

2 Organisational digitalisation

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Introduction

Having examined digitalisation processes from a territorial perspective in the previous chapter, this one turns to an organisational lens to investigate them in greater depth. The analysis draws on a study of 60 Small and Medium-sized Enterprises (SMEs) located in the seven regions considered in the research – Piedmont, Lombardy, Veneto, Emilia-Romagna, Tuscany, Marche, and Campania – and aims to explore how the digital transition unfolds within organisational structures.¹ This approach enables a more nuanced understanding than dichotomous perspectives, which tend to portray technology either as a driver of economic growth and a tool for individual empowerment (Brynjolfsson and McAfee 2014) or as an enabling factor for new forms of control and surveillance (Zuboff 2019).

Capturing the complexity of digitalisation processes requires joint attention to individual behaviours, group dynamics, and the role of collective actors, as action – both individual and organisational – is always situated within specific socio-economic and institutional contexts. On this basis, the chapter adopts a multilevel analytical framework that distinguishes three levels of observation: individual (micro), organisational (meso), and socioeconomic–institutional (macro) (Allison and Zelikow 1999; Catino 2013; Scott and Davis 2007). The joint analysis of these levels of observation and their interactions shows that SMEs tend to outsource the design, implementation, and maintenance of technological infrastructures. While this model of digitalisation – largely dependent on external actors – offers clear advantages, it also poses significant challenges. On the one hand, it enables firms to access indispensable resources and advanced competences; on the other, it may lead to a gradual impoverishment of job content and internal competences, alongside increasing structural dependence on external actors. This dynamic appears to be enabled and further reinforced by the growing adoption of servitisation-oriented business models among technology providers.

The organisational dimension of smart manufacturing

The scientific literature has long acknowledged the role of technologies in fostering firms' development and enhancing environmental and social sustainability. As a

result, scholars have devoted increasing attention to the factors that may accelerate or hinder digitalisation, particularly among SMEs (Müller et al. 2018; Tirabeni et al. 2019). Compared to large firms, SMEs face a range of specific challenges (Horváth and Szabó 2019; Mittal et al. 2018), notably the lack of adequate foundations for adopting advanced technological solutions. Addressing these limitations requires substantial upfront investments, which are especially burdensome for organisations with limited financial resources and more restricted access to credit than large firms.

Another set of critical factors relates to skills and human resources. Workforce reskilling, on the one hand, is particularly demanding and difficult to plan and manage for SMEs (Horváth and Szabó 2019). On the other hand, firms face a significant shortage of qualified workers, especially in contexts – such as Southern Europe – where SMEs are particularly prevalent. Competition from large firms, which have traditionally been more attractive to highly specialised profiles, further exacerbates this challenge (Mittal et al. 2020). Finally, the literature highlights that external measures and interventions aimed at supporting digitalisation are not always tailored to the specific characteristics of SMEs. Digital maturity assessment models, for instance, are often designed around the needs of large firms and tend to prove inadequate when applied to smaller ones (Mittal et al. 2018).

In sum, the digitalisation of SMEs is hindered by a range of specific factors, arising from structural and financial constraints as well as from shortcomings in digital skills and institutional support. A comprehensive understanding of these specific challenges and of the reasons underlying SMEs' accumulated digital lag, therefore, requires an analytical perspective attentive to organisational and institutional dynamics. From this standpoint, the sociology of organisation provides particularly valuable analytical tools for the study of digitalisation processes (Plesner and Husted 2020). Technology has long been a central concern within organisation studies, and the recent diffusion of digital solutions within firms has renewed its relevance. Digitalisation can thus be understood as an organisational process, since the effects of technologies on work and organisational structures depend not only on their technical characteristics, but also on the contexts in which they are used.

In this vein, Fleming (2019) introduces the concept of *bounded automation* to emphasise that automation is shaped not only by the technical capabilities afforded by technology, but also by a range of social and organisational constraints, such as labour costs, workforce availability, and internal power relations. This often results in forms of *blended automation* (Beunza and Millo 2015), in which automated activities – typically standardisable and routine – coexist within firms with non-automated tasks that remain resistant to automation due to their complexity or non-routine nature.

Organisational issues in Italian smart manufacturing: A three-level analysis

The analysis is grounded in the assumption that action is always *situated* within socially organised contexts that define both its constraints and opportunities

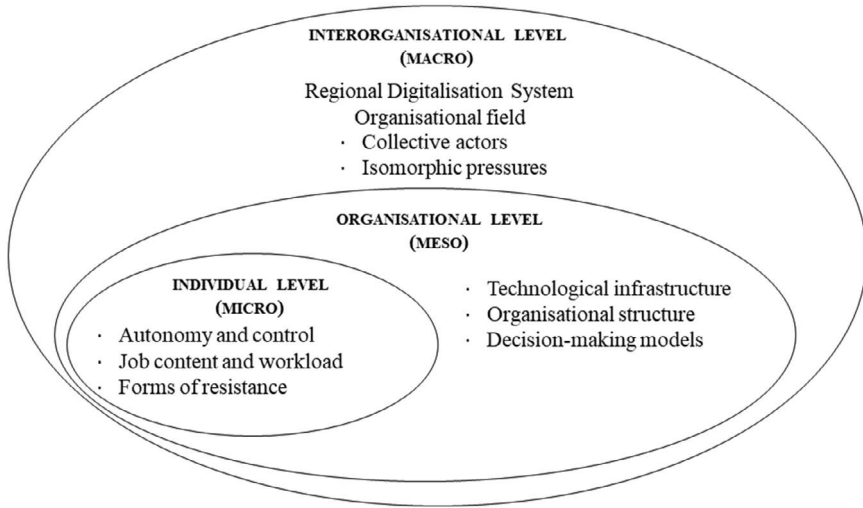


Figure 2.1 A multilevel framework of SMEs' digitalisation: organisational field, organisation, and work.

(Vaughan 1998). From this standpoint, individual action is embedded in organisational contexts, whereas organisational action is situated within socioeconomic and institutional environments. In this study, for instance, the seven regions under analysis display heterogeneous productive structures and Regional Digitalisation Systems (RDSs), which generate specific constraints and opportunities for firms. In line with this perspective, the chapter adopts a multilevel analytical approach (Figure 2.1) to reconstruct the interactions between the individual (micro), organisational (meso), and socioeconomic–institutional (macro) dimensions (Allison and Zelikow 1999; Catino 2013; Scott and Davis 2007).

At the macro level, the analysis focuses on the system of interorganisational relations within which organisations exchange material (e.g. funding, technologies) and intangible (e.g. ideas, know-how) resources, and to which they must adapt to survive (Scott and Davis 2007). As discussed in Chapter 5, the regional socioeconomic–institutional environment constitutes a crucial analytical dimension for understanding the digitalisation of SMEs. To empirically reconstruct the dynamics and processes of RDS, the chapter draws on the concept of *organisational field* (DiMaggio and Powell 1983), understood as a *relational space* populated by collective actors that occupy distinct roles and act according to different logics (Wooten and Hoffman 2017). Taking SMEs as the primary analytical vantage point, the analysis identifies the main categories of collective actors and the forms of isomorphic pressure they exert in support of digitalisation. This distinction is, of course, purely analytical: in practice, the boundaries between categories are often porous, and different forms of influence tend to intersect and overlap. Nonetheless, this classification proves highly useful for identifying the collective actors and dynamics that characterise the organisational field under examination.

At the meso level, the analysis focuses on the organisation itself – its structures and the internal processes that regulate its functioning. It examines how, and to what extent, digitalisation has affected SMEs' organisational structures and decision-making models.

Finally, at the micro level, attention shifts to individual behaviours within organisational contexts, everyday interactions, and modes of task performance. Here, the analysis concentrates on selected dimensions of work, including autonomy and managerial control, workload, job content, and forms of resistance.

The macro level: Interorganisational relations and technologies:

The organisational field of digitalisation

The organisational field of manufacturing SMEs is populated and structured by a multiplicity of collective actors that orient firms towards digitalisation. These actors can be grouped into four main categories: (1) *market actors* (SMEs' customer firms as well as competitor and non-competitor firms); (2) *knowledge actors* (public and private organisations providing advanced digital technologies, competences, and know-how for the design and implementation of digitalisation); (3) *institutional intermediaries* (actors designated by legislators to promote digitalisation among firms); and (4) *government actors* (primarily at the national and regional levels). Table 2.1 provides an overview of the organisational field of SMEs' digitalisation² by summarising the different categories of collective actors (column 1), the main actors identified within each category (column 2), and the mechanisms of influence they exert on SMEs (column 3).

- 1 *Market actors* orient firms' digitalisation through two main mechanisms of influence: competitive pressures and emulation effects. These mechanisms correspond, respectively, to the coercive and mimetic isomorphism³ described by DiMaggio and Powell (1983). In the former case, the influence exerted on SMEs originates in the power asymmetry characterising the customer–supplier relationship, an imbalance that tends to increase as the importance of the customer grows. The empirical data show that competitive pressures represent one of the main drivers of firms' digitalisation. The adoption of advanced digital technologies is widely regarded by firms as indispensable for preserving competitiveness and responding to increasingly demanding market requirements. Cost containment alone is no longer sufficient to retain or attract customers, who now expect speed and reliability in deliveries, accurate control over production processes, and high-quality standards, outcomes that are difficult to achieve without the support of advanced digital technologies (F3, F42, F32, F57, F30, F17, F16, F34, F46, F10).

In this regard, the managing director of a firm producing plastic materials (F3) noted that digitalisation has become a fundamental requirement not only for successfully passing audits – a form of assessment now widespread even beyond the automotive sector – but also for gaining access to technologically advanced sectors

Table 2.1 The organisational field of SMEs' digitalisation.

<i>Category of collective actors</i>	<i>Main key actors identified</i>	<i>Isomorphic Pressure Exerted on SMEs</i>
Market actors	Customer firms/competitors	Coercive
	Non-competing firms	Mimetic
Knowledge actors	Technology producers	Normative
	Software houses	
	System Integrators	
	Universities	
	Consulting firms	
Institutional intermediaries	PID – Chambers of Commerce	Normative and Incentive-based
	DIH – Employers' associations	
	Competence Centres	
	Other territorial initiatives	
Government actors	National government	Incentive-based
	Regional governments	

such as aerospace and medical devices, where technologies such as blockchain are becoming a *de facto* prerequisite for integration into supply chains.

Coercive isomorphism also operates within the subcontracting networks of large firms, where vertical relationships characterised by strong dependence generate pressures towards digitalisation among involved SMEs. To maintain their position within the supply chain, these firms may be required to adopt the technical standards defined by their most significant customers (F2).

Firms – both large companies and SMEs – may also foster the digitalisation of other firms by serving as *successful examples* of the implementation of digital solutions. Comparison and sharing of experiences among firms – including the challenges encountered, the strategies adopted to address them, and the outcomes achieved – can strengthen perceptions of the feasibility and benefits of digitalisation, thereby activating dynamics of emulation. This process can be interpreted as a form of mimetic isomorphism (DiMaggio and Powell 1983) arising under conditions of uncertainty – whether environmental, technological, or strategic – that prompt firms to reproduce solutions already tested by other organisations. However, the activation of this mechanism depends on entrepreneurs' willingness to engage in sharing and mutual comparison – a predisposition that may be significantly constrained by competitive logics. This limitation is particularly evident in regions such as Lombardy, where a strongly competitive entrepreneurial culture leads firms to perceive the exchange of experiences and practices as a potential threat to strategic know-how and competitive advantage.

A different case is represented by contexts characterised by district-based logics, where the collaborative dimension of interfirm relations also plays a significant role (Bagnasco 1977; Becattini 2000). In industrial districts and innovative partnerships – found primarily, though not exclusively, in regions of the so-called Third Italy – digitalisation is fostered by both horizontal and vertical forms of

cooperation grounded in productive interdependence, information exchanges, and shared learning processes. In such contexts, hybrid dynamics of cooperation and competition (*coopetition*) contribute to shaping the adoption of digital technologies.

- 2 *Knowledge actors* provide SMEs not only with the hardware and software required for digitalisation, but also with the know-how necessary for their implementation. In doing so, they exert a form of normative isomorphic pressure⁴ (DiMaggio and Powell 1983), stemming from professionalisation and from the definition of normative, cognitive, and technological standards associated with digitalisation. Knowledge actors include technology producers, software houses, system integrators, and consultants (i.e. private companies and universities). The latter supply SMEs with ideas, strategies, and models for digitalisation, as well as highly specialised training, and support them in the redefinition of production processes and in the management and valorisation of data within an Industry 4.0 framework (F17, F57, F60, F46, F28, F11).

The role of system integrators is also central in SMEs' digitalisation. Rather than producing technologies themselves, they tailor and integrate existing market solutions to clients' specific needs, thereby creating coherent platforms in which information systems, applications, and hardware components communicate and operate in a coordinated manner. System integrators thus act as custodians of production technologies that represent a key source of competitive advantage for firms. The business models adopted by these providers are increasingly oriented towards servitisation: alongside the development and implementation of integrated solutions, system integrators also offer training and post-sales support. This represents a significant development, as it enables SMEs to introduce new technologies without the need to develop advanced technological competences in-house. As an Information Technology (IT) manager (F57) points out, workers are often able to use production technologies by following simple instructions and standardised procedures, while the handling of critical issues is outsourced to technology providers, as the firm's limited size and resources do not allow for the internal development of the required competences. The logic of servitisation is likely to be further strengthened by the introduction of pay-per-use schemes, whereby firms do not purchase production technologies but instead pay providers a fee proportional to actual usage. Under this model, management and maintenance activities remain entirely the responsibility of providers (F19).

Given the strategic importance of system integrators, firms pursuing a digitalisation that goes beyond merely "cosmetic" changes carefully select their providers (F9, F17, F57, F10). As a production manager explains:

We essentially rely on a small number of suppliers [...] who build custom-made machines for us. So the choice is largely driven by long-established relationships with two or three companies who design and build our machines and production lines and who [...] also have the expertise required to take

the next step – connection [of different machines] or compliance with all Industry 4.0 requirements.

(Production manager, F17)

- 3 *Institutional intermediaries* – such as the *Punti Impresa Digitale* (PIDs) (Digital Enterprise Hubs) of the Chambers of Commerce, the Digital Innovation Hubs (DIHs) promoted by trade associations, the Competence Centres (CCs), and other regional initiatives – exert a form of normative isomorphic pressure, as the collective actors discussed above. Through the organisation of awareness-raising events and training activities, institutional intermediaries play a crucial role in disseminating information, ideas, and practices related to digitalisation, as well as in fostering interorganisational networks (F10, F1, F15, F44, F29, F43, F60, F9, F17). As a Chief Executive Officer (CEO) points out, these initiatives represent an important enabling factor for innovation:

Cross-fertilisation is certainly the first driver that helps an idea to emerge, that helps bring to light a need you did not realise you had. [...] Taking part in these events, listening to people who are already talking about things that you do not even know what they are, helps to generate doubt. And from doubt, ideas begin to take shape; from those ideas, you then explore further and eventually turn them into an operational project.

(CEO, F30)

- 4 Finally, the fourth category comprises *government actors* at both the national and regional levels. These actors exert isomorphic pressure on SMEs primarily – though not exclusively, given the role of institutional intermediaries – through an incentive-based mechanism, generating a significant push towards digitalisation. Fiscal and financial incentives – most notably the Industry 4.0 Plan – have stimulated investment in new digital technologies, including the acquisition of innovative production lines, the upgrading or enhancement of existing ones, and the replacement of obsolete machinery with more advanced solutions (F3, F17, F36, F30, F57, F32, F15, F29). Some firms (F1, F44) warn that a substantial share of these investments risks failing to generate lasting benefits, as they are primarily oriented towards meeting the formal requirements for accessing incentives. However, in several of the cases analysed, such measures appear to have accelerated and reinforced digitalisation projects that were already planned and, in some instances, to have triggered virtuous cycles. One illustrative example is provided by a chemical firm, where digitalisation:

at first, it was perhaps not [...] fully understood as part of the company's evolution. It was almost [as if to say]: we have an opportunity [...] to replace a machine. [...] Then we began to see all the benefits. It proved to be very useful, and today, even without public funding, we would actively pursue these outcomes ourselves.

(Commercial manager, F42)

Despite the importance of incentives for SMEs' digitalisation, the data point to several elements – particularly within regional initiatives – that discourage firms from applying (F9, F60, F30). These include excessive bureaucratisation and administrative complexity, the allocation of funds on a *first-come, first-served* basis, and the lack of advance payments, all of which appear poorly aligned with SMEs' limited financial resources and internal competences.

In conclusion, applying the concept of *organisational field* to the analysis of RDSs allows for the identification of the distinct yet complementary roles of collective actors, their logics of action, and the modes through which they influence SMEs. The findings underscore the importance of the socioeconomic and institutional environments in shaping SMEs' digitalisation, in line with earlier contributions within innovation studies (Edquist 2005; Ramella 2016). Indeed, the analysis suggests that, through their relationships with other actors in the field, SMEs can gain access to resources that are essential for digitalisation – such as capital, advanced technologies, knowledge, and digital skills – but which they possess only to a limited extent.

The meso level: Organisational structures and data-driven decision-making models

At the organisational level, the analysis highlights the ongoing and gradual construction of technological infrastructure within SMEs, understood as the set of technologies, standards, and protocols that underpin day-to-day operations, coordination, and the interoperability of organisational processes (Star and Ruhleder 1996). In the context of digitalisation, such infrastructure enables the real-time collection and circulation of data, opening up new opportunities for monitoring and control – particularly of production processes – through the interconnection of machinery and software (e.g. F17, F60, F42, F57, F30, F27, F10, F11, F12). At the core of this architecture lies the Enterprise Resource Planning (ERP) system, a software solution that centralises information flows by collecting, processing, and integrating data from different organisational functions. As an IT manager observes, the adoption of the ERP system marked the firm's effective shift from automation towards a broader process of digital transformation:

For those responsible for IT, the effort involved in introducing a solution such as SAP⁵, for me, speaking almost twenty years later, is the effort of laying the foundations that then make everything else possible. When we introduced a robot, it felt almost natural, like connecting a cable to the server and downloading data. However, without a management platform that allows you to develop and manage individual modules, you can install a robot and that is where it ends. It will stack boxes, but at that point it is something different. With an ERP system, it is not merely simple mechanization.

(IT manager, F57)

As this account illustrates, digitalisation within firms cannot be reduced to the introduction of individual technologies; rather, it requires foundational organisational infrastructures that enable their integration and further development. The construction of technological infrastructure in SMEs can therefore be understood as a modular and progressive process, consistent with a fractal logic (Prause 2015), whereby successive investments in hardware and software mark the incremental integration of new organisational processes and functions (F57, F17, F60).

From this perspective, the firms analysed appear, at present, to be predominantly in a phase of *digital transition*, while also displaying some features that can be associated with *digital transformation* (see the Introduction to this volume). An illustrative example is provided by a sheet metal processing firm (F30). In this case, the initial adoption of an ERP system was followed by a lengthy implementation and progressive optimisation process lasting approximately ten years. This trajectory can be interpreted as a process of digital transition, whereby digital technologies were employed to improve and increase the efficiency of existing processes, without entailing more radical transformations. Only more recently has the firm embarked on a project aimed at integrating its various functional (area-based) management software systems – namely, those used by individual organisational units. This phase appears to mark the onset of a genuine process of digital transformation. More broadly, *integration* emerges as a key element of digitalisation, as the compatibility of new machinery with existing technological infrastructure constitutes a decisive criterion in firms' investment strategies (F10).

In terms of firms' formal structure – roles, functions, and hierarchical arrangements – the analysis points to significant continuity (F57, F27, F7, F35, F50, F5, F11), with organisational configurations remaining largely unchanged over time. SMEs predominantly retain a functional organisational structure⁶; only in a limited number of cases does the introduction of new roles aimed at strengthening coordination across functions emerge (F19, F60, F28, F17, F3, F36), potentially signalling the early stages of a more mature phase of digital transformation. Continuity also prevails at the level of formal roles. In only a few cases (e.g. F19, F30) does the analysis reveal the introduction of new positions, such as innovation manager. However, this role is not specifically dedicated to digitalisation but rather serves as a focal point for innovation activities in a broader sense.

Finally, the analysis shows that real-time data sharing has significantly strengthened both intra- and interorganisational coordination. According to Castells (2010), the reduction in coordination costs enabled by digital technologies fosters a shift towards more horizontal and network-based organisational models.⁷ However, the present research does not provide unequivocal evidence in support of this view. Rather, it suggests that digitalisation does not constitute a radical source of discontinuity with existing organisational forms but instead operates as an enabling factor that becomes embedded within pre-existing organisational logics. Several elements of continuity, indeed, clearly emerge from the analysis.

First, hierarchy continues to represent – at least in the current phase of digitalisation – an important ordering principle of intra-organisational relations (F9, F32, F30, F17, F1, F5, F15, F7, F41, F3). For instance, technological infrastructure

tends to reproduce the hierarchical logic already embedded in formal organisational structures: on the one hand, data generated by different processes are collected, processed, and centralised within a single database (F17, F42, F3); on the other hand, access to this database is differentiated according to roles and hierarchical positions (F60).

Second, the analysis does not reveal a clear and univocal tendency among SMEs towards the adoption of network-based organisational models. Although the reduction in coordination costs associated with digitalisation should, in principle, make the outsourcing of activities (*buy*) more advantageous than their internalisation (*make*) (Williamson 1975), some firms (F32, F42, F57) have instead opted for the latter strategy in the production area in order to contain costs, increase responsiveness to market demands, and strengthen product customisation capabilities.

Regarding decision-making models, SMEs display a growing awareness of the added value of data-driven approaches. At the same time, the availability of technologies such as the Industrial Internet of Things (IIoT) and cloud computing has enabled firms to collect and store large amounts of data at relatively low cost, thereby providing the informational basis required for this form of decision-making. Several firms (e.g. F42, F57, F60, F17) have recognised that the use of data, when appropriately structured and analysed, enhances the effectiveness of both operational and strategic choices. Data allow decision-makers to exercise greater control over internal processes and to monitor the external environment more effectively, thereby fostering a timelier understanding of ongoing changes. This development represents a significant shift in decision-making logics: away from a strongly idiosyncratic orientation – based primarily on the intuition and experience of individual decision-makers – and towards more standardised and systematic approaches, with important implications for the organisation of work as well (see Section The micro level: Autonomy and control, job content, and forms of resistance).

The fact that many of the firms analysed report using data across different decision-making domains – or that indicate they are close to doing so – suggests the ongoing diffusion of a data culture among SMEs. The domains most frequently mentioned include the analysis and optimisation of production processes (F17, F42, F5, F10, F11), product improvement (F9, F60), the estimation of production times and costs (F3, F27, F34, F58), the definition of marketing (F60, F5) and business strategies (F3, F15), and after-sales services (F9, F19, F60, F26). At the same time, in many firms, the use of data remains below its potential (F1, F10, F36, F25, F50, F28). Real-time data and historical data series tend to be underexploited due to limited analytical capabilities within firms (F15, F57) and/or the incomplete implementation of data collection, selection, validation, and structuring processes – namely, the establishment of rules for transforming data into information that is meaningful for decision-making (F17). Moreover, only a small number of SMEs report having recently begun to consider the use of artificial intelligence for data analysis (F57, F3, F11, F35, F44, F7, F26, F48).

Taken together, these findings suggest that the systematic integration of data into decision-making processes does not depend solely on the availability of

adequate technological infrastructures or the reorganisation of information flows but also requires the development of specific analytical capabilities (McAfee and Brynjolfsson 2012). At the same time, the emergence of a data culture appears to be strongly influenced by organisational factors, such as corporate culture and prevailing governance models (Szukits and Móricz 2024). In this regard, top management's commitment to resource allocation and to fostering a supportive organisational culture is critical to the adoption of data-driven decision-making models, given that decision-makers' attitudes towards these tools may themselves represent a significant barrier (Verma and Bhattacharyya 2017). Accordingly, the introduction of a data culture may be understood as a technical, organisational, and cultural change, with direct implications for the governance of SMEs.

In conclusion, at the organisational level, there appears to be a discrepancy between the evolution of technological infrastructure and the persistence of established functional structures and decision-making models. On the one hand, the expansion and optimisation of technological infrastructure tend to follow an incremental, learning-by-doing process, characterised by close attention to the financial, human, and economic sustainability of change, which must occur without disrupting ongoing production activities. On the other hand, this process has so far had only a limited influence on organisational structures and decision-making practices. It should be noted, however, that this assessment reflects the current stage of a still-unfolding phenomenon.

The micro level: Autonomy and control, job content, and forms of resistance

Digitalisation has brought about transformations in both the content and regulation of work, particularly in relation to the growing demand for information (F60, F18, F1, F9, F57, F17). First, as systematic data collection is necessary for process control in digitalised firms (see Section The meso level: Organisational structures and data-driven decision-making models), tensions may arise between managerial objectives oriented towards expanding the volume and granularity of collected data and workers' attempts to defend their margins of autonomy, especially regarding the regulation of work pace. The case of a mechanical components manufacturing firm (F17) is illustrative in this respect. Here, management's request that operators systematically record, on the control panel of an automated production line, the reasons why the line – despite being active – was not producing, was met with dissatisfaction among workers. These tensions appear to stem from divergent interpretations of the underlying aims of this request:

I need to know how much it costs me to produce this item, because once I know the cost – and it may be high or low, but it must be a reliable figure – I can also develop commercial and pricing strategies, knowing exactly what this item costs me. So, either we know this, or the company runs the risk of selling below cost without even knowing it. However, this is not always

easily understood... “if I take five extra minutes for a break, then you are monitoring me” ... this kind of reaction tends to come up.

(Production manager, F17)

Second, the growing demand for information has rendered data collection a central activity, both in production departments and in administrative units. Where data collection is not automated, data-entry tasks are added to workers' daily activities, increasing their workload and generating tensions between the demands of *productive efficiency*, namely speed and accurate task execution, and those of *informational efficiency*, namely the completeness and accuracy of the data collected. As one human resources manager puts it, this activity amounts to a fully-fledged “second job”:

I notice that even for young people, that during interviews want all these things [software, reporting tools], it is a work to maintain them, to populate them, to manage them. It is a second job, because before I used to do everything on my own, whereas now everything must be entered into these systems. So, it is like producing substantial reporting: for these systems to actually provide information, they need to be populated accurately. This means that everyone [worker], for his part, must enter this information and keep it up to date. So sometimes resistance also stems from the daily rush, from having yet another task to deal with.

(Human resources manager, F60)

When demands for *informational efficiency* risk undermining *productive efficiency*, workers tend to resist data-entry activities to preserve the latter (F32). The implementation of the production management system, for example, may generate resistance among workers if its data-collection requirements are perceived as excessively burdensome:

The go-live phase of the new MES⁸ was disastrous, to the point that it convinced us to simplify the information flow by eliminating some stages that would actually have been useful. My interest was in recording processing times to feed analytical accounting. That was precisely where we had to take a step back. After several months of attempts, we gave in—we realised it was pointless to keep insisting. We simplified the system, lost information, and moved forward in this way. More generally, this was done to maintain a workable compromise and achieve not 100 per cent, but around 90 per cent of the intended outcome.

(IT manager, F18)

The predominantly top-down nature of technology selection and design, characterised by limited opportunities for ex ante consultation with workers,⁹ is thus a factor contributing to the emergence of resistance. In SMEs, the introduction of new technologies often stems from strategic decisions taken by ownership, which are subsequently translated into operational terms by management and

only later communicated to the rest of the organisation (F57, F60, F18, F17, F42). However, some firms (F30, F32) adopt a different approach, involving the workers who will use the new technologies from the design phase onwards, with the aim of reducing resistance to change by ensuring closer alignment between the adopted solutions and actual operational needs. Moreover, these firms pay close attention to signals of resistance that may emerge *ex post* within teams, interpreting them as potential indicators of the partial suitability of certain technological choices.

Finally, digitalisation of production processes is reshaping job content and skills requirements, with mixed outcomes. Automation and digitalisation can improve job quality by reducing repetitive, physically demanding, and potentially hazardous tasks. Depending on the technology in use and the specific role, workers may be supported – as in the case of advanced robotic systems – or replaced, as in fully automated production lines (F57, F52, F32). A gradual transformation of the worker's role can thus be observed, with workers becoming progressively less involved in the direct execution of production tasks and increasingly oriented towards the programming and management of machinery. However, this shift from *maker* to *programmer-operator* does not necessarily entail an enrichment of job content or a substantive expansion of skills. Empirical evidence suggests that manufacturing firms tend to favour machinery with short learning curves and intuitive interfaces, whose programming and configuration do not require particularly advanced digital competences (F57, F30, F7, F11, F45, F32). Some firms (F44, F19) further confirm that such choices are often driven by the intention to minimise human intervention on the shop floor, including in the loading of production plans. Accordingly, demand for technology is increasingly oriented towards solutions that can operate autonomously once switched on – that is, *plug-and-play* machinery.

The research thus highlights SMEs' tendency to prioritise production solutions that minimise the role of the worker. At the same time, however, SMEs continue to regard a highly skilled workforce capable of learning as fundamental (F32, F30, F9, F17, F19, F36). This view is consistent with the literature on the industrial district model, which emphasises tacit knowledge and workers' adaptive capacity as a distinctive resource and source of competitive advantage for SMEs (e.g. [Beccattini 2000](#)). This apparent contradiction suggests a condition of *blended automation* ([Beunza and Millo 2015](#)), in which automated and non-automated activities coexist.

On the one hand, SMEs seek to automate as much as possible those activities that are sufficiently standardised and repetitive, an effort shaped by at least two human resource-related constraints. The first concerns the high costs associated with training unskilled personnel, the difficulty of recruiting qualified workers, and the challenge of retaining them within the firm (F32, F30, F9, F17). As the Chief Executive Officer (CEO) of one of the firms analysed notes (F30), young engineers and technicians exhibit an average turnover of around two years. As a result, it has become crucial for the firm to render new hires operational within a very short time – an objective achieved through the adoption of various technological solutions.

The second constraint relates to SMEs' need to remain competitive and to grow by enhancing efficiency, speed, and production quality – understood here in terms of standardisation and precision. Automation plays a key role in this respect because, as one production manager remarks (F57), “a person cannot compete with a machine, and the outcome expected from a machine is much higher than that of a person. Even when a person is skilled, they still cannot compete with a machine”. On the other hand, SMEs continue to perform activities in which workers' skills remain central. These include tasks that are too complex to be automated (F32), customised production with volumes too small to justify the costs associated with automation (F17), as well as tasks in which the artisanal component is regarded as a source of added value (F32).

The analysis also highlights the ambiguous impact of advanced digital technologies on job content. On the one hand, digitalisation may have positive effects in terms of upskilling and the creation of new opportunities (Autor 2015; Brynjolfsson and McAfee 2014). On the other hand, it may also lead to the deskilling of workers, a risk well documented since early studies on the mechanisation of production (Braverman 1974). In this regard, the simplification of production tasks and the associated reduction in skills requirements appear to constitute one – albeit not the only one (see Section The macro level: Interorganisational relations and technologies. The organisational field of digitalisation) – of the objectives of shop-floor digitalisation. This dynamic is compounded by the loss of workers' expertise associated with the codification of tacit knowledge that often accompanies the introduction of new technologies. The formalisation of such knowledge into standardised procedures renders workers more easily replaceable, both by less experienced colleagues and by machines that are more precise and efficient, creating tensions on the shop floor (F57, F10, F32).

Finally, digitalisation may also give rise to forms of cognitive resistance, linked to difficulties in learning how to use digital technologies and in adapting to new work practices. These difficulties do not appear to be confined to sporadic cases, to the extent that some firms (F30, F60) have adopted a “gradual” approach to the transition. The strategies implemented include pairing younger staff, who are more familiar with digital technologies, with more experienced workers, as well as maintaining a temporary “dual-track” system in which old and new ways of working coexist. In administrative roles, this may translate, for example, into managing the same process both through digital programmes and procedures and through paper-based formats. Although less efficient, this system has helped to accommodate employees with long tenure and, in some cases, positions of responsibility, who struggle to adapt their work practices to new tools. It remains unclear to what extent these difficulties can be attributed to a mindset less oriented towards change, and to what extent they should instead be ascribed to training activities that are insufficiently targeted at supporting learning and the reconfiguration of skills. In any case, the difficulties encountered during the implementation phase underscore the bounded nature (Fleming 2019) of digitalisation processes, which emerge from the situated interaction between digital technologies and socio-organisational dynamics.

Digitalisation thus produces ambivalent outcomes, often shaped by pre-existing organisational arrangements (Tirabeni 2024). While it creates new opportunities, it also generates critical issues, particularly regarding job quality and workers' well-being. Overall, empirical evidence pointing to a transformation of work towards higher levels of autonomy remains limited. This suggests the need for more fine-grained studies that examine the introduction of digital technologies at different analytical levels, highlighting potential differences in impact between administrative and production activities, as well as across roles located at different hierarchical positions.

Discussion and conclusions

After examining the dynamics and logics of digitalisation at the three levels of observation, the discussion now turns to their interactions. The aim is to show how the different elements do not develop in isolation, but rather mutually influence and reshape one another. In particular, the analysis explores the relationships between the institutional and economic environment and firms' digitalisation trajectories, and between these trajectories and processes of work transformation. The multi-level perspective highlights two main aspects: SMEs' strong tendency to outsource large parts of the digitalisation of their processes, and forms of automation that remain enhanced by human intervention.

In the first process (Figure 2.2a), at the macro level, system integrators, software houses, and consultants – together with institutional intermediaries – provide the digital competences and technologies required for digitalisation (1). At the meso level, SMEs that decide to digitalise, given the generally limited internal competences and human resources at their disposal, tend to rely on these collective actors not only for technology selection and the construction of technological infrastructures, but also for their maintenance and updating (2). In practice, SMEs tend to outsource the design and implementation of digitalisation, which helps explain the relevance of the role and performance of RDSs analysed in chapters five and six. This outsourcing strategy, in turn, influences job content in production roles (micro level). The introduction of new technologies may result in deskilling and in a reduction in job content, as machinery is increasingly designed to maximise ease of use (3). At the same time, limited internal competences tend to reinforce SMEs' dependence on technology providers and suppliers of digital know-how, encouraging the latter to adopt business models that are increasingly oriented towards servitisation (1). As discussed in Section The macro level: Interorganisational relations and technologies. The organisational field of digitalisation, this represents an evolutionary trajectory towards pay-per-use models, under which providers retain ownership of both production technologies and the associated advanced know-how.

The multilevel analysis points to the ambivalent role of providers of digital technologies and know-how in SMEs' digitalisation processes. On the one hand, these actors operate as enabling factors by supplying technologies, tools, and competences that are scarce within firms; on the other hand, this very role allows SMEs to maintain a structural shortage of internal digital competences, thereby limiting

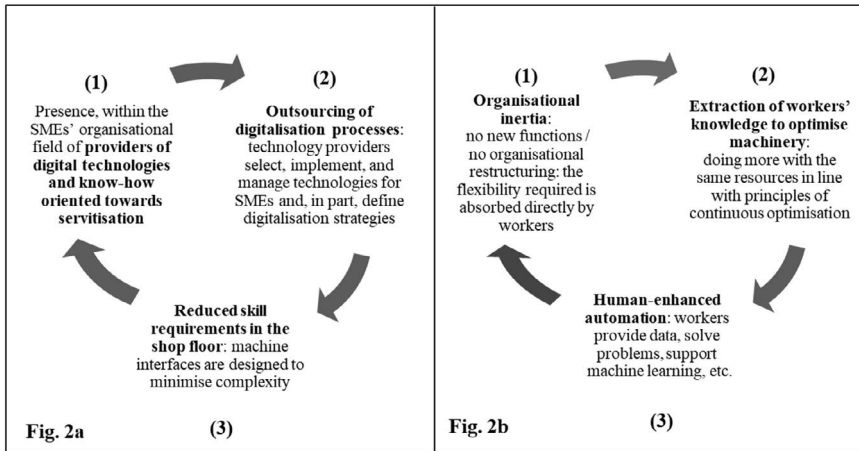


Figure 2.2 SMEs' digitalisation processes.

the effectiveness and transformative potential of digitalisation. On this basis, two main considerations emerge.

First, the mere availability of multiple technology and knowledge providers does not, in itself, ensure effective digitalisation trajectories: providers must possess the expertise required to design and implement solutions tailored to sectoral, organisational, and size-specific characteristics of individual SMEs. Second, firms need at least one internal actor capable of competently interfacing with external providers to mitigate the risk of opportunism associated with relationships characterised by significant information asymmetries (Williamson 1975). In this light, the overlap observed in some firms (F17, F3) between the start of digitalisation processes and the hiring of individuals with prior experience in digital transformation into key managerial positions (e.g. IT manager, managing director) appears particularly significant.

Regarding the second process (Figure 2.2b), the multilevel analysis allows us to capture the influence of organisational structures on work. At the meso level, a certain *organisational inertia* can be observed: although workers perform new tasks, no new formal functions are created. The flexibility required is therefore absorbed directly by existing employees, thereby avoiding both a visible restructuring of hierarchies and roles and a significant modification of the organisational structure, which remains typically functional and only in rare cases appears to evolve towards a *modified* functional structure or a project-based one (1).

What is observed at the meso level is reproduced at the micro level (2). Workers contribute to the functioning of the factory by providing knowledge and competences, but this information is immediately extracted from them and recoded into technology. Workers' knowledge is thus appropriated and formalised as data, with the evident risk that it may be used to increase efficiency and control, following a process of expropriation carried out by machines that has already been documented

in large firms (see, for example, [Delfanti 2021](#)). This mechanism fuels a cycle of continuous optimisation aimed at increasing productivity – in practical terms, achieving more with the same resources. A distinctive human–machine division of labour therefore emerges; workers are called upon to perform operations that machines cannot (yet) carry out, such as handling complex objects and processes or dealing with unforeseen problems. From this perspective, the digital factory does not eliminate workers; rather, it integrates them into more advanced automation systems (3), according to a dynamic that is typical of large, digitalised firms (see, for example, [Delfanti and Frey 2021](#)).

In conclusion, to observe even more closely how these processes are configured at the level of the individual firm, it is useful to draw on Theory of Social Regulation (TSR) ([de Terssac 2003; 2012; Reynaud 1989; 1991; Richebé et al. 2020; Thoemmes 2025](#)). This theoretical approach is grounded in the idea of the organisation as a process of regulating the actions of purposeful actors oriented towards the achievement of objectives, and it posits the coexistence of multiple forms of regulation. The primary distinction is between *control regulation* and *autonomous regulation*. The former originates outside the work group (e.g. management, but also institutions, vendors, technology designers, etc.) and aims to orient, prescribe, and standardise action. Autonomous regulation, by contrast, emerges within the work group itself, drawing on practical knowledge, experience, and collaborative dynamics among peers. These two forms of regulation do not exclude one another but rather interact. When they intersect, they result in *joint regulation* ([Figure 2.3](#)), which Reynaud describes as an unstable compromise marked by tensions.

In our case, such regulation emerges from the interplay of dynamics operating at different levels: micro-level dynamics, namely forms of autonomous regulation originating from below; meso-level dynamics, that is, regulation stemming from management, which we have often observed to limit workers' autonomy; and

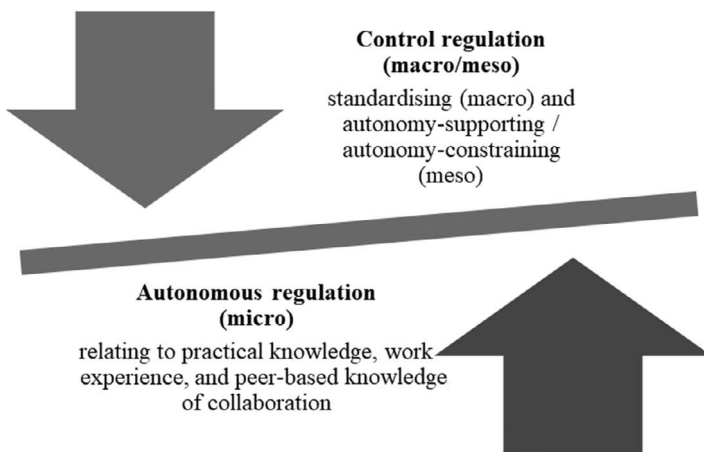


Figure 2.3 The joint regulation of digitalisation.

macro-level dynamics, namely the standardising regulation exerted by institutional and market actors. The transformations currently underway in digital SMEs, therefore, do not eliminate human labour but rather reconfigure it. Workers remain central, albeit in a more subordinated, integrated, codified form, and subject to more pervasive forms of control. Through a joint reading of the micro, meso, and macro levels, it is possible to grasp the full organisational complexity of these processes: here, cooperation, control, and technological adaptation intertwine in unstable and emergent ways.

To conclude, our research shows that the digitalisation of SMEs differs from that of large firms in several respects: it is structurally more dependent on external actors, develops along predominantly incremental paths, is less transformative at the organisational level, and is more exposed to vulnerabilities related to internal competences. Nevertheless, SMEs display a significant capacity for situated adaptation, human-machine integration, and the development of *ad hoc* solutions, often of a *handcrafted* nature. They thus delineate specific digitalisation trajectories, strongly shaped by the dimensional, organisational, and institutional constraints within which they operate. From this perspective, SME digitalisation cannot be understood as the mere adoption of technologies, but rather as a process of *multilevel and dynamic institutional translation*, in which pressures from the institutional and economic environment, internal organisational choices, and work practices are continuously reconfigured according to logics of joint regulation, giving rise to firm-specific evolutionary trajectories.

This process is characterised by structural tensions and contradictions that delineate both its limits and its potential. First, a tension emerges between structural rigidity and technological flexibility: while digital technologies enable new forms of work organisation, existing hierarchies and established roles tend to reproduce themselves, thereby constraining the actual capacity for transformation. Second, a contradiction arises between innovation that is often largely rhetorical and limited organisational learning. The adoption of technologies is frequently framed as an innovative turning point for the firm; in practice, however, organisational learning remains limited and is at times largely delegated to external providers such as system integrators and software houses (see Section The macro level: Interorganisational relations and technologies. The organisational field of digitalisation, point 2), resulting in dependence and weak internalisation of competences.

Finally, a tension becomes apparent between automation and the intensification of human labour. Digitalisation is commonly portrayed as a process of substituting manual work, yet in several cases it translates into an increase in work activities – particularly tasks related to data entry, monitoring, or interfacing with digital systems – thus generating new forms of work intensification and, at times, reduced transparency of work processes. Taken together, these tensions show that digitalisation does not follow linear trajectories but rather takes shape as an ambivalent process, capable both of enabling innovation and of reproducing organisational constraints, thereby calling for critical reflection on the ways in which SMEs integrate digital technologies into their development paths.

Notes

- 1 Details of the firms included in the study and the criteria adopted for company selection are provided in the Methodological Appendix of the volume. All firms have been anonymised and identified using a sequential numbering system, which is also employed in this chapter for citation purposes. References to the interviews are indicated in the text by reporting the corresponding interview number in parentheses. All direct quotations appearing in the text have been translated into English by the authors.
- 2 It is plausible to assume that the relevance of collective actors and categories varies across local and regional contexts. However, an analysis of the specific territorial configurations of the organisational field lies beyond the scope of this chapter.
- 3 Following DiMaggio and Powell (1983), *coercive* isomorphism can be understood as a process of homogenisation induced by formal and informal pressures exerted on an organisation by other organisations upon which it depends. Such pressures may stem from regulatory or legislative constraints, or from the control of strategic resources – as, for example, in the case of the influence exerted by a multinational corporation over its suppliers. *Mimetic* isomorphism, by contrast, represents a form of organisational convergence that emerges under conditions of uncertainty both regarding changes in the external environment and the definition of problems and their solutions. In such contexts, organisations tend to reduce uncertainty by adopting strategies, practices, and configurations already experimented with by other organisations perceived as successful, thereby generating institutionally legitimated processes of imitation.
- 4 Following DiMaggio and Powell (1983), *normative* isomorphism is one of the main mechanisms through which organisations tend to become similar within a given institutional field. It stems from the formalisation of professional knowledge and from the diffusion of shared standards of behaviour, which orient organisational practices and models towards convergence. Homogenisation is fostered in particular by the common training of professionals and by the action of professional associations, which play a crucial role in defining and legitimating criteria of competence, operational procedures, and norms of conduct. In this way, organisational models recognised as appropriate and legitimate become consolidated within specific organisational fields.
- 5 It is one of the world's leading companies in the provision of management software. In this specific case, the reference is to an ERP (Enterprise Resource Planning) system, that is, an integrated management system that enables the coordination and automation of a wide range of business functions, from production to accounting.
- 6 It refers to an organisational structure in which activities are grouped according to business functions (production, marketing, finance, etc.), and in which hierarchy constitutes the primary mechanism for decision-making and coordination.
- 7 In horizontal organisational structures, activities are organised around work processes (rather than functions) and are coordinated through work teams. Network-based organisation, by contrast, is characterised by the primacy of the relational dimension over the legal-formal one: it consists of a system of stable relationships among legally distinct actors, within which production and decision-making processes take place. As a result, these relational networks ultimately come to constitute a *de facto* collective actor.
- 8 It refers to a *Manufacturing Execution System* (MES), an advanced information system that manages, controls, and monitors shop-floor operations in real time.
- 9 Over the course of the research, no significant role emerged for trade unions, a finding that is plausibly attributable to the limited size of the firms analysed.