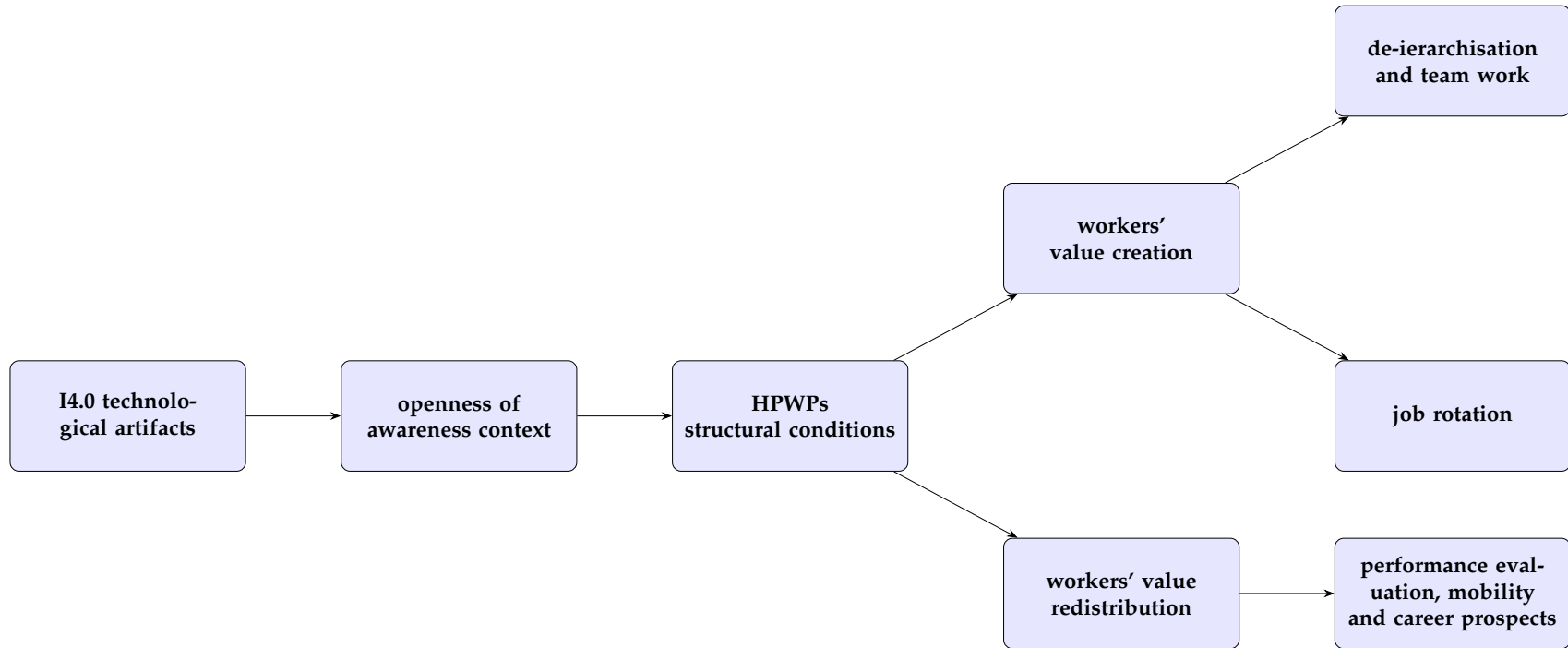


Figure 2: The research design flow

Cesab-Toyota	Ducati	Lamborghini
<ul style="list-style-type: none"> ◇ digital utensils (e.g. torque wrenches) and their data analytics ◇ digital internal communication via tablet computers ◇ 3D printers for prototyping ◇ ERP software 	<ul style="list-style-type: none"> ◇ digital utensils (e.g. torque wrenches) and their data analytics ◇ partial paperless factory ◇ 3D printers ◇ pick-to-light ◇ virtual configurators ◇ AGVs ◇ collaborative robots 	<ul style="list-style-type: none"> ◇ IoT and machine-to-machine connections ◇ big-data analytics (early phase) ◇ MES software ◇ AGVs ◇ collaborative robots

Table 1: The implementation of Industry 4.0 technologies within our case study firms.

5 De-hierarchisation and team work introduction

An overall picture that emerges from the interviews is that the team leader role and teamwork configuration vary considerably not only between firms, but also within the same plant. This is not only true regarding different configurations found between the production and planning departments, whose diversity may well be expected. Even restricting the analysis to the production area alone we can detect different configurations with respect to (i) the structure of teams, (ii) the practical involvement and responsibility of workers and (iii) the role and functions of the team leaders.

5.1 Structure of the teams

With regard to the structure of the teams, the team leader is accompanied in some departments by a figure, called ‘jolly’, which has a substitutive function in case of absence of an operator or support if an operator is in trouble while carrying out its task in a predetermined time. If there is one or more jollies, more widespread in the production departments of Cesab Toyota and less in Lamborghini and Ducati, the team leader is relieved from the replacement function of workers, and operational support to their work.

Although the jolly figure is much less complex than that of the team leader and its functional responsibilities are smaller, the workers interviewed highlight several critical issues in the exercise of this role. In particular, as will be better understood later, the degree and type of knowledge of the production process and the presence of social skills related to team work are considered important both in the figure of the jolly and of the team leader.

Where instead the figure of the jolly is not established, it is a widespread practice that the team leaders replace the operator in case of absence or temporary removal from the station, or intervene on a workstation in the event the operator is in trouble. This is a widespread practice, although not formalised, which reveals a certain degree of team leader discretion in deciding whether to perform this function and, as will be clear later, this very discretion in enlarging the boundaries of its role and its functions constitutes one of the most critical traits of this figure.

“The joker is one who masters several stages of work. It is also true that [...] there may be one [...] that know them all and one that doesn’t know any [...] With regard to technical knowledge, the joker is less expert than the team leader. The joker is supposed to do what they ask him, but he’s not required to know how to solve problems because his experience and knowledge is partial. He must act as a replacement, full stop. The

Firm	Department*	Task*
Cesab-Toyota	assembly line	vehicle assembly (×2)
	customisation	installation of cabin and optionals welding of cabin
	external logistics office	management of incoming supplies
	parts warehouse	assembly lines supplies
	quality control	intermediate vehicle quality control
Ducati		engine assembly team leader
	assembly line	vehicle assembly (×4)
	process designer	engine production designer
	product R&D	engine testing-room service
	quality control	process quality control
	testing	test drive
		engine assembly
	assembly line	vehicle assembly (×2)
Lamborghini	carbon fibre composites	carbon fibre lamination shell assembly
	pre-series center	carbon fibre process development
	process R&D	MES implementation human-machine interface development
	purchases department	parts purchases
	quality control	final quality control
	sales department	franchise and business development
	'task-force'	incoming supplies quality control
	torque team	control of electric screwer systems
	union representative	union representative

* At the time of the interview.

Table 2: Classification of interviewees by firm, department, and task.

team leader is the one who knows everything. [...] But the joker must be chosen on the basis of other criteria, not simply on his knowledge of the various phases. [...] He must know how to relate and work with others, being available, and if he sees someone in trouble, he has to come and help [...] [Some of the jokers] are [...] disagreeable, [...] others, [...] for example the one who works on my segment, is an extraordinary guy. He knows how to do things, he is capable, but above all he is available to help you. If you are in need, he wants to do it; here he is an ideal joker [...] Also because the willingness to help someone in trouble should be the criterion of choice for a joker. But sometimes I do not understand how they choose these people for this role. [...] Sometimes I ask myself: how did they choose them? Because if they do not have the natural willingness to help others, what are they doing there? They should be available if they see someone in difficulty, but they don't care [...] The selection criterion of the joker is in my opinion one of the flaws we have. That is, no criterion other than professionalism is considered. The criterion should be that the candidate knows how to 'gel' with the group, and his availability." (anon. from [Cesab-Toyota](#))

Another variability of the team structure is the breadth of the team leader domain, or the number of components that belong to the team. In this sense the domains can vary considerably: from small domains consisting of a few employees (in some cases even 4-5) up to domains of about 20 employees. It seems though evident that in those departments in which the production process is more composite and diversified (e.g. inspection, testing, quality check...) the domain size is small, whereas in departments in which the process is more routinised and fragmented (e.g. assembly lines) the domain is large.

In all this, the type of production technology itself seems also to play a role. For assembly lines the domain varies according to whether they are 'towed' or 'stop-and-go': in the first case the domain is larger, in the second it is smaller. Furthermore, in the segments of production featuring state-of-the-art robots and where the process of digitalisation is more advanced, the size of the domain tends to decrease (together with the total number of workers employed in these specific phases).

These aspects related to the size of the domain indeed deserve further investigation. However, it is possible to acknowledge that in no case the size of the domain and its variability have been discussed with the workers. The dimensional characteristics of the domain and therein the number of team leaders to be appointed has been decided by managers and implemented without involving workers (not even for advisory purposes). What is clear to the interviewees is that the issue of domain dimension hasn't been negotiated with union representatives either.

The size of the domain, however, affects the relationship that is established between the employees involved in the domain and the team leader, the role that the latter is called to perform and the type of practices of involvement and accountability of the members of the domain.

5.2 Practices of involvement and empowerment of workers

The involvement and empowerment practices represent a further aspect of variability both between and within each firm. The two most common practices of involvement and empowerment appear to be (i) team meetings and (ii) systems to support the process of continuous improvement.

5.2.1 Team meetings

At Cesab-Toyota *asaichis* are set (classic devices of the Toyota way), at Ducati a number of periodic meetings are carried out among professionals of a phase (defined as *briefings* by respondents), and at Lamborghini such meetings take place regularly and are defined *team work*. Beyond the different definitions, in all cases these meetings are aimed, at least theoretically, to communicate programmes, to socialise knowledge, to investigate problems and possibly come up with collective solutions. Each of these devices, however, has different characteristics from department to department within the same establishment. For instance, the frequency with which the meetings take place varies: at Cesab-Toyota some respondents claim to attend the *asaichi* on a weekly basis, while other respondents, questioned about the frequency of *asaichis*, answer with a generic ‘when it happens’ (note that in this case it is almost a contradiction since the Japanese word *asaichi* literally translates to ‘morning meetings’, and a rigorous application of the Toyota way would require their daily scheduling). At Ducati, the frequency varies from weekly to monthly; likewise, at Lamborghini the frequency of meetings, that take place in a room with transparent walls next to workstations, vary from department to another. However, what seems to be even more variable is their function: despite all respondents consider these meetings to be useful for socializing knowledge, only in some cases they are considered real teamwork and decision-making practices that generate collective solutions to problems that arise. In several other situations – and in this case also depends a lot on the specific department – meetings are considered simple collective communication devices, effective especially in reaching a large number of production workers at a time.

“In the warehouse we do [...] the *asaichi* on a weekly basis. [...] Meetings range between 15 and 30 minutes [...] The person in charge of the *asaichi* presents the problems without specifying names [...] then the quality responsible calls one by one to solve the specific problem. [...] The team leader sets up the meetings. We have this habit [...] of discussing over how things go, the communications the team leader himself receives [...] we are quite up to date [...] I feel I’m aware of what’s going on.”
(anon. from [Cesab-Toyota](#))

“We do the *team work* every couple of weeks with the team leader and the head of the department. This habit came with Audi; it wasn’t there earlier. I find it right. If someone has to say something or has to raise some issues, it is important to discuss them.”
(anon. from [Lamborghini](#))

5.2.2 Continuous process improvement support systems

Within the firms under study, there is a widespread presence of support systems to the process of continuous improvement: at Cesab-Toyota there is an implementation of the *kaizen* system, Lamborghini adopts instead a system called ‘management of ideas’; Ducati also implements practices of this type by placing in various departments whiteboards and boxes through which to collect proposals for improvement by workers. The assessment of these practices by respondents, however, is ambiguous with respect to the effects that these have in terms of involvement and empowerment of workers. In the first place, it emerges a good deal of discretion of the feedback to the proposals for improvement. While in some cases, in fact, the process of assessment of proposals is clear and decision-making is also extended to an employee representation (in the case of Lamborghini, in which the selection committee of the proposals for improvement also involves a union representative), in other cases, the very criteria used to evaluate a proposal and the reasons that can lead to its approval or rejection are opaque. The response times are, especially in the latter case,

long and uncertain. These aspects, which inevitably increase the perception of discretion regarding important decisions, lower the expectations of the workers regarding the effectiveness of the improvement support system and especially increase the feeling that their impact on the effective involvement and empowerment of workers is limited.

“We make suggestions for improvements, we provide ideas on how we should work, but they are not always taken into account [...] You just have to hope it is a period they are not busy so they take our suggestions and answer back; when they are busy they’ll postpone to the next round.” (anon. from [Ducati](#))

Anyway, even where the support systems to the process of continuous improvement and ensuing award schemes are more formalised, other issues emerge. In particular respondents emphasise the bureaucratic burden that they entail, with an ultimately encouragement to bypass the system in place and rather directly address the team leader or a hierarchical superior.

“I have 17 years of experience and I’ve tried to give suggestions [...] in Toyota there is this kaizen system, but in reality you lose a lot of time writing and our suggestions are not often accepted [...] for example when we make the cabins [...] we always work and move on manual stairs. I told my boss three years ago but they never listened to me [...] I told them it’s not because I’m scared of working on these stairs, but if we now make 60 cabins and it seems that soon we’ll make 70, while before they were only 35, I do not find it right to do such a repetitive job where I have to climb the ladder, continuously up and down, and move it every time while we could for example consider the use of ramps. But they have never considered it.” (anon. from [Cesab-Toyota](#))

Additionally, far more importantly, the mode of forwarding of proposals and the rewarding system are not always perceived as boosting the cohesion of the team. Although it is possible for workers to forward suggestions for improvement as a group, the proposals are usually made individually and the prizes, either monetary or fringe benefits, for the best proposals are awarded to single individuals. According to some respondents, this reward system strengthens cooperative relationships between individuals and the company, but also feeds the establishment of competitive dynamics between individual workers, and not coincidentally a widespread feeling of competitiveness is recognised by many respondents. Such practices do not seem to favour the socialisation of knowledge, for example about a problem and its solutions, with colleagues until a further hierarchical step is performed.

5.3 Roles and functions of the team leader

Our interviews confirm that the introduction of the figure of the team leader represents an element of organisational innovation. The team leader performs functions that are not reducible to a command-and-control leadership. Roles such as supporting/guiding the professional growth of the workers (*coaching*), supervising the production process, and training and motivating the team, are aspects that respondents recognise as distinctive of the team leaders figure compared to a traditional figure of line-, area- or department-manager.

In some cases the team leader also represents an important node of vertical (for example with the head of the department) and horizontal (e.g. with other team leaders) coordination, acting as a communication intermediate.

The role of team leader, as many point out, is largely perceived as symbolic, status-upgrading without a significant wage increase, nor a formal upgrading within the organisational chart. It is therefore understandable that respondents recognise as particularly difficult the position in which the team leader sits. Pictures of 'stressed', 'multitasking', and 'always running' team leaders are very recurrent in the interviews.

At the same time, it emerges a permanent unstable balance between the formal and informal dimension in which the team leader role is positioned. Formally, the team leader is not required to take responsibility for deciding how to deal with contingencies that arise during the production process, nor to take direct action to solve problems. In fact, its function should be limited to support and enhance the problem solving skills of employees, leaving to these latter the responsibility to decide how to solve the underlying issue. However, it is normal practice that the team leader himself takes discretionary responsibility for the intervention, giving precise directions on how to solve the problem or intervening in first person on the process to allow the workflow to continue.

"The team leader is the figure that intervenes when we are in need. We have buttons [where we work] [...] in case of need we press the button, the light appears on the notice board at the top [of the line]. He sees it and intervenes [...] for instance in case we have problems with documentation, or with the cart that we can not inspect [...] He arrives, you explain what happened, you tell him the problem and he decides what to do, calls here and there, understands if it's something he can solve right away, otherwise he tells you to make a note on the log and send the cart forward. He'll take care of the problem and how to solve it." (anon. from [Cesab-Toyota](#))

A team leader that we interviewed describes her working days as 'strongly multifunctional', and whose boundaries are discretionary.

Such 'breach' of formal rules on behalf of the team leader, understood as the availability to teach how to deal with a technical glitch, to take direct action to solve a problem, to help those in need and/or replace a worker in case of unforeseen or short absences from the station, is often appreciated by respondents. The discretion through which the team leader plays its role seems to allow workers to recognise her as depositary of technical and professional knowledge and socialiser of the latter through cooperative relationships with the team.

Technical and professional skills, while not considered the core of the team leader competences, appears crucial for her recognition by the workers of the authority to exercise management and supervision functions. All this highlights a contradiction about the perception of the team leader selection criteria: on the one hand, it is argued that the expertise that the team leader must possess to effectively play its role consists of soft skills and management skills; on the other, it highlights the opportunity that the team leaders are selected among the most technically competent operators, and stigmatises the figure of the team leader coming from outside the underlying unit or department, with little experience of that segment of the production process.

"He's a very young guy and has been with us for 2 months, he worked a bit both in our line and elsewhere [...] when he came with us he had been coaching with our old TL who went to the Urus [...] but now we are helping him too. On some technical things the TL manages to interact with us [but] [...] there are other things that he just doesn't know [...] In my opinion this is wrong. In my opinion a TL must have worked across the line, from the start to finish, and know it by heart." (anon. from [Lamborghini](#))

Lamborghini has recently ruled that those eligible as team leaders must have the highest professional skills. These are symbolised by the presence of three black dots on the flexibility matrix

for all the phases the team is supposed to carry out. Three black dots indicate that the person not only knows and is able to perform the task, but that is also able to teach it. Once these skills are verified, in order to become team leader the candidate has to attend a training course focused on the acquisition of interpersonal and managerial skills.

Certainly, the degree of discretion of the team leader may vary from one another, even within the same plant, and consequently the coexistence of very different figures is possible. The discretionary action of team leader is a reinforcing factor of the non-hierarchical nature of its role. The same discretion, however, is perceived by some respondents as a way through which, paradoxically, a re-hierarchisation of that role seems to pass. In several cases, in fact, the specific declination of the team leader discretion is accompanied by typically hierarchical functions. For instance, the team leader is the only member of a team in charge of the implementation of involvement practices and empowerment of workers that have been described in the previous pages. Although the *asaichi*, the teamwork, *kaizen* or 'management of ideas' are systems put in place by the management, their operational details are largely at the team leader discretion, e.g. the frequency of meetings, the time spent collecting improvement proposals, etc... It is always the team leader who has the authority to stop the assembly line in case of a problem, and the operator only has to draw the team leader attention by pushing a button, connected to a visual or aural alarm. In fact it is rare, in a system where the *andon* is implemented, that the single operator has the right to stop the assembly line. It is usually a hierarchical superior (e.g. the head of department) who has the right to consider and, if deemed necessary, stop the line. In all our case studies, this authority belongs to the team leader.

"The team leader has the authority to stop the process [...] I report the problem, I press the button, the light comes on the screen, the team leader arrives, evaluates the type of problem and decides to stop the line if necessary. [...] but I do not [personally] stop anything, I can not, it is him who decides." (anon. from [Cesab-Toyota](#))

The overlap between the functions of the team leader and the head of department (the latter being a typical hierarchical figure) is apparent when respondents identify the evaluation of workers, which are also relevant for career upgrades, among the activities carried out by the team leader (more on this in [Section 7](#)).

All this confirms the vague and ambiguous nature of the team leader role. Her multi-functional character and her high degree of discretion are well recognised. Such discretion can be a reinforcing factor of a hierarchisation, or even a re-hierarchisation, process with obvious consequences on the team work environment. After all, the term that many of the workers use to address the team leader as 'boss', and in the respondents' outline of organisational hierarchy she is almost always included as a hierarchical figure.

"The team leader is your boss. Above him, the head of department. He is our reference. If you have to ask for the holidays you go to him, then he talks up to the head of department, but we go to him [...] He is also a channel of communication. If you have a problem, you go to talk to him and he tries to solve it."

(anon. from [Cesab-Toyota](#))

6 Job rotation practices

The literature identifies three distinct hypotheses related to the introduction of job rotation practices: *employee learning*, *employee motivation*, and *employer learning*. Along with these, a complement-

arity is recognised between job rotation practices and the presence of team work and, in general, the active participation of employees within the production process.

These categories have been reorganised by distinguishing direct and indirect goals linked to the introduction of job rotation, and the degree of complementarity with respect to other HPWPs aiming at the creation of horizontal and widespread knowledge among workers. This was done in order to intertwine the theoretical categories with the empirical evidence, thus not performing a simple theoretical validation process.

The analysis of the textual body of the interviews is intended to check to what extent the respondents lead back or report an experience of job rotation due to direct and/or indirect targets. In addition we seek, whenever possible, to assess the degree of awareness expressed by respondents, both with respect to the presence of the practices and their ultimate goal.

The introduction of job rotation practices has the direct aim of ensuring a flexible production by means of maintaining a 'tense' production flow. In particular, it is reported that job rotation finds its fundamental purposes for the firm in terms of i) gaining a time advantage with respect to the flow, ii) intervening within the process in case there are interruptions and iii) allowing substitutions between workers in the case of absence. More in detail, such substitution takes place not only at the level of task, but also between the worker and the machine.

"And then job rotation is useful for the question of keeping the flow continuously tense. We are two days ahead with respect to the assembly line. If you lose this advantage you risk screwing up everything, so you have to keep this advantage at all costs. If the robot breaks down we start welding everything by hand not to lose the advantage, but we must know how to do, otherwise the line stops! [...] [If] the robot that welds breaks, we can fall back on our craftsmanship, but this craftsmanship must be cultivated."
(anon. from [Cesab-Toyota](#))

While the replacement of a defective robot turns out to be a peculiarity of the specific firm and stage of the process (e.g. in the welding department of Cesab-Toyota), the aim of allowing substitutions between workers in the case of absences appears more widespread.

The degree of awareness of the purpose of job rotation is such that, although it is not explicitly known *who* does actually decide how to rotate between the stations, it is clear why this happens.

"I do not know how it is decided who needs to know what, but I think the head of department and the eldest TL make an agreement. They aim at making everyone learn about all the stations. The problem is that unfortunately there can be absences and it is better if everyone knows how to do everything."
(anon. from [Lamborghini](#))

In line with the theory of the firm, the perception of the operators is particularly interesting with respect to the possible contradiction between job rotation and a high degree of specialisation. However, the operators themselves recognise that it is the employer who benefit from the rotation between tasks, in so far as it allows to increase the coordination and the quality of both the process and the product. The degree of formalisation of job rotation practices is very different both between firms and between different departments of the same plant. Examples of a very formal and rigid structuring of the rotation may well coexist with more discretionary and flexible case, even within the same factory.

Although in all three case studies job rotation practices are widespread, in most cases the rotation takes place between tasks/workstations rather than between departments. At Ducati, for instance, the difference between these two forms of rotation is also contractually recognised and

distinguished in multi-purpose (i.e. being able to perform multiple tasks) and multi-functional (being able to operate on different stages of the production process).

“Earlier, I spent 10 years working in the assembly line. In nine years I have done several things, testing, control units, I do not have multi-functionality, but I’ve been recognised as highly multi-purpose.” (anon. from [Ducati](#))

Along with the direct aim of increasing productivity, there are a number of indirect, or intermediate, goals, resulting from the adoption of job rotation. Among them, (i) the process of learning and increased knowledge on behalf of the operator with respect to the production flow (employee learning), (ii) an improvement of working conditions due to the decrease of repetitive tasks, and (iii) the opportunity for the employer to monitor the work of employees, distinguishing the skills of the individual on the basis of the degree of multi-functionality in the process. Some workers report themselves a high degree of participation in the production process, through the explicit willingness to learn those process steps that do not know yet.

Along with the learning idea, the worker benefits from being able to break the repetitiveness of the activity. This aspect (employee motivation) is certainly one of the key elements reported by respondents. In fact, the repetitive work is clearly poorly tolerated by the operators, in which case fatigue and stress are reported. In particular, the benefits from job rotation relative to the reduction of physical and psychological strain are the most appreciated.

“It has been three months now that I am stationed at the same point of the assembly line and it is driving me a little crazy.” (anon. from [Ducati](#))

In terms of efficiency of the production process, it emerges in a non-obvious way how the continuous performing of the same tasks not only demotivates the operator, but also increases the probability of making mistakes.

“I’d like to change my task due to monotony, because repeating the same thing for 10 months makes you lose the stimulus and you are more prone to those mistakes that if you change a little more often occur less.”

(anon. from [Cesab-Toyota](#))

Finally, job rotation and degree of tasks flexibility can constitute key criteria for the evaluation of the individual worker. In fact, while at [Ducati](#) versatility and multi-functionality are contractually recognised, at [Lamborghini](#) it is rather the flexibility matrix that is used for the evaluation. For instance, these matrix appears to be a crucial driver in choosing those workers to relocate to a brand new assembly line. In this regard, the introduction of the new [Urus SUV](#) at [Lamborghini](#) has seen the displacement of a number of workers towards the new line. One respondent reports that workers with a permanent job, that incidentally have acquired better expertises and knowledge of the production process and therefore display a greater added value, are more likely to be transferred to the new line, while temporary workers are placed in the old lines. However, at the current stage, is not yet entirely clear to respondents how such transfers from the old to the new line will actually take place.

From these excerpts it emerges that there is no co-managed process in the selection of workers to be transferred to the new line; rather, this decision appears uniquely up to the HR department. Some respondents at [Lamborghini](#) fear that this approach could also result in short-sighted choices.

Therein, an additional level of contradiction with respect to the implementation of job rotation and workers participation practices emerges. These schemes appear successful in increasing

the knowledge of the worker, and 'breaking the routine'; however, the degree of participation in decision-making concerning the extent and mode of rotation of workers is perceived as very limited. This leads to potential tensions between management and workers. It seems that the workers themselves may possess greater awareness of who might be better suited to step on the new line, rather than a top-down decision of the HR department. Although the relationship between knowledge and decision-making power is not fully addressed in the body of the interviews, there is evidence of tension between bottom-up knowledge creation and top-down decision making.

After distinguishing between direct and indirect objectives related to job rotation, it is relevant to understand the coexistence of job rotation practices with other HPWPs, in particular the presence of team work and other mechanisms team aimed at increasing the workers' participation in the production process through the collection of suggestions for improvements and/or resolution of errors.

Some of these aspects have been already analysed in [Section 5](#). In the present section we focus instead on the analysis of the effects of such practices, both on the potential improvement of the production process efficiency, and how they impact the degree of awareness of workers about the firm's objectives. This kind of awareness regarding the benefits to the firm coming from team working is evident in some of the interviews.

"We work a lot together, we work a lot as a team but it is obvious that everyone has his own role. It's a planned thing, done by the coordinators who design this programme for everyone. They want each of us to be able to do the work of others, and there are organised learning paths for us to do so." (anon. from [Cesab-Toyota](#))

However it is also clear how respondents feel a sharp perception of hierarchy, and ensuing fear/reverence with respect to their boss. The flow of information and decisions, although it is formally structured according to a horizontal hierarchy (the team), turns out to be considerably imbued with hierarchy, both in terms of knowledge, from the head to subordinates, and during the evaluation of proposals, which always passes through a higher figure in the hierarchy.

"We have the 'management of ideas': working on a station I notice a defect, I ask the TL to bring me the sheet for the management of ideas, I write the improvement and I deliver it to the head of department. The latter will deliver it to the heads of the other entities who assess the idea and there is also an economic compensation if there is an improvement e.g. about safety issues." (anon. from [Lamborghini](#))

In spite of many findings in the literature, even in those cases in which the practice of job rotation is quite structured, the proposals resulting from the suggestions of workers, namely the bottom-up implementation of a systematic process of collecting knowledge, are largely unfilled.

"I had brainstorming experiences during the GMK period. In general, however, one speaks with the supervisor. Thanks to GMK we have put a box next to the line where an operator can make an improvement request. I do it mostly by habit, but I notice that most of the time suggestions are not considered. It is difficult to translate the idea into a practical act." (anon. from [Ducati](#))

Although systems for proposing potential improvements are in place (ranging from the kaizen to the 'management of ideas' or GMK), there appears to be a lack of a systematic collection and consideration of such proposals. In addition, there is no explicit notification when a certain proposal is under evaluation. Both the collection and the assessment still appear to be carried out in a discretionary fashion.

“Are reports of improvements accepted? If the head of department is in a good mood he will listen to you. Sometimes the supervisors do; it depends on who is in front of you. It happened to me now that we are doing GMK. There they listen to you and if you have some ideas they want to put them into action.”

(anon. from [Ducati](#))

7 Performance evaluation systems, mobility, and career prospects

The organisational literature has often highlighted the importance of evaluation systems of business performance with respect to the effort that workers put on the job, and the consequent benefits for the firm. In the specific context of this analysis we intend to investigate the perception by the workers about the mechanisms of evaluation and the related award of prizes. The existence of non-monetary incentives that are designed to reward job performance through access to ‘opportunity’ can affect worker satisfaction, which in turns contributes to the construction of proactive attitude towards the company’s organisational culture.

The analysis of the interviews reveals the existence of a certain heterogeneity in the perception of the evaluation systems especially regarding the discretion and uncertainty in the appointment of awards, and clarity about the assessment criteria. A lesser degree of heterogeneity emerges about those people that are influential within the evaluation process. The respondents highlight the existence of a certain amount of discretion in the allocation of monetary prizes (e.g. the zero-error award) and non-monetary incentives (e.g. contractual level upgrade, promotions etc...). The performance evaluation system is perceived as discretionary, and in some cases even unfair, especially regarding non-monetary incentives and career prospects.

“I’ve won a zero-error prize [...] this also at the discretion of the boss every three or four months. My supervisor came and told me ‘go see the head’ and the latter told me ‘look, in this period here you worked very well; if you want I can award you a prize’, with a procedure that is a bit embarrassing.”

(anon. from [Ducati](#))

Sometimes, the non-allocation of these incentives can fulfil a disciplinary function of individual behaviour within the workplace.

“The level upgrade is sometimes given as a prize, sometimes to those who are more motivated on the job, sometimes to others that...you get what I mean...[...] Working extra hours, always being available, always saying yes... there are people like this and others who set more boundaries. The latter are less likely to get a level upgrade.”

(anon. from [Cesab-Toyota](#))

The perception of discretion in the allocation of monetary prizes is attributable to some variability in relation to age and the seniority of the worker. Younger respondents report the existence of a common practice by which prizes and incentives are generally awarded taking into consideration the experience of the worker and time she spent in the factory.

Some workers recognise the existence of a formalised system of evaluation and, therefore, give a lower level of discretion in the allocation of rewards and levels. However, despite the introduction of a formalised ‘report card’ (only in Lamborghini) containing an assessment of the performance of the worker, some respondents perceive a margin of discretion in the association between the evaluation and the ensuing economic prize.

“There are people who have all three dots for all the tasks. But from an economic standpoint there is no difference compared to others. I do not think there are advantages, even in terms of status.” (anon. from [Lamborghini](#))

Among the monetary incentives, bonuses may apply. Again, however, some workers denounce the lack of clarity and confusion about the adopted criteria for the allocation of bonuses.

Even the existence of a more formalised system of employee evaluation and awarding of prizes does not rule out that some workers express a lack of knowledge regarding the use of the ‘report card’.

“I do not think that report cards are used to fine tune the remuneration. I understand the concept of the report card as in school, in the sense that if you’re good you get a good grade, but I do not know then where this report actually ends up.” (anon. from [Lamborghini](#))

Closely intertwined with the perception of greater or lesser discretion in the allocation of prizes, is the clarity about the evaluation criteria. At Lamborghini, this system turns out to be quite clear and formalised. As noted above, in some cases, such as Lamborghini, a system of worker co-participation in the drafting of goals against which to calibrate the evaluation criteria is in place.

“There are annual evaluations in which they assess professional objectives (related to what you do), company objectives (linked to the firm), and individual objectives (e.g. learning German). The goals are decided together.” (anon. from [Lamborghini](#))

The existence of some form of evaluation of performance in qualitative terms is sometimes perceived as beneficial in order to improve the working practice.

The influential figures on the evaluation of performance also deserve some reflection. In all three cases studies, it is the head of the department that plays an important role in the assessment of workers, although the team leader retains some degree of influence. Where the evaluation process is perceived as more standardised, there is also greater clarity on who are its influential figures.

“It is the head of department who has the last word. Perhaps the supervisor can notify that a person is working well. The head of department knows us personally, also because mine has been here for 15-20 years.” (anon. from [Ducati](#))

The team leader also serves as an intermediary between the operator and the head of the department.

“The team leader can have a say in giving you a higher level, he makes his own assessments about you and advises the head of department, who in the end is the one who decides. But the team leader has a say because he is the one who keeps his finger on the pulse of the situation, he sees us there every day and knows us. In short, the team leader has influence, and even to a good extent, although the final decision is on behalf of the head of department.” (anon. from [Cesab-Toyota](#))

There is a certain degree of variability between different departments. For instance, white collar workers do not have a team leader and their evaluation is carried out by their coordinator.

The assessment mechanism is sometimes supported by regular audits entrusted to external firms. Such a procedure is not perceived as intrusive by respondents.

“In my opinion this is valid because the operator is more inclined to engage.”
(anon. from [Lamborghini](#))

In all the three case studies, an operator’s versatility and/or multi-functionality are encouraged and recognised characteristics. However there is a perception of arbitrariness and sometimes of injustice concerning their formal recognition.

“The recognition of being multi-purpose works that, the more things you know to do [...] for example, this year I got the basic one, maybe I should have the high one since I know how to run the trial stage, maybe I should have that medium one at least. Regarding levels I do not know [...] the other day a guy who knows how to do everything was recognised medium multi-purpose when he would deserve the high one – there should be a medium-high one and multi-functionality. In the end it is not so much for the remuneration premium, it is more a matter of personal recognition, the economic side is almost irrelevant.”
(anon. from [Ducati](#))

A different reasoning goes with mobility programmes, which in many cases are managed as a replacement or extension of the awards/monetary incentives put in place to motivate the employees in relation to their work and encourage a sense of ‘membership’ and attachment to the firm. Different respondents provide different perceptions even within the same firm. Some workers – mainly assigned with assembly tasks – highlight the existence of mobility criteria that are not clear, nor formalised. While the possibility of ‘getting ahead’ is widely recognised, the contractual level upgrade is subordinated to assessment contained in the report card (at [Lamborghini](#)) or to the judgement and discretion of the boss.

“Career advancement is not clear, as isn’t the reason why one person is chosen over another.”
(anon. from [Ducati](#))

What is especially perceived as relevant for career prospects is the ability to stand in terms of social aptitude, and anything that can be traced to soft skills. The same perception applies to the assignment of the role of team leader. In some cases, it appears that the choice of appointing a worker as a team leader has been arbitrarily dictated by non-work-related factors.

“Who becomes a team leader here? Those who do more overtime and those who have no children! Of course, afterwards he receives training and becomes a truly competent figure, but the selection is... on the basis of sympathy so to speak, we cannot not hide it.”
(anon. from [Cesab-Toyota](#))

Some responders emphasise the presence of a limited vertical mobility, hardly formalised, and more often not individually negotiated. At [Ducati](#), the upgrade 4th to 5th contractual level is perceived as distant, remote. Feelings of immobility in career terms negatively affect what may be otherwise called a general job satisfaction. As for the incentives and monetary rewards, even the level upgrades are perceived in some cases as discretionary. In some cases, the paths vertical mobility are perceived as rare and difficult among employees. Sometimes, this immobility is linked to gender issues, turning into a complaint in unequal treatment between men and women with respect to career prospects and work/life time reconciliation.

“As a woman I think I have limited career prospects. I do not see big career opportunities inside my office. We have a boss, a German coordinator who will return to Germany. We are all more or less on the same level. The maximum I can aspire to in my office

is the coordinator. Instead if they move you to other departments they can give you salary increases and responsibilities.” (anon. from [Lamborghini](#))

The passage from a blue-collar to a white-collar job within the same firm, although being not exceptional, is perceived as such. The overall recent introduction of more stringent requirements for access to white-collar jobs in terms of degrees and qualifications is sensed as a barrier for such transition. White-collar respondents report the desire on behalf of the management of more frequent vertical mobility from the assembly line to the office, although their perception parallels that of their blue-collar counterparts.

“Those who are hired nowadays as white-collars are all engineers, but many employees who have been here for some time have moved there from the workshop [...] Once it was easier. [...] I was a joker, I could do pretty much everything. Now there is the assembly line, but once it was different: we used to build the cart more from the beginning to the end [...] you could see who was good, now you see less your ability. Then I finished the university [...] they saw me and they put me in the office.” (anon. from [Cesab-Toyota](#))

In the specific case of Lamborghini, horizontal mobility between departments appears to be encouraged, and is associated with the recognition of the worker as multi-functional. The implementation of horizontal mobility paths falls within the practices aimed at increasing the motivation of the worker with respect to his job and her exerted effort (see [Section 6](#)).

“Many people after a while ask to be moved, e.g. a guy that has been with us for 4 years and rightly asked to see more because after some time always doing the same thing can be boring.” (anon. from [Lamborghini](#))

Horizontal mobility allows to overcome the monotony of continuously performing the same task, and is deemed valuable as a HR practice aimed at increasing the motivation of the worker and the level of his job satisfaction. Sometimes it is also aimed at relieving the worker engaged in challenging/demanding tasks. But there are also cases in which this practice is perceived as sporadic, and therefore almost unnecessary for lightening the burden of repetitive tasks.

8 Interpretation of the empirical results

The study of the co-evolution of processes of technological innovation and the resulting organisational changes has been a topic of interest since the first appearance of the idea of division of labour and specialisation in Adam Smith’s works. The major phases of organisational change are in fact the result of ‘waves’ of technological innovations attributable to the various industrial revolutions. To date, a new technological paradigm potential, dubbed ‘Industry 4.0’, is shaping the manufacturing output of the United States, Europe, and China, particularly in the automotive/engineering industry. With reference to the latter, the present research contribution aims at investigating the degree of openness of the awareness context of workers and their ability to intervene on the production process within three factories belonging to the so-called Italian ‘Motor Valley’. Together with state-of-the-art 4.0 technology adoption, the three case study firms exhibit different organisational practices ranging from the Japanese Toyotism (Cesab-Toyota), to a mix of Taylorism and co-determination (Ducati), up to the example most akin to the German ‘*Mitbestimmung*’ (Lamborghini).

In order to identify how technological change in these enterprises has been implemented into organisational practices, and how these latter exert influence on the awareness context of workers and ability to intervene on the production processes, we conducted a field survey mainly consisting of a number of semi-structured interviews to the workers, including both middle-management figures and assembly line operators.

The ensuing textual body has been decoded according to three organisational levers that, apart from being formally recognised by the organisational studies literature, have emerged naturally during the interviews as key mechanisms for the organisational transformation processes aimed at lean production: (i) de-hierarchisation and teamwork, (ii) job rotation and participation schemes, and (iii) performance evaluation systems, mobility, and career prospects.

From our case studies it emerges that the introduction of I4.0 technologies has been accompanied by the effective implementation of organisational changes aimed at increasing workers' involvement and responsibilities. All this, however, seems to have occurred through forms and processes of hybridisation between formalisation and arbitrariness. This hybridisation does not occur simply in the comparison between companies, but also in the coexistence of the organisational levers within the same organisation and in particular in an evident tension between the implementation of HPWPs not related to monetary incentives, and valuation systems and monetary incentives.

The notion of arbitrariness is particularly relevant with respect to the absence of formal mechanisms regarding career advancement and the awarding of individual prizes: in this sense, workers perceive as arbitrary the identification of those who 'deserve' a contractual level upgrade, what are the parameters of this evaluation (e.g. performance, dedication...), and what are the timing of such advancements. Although the degree of such formalisation varies across firms, even in the case of Lamborghini that implements clear flexibility matrices, workers struggle to understand the purpose of the 'report cards' they receive. Moreover, unlike the HPWPs, career advancements and prizes are more related to disciplining, rather than motivational goals. In what can be seen as a blurred dichotomy between the ensemble of those practices that are intended to 'extract value from workers', in the form of productivity increases, substitutability between tasks, streamlining of downtime, greater coordination (job rotation, participation, team work), and those intended to 'redistribute value to workers', such as level upgrades and monetary prizes. It should be noted that this tension is present in all our case studies.

It can be argued that in general the introduction of I4.0 technology has been accompanied by organisational changes that favoured the opening the awareness context of workers. These latter report an increase and broader diffusion of knowledge of the work process within their establishments and they associate the improvement to the organisational changes that over time have been implemented. We will now list a few of them. The introduction of new technological artefacts or processes are often preceded by moments of information and communication through team meetings (and in some cases even by moments of proper formation). These meetings (e.g. *asaichi*) also serve as communication channels for the socialisation of knowledge regarding, e.g. issues and contingencies that occur along the assembly line. Alongside, continuous improvement processes have been implemented, requiring the active participation of workers. Job rotation fulfils the dual function of extraction/restitution of value and knowledge to/from the workers, and in fact contributes to increase the spectrum of the tasks that operators can perform; these multi-functional aspects are also taken into account – and encouraged – by systems of evaluation and career progression in all three case studies.

A first result of our field research is that the introduction of I4.0 technological artefacts, along

with the implementation of the three organisational levers taken into account in the previous sections, has generated a general opening of the workers' awareness context.

On a general level, the opening of the awareness context in the three studied companies appears to have also produced an increase in the ability to intervene on the production process in terms of discretion. Such discretion is in many cases required or at least favoured by the organisational practices in place. Many respondents in this regard have confirmed that the new introduced technologies require an organisation of work that entitles the operator with deciding how to reach a specific goal. However, while there is a general link between the opening of the awareness context and increase in the ability to intervene in terms of discretion, many respondents have revealed important differences not only between different firms, but also between different departments of the same factory. In this sense, it is not possible to ignore the case of Cesab-Toyota, in which the increase of discretion, formally encouraged by the firm itself, collides with the strong reduction of the takt time, in line with the Toyota way inspiration. From the interviews with workers therein, it emerges the friction that occurs between the encouragement of proactivity and variability of tasks, and the limited time available for exercising them. This conflict is attenuated at Ducati and is hardly present at Lamborghini. Arguably, the specific product that is manufactured in the three firms might well play a role in the explanation of the differences found. The forklifts of Cesab-Toyota cannot be considered mass consumer products and their customisation has grown considerably over time; still, they are serially produced in large quantities, especially compared with other actors in the industry. Despite the possibility of customising some details on certain products, also the production of Ducati stands at high volumes (grown considerably in recent years), but compared to other competitors in the industry (such as Honda and Kawasaki) it ranks comparatively low. Finally, cars made in Lamborghini represent a typical example of a niche product (also in this case however there has been an increase in the volume of production, and is expected to grow at a faster pace in the future after the launch of the new Urus SUV).

Along with these differences in the ability to intervene on the production processes detected across firms, a few situations appear to differ within the same factory. In other words, while the technologies are generally accompanied by organisational changes that extend across the enterprise fostering the opening of the awareness context, in some departments the consequences appear dampened, and in some cases the ability of intervening of workers is even reduced. An extreme but emblematic example is the adoption of digital torque wrenches on assembly lines (within all three studied factories). The digitalisation of torque wrenches allows to collect, store, and analyse (through dedicated wireless networks) high-precision data about how a specific bolt has been tightened, although the digitalisation appears to be instead used to stiffen the procedure of the various tasks. The data can be processed in real time and monitored remotely from a supervisor; the operator using the torque wrench can see on a screen the result of his work; in case the bolt is not correctly tightened, the screen displays a red light indicating that the operation has to be repeated; if the error doesn't get corrected (the bolt is not unscrewed and screwed back again) the light doesn't turn green (the signal indicating that the operation has been carried out correctly) and the computer doesn't unlock the tool to perform the next tasks, thereby enforcing a rigid sequence in which the operator must perform the various operations.

As a second result of our field research, the general opening of the awareness context generated through organisational changes that have accompanied the introduction of I4.0 technology has generally produced an increase of workers ability to intervene on the production process in terms

of discretion, but this increase is significantly different not only between one factory to another, but also among departments of the same factory.

The analytical distinction between discretion and autonomy in our theoretical framework also made it possible to detect another very important aspect, namely that the general (although non-homogeneous) increase of discretion on behalf of respondents do not seem to match a likewise increase of the autonomy in adjusting the working process. The possibility of being involved in the design of the very organisational practices expected to foster discretion on behalf of the workers is also perceived as limited. For instance, it emerges that while team working and job rotation constitute practices aimed at increasing the knowledge of workers about the production process, but such an increase of knowledge in many cases results in an expansion of *ex-ante*, *pre-defined* actions.

Therefore, if an increase of autonomy in decision-making appears to be characterised by the ability to assert an own set of rules, not only through the intrinsic regulation (in which the presence of autonomy, as is evident from the theoretical framework, can only be taken for granted), but also through prior rules, our results picture a framework in which the autonomy of workers appears quite limited, and upon which the introduced organisational practices do not seem to have exerted a significant impact. The case of Cesab-Toyota is emblematic in the sense that, although the andon is present, the individual worker has no decision authority to stop the assembly line, and instead this formal decision is always up the team leader. In case such decision is made jointly by the team leader and an operator, it is the team leader who deliberately derogates from its formal authority, that is by a rule which is heteronomous from the operator's point of view. Likewise, the support mechanisms for continuous improvement and the evaluation systems do not seem to significantly improve the autonomy of workers: despite the fact that these systems are more or less effective in engaging, empowering, and motivating the workers, it rarely emerges from the interviews the ability to decide the timing and mode of operation of these systems. Similarly, in the case of introduction of a new production line at Lamborghini, the choice of workers to relocate turns out to be entirely taken by the management, or at the most by individual candidates, but not for example through the involvement of the team work.

Therefore, a third result of our field research is that the general opening of the awareness context generated through organisational changes that have accompanied the introduction of I4.0 technology in general did not create the conditions for an increase in the autonomy of workers, especially in terms of the increased ability of establishing their own rules in the organisational and production process.

9 Conclusions

Given our methodological framework, the research does not aim at formulating generalisations, and the results that have been reported can not be readily extended beyond the scope of the three case studies considered in this paper. It is however possible to formulate a theoretical contribution that we hope will prove useful to orientate future research on this topic. It can in fact be argued, on the basis of what has emerged from this research and consistent with the epistemological perspective in which we are positioned, that the implementation of organisational changes that accompanying the introduction of I4.0 technology can foster the opening of the awareness context without necessarily result in a uniform increase in the discretion of the operators, and especially not necessarily lead to an increase of their autonomy.

It is possible to inquire, again on a theoretical level, whether the results that this research highlights actually reflect a specific 'lean philosophy', or rather how much they represent an intentionally designed organisational model. We believe that the answer to this question should be sought in the theoretical-epistemological perspective through which to interpret the results. Within a theoretical perspective of institutionalist character, which contemplates a possible dialectic coexistence of multiple organisational logics, the hybridisation of arbitrariness/formalisation through which the new organisational practices have been implemented can be attributed to a conflict between different organisational cultures exerting pressure on change. In an analogous fashion, the opening of the awareness context without a corresponding increase of discretion and autonomy it can be interpreted as the product of the conflict between different cultures, while none of them is able to penetrate completely. And if it is assumed at the same time that one of these logic is a clear winner, in terms of adequate exploitation (not necessarily in efficiency terms) of the I4.0 technology potential, it is easy to fall in the idea of 'non-completed implementation stage' or rather 'cultural conservativeness of the management'. If, instead, our results are deciphered within a theoretical-epistemological perspective in which the organisational rationality, albeit limited, assumes a greater weight, then the interpretation changes significantly. In this case, the selective adoption of practices which are institutionally prescribed by an organisational paradigm (lean production aimed at I4.0) can result from a misalignment or discrepancy between aspirations and performance, whose relationship is subject to a process of continuous adjustment. However, the process of creation of these aspirations is very inertial (Winter, 2000). Changes of aspirations are in fact influenced by both the cognitive framework and the experience accumulated in the execution of the practices already in place, and therefore the cost of adoption of new practices related to the emergence of new aspirations are high. This results in stable organisational routines. The ability to transform and innovate the existing organisational routines derives from the development of *dynamic capabilities* (Gavetti, 2005) which allow the adoption of change. In this respect, it is therefore possible to interpret the identified hybridism as, paraphrasing Vidal (2017), 'lean enough'. The set of adopted practices are attributed to those at the base of the lean philosophy, which is, however, designed more like a 'toolbox' from which to draw in order to meet a predetermined target, albeit temporarily. Similarly, the situation of misalignment between the opening of the awareness context, discretion, and autonomy is not attributable to a delay or an irrational deviation, but rather as a goal that is deliberately pursued (again temporarily). It is clear that research trajectories that can be identified from the present findings may well change direction, depending on the specific adopted perspective.

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