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The Inox Valley: a knowledge-based reading of seven decades of industrial cluster evolution

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Introduction

Background and Intellectual Motivation

The persistence of geographically concentrated industrial production in an era of global supply chains and digital dematerialization constitutes one of the most compelling puzzles of contemporary economic geography.

The Inox Valley — the industrial district stretching between Conegliano and Vittorio Veneto in the province of Treviso, Veneto — represents one of the most instructive examples of this phenomenon in the European manufacturing landscape. Specialized in the production of stainless-steel professional food service equipment and domestic appliances, the cluster has evolved over seven decades from a Fordist manufacturing hub anchored around the Zoppas Group into a complex innovation ecosystem integrating advanced mechatronics, digital manufacturing, and sustainability engineering. As documented by the Camera di Commercio di Treviso-Belluno (2022), the area today hosts a dense network of firms — ranging from world-class producers such as Irinox, Lainox, and the Electrolux Professional division, to a constellation of specialized small and medium-sized enterprises (SMEs) — whose collective capabilities position Italy as one of the leading global exporters in the professional food service equipment sector. Yet the mechanisms through which this cluster formed, adapted, and continues to upgrade its competitive position have not been systematically examined through the lens of two theoretical perspectives particularly relevant to analyze these dynamics: Joel Mokyr's knowledge-economy framework and Joseph Schumpeter's theory of creative destruction.

Research Question and Theoretical Motivation

This thesis asks: to what extent and through what mechanisms can the development of the Inox Valley industrial cluster be explained by the interaction between Mokyr's theory of knowledge accumulation and Schumpeter's theory of creative destruction?

The choice of these two theoretical frameworks is not arbitrary. Mokyr's work, and in particular *The Gifts of Athena: Historical Origins of the Knowledge Economy* (2002), provides an analytical vocabulary for understanding how industrial progress is driven by the accumulation and diffusion of two distinct types of knowledge: propositional knowledge (know-why, or systematic understanding of natural phenomena) and prescriptive knowledge (know-how, or the practical techniques derived from such understanding). The Inox Valley's trajectory — from artisanal metalworking learned through apprenticeship in the Zoppas factories, to the codified mechatronic and digital engineering competencies of today's ITS Academy graduates — is precisely the kind of historical process Mokyr's framework was designed to illuminate. Knowledge in this cluster did not descend from abstract science; it accumulated incrementally, was embedded in workers and routines, and diffused through the social mechanisms of spin-off entrepreneurship, labor mobility, and inter-firm collaboration.

Schumpeter, instead, offers the complementary dynamic: economic progress does not proceed smoothly, but through discontinuous waves of innovation in which new combinations of productive factors displace existing ones. His concept of creative destruction, introduced in *The Theory of Economic Development* (1934) and further elaborated in *Capitalism, Socialism and Democracy* (1942), captures the transformative character of the Inox Valley's history — moments of structural rupture, such as the collapse of the Zoppas model, the multinational acquisitions of the 1980s and 1990s, and the Industry 4.0 transition, which destroyed existing productive arrangements while simultaneously creating the conditions for new firm entry, product innovation, and market repositioning. Crucially, Schumpeter's distinction between Mark I dynamics (dominated by new entrants and entrepreneurial disruption, characteristic of early cluster formation)

and Mark II dynamics (dominated by established firms with internal R&D capabilities, characteristic of mature cluster consolidation) maps with considerable analytical precision onto the different phases of the cluster's development.

What distinguishes this thesis from existing studies of Italian industrial districts — which have largely adopted either Marshallian external economies frameworks or Porterian competitive advantage models — is the attempt to integrate the knowledge-creation dimension (Mokyr) with the innovation-dynamics dimension (Schumpeter) into a unified historical narrative. As Jérôme Vicente argues in his synthesis of cluster theory (Vicente, 2018), modern cluster analysis must move beyond static models of agglomeration toward understanding the evolutionary dynamics through which clusters generate, absorb, and recombine knowledge over time. This thesis seeks to apply these theories to the Inox Valley by drawing on my professional involvement in the area. By observing the cluster from within, I aim to provide a more nuanced understanding of the practical mechanisms that drive its competitive upgrading.

Methodology and Positionality

This thesis adopts a qualitative, longitudinal case study methodology. The case study approach is appropriate when the research question concerns contemporary processes embedded in their real-world context and when the boundaries between the phenomenon under study and that context are not clearly evident (Yin, 2003). The Inox Valley is studied across three historically distinct phases — formation (1950–1990), transformation (1990–2015), and digital-green transition (2015–present) — drawing on a triangulated body of primary and secondary sources. These include sector reports by the Camera di Commercio di Treviso-Belluno (2021, 2022), the Libro Bianco on the Italian professional appliance industry (2002), the TEHA Group report on the professional food service supply chain, corporate sustainability reports by Irinox SpA, and a range of

academic literature on cluster theory, knowledge economics, and industrial district evolution.

A necessary epistemological disclosure is required here. The author of this thesis holds the position of Strategic Sales Manager at Irinox SpA, one of the leading firms within the Inox Valley cluster and a company that serves as a primary empirical reference throughout the analysis. This insider position carries both advantages and responsibilities. On the one hand, it provides privileged access to the tacit, firm-level knowledge that is precisely the object of study — the kind of knowledge that, as Mokyr (2002) observes, is by definition resistant to full explication in documents and reports and can only be fully appreciated through direct professional experience. Observing from within the cluster's institutional fabric affords an understanding of competitive dynamics, inter-firm relationships, and knowledge transmission mechanisms that for external observer could be difficult to fully replicate. On the other hand, insider research entails a risk of confirmation bias and loss of analytical distance. To mitigate this risk, the thesis deliberately grounds all empirical claims in publicly available documentary sources, maintains a critical stance toward the firms discussed — including Irinox — and subjects the case study to theoretical frameworks developed entirely outside the industry context. The analysis is therefore positioned as a form of reflective practitioner research in the tradition advocated by Schön (1983), in which professional experience becomes a source of analytical insight rather than a substitute for scholarly rigor.

Use of AI tools. The large language model Claude (Anthropic, version Sonnet 4.6) was used as a support tool for the drafting and structural organization of the thesis. Specifically, it was employed for: the structuring and drafting of textual sections on the basis of analytical and bibliographical directions provided by the author; support for stylistic revision and argumentative coherence across chapters; and the production of successive versions of paragraphs already outlined by the author on the basis of critical feedback. All texts produced with the support of the AI tool were subject to systematic manual re-reading and revision by the author. Factual claims were verified through direct

comparison with the cited sources. Interpretations and analytical propositions were critically assessed by the author, who modified, integrated, or rejected generated formulations whenever they did not correspond to his own conclusions or were not supported by the available evidence. The theoretical choices, the selection of bibliographical sources, the argumentative structure, and the conclusions of the thesis are entirely the author's own. The contribution of the AI tool was editorial and organizational in character, not analytically or interpretively autonomous.

Structure of the Thesis

The thesis is organized into six chapters. Chapter 1 reviews the principal theoretical traditions in industrial cluster analysis, from Marshall's foundational concept of external economies and industrial atmosphere to the Italian school of Becattini and Brusco, through Porter's diamond model, Krugman's New Economic Geography, and the modern synthesis of cluster theory incorporating innovation systems, knowledge spillovers, and evolutionary economic geography. The chapter concludes by positioning the thesis's analytical contribution within this literature. Chapter 2 develops the theoretical framework that will be applied throughout the empirical chapters: Mokyr's distinction between propositional knowledge (know-why) and prescriptive knowledge (know-how), Schumpeter's theory of creative destruction and the two innovation regimes he identified, and the economic complexity framework of Hausmann and Hidalgo as a third analytical instrument. The chapter concludes by posing the four analytical questions that the empirical analysis will seek to answer. Chapter 3 provides a structured overview of the Inox Valley cluster: its historical background and origins in the post-war Zoppas and Zanussi industrial groups, its chronological evolution through four phases — Industrial Foundation (1950s–1970s), Crisis, Consolidation and Diversification (1970s–1990s), Maturation and the Rise of Food Service Equipment (1990s–2010s), and Digital Transition and Sustainability Challenges (2010s–present) — its current industrial

structure, its economic performance and international positioning, and the shared knowledge base that gives the cluster its distinctive epistemic identity. Chapter 4 applies the three analytical frameworks to each of the four phases of the cluster's development, tracing the evolution of its propositional knowledge base, the episodes and mechanisms of creative destruction, and the trajectory of its productive portfolio in the Product Space. The chapter also examines the multi-dimensional challenges of the current phase, including digital transition, sustainability, human capital, servitization, institutional innovation, and market-driven consolidation through the emergence of federated ownership structures within and adjacent to the cluster. Chapter 5 situates the Inox Valley within an international comparative perspective through an in-depth case study of the Shunde/Foshan cluster in China's Pearl River Delta — the world's most significant production cluster for home appliances and professional food equipment. The comparison is structured using the same six analytical categories applied to the Inox Valley in Chapter 3, followed by a comparative analysis through the three lenses of Mokyr, Schumpeter, and economic complexity. Chapter 6 synthesises the findings of the preceding chapters, answers the four analytical questions posed in Chapter 2, documents the emerging institutional responses to the cluster's structural challenges, reflects on the methodological limitations of the work, identifies directions for future research, and offers a closing reflection on the implications of the analysis for the cluster's competitive future.

CHAPTER 1. The Industrial Cluster: Theoretical Foundations and the Evolution of a Concept

1.1 Origins: Marshall and the Birth of the Industrial District

The intellectual genealogy of the industrial cluster concept is long and complex, rooted in the late nineteenth-century reflections of Alfred Marshall. As Belussi and Caldari (2009) have demonstrated in their thorough reconstruction of the original Marshallian formulation, Marshall discovered the existence of industrial districts empirically — probably during his visits to British factories — and began theorizing the phenomenon as early as *The Pure Theory of Domestic Values* (c. 1873–77), returning to it more systematically in *Principles of Economics* (1890) and *Industry and Trade* (1919).

The industrial district, in Marshall's original conception, is not simply a localized industry. It is a qualitatively different phenomenon: a territorial community of small and medium-sized firms that collectively benefit from what Marshall termed external economies, defined as those advantages that “depend on the general organization of the trade, on the growth of the knowledge and appliances common to the trade, on the development of subsidiary industries” (Marshall, 1898, p. 50, as cited in Belussi and Caldari, 2009). These externalities are explicitly opposed to the internal economies that characterize large, vertically integrated firms — a distinction that constitutes the cornerstone of Marshall's theoretical innovation.

The competitive strength of firms gathered in a district stems from three intertwined mechanisms. First, the formation of a specialized and thick labor market, in which workers develop highly specific skills that are simultaneously useful to multiple firms and in which employers find a deep pool of specialized competences. Second, the development of a dense network of intermediate input suppliers, creating demand

externalities that lower costs and increase quality for all participants. Third, and most distinctively, the emergence of what Marshall evocatively called the industrial atmosphere — an informal, socialized environment in which tacit knowledge and technological know-how diffuse through the community almost spontaneously, as if 'in the air' (Marshall, 1919). This last mechanism anticipates many of the modern discussions on knowledge spillovers and is arguably one of Marshall's most enduring contributions to economic thought.

An equally central feature of the Marshallian district is its peculiar combination of competition and cooperation. Firms specialize in particular phases of the productive process, establishing exchange relations with each other in what Marshall described as 'associated actions.' As he wrote, 'the broadest and in some respects most efficient forms of cooperation are seen in a great industrial district where numerous specialized branches of industry have been welded almost automatically into an organic whole' (Marshall, 1919, p. 599, cited in Vicente, 2018). This productive ecosystem is self-sustaining and evolutionary: the distributed division of labor generates a greater dynamic of production, diffusion, and selection of ideas than would be achievable within any single large bureaucratic organization. In this sense, as Loasby (1999) observed, the Marshallian industrial district exhibits the characteristics of an organic system that combines differentiation and integration to ensure its own maintenance and reproduction — an insight that directly prefigures modern evolutionary approaches to cluster dynamics.

It is important to note, as Belussi and Caldari (2009) carefully document, that subsequent theorizations on local agglomeration — including Porter's popular notion of the cluster — gradually departed from the richness of this original concept. The Porterian cluster, built on a broad geographical and functional indeterminacy of the unit of analysis, loses many of the features of the Marshallian district: the emphasis on the industrial atmosphere; the precise articulation of competition and cooperation; and the time-dependent, endogenous social and economic forces of growth embedded in a specific

local community. Recognizing this genealogical relationship and its subsequent distortions is essential for understanding both the theoretical richness and the definitional ambiguities that have characterized cluster research ever since.

1.2 The Eclipse of the District Concept and the Fordist Interlude

Despite its theoretical richness, Marshall's framework was largely set aside for much of the twentieth century. As Vicente (2018) notes, attention shifted towards the Fordist model of large-scale mass production, in which productivity gains and growth were primarily associated with the development of the large firm and the pursuit of internal economies of scale. During this period, economists such as Perroux (1955) focused on the broader regional impact of firms as 'growth poles,' underscoring the ability of large integrated enterprises to extend their market power through product standardization — an approach that departed significantly from Marshallian intuitions about the advantages of small-firm districts.

The territorial dimension of economic organization was not entirely neglected, however. Scholars within what Becattini (1987) would later call the 'Old Cambridge School' — the circle of Marshall's pupils including Pigou, Robertson, Bowley, Chapman, and Sargant Florence — continued to develop related research on industrial location and agglomeration. Sargant Florence contributed empirical analyses of localization patterns, introducing the concept of the location quotient as a tool to measure industrial concentration, and identifying what he called 'immobile external economies' — a notion close to what modern economists call agglomeration economies. Yet, as Belussi and Caldari (2009) observe, Florence's approach was largely static and lacked the evolutionary flavor that had characterized Marshall's original formulation; he tended to merge the concepts of localized industry and industrial district, losing the richer social and organizational dimensions that Marshall had identified.

1.3 The Rediscovery of Marshall: Italian Industrial Districts and the Flexible Specialization Paradigm

The decisive turning point came at the beginning of the 1980s, when the Fordist growth model entered into crisis and scholars began searching for alternative organizational models. It was precisely in this context that Marshall's ideas were retrieved and powerfully re-elaborated. The pivotal contribution came from the Italian economist Giacomo Becattini, who, in his 1979 article 'Dal "Settore" industriale al "distretto" industriale,' proposed a systematic reinterpretation of the industrial district as the appropriate unit of analysis for understanding the competitive success of those Italian regions — concentrated in the so-called 'Third Italy' (Emilia-Romagna, Tuscany, and North-Eastern Veneto) — that maintained high growth rates and export performance despite the economic turbulence of the late 1970s. Becattini's contribution, rooted in the tradition of the Florence School, restored to the district concept its full social and cultural dimensions, treating the industrial district as a socio-territorial entity in which a community of people and a population of firms share a common industrial culture and identity (Vicente, 2018).

The academic recognition of this Italian experience was greatly accelerated by the publication of Piore and Sabel's *The Second Industrial Divide* (1984), which developed the foundations of a new industrial bifurcation. Piore and Sabel argued that the crisis of mass production opened the door to a revival of decentralized forms of industrial organization, centred on what they called flexible specialization: the capacity of networks of small firms to adapt rapidly to changing market conditions by combining craft-based know-how with flexible technology. The Italian districts — alongside other regional industrial systems in Europe — were presented as the empirical exemplars of this new paradigm (Vicente, 2018). Brusco's (1982) study of the 'Emilian model' provided further empirical grounding, documenting the productive decentralization and social integration that characterized districts such as those of Modena, Reggio Emilia, and Bologna.

The Piore and Sabel framework prompted scholars from different disciplines and different parts of the world to theorize the mechanisms of district-based regional growth. In the United States, Saxenian (1990) notably described Silicon Valley as 'an American variant of the industrial district of Europe,' arguing that the region's decentralized network structure was more flexible and innovative than the vertically integrated corporations of Route 128. As she observed, 'the process of solving problems and charting future directions in a technologically volatile environment is increasingly a cooperative effort by networks of linked firms' (Saxenian, 1990, p. 103). Related contributions emerged from economic geography and economic sociology, including the concepts of industrial agglomeration (Storper, 1989), innovative environment (Camagni, 1995), and technopole (Scott, 1990), each highlighting particular dimensions of the territorial organization of innovation that Marshall had originally intuited (Vicente, 2018).

1.4 Porter and the Mainstreaming of the Cluster Concept

It was not until the mid- to late 1990s that the vocabulary of the 'cluster' as such became dominant in both academic research and policy circles. The academic community broadly attributes this popularization to Michael Porter, whose work emerged from management science rather than from the political economy and economic geography tradition that had produced the district literature. Porter first addressed the phenomenon in *The Competitive Advantage of Nations* (1990), and then developed his cluster framework in two landmark articles (Porter, 1998, 2000). In Porter's definition, a cluster is 'a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities' (Porter, as cited in Vicente, 2018). This encompasses not only competing firms but also a wide range of related suppliers, service providers, research institutions, universities, standardization agencies, and professional associations — a broader and more institutionally inclusive conception than the Marshallian district.

The intellectual bridge to Marshall was explicit. Porter himself acknowledged that 'the antecedents of clusters date back at least to Marshall, who included a fascinating chapter on the externalities of specialized industrial locations in his *Principles of Economics*' (Porter, 2000, p. 16, cited in Vicente, 2018). His Diamond Model identified four interdependent determinants of cluster competitiveness: the quality of factor conditions, the nature of local demand conditions, the structure and rivalry of firms, and the presence of related and supporting industries. At the practical level, Porter's work was deliberately crafted as a policy tool, translating complex theoretical insights into frameworks directly usable by governments and regional authorities. The early cluster policy of the Spanish Basque Country, developed in the early 1990s following a consultancy with Porter's Monitor Group, became the pioneering example of a cluster development program and catalyzed a wave of similar initiatives worldwide (Vicente, 2018).

Despite its enormous influence, Porter's cluster concept attracted significant critical scrutiny. Martin and Sunley (2003) and Duranton (2011) pointed to the definitional vagueness of the cluster concept and to the ambiguity generated by the multiplicity of its parameters and their complex interactions. These criticisms stimulated further theoretical maturation, giving rise to new research programs that systematically isolated and formalized different dimensions of Marshall's original insights. One direction of this reaction called for a more concrete and institutionally grounded specification of the conditions enabling cluster advantages — an approach that would later characterize the research program on scaffold structures and competitive peripheries, to be discussed in Section 1.5.

1.5 New Economic Geography, Knowledge Spillovers, and the Geography of Innovation

Following the mainstreaming of the cluster concept, scholarly research developed along several converging trajectories that progressively deepened the microeconomic and dynamic foundations of cluster theory.

The New Economic Geography (NEG), associated primarily with Paul Krugman (1991), offered a formal general equilibrium framework for explaining why economic activities tend to concentrate spatially. Krugman's core-periphery model showed that the interplay between increasing returns to scale, transport costs, and market size generates centripetal forces that pull firms and workers towards agglomerated locations. As Krugman (2011) later acknowledged, his original NEG formulation deliberately downplayed intangible externalities — such as information spillovers — precisely in order to derive agglomeration economies from fully micro founded principles. While NEG contributed important insights into the mechanics of spatial concentration, its analytical focus on tangible sources of agglomeration left the most distinctive features of clusters — notably tacit knowledge and social relations — undertheorized.

This gap was addressed by the geography of innovation research program, which placed knowledge spillovers at the center of its analysis. Drawing on Arrow (1962) and Griliches (1979), scholars such as Audretsch and Feldman (1996) argued that knowledge, unlike physical goods, has strong tacit dimensions whose transmission requires face-to-face interaction and geographical proximity. Knowledge spillovers do not travel well across space: they are localized externalities that make proximity to knowledge-producing agents a strategic asset for innovative firms. The empirical research of Jaffe, Trajtenberg, and Henderson (1993), which traced the geographical localization of knowledge spillovers through patent citation data, provided compelling evidence that innovative activity is far more spatially concentrated than production activity. According to Vicente (2018), because the channels of tacit knowledge transmission are rooted in high-frequency, face-to-face interaction, geographical proximity confers an advantage that

cannot be replicated through information and communication technologies alone; as the share of knowledge capital in firms' production functions grows, the strategic value of cluster membership increases correspondingly.

This theoretical framework also helps to specify more precisely what the institutional context of a cluster must provide for knowledge spillovers to materialize. What enables the diffusion of contextual and tacit knowledge within a cluster is not mere co-location but the presence of what he calls scaffold structures: intermediate institutions around which economic agents interact around a family of evolving artefacts. These include universities and technical educational institutions, research and professional networks, industry associations, trade centers, leader firms, and financial agents such as banks and venture capital providers. This concept of scaffolding updates and institutionalizes the Marshallian notion of industrial atmosphere, translating the idea of spontaneous knowledge diffusion into a more organized and deliberate set of conditions. It also responds directly to the vagueness that Martin and Sunley (2003) identified in Porter's diamond: rather than treating 'related and supporting industries' as an undifferentiated catch-all, the scaffold structure framework specifies the types of institutional intermediaries that actually perform the function of knowledge circulation within a cluster. The evolutionary economic geography literature, building on contributions by scholars such as Martin (2010) and Boschma (2015), introduced a dynamic perspective on cluster trajectories — addressing questions of emergence, growth, lock-in, and decline — that had been largely absent from both the Porterian and NEG frameworks. By integrating insights from evolutionary economics and complexity theory, this literature enriched the understanding of clusters as path-dependent systems shaped by cumulative processes of institutional co-evolution, technological change, and relational dynamics. The concept of cluster resilience — the capacity of a cluster to adapt and transform in response to external shocks — has emerged as a central concern of this strand of research (Vicente, 2018). A particularly important recent contribution to the mechanisms of cluster resilience has been provided by Buciuni and Pisano (2018), who identified knowledge integrators

as the specific organizational actors through which resilience is produced in manufacturing clusters — a concept discussed in Section 1.6 below.

1.6 Clusters in the Global Economy: Value Chains, Knowledge Integrators, and Competitive Peripheries

The theoretical frameworks reviewed in the preceding sections were largely developed with reference to closed or semi-closed regional systems in which the cluster's competitive advantages derived primarily from its internal dynamics — labor market pooling, input-output linkages, tacit knowledge spillovers, and institutional scaffolding. From the 1990s onwards, however, and with increasing urgency since the 2000s, it became clear that the growing integration of national economies into global value chains (GVCs) posed a fundamental challenge to this internally oriented model: cluster-based firms were no longer competing primarily with other locally embedded enterprises but with global supply chains capable of sourcing any productive function from anywhere in the world. This section reviews the theoretical and empirical responses to this challenge, with particular attention to three interconnected concepts that have reframed the cluster in an open-economy perspective: the repositioning of clusters within GVCs, the role of knowledge integrators in mediating between local and global, and the conditions under which non-metropolitan clusters can sustain competitive advantage in the knowledge economy.

The relationship between local clusters and global value chains was first addressed systematically in the economic geography literature through the notion of 'local clusters in global value chains' (De Marchi, Di Maria, and Gereffi, 2017), which showed that the insertion of cluster firms into global networks could produce both upgrading and downgrading trajectories, depending on the governance structure of the chain and the capabilities of local actors. Buciuni, Corò, and Micelli (2013), in their comparative study of the furniture industry across multiple countries, contributed a refined version of this

argument: the survival and upgrading of manufacturing clusters depends on the capacity of local firms to reposition themselves within global production chains, a process that requires not the abandonment of local productive roots but their deliberate integration with transnational market linkages. As the authors argue, the more markets globalize, the more likely resources are to flow towards more attractive regions, reinforcing regional specialization and the role of clusters — but also making it imperative for clusters to develop active global connectivity through the attraction of multinational corporations, international talent, and state-of-the-art infrastructure.

The question of which actors within the cluster perform this bridging function was addressed directly by Buciuni and Pisano (2018), in their study of four manufacturing clusters in North-Eastern Italy. By comparing two pairs of 'twin clusters' operating in the same sectors and regions — the footwear cluster of the Riviera del Brenta and the furniture cluster of Pordenone (both resilient) against the chair cluster of Manzano and the sports footwear cluster of Montebelluna (both in decline) — the authors found that the decisive differentiating factor was the presence of what they termed knowledge integrators: large local firms that participate directly in global value chains, sometimes coordinating them, while simultaneously maintaining an active industrial presence at the local level, channeling new knowledge and innovative inputs from their global networks back to local suppliers and sub-contractors. The two resilient clusters maintained a stable number of local firms and workers between 2005 and 2014; the two declining clusters experienced contractions of 29% and 40% respectively in active local firms over the same period (Buciuni and Pisano, 2018).

The knowledge integrator concept makes a specific and verifiable contribution to cluster theory that extends, but does not replace, earlier frameworks. In relation to Marshall's industrial district, it introduces a hierarchical dimension: the district is no longer conceived as a relatively horizontal community of SMEs but as a system in which the strategic decisions of certain leading firms have systemic effects on the entire local ecosystem. In relation to the Porterian diamond, it provides a systemic link — the

deliberate transfer of extra-local knowledge by knowledge-integrating actors — that puts into practice what Porter had described only in general terms as the beneficial effects of 'related and supporting industries'. In relation to the evolutionary geography literature, it identifies a specific organizational pathway to cluster resilience, complementing the systemic analyses of lock-in and adaptation with a firm-level account of how new knowledge enters a cluster and renews its technological base.

A third dimension of the contemporary cluster challenge concerns the geographical distribution of innovative capacity. The rapid concentration of innovation, talent, and investment in a small number of global metropolitan hubs — what Moretti (2012) has called 'superstar cities' — has generated a growing territorial divide, in which second-tier cities and industrial provinces risk losing their capacity to attract and retain the human and technological capital necessary for competitiveness in the knowledge economy. This is not merely an abstract theoretical concern: as Buciuni and Corò (2023) document in their comparative study of successful non-metropolitan industrial systems, the triumph of large metropolitan cores has in many cases been accompanied by the relative decline of the industrial provinces that drove economic growth during the Fordist era — a dynamic with significant political and social consequences. Against this backdrop, the central question for cluster theory becomes: under what conditions can clusters located outside global metropolitan cores sustain competitive advantage in the knowledge economy?

Drawing on case studies of successful non-metropolitan production systems in Europe and the United States — including the medical devices cluster in Galway (Ireland), the Research Triangle Park in Raleigh-Durham (USA), the Metropole Ruhr cultural and environmental cluster in Germany, and the Motor Valley districts around Bologna (Italy) — Buciuni and Corò (2023) identify three structural conditions that characterize what they call competitive peripheries. The first, differentiation and complexity, refers to the capacity of local productive systems to specialize in sophisticated market niches drawing on a heterogeneous set of local capabilities that enable cross-industry fertilization —

niches where the premium placed on tacit knowledge and craftsmanship insulates local producers from pure price competition. The second, global connectivity, captures the paradox that local resilience increasingly depends on extra-local linkages: the local presence of multinational corporations, access to state-of-the-art infrastructure, and the attraction of internationally mobile talent all function as channels through which external knowledge enters the local system without dissolving its distinctive character. The third, public-private cooperation, encompasses the institutional arrangements through which universities, research centres, vocational training institutions, and local public authorities act as active intermediaries between global knowledge frontiers and local productive systems — including joint research projects, active learning laboratories, incubators for knowledge-intensive services, and cultural initiatives that increase the global visibility and attractiveness of the territory (Buciuni and Corò, 2023).

In this framework, universities emerge as particularly critical actors in the competitive periphery, performing a bridging role that is analytically distinct from both the informal knowledge diffusion described by Marshall and the impersonal market mechanisms emphasized by the New Economic Geography. As Buciuni and Corò (2023) document, in all their case studies of successful non-metropolitan production systems, universities played a decisive role in local development not merely as providers of human capital but as active brokers between the local economy and global knowledge networks — attracting and retaining foreign direct investment, co-developing technology with local firms, training skilled professionals who remain in the territory, and building the cultural openness and institutional quality that distinguishes competitive peripheries from stagnant ones. This institutional role constitutes a contemporary specification of the scaffold structure concept: it identifies the particular scaffold that is most critical for cluster competitiveness in the knowledge economy.

1.7 Synthesis: The Industrial Cluster as a Cumulative Theoretical Concept

The account developed across the preceding sections reveals a theoretical tradition that is genuinely cumulative: each successive contribution addressed specific limitations of its predecessors, adding new analytical dimensions without entirely superseding what had come before. Marshall established the foundational triad of labor market pooling, input-output linkages, and knowledge spillovers, embedded in a form of local social organization he called the industrial atmosphere. The Italian School — Becattini, Brusco, and their collaborators — restored the sociological and cultural depth of this concept, demonstrating its empirical relevance for the post-Fordist economy. Piore and Sabel generalized these insights into a broader theory of flexible specialization, catalyzing an international research program. Porter mainstreamed and institutionalized the cluster concept, making it actionable for policy — at the cost of definitional imprecision that subsequent scholars sought to remedy. The New Economic Geography provided formal micro foundations for spatial concentration, while the geography of innovation situated knowledge spillovers at the center of the cluster's competitive advantages. The evolutionary geography literature added a dynamic and resilience-oriented perspective, addressing the life cycles and transformations of clusters over time. More recent scholarship has further enriched this tradition by reframing clusters as open systems embedded in global value chains and facing the challenge of competing in knowledge-intensive markets from non-metropolitan locations. The concept of scaffold structures specifies the institutional conditions under which tacit knowledge circulates within a cluster. The knowledge integrator concept identifies the organizational actors who mediate between local productive ecosystems and global networks, generating systemic upgrading effects. The competitive peripheries framework theorizes the conditions under which clusters located outside global metropolitan cores can sustain competitive advantage in the knowledge economy. Together, these contributions shift the theoretical focus from the cluster-as-production-system — a geographically bounded set of firms and input-output linkages — towards the cluster-as-innovation-ecosystem: a territorially

embedded, institutionally mediated, and globally connected system of actors capable of generating, absorbing, and recombining knowledge in ways that sustain collective competitiveness over time.

This evolution in the concept has important implications for empirical research. It means that assessing the competitive performance of a cluster requires attending not only to its internal structure — the density of inter-firm linkages, the depth of local labor market specialization, and the quality of knowledge spillovers — but also to its external embeddedness: the governance structure of the value chains in which it participates, the quality of the institutional intermediaries that scaffold its innovation processes, and the presence of knowledge-integrating actors capable of channeling global inputs into the local ecosystem. It is within this multi-dimensional theoretical framework that the analysis developed in the following chapters is situated. The cluster under examination — the professional appliance and inox district of the Conegliano (Treviso) area — represents an instructive case: a non-metropolitan, SME-dominated manufacturing system that has simultaneously maintained significant productive vitality and undergone significant structural transformation in response to the pressures of globalization and technological change. Understanding this trajectory requires precisely the combination of perspectives that the evolution of cluster theory, from Marshall to the present, has progressively put in place.

CHAPTER 2. Knowledge and Innovation: Mokyr's Useful Knowledge Framework and Schumpeter's Creative Destruction

2.1 Introduction: Why Theory Matters for Case-Study Analysis

Understanding how an industrial district emerges, consolidates, and adapts to successive waves of technological change is not simply a matter of collecting facts and data. Without a clear theoretical framework, even the most detailed empirical observation risks telling us little about the mechanisms that drive industrial change — facts alone do not explain themselves; what gives them meaning is a set of analytical tools that help identify the dynamics at work beneath the surface. This chapter introduces and develops the two principal theoretical lenses adopted in this thesis: first, Joel Mokyr's epistemological framework of useful knowledge, drawn primarily from his landmark work "The Gifts of Athena: Historical Origins of the Knowledge Economy" (2002); and second, Joseph Alois Schumpeter's theory of innovation cycles and creative destruction, elaborated across his major works *The Theory of Economic Development* (1911/1934) and *Capitalism, Socialism and Democracy* (1942).

These two frameworks are not drawn from separate intellectual traditions that require bridging: they are both expressions of what Nelson and Winter (1982) established as the evolutionary economics programme — a body of thought that understands economic change as an endogenous, path-dependent process driven by variation, selection, and the cumulative accumulation of knowledge and capabilities, in explicit contrast to neoclassical models in which economies tend toward static equilibrium. Schumpeter is the founding figure of this tradition. His insistence that capitalist development is driven from within — by the restless activity of entrepreneurs introducing new combinations, by the waves of creative destruction that displace established routines and firms — defines the core of the evolutionary approach to economic change. Mokyr extends this programme into the domain of the history of technology, asking what the structure and

distribution of knowledge itself — rather than its competitive deployment alone — can explain about the long-run dynamics of industrial progress. Where Schumpeter illuminates the competitive and institutional mechanisms through which innovation transforms economic structures, Mokyr illuminates the epistemic architecture that determines what innovations are possible at any given historical moment. They are therefore best understood not as two complementary but independent lenses requiring reconciliation, but as two analytical levels of the same evolutionary inquiry: one operating at the level of market dynamics and entrepreneurial agency, the other at the level of the knowledge base from which those dynamics draw their substance. Together, they provide the conceptual vocabulary needed to trace how the stainless-steel and professional appliance industry of the Conegliano-Treviso area has navigated successive technological paradigm shifts, from its origins in mid-twentieth-century industrial expansion to the contemporary challenges posed by digital transformation and sustainability imperatives.

The chapter is structured as follows. Section 2.2 presents Mokyr's epistemological framework in detail, covering the fundamental distinction between propositional and prescriptive knowledge, the role of access costs, the Industrial Enlightenment as a historical turning point, and the mechanisms of knowledge recombination. Section 2.3 develops Schumpeter's theory, tracing the evolution of his thinking from the heroic entrepreneur of Mark I to the routinised R&D of Mark II, and situating creative destruction within broader frameworks of technological waves and paradigms. Section 2.4 brings the two frameworks into explicit dialogue, discussing their complementarities and the analytical synthesis that guides the empirical chapters. Finally, Section 2.5 reflects on the methodological implications of adopting these lenses for the case study at hand.

2.2 Joel Mokyr's Framework of Useful Knowledge

2.2.1 The Central Question: What Makes Technological Progress Possible?

Joel Mokyr's intellectual project in *The Gifts of Athena* is grounded in a seemingly simple question: why do some economies and historical periods generate sustained technological progress while others stagnate? His answer departs from purely institutional or incentive-based explanations and focuses, instead, on the structure and accessibility of knowledge itself. In Mokyr's framework, technology is not a black box that responds passively to market signals or property-right protections; it is a form of knowledge with specific internal architecture and understanding that architecture is essential to explaining innovation.

For Mokyr, economic growth is fundamentally driven by the progressive accumulation of knowledge. Every innovation builds on the knowledge embedded in preceding ones, meaning that the history of technology is not a sequence of independent inventions but a branching and self-reinforcing process, where each advance opens new possibilities that would not have been conceivable before. Crucially, however, this accumulation is not automatic: it depends on institutional conditions that protect innovators, on competitive markets that allow innovative firms to displace incumbents, and above all on the mechanisms by which knowledge diffuses across individuals, firms, and territories.

2.2.2 The Fundamental Distinction: Propositional and Prescriptive Knowledge

The centerpiece of Mokyr's analytical framework is a formal distinction between two types of knowledge, denoted in his notation as Ω (Omega) and λ (lambda). Propositional knowledge (Ω) refers to knowledge about what is — that is, knowledge of natural regularities, phenomena, and principles. It answers questions of the form: 'what is true about the natural world?' Examples include knowledge of thermodynamic laws, chemical reactions, biological processes, and electrical phenomena. Prescriptive knowledge (λ), by contrast, refers to knowledge about how to do things — instructions, recipes,

techniques, and procedures. It answers questions of the form: 'how can one manipulate natural processes to achieve a desired outcome?' A recipe for making steel, a blueprint for a machine tool, or a protocol for a chemical synthesis all belong to this category.

Mokyr's key insight is that prescriptive knowledge is always grounded in, or at least constrained by, propositional knowledge, even if the relationship is loose and indirect. An artisan can possess a highly effective technique without understanding the scientific principles underlying it; but the frontier of what techniques are possible is ultimately determined by what is known about nature. As the propositional knowledge base expands — through scientific inquiry, systematic observation, and codification — new techniques become conceivable that were previously beyond imagination. Conversely, the attempt to improve or troubleshoot existing techniques stimulates enquiries into propositional knowledge, creating a feedback loop between the two domains. Mokyr describes this as 'the strong complementarity, the continuous feedback between the two types of knowledge, that set the new course' of modern economic growth (Mokyr, 2002, "The Gifts of Athena: Historical Origins of the Knowledge Economy").

The distinction carries important implications for how one conceptualizes innovation. Radical innovation — the invention of genuinely new techniques — requires not only incentives and entrepreneurial talent but an adequate propositional epistemic base (Ω) from which new prescriptive recipes (λ) can be derived. A society lacking sufficient propositional knowledge may be entrepreneurially dynamic yet technologically limited, capable only of incremental improvements to existing techniques. Mokyr refers to the propositional foundation of a given technique as its 'epistemic base,' and argues that the history of industrialization can in large part be narrated as the history of successive expansions in epistemic bases enabling new rounds of prescriptive innovation.

This framework has direct relevance to the analysis of the professional appliance industry. Much of the sector's evolution over the twentieth century can be read as a sequence of expansions in the relevant epistemic bases: from mechanical engineering and thermodynamics in the early phase, through electrotechnics and control engineering

in the mid-century, to electronics, digital signal processing, and materials science in the contemporary phase. Each epistemic expansion opened new prescriptive possibilities — new types of machines, new performance envelopes, new product categories — and thereby altered the competitive landscape.

2.2.3 The Role of Access Costs

A second analytical pillar of Mokyr's framework concerns what he calls 'access costs' — the costs of accessing and diffusing propositional knowledge within a society. Even if the stock of useful knowledge is large, its impact on innovation depends critically on whether potential innovators and entrepreneurs can access it. Tacit knowledge, which cannot be fully articulated or codified, is by its nature difficult to transmit; it tends to diffuse through personal contact, apprenticeship, and migration of skilled workers. Codified knowledge, expressed in written texts, drawings, specifications, and standards, is in principle accessible to anyone who can read and possesses the relevant background. The key insight is that the reduction of access costs — through printing, encyclopedias, scientific societies, engineering schools, standardization of terminology, and eventually electronic communication — amplifies the effective knowledge base available to potential innovators.

Mokyr illustrates this argument extensively through the history of the Industrial Enlightenment of the eighteenth century. He observes that 'the knowledge revolution of the eighteenth century was not just the emergence of new knowledge; it was also better access to knowledge that made the difference' (Mokyr, 2002, "The Gifts of Athena: Historical Origins of the Knowledge Economy"). The proliferation of technical encyclopedias, from John Harris's *Lexicon Technicum* (1704) to Diderot's *Encyclopédie* (1751–1772), dramatically reduced the cost of finding out what was known about any given technique. The emergence of scientific societies and 'invisible colleges' — informal scholarly communities maintaining correspondence across national borders — created

transnational circuits of knowledge exchange. The standardization of measurement and nomenclature (units of force, chemical nomenclature, weights and measures) made it possible for knowledge generated in one locality to be unambiguously reproduced elsewhere.

A further implication of the access-cost framework is that the spatial concentration of knowledge-intensive activities — precisely what characterizes an industrial cluster — can be understood as a mechanism for reducing access costs. When skilled workers, engineers, scientists, and entrepreneurs are co-located, the costs of transmitting tacit knowledge fall substantially: the social contact between 'knowers' and 'doers' that Mokyr identifies as indispensable for technological progress becomes cheaper and more frequent. An industrial district, in this reading, is not merely an agglomeration of firms; it is a structured social environment that lowers the access costs of both propositional and prescriptive knowledge, and thereby raises the productivity of innovative effort.

2.2.4 The Industrial Enlightenment and the Feedback Loop between Science and Practice

Mokyr's historical argument centers on the emergence of what he calls the 'Industrial Enlightenment' — a cultural and institutional transformation, originating in Western Europe during the seventeenth and eighteenth centuries, that brought about systematic interaction between natural philosophy (propositional knowledge) and the practical arts (prescriptive knowledge). Prior to this transformation, the two domains were largely segregated: natural philosophers pursued knowledge for its own sake, while artisans transmitted techniques through guild apprenticeship, with little cross-fertilization. The Industrial Enlightenment, Mokyr argues, fundamentally altered this relationship.

The key mechanism was the narrowing of the social and cognitive gap between 'savants' (natural philosophers and scientists) and 'fabricants' (manufacturers and craftsmen). This bridging took institutional form in scientific societies such as the Royal Society of

London, in the emergence of engineering as a semi-scientific profession, in the establishment of technical schools, and in the diffusion of the idea — emblematic of the Baconian tradition — that the study of nature should serve practical ends. As Mokyr argues, the Industrial Enlightenment 'meant that useful knowledge would henceforth be judged by its intrinsic value, not by the nationality of its origin' (project files), creating a transnational republic of useful knowledge available to any economy with the institutional capacity to access it.

An important consequence of this transformation was what Mokyr describes as the 'continuous feedback' between Ω and λ : practical problems encountered by engineers and manufacturers stimulated scientific inquiry into their underlying causes, while scientific discoveries opened new technological possibilities that inventors could explore. The history of the steam engine is paradigmatic: its improvement drove advances in thermodynamic theory, which in turn enabled more systematic and efficient engine design. This feedback loop, Mokyr argues, is what distinguishes modern economic growth from earlier episodes of technological progress: for the first time, advances in prescriptive knowledge were systematically grounded in, and contributory to, a growing stock of propositional knowledge, making innovation not just more frequent but self-sustaining.

The Industrial Enlightenment also demonstrated a crucial geopolitical dimension relevant to understanding industrial clusters. Mokyr shows that 'France's strength was in Ω , Britain's in λ , and that the mapping function bridged the Channel' (Mokyr, 2002, "The Gifts of Athena: Historical Origins of the Knowledge Economy"): Britain's advantage lay not in superior science but in a denser network of practical entrepreneurs capable of translating scientific knowledge into working machines. Yet this advantage was temporary, as knowledge flowed across borders and other nations caught up. This observation points to a general truth about knowledge-based competitive advantage: it is inherently dynamic, and the capacity to continuously access and absorb new

propositional knowledge is ultimately more important than any particular technological lead.

2.2.5 Recombination and the Combinatorial Character of Invention

A further analytical concept of great relevance is Mokyr's treatment of technological recombination. He observes that 'a substantial portion of invention consists of recombination, the application of sometimes remote and disjoint sections of Ω together to form something novel' (Mokyr, 2002, "The Gifts of Athena: Historical Origins of the Knowledge Economy"). The insight, drawing on the work of Weitzman (1996) and Francois Jacob, is that most innovations are not created *ex nihilo* but are new combinations of existing knowledge elements. If the set of knowledge elements available is large and well-organized, the combinatorial space of possible innovations becomes enormous — indeed, it grows faster than exponentially with the size of the knowledge base. This explains why reductions in access costs, which increase the effective size of the knowledge pool available to any given inventor, can produce disproportionate increases in the rate of innovation.

The combinatorial character of invention implies that the value of any given piece of knowledge depends not only on its intrinsic content but on the complementary knowledge with which it can be combined. This has direct implications for industrial clusters, where the co-presence of multiple specializations — mechanical engineering, electronics, industrial design, software development, logistics — creates a rich combinatorial environment for innovation. The Conegliano-Treviso stainless steel and professional appliance district, with its mix of large integrated producers, specialized component suppliers and engineering consultancies, can be understood as a combinatorial environment in Mokyr's sense: a setting where diverse knowledge elements are accessible at relatively low cost, enabling the recombination processes that drive incremental and radical innovation alike.

Mokyr also emphasizes the self-referential structure of the knowledge stock: before one can try to access a particular piece of knowledge, one must know that it exists. This implies that the reduction of search costs — knowing where to look and who to ask — is itself a form of valuable knowledge. Encyclopedias, professional associations, trade fairs, and academic conferences all serve the function of advertising the existence of knowledge, enabling potential users to initiate targeted searches. In the context of an industrial cluster, local institutions such as chambers of commerce, trade associations, and technical schools play an analogous role, maintaining a shared awareness of the technical knowledge available within the community.

2.2.6 Implications for the Knowledge Economy of the Twenty-First Century

Mokyr explicitly draws the parallel between the Industrial Enlightenment of the eighteenth century and what he calls the 'knowledge economy' of the contemporary era. He observes that 'the accelerating decline in access costs has opened the floodgates to further technological progress in our age, not just thanks to a single advance such as the Internet but through a host of changes that reduced access to knowledge as it increased the size of Ω ' (Mokyr, 2002, "The Gifts of Athena: Historical Origins of the Knowledge Economy"). The digital revolution has reduced marginal access costs for codified knowledge to near zero, dramatically expanding the combinatorial space available to innovators. At the same time, the growing importance of highly tacit and complex knowledge — in advanced manufacturing, biotechnology, artificial intelligence — means that proximity and social contact remain irreplaceable as mechanisms of knowledge transmission, even as digital tools reduce access costs for codified components.

This contemporary inflection of Mokyr's framework is directly relevant to the empirical focus of this thesis. The professional appliance industry today operates at the intersection of multiple expanding epistemic bases: mechatronics, digital connectivity, machine learning, sustainability science, and regulatory knowledge. Firms that can access and integrate knowledge from these diverse domains are better positioned to develop products at the frontier of the technologically possible. Industrial clusters that

sustain dense networks of skilled workers, engineers, and research institutions provide the social infrastructure for this knowledge integration. The analytical question, to be addressed in the empirical chapters, is whether the Conegliano-Treviso district has maintained and renewed this social infrastructure through successive rounds of technological change.

2.3 Schumpeter's Theory of Innovation and Creative Destruction

2.3.1 The Primacy of Innovation in Schumpeter's System

Joseph Alois Schumpeter is one of the most influential economists of the twentieth century, widely recognized for placing innovation at the center of his understanding of how capitalist economies grow and change over time. His work offers a vision of economic life that is fundamentally dynamic rather than static, one in which the engine of long-run development is not the efficient allocation of existing resources but the continuous introduction of new ideas, products, and ways of organizing production. His vision of the economic process was fundamentally evolutionary: not a system tending towards equilibrium but one characterized by continuous transformation driven from within by the creative activity of entrepreneurs and firms.

Schumpeter's starting point, elaborated in *The Theory of Economic Development* (originally published in German as *Theorie der wirtschaftlichen Entwicklung* in 1911 and translated into English in 1934), is a sharp distinction between static equilibrium and dynamic development. In a stationary economy, the circular flow of economic life reproduces itself unchanged: firms use given methods to produce given goods, prices and quantities settle into routine, and no development in the proper sense occurs. Development, by contrast, occurs when the circular flow is disrupted by the introduction of 'new combinations' — a concept that serves as Schumpeter's formal definition of innovation.

2.3.2 The Five Forms of Innovation: New Combinations

Schumpeter enumerates five canonical forms in which new combinations can manifest themselves, a taxonomy that retains its analytical purchase to this day. These are: the introduction of a new good or a new quality of an already existing good; the introduction of a new method of production; the opening of a new market; the conquest of a new source of supply of raw materials or half-manufactured goods; and the carrying out of a new organization of any industry, such as the creation or breaking up of a monopoly position (Schumpeter, 1934, pp. 65–66). This breadth of scope is significant: Schumpeter's concept of innovation is not limited to product or process technologies in a narrow engineering sense but encompasses market innovations, organizational innovations, and supply-chain innovations. This wide definition is particularly appropriate for understanding the evolution of industrial districts, where competitive advantage derives from configurations of the entire value chain, not merely from the sophistication of individual products.

Of particular relevance for the present study is the category of new methods of production, which maps closely onto Mokyr's concept of new prescriptive knowledge (λ). The introduction of numerical control in machine tools, the adoption of computer-aided design and manufacturing, the transition to digital monitoring and remote diagnostics in professional appliances — all represent new methods of production in Schumpeter's sense, derived from expansions in the relevant propositional knowledge bases. Equally relevant is the category of new organizational forms: the emergence of lean production, just-in-time logistics, modular product architectures, and platform-based business models all represent innovations in industrial organization that have reshaped the competitive dynamics of manufacturing industries.

2.3.3 The Entrepreneur as Agent of Creative Destruction

Central to Schumpeter's early model of innovation is the role of the entrepreneur — not in the sense of the owner-manager of everyday economic activity, but as an exceptional individual who perceives the opportunity latent in a new combination and possesses the energy, vision, and authority to overcome the resistance that any disruption of established routines encounters. Schumpeter famously argued that 'in general it is not the owner of stagecoaches who builds railways' (Schumpeter, 1934): the incumbents who benefit from existing technologies and market structures are typically the last to introduce the innovations that displace them. It falls to outsiders — new firms, new entrepreneurs, individuals without established stakes in the current order — to realize new combinations.

The mechanism by which new combinations create economic value and simultaneously destroy existing value is what Schumpeter, in *Capitalism, Socialism and Democracy* (1942), denominated 'creative destruction' (schöpferische Zerstörung). The process of continual transformation of the economic structure, Schumpeter argued, comes from within the system itself, continuously destroying existing structures and replacing them with new ones. Central to this process is the entrepreneur, who through his activity enables the mechanism of creative destruction and drives the technological and industrial progress of an economic system (Schumpeter, 1934; Buciuni, 2024). Creative destruction is thus not merely a metaphor for rapid change; it is a precise theoretical claim about the endogenous dynamics of capitalist development: innovation is the fundamental cause of both growth and structural change, and these two phenomena are inseparable.

The concept of creative destruction carries important implications for understanding long-run industrial dynamics. It implies that no technological or market position is permanently defensible; every competitive advantage is eventually eroded by the arrival of a new combination that renders existing technologies, products, or organizational forms obsolete. As the empirical literature on productivity documents, the link between

creative destruction and aggregate productivity growth is direct: productivity gains and markers of business dynamism such as firm entry and exit rates and job creation and destruction are deeply interconnected phenomena, two sides of the same underlying process (author, Finance & Development, IMF, September 2024). Conversely, a decline in creative destruction — measured by falling entry rates of new firms, reduced rates of job creation and destruction, and growing concentration among large incumbents — is associated with a slowdown in productivity growth.

2.3.4 Mark I and Mark II: Two Schumpeterian Regimes

As Schumpeter's thinking evolved from *The Theory of Economic Development* to *Capitalism, Socialism and Democracy*, a significant shift occurred in his view of where innovation comes from. In the earlier work, innovation is the prerogative of the individual entrepreneur operating in a competitive, atomistic market environment — what subsequent scholars have termed 'Schumpeter Mark I.' By the time of *Capitalism, Socialism and Democracy*, Schumpeter had observed the rise of the large industrial corporation and its in-house research and development laboratory and concluded that innovation was increasingly being 'routinised': systematically organized and produced by salaried engineers and scientists within large bureaucratic organizations — 'Schumpeter Mark II.' This distinction can be succinctly summarized as 'New entrepreneurship (Mark I) and oligopoly (Mark II).'

The Mark I/Mark II distinction has generated a large subsequent empirical literature on the sources of innovation across industries and phases of development. The two regimes are associated with different competitive dynamics: Mark I industries are characterized by high rates of firm entry and exit, small firms with short histories, and innovations that frequently originate outside the incumbent firms. Mark II industries are characterized by high barriers to entry, domination by a few large firms with established R&D capabilities, and innovations that are predominantly incremental refinements of existing designs.

Industrial clusters, with their high densities of small and medium-sized enterprises, typically exhibit Mark I characteristics in their early phases and may or may not transition towards Mark II as they mature.

The distinction is further complicated by the empirical finding, documented in contemporary research, that as large firms grow and dominate their markets, 'they often shift their focus from innovation to protecting their market position' (Akcigit, 2024). This dynamic — the 'leadership paradox' identified by Akcigit (2024) — implies that the very success of innovation can generate incumbency advantages that eventually suppress further creative destruction. The empirical literature on sectoral innovation patterns confirms that Mark I and Mark II industries exhibit systematically different competitive dynamics across industries and over time (Breschi, Malerba, & Orsenigo, 2000). Understanding whether and how industrial clusters in mature sectors manage to maintain the entrepreneurial dynamism of Mark I while leveraging the knowledge and resource advantages of Mark II is among the central analytical questions of this thesis.

2.3.5 Social Resistance, Distributional Conflict, and Institutional Conditions

A dimension of Schumpeter's framework that is sometimes underemphasized in standard treatments is his insistence on the social and political frictions that creative destruction generates. Innovation is not merely a technical process; it is a social process that redistributes rents and opportunities among existing actors, creating winners and losers. Those who benefit from existing technologies and market structures — the 'owner of stagecoaches' — have both the incentive and, in many cases, the political power to obstruct innovations that would displace them. Schumpeter identifies creative destruction and the social resistance to change as a fundamental feature of the innovation process (Schumpeter, 1942, pp. 81–86)

This observation has important institutional implications. For creative destruction to generate economic progress, the institutional framework must be capable of mediating

the distributional conflicts it creates, protecting the property rights of innovators, and maintaining competitive markets that allow innovative new firms to enter and displace incumbents. Innovation needs a favorable institutional environment, starting with strong protection of property rights, and requires a competitive environment so that innovative new firms can continuously enter and displace incumbents. The contemporary concept of 'productive entrepreneurship,' developed by William Baumol drawing on Schumpeter, captures this institutional dimension: it is the legal, regulatory, and normative environment that determines whether entrepreneurial energy is channeled into productive innovation, unproductive rent-seeking, or destructive activities (Baumol, 1990).

For industrial districts in traditional manufacturing sectors, the social dimension of creative destruction is particularly salient. The transition from analogue to digital technologies, from labor-intensive to capital-intensive production, from mass production to customization — each of these transitions has involved significant redistribution of rents and capabilities, generating resistance from incumbent firms, workers, and institutions invested in the old paradigm. The capacity of a district to navigate these transitions without succumbing to lock-in depends not only on the entrepreneurial initiative of individual firms but on the institutional arrangements — industrial relations systems, vocational training institutions, technical schools, local finance — that shape the social context of innovative activity.

2.3.6 Technological Waves and Long Cycles

A further dimension of the Schumpeterian tradition, elaborated by subsequent scholars building on his insights, concerns the temporal clustering of innovation into 'technological waves' or long cycles. Schumpeter himself was influenced by the Russian economist Nikolai Kondratiev, who identified approximately fifty-year cycles of economic activity associated with major clusters of radical innovations (Kondratiev, 1935). In Schumpeter's

interpretation, each Kondratiev wave is driven by a cluster of interconnected innovations that define a 'technological paradigm' — a set of dominant design principles, production methods, and organizational forms — around which an entire epoch of economic activity is organized.

The subsequent literature, particularly the work of Carlota Perez on 'techno-economic paradigms,' has developed this insight into a sophisticated account of how radical innovations diffuse through the economy (Perez, 2002). Each new paradigm initially creates turbulence and displacement as it disrupts existing industries; but as it matures and its organisational and institutional complements develop, it generates a new wave of sustained productivity growth. The history of capitalism can thus be read as a sequence of overlapping technological waves: the mechanization of the late eighteenth century, the age of steam and railways in the mid-nineteenth, the electrification and mass production of the early twentieth, the Fordist-Keynesian regime of the post-war decades, and the information and communication technology revolution of the late twentieth century (Perez, 2002). This periodization is also reflected in the representation of successive industrial revolutions from Industry 1.0 to Industry 5.0 adopted in contemporary industrial policy debates.

For the professional appliance industry, the technological wave framework provides a useful periodization. The sector's origins lie in the second industrial revolution (electrification and mechanical engineering); its mid-century expansion coincided with the Fordist wave of mass production; and its contemporary challenges are defined by the transition to the digital paradigm (Industry 4.0) and the emerging sustainability imperative. Creative destruction does not manifest uniformly across all technological transitions: the shift from mechanical to electro-mechanical designs, for instance, may require different organisational capabilities than the shift from electro-mechanical to digital-embedded systems. Firms and districts that possess the absorptive capacity to adapt their knowledge base to successive paradigm shifts are more likely to survive and

prosper; those locked into the prescriptive knowledge of an obsolete paradigm face displacement.

2.3.7 Creative Destruction and the Productivity Paradox

A particularly relevant contemporary application of Schumpeter's framework concerns the so-called 'productivity paradox' documented in advanced economies since the 1980s. Despite massive increases in R&D investment and spectacular advances in information and communication technologies, productivity growth has generally decelerated. Peters (2024) argues that changes in the process of creative destruction and reallocation across businesses may hold the key to understanding this slowdown. The entry rate of new firms in the United States fell from 13 percent in 1980 to 8 percent in 2018; older and larger companies now account for a much greater share of economic activity, and there is evidence that dominant firms increasingly invest in defending their market position rather than in genuine innovation (Peters, 2024; Akcigit, 2024).

From a Schumpeterian perspective, this decline in business dynamism represents a weakening of the creative destruction mechanism, with direct consequences for aggregate innovation and productivity growth. The data on creative destruction measured by job creation and destruction or enterprise birth and death rates show a positive correlation with GDP per capita growth across European regions, confirming the empirical importance of the mechanism that Schumpeter theorized. For the industrial clusters of North-East Italy, the question of whether the local entrepreneurial ecosystem maintains sufficient dynamism — sufficient rates of firm entry, exit, and knowledge recombination — to sustain productive creative destruction is thus not merely of academic interest but has direct policy relevance.

2.4 Putting the Frameworks in Dialogue: A Synthetic Perspective

2.4.1 Two Analytical Levels of the Same Inquiry

Within the shared evolutionary framework established in Section 2.1, Mokyr's useful knowledge framework and Schumpeter's theory of creative destruction operate at different but interlocking analytical levels. Schumpeter identifies the economic and competitive dynamics of innovation — who innovates, why they do so, what happens to incumbents, and how innovation cycles generate long-run growth — but treats the content of technological change as largely given. Mokyr, conversely, provides a detailed account of the epistemic architecture of technology — what kinds of knowledge underlie innovation, how they relate to one another, and how their organization and diffusion shape the rate and direction of technological change — but says relatively little about the competitive and entrepreneurial dynamics through which new knowledge is translated into market outcomes.

Their combination provides a more comprehensive account than either offers alone. From Schumpeter, we derive the understanding that innovation is driven by entrepreneurial profit-seeking, is inherently disruptive of established economic arrangements, and unfolds in waves shaped by the temporal clustering of radical innovations. From Mokyr, we derive the understanding that the possibility space of innovation is defined by the available knowledge base, that access to knowledge is a fundamental determinant of innovative capacity, and that the institutional arrangements governing knowledge production and diffusion are as important as property-right protection in shaping long-run technological trajectories. Together, the two frameworks imply that sustainable industrial competitiveness depends both on the capacity to generate and access new knowledge (Mokyr) and on the institutional conditions that allow innovative firms to enter, grow, and displace incumbents without being suppressed by social and political resistance (Schumpeter).

2.4.2 The Knowledge-Innovation Nexus in Industrial Clusters

The synthesis of Mokyr and Schumpeter offers a particularly productive analytical lens for industrial clusters. A cluster can be understood, in Mokyr's terms, as a social infrastructure for reducing access costs to both propositional and prescriptive knowledge: the co-location of skilled workers, engineers, scientists, and entrepreneurs creates a dense network of personal contacts through which tacit knowledge flows, while shared institutions (technical schools, industry associations, chambers of commerce) lower the costs of accessing codified knowledge. This social infrastructure raises the local rate of recombination and thereby the local rate of innovation.

At the same time, in Schumpeterian terms, a cluster is a competitive ecosystem in which creative destruction operates at relatively high intensity: the density of firms and entrepreneurs, the availability of specialized labor and suppliers, and the reduced costs of market entry created by dense local networks all tend to sustain the business dynamism that Schumpeter identified as the engine of growth. Local knowledge spillovers — the unintentional diffusion of knowledge from innovators to neighboring firms — amplify the productivity of innovative investment, creating agglomeration benefits that attract further investment and skilled labor.

The dynamic interplay between the two frameworks also illuminates the vulnerability of clusters to lock-in. Drawing on Grabher's (1993) analysis of the Ruhr area, a cluster that has developed a highly integrated and efficient knowledge infrastructure around a particular technological paradigm may find it difficult to adapt when the relevant epistemic bases shift: the very density of social networks that sustains knowledge circulation within the established paradigm can become, in Grabher's terms, a 'weakness of strong ties,' blinding cluster members to emerging technological opportunities and inhibiting diversification. This rigidity is further reinforced by the mechanisms of path dependence identified by David (1985) and Arthur (1989): once a cluster's institutions, skills, and supplier networks are aligned around a given technological trajectory, the increasing returns to staying on that path make cognitive and institutional reorientation costly, even

when the trajectory is becoming obsolete. In Schumpeterian terms, this corresponds to the risk that incumbent firms and their political allies will use their market and institutional power to suppress the creative destruction that would allow new entrants with knowledge of the emerging paradigm to displace them (Schumpeter, 1942).

Overcoming this risk requires maintaining what Frenken, Van Oort, and Verburg (2007) call 'related variety' — the capacity of a cluster to develop competences in technologically adjacent domains, close enough to the established specialisation to leverage existing knowledge, yet sufficiently distinct to open new trajectories when the current paradigm becomes obsolete. The 'adaptive cycle' model of industrial evolution, developed by Martin and Sunley (2011), captures this dynamic: clusters that can enter a reorganisation phase — drawing on the knowledge and institutions of the existing paradigm to explore new technological directions — are more likely to renew themselves than those locked into a rigid path.

2.4.3 Analytical Framework for the Empirical Chapters

The synthesis of Mokyr and Schumpeter establishes the analytical architecture that will guide the empirical analysis of the subsequent chapters. The central questions that this framework generates for the case study of the Conegliano-Treviso professional appliance industry are the following. First, what has been the evolution of the relevant propositional knowledge bases (Ω) over the history of the sector, and how have shifts in these bases altered the prescriptive frontier (λ) available to firms? Second, how have access costs to the relevant knowledge bases evolved, and what role have local institutions (technical schools, industry associations, University of Padua and Ca' Foscari) played in maintaining favorable access conditions? Third, in Schumpeterian terms, what episodes of creative destruction has the district experienced, and how have the dynamics of firm entry, exit, and knowledge recombination shaped its competitive trajectory? Fourth, what are the social and institutional conditions that have either

facilitated or resisted creative destruction, and how have distributional conflicts over the rents generated by technological leadership been managed? Finally, what are the prospects for the district's current adaptation to the digital and sustainability transitions, assessed through both the Mokyrrian lens of epistemic base evolution and the Schumpeterian lens of entrepreneurial and institutional dynamics?

2.5 Methodological Reflections

The adoption of these two theoretical frameworks has direct methodological implications for the empirical analysis. Both Mokyr and Schumpeter are historically minded theorists who emphasize the importance of understanding economic phenomena in their temporal and institutional context; both resist purely formal modelling in favor of what Nelson and Winter (1982) call 'appreciative theorizing' — a mode of analysis that stays close to the complexity of historical and institutional processes rather than abstracting from them into formal models. This methodological orientation is congruent with the case-study approach adopted in this thesis, which draws on qualitative evidence — historical documents, industry reports, company histories, interview data — alongside quantitative indicators of economic performance and innovative activity.

The Mokyrrian framework directs particular attention to the history of knowledge in the sector: to the scientific and technical developments that have periodically redefined the frontier of the technologically possible, to the diffusion channels through which new knowledge has been absorbed by local firms, and to the role of local institutions in managing knowledge access. This calls for engagement with technical and industrial histories of the sector, as well as with the literature on knowledge spillovers and industrial districts.

The Schumpeterian framework, by contrast, directs attention to the competitive and entrepreneurial dynamics of the sector: to the identification of episodes of creative destruction, to the entry and exit patterns of firms, to the role of exceptional

entrepreneurs in introducing radical innovations, and to the institutional conditions — labor market, finance, regulation, industrial relations — that have shaped the innovative environment. This calls for engagement with business histories, firm-level data, and the literature on industrial evolution and cluster lifecycles.

Together, the two lenses produce a multi-dimensional account of industrial change that neither pure economic history nor standard industrial organization would generate alone. The empirical chapters will not apply the frameworks mechanically but will use them as heuristic guides.

2.6 Conclusion

This chapter has presented and elaborated the two principal theoretical frameworks that will guide analysis of the cluster in the following chapters. Mokyr's framework of useful knowledge provides the analytical tools to understand how the evolution of propositional knowledge bases opens and closes possibilities for prescriptive innovation, how access costs shape the distribution of innovative capacity across firms and territories, and how social infrastructure can amplify the productivity of innovative effort. Schumpeter's theory of creative destruction and innovation cycles provides the tools to understand how entrepreneurial agency translates knowledge possibilities into market realities, how creative destruction reshapes industrial structures over time, and how institutional conditions either facilitate or obstruct the renewal of industrial systems.

The synthesis of these two frameworks generates a set of analytical questions that will organize the next chapters: questions about the evolution of epistemic bases and access costs in the professional appliance sector; about episodes and mechanisms of creative destruction; about the social and institutional conditions of innovative activity; and about the prospects for adaptation to new technological paradigms. Before turning to these empirical questions, the next chapter places the theoretical analysis in its empirical

context by providing a profile of the Conegliano-Treviso district and the professional appliance industry it hosts.

CHAPTER 3. The Inox Valley: Historical Background and Industrial Overview

3.1 Introduction

The preceding chapters have established the conceptual architecture that will guide this thesis: a theoretical framework built on Mokyr's epistemology of useful knowledge and Schumpeter's theory of creative destruction, deployed to understand how industrial clusters emerge, consolidate, and adapt to successive technological paradigm shifts. Before this framework can be applied analytically, however, it is necessary to introduce the object of study — to provide, in other words, a structured overview of the cluster under examination.

This chapter describes the Inox Valley, the stainless-steel industrial cluster concentrated in the area between Conegliano and Treviso in the north-east of Italy. The chapter proceeds from the general to the specific. It opens with a brief account of Italy's manufacturing system and the role that specialized industrial districts play within it, situating the Inox Valley within the broader national industrial landscape. It then narrows its focus progressively: to the Veneto region, to the Treviso province, and finally to the cluster itself. The chapter traces the cluster's origins in the 1950s, documents its chronological evolution through a series of identifiable phases, describes its current industrial structure and economic weight, and concludes by identifying the shared knowledge base — stainless steel processing and related mechanical engineering competences — that underpins the cluster's diversity and gives it analytical coherence as a unit of study.

All information presented in this chapter draws on the following primary sources: the *Libro Bianco dell'Industria degli Apparecchi Domestici e Professionali* (Pontarollo, Martelli and Prandini, 2002), the statistical report *Elettrodomestici ed Inox di Conegliano*

e del Trevigiano (Camera di Commercio Treviso-Belluno, 2022), the industry study *La filiera della ristorazione in Italia* (The European House – Ambrosetti/EFCEM, 2024), and the historical account *Le due zeta dall'alba al tramonto* (Salvador, 2020), which reconstructs the origins of the Zoppas and Zanussi groups and the entrepreneurial ecosystem they generated.

3.2 Italy's Manufacturing System and the Role of Industrial Districts

Italy is one of the largest manufacturing economies in Europe and one of the most distinctive in terms of its industrial organization. While other advanced economies have seen manufacturing become increasingly concentrated in large corporations or relocated to lower-cost countries, Italy has maintained a substantial and internationally competitive manufacturing base built largely on networks of small and medium-sized enterprises clustered in specialized territories. According to ISTAT census data, Italian industrial districts in 2011 counted 141 clusters representing approximately 24.5 percent of total productive units and employment, with manufacturing employment in district territories accounting for over one third of total Italian manufacturing employment (ISTAT, 2011). More recent data from Intesa Sanpaolo (2025) confirm that this share has remained stable, with district manufacturing employment rising from 21.3 to 24 percent of total manufacturing between 2011 and 2023, while district exports reached a record 153 billion euros in 2022.

This form of territorial industrial organization, as noted in the first chapter, has its intellectual origins in the work of Alfred Marshall, who first identified the external economies generated by the geographical concentration of related firms — the shared labor market, the thick markets for specialized inputs, and above all the diffusion of what he famously called 'industrial atmosphere': the tacit knowledge, practices, and skills that circulate within a localized industrial community and which collectively constitute a source of competitive advantage unavailable to isolated firms (Marshall, 1919). Giacomo

Becattini, the Italian economist who revived and formalized the Marshallian district concept in the 1970s and 1980s, emphasized that the Italian district was not merely an economic organization but a socio-territorial community, in which productive relationships were embedded in shared cultural values, family ties, and local institutions (Becattini, 1987).

Italy's industrial districts cover an extraordinary range of specializations: some examples are textiles and clothing (Prato, Carpi, Biella), ceramics and tiles (Sassuolo), furniture and wood products (Brianza, Livenza), mechanical engineering and machine tools (Brescia, Bologna, the Motor Valley of Modena and Reggio Emilia), eyewear (Belluno), footwear and leather goods (the Marche, Brenta), and household and professional appliances (the Veneto–Friuli corridor, Fabriano). What unites these very different specializations is a common structural logic: a dense network of inter-firm relationships organized around a shared technical knowledge base, sustained by a local labor market rich in specialized skills, and governed by a combination of market competition and cooperative norms that generates what Porter (1998) calls the 'diamond' of competitive advantage at the local level.

The Veneto region is one of Italy's most significant industrial district territories. Italian industrial districts as a whole represent a substantial share of the country's manufacturing base: the analysis of approximately 22,700 district firms conducted by Intesa Sanpaolo (2025) documents total revenues of 344 billion euros in 2023, with exports reaching a record 163.4 billion euros in 2024 and a trade surplus exceeding 100 billion euros — figures that confirm the structural weight of the district model in the Italian economy. Within this national picture, Veneto stands out as the second region by number of high-performing district firms, with 268 so-called 'champion' enterprises, behind only Lombardia (Intesa Sanpaolo, 2025). Veneto district exports alone reached 33.2 billion euros in 2024, accounting for approximately one fifth of total Italian district exports (Intesa Sanpaolo, 2024). The prevalence of SMEs is a defining feature of the region's productive structure (OECD, 2021), and the localization advantages typical of Italian districts —

including the diffusion of professional competences, the presence of training institutions and research centres, and the proximity of supply chain networks — are particularly well developed in the Veneto manufacturing system (Intesa Sanpaolo, 2025).

Buciuni (2024) documents how the Veneto's manufacturing trajectory has in recent decades been shaped by the twin pressures of globalisation and technological change, with a significant contraction in the number of manufacturing firms: between 2012 and 2022 alone, the province of Treviso lost 1,444 manufacturing firm headquarters, representing a decline of approximately 9 percent of its manufacturing base, with the heaviest losses in fashion, wood-furniture, and metalworking (Buciuni, 2024). Yet despite these pressures, the core of the Veneto's specialized industrial clusters has proven resilient, and the Inox Valley is among its most significant examples.

3.3 Territorial Boundaries and Institutional Recognition

The Inox Valley is a stainless-steel industrial cluster located in the north-east of Italy, concentrated primarily in the province of Treviso in the Veneto region. Its geographic core lies in the corridor between Conegliano and Vittorio Veneto, the two towns that gave the cluster its functional identity, with a significant secondary pole in the city of Treviso itself and its surrounding municipalities.

The cluster's official territorial boundaries are defined by the Delibera della Giunta Regionale del Veneto n. 2415/2014 (DGRV 2415/2014), which formally recognised the district and delimited its perimeter to 33 municipalities in the province of Treviso, including: Breda di Piave, Cappella Maggiore, Carbonera, Casale sul Sile, Cimadolmo, Colle Umberto, Conegliano, Cordignano, Gorgo al Monticano, Mareno di Piave, Monastier di Treviso, Oderzo, Ponte di Piave, Ponzano Veneto, Povegliano, Refrontolo, San Biagio di Callalta, San Fior, San Pietro di Feletto, San Vendemiano, Santa Lucia di Piave, Sernaglia della Battaglia, Silea, Susegana, Treviso, Vazzola, Vittorio Veneto, Fossalta di Piave, Meolo, Musile di Piave, Noventa di Piave, San Donà di Piave, and

Torre di Mosto (Camera di Commercio Treviso-Belluno, 2022). The productive activities of the cluster, however, extend beyond this formal perimeter into adjacent municipalities of the provinces of Belluno and Pordenone, which are not formally included in the district boundary but are functionally integrated into its supply chain.

The denomination 'Inox Valley' — a name that evokes Silicon Valley while anchoring the cluster's identity in its material specialisation — refers specifically to the concentration of stainless-steel processing firms in the Conegliano–Vittorio Veneto corridor. The term 'inox' (from the French 'inoxydable', meaning rustproof) has become synonymous with the cluster's identity: stainless steel is the primary material used in the production of household appliances, professional food equipment, and the full range of related products that emerge from the area. The material is valued in these applications for its combination of hygienic properties, durability, and aesthetic finish — qualities that are particularly critical in the professional kitchen and food processing environment, where regulatory compliance with hygiene standards such as HACCP is mandatory (Pontarollo, Martelli and Prandini, 2002).

The name also reflects a broader truth about the cluster's competitive advantage: it is grounded not in a single product but in a shared material competence. The Inox Valley is, in analytical terms, a knowledge community organized around the processing of stainless steel and the mechanical, thermal, and electrical engineering knowledge that surrounds it. Different firms within the cluster apply this shared competence to different end markets — domestic appliances, professional food equipment, air conditioning, components manufacturing — but they draw on the same epistemic base and the same pool of specialized labor, suppliers, and tacit knowledge. This is what gives the cluster its analytical unity and what justifies treating it as a single object of study, rather than as a collection of unrelated industries that happen to share a postcode.

3.4 Origins and Formation: The Zoppas Engine and the Spin-Off Mechanism

3.4.1 The Zoppas Group and the Birth of the White Goods Industry

The origins of the Inox Valley cluster lie in the industrial history of the Zoppas family, whose manufacturing activities in the area around Conegliano date back to the early twentieth century. The Zoppas brothers — Gino, Lino, and Ferdinando — established their workshop in the 1920s, initially producing kitchen ranges and heating appliances. Their first major product innovation came in 1930 with the development of a lightweight economic kitchen stove, the 'Augusta', which replaced the traditional heavy cast-iron frame with pressed sheet metal from recycled oil drums, making the product both cheaper and significantly lighter. This innovation illustrates, even at this early stage, the characteristic combination of material ingenuity and practical entrepreneurship that would define the cluster's identity for the following decades (Salvador, 2020).

The post-war decades marked a decisive acceleration. The establishment of the European Economic Community in 1957 and the consequent elimination of tariff barriers opened new export markets and stimulated production growth across the Italian appliance industry. The Zoppas group responded by dramatically expanding its manufacturing capacity, building new facilities along Via Cesare Battisti in Conegliano and launching new product lines — refrigerators, washing machines, gas cookers — that defined the white goods sector of the Italian economic miracle. By the 1950s and 1960s, the Zoppas factories had become the largest employers in the area, with thousands of workers trained in the specific skills of sheet metal fabrication, stainless steel processing, electro-mechanical assembly, and quality inspection that the production of modern household appliances required (Salvador, 2020).

It was precisely this concentration of skilled industrial labor that created the conditions for what would become the cluster's defining formation mechanism: the spin-off process through which former Zoppas workers became independent entrepreneurs.

3.4.2 The Spin-Off Mechanism: How Workers Became Entrepreneurs

The Inox Valley's emergence as an industrial cluster is a textbook illustration of Schumpeter's creative destruction operating at the territorial level. The growth of the Zoppas group created a large pool of technically skilled workers, many of whom acquired deep knowledge of specific production processes — inox sheet metal fabrication, die and mold making, electrical resistance manufacturing, plastic component production — that were potentially valuable outside the walls of the parent company.

The mechanism that activated this potential was a deliberate strategy adopted by Zoppas and, later, by Zanussi: rather than internalizing all production stages, the large firms began externalizing the more specialized or costly phases to newly established external suppliers, actively encouraging their most capable and entrepreneurially minded workers to set up their own workshops. The relationship between the large firms and their new suppliers was governed, at least initially, not by formal contracts but by tacit agreements — often sealed with nothing more than a handshake — through which the parent company guaranteed a minimum volume of orders sufficient to sustain the new venture in its early years (Salvador, 2020).

The historical record documents numerous individual cases that illustrate this process. Pietro Barazza, hired at Zoppas in 1943, left in 1959 to found Fratelli Barazza in Santa Lucia di Piave, initially as a Zoppas supplier, later specializing in built-in appliances and bespoke kitchens. Luigi Ongaro, who had worked at Zoppas, founded Mareno Cucine in 1961, subsequently establishing GICO in Vazzola for the production of professional catering kitchens. Orfeo Saccol, after thirteen years at the Conegliano plant, opened a precision mechanics workshop in Pieve di Soligo supplying moulds to Zoppas. The Gianfranco Zoppas family, following the sale of the Zoppas brand to Zanussi in 1970, retained a small factory in San Vendemiano producing heating resistances under the IRCA brand, which grew over the following decades into a global leader in its segment (Salvador, 2020).

The motivations driving workers to become entrepreneurs, as documented through interviews in the historical sources, were a combination of passion for the craft, ambition, and the desire for economic and organisational autonomy. The initial barriers — access to finance, establishing a client base — were real but manageable, precisely because the anchor firms provided an initial guaranteed demand. This combination of market opportunity, tacit knowledge transfer, and institutional support from the parent firms created what the cluster literature would recognize as a classic Mark I Schumpeterian environment: high rates of entrepreneurial entry, small firms with recent founding dates, and innovations driven by individuals departing from the established industrial order (Schumpeter, 1934; Breschi, Malerba and Orsenigo, 2000).

3.4.3 The Parallel Role of Zanussi

The formation of the Inox Valley cluster cannot be understood without reference to the parallel and, in many respects, complementary role played by the Zanussi group, headquartered in Pordenone but with significant productive and supply chain activities in the Treviso area. Founded by Antonio Zanussi in the early twentieth century, the group grew in the post-war decades into one of Europe's major white goods producers, developing particularly strong capabilities in washing machines and refrigerators. The acquisition of the Zoppas group by Zanussi — a process completed in the early 1970s following the financial difficulties that had resulted from Zoppas's ill-fated acquisition of the Triplex company of Solaro — effectively united the two largest anchors of the local industrial ecosystem under a single corporate structure, and subsequently under the Swedish Electrolux group following Electrolux's acquisition of Zanussi in 1984 (Pontarollo, Martelli and Prandini, 2002; Salvador, 2020).

What is analytically significant about the Zanussi–Zoppas relationship for the purposes of understanding the cluster is that it was precisely this corporate consolidation — which might appear to represent a contraction of the local entrepreneurial ecosystem — that in

fact accelerated the spin-off process. The rationalization of production that followed the Electrolux acquisition pushed the group towards greater externalization of non-core activities, generating new opportunities for independent suppliers. Simultaneously, many former Zoppas and Zanussi managers and engineers, freed from the constraints of large corporate bureaucracy, channeled their technical knowledge and entrepreneurial energy into new ventures. The Libro Bianco (Pontarollo, Martelli and Prandini, 2002) notes explicitly that the industrial activity in the Veneto–Friuli corridor was substantially ‘invented’ by Italian producers — particularly Zoppas — through the transformation of tailor-made artisanal production into standardized industrial output. This transition, driven by the division professional of Zoppas which introduced the first modular and combinable professional kitchen equipment, created an entirely new product category and market segment in Europe.

3.5 Chronological Evolution: Four Phases of Cluster Development

For the purposes of this analysis, the history of the Inox Valley is organized into four broad phases, each corresponding to a distinct technological and competitive context. This periodization is proposed as an interpretive framework to structure the available historical evidence, rather than as an exhaustive account of the cluster's development.

3.5.1 Phase I: Industrial Foundation (1950s–1970s)

The first phase covers the period from the early post-war years to the mid-1970s, and is characterized by the rapid industrialization of the area around Conegliano driven by the Zoppas group's expansion into white goods manufacturing. This is the phase of cluster formation: the emergence of the anchor firms, the accumulation of a specialized labor force, the beginning of the spin-off process, and the gradual constitution of a supplier ecosystem. The technological paradigm of this phase is electro-mechanical: the core

products — gas and electric cookers, refrigerators, washing machines — are based on relatively mature mechanical and electrical engineering principles, and the competitive advantage of the Italian producers lies primarily in their ability to achieve high-volume standardized production at low cost, leveraging the newly integrated European market. The professional food service equipment segment emerges during this same period as a significant secondary specialisation. The Zoppas divisione professionale, later absorbed by Zanussi, introduced the key product innovation that defined the European market for professional catering equipment: modular, combinable kitchen equipment that could be adapted to the needs of different clients — from small restaurants to large institutional catering operations — without the bespoke production costs associated with artisanal manufacturing. This innovation, as the Libro Bianco (Pontarollo, Martelli and Prandini, 2002) documents, was substantially an Italian invention, and it established the Italian — and specifically the north-east Italian — producers as the dominant force in the European professional kitchen equipment market.

3.5.2 Phase II: Crisis, Consolidation and Diversification (1970s–1990s)

The second phase is marked by a series of structural shocks that transformed the cluster's configuration. The first was the financial crisis and subsequent absorption of Zoppas by Zanussi in the early 1970s, which effectively ended the independent existence of the cluster's founding anchor firm. The second was the Electrolux acquisition of Zanussi in 1984, which integrated the local productive base into a global Swedish multinational and subjected it to the rationalization pressures characteristic of large-scale corporate restructuring. Employment at the large plants was reduced substantially through successive waves of restructuring: between 1997 and 2001 alone, Electrolux reduced its total global workforce from 106,000 to 87,000 employees (Pontarollo, Martelli and Prandini, 2002).

Paradoxically, however, the very pressures that contracted employment at the anchor firms accelerated the growth of the independent SME network. The large firms' strategy of externalizing non-core production activities created a sustained demand for specialized suppliers, while the redundant workers and managers released by successive restructurings constituted a reserve of entrepreneurial talent and tacit knowledge available to the cluster. The result was a proliferation of small and medium-sized firms specializing in specific niches within the broader stainless-steel and appliance ecosystem: component manufacturers, die and mold makers, precision engineering workshops, industrial design studios, and specialized producers of niche products such as professional refrigeration equipment, coffee machines, and air conditioning units.

This phase also saw the beginning of the cluster's internationalization. Facing increasing competitive pressure from lower-cost producers — initially from other European countries, subsequently from Asia — the most dynamic cluster firms began investing in export markets and, in some cases, in production facilities abroad. The Gruppo Zoppas Industries (heir to the original family through IRCA and SIPA) established production in Romania, a country that by 2007 hosted an estimated 15,000 Italian firms and was sometimes described as 'the eighth province of the Veneto' (Salvador, 2020). This offshoring of labor-intensive production was not a retreat from manufacturing but a strategic repositioning: by externalizing the most commoditized phases of production, cluster firms were able to concentrate their local resources on the higher-value activities — product design, precision engineering, final assembly, quality control, and after-sales service — that sustained their competitive advantage.

3.5.3 Phase III: Maturation and the Rise of Food Service Equipment (1990s–2010s)

The third phase, covering roughly the two decades from the mid-1990s to the mid-2010s, is characterized by the maturation of the cluster's structure and the consolidation of professional food service equipment as its most dynamic and internationally visible specialisation. The white goods segment, dominated by large multinationals such as

Electrolux–Zanussi and De’Longhi, remained an important source of employment and supply chain activity in the area, but its growth dynamics were constrained by the intense price competition and production rationalisation characteristic of mature consumer durables markets.

The professional food service equipment segment, by contrast, offered a more favorable competitive environment for the cluster’s characteristic strengths: product customization, technical sophistication, strong relationships with professional end-users, and export orientation. Italian producers came to account for approximately one quarter of the European professional food equipment market, estimated at around 3.165 billion euros in the early 2000s (Pontarollo, Martelli and Prandini, 2002). The Italian production was valued at approximately 800 million euros and was characterized by extreme productive fragmentation: numerous firms with turnovers rarely exceeding 25 million euros, a strong propensity to export, and a wide range of specialized product segments. The main Italian producers were concentrated in the Veneto–Friuli corridor along the Conegliano–Pordenone axis, with secondary concentrations in the Milan area and in the Emilia-Romagna provinces of Reggio Emilia, Modena, and Bologna (Pontarollo, Martelli and Prandini, 2002).

This phase also saw the consolidation of two large groups — ALI and Electrolux Professional — as the dominant players in the Italian professional equipment market, operating on a logic of broad market coverage, alongside a dynamic layer of highly specialized mid-sized firms — including Baron Cucine, Frimont, Irinox, and Afinox — that were building significant export positions in specific product niches (Pontarollo, Martelli and Prandini, 2002).

3.5.4 Phase IV: Digital Transition and Sustainability Challenges (2010s–present)

The fourth and current phase is defined by the convergence of two major transformation drivers that are reshaping the competitive dynamics of the cluster: the digital transition

associated with Industry 4.0, and the sustainability imperative driven by energy efficiency regulations, circular economy requirements, and the growing environmental awareness of professional end-users.

The digital transition has introduced new product categories — connected appliances, smart kitchen equipment, machines with embedded diagnostics and remote monitoring capabilities — and has simultaneously transformed production processes through the adoption of automation, robotics, and digital supply chain management. This transition requires cluster firms to develop new epistemic bases — in software engineering, digital connectivity, sensor technology, and data analytics — that extend well beyond the traditional stainless steel and mechanical engineering competences on which the cluster's competitive advantage was originally built (The European House – Ambrosetti/EFCEM, 2024).

The sustainability imperative is equally demanding. Professional food equipment is an energy-intensive product category: commercial ovens, dishwashers, refrigeration units, and food preparation machines collectively account for a significant share of the energy consumption of the hospitality and food service sectors. The Ambrosetti-EFCEM report (2024) notes that the HoReCa sector in Italy is responsible for approximately 27 percent of food waste, and that modern professional appliances equipped with the best available technologies can play a significant role in reducing this waste through more precise temperature control, programmable cooking cycles, and advanced preservation technologies. This positions the cluster's products at the intersection of environmental regulation, energy efficiency investment, and food waste reduction policy — a strategic space that creates both competitive opportunities and significant product development challenges.

These two transformation drivers will be examined in greater analytical detail in the chapters that follow. For the purposes of this profile chapter, it is sufficient to note that they represent the most significant challenge to the cluster's competitive position since the corporate restructurings of the 1970s and 1980s, precisely because they require not

merely incremental improvement of existing products but a genuine expansion of the cluster's knowledge base into new epistemic territories.

3.6 The Industrial Structure of the Cluster Today

3.6.1 Firm Count and Employment

The most recent comprehensive statistical picture of the Inox Valley cluster is provided by the Camera di Commercio Treviso-Belluno (2022), which analyzed firm and employment data from the Infocamere business register as of 31 December 2022, covering the territorial perimeter defined by the DGRV 2415/2014.

Considering the core sectoral definition of the district — firms classified under ATECO code 27.5 (Fabbricazione di apparecchi per uso domestico, i.e., manufacture of domestic appliances) — the cluster contained 32 active firm headquarters, all located within the province of Treviso, together with 23 dependent production and/or distribution units, of which 20 were in the Treviso area. These units together employed approximately 3,900 workers (Camera di Commercio Treviso-Belluno, 2022).

The cluster's productive scope, however, extends well beyond domestic appliances in the strict sectoral sense. The broader food service equipment and related manufacturing activities — classified under ATECO codes 28.25 (Manufacture of non-domestic cooling and ventilation equipment) and 28.93 (Manufacture of machinery for food, beverage and tobacco processing) — add a further 77 firm headquarters and 49 dependent units, predominantly in the Treviso area, employing over 3,100 additional workers. In total, the district as thus comprehensively defined comprised 181 active local units employing approximately 7,000 workers in 2022 (Camera di Commercio Treviso-Belluno, 2022).

Sectoral Category	ATECO Code	Active Units	Employees (approx.)
Domestic appliances	27.5	55	3,896
Non-domestic refrigeration & ventilation	28.25	36 + 24	822
Food, beverage & tobacco machinery	28.93	90 + 53	2,279
Total district	—	181 + 109	~7,000

Table 3.1 — Industrial structure of the Inox Valley district (31 December 2022). Source: Camera di Commercio Treviso-Belluno (2022), elaboration on Infocamere data.

These figures, while significant in themselves, do not fully capture the cluster's economic footprint, for two reasons. First, they represent a snapshot of the formally registered cluster perimeter and do not include the many supply chain firms — component manufacturers, mold and die makers, logistics providers, engineering consultancies — that are functionally integrated into the cluster but classified under different sectoral codes or located in adjacent territories. Second, as the Camera di Commercio (2022) notes, Intesa Sanpaolo's analysis of a sample of 164 company financial statements from the sector recorded a total turnover for 2021 of over 6.3 billion euros, growing by 9.5 percent compared to 2019 — a figure that reflects the consolidated economic weight of the entire productive system associated with the cluster, including its larger anchor firms.

3.6.2 Size Structure and the Role of Large Firms

The industrial structure of the Inox Valley combines, in characteristic Italian district fashion, a layer of large and medium-sized anchor firms with a dense network of small

and specialized suppliers. The large firms provide the cluster with market access, brand recognition, product development resources, and international distribution networks; the small and medium suppliers provide flexibility, specialized competences, and the competitive dynamism that sustains the cluster's capacity for innovation.

Among the most significant large firms with a productive or corporate presence in the cluster are Electrolux Professional, with facilities in the Pordenone–Treviso corridor and historically rooted in the Zoppas–Zanussi tradition; De'Longhi, headquartered in Treviso with production facilities in Mignagola and Gorgo al Monticano; and Electrolux Zanussi, with its major refrigerator and freezer plant in Susegana. The professional equipment segment is characterized by a greater fragmentation: alongside the two large groups — ALI and Electrolux Professional — a large number of mid-sized and specialized firms operate with strong export positions in specific product niches, including professional refrigeration, blast chilling, combi ovens, dishwashing, and coffee equipment (Pontarollo, Martelli and Prandini, 2002).

The supply chain layer of the cluster includes firms specialized in the production of mechanical components (stamped and cut sheet metal, welded assemblies), electrical components (heating elements and resistances, electric motors), plastic components (injection molded parts, insulation foams), and industrial moulds and dies. Many of these firms originated as Zoppas or Zanussi suppliers and have, over the decades, diversified their client base far beyond the original anchor firm, supplying producers in different sectors and different countries. This trajectory of emancipation from the anchor firm — described explicitly in the Camera di Commercio (2022) report — is itself a form of related variety (Frenken, Van Oort and Verburg, 2007): the knowledge and capabilities developed in serving the appliance producers were progressively redeployed in adjacent application domains, broadening the cluster's economic base without abandoning its material and technical foundation.

3.7 Economic Performance and International Positioning

The economic performance of the Inox Valley cluster is best assessed through the lens of its export data, which reflect both the international competitiveness of its products and the depth of its integration into global value chains.

The province of Treviso is the leading Italian province for the export of household and professional appliances, accounting for 21.5 percent of total Italian national appliance exports in 2022 — a share that underscores the extraordinary geographical concentration of competitive production in this relatively small territory. In absolute terms, appliance exports from the province reached approximately 1.47 billion euros in 2022, a slight decline of 1.9 percent compared to 2021 following two years of strong growth in 2020 and 2021 (Camera di Commercio Treviso-Belluno, 2022).

The geographical distribution of exports reflects the cluster's predominantly European market orientation, while also demonstrating significant penetration of non-European markets. Approximately two thirds of 2022 exports were destined for the European Union, with Germany as the leading destination at 287 million euros (19.5 percent of total exports), followed by France at 128 million euros (8.7 percent). Among non-EU markets, the United States represented 6.5 percent and the United Kingdom 4.9 percent of total exports. Notably, American exports grew significantly (+22.9 percent on 2021), while exports to the United Kingdom declined (-4.7 percent), reflecting the continuing disruptions associated with Brexit on supply chains and distribution networks. The most dramatic movement was the collapse of Russian exports (-74.3 percent year-on-year), a consequence of the international sanctions imposed following the invasion of Ukraine in February 2022 (Camera di Commercio Treviso-Belluno, 2022).

Destination Market	Value (EUR million, 2022)	Share (%)	Change vs. 2021
Germany	287	19.5%	n.a.
France	128	8.7%	n.a.
United States	~96	6.5%	+22.9%
United Kingdom	~72	4.9%	-4.7%
China & Hong Kong	n.a.	n.a.	-12.3%
Russia	n.a.	n.a.	-74.3%

Table 3.2 — Principal export destinations for Treviso province appliance exports (2022).

Source: Camera di Commercio Treviso-Belluno (2022), provisional data.

At the level of the broader Italian professional appliance industry, the TEHA report (2024) provides a complementary picture. Italy is the leading European producer of professional food service equipment: Italian manufacturers, predominantly located in the north-east and particularly in the Inox Valley area, account for a dominant share of the European market. The extended restauration supply chain in Italy — encompassing professional equipment manufacturers, food service operators, distributors, and related service providers — generated 1.9 million jobs in 2022, a figure that places it significantly above comparable manufacturing sectors such as the agri-food industry (1.4 million), textiles and clothing (470,000), and furniture (425,000) (The European House – Ambrosetti/EFCEM, 2024).

The financial performance of cluster firms in the most recent period has been broadly positive, despite the disruptions of the Covid-19 pandemic and the geopolitical turbulence that followed. The Intesa Sanpaolo sample of 164 firm financial statements recorded median revenue growth of 9.5 percent in 2021 compared to 2019, suggesting

that the cluster's productive base weathered the pandemic shock with greater resilience than many other Italian manufacturing sectors (Camera di Commercio Treviso-Belluno, 2022).

3.8 The Shared Knowledge Base: Stainless Steel as an Epistemic Community

The preceding sections have described the Inox Valley in terms of its geography, history, industrial structure, and economic performance. This final section steps back to offer a more analytical interpretation of the cluster's identity — one that directly engages the theoretical framework established in Chapter 2 and prepares the ground for the analytical chapters that follow.

The key argument is that what makes the Inox Valley a cluster in the analytically meaningful sense — rather than merely a geographical concentration of firms that happen to be located near each other — is the existence of a shared knowledge base. In Mokyr's (2002) terms, the cluster is bound together by a common set of propositional knowledge (Ω) concerning the properties of stainless steel and related metallic materials, their behavior under different processing conditions, and the physical and chemical principles governing their fabrication; and by a rich and continuously evolving set of prescriptive knowledge (λ) concerning the specific techniques, processes, tools, and product designs through which this material understanding is translated into finished goods.

This shared epistemic base has several important properties. First, it is cumulative: each generation of cluster firms and workers builds on the knowledge accumulated by their predecessors, and the prescriptive frontier of what is technologically possible within the cluster expands over time as the propositional base grows. The introduction of computer numerical control (CNC) machining, laser cutting, and robotic welding in the more recent phases of the cluster's history represents precisely this kind of expansion: new propositional knowledge about the behavior of materials under computer-controlled

processing conditions has opened new prescriptive possibilities — more precise tolerances, more complex geometries, more consistent quality — that were previously beyond the technological frontier.

Second, the shared knowledge base is tacit as well as codified. A substantial part of what skilled workers in the Inox Valley know about stainless steel fabrication cannot be fully articulated in manuals or specifications; it is embodied in the hands and eyes of craftsmen, in the informal heuristics of experienced engineers, in the shared understanding of what ‘good’ production looks like that develops through years of working alongside colleagues in the same industry. This tacit dimension is, in Mokyr’s framework, precisely what justifies the spatial concentration of the cluster: the reduction of access costs for tacit knowledge requires physical proximity and social interaction, both of which are provided by the dense network of co-located firms, workers, and institutions that constitutes the Inox Valley.

Third, the shared knowledge base supports related variety. Because the fundamental competences of stainless-steel processing are applicable to a range of end products — domestic appliances, professional kitchen equipment, refrigeration systems, air conditioning components, food processing machinery — the cluster has been able to diversify its product portfolio without abandoning its material and technical foundation. In Frenken, Van Oort and Verburg’s (2007) terms, the Inox Valley exhibits precisely the kind of ‘related variety’ that their empirical research shows to be associated with sustained regional economic growth: diversity within a coherent domain of technological relatedness, rather than either excessive specialisation or unrelated diversification.

It is this combination of shared knowledge, tacit expertise, and related variety that gives the Inox Valley its resilience in the face of competitive shocks and its capacity for adaptation to new technological paradigms. Whether this resilience has been sufficient to navigate the current transition to digital and sustainable production — and what conditions have determined the differential outcomes across firms within the cluster — are the central analytical questions addressed in the chapters that follow.

3.9 Conclusion

This chapter has provided a structured overview of the Inox Valley cluster. It has situated the cluster within Italy's distinctive manufacturing tradition of specialized industrial districts, described its territorial boundaries and institutional recognition, traced its origins in the spin-off dynamics generated by the Zoppas and Zanussi anchor firms, documented its chronological evolution through four identifiable phases, and assessed its current industrial structure and economic performance using the most recent available data.

Several features of the cluster's profile deserve to be carried forward into the analytical chapters that follow. The first is the centrality of the spin-off mechanism as the cluster's founding dynamic: the Inox Valley was not planned or created by policy but emerged from the entrepreneurial energy of workers who converted their tacit knowledge of stainless-steel fabrication into independent productive activities — a quintessentially Schumpeterian process of creative recombination. The second is the role of the shared material competence as the cluster's analytical unit: the Inox Valley is a stainless-steel community, and its competitive advantage derives from the depth, breadth, and continuous renewal of the knowledge associated with this material. The third is the current moment of structural challenge: the simultaneous pressures of digital transformation and sustainability transition are requiring the cluster to expand its knowledge base into new epistemic territories, a process whose outcome is not predetermined and whose mechanisms the following chapters will examine in detail.

The next chapter applies the Mokyr–Schumpeter analytical framework directly to the cluster's history, tracing the successive expansions of the relevant propositional knowledge bases and the episodes of creative destruction through which they were translated into competitive outcomes.

CHAPTER 4. Knowledge, Innovation, and Creative Destruction in the Inox Valley: An Analytical Reading

4.1 Introduction

This chapter applies the theoretical framework developed in Chapter 2 to the historical and structural material presented in Chapter 3. Its purpose is to read the evolution of the Inox Valley cluster through the analytical lenses of Mokyr's useful knowledge framework, Schumpeter's theory of creative destruction, and the concept of economic complexity as developed by Hausmann and Hidalgo (2014). The aim is not to produce an historical account — that was the purpose of Chapter 3 — but to identify, interpret, and theorize the mechanisms that have driven the cluster's evolution over time.

Three analytical questions organize the chapter. First, how have the propositional knowledge bases (Ω) relevant to the cluster's activities expanded and shifted across successive phases of development, and how have these shifts opened or closed prescriptive possibilities (λ) for cluster firms? Second, what episodes of creative destruction can be identified in the cluster's history, and what were the agents, mechanisms, and consequences of each? Third, how has the cluster's productive knowledge portfolio evolved in terms of complexity and relatedness, and what does this evolution suggest about its capacity for continued adaptation?

Before applying these frameworks, Section 4.2 introduces the concept of economic complexity as an analytical tool, explaining its theoretical foundations and its relationship to the Mokyr and Schumpeter frameworks already established in Chapter 2. Section 4.3 discusses the analytical approach and the positionality of the author. Sections 4.4 through 4.7 then apply the framework to the four phases of the cluster's history identified in Chapter 3. Section 4.8 synthesizes the findings across phases, and Section 4.9 offers a conclusion that bridges the analysis to the thesis's closing chapter.

It should be noted at the outset that the analysis presented here is interpretive in nature. It draws on the secondary and primary sources reviewed in the preceding chapters, and the analytical conclusions it reaches are propositions grounded in the available evidence rather than empirically tested hypotheses. Where the evidence is insufficient to sustain a strong claim, this is stated explicitly.

4.2 Economic Complexity as an Analytical Lens

4.2.1 The Concept and Its Origins

The concept of economic complexity was formalized by Ricardo Hausmann and César Hidalgo in a series of contributions beginning with the foundational theoretical paper of 2009 (Hidalgo and Hausmann, 2009) and culminating in the Atlas of Economic Complexity, first published in 2011 and subsequently updated in a widely cited MIT Press edition (Hausmann and Hidalgo, 2014). Together, these works have established economic complexity as one of the most productive frameworks in contemporary economic geography and development economics. The central intuition is deceptively simple: the wealth of nations does not depend primarily on the quantity of resources they possess but on the diversity and sophistication of the productive knowledge embedded in their economic activities. Countries that produce a wide variety of complex products — products that few other countries can produce — tend to be wealthier and grow faster than those specialized in simpler, more widely replicable products.

This intuition is operationalized through the Economic Complexity Index (ECI), which measures the amount of productive knowledge embedded in a country's export basket. The ECI is computed iteratively from two observable quantities: the diversity of a country's exports (how many different products it exports with revealed comparative advantage) and the ubiquity of each product (how many countries export it). A country that exports many products, including products that few other countries export, has a high ECI. A country that exports few products, or products that are exported by many

others, has a low ECI. By the most recent rankings published by the Harvard Growth Lab (2024), Italy ranks 17th in the world by ECI, reflecting its productive structure concentrated in sophisticated manufacturing — machinery, precision instruments, fashion goods, specialty chemicals, and, precisely, professional appliances (Hausmann and Hidalgo, 2014; Harvard Growth Lab, 2024).

The complementary concept of Product Complexity Index (PCI) measures the complexity of individual products rather than countries. Products with high PCI are those that require a wide and rare set of productive capabilities to manufacture, and that are therefore produced only by a small number of highly complex economies. Stainless steel processing, electro-mechanical engineering, and the integration of digital control systems in professional appliances are all activities associated with high PCI products, since they require the simultaneous presence of multiple specialized competences that are not widely distributed across the global economy.

4.2.2 The Product Space and Related Diversification

A particularly powerful analytical tool derived from the economic complexity framework is the Product Space, introduced by Hidalgo, Klinger, Barabási, and Hausmann (2007). The Product Space is a network representation of all tradeable products, where two products are positioned close to each other if countries that export one tend also to export the other — a proximity that is interpreted as reflecting shared productive capabilities. Products that are close in the Product Space require similar knowledge, skills, machinery, and organisational routines; products that are far apart require fundamentally different capability sets.

The Product Space has a strongly heterogeneous structure: there is a dense core of sophisticated manufacturing products — machinery, chemicals, electronics, precision instruments — that are highly interconnected, and a sparse periphery of primary commodities and simple manufactures that are only weakly connected to each other and

to the core. Countries positioned in the dense core of the Product Space have many ‘nearby’ products into which they can diversify, since each new product requires capabilities that are already largely in place. Countries in the periphery face a much harder diversification challenge, since the nearest products in the Space may still require very different capabilities from those currently possessed.

This framework has direct relevance to the analysis of industrial clusters. A cluster can be understood as a local concentration of productive capabilities that corresponds to a particular region of the Product Space. The productive profile of the Inox Valley described in Chapter 3 — its concentration in stainless steel processing, thermal engineering, electro-mechanics, and precision manufacturing, its strong export performance, and its progressive diversification into professional food service equipment — is consistent with a positioning in the dense, interconnected core of the Product Space rather than in its periphery. Higher values of ECI indicate a more sophisticated local production structure with complex and knowledge-intensive products and greater diversification, implying a broader range of capabilities (Basile and Cicerone, 2022). While a formal ECI measurement at the cluster level is not available — provincial-level complexity measures for Italy carry known methodological limitations (Basile and Cicerone, 2022) — the cluster’s documented export orientation, productive diversity, and technological sophistication are all indicators associated with high complexity economies in the literature (Hausmann and Hidalgo, 2014). Whether and how this structural position has translated into actual diversification capacity across the cluster’s successive phases of development is one of the central questions that the analysis in the following sections seeks to address.

4.2.3 Economic Complexity, Mokyr, and Schumpeter: A Triangulation

The relationship between the economic complexity framework and the two theoretical lenses introduced in Chapter 2 is one of complementarity and mutual reinforcement rather than overlap. Mokyr's framework operates at the level of knowledge architecture: it identifies the types of knowledge (propositional versus prescriptive, tacit versus codified) that underlie productive capabilities and explains how their expansion and diffusion drive technological progress. Economic complexity operates at the level of observable productive outcomes: it measures, through export patterns, the breadth and sophistication of the capabilities that a country or cluster actually possesses. The two frameworks are in this sense the inside and outside views of the same phenomenon: Mokyr explains what capabilities are made of and how they develop; economic complexity measures how many of them a territory has and how complex they are.

Schumpeter's framework contributes the competitive and dynamic dimension: it explains the mechanism through which new capabilities are introduced into the economy — through entrepreneurial innovation — how they displace existing activities through creative destruction, and why this process is inherently cyclical and uneven. It is important to note that creative destruction operates not only at the level of products but also across processes, organizational forms, and market relationships: a new production method, a new form of industrial organization, or the opening of a new market can all trigger episodes of creative destruction without necessarily introducing a new product. In the economic complexity language, Schumpeter's entrepreneurs are the agents who navigate the Product Space — identifying nearby products and processes that the cluster's existing capabilities could support and taking the risk of moving into them. Creative destruction, in this reading, is the process by which moves into new regions of the capability space — whether expressed in new products, new production methods, or new organisational forms — displace activities and structures anchored in the old ones. Together, the three frameworks allow for a multi-level analysis of the Inox Valley's evolution: Mokyr explains the knowledge dynamics; Schumpeter explains the

competitive and entrepreneurial dynamics; and economic complexity provides the aggregate measure of how successfully the cluster has translated its knowledge base into a diverse and sophisticated productive portfolio. It is worth noting that this triangulation is proposed as an interpretive framework, not as a formally tested model. The evidence available for the Inox Valley does not lend itself to quantitative ECI measurement at the cluster level, and the analysis that follows is therefore qualitative and based on the available secondary sources.

4.3 A Note on Analytical Approach and Positionality

Before proceeding to the analysis, it is appropriate to acknowledge the author's positionality with respect to the object of study. The author of this thesis is employed as Strategic Sales Manager at Irinox S.p.A., one of the most internationally recognized firms within the Inox Valley cluster, specialized in professional blast chilling and food preservation technology. This professional position provides a privileged observational vantage point on the cluster's contemporary dynamics — on the competitive pressures facing cluster firms, the organisational transformations underway, the challenges of attracting specialized talent, and the strategic responses being developed by the cluster's leading firms. This first-hand familiarity with the cluster's current condition informs, at least indirectly, the interpretation offered in the following sections.

At the same time, this proximity to the object of study carries the risk of analytical partiality, and the author is aware of the need to maintain a critical distance from the perspectives and narratives that are dominant within the cluster itself. The analysis that follows draws primarily on published and verifiable sources, and interpretive propositions are presented as such rather than as established facts. Where the author's professional experience informs an observation, this is signaled explicitly.

4.4 Phase I (1950s–1970s): The Electro-Mechanical Epistemic Base and the Founding Creative Destruction

4.4.1 The Propositional Knowledge Base of the Founding Phase

The Inox Valley's emergence in the post-war decades can be read, in Mokyr's terms, as the local crystallization of a set of propositional knowledge bases that had been developing in the broader European engineering tradition since the late nineteenth century. The relevant Omega in this phase encompasses: the metallurgical knowledge of stainless steel — its composition, its corrosion resistance properties, its behavior under different forming and welding processes; the thermal engineering knowledge underlying refrigeration and cooking technologies — thermodynamic cycles, heat transfer, insulation; and the electro-mechanical engineering knowledge required to design and manufacture the control and drive components of domestic appliances.

These propositional bases had been substantially codified and institutionalized in European engineering education by the mid-twentieth century. What the Zoppas group contributed was not new science but a distinctive prescriptive capability: the ability to translate this available propositional knowledge into standardized, high-volume, cost-effective products. In Mokyr's framework, this is precisely the function of the lambda — the set of techniques through which propositional knowledge is mapped onto productive outcomes. The Zoppas innovation was organisational and prescriptive rather than scientific: it consisted in developing the manufacturing routines, quality control procedures, supply chain relationships, and workforce training systems that allowed complex electro-mechanical products to be produced at industrial scale and at prices accessible to the mass consumer market of the Italian economic miracle.

The access costs to the relevant propositional knowledge were low in this phase, in the sense that the knowledge was codified and available in engineering education systems, and the Zoppas group was able to attract technically trained engineers who could serve as knowledge brokers between the scientific frontier and the shop floor. The key tacit

knowledge — the specific skills of sheet metal forming, inox welding, precision assembly, and quality testing — was, however, genuinely local and difficult to replicate elsewhere: it resided in the hands and routines of the workforce that Zoppas had trained over decades, and it constituted the cluster's most distinctive and durable competitive asset.

4.4.2 The Founding Creative Destruction: Spin-Off as Innovation

The mechanism of creative destruction in this founding phase operated not at the product level but at the organisational level. The Zoppas group's strategy of externalizing production phases to newly established independent suppliers — described in detail in Chapter 3 — can be read as a Schumpeterian innovation of the fifth type: a new form of industrial organization. By separating the manufacturing of specialized components from the assembly and marketing of finished products, Zoppas effectively invented a new organisational paradigm for the Italian appliance industry — one that proved far more flexible and dynamically efficient than vertically integrated large-scale production.

The spin-off entrepreneurs who emerged from this process — Barazza, Ongaro, Pagotto, Saccol, and others documented by Salvador (2020) — are recognizable as Schumpeterian Mark I entrepreneurs: individuals without established stakes in the existing industrial order, who perceived the opportunity latent in the new organisational form and had the technical competence and entrepreneurial energy to realize it. What is particularly interesting, from a Mokyr perspective, is the mechanism of knowledge transfer that made their ventures possible: the tacit knowledge of stainless-steel processing and electro-mechanical assembly that these individuals had accumulated during their years at Zoppas was not formally codified or contractually protected. It was embodied knowledge — the kind that Mokyr identifies as the most difficult to transmit across distance but the easiest to transmit through social proximity and direct apprenticeship. The workers who left Zoppas to found their own workshops were, in this

sense, carrying the cluster's epistemic base out of the factory and redistributing it across the territory.

The creative destruction in this phase was not primarily destructive in the sense of displacing existing firms — Zoppas itself continued to grow throughout this period. Rather, it was creative in the original Schumpeterian sense: it created new organisational forms, new productive units, and new market relationships that collectively constituted the cluster as a structured economic ecosystem. The destruction came later, when the very success of the spin-off network eventually eroded the cost advantages of vertical integration that had been Zoppas's original competitive foundation.

4.4.3 The Knowledge Portfolio in Phase I: Positioning in the Product Space

Applying the economic complexity lens to Phase I requires acknowledging an important methodological limitation: quantitative complexity measures for the productive portfolio of the Inox Valley in the 1950s and 1960s are not available, and the following reading is therefore interpretive in nature, grounded in the historical evidence reviewed in Chapter 3 rather than in formal complexity measurement.

On that interpretive basis, it can be argued that the cluster's productive portfolio in this founding phase was concentrated in the manufactured goods associated with electro-mechanical engineering applied to domestic appliances — refrigerators, washing machines, cooking ranges, and their components. The Libro Bianco (Pontarollo, Martelli and Prandini, 2002) documents that the competitive advantage of Italian producers in this phase derived primarily from their capacity to translate available engineering knowledge into standardized, cost-effective products at scale, rather than from proprietary technological knowledge or radical product innovation. Salvador (2020) confirms that the Zoppas group's strength lay in organisational and prescriptive innovation — the development of manufacturing routines, supply chain relationships, and workforce training systems — rather than in scientific leadership. In the language of

economic complexity, this positioning is consistent with a location in the manufactured goods cluster of the Product Space, where product relatedness — the degree to which different goods share underlying productive capabilities — tends to be high among electro-mechanical products (Hidalgo, Klinger, Barabási and Hausmann, 2007). However, whether the cluster's specific portfolio in this phase placed it in the dense core or the intermediate zones of the Product Space cannot be determined without quantitative data that are not available for this period and at this geographical scale. What can be said, drawing on the available historical sources, is that the productive knowledge accumulated in this phase — in stainless steel processing, thermal engineering, and electro-mechanical assembly — provided the foundation for the diversification moves that characterized the subsequent phases.

4.5 Phase II (1970s–1990s): Corporate Restructuring, Knowledge Externalization, and Productive Diversification

4.5.1 The Schumpeterian Shock: Acquisition, Rationalisation, and Displacement

The second phase of the cluster's development was inaugurated by a series of corporate events that, taken together, constitute one of the most significant episodes of creative destruction in the cluster's history: the financial difficulties and subsequent acquisition of Zoppas by Zanussi in the early 1970s, followed by the acquisition of Zanussi by the Swedish multinational Electrolux in 1984. These events can be read, in Schumpeterian terms, as a transition from the Mark I regime of the cluster's founding phase to a nascent Mark II regime: the replacement of individual entrepreneurial leadership by the routinised R&D and professional management of large corporate organizations.

The rationalisation that followed the Electrolux acquisition had two contradictory effects on the cluster. On one hand, it contracted employment at the large plants and reduced the productive autonomy of the local operations, subordinating their product development and investment decisions to the strategic logic of a transnational

corporation headquartered in Stockholm. On the other hand, it accelerated the externalization of production activities — Electrolux's drive to reduce costs and focus on core competences created sustained demand for independent suppliers — and simultaneously released a further wave of technically skilled managers and engineers who, finding themselves redundant in the restructured corporate hierarchy, channeled their knowledge and energy into new entrepreneurial ventures. In Mokyr's terms, the corporate restructuring functioned as an involuntary knowledge diffusion mechanism: it redistributed tacit knowledge from the large integrated firm to the independent SME network, reducing the access costs to this knowledge for potential innovators throughout the cluster.

4.5.2 Diversification as Related Variety: Expanding the Knowledge Portfolio

The most analytically significant development of Phase II, from the perspective of economic complexity, is the cluster's diversification into new product segments that, while related to the original electro-mechanical and stainless-steel competence base, opened new regions of the Product Space. The transition from domestic to professional food service equipment — already noted in Chapter 3 as a defining feature of the cluster's competitive evolution — can be understood, in the Product Space framework, as a move into a nearby but distinct region: one characterized by higher customization requirements, more demanding performance standards, stronger regulatory compliance obligations, and more direct relationships with professional end-users.

This diversification move required an expansion of the cluster's λ — its prescriptive knowledge — into several new areas. Among these, particularly significant examples include the hygiene engineering required by HACCP regulations in professional kitchens, the blast chilling technology that preserves food safety and quality in professional food service operations, and the modular design principles that allow professional kitchen equipment to be configured for different institutional settings. These new prescriptive

capabilities were built on the cluster's existing propositional base — stainless steel processing, thermal engineering, electro-mechanics — but required new applications and refinements of that base that constituted genuine innovation.

The internationalization of cluster firms that characterized this phase is also analytically significant. The decision by a number of cluster firms to establish production facilities in Central and Eastern European countries — documented by Salvador (2020) as a defining feature of the Veneto industrial model of the 1980s and 1990s — can be interpreted, in economic complexity terms, as a strategy of capability-preserving offshoring: by externalizing the most labor-intensive and lowest-complexity stages of production, cluster firms were able to concentrate their local resources on the highest-complexity activities — product design, precision engineering, quality control, after-sales service — that sustained their position in the dense core of the Product Space.

4.5.3 The Propositional Frontier in Phase II: Regulatory Knowledge as a New Omega

A dimension of the cluster's knowledge dynamics in Phase II that deserves explicit attention, because it is often underemphasized in the cluster literature, is the emergence of regulatory compliance knowledge as a significant component of the relevant propositional base. The progressive tightening of European food safety regulations — culminating in the introduction of HACCP principles in the mid-1990s — created a new category of propositional knowledge that cluster firms were required to master: the scientific and technical understanding of microbial risk, temperature control, food preservation, and hygienic design that underlies compliance with food safety standards. This regulatory knowledge functioned, in Mokyr's framework, as an exogenous expansion of the relevant Omega: it was generated by scientific research and regulatory institutions external to the cluster, but it had direct implications for the prescriptive frontier available to cluster firms. Those firms that were able to access and internalize this

knowledge — by hiring food scientists, by establishing relationships with university research groups, by participating in the development of industry standards — gained access to new prescriptive possibilities: the ability to design equipment that was not merely functional but demonstrably compliant with the highest food safety standards, and that could command a significant price premium in professional markets where regulatory compliance was a mandatory requirement. Those firms that could not access this knowledge faced competitive displacement.

This episode illustrates a general mechanism that will recur in the subsequent phases: the expansion of relevant propositional knowledge bases as a result of regulatory change, and the consequent redistribution of competitive advantage among cluster firms according to their differential capacity to access and exploit the new knowledge. It is, in Schumpeterian terms, a form of creative destruction driven not by entrepreneurial innovation but by institutional change — a reminder that the agents of creative destruction in mature industrial systems are not always individual entrepreneurs but sometimes regulatory and political institutions.

4.6 Phase III (1990s–2010s): The Professional Appliance Specialisation and the Deepening of Complexity

4.6.1 Knowledge Deepening and the Consolidation of Prescriptive Capabilities

The third phase of the cluster's evolution — from the mid-1990s to approximately the mid-2010s — can be characterized, in Mokyr's terms, as a period of knowledge deepening rather than expansion: the cluster's propositional base did not change as dramatically as in previous phases, but the prescriptive knowledge built upon it became substantially richer, more sophisticated, and more differentiated across firms and product segments. This deepening was driven by three mechanisms: increasing market sophistication on the demand side, growing regulatory stringency, and the progressive

codification of tacit knowledge through industry standards, certification systems, and professional training programs.

The professional food service equipment segment, which emerged as the cluster's most dynamic specialisation in this phase, is particularly instructive. The requirements of professional chefs, institutional caterers, and food service operators are substantially more demanding than those of domestic consumers: professional equipment must perform reliably under intensive continuous use, must meet precise temperature and timing specifications, must be cleanable to regulatory hygiene standards, and must integrate with the workflow and physical constraints of professional kitchen environments. Meeting these requirements demanded from cluster firms a level of prescriptive knowledge — of engineering design, materials science, thermodynamics, and human-factors engineering — that was genuinely distinctive and difficult to replicate without the accumulated tacit knowledge of the cluster.

The development of blast chilling technology — one of the cluster's most internationally recognized product innovations in this phase — offers a concrete illustration of this knowledge-deepening process. Blast chilling requires the integration of refrigeration engineering, airflow dynamics, control electronics, and food science into a unified product design capable of achieving rapid and uniform temperature reduction without compromising food quality or safety (Pontarollo, Martelli and Prandini, 2002). The propositional knowledge underlying this integration — the thermodynamics of heat transfer, the microbiology of food preservation, the electronics of programmable temperature control — was available in the scientific and technical literature. What the cluster's firms developed was the prescriptive knowledge of how to combine these elements into reliable, manufacturable, and commercially viable products. Drawing on the author's professional experience at Irinox S.p.A., one of the leading cluster firms in this segment, it can be observed that this prescriptive knowledge is substantially tacit in character: it is embedded in the engineering teams of cluster firms through accumulated

problem-solving experience and is not readily accessible to outside competitors through codified documentation alone.

4.6.2 Managerialization and Organisational Innovation

A dimension of the cluster's evolution in Phase III that is significant from both Schumpeterian and Mokyr perspectives is the progressive managerialization of cluster firms: the transition, in a substantial number of cases, from family-owned and family-managed enterprises to firms with professional management structures, formal governance arrangements, and systematic human resources policies. This transition can be read as a Schumpeterian organisational innovation — the introduction of a new form of industrial organization that is more appropriate to the scale and complexity of the markets in which cluster firms are competing.

In Mokyr's terms, managerialization represents a codification and institutionalization of organisational knowledge that was previously tacit and personalized: the knowledge of how to manage a complex manufacturing enterprise, coordinate supply chains, develop new products, enter new markets, and manage human resources was, in the cluster's early phases, embedded in the personal capabilities of individual entrepreneurs and family leaders. As firms grew and markets became more complex, this tacit organisational knowledge needed to be codified into formal management systems, strategic planning processes, and professional development programs — a process that reduced the access costs of organisational knowledge for subsequent generations of managers, even as it risked losing some of the entrepreneurial flexibility and tacit wisdom of the founding generation.

The Intesa Sanpaolo (2025) report documents a consistent performance advantage among Italian district firms that have invested in professional management structures and human capital upgrading, including advantages in EBITDA margins, export intensity, and innovation investment. While the report does not isolate the generational transition

as an independent variable, it is consistent with the broader argument that the managerialization of cluster firms is not merely an organisational change but a knowledge management challenge: the challenge of preserving the tacit entrepreneurial knowledge embedded in the founding generation while building the codified management capabilities required to compete in global markets.

4.6.3 Internationalization and the Opening of New Markets

The third mechanism of knowledge expansion in Phase III is the cluster's progressive internationalization, understood not merely as export growth but as a genuine expansion of the prescriptive knowledge base into the domain of global market management. Exporting to markets as diverse as Germany, France, the United States, the Middle East, and South-East Asia requires a level of market knowledge — of regulatory environments, distribution systems, cultural preferences, and competitive landscapes — that is in Mokyr's terms a genuine extension of the cluster's lambda: new prescriptive knowledge about how to adapt products, services, and commercial relationships to the requirements of different markets.

The Camera di Commercio Treviso-Belluno (2022) data confirms the cluster's strong export orientation in this phase: by 2022, the province of Treviso accounted for 21.5 percent of total Italian appliance exports, and the Intesa Sanpaolo (2025) research confirms that Veneto district firms with a higher Technological Complexity Index — those that have adopted a broader and more sophisticated range of productive technologies — also tend to export to a broader range of countries and to compete more effectively in premium market segments. This finding, which is directly relevant to the Inox Valley, suggests that the deepening of productive knowledge complexity and the broadening of international market reach are mutually reinforcing: firms that know more can reach further, and reaching further requires knowing more.

4.7 Phase IV (2010s–Present): A Multi-Dimensional Epistemic Transition

4.7.1 The Digital Frontier: A New Propositional Challenge

The fourth and current phase of the cluster’s development is characterized by what can be described, in Mokyr’s terms, as a significant expansion of the relevant propositional knowledge bases in directions that are partially discontinuous with the cluster’s accumulated expertise. The digital transformation of both products and production processes — encompassing IoT connectivity, embedded software, digital diagnostics, artificial intelligence, and advanced automation — requires propositional knowledge in software engineering, data science, sensor technology, and cybersecurity that is qualitatively different from the thermal engineering, materials science, and electro-mechanics that have historically constituted the cluster’s epistemic foundation.

The global commercial kitchen appliances market, valued at approximately 98.34 billion US dollars in 2024 and projected to grow at a compound annual growth rate of 7.3 percent through 2030 (Grand View Research, 2024, commercial market estimate), is being reshaped by the diffusion of IoT-enabled equipment: connected ovens that can be remotely monitored and programmed, refrigeration units with predictive maintenance capabilities, blast chillers with cloud-connected performance logging, and dishwashers with AI-optimized cycle management. According to commercial market intelligence estimates, approximately 37 percent of US commercial kitchens had integrated IoT-enabled appliances by 2024 (Market Data Forecast, 2024), and European adoption, while lagging, is accelerating under the combined pressure of energy efficiency regulations and labor cost pressures. These figures should be treated as indicative market estimates rather than statistically verified data.

For cluster firms, this digital frontier represents both an opportunity and a structural challenge. The opportunity is significant: digital connectivity creates new value propositions — remote service contracts, performance guarantees, data analytics services, predictive maintenance — that command higher margins and create stronger

customer lock-in than the sale of standalone equipment. The challenge is equally significant: developing and sustaining software and connectivity capabilities requires skills and organisational routines that are substantially different from those associated with mechanical engineering and stainless-steel fabrication, and that are in high demand across many industries, making talent attraction and retention particularly difficult for SMEs in a geographically peripheral industrial area.

The Corò, Pejčić and Volpe (2017) analysis of Industry 4.0 diffusion in the Veneto region confirms the heterogeneity of digital technology adoption across manufacturing firms: adoption is strongly correlated with firm size, human capital endowment, export intensity, and financial structure, suggesting that the digital transition is likely to widen the productivity and competitiveness gap between the cluster's larger and more resourced firms and its smaller and more traditional ones. More recently, the survey of nearly 2,000 Veneto firms conducted by Corò and Borsato (2026) demonstrates that firms with a higher Technological Complexity Index — those that have adopted a more diverse and sophisticated portfolio of digital technologies — are significantly more likely to export and to serve a broader range of international markets. This finding suggests that the digital transition is not merely a matter of operational efficiency but a strategic positioning choice with direct implications for the cluster's future complexity profile.

As of June 2025, survey data from Veneto Congiuntura — supported by Ca' Foscari University of Venice, the University of Padua, and the University of Verona — shows that 54 percent of Veneto manufacturing firms had adopted at least one digital technology, rising to 67.2 percent among exporters and 79.2 percent among firms with more than 50 employees (Treviso Belluno System, 2026). While artificial intelligence investment currently accounts for only 4.9 percent of firms, 38.2 percent identify it as a priority for the next three years — a figure that signals a significant impending acceleration in the depth of digital knowledge adoption across the regional manufacturing base.

4.7.2 The Sustainability Imperative: Regulation as Epistemic Driver

The sustainability transition represents a second, partially independent axis of propositional knowledge expansion in Phase IV. European regulatory pressure — through the Ecodesign Regulation, the Energy Labelling Directive, the Waste Electrical and Electronic Equipment (WEEE) Directive, and the emerging requirements of the EU Green Deal — is imposing new engineering requirements on professional appliance manufacturers: minimum energy efficiency standards, restrictions on refrigerants with high global warming potential, mandatory recyclability criteria, and documentation requirements for lifecycle environmental impact.

In Mokyr's framework, regulatory change of this kind functions as a forced expansion of the relevant Omega: firms that do not develop the propositional knowledge of energy systems engineering, refrigerant thermodynamics, lifecycle assessment, and environmental compliance will be unable to manufacture legally compliant products in European markets. The TEHA report (2024) identifies the replacement of obsolete appliances with best available technologies as one of the most significant opportunities for reducing food waste and energy consumption in the Italian HoReCa sector: the Horeca sector in Italy is responsible for approximately 27 percent of food waste, and modern professional appliances with programmable cooking cycles and advanced preservation technologies can play a significant role in reducing this figure. This creates a positive alignment between regulatory compliance, innovation, and sustainability that cluster firms with the appropriate knowledge base can exploit commercially.

The sustainability transition is also creating new market opportunities that reward knowledge complexity. Professional customers in the hospitality and food service sectors are increasingly making purchasing decisions on the basis of total cost of ownership — incorporating energy costs, maintenance costs, and regulatory compliance costs alongside the purchase price — rather than on initial price alone. Firms that can document the energy efficiency, durability, and environmental performance of their products with credible technical evidence are better positioned to compete in this

increasingly sophisticated market, particularly in Northern European and North American markets where sustainability credentials are a significant purchasing criterion.

4.7.3 The Human Capital Challenge: Knowledge Access in a Tight Labor Market

The digital and sustainability transitions both require human capital with new and scarce skills — software engineers, data scientists, energy system specialists, environmental compliance managers — that are in high demand across many industries and are therefore difficult for SMEs in peripheral industrial areas to attract and retain. This challenge has a direct Mokyrrian dimension: if the access costs to tacit human knowledge — the knowledge embodied in skilled workers — rise because those workers have many attractive alternative employers, the cluster's capacity to develop and sustain new prescriptive capabilities is directly constrained.

The Intesa Sanpaolo (2025) focus group with Veneto manufacturing entrepreneurs, conducted at the University of Padua in January 2025, documents this challenge explicitly. Participating firms reported significant difficulties in finding candidates with the technical and managerial skills required for their businesses and identified human capital retention as one of their most pressing strategic concerns. Between 2013 and 2023, approximately 17,900 Veneto graduates aged 25–39 moved their residence abroad, against only 6,440 who returned, representing a net loss of approximately 11,500 graduates — a figure that reflects the structural vulnerability of the Veneto manufacturing system to the global competition for talent (Intesa Sanpaolo, 2025).

In economic complexity terms, this brain drain represents a reduction in the local supply of the most complex and scarce productive knowledge: the tacit knowledge embodied in highly educated and experienced workers. Since economic complexity is ultimately grounded in human capabilities — in what people know how to do — a sustained loss of highly skilled workers represents a genuine threat to the cluster's long-run complexity

trajectory, independently of the quality of its physical capital and productive infrastructure.

4.7.4 Organisational Innovation and Collective Response: The Parco Industriale Prealpi Trevigiane

The fourth dimension of the cluster's current transition concerns organizational innovation — the development of new institutional forms better suited to the collective challenges of the digital and sustainability transition than the individual firm strategies of previous phases. One concrete and recent example of this tendency, which can be interpreted as a Schumpeterian organizational innovation of the fifth type, is the establishment of the Associazione Parco Industriale delle Prealpi Trevigiane in October 2024.

The Association, formally constituted on 16 October 2024 with Irinox S.p.A. among its nine founding members — alongside Amorim Cork Italia, IRCA, Keyline, Maglieria GZ, Ristorazione Ottavian, Serena Wines 1881, Tegola Canadese, and Tema — and promoted with the active support of Confindustria Veneto Est, represents a new form of collective action among the firms of the Conegliano–Vittorio Veneto industrial zone (Confindustria Veneto Est, 2024). The industrial zone of San Giacomo di Veglia/Scomigo covers 130 hectares and hosts approximately 100 firms with around 6,000 direct employees — a concentration that makes collective management of shared infrastructure and public goods both feasible and economically rational.

The analytical significance of the Association extends beyond its formal constitution. A research contract commissioned by Confindustria Veneto Est to the IUAV University of Venice — Contratto di ricerca rep. n. 1237/2022, entrusted to a team led by Professor Marco Ferrari of the Department of Culture of the Project — produced a comprehensive plan for the area's transformation with a horizon to 2040 (Ferrari, Bortolotto and Mantelli, 2024). The research is analytically important not only for its concrete proposals but for

the diagnosis it offers of the industrial area's current condition. As the IUAV report documents, the productive area of the Prealpi Trevigiane emerged rapidly from the 1950s onward on what had been agricultural land, built without adequate planning: it developed alongside an inadequate road network, severed minor waterways, interrupted ecological corridors, and contributed to soil consumption and waterproofing. The result is an area that, despite hosting some of the most internationally competitive firms in the cluster, suffers from poor connectivity to the A27 motorway, a chronic shortage of services for firms and workers, fragmented and low-quality public space, and approximately 2,100 public parking spaces covering some 52,000 square meters — the equivalent of ten football pitches — that for much of the day remain largely empty, reinforcing the perception of a degraded and inhospitable environment incompatible with the vitality of the surrounding urban centers (Ferrari, Bortolotto and Mantelli, 2024).

The scenario proposed by the IUAV team for the period 2025–2040 is organized around three thematic axes and three corresponding quality indices. The first axis — green infrastructure — proposes the creation of five linear green transects crossing the productive area, the transformation of existing parking areas into ecological devices capable of filtering rainwater and reducing hydraulic risk, and the progressive constitution of ecological corridors connecting the industrial area to the broader environmental systems of the Treviso upland plain. The second axis — welfare — proposes a new multi-functional services center of approximately 11,500 square meters, incorporating a 400-seat auditorium, co-working spaces, a business incubator, a training center, and an 180-bed hotel — a landmark structure approximately 50 meters tall that would serve as a territorial reference point and represent the cluster's ambition to be a place worth working and living in, not merely a place of production. The third axis — alternative mobility — proposes a new dedicated railway station within the industrial area, an inter-firm shuttled loop service, inter-company carpooling platforms, and expanded cycling infrastructure connecting the area to the surrounding urban centers. The three axes are measured against three quality indices: environmental sustainability, worker wellbeing, and area

efficiency. The scenario is phased across three five-year steps — 2025–2030, 2030–2035, 2035–2040 — and envisages a 15–20 percent reduction in vehicle traffic generated by the industrial area as a whole (Ferrari, Bortolotto and Mantelli, 2024).

In Mokyr's framework, the Association and its associated planning process can be understood as a new institution designed to reduce the access costs to collective knowledge — in environmental management, urban planning, sustainable mobility, and worker welfare — that no individual firm could acquire or act upon effectively on its own. The investment in territorial attractiveness is, in this reading, simultaneously an investment in the cluster's human capital base: making the industrial area a more desirable place to work and live is a precondition for attracting and retaining the skilled workers on whom the cluster's knowledge architecture depends. In Schumpeter's framework, it is an organizational innovation of the fifth type — a new form of industrial organization that responds collectively to the structural challenges that individual firm strategies cannot address. Whether initiatives of this kind will prove sufficient to sustain the cluster's knowledge base and territorial attractiveness in the face of the structural pressures of the digital and sustainability transition remains an open question that future research will be better positioned to answer.

4.7.5 The Servitization Challenge: From Product Sales to Integrated Solutions

The concept of servitization — defined by Vandermerwe and Rada (1988) as the strategic integration of services into a manufacturer's core offering in order to add value and deepen customer relationships — represents a fifth and increasingly prominent dimension of the transformation currently facing the Inox Valley cluster. While the preceding four dimensions (digital transition, sustainability, human capital, and organisational innovation) all concern the cluster's internal capabilities and institutional arrangements, servitization concerns the fundamental logic of its business model: the

shift from selling products transactionally to providing customers with integrated bundles of goods, services, support, and knowledge over time.

In Mokyr's framework, servitization requires a genuinely new category of prescriptive knowledge — not knowledge of how to make things better, but knowledge of how to design, price, deliver, and manage services that are bundled with physical products. This includes knowledge of service contract design, predictive maintenance systems, customer data management, remote diagnostics, and performance-based pricing models. These are capabilities that are qualitatively different from those associated with manufacturing excellence, and that require new organisational structures, new commercial competences, and new relationships with customers that extend well beyond the transactional moment of sale.

The competitive dynamics of servitization in the professional food service equipment sector are already visible in the strategies of the sector's leading global firms. Rational AG, the German world market leader in combi-steamer technology with over 50 percent global market share in multifunctional cooking appliances, has developed ConnectedCooking — a cloud-based IoT platform launched in 2015 that has reached over 150,000 networked users worldwide as of 2024 (Rational AG, 2024). ConnectedCooking enables remote monitoring and programming of cooking systems, automatic HACCP-compliant documentation, recipe management and distribution across multiple kitchen locations, and AI-based predictive maintenance through the Digital Service Manager platform (Rational AG, 2024; Catering Insight, 2024). The platform creates a service ecosystem — of certified technicians, data analytics services, and software updates — that deepens the commercial relationship between Rational and its customers well beyond the product sale. Importantly, the Digital Service Manager also offers a Pro version with AI-based analytics, creating a subscription revenue stream for service partners (Catering Insight, 2024).

Unox, the Padua-based professional oven manufacturer and one of the most innovative Italian firms in the sector, offers an analogous model through its Digital.ID operating

system embedded in the CHEFTOP-X product line. The system provides AI-powered cooking assistance that learns from user feedback, remote monitoring and oven management via smartphone, voice control through the HEY.Unox interface, and remote technical assistance directly through the oven panel (Unox, 2024). The CHEFTOP-X integrates carbon footprint estimation per cooking cycle, positioning the product at the intersection of digital servitization and the sustainability imperative. As Unox's regional service team leader has stated publicly, "service and support are as crucial to the Unox business model as manufacturing the most advanced professional ovens on the market" (Public Sector Catering, 2023). The Nice Kitchen (TNK Group), the Italian multi-brand professional kitchen group, takes a further step by integrating device monitoring, energy optimisation, and restaurant management on a single digital platform, and by developing ghost kitchen operations — Merryday — as a research and commercial laboratory for its own technologies (The Nice Kitchen, 2024).

These examples illustrate a broader competitive dynamic in which the manufacturers that are most successfully navigating the transition to servitized business models are those that have combined deep product engineering knowledge with new software, data, and service design capabilities. From the perspective of economic complexity, this represents a significant move in the Product Space: the capabilities required for service-intensive, subscription-based business models are substantially different from those required for transactional product manufacturing and are therefore not immediately available to cluster firms whose prescriptive knowledge has been historically concentrated in the latter.

From the author's professional experience within the cluster, it can be observed that servitization is perceived by the sector's leading firms as both an inevitable competitive direction and a significant organisational challenge. The transition from product-centered to solution-centered commercial models requires changes not only in technology but in sales force capabilities, pricing logic, customer relationship management, and after-sales organization — changes that are particularly demanding for SMEs that have historically

competed on product quality and price rather than on service breadth and customer intimacy. Whether and how the Inox Valley cluster will develop the collective institutional arrangements to support this transition — through shared service platforms, training programs, or sector-wide standards — is a question that the available evidence does not yet allow to answer definitively.

4.7.6 Intra-cluster Competition and Market-Driven Consolidation

A further structural feature of the cluster's current phase, observable through the lens of industrial organization, concerns the relationship between intra-cluster competition and collective action. Within the Inox Valley, firms operating in adjacent or overlapping market segments typically compete rather than cooperate: the absence of structured inter-firm collaboration platforms — with the exception of the Parco Industriale Prealpi Trevigiane initiative discussed in Section 4.7.4 — is a characteristic feature of the cluster's organizational landscape that reflects both the entrepreneurial independence of its SME fabric and the commercial sensitivity of sharing capabilities with competitors who serve the same professional end-users. This observation, while not systematically documented in the available secondary sources, is consistent with the broader cluster literature's recognition that geographic co-location generates knowledge spillovers through informal mechanisms despite — rather than because of — deliberate inter-firm collaboration (Breschi and Lissoni, 2001), and is informed by the author's direct professional experience within the cluster. Against this backdrop, three organizational consolidation processes currently underway in the North-East Italian professional kitchen equipment ecosystem are analytically significant as market-driven responses to the commercial fragmentation that voluntary cooperation has not resolved. The first is the role of Ali Group — the Milan-headquartered global conglomerate whose origins lie in the Italian professional appliance tradition — as an integrating force within and adjacent to the cluster itself. Ali Group's acquisition history reveals a systematic absorption of North-

East Italian professional kitchen equipment brands: in 2004 alone, the group acquired Baron, DIHR, Friulinox, Kromo, Olis, and Polaris — all Italian manufacturers — in addition to Lainox, founded in 1981 in Vittorio Veneto, Treviso, which had been part of the portfolio since 1989 (Ali Group, 2024). The group has subsequently organized these brands into a formally designated 'North-East Group' (Raggruppamento Nord Est), whose members — Lainox, Alphatech, Mareno, Silko, Olis, Baron, Friulinox, and Polaris — share a logistics and spare parts infrastructure managed through Ali Parts, a dedicated division (Ali Parts, 2024). The group's explicit governance model — in which 'each Ali company operates independently and is encouraged to cultivate its individual strengths and spirit of initiative' while group headquarters defines investment strategies and provides shared services (Ali Group, 2024) — represents a federated ownership model that generates coordination and logistical benefits without eliminating brand autonomy or local productive identity. The second is the consolidation strategy of Somec Group, a publicly listed company headquartered in San Vendemiano, Treviso, that acquired GICO — Grandi Impianti Cucine of Vazzola in July 2020, subsequently reaching 100 percent ownership — and has assembled within its Talenta division a cluster of Inox Valley-based professional kitchen manufacturers including GICO, Pizzagroup, Inoxtrend, and Primax (Somec Group, 2024; PitchBook, 2026). Somec's website explicitly frames this consolidation as rooted in the Inox Valley: 'the production of custom integrated professional cooking equipment is based in the Inox Valley, a district in north-eastern Italy recognized as a leader in Europe and the world' (Somec Group, 2024). The third is TheNiceKitchen (TNK), headquartered in Oderzo in the province of Treviso, which since the entry of private equity investor 21 Invest in 2024 has pursued an explicit build-up strategy, acquiring Krupps — a professional dishwasher manufacturer from Padua — in 2025, and targeting revenues of over €75 million while aiming to build 'an Italian centre of excellence in professional cooking equipment' offering fully integrated, technology-enabled kitchen systems (21 Invest, 2025; The Nice Kitchen, 2025).

These three consolidation processes represent, on an interpretive basis, a market-driven organizational response to the commercial fragmentation that has historically characterized the cluster: where voluntary inter-firm cooperation has not produced the integrated service propositions and commercial scale that the current competitive environment demands, financial integration through acquisition and federated ownership is emerging as the alternative mechanism. This dynamic is consistent with the broader observation in the cluster evolution literature that the boundaries between industrial districts and multi-firm corporate groups are becoming increasingly fluid as clusters mature and face intensifying competitive pressures (Martin and Sunley, 2011).

4.8 Synthesis: The Inox Valley as a Dynamic Knowledge System

4.8.1 The Pattern of Epistemic Evolution

Reading the Inox Valley's history through the Mokyr framework reveals a pattern of epistemic evolution that is neither linear nor unidirectional. The cluster's propositional knowledge base has expanded across successive phases in ways that closely track the chronological trajectory described in Chapter 3: from the electro-mechanical engineering and stainless steel metallurgy of Phase I — Industrial Foundation — through the diversification into professional kitchen engineering and the first expansion toward food service competences that characterized Phase II — Crisis, Consolidation and Diversification — to the deep specialisation in blast chilling, precision refrigeration, and food safety knowledge that defined Phase III — Maturation and the Rise of Food Service Equipment — and now to the qualitatively more demanding expansion into software engineering, AI, IoT connectivity, and environmental systems science required by Phase IV — Digital Transition and Sustainability Challenges. Each phase has required cluster firms to access new propositional knowledge that was initially external to the cluster, to develop new prescriptive capabilities on the basis of this knowledge, and to manage the transition between old and new knowledge regimes without losing the accumulated

competences that constituted their competitive advantage. The cluster has, on this reading, demonstrated a notable capacity for epistemic renewal: it has repeatedly expanded its knowledge base in response to changing technological and competitive environments, and it has done so while maintaining continuity in its core material competence — stainless steel processing — that has provided a stable foundation for each new round of diversification. This pattern corresponds, in economic complexity terms, to a trajectory of related diversification: each successive move has been into a region of the Product Space that was nearby — cognitively accessible — from the cluster's existing position, allowing the accumulated capabilities of the cluster to be leveraged rather than discarded.

4.8.2 The Pattern of Creative Destruction

The Schumpeterian reading of the cluster's evolution reveals a succession of creative destruction episodes that have periodically reconfigured the cluster's competitive structure, each corresponding to one of the four phases identified in Chapter 3. The founding spin-off dynamic of Phase I constituted a prototypical Mark I episode of entrepreneurial creative destruction: individual workers became entrepreneurs, displacing the vertically integrated model of the anchor firms while collectively enriching the cluster's epistemic commons. The crisis and corporate restructuring of Phase II — culminating in the Electrolux acquisition of Zanussi and the rationalisation of large productive units — constituted a market-driven and corporate episode in which established organizational forms were displaced and productive resources were externalized into the emerging SME network. The maturation of Phase III generated creative destruction within the cluster itself: firms that deepened their capabilities in blast chilling, precision refrigeration, and HACCP-compliant engineering progressively displaced those that remained anchored to lower-complexity products. The digital and sustainability transitions of Phase IV are generating a new episode whose agents are

multiple and diffuse — technology platform providers, global conglomerates with superior digital capabilities, and regulatory bodies setting sustainability standards — and whose outcome for the cluster remains genuinely open. What is consistent across these episodes, and consistent with Schumpeter's theoretical framework, is that the creative destruction process has generated both losers and winners: firms and organisational forms that were unable to adapt to the new competitive environment were displaced, while those that could access the new knowledge and develop the new capabilities required by each phase have survived and often prospered. The cluster's overall trajectory — from a relatively undifferentiated electro-mechanical production base in the 1950s to a diversified, internationally competitive complex of professional and domestic appliance manufacturers in the 2020s — is the aggregate outcome of this repeated creative destruction process.

4.8.3 The Complexity Trajectory

In economic complexity terms, the Inox Valley's trajectory can be characterized as one of progressive deepening and selective broadening: the cluster has continuously deepened its capabilities in its core areas of specialisation while selectively broadening into related activities that leverage and extend those capabilities. This trajectory has been sustained by the cluster's institutional infrastructure — the dense network of supplier relationships, the shared labor market, the local technical education institutions, and, more recently, the emerging collective organizations such as the Parco Industriale — that have maintained the social conditions for knowledge circulation and entrepreneurial activity.

The current phase of the cluster's evolution presents, from a complexity perspective, both the most significant challenge and the most significant opportunity in the cluster's history. The digital and sustainability transitions are requiring the cluster to diversify into regions of the Product Space that are further from its current position than any previous

diversification move: the capabilities required for IoT-enabled professional appliances, for AI-optimized cooking systems, and for circular economy compliant product design are more distant from the cluster's core stainless steel and mechanical engineering competences than food safety engineering or blast chilling technology were from its original electro-mechanical base. Whether the cluster has the institutional capacity, the entrepreneurial dynamism, and the human capital to navigate this more demanding diversification challenge is, as argued above, a question that remains genuinely open.

4.9 Conclusion

This chapter has offered an analytical reading of the Inox Valley's evolution through three complementary theoretical lenses: Mokyr's framework of useful knowledge, Schumpeter's theory of creative destruction, and the economic complexity framework of Hausmann and Hidalgo. The analysis has traced a pattern of repeated epistemic expansion and creative destruction that has sustained the cluster's competitiveness across four distinct phases of development — from the post-war electro-mechanical foundation of Phase I to the multi-dimensional challenges of the current digital and sustainability transition in Phase IV.

Several findings emerge from this analysis that are worth carrying forward. First, the cluster's resilience has depended critically on its capacity to maintain a shared material competence base — stainless steel processing and related engineering knowledge — while repeatedly expanding into adjacent propositional and prescriptive territories. Each successive expansion has been cognitively accessible from the cluster's existing position in the Product Space, allowing accumulated capabilities to be leveraged rather than discarded. Second, the mechanisms of creative destruction in the cluster have been diverse in their agents and forms: entrepreneurial and organic in the founding phase, corporate and market-driven in Phase II, regulatory and competitive in Phase III, and increasingly collective and institutional in the current phase. Third, the human capital

dimension of the cluster's knowledge system is becoming both increasingly critical and increasingly vulnerable: the global competition for digital and sustainability expertise is raising the access costs to the most valuable tacit knowledge at precisely the moment when the cluster most needs it. Fourth, the current phase has revealed a tension between the cluster's historically distributed model of knowledge circulation and innovation — which has been its greatest competitive strength — and the emerging forces of market-driven consolidation through federated ownership structures such as Ali Group's North-East Group, Somec/Talenta, and TheNiceKitchen, which represent an alternative organizational response to the commercial fragmentation that voluntary cooperation has not resolved.

These findings are interpretive propositions grounded in the available evidence, not empirically tested conclusions. They acquire additional analytical precision, however, when situated within a comparative perspective. The analysis of a single case — however carefully conducted — cannot distinguish between what is specific to the Inox Valley and what reflects more general mechanisms of cluster evolution in the home appliance and professional food equipment industry. Chapter 5 addresses this limitation by placing the Inox Valley alongside the Shunde/Foshan cluster in China — a case that shares the same broad industry but has followed a radically different developmental trajectory — and by applying the same three analytical lenses to identify where the two cases converge and where they diverge. The comparison will show that the Inox Valley's distributed knowledge architecture is not a generic feature of all successful appliance clusters but a specific institutional achievement with distinctive strengths and vulnerabilities that only become fully visible through the contrast with an alternative model.

CHAPTER 5. The Shunde/Foshan Cluster: An International Comparative Perspective

5.1 Introduction and Rationale for the Comparison

The analytical framework developed in Chapter 2 and applied to the Inox Valley in Chapters 3 and 4 acquires additional explanatory power when tested against a case that shares the same industry but has followed a radically different developmental trajectory. The comparison proposed in this chapter is between the Inox Valley — a Marshallian district of small and medium-sized enterprises in North-East Italy, specialized in the manufacture of domestic appliances and professional food service equipment based on stainless steel processing competences — and the Shunde district of Foshan municipality in China's Pearl River Delta, recognized as the world's most significant production cluster for household appliances and among the largest for professional cooking equipment.

The choice to conduct an in-depth comparison with a single case rather than a superficial survey of multiple cases reflects a deliberate methodological preference. As Eisenhardt and Graebner (2007) argue, single-case comparative analysis permits the kind of fine-grained analytical engagement that multi-case surveys preclude. The Inox Valley and Shunde share enough structural features — same broad industry, geographic concentration, presence of a diverse supply chain ecosystem, progressive internationalization — to make comparison analytically meaningful; and they differ enough — in institutional context, knowledge architecture, innovation regime, and evolutionary trajectory — to make the comparison analytically productive.

This chapter is structured as follows. Sections 5.2 through 5.7 describe the Shunde cluster using the same six analytical categories applied to the Inox Valley in Chapter 3: historical background, industrial overview, chronological evolution, industrial structure

today, economic performance and international positioning, and the shared knowledge base. Section 5.8 then develops the comparative analysis across three analytical lenses: the Mokyr framework of useful knowledge, the Schumpeter framework of creative destruction and innovation regimes, and the economic complexity framework of Hausmann and Hidalgo. Section 5.9 synthesizes the comparative findings and identifies what the comparison reveals about the Inox Valley's competitive position and future trajectory that would not emerge from a purely internal analysis.

A quantitative dataset covering the two clusters across five dimensions — territorial scale, industrial structure, productive specialization, economic output, and international orientation — is provided in Appendix A, to which the reader is referred for the empirical underpinning of the analysis that follows.

A methodological caveat must be stated at the outset. The description of Shunde draws primarily on secondary sources: the academic literature on the cluster's development (most importantly Liu and Yang, 2014; Yang, 2013), corporate reports of major cluster firms, and institutional data from Chinese government sources. The depth of the Shunde analysis is therefore necessarily shallower than that of the Inox Valley, for which the author has direct professional experience and access to primary institutional sources. Where the evidence for Shunde is insufficient to support a strong analytical claim, this is stated explicitly. The quantitative data available for both clusters has been compiled in Appendix A.

5.2 Historical Background: Two Clusters, Two Founding Moments

The Shunde district of Foshan municipality is located in the western Pearl River Delta of Guangdong Province, approximately 25 kilometers south of Guangzhou. Covering an area of approximately 806 square kilometers with a resident population of approximately 2.9 million, Shunde is today one of China's most productive manufacturing districts: its

GDP exceeded RMB 430 billion in 2023, and the district has been consecutively recognized as the 'Hub of Chinese Home Appliances' for five consecutive years (GDToday, 2025; Liu and Yang, 2014).

The origins of the Shunde cluster are rooted in the longstanding commercial and manufacturing traditions of the Pearl River Delta, a region that had been a center of silk production, trade, and artisanal manufacture since the Song Dynasty. The mulberry-fish pond system — an integrated agricultural model that combined silk cultivation with aquaculture — accumulated substantial commercial capital in the region and created a culture of entrepreneurship and market orientation that would later prove conducive to industrial development (Liu and Yang, 2014). Unlike the Inox Valley, whose industrial identity was forged in the post-war reconstruction period of the 1950s, Shunde's industrial identity has much deeper roots in a regional culture of commercial pragmatism that predates the Communist period by centuries.

The transformation of Shunde into a major industrial center took place in two distinct phases corresponding to China's political-economic history. The first phase, beginning with the reform and opening-up policy launched by Deng Xiaoping in 1978, saw Shunde emerge as one of the 'Four Tigers' of the Guangdong economy — alongside Dongguan, Zhongshan, and Nanhai — characterized by the rapid growth of Township and Village Enterprises (TVEs), the collective industrial enterprises owned by local governments that drove rural industrialization across China during the 1980s. In Shunde, the TVE model took a distinctive form: rather than relying primarily on foreign direct investment and export-oriented assembly manufacturing — the dominant model in the eastern Pearl River Delta cities of Dongguan and Shenzhen — Shunde developed a domestic market-oriented production system in which local firms produced for Chinese consumers using technologies licensed from or jointly developed with foreign partners (Liu and Yang, 2014).

The second and analytically more significant phase was the radical privatization of Township and Village Enterprises that Shunde undertook between 1992 and 1995 — a transformation that constitutes the most consequential episode of institutional creative destruction in the cluster's history and that created the conditions for the emergence of global champions such as Midea. The contrast with the Inox Valley's founding moment is already visible at this stage of the description: where the Italian cluster's formation was driven by the dispersal of tacit knowledge from large anchor firms to individual entrepreneurs acting on private initiative, Shunde's formative transition was driven by a deliberate institutional decision by the local state to restructure property rights in ways that would unlock private entrepreneurial incentives. Different institutional architectures, operating within the same broad industry, produced radically different cluster formation dynamics. This transition will be examined in greater depth in Section 5.4.

5.3 Industrial Overview: The Cluster and Its Principal Actors

The Shunde cluster is organized around a dense productive ecosystem concentrated in the district's ten sub-districts (jiedao), with the greatest concentration of home appliance manufacturing in Beijiao Town — the headquarters of Midea Group — and Ronggui sub-district, which hosts Hisense Kelon, Galanz, Wanjiale, and numerous other manufacturers. The G105 highway connecting Shunde to the neighboring city of Zhongshan is frequently described as a 'golden corridor' of consumer appliances, with factories concentrated on both sides of the road and a supply chain so dense that 'eighty percent of accessories can be quickly found within a radius of fifty kilometers' (GDToday, 2025). This spatial concentration of vertically integrated supply chains is one of the cluster's most distinctive competitive features, enabling rapid prototyping, flexible production scheduling, and logistics efficiencies that geographically dispersed production systems cannot replicate.

The cluster hosts more than 3,000 home appliance production and supporting enterprises, ranging from global giants to small component manufacturers (GDToday, 2025). Its product portfolio is extraordinarily broad: major domestic appliances (refrigerators, washing machines, dishwashers, air conditioners), small appliances (microwave ovens, rice cookers, electric fans, kettles), kitchen equipment (range hoods, induction cookers, ovens), and increasingly, commercial and professional cooking equipment. Shunde is the world's largest supply base for rice cookers and microwave ovens, and its manufacturers are significant producers of commercial kitchen equipment for the Chinese HoReCa market and, progressively, for export.

The dominant firm within the cluster — and one of the most important in the entire global appliance industry — is Midea Group, headquartered in Beijiao, Shunde. Founded in 1968 by He Xiangjian with an initial capital of 5,000 yuan and 23 residents of Beijiao (Midea Group, 2024), Midea has grown into a Fortune Global 500 company with 2024 revenues of RMB 409.1 billion (approximately €52 billion), 190,000 employees, operations in over 200 countries and regions, and a portfolio spanning home appliances, HVAC systems, building technologies, robotics and industrial automation, energy, and healthcare (Midea Group, 2024). Its ten-year cumulative R&D investment has surpassed RMB 100 billion, and in 2024 alone the company invested over RMB 16 billion in R&D, adding 11,000 globally authorized patents and leading the formulation or revision of 230 industry technical standards (Midea Group, 2024).

Galanz, also headquartered in Shunde's Ronggui sub-district and founded in 1978 by Liang Qingde, is the world's largest manufacturer of microwave ovens with approximately 40 percent global market share, and has progressively extended its portfolio into air conditioners, refrigerators, and professional catering equipment. Hisense Kelon — the Shunde-based subsidiary of the Qingdao-based Hisense Group — specialises in refrigerators and air conditioners. These three firms, together with dozens of mid-sized specialists, constitute the commercial core of the Shunde appliance ecosystem.

5.4 Chronological Evolution: From Collective Enterprises to Global Champions

5.4.1 Phase I: TVE Industrialization (1978–1992)

The first phase of Shunde's industrial development was defined by the Township and Village Enterprise model. Following the reform and opening-up of 1978, Shunde's local government established numerous TVEs in manufacturing activities ranging from agricultural machinery to consumer goods, leveraging the district's commercial traditions and its geographic proximity to Hong Kong and the export networks of the Pearl River Delta. Among the most significant of these ventures was the founding by He Xiangjian and 23 co-workers of a collective enterprise in Beijiao in 1968 — initially producing lids for plastic bottles, then diversifying into electric fans and, from the mid-1980s, into air conditioners and other major home appliances. This enterprise would become Midea.

The TVE model generated rapid industrial growth but also significant structural inefficiencies. Township leaders were incentivized to maximize output rather than profits, leading to overinvestment and the accumulation of non-performing loans. By the early 1990s, approximately one third of Shunde's 978 TVEs were facing bankruptcy (Liu and Yang, 2014). The bubble in real estate and stock markets, combined with the tightening of national banking credit, created a systemic financial crisis that demanded a structural institutional response.

5.4.2 Phase II: Radical Privatization and the Founding Creative Destruction (1992–1998)

The response that Shunde's local government chose — in the face of significant ideological opposition from higher levels of the Chinese state — was a radical and pioneering privatization of TVEs, which local authorities reframed as 'institutional transformation' (zhuanzhi) rather than privatization (siyouhua) to navigate political

sensitivities (Liu and Yang, 2014). Between 1992 and 1995, Shunde became the first district in China to systematically transfer ownership of collective enterprises to private individuals, a transformation that the national government would only officially sanction for other regions years later.

The privatization process had two direct consequences of lasting analytical significance. First, it subjected Shunde's industrial enterprises to genuine market discipline for the first time: firms that could not survive on their commercial merits were allowed to fail, while those with competitive products and management were able to invest and expand without the budgetary soft constraints that had undermined TVE efficiency. Second, it created a class of enterprise managers who became genuine owners with strong incentives to maximize firm value rather than output volumes. He Xiangjian's gradual acquisition of full ownership of Midea through successive equity transactions between 1992 and 2001 exemplifies this trajectory: a collective enterprise manager became a private entrepreneur and, ultimately, one of China's wealthiest individuals.

This episode constitutes, in Schumpeterian terms, a moment of institutional creative destruction: the existing organisational form (TVE collective ownership) was destroyed and replaced by a new one (private corporate ownership) that proved far more conducive to innovation and growth. It is significant that this transition was not driven by individual entrepreneurial initiative in the Schumpeter Mark I sense but by deliberate institutional action by the local state — a reminder that the agents of creative destruction can be institutional as well as individual, and that the appropriate institutional framework is as important for innovation as entrepreneurial talent.

5.4.3 Phase III: Domestic Market Leadership and Global Coupling (1998–2012)

Following privatization, Shunde's leading firms entered a phase of rapid growth driven by the expansion of domestic Chinese consumer demand. The Chinese middle class,

growing rapidly with the sustained economic boom of the 1990s and 2000s, provided an enormous home market for the cluster's products — a market that, unlike the export-oriented eastern Pearl River Delta clusters, Shunde's firms had been oriented towards from the beginning. This domestic market orientation was both a strategic choice and a structural advantage: it allowed Shunde's manufacturers to develop deep understanding of Chinese consumer preferences and to build national distribution networks at a time when foreign manufacturers had neither the local knowledge nor the distribution reach to compete effectively at the mass market level.

At the same time, and in contrast to the domestic orientation of their market strategy, Shunde's leading firms actively pursued what Liu and Yang (2014) term 'strategic coupling' with foreign technology partners: the deliberate establishment of technology licensing agreements, joint ventures, and OEM manufacturing relationships with global appliance brands, through which they accessed the propositional and prescriptive knowledge of more technologically advanced producers. Midea, for example, established technology licensing agreements with Japanese manufacturers of compressors and inverter control systems, acquiring the engineering knowledge necessary to develop domestically manufactured alternatives to imported components. This coupling strategy was the mechanism through which the Shunde cluster expanded its propositional knowledge base during this phase: not through organic R&D but through the strategic acquisition of external knowledge through commercial relationships with technologically superior partners.

5.4.4 Phase IV: Global Ambition and Technological Transformation (2012–present)

The current phase of the cluster's evolution is defined by Midea's transformation from a large domestic appliance manufacturer into a technology-driven multinational with ambitions extending well beyond the appliance industry. The strategic pivot began with Midea's decision to invest systematically in R&D from 2011 onwards — a decision that

has produced, over the following decade, a cumulative R&D investment exceeding RMB 100 billion and a patent portfolio placing Midea seventh globally by patent family count and first among Chinese companies and home appliance manufacturers worldwide (Midea Group, 2024). The company's six World Economic Forum Lighthouse Factories — recognized as among the most advanced examples of digital manufacturing globally — represent the physical expression of this transformation.

The geographic expansion of Midea's knowledge acquisition strategy has been equally significant. The 2016 acquisition of KUKA AG, the German industrial robotics manufacturer, for approximately 4.5 billion euros provided Midea with direct access to German engineering knowledge in robotic automation — a deliberate expansion of the cluster's propositional base into a domain that is essential for the future of intelligent manufacturing. Subsequent acquisitions of Toshiba Home Appliances (Japan, 2016), the Italian climate control specialist Clivet (2018), the Spanish-German kitchen appliance group Teka (2023), and the Swiss climate technology group ARBONIA Climate (2024) have extended the cluster's knowledge reach across multiple technological and geographical dimensions (Midea Group, 2024). For the Shunde cluster as a system, Midea's global acquisition strategy functions as a mechanism for importing propositional knowledge that the cluster would be unable to generate independently: in Mokyr's terms, each acquisition is a reduction of access costs to a specific domain of Omega.

5.5 Industrial Structure Today

The contemporary industrial structure of the Shunde cluster is characterized by a pronounced asymmetry between the dominant anchor firms and the supporting SME ecosystem — an asymmetry that contrasts markedly with the more balanced structure of the Inox Valley. Midea Group alone generates revenues equivalent to approximately five times the total estimated revenues of the Inox Valley cluster, and its workforce of 190,000 employees exceeds the total employment of the entire Treviso province's

appliance sector by an order of magnitude. This asymmetry is not merely quantitative: it reflects a fundamentally different organisational logic in which the cluster's innovation and market development capacity is concentrated in a single dominant firm rather than distributed across a network of specialized SMEs.

The supporting ecosystem of 3,000-plus enterprises around Midea and the other anchor firms is, however, genuinely dense and functionally integrated. The 50-kilometre supply chain radius documented by GDToday (2025) reflects a degree of vertical integration at the cluster level that generates significant logistics and coordination efficiencies. Component manufacturers specializing in compressors, electric motors, heating elements, electronic control boards, plastic housings, and metal stampings are clustered in the same sub-districts as the final assembly operations, enabling just-in-time delivery and rapid prototyping that the Inox Valley's more dispersed supply chains cannot match in terms of response speed.

The governance of the cluster's development reflects the active role of the Shunde district government, which has historically played a constitutive role in the cluster's institutional architecture. Unlike the Inox Valley's relatively arm's-length relationship between the state and the market — mediated through chambers of commerce, industry associations, and vocational training institutions — the Shunde government has been a direct participant in the cluster's development: through the Shunde Rural Commercial Bank, which has provided sustained financing to local firms; through explicit backing for Midea's international acquisition strategy (Liu and Yang, 2014); and through the active recruitment of industrial design talent and the establishment of the Guangdong Industrial Design Center with over 285 research and design companies in the Shunde district (China Daily HK, 2022).

5.6 Economic Performance and International Positioning

The economic performance of the Shunde cluster is, in aggregate terms, substantial. Shunde-made household appliance sales reached RMB 420 billion in 2022 — equivalent to approximately 56 billion euros at the average 2022 exchange rate — with nearly 400 manufacturers above the designated size threshold (GDToday/Xinhua, 2023). The district produces approximately one fifth of China's total home appliance output. In specific product categories, the concentration of production is particularly pronounced: Galanz alone is estimated to account for approximately half of global microwave oven production, and the district as a whole is among the world's largest production bases for rice cookers and small domestic appliances (GDToday, 2025). These figures illustrate how the cluster's productive specialisation in specific categories has generated commanding positions in global supply chains for particular products, even as its overall share of the broader appliance market remains one component among several major producing regions worldwide.

The internationalization of Shunde's production is extensive but qualitatively different from that of the Inox Valley. Chinese home appliance exports overall reached RMB 712.2 billion (approximately €90 billion) in 2024, growing 15.4 percent year-on-year, with smart and energy-efficient appliances growing at over 15 percent (TMTPOST, 2024). However, a substantial portion of this export value consists of OEM production for foreign brands rather than own-brand exports — a distinction that is analytically significant for the economic complexity framework, since OEM production generates lower value-added per unit and does not build the relational capital associated with own-brand international commercial presence. Midea's domestic market share is already very high, but as its CFO acknowledged in 2023, its overseas penetration 'remains in the single digits — meaning there's still huge growth potential' (TMTPOST, 2024).

Midea's own international positioning is, however, rapidly evolving. The company's overseas revenue exceeded 40 percent of total sales in 2023 — a figure that includes both exports from Chinese facilities and the revenues of its international subsidiaries acquired through M&A. Its OBM (own-brand manufacturing) operations have grown rapidly, with own-brand overseas revenue increasing from 29 to 43 percent of international sales in five years (TMTPOST, 2024). The company is building manufacturing facilities in Indonesia, India, Thailand, Brazil, Mexico, Italy, and Egypt — a geographic diversification that reduces its exposure to trade policy risks, notably the US tariff hikes of 2025 that represent a significant challenge to Chinese appliance exporters relying on trans-Pacific supply chains (Morningstar, 2025).

A direct comparison with the Inox Valley's international positioning reveals both structural similarities and fundamental differences across several analytical dimensions. Both clusters are strongly export-oriented: the province of Treviso accounted for 21.5 percent of total Italian appliance exports in 2022 (Camera di Commercio Treviso-Belluno, 2022), and the Inox Valley's firms have built deep relational capital in European, American, and Middle Eastern markets through decades of sustained export activity. However, the nature, geographic pattern, value chain position, and institutional underpinning of this internationalization differ substantially between the two cases.

On the nature of internationalization, the most analytically significant distinction concerns the OEM versus OBM composition of export revenues. The Inox Valley's export model is predominantly own-brand and relationship-intensive: Italian cluster firms compete in international markets under their own names, building the commercial partnerships, service networks, and market reputations that constitute durable relational capital in the sense identified in Chapter 4. Shunde's export model has historically been more mixed, combining a significant OEM component — in which Chinese manufacturers produce under the brand names of foreign buyers — with a growing own-brand presence. This distinction carries direct implications for the economic complexity framework: OEM

production captures lower value-added per unit and does not generate the brand equity, customer knowledge, and market embeddedness that sustain long-term competitive positioning in premium segments. Midea's rapid shift from OEM towards OBM — with own-brand international revenue rising from 29 to 43 percent of international sales in five years (TMTPOST, 2024) — signals a deliberate strategic convergence towards the higher-value internationalization model that Inox Valley firms have historically practiced. Whether this convergence will erode one of the cluster's most durable competitive advantages in premium international markets is one of the more consequential open questions for the Inox Valley's future.

On the geographic pattern of internationalization, the two clusters differ in ways that reflect their different competitive positioning in global markets. The Inox Valley's export destinations are predominantly premium European and North American markets where product quality, technical sophistication, and brand reputation command price premiums: Germany accounted for 19.5 percent of Treviso's appliance exports in 2022, France for 8.7 percent, and the United States for 6.5 percent (Camera di Commercio Treviso-Belluno, 2022). These are sophisticated, demanding markets in which the tacit knowledge depth and product complexity of Italian cluster firms provide genuine competitive protection. Shunde's export geography has historically been more volume-driven and price-sensitive, with significant exposure to emerging markets in Southeast Asia, the Middle East, and Africa where Chinese brands compete primarily on cost and availability. Midea's active geographic diversification — establishing manufacturing facilities in Indonesia, India, Thailand, Brazil, Mexico, Italy, and Egypt — reflects a strategy of penetrating high-growth emerging markets and reducing tariff exposure rather than consolidating a premium position in mature Western markets (Midea Group, 2024). These are structurally different internationalization strategies with different implications for value capture, brand building, and long-run competitive positioning.

On value chain position, the two clusters occupy structurally different positions in global value chains, with direct consequences for value-added capture and long-run competitive upgrading. Humphrey and Schmitz (2002) argue that clusters are inserted into global value chains in different ways, and that the type of insertion — whether as commodity OEM producers, as design-capable ODM manufacturers, or as own-brand innovators — has fundamental consequences for the upgrading opportunities available at the local level. The Inox Valley's firms occupy predominantly mid-to-upper positions in international value chains: they are typically the final product manufacturer and brand owner in their export relationships, competing on the technical complexity of their products — blast chilling, professional cooking systems, precision refrigeration — rather than on cost. This positioning corresponds to what Humphrey and Schmitz (2002) identify as functional upgrading: the ability to perform higher-value functions in the chain, including product design, brand management, and after-sales service, rather than remaining confined to manufacturing assembly for foreign buyers. Shunde's cluster, by contrast, has historically occupied a broad and internally heterogeneous range of value chain positions, spanning from commodity OEM production — where, as the global value chain literature documents, profits are thin and value-added per unit is low (Gereffi, Humphrey and Sturgeon, 2005) — to Midea's own premium branded products at the upper end. This internal variance is itself analytically significant: the cluster cannot be characterized by a single value chain position, and the aggregate export value conceals enormous differences in value-added capture across firms. Midea's strategic shift from OEM towards OBM — raising own-brand international revenue from 29 to 43 percent of international sales in five years (TMTPOST, 2024) — can be read precisely as an attempt to move up the value chain in the direction that Humphrey and Schmitz (2002) identify as functional upgrading, and to close the value-added gap with the Inox Valley's own-brand model. On the institutional underpinning of internationalization, the two clusters differ in ways that reflect their broader institutional architectures. The Inox Valley's internationalization has been driven predominantly by firm-level commercial initiative,

supported by trade promotion institutions such as chambers of commerce, sector associations, and the relational networks of individual entrepreneurs. Shunde's internationalization — and particularly Midea's global acquisition strategy — has been explicitly backed by the district government, with party officials reportedly accompanying corporate executives to acquisition negotiations, including Midea's initial visit to KUKA's headquarters following the 2016 takeover (Liu and Yang, 2014). This state-backed internationalization model accelerates market entry, reduces transaction costs, and provides political legitimacy for strategically sensitive investments in ways that market-driven internationalization cannot replicate. It does, however, create dependencies on political relationships and strategic alignments — most visibly in Midea's exposure to the US tariff escalation of 2025, which represents a significant risk for Chinese manufacturers relying on trans-Pacific supply chains (Morningstar, 2025) — that the Inox Valley's more commercially grounded internationalization does not face to the same degree.

5.7 The Shared Knowledge Base: Scale, Technology, and the Architecture of the Shunde Omega

The question of what constitutes the shared knowledge base of the Shunde cluster — the equivalent of what Chapter 3 identified as the Inox Valley's stainless steel epistemic community — is analytically more complex than it might initially appear, for two reasons. First, the cluster's knowledge base has changed qualitatively across its four phases of development, making it difficult to identify a single stable epistemic foundation of the kind that stainless steel processing provides for the Inox Valley. Second, the cluster's knowledge is distributed very asymmetrically between the dominant anchor firm, Midea, and the surrounding SME ecosystem, raising the question of whether the cluster as a whole possesses a genuinely shared knowledge base or whether its productive capability is better understood as the aggregation of firm-specific capabilities organized

around a common supply chain infrastructure. These are not merely empirical questions; they are analytical questions about what kind of knowledge community the cluster constitutes, and the answer has direct implications for assessing its long-run resilience. In the TVE and early privatization phases, it can be argued — on the basis of the cluster formation dynamics documented by Liu and Yang (2014) — that the shared knowledge base of the Shunde cluster was predominantly prescriptive (λ) in character: the cluster's firms excelled at efficiently replicating existing product designs at scale, optimizing production processes for cost and volume, and managing the logistics of large-scale supply chains. Liu and Yang (2014) document that Shunde firms established their market positions primarily through domestic market-oriented production networks, mobilizing regional assets and strategic coupling with foreign firms to access technologies that they did not generate independently. The propositional knowledge (Ω) underlying these prescriptive capabilities was not primarily generated within the cluster but was accessed through technology licensing, joint ventures, and OEM relationships with more technologically advanced foreign partners — mechanisms through which, as the global value chain literature documents, developing country manufacturers absorb prescriptive knowledge without necessarily developing the deeper propositional understanding that would allow them to innovate independently (Gereffi, Humphrey and Sturgeon, 2005). In Mokyr's analytical framework, this corresponds to a high λ capacity built on a relatively shallow and externally sourced Ω : an arrangement that is effective for rapid industrial catch-up but that constrains the capacity for frontier innovation in the long run. This characterization is advanced as an interpretive proposition grounded in the available evidence, not as a directly measured description of the cluster's knowledge stock.

This characterization requires significant qualification for the current phase. Midea's sustained R&D investment — over RMB 100 billion cumulatively over ten years, with more than 23,000 R&D personnel worldwide and 33 global R&D centers — represents a genuine effort to build proprietary propositional knowledge in areas critical to the

cluster's future competitive advantage: AI-driven control systems, energy efficiency technologies, human-robot collaboration, smart home connectivity, and advanced manufacturing processes (Midea Group, 2024). The acquisition of KUKA provided direct access to deep German engineering knowledge in robotics. The 80,000-plus authorized patents maintained by Midea, and its position as the global home appliance industry leader in patent families, signal that the cluster's propositional base is expanding rapidly and in directions that are not easily accessible to competitors.

What remains analytically distinctive about Shunde's knowledge architecture, however, is the pronounced concentration of its growing propositional base within Midea rather than its distribution across the cluster as a whole. The Marshallian literature on industrial districts identifies three principal mechanisms through which knowledge circulates within geographically concentrated clusters: labor market pooling, which enables tacit knowledge to move across firm boundaries as skilled workers change employers; specialized input markets, which create sustained inter-firm technical exchanges along supply chains; and knowledge spillovers proper, understood as the informal diffusion of technical understanding through face-to-face interaction, social networks, and shared institutional environments (Marshall, 1919; Audretsch and Feldman, 1996; Breschi and Lissoni, 2001). In the Inox Valley, all three mechanisms are active: the shared labor market for stainless steel fabrication skills, the dense supplier network, and the informal inter-firm exchanges enabled by geographic concentration collectively sustain the circulation of tacit knowledge as a cluster-level public good. In the Shunde cluster, the SME ecosystem around Midea benefits substantially from the first two mechanisms — demand spillovers generated by the scale of Midea's production create a large and sustained market for specialized components, and the dense 50-kilometre supply chain ecosystem facilitates inter-firm technical exchanges. However, the third mechanism — the free circulation of propositional knowledge generated through formal R&D — operates very differently in a cluster dominated by a single firm investing over RMB 16 billion annually in proprietary research (Midea Group, 2024). Corporate R&D knowledge

is by its nature appropriable and legally protected through patents and trade secrets; the 80,000-plus patents maintained by Midea (Midea Group, 2024) represent propositional knowledge that is explicitly withheld from free circulation rather than allowed to diffuse through the cluster as a shared epistemic commons. It can be argued, on this interpretive basis, that as Midea's R&D investment grows and its patent portfolio deepens, the gap between the propositional knowledge available to Midea specifically and that available to the broader Shunde SME ecosystem widens — a structural tendency that has no direct equivalent in the Inox Valley's more distributed knowledge architecture.

5.8 Comparative Analysis: The Inox Valley and Shunde through Three Analytical Lenses

5.8.1 The Mokyr Lens: Two Epistemic Trajectories

Mokyr's framework of useful knowledge provides perhaps the most analytically productive lens for understanding the structural differences between the Inox Valley and Shunde, because it focuses attention precisely on the mechanisms through which propositional knowledge (Ω) is generated, accessed, and converted into prescriptive innovation (λ) — mechanisms that differ profoundly between the two cases. In Mokyr's historical analysis, the decisive variable in explaining differences in long-run innovative capacity is not the quantity of knowledge available in a given context but the institutional arrangements that determine the costs of accessing it: the encyclopedias, scientific societies, and practical journals of the Industrial Enlightenment reduced access costs and enabled the feedback loop between Ω and λ that drove sustained technological progress (Mokyr, 2002). Applied to the comparison between Shunde and the Inox Valley, the framework asks: how has each cluster organized access to the propositional knowledge relevant to its competitive position, and how have these different access mechanisms shaped the character and trajectory of prescriptive innovation in each case?

The Inox Valley's epistemic trajectory can be characterized, on the basis of the historical and structural evidence reviewed in Chapters 3 and 4, as one of progressive lambda deepening grounded in an externally generated Omega. As argued in Section 3.8, the cluster is bound together by a common set of propositional knowledge — concerning the physical and chemical properties of stainless steel and related metallic materials, the thermodynamic principles underlying refrigeration and cooking technologies, and the electro-mechanical engineering knowledge required to design and manufacture professional appliances — and by a rich and continuously evolving set of prescriptive knowledge concerning the specific techniques, processes, tools, and product designs through which that material understanding is translated into finished goods. The Omega underpinning the cluster's productive activities has been generated predominantly outside the cluster itself — in the broader European tradition of engineering science, transmitted through university faculties, polytechnics, and technical education systems — though a minority of technologically advanced firms have developed internal R&D capabilities that constitute a partial and growing source of locally produced propositional knowledge, particularly in Phase IV. What the cluster has generated with exceptional depth and continuity is lambda: the prescriptive knowledge embedded in the hands and routines of its workforce, in the engineering capabilities of its firms, and in the informal heuristics accumulated through decades of working on shared technical problems.

The spin-off mechanism documented in Chapter 3 (Salvador, 2020; Pontarollo, Martelli and Prandini, 2002) is the most visible expression of this lambda accumulation process: skilled workers who departed from Zoppas and Zanussi carried with them the embodied technical knowledge of stainless-steel fabrication, thermal engineering, and electro-mechanical assembly — techniques, routines, and practical capabilities rather than scientific principles — and applied it in new entrepreneurial ventures that extended the cluster's prescriptive frontier into adjacent niches. Each generation of spin-offs deepened the cluster's lambda in specific areas while contributing to the shared prescriptive commons that all cluster firms could draw upon. The key feature of this trajectory is

therefore not the local production of Omega but the maintenance of low access costs to externally generated propositional knowledge, combined with an exceptional institutional capacity to convert that knowledge into locally embedded, tacit prescriptive capabilities. Audretsch and Feldman (1996) document that knowledge spillovers are geographically bounded precisely because the tacit component of knowledge — the component most difficult to codify and transmit across distance — requires physical proximity and repeated social interaction to circulate effectively. The Inox Valley's geographic concentration in the Conegliano–Treviso corridor has sustained exactly this kind of proximity for λ : the shared labor market for stainless steel fabrication skills, the dense inter-firm supplier network, and the institutional infrastructure of technical schools, chambers of commerce, and industry associations collectively constitute what Marshall (1919) described as industrial atmosphere — the social medium through which prescriptive knowledge diffuses without being deliberately taught or formally transferred. Breschi and Lissoni (2001) make the important analytical qualification that knowledge spillovers in industrial clusters flow primarily through social networks of practitioners — through the informal relationships between engineers, technicians, and entrepreneurs who share common professional backgrounds — rather than freely across all co-located firms. In the Inox Valley, this network-mediated λ circulation has been dense and productive across the cluster's history, as the repeated episodes of spin-off entrepreneurship and related diversification documented in Chapter 4 confirm. The current challenge — directly relevant to the comparison with Shunde — is that the social network sustaining this λ circulation is under structural strain from the human capital dynamics of the Veneto, as the emigration of graduates progressively reduces the density of the technically skilled workforce on which the cluster's informal prescriptive exchange depends (Intesa Sanpaolo, 2025).

Shunde's epistemic trajectory has been qualitatively different: rather than organic λ deepening through the social mechanisms of geographic proximity, it represents a series of strategic acquisitions of externally accumulated prescriptive knowledge, through which

the cluster — and more precisely its dominant firm, Midea — has progressively supplemented its initially shallow lambda with manufacturing know-how and engineering capabilities imported from technologically more advanced producers. The technology licensing agreements of the 1980s and 1990s, the strategic coupling with Japanese and European technology partners documented by Liu and Yang (2014), and the global M&A strategy of Midea in the 2010s and 2020s are all instances of the same underlying mechanism: the deliberate reduction of access costs to specific domains of external lambda through commercial and organisational means. In Mokyr's terms, what Midea acquired through these operations was not propositional knowledge — the scientific principles underlying robotics, climate technology, or kitchen appliance engineering remain embedded in the universities and research institutes that generated them, and cannot be purchased — but the prescriptive knowledge accumulated by experienced producers: the manufacturing routines, product design capabilities, quality control procedures, and skilled workforces that constitute the operational lambda of the acquired firms.

This difference in lambda acquisition mechanism has two important implications. First, Shunde's approach is in principle faster and more scalable than the Inox Valley's: acquiring a firm that has accumulated the desired prescriptive capabilities through decades of productive experience is quicker than building those capabilities organically, and it can be done at any scale if the financial resources are available. The speed at which Midea has expanded its prescriptive base through M&A — from KUKA's robotics manufacturing capabilities to Teka's kitchen appliance engineering know-how to ARBONIA's climate technology production routines — would be impossible to replicate through the organic processes of cluster-level lambda accumulation. Second, however, prescriptive knowledge acquired through acquisition is not automatically distributed through the broader cluster. The lambda embodied in the firms Midea has acquired does not circulate freely to the 3,000 supporting enterprises in the Shunde ecosystem; it

remains embedded in Midea's corporate structure and generates competitive advantage for Midea specifically, rather than for the cluster as a collective.

The Inox Valley's knowledge architecture, by contrast, generates positive externalities for the cluster as a whole: when a skilled engineer moves from one firm to another, when a supplier relationship generates informal technical exchange, when a vocational school trains students who subsequently enter multiple different firms, the prescriptive knowledge that circulates — the techniques, routines, and product design capabilities that constitute the cluster's lambda — is not appropriated by any single firm but becomes part of the shared epistemic commons described in Section 3.8. This mechanism is well established in the Marshallian and neo-Marshallian literature on industrial districts: as Breschi and Lissoni (2001) document, knowledge in geographically concentrated industrial communities tends to diffuse through the social networks of practitioners rather than remaining enclosed within corporate boundaries, generating localized knowledge externalities that are available to all firms embedded in the network. It is on this basis that Becattini (1987) argued that the Italian industrial district constitutes not merely an economic organization but a socio-territorial community in which productive knowledge is a collective rather than purely private good.

This distributed lambda architecture has two analytically important properties that the comparison with Shunde illuminates. First, it is structurally difficult to replicate through the mechanisms available to a dominant firm such as Midea: corporate R&D investment and international acquisitions can build proprietary prescriptive capabilities rapidly and at scale, but they cannot generate the distributed, socially embedded, network-mediated lambda externalities that characterize a functioning Marshallian district. Saxenian (1994) argues that network-based industrial architectures — in which knowledge circulates freely through inter-firm mobility and social exchange rather than being internalized within corporate boundaries — tend to exhibit greater adaptive capacity in the face of technological paradigm shifts than vertically integrated firm-internalized models, precisely because the distributed network can reconfigure itself around new

technological opportunities without depending on the strategic decisions of any single dominant actor. Second, and paradoxically, this same architecture is institutionally fragile: unlike corporate R&D, which can be sustained through financial investment as long as the firm remains profitable, the social network through which the cluster's lambda circulates depends on the maintenance of a dense, active, and technically skilled community of practitioners. As the human capital dynamics identified in Chapter 4 suggest — and as the net emigration of approximately 11,500 Veneto graduates between 2013 and 2023 confirms (Intesa Sanpaolo, 2025) — this community is under structural strain that financial investment alone cannot easily reverse.

A third, prospective dimension of the comparison concerns the response of each cluster to the expansion of the relevant Omega required by the digital and sustainability transitions. Both clusters face the same structural challenge: the propositional knowledge domains that are becoming decisive for competitive differentiation — software engineering, artificial intelligence, IoT connectivity, energy systems, circular economy design — are qualitatively different from the technical domains in which each cluster has historically excelled, and neither cluster has historically been a producer of Omega. The critical difference lies in the mechanisms available to each for accessing this new propositional knowledge and converting it into new lambda. Midea can pursue Omega access through systematic corporate R&D investment and through partnerships with universities and research institutes at a scale and pace that no cluster of Inox Valley SMEs can match individually; the lambda required to operationalize that Omega can then be built through the same M&A mechanism that has served Midea throughout its international expansion. The Inox Valley's response — which must necessarily be more diffuse, more gradual, and more institutionally dependent — requires investment in the collective knowledge infrastructure capable of mediating access to new external Omega: precisely the kind of university-industry linkages, competence centres, and collaborative R&D programmes that the SMACT Competence Centre and the emerging Parco

Industriale initiative represent, but at a much greater scale and depth than those initiatives currently provide.

5.8.2 The Schumpeter Lens: Two Paths of Creative Destruction

The Schumpeterian framework reveals a striking contrast in the mechanisms and agents of creative destruction that have shaped the two clusters' histories — a contrast that illuminates important structural differences in how innovation is organized and sustained in each case. For Schumpeter, the specific form that creative destruction takes in any given economic system is not predetermined by the abstract logic of capital accumulation but is shaped by the institutional conditions of the time and place in which it occurs: the nature of entrepreneurial agency available, the competitive regime that obtains, and the organisational forms through which innovation is pursued (Schumpeter, 1942). The Inox Valley and Shunde illustrate this institutional specificity with particular clarity: both have experienced significant episodes of creative destruction that have fundamentally reshaped their productive structures, but the agents, mechanisms, and consequences of those episodes have been radically different in each case, reflecting the radically different institutional contexts — post-war Italian family capitalism and post-reform Chinese state-market hybridity — within which each cluster has developed.

The Inox Valley's founding episode of creative destruction was prototypically Schumpeter Mark I: individual workers, carriers of the tacit knowledge accumulated at Zoppas and Zanussi, exited the established firms to found new enterprises, bringing with them the prescriptive knowledge of stainless-steel fabrication and applying it to new product categories and market niches. The agents of this creative destruction were individual entrepreneurs acting on private initiative and market opportunity, without state direction or institutional planning.

Three features of this process deserve analytical attention. First, it was decentralized: no single actor — neither the state, nor a dominant firm, nor a coordinating institution —

directed the formation of the cluster's productive ecosystem. Each spin-off decision was taken independently by an individual or small group of workers responding to perceived market opportunities, and the cumulative result was an industrial structure that emerged from the interaction of hundreds of individual choices rather than from any collective design. This is precisely the spontaneous order that Schumpeter (1934) associated with the Mark I regime: innovation as an emergent property of decentralized entrepreneurial competition rather than as the planned output of organized R&D. Second, the process was organic in the sense that each new venture grew out of the existing knowledge base of the cluster rather than introducing knowledge from outside it: the founders of spin-off firms did not bring new propositional knowledge from external scientific or technological communities, but recombined and extended the prescriptive knowledge they had already accumulated through their experience at Zoppas and Zanussi. In Mokyr's terms, the expansion of the cluster's lambda was driven primarily by the recombination of an existing shared Omega rather than by its expansion — a characteristic of the organic deepening trajectory that distinguishes the Inox Valley's founding dynamic from the technology licensing and strategic coupling mechanisms that characterized Shunde's early development. Third, the process was cumulative in the sense identified by Marshall (1919) in his analysis of industrial districts: each new enterprise that entered the cluster added to the shared pool of knowledge, skills, and productive relationships available to all cluster members, generating the positive externalities that made subsequent entrepreneurial entry progressively easier and more productive. The knowledge that a former Zoppas worker carried into a new venture became, through labor market mobility and inter-firm exchange, part of the epistemic commons available to the next generation of entrepreneurs — a self-reinforcing dynamic that sustained the cluster's innovative vitality across multiple generations of firms and founders (Salvador, 2020)."

Shunde's foundational episode of creative destruction was, by contrast, institutional rather than entrepreneurial: it was the privatization of TVEs between 1992 and 1995 that

constituted the decisive structural rupture in the cluster's history. This episode does not fit neatly into either the Mark I or Mark II category as Schumpeter defined them. It was not driven by individual entrepreneurial innovation introducing a new product, process, or market; nor was it the result of systematic corporate R&D displacing an existing technology. Rather, it was a political-institutional transformation that destroyed an existing organisational form — collective TVE ownership — and replaced it with a new one — private corporate ownership — that proved far more conducive to innovation and value creation. This institutional creative destruction, driven by local state actors rather than by entrepreneurs or corporations, underscores the importance of the political-institutional dimension of Schumpeter's theory that is sometimes underemphasized in standard treatments: the observation that the institutional environment is not merely a backdrop to entrepreneurial innovation but an active determinant of whether creative destruction generates productive or destructive outcomes.

The evolution of the Schumpeterian regime in each cluster since its founding phase also reveals important differences. The Inox Valley has remained predominantly in a Mark I/II hybrid regime: the cluster's SME network continues to generate significant entrepreneurial dynamism at the firm level, even as the larger cluster firms have progressively institutionalized their innovation processes. This hybrid regime generates both the resilience of distributed innovation and the vulnerability of limited R&D resources. Shunde's regime has evolved more dramatically: from the collectivist stasis of the TVE period, through the entrepreneurial dynamism of the post-privatization phase (a genuine Mark I moment), to the highly routinised, systematic, and corporate innovation regime that characterizes Midea today. Midea's R&D operation — 23,000 researchers across 33 global centers, investing over RMB 16 billion annually, pursuing 230 industry standard revisions simultaneously — is a paradigmatic Mark II regime: innovation as a managed, predictable, and systematically resourced corporate process rather than as the outcome of individual entrepreneurial insight.

The implications of this regime difference for creative destruction dynamics are significant. In the Inox Valley, creative destruction at the firm level remains relatively active: new entrants can and do challenge incumbents in specific niches, and the cluster's productive diversity is sustained by the continuous entry and exit of specialized firms. In Shunde, the dominance of Midea has progressively shifted the cluster's innovation dynamics towards the Mark II pattern that Schumpeter (1942) identified in mature capitalist systems: a reduction in entrepreneurial entry as the dominant firm's advantages become increasingly difficult to overcome, and a corresponding risk of the 'leadership paradox' identified by Akcigit (2024), in which sustained market dominance progressively shifts organisational attention from innovation to incumbency defense.

This observation carries a counterintuitive implication for the comparative assessment of the two clusters. Despite — or perhaps because of — the Inox Valley's apparent disadvantage in financial scale and R&D resources relative to Midea, its more distributed and entrepreneurially active regime may prove more resilient to the kinds of technological disruption that a highly concentrated Mark II regime struggles to accommodate. Martin and Sunley (2011) argue that industrial clusters maintain their adaptive capacity through cycles of creative destruction at the firm level: the exit of firms that cannot adapt to new technological requirements releases resources and knowledge that new entrants can recombine in novel ways, sustaining the cluster's innovative variety over time. In a more distributed regime — where no single firm accounts for a dominant share of the cluster's innovative activity — this mechanism operates continuously and without dependence on any single actor's strategic choices. Boschma and Lambooy (1999) make the related point that path dependence and lock-in in industrial clusters are more likely to arise when the cluster's innovative trajectory becomes too closely aligned with the capabilities and interests of a small number of dominant actors. Whether the Inox Valley's distributed regime will in practice prove more adaptive than Shunde's concentrated model in navigating the current digital and sustainability transition is a question that the available

evidence does not yet allow to answer; it is advanced here as an interpretive proposition grounded in the cluster evolution literature, and as a direction for future empirical research.

5.8.3 The Economic Complexity Lens: Related Deepening versus Scale-Enabled Jumping

The economic complexity framework of Hausmann and Hidalgo (2014) provides a third analytical perspective that illuminates a fundamental difference in the two clusters' strategies for navigating the Product Space — a difference that is not captured by either the Mokyr or the Schumpeter framework alone. Where the Mokyr framework focuses on the character and architecture of knowledge, and the Schumpeter framework focuses on the agents and mechanisms of innovation, the economic complexity framework focuses on the observable productive outcomes of knowledge-based competition: the portfolio of products and capabilities that a cluster occupies at any given moment, and the trajectory through which that portfolio evolves. By mapping each cluster's position in the Product Space and identifying the logic of its diversification moves, the framework makes it possible to assess, even in the absence of direct measurement of knowledge stocks or innovation inputs, the structural character of each cluster's competitive advantage and the plausibility of different future trajectories. This is particularly valuable for a comparison between two clusters in different countries, where direct data on knowledge stocks and R&D investments are not always comparable.

As argued in Chapter 4, the Inox Valley's trajectory in the Product Space can be characterized as one of related deepening: the cluster has expanded its productive portfolio through small, cognitively close moves that leverage and extend the stainless steel and mechanical engineering capabilities at its core. The move from domestic appliances to professional food service equipment required an extension of the relevant lambda into hygiene engineering, blast chilling, and modular kitchen design, but this

extension was grounded in the same Omega of stainless-steel metallurgy, thermal engineering, and precision manufacturing that the cluster had already mastered. Similarly, the subsequent move towards connected and digitally enabled products requires an extension into software, IoT, and data analytics — but this extension can, in principle, be achieved by adding new capabilities to the existing productive base without abandoning its foundations. In the Product Space mapping of Hidalgo, Klinger, Barabási, and Hausmann (2007), the Inox Valley's trajectory corresponds to a path of short, dense steps through the interconnected core of the Space, each leveraging the capabilities of the previous position to access the next.

Shunde's trajectory in the Product Space, particularly in its most recent phase, is qualitatively different: it can be characterized as scale-enabled jumping — the ability to make large, cognitively distant moves in the Product Space through the acquisition of firms that already possess the relevant capabilities. The acquisition of KUKA moved Midea from the domestic appliance segment into the industrial robotics segment — a jump of considerable cognitive distance that would be essentially impossible to achieve through organic capability development at the speed that Midea accomplished it. The acquisitions of Toshiba Home Appliances (Japan), Clivet (Italy), Teka (Spain/Germany), and ARBONIA Climate (Switzerland) represent similarly ambitious moves across the Product Space, each accessing new capability domains that Midea could not have generated internally in the relevant timeframe.

This comparison of trajectories reveals a fundamental trade-off between the two strategies. The Inox Valley's related deepening strategy is more resilient in the sense that the capabilities built through each incremental move remain embedded in the cluster's institutional fabric — in its firms, workers, training institutions, and inter-firm networks — and cannot be lost through a single corporate decision. The knowledge is distributed and socially embedded, making it durable across firm-level changes in ownership or strategy. Shunde's scale-enabled jumping strategy is faster and more

ambitious, able to access distant regions of the Product Space in years rather than decades; but the capabilities acquired through acquisition are concentrated in corporate structures that can be divested, restructured, or geographically relocated without the cluster as a whole retaining the knowledge. If Midea were to divest KUKA, for example, the robotics knowledge that KUKA embodies would leave the Shunde cluster with it; if an Inox Valley firm loses key engineers to a competitor, the tacit knowledge those engineers carry remains largely within the cluster through the labor market.

The economic complexity framework also illuminates a significant asymmetry in the current competitive positions of the two clusters. At the product level, Shunde's cluster generates products spanning an extremely wide range of the Product Space — from simple kitchen utensils to sophisticated industrial robots — but the highest-complexity products in that range are accessible only through Midea's corporate M&A strategy, not through the organic capability building of the cluster's SME ecosystem. The Inox Valley's productive portfolio is narrower in range but more deeply embedded in the cluster's collective capability base: every firm in the cluster can draw on the shared epistemic commons of stainless-steel knowledge to develop new products and processes, whereas only Midea and a few of the largest Shunde firms can access the robotics, AI, and climate technology knowledge that Midea has acquired through acquisition. In economic complexity terms, the Inox Valley's ECI-equivalent profile — if it could be measured at the cluster level — would likely show a concentrated but genuinely embedded complexity in a specific region of the Product Space, while Shunde's profile would show a broader but more unevenly distributed complexity, concentrated in the capabilities of the dominant firm.

5.9 Synthesis: What the Comparison Reveals

The comparative analysis of the Inox Valley and Shunde across the three analytical lenses of Mokyr, Schumpeter, and economic complexity generates several observations

that are not accessible from a purely internal analysis of either cluster. Comparison, in this context, functions as an analytical amplifier: it makes visible features of each cluster's knowledge architecture, innovation regime, and productive trajectory that would remain invisible or underspecified if each cluster were studied in isolation. The observations that follow are presented as interpretive propositions grounded in the available evidence, not as empirically tested conclusions; they represent the analytical yield of the comparison rather than established facts about the clusters' futures.

The first is that the two clusters represent genuinely alternative models of industrial competitive advantage in the same broad industry — not a hierarchy in which one model is superior, but a genuine diversity of viable strategies with different strengths and vulnerabilities. On an interpretive basis, it can be argued that the Inox Valley's distributed tacit knowledge model is more deeply embedded in its territorial institutional fabric and more conducive to the kind of continuous incremental innovation that sustains competitive differentiation in specialized premium segments — a form of resilience that derives precisely from the distributed character of its knowledge architecture, as the cluster evolution literature suggests (Martin and Sunley, 2011; Boschma and Lambooy, 1999). Shunde's concentrated-knowledge, scale-enabled model is, by contrast, more financially powerful and more capable of making rapid and ambitious moves across the Product Space through acquisition, as Midea's documented trajectory confirms (Midea Group, 2024). Neither model dominates on all dimensions; each is vulnerable in ways the other is not, and the comparison is best read as an illustration of the institutional specificity of competitive advantage rather than as a ranking of alternative strategies.

The second observation concerns the role of the institutional context in shaping the knowledge architecture of each cluster. The Inox Valley's distributed knowledge model is inseparable from the institutional context of Italian industrial districts: the family ownership culture, the inter-firm trust networks, the vocational training systems, and the territorial identity that sustains the social fabric of knowledge circulation. Shunde's

concentrated-knowledge model is equally inseparable from its institutional context: the active role of the local developmental state, the banking relationships that sustained firm growth, and the political backing for Midea's global M&A strategy. Neither model could simply be transplanted to the other's institutional context — a point consistent with the broader argument in the evolutionary economic geography literature that productive knowledge and competitive capabilities are path-dependent and institutionally embedded in ways that resist deliberate replication (Boschma and Lambooy, 1999). The implication is that any evaluation of the Inox Valley's future trajectory must take seriously the specific institutional conditions that have produced and sustained its distinctive knowledge architecture, rather than assuming that the cluster can adopt strategies developed in a radically different institutional environment.

The third observation, and perhaps the most policy-relevant, concerns the diverging human capital dynamics of the two clusters. Shunde's dominant position in the appliance industry — and Midea's status as a Fortune Global 500 company with 190,000 employees and RMB 16 billion in annual R&D investment — attracts talent from across China and increasingly from abroad. The cluster's growing innovation intensity creates career opportunities that, on an interpretive basis consistent with the human capital and agglomeration literature, may reinforce its attractiveness to skilled workers over time — a dynamic that stands in structural contrast to the Inox Valley's documented net emigration of graduates. The Inox Valley's human capital dynamics are, as documented in Chapter 4, moving in the opposite direction: the net emigration of graduates from the Veneto, combined with the difficulty of attracting digital talent to a geographically peripheral cluster of SMEs, represents a structural vulnerability that is not self-correcting through market mechanisms alone. The comparison with Shunde underscores the urgency of addressing this vulnerability: in the long run, the knowledge base of a cluster is only as strong as the human capital that carries and renews it.

5.10 Summary Comparative Table

Table 5.1 summarizes the comparative analysis across the principal dimensions discussed in this chapter. The characterizations are based on the interpretive analysis of the preceding sections and should be read as analytical propositions rather than established facts.

Dimension	Inox Valley (Italy)	Shunde/Foshan (China)
Founding mechanism	Entrepreneurial spin-off from Zoppas/Zanussi; tacit knowledge carrier workers become entrepreneurs	TVEs (collective local government enterprises) → privatization 1992–1993; state-directed industrialization
Schumpeter regime	Mark I founding; progressive hybridization toward Mark II in mature firms	Pre-market collective regime (TVEs) → Mark I entrepreneurial regime post-privatization → advanced Mark II (Midea)
Dominant Omega (propositional base)	Stainless steel metallurgy, thermo-mechanical engineering, food science, regulatory compliance knowledge	Initially: process replication efficiency. Now: AI, robotics, digital manufacturing, smart home connectivity
Knowledge access mechanism	Social proximity, inter-firm spillovers, shared labor market, tacit knowledge circulation; low formalization	State-directed R&D centers, acquisitions of foreign firms (KUKA, Toshiba), 33 global R&D centers
Diversification path	Related deepening within inox ecosystem: domestic appliances → professional	Scale-enabled jumping: appliances → robotics → HVAC → automotive components → healthcare

Dimension	Inox Valley (Italy)	Shunde/Foshan (China)
	food equipment → blast chilling → connected products	
Industrial structure	Dense SME network + anchor firms (Electrolux, De'Longhi); horizontal knowledge spillovers; no dominant single firm	Midea as hyper-dominant anchor (RMB 409bn revenue 2024); 3,000+ supporting firms in 50km radius
Digital transition	Heterogeneous; accelerating under regulatory pressure; human capital constraint	Advanced: Midea started 2011; 6 WEF Lighthouse Factories; 33% of major firms digitally transformed
Institutional support	Chambers of commerce, industry associations, technical schools; Parco Industriale (2024)	Active local government (Shunde district); Shunde Rural Commercial Bank; state-backed M&A strategy
Main strength	Tacit knowledge depth, diversity, related variety, export relational capital	Scale, cost efficiency, digital leadership (Midea), state backing, supply chain density (80% within 50km)
Main vulnerability	Human capital gap, servitization lag, commercial fragmentation, digital transition heterogeneity	Geopolitical exposure (US tariffs), dependence on Midea as single dominant actor, brand premium ceiling in professional segment

Table 5.1 — Comparative overview of the Inox Valley and the Shunde/Foshan cluster across principal analytical dimensions. Source: author's elaboration on the basis of the sources cited in this chapter.

5.11 Conclusion

This chapter has offered an in-depth comparative analysis of the Inox Valley and the Shunde/Foshan cluster, two of the world's most significant productive concentrations in the home appliance and professional kitchen equipment industry. The comparison has been structured in two parts: a descriptive profile of the Shunde cluster using the same six analytical categories applied to the Inox Valley in Chapter 3, followed by a comparative analysis through the three theoretical lenses of Mokyr, Schumpeter, and economic complexity.

The analysis has revealed that the two clusters represent genuinely alternative models of competitive advantage — the Inox Valley's distributed tacit knowledge model versus Shunde's concentrated-knowledge, scale-enabled model — with different strengths, vulnerabilities, and institutional conditions. The Mokyr framework has shown that the two clusters differ fundamentally in how their propositional knowledge bases are generated, accessed, and distributed. The Schumpeter framework has revealed that the two clusters have followed radically different paths of creative destruction — entrepreneurial spin-off versus institutional privatization — and have evolved towards different innovation regimes with different implications for long-run dynamism. The economic complexity framework has shown that the two clusters have pursued different strategies for navigating the Product Space — related deepening versus scale-enabled jumping — with different implications for the embeddedness and resilience of their productive capabilities.

The most important analytical conclusion emerging from this comparison is that the Inox Valley's distributed knowledge architecture — here identified as one of its most distinctive competitive assets — is simultaneously one of its most significant institutional vulnerabilities. It depends on the maintenance of a dense, active, and high-quality social network of firms, workers, and institutions that is currently under structural strain from

the human capital dynamics, digital capability gaps, and commercial fragmentation identified throughout this thesis. The comparison with Shunde makes this vulnerability analytically visible in a way that an internal analysis of the Inox Valley alone could not: it is precisely because Shunde's model concentrates knowledge within a single dominant firm with the financial resources to sustain its R&D investment independently of local labor market conditions that the contrast with the Inox Valley's socially distributed architecture becomes analytically sharp.

CHAPTER 6. Conclusions: Knowledge, Creative Destruction, and the Future of the Inox Valley

6.1 Introduction

This concluding chapter draws together the analytical threads developed across the preceding five chapters and offers a synthesis of the thesis's principal findings. It does not repeat the descriptive or analytical content of the preceding chapters but seeks to present, in integrated form, what that content collectively reveals about the object of study and about the theoretical framework applied to it.

The thesis has proposed a reading of the Inox Valley industrial cluster through three complementary analytical lenses: Mokyr's framework of useful knowledge, which provides the tools to understand how the evolution of propositional knowledge bases opens and closes possibilities for prescriptive innovation, and how the social and institutional infrastructure of a cluster shapes the costs of accessing relevant knowledge; Schumpeter's theory of creative destruction, which explains how entrepreneurial agency and institutional change translate knowledge possibilities into market realities, and how successive waves of innovation reshape industrial structures over time; and the economic complexity framework of Hausmann and Hidalgo, which provides an aggregate measure of the sophistication and diversity of a cluster's productive knowledge portfolio and a map of the trajectories available for its future evolution. Together, these three lenses have been applied first to the Inox Valley's own history across four chronological phases, and then to a comparative analysis with the Shunde/Foshan cluster in China — a case that shares the same broad industry but has followed a radically different developmental trajectory.

It should be recalled at the outset that this thesis is primarily a desk-based work, drawing on published and publicly available secondary sources as its principal evidential base. It

does not draw on primary empirical research in the form of structured interviews, surveys, or systematic data collection. The analytical conclusions it reaches are interpretive propositions grounded in the available evidence rather than empirically tested hypotheses, and they should be read as such. At the same time, the author brings to this analysis a professional positionality that has meaningfully shaped its interpretive framework. The author is currently employed as Strategic Sales Manager at Irinox S.p.A., one of the most internationally recognized firms within the Inox Valley cluster and a global leader in professional blast chilling and food preservation technology. Prior to this position, the author worked at Unox S.p.A., a highly innovative Padua-based manufacturer of professional combi ovens that, while not part of the Inox Valley cluster geographically, represents one of the most significant players in the professional food equipment industry of the Italian North-East. Through these professional experiences, the author has accumulated direct observational knowledge of the cluster's competitive dynamics, organizational culture, and strategic challenges, and has had access to informal conversations with entrepreneurs, managers, and colleagues active within the Inox Valley ecosystem, as well as to institutional documents that are not publicly available. This professional insider knowledge has informed the interpretive propositions of the thesis, particularly in the chapters addressing the cluster's current transition and emerging institutional responses. Where this knowledge has influenced specific observations, it is framed as such in the text. Individual interlocutors and firms are not identified, in order to protect the privacy of those whose informal contributions have shaped the author's understanding and to avoid tying the thesis's analytical conclusions to the perspectives of specific actors. The author has sought to maintain analytical distance through the consistent application of the theoretical frameworks and the explicit qualification of all interpretive claims; but readers engaging critically with the conclusions should bear this positionality in mind, as it is honest to acknowledge both its analytical value and its potential for partiality.

6.2 The Central Analytical Conclusion

The central analytical conclusion of this thesis is that the Inox Valley is best understood not as a static concentration of stainless-steel manufacturing competences but as a dynamic knowledge system whose competitive advantage is grounded in the depth, tacit richness, and distributed character of its epistemic base. This characterization has three dimensions that deserve to be stated precisely.

The first dimension is epistemological. In Mokyr's framework, the cluster's competitive advantage is grounded in a propositional knowledge base — an Omega — that has been progressively deepened across seven decades through the cumulative experience of hundreds of firms working on related technical problems, and through the informal circulation of tacit knowledge enabled by geographic concentration. The key feature of this epistemic architecture is that it is distributed: the relevant knowledge is not concentrated in any single firm's R&D laboratory or patent portfolio but is embedded in the social network of practitioners — engineers, technicians, entrepreneurs, and workers — who constitute the cluster's epistemic community. This distributed architecture generates the positive externalities that Breschi and Lissoni (2001) identify as the defining feature of cluster-level knowledge systems: knowledge circulates through inter-firm labor mobility, supplier relationships, and informal exchange without being fully appropriated by any single actor, making it available to the cluster as a collective good. It also generates the cluster's most durable competitive protection: a knowledge base that is distributed, tacit, and socially embedded is genuinely difficult to replicate through the mechanisms available to firms competing through different organizational models — whether the concentrated corporate R&D of a Midea, analyzed in the comparative chapter, or the acquisition-driven portfolio assembly that characterizes the major global conglomerates in the professional food equipment sector.

The second dimension is dynamic. In Schumpeter's framework, the cluster's history is a succession of creative destruction episodes in which new knowledge, new organizational

forms, and new market relationships have displaced established ones, generating renewal rather than stagnation. Phase I saw the founding creative destruction episode par excellence: the spin-off dynamic through which workers from Zoppas and Zanussi established independent ventures, dispersing tacit knowledge across an emerging network of specialized firms. Phase II brought the crisis and consolidation of the white goods industry, the restructuring of large anchor firms including the Electrolux acquisition of Zanussi, and the first significant diversification into professional food service equipment. Phase III witnessed the maturation of the professional food service segment and the rise of blast chilling and precision refrigeration as high-complexity niches in which the cluster achieved genuine global leadership. Phase IV confronts the cluster with the twin imperatives of digital transition and sustainability, which together constitute the most demanding episode of creative renewal in the cluster's history because they require an expansion of the relevant knowledge base into domains qualitatively discontinuous from its historical foundations. What is consistent across all four phases is that productive renewal has depended on the cluster's capacity to access and absorb the new propositional knowledge required by the changed competitive environment.

The third dimension is structural. In the economic complexity framework, the cluster's trajectory corresponds to a strategy of related deepening — progressive moves into nearby regions of the Product Space, each leveraging and extending the capabilities already in place, rather than the scale-enabled jumping across distant regions of the Product Space that characterizes Midea's global acquisition strategy. This strategy is well-suited to the institutional architecture of an Italian industrial district: it generates capabilities that are genuinely embedded in the cluster's social fabric rather than concentrated in a single corporate structure, and it is self-reinforcing in the sense that each diversification move enriches the shared epistemic commons available to all cluster firms. Its limitation — visible in the comparison with Shunde — is that it is slower and more institutionally dependent than scale-enabled jumping, and it may not be able to

match the pace of the current technological transition without deliberate institutional support.

The comparison with Shunde renders this conclusion analytically more precise in two ways. First, it demonstrates that the distributed knowledge architecture of the Inox Valley is not a generic feature of all successful appliance clusters but a specific institutional achievement that reflects the particular history and social infrastructure of the Italian district model. Second, the comparison reveals that this architecture is simultaneously one of the cluster's most difficult-to-replicate competitive asset and its most urgent institutional vulnerability, because it depends on the maintenance of a dense and active social network of practitioners that is currently under structural strain from the human capital dynamics of the Veneto.

6.3 Answering the Analytical Questions

6.3.1 The Evolution of Epistemic Bases and Access Costs

The analysis has identified a pattern of progressive epistemic expansion across the cluster's four phases that corresponds directly to the chronological trajectory described in Chapter 3. In Phase I — Industrial Foundation — the relevant Omega was electro-mechanical engineering and stainless-steel metallurgy, accessed primarily through the social mechanism of the spin-off process: tacit knowledge circulated from the Zoppas and Zanussi anchor firms to the emerging network of independent specialized producers. In Phase II — Crisis, Consolidation and Diversification — the cluster's epistemic base expanded under competitive pressure: the crisis of the white goods segment forced firms to diversify into professional food service equipment, requiring new prescriptive knowledge in kitchen engineering, catering systems, and the specific technical requirements of the HoReCa market. In Phase III — Maturation and the Rise of Food Service Equipment — the cluster deepened its lambda significantly, developing world-

leading capabilities in blast chilling technology, precision refrigeration, and modular professional kitchen systems, partly driven by the prescriptive requirements of HACCP food safety regulations that created new competitive frontiers for firms with the relevant engineering knowledge. In Phase IV — Digital Transition and Sustainability Challenges — the cluster is required to expand its Omega into software engineering, AI, IoT connectivity, and environmental systems science: domains qualitatively discontinuous from its historical base and that carry substantially higher access costs than the previous expansions. The mechanism of access cost reduction has remained fundamentally the same throughout all four phases: the social infrastructure of co-location — shared labor markets, inter-firm mobility, dense supplier networks, and institutional support from chambers of commerce and technical schools. This mechanism is effective for tacit, practice-based knowledge but significantly less effective for the codified, formally trained, and rapidly evolving domains the current transition requires. The increasing strain on the cluster's human capital base, documented in Chapter 4 through the data on graduate emigration from the Veneto, is the most direct empirical indicator of this structural limitation: between 2013 and 2023, the Veneto recorded a net loss of approximately 11,500 graduates aged 25–39 (Intesa Sanpaolo, 2025), a figure that directly measures the erosion of the social network on which the cluster's knowledge architecture depends.

6.3.2 Episodes and Mechanisms of Creative Destruction

The analysis has identified creative destruction dynamics across all four phases of the cluster's development, each operating through distinctive mechanisms and agents. In Phase I, the founding creative destruction episode was prototypically Schumpeterian Mark I: individual workers and entrepreneurs, carrying tacit knowledge from Zoppas and Zanussi, created new productive units that collectively displaced the vertically integrated model of the anchor firms while enriching the cluster's epistemic commons. In Phase II, the crisis of the white goods sector and the subsequent consolidation — culminating in

the Electrolux acquisition of Zanussi — constituted an episode of market-driven and corporate creative destruction that forced diversification away from domestic appliances and toward the professional food service segment, releasing productive resources and knowledge that the emerging cluster network could absorb and recombine. In Phase III, the maturation of the food service equipment segment generated creative destruction within the cluster itself: firms that successfully deepened their capabilities in blast chilling, precision refrigeration, and HACCP-compliant engineering displaced those that remained anchored to lower-complexity products, progressively reshaping the cluster's productive hierarchy. In Phase IV, the digital and sustainability transitions are generating a new episode of creative destruction whose agents are multiple and diffuse — technology platform providers, global conglomerates with superior digital capabilities, and regulatory bodies setting sustainability standards — and whose outcome for the cluster remains open. What is consistent across all four phases is that productive renewal has depended on the cluster's capacity to access new propositional knowledge. The comparison with Shunde has enriched this account by showing, through contrast, the specifically Italian character of the Inox Valley's creative destruction: where all four Italian episodes were driven by market forces, entrepreneurial initiative, or regulatory pressure operating within a context of private ownership and competitive markets, Shunde's foundational episode was driven by deliberate institutional action from above — the state-directed privatization of Township and Village Enterprises between 1992 and 1995. Different institutional architectures, operating within the same broad industry, have produced radically different patterns of creative destruction with different implications for the distribution of innovative capacity within each cluster.

6.3.3 Social and Institutional Conditions of Innovative Activity

The analysis has confirmed the centrality of the social and institutional infrastructure for the cluster's innovative capacity — a finding that is consistent across all four phases of

the cluster's history and that constitutes one of the most robust conclusions of the thesis. The institutional conditions that have sustained the cluster's innovative activity can be organized around three analytically distinct levels.

At the level of knowledge circulation, the cluster's distributed knowledge architecture — constituted by the dense network of inter-firm relationships, the shared labor market for stainless steel and mechanical engineering skills, and the informal exchanges enabled by geographic co-location — has functioned as the primary mechanism through which tacit productive knowledge circulates as a collective good rather than remaining enclosed within individual firm boundaries. As Breschi and Lissoni (2001) argue, this mechanism operates through the social networks of practitioners rather than through formal knowledge transfer channels, and it is precisely because of its social and informal character that it has proven so durable across successive phases of technological change: it does not depend on any single institutional actor to sustain it, but emerges from the density of the social fabric itself.

At the level of human capital reproduction, the vocational training system — combining regional technical schools with the informal apprenticeship and mentoring traditions embedded in cluster firms — has historically reproduced the specialized workforce across generations, ensuring a continuous supply of the tacit skills on which the cluster's prescriptive knowledge depends. This mechanism, however, is under increasing strain in the current phase: as Chapter 4 documents, the digital and sustainability transitions are requiring skills that the existing vocational training infrastructure does not adequately produce, and the net emigration of graduates from the Veneto is reducing the density of the technically skilled community on which informal knowledge circulation depends.

At the level of collective organization, the chambers of commerce, industry associations, and more recently the Associazione Parco Industriale Prealpi Trevigiane have provided the institutional architecture through which cluster firms coordinate on issues of common interest — from trade promotion and regulatory representation to, in the current phase,

territorial attractiveness and governance quality. The significance of these collective institutions is not merely functional: they are the organizational expression of the cluster's identity as a productive community, and their capacity for institutional innovation — exemplified by the IUAV territorial plan and the NATIVA Benefit Corporation proposal described in Section 6.4 — is a direct indicator of the cluster's collective adaptive capacity. The current phase is defined, in this reading, not only by the technological and competitive challenges facing individual firms but by the adequacy or inadequacy of the cluster's institutional architecture to respond to those challenges collectively.

6.3.4 Prospects for Adaptation to New Technological Paradigms

The analysis produces an assessment that is structurally differentiated rather than uniformly optimistic or pessimistic. On the product complexity dimension — the ability to continue deepening technical performance in the cluster's established niches — the prospects are relatively favorable: the accumulated tacit knowledge base in thermal engineering, food science, and stainless-steel fabrication remains a genuine competitive asset, and the cluster's firms have demonstrated consistent capacity for incremental innovation in these domains.

On the servitization dimension — the ability to transition from transactional product sales to integrated service provision — the cluster's current position is weaker. Rational AG's ConnectedCooking platform, with over 150,000 networked users (Rational AG, 2024) and an AI-powered Digital Service Manager analysed in Chapter 5, illustrates the frontier of digital service integration in the professional food equipment industry — a frontier that most Inox Valley SMEs have not yet reached. Drawing on the author's professional experience within the cluster, it can be observed that the commercial model of the large majority of cluster firms remains primarily transactional: revenue is generated through product sales rather than through recurring service contracts, data analytics, or performance-based agreements. This gap will not close without deliberate investment in

software capabilities, service infrastructure, and the organizational transformation that a shift from product-centred to solution-centred commercial models requires.

On the human capital dimension — the ability to attract and retain the software engineers, data scientists, and digital product managers that the transition requires — the structural conditions are challenging. The net emigration of approximately 11,500 Veneto graduates aged 25–39 between 2013 and 2023 (Intesa Sanpaolo, 2025) measures directly the erosion of the social network on which the cluster's knowledge architecture depends. This is not a conjunctural problem that an economic upturn could resolve; it reflects a structural imbalance between the career opportunities available in the cluster's industrial area and those available in larger urban centers in Italy and abroad.

6.4 The Emerging Institutional Response: Initiatives in Context

Against the backdrop of these structural challenges, a set of recent institutional initiatives and organizational responses deserve attention as evidence of an emerging collective and market-driven adaptation that is analytically significant even if its ultimate adequacy cannot yet be assessed. These responses operate on different dimensions — governance, territorial quality, organizational identity, knowledge access, and commercial scale — and are best understood as complementary rather than alternative strategies.

The first is the establishment of the Associazione Parco Industriale Prealpi Trevigiane in October 2024, with Irinox S.p.A. among its nine founding members and the active support of Confindustria Veneto Est (Confindustria Veneto Est, 2024). The Association represents the first formal collective governance structure for the industrial area of San Giacomo di Veglia/Scomigo — an area covering 130 hectares and hosting approximately 100 firms with around 6,000 direct employees. Its establishment represents a form of

organizational innovation in the broad Schumpeterian sense: a new institutional form that did not previously exist in this context, designed to address collective challenges — territorial quality, worker welfare, shared infrastructure — that individual firm strategies cannot resolve independently.

The second is the comprehensive spatial transformation plan developed by the IUAV University of Venice for the Area Produttiva delle Prealpi Trevigiane (Ferrari, Bortolotto and Mantelli, 2024), commissioned by Confindustria Veneto Est and delivered following an extended process of engagement with the founding firms and the municipal administrations of Conegliano and Vittorio Veneto. The IUAV plan is analytically important not only for its concrete proposals but for the diagnosis it offers. As the research documents, the productive area emerged rapidly from the 1950s onward without adequate planning — built alongside an inadequate road network, severing minor waterways, interrupting ecological corridors, and generating approximately 2,100 public parking spaces covering 52,000 square meters that remain largely empty for much of the day, reinforcing the perception of a degraded and inhospitable environment incompatible with the vitality of a competitive industrial district. The scenario proposed for 2025–2040 organizes interventions across three thematic axes — green infrastructure, worker welfare, and alternative mobility — measured against three quality indices of environmental sustainability, worker wellbeing, and area efficiency, phased across three five-year steps. In Mokyr’s framework, this spatial investment is an intervention in the social infrastructure of knowledge access: making the industrial area a more attractive, more connected, and more livable environment is a precondition for the human capital renewal on which the cluster’s distributed knowledge architecture depends.

The third initiative — the most recent and the most ambitious in terms of its governance implications — is the proposal developed by NATIVA in May 2026 to position the Parco Industriale Prealpi Trevigiane as the first industrial association in Europe to adopt the

Benefit Corporation governance framework (NATIVA, 2026, internal document, by permission of the Parco Industriale Prealpi Trevigiane). The Benefit Corporation model formalizes the commitment to create value for all stakeholders — not merely shareholders — through three architectural pillars: a shared purpose inscribed in the association's statutes that guides strategic decisions; an expanded fiduciary duty toward the entire ecosystem in which the association operates; and annual impact reporting according to internationally verifiable standards. The economic rationale for the model is not merely normative: the available data on Italian Società Benefit suggest a consistent performance advantage, with benefit manufacturing firms outperforming non-benefit peers in revenue growth (+14.6 percent versus +5.3 percent between 2022 and 2024), export intensity (68 percent versus 56 percent), and patenting activity (28 percent versus 14 percent of firms holding patents), according to the Ricerca Nazionale sulle Società Benefit (February 2025, cited in NATIVA, 2026). Whether these differentials reflect the causal impact of the Benefit model or the self-selection of more dynamic firms is an open empirical question; but the direction of the association is consistent with the thesis's broader argument that institutional innovation is a productive response to competitive pressure.

A fourth and analytically significant dimension of the emerging institutional response concerns the development of university-industry linkages and open innovation partnerships as mechanisms for reducing access costs to the codified knowledge domains that the digital and sustainability transitions require. This dimension is partly documentable through public sources and partly observable through the author's professional experience within the cluster. At the institutional level, the SMACT Competence Center — founded in December 2018 as a public-private consortium of 40 entities including eight universities of the Triveneto area and twenty-nine private firms, financed with a ministerial grant of seven million euros to support digital technology transfer to SMEs (SMACT, 2018; University of Padova, 2019) — represents the most

significant regional infrastructure for industry-academia knowledge transfer in the Triveneto, with a focus on Social, Mobile, Analytics, Cloud, and Internet of Things technologies directly relevant to the digital transition challenges identified in Chapter 4. Among its founding corporate partners are two firms with direct ties to the Inox Valley: Keyline, a Treviso-based firm and a member of the cluster's productive ecosystem, and Electrolux Italia, the Italian subsidiary of the multinational that acquired Zanussi in 1984 and whose historical connection to the cluster's formation was examined in Chapter 3 (SMACT, 2018; University of Padova, 2019). Le Village by Crédit Agricole Triveneto — the startup accelerator promoted in Padova by Crédit Agricole Italia and co-participated by Confindustria Veneto Est (Le Village by CA Triveneto, 2026) — provides a complementary mechanism for connecting established cluster firms with innovative startups: Irinox S.p.A. is documented among its corporate partners (Crédit Agricole Nordest, 2023). Falmec — a Vittorio Veneto-based manufacturer of kitchen hoods and air treatment systems — has documented a specific research collaboration with the University of Padova for the development and patenting of its NRS noise reduction system (Area-arch.it, 2018). CUOA Business School, founded in 1957 by Lino Zanussi within the University of Padova's Engineering Faculty — a founding detail historically resonant given the Zanussi group's centrality to the cluster's formation — counts Confindustria Veneto Est and Zoppas Industries IRCA among the members of its governing body (CUOA Business School, 2025). These documented partnerships represent the publicly verifiable layer of a broader pattern of university-industry engagement that, on the basis of the author's professional experience within the cluster, extends to additional firms and institutions not systematically documented in publicly available sources. The emergence within some cluster firms of dedicated innovation manager roles — operating alongside or distinct from traditional R&D functions, with a specific mandate to manage open innovation relationships with universities, competence centers, and startup ecosystems — represents a further organizational innovation observed by the author through direct professional experience and informal exchanges

with sector peers. In Mokyr's framework, this is analytically significant: it signals a recognition, at the firm level, that the knowledge required for the current technological transition cannot be generated entirely internally but must be systematically sourced through structured external relationships — a shift in the cluster's epistemic access strategy from exclusive reliance on informal social spillovers toward deliberate open innovation architecture.

It is worth noting that these institutional responses emerge against a background in which voluntary inter-firm cooperation within the cluster has historically been limited. The cluster's characteristic organizational culture — strongly entrepreneurially independent, commercially competitive even among neighboring firms — has not generated the kind of structured collaboration platforms that other European cluster models have developed. The Parco Industriale initiative is significant precisely because it represents a departure from this default: the first formal collective governance structure for the industrial area. Alongside these institutional responses, the market is producing its own answer to commercial fragmentation through financial consolidation: Ali Group, Somec/Talenta, and TheNiceKitchen are all assembling portfolios of Inox Valley and North-East Italian professional equipment brands through acquisition, each adopting a federated model that preserves brand autonomy while generating shared commercial and technological infrastructure. Whether voluntary collective governance and market-driven financial consolidation will prove complementary or competing responses to the cluster's structural challenge is one of the open questions that the current period will answer.

Taken together, these institutional initiatives and market-driven responses constitute what can be described, on an interpretive basis, as a nascent multi-dimensional adaptation strategy for the next phase of the cluster's development — one that addresses, through different mechanisms and at different levels, the territorial attractiveness, governance quality, knowledge access, and commercial scale

dimensions of the cluster's structural challenge. Whether this emerging architecture will prove adequate to the scale and speed of the digital and sustainability transition cannot be determined on the basis of available evidence. What the analytical framework of this thesis does suggest is that the direction of travel is analytically sound: the cluster's competitive advantage is collective in nature, and the institutional forms designed to sustain it must be equally collective in their ambition and scope.

6.5 Methodological Limitations

The interpretive conclusions of this thesis are subject to several methodological limitations that deserve explicit acknowledgment, presented not as weaknesses to be minimized but as honest characterizations of the scope of the work.

The most significant limitation is the desk-based character of the research. The thesis draws primarily on secondary sources — academic literature, institutional reports, company documents, and statistical data — supplemented by professional insider knowledge acquired through direct experience in the cluster, informal conversations with practitioners, and access to non-public institutional documents. It does not generate new primary data through structured fieldwork or surveys. This means that the thesis's central analytical claims — about the density of inter-firm knowledge flows, the access costs to different knowledge domains, the firm-level effects of the digital transition — are grounded in inference from available evidence rather than in direct measurement.

The second limitation concerns the asymmetry of the comparative analysis in Chapter 5. The description of the Inox Valley draws on a rich and diverse set of sources, including the author's direct professional experience at Irinox S.p.A. The description of Shunde relies primarily on Liu and Yang (2014) and on corporate sources of variable comparability. The comparative conclusions of Chapter 5 should therefore be treated as analytically suggestive rather than definitive: they identify structural differences that are

plausible and theoretically grounded, but that would require primary fieldwork in both clusters to be confirmed with confidence.

The third limitation concerns the economic complexity framework as applied at the cluster level. As noted in Chapter 4, provincial-level complexity measures for Italy carry known methodological limitations (Basile and Cicerone, 2022), and the analysis of the cluster's position in the Product Space has therefore been conducted on a qualitative and interpretive basis rather than through formal quantitative measurement.

The fourth limitation concerns positionality. The author's professional position at Irinox S.p.A. has provided access to sources and perspectives that would otherwise not have been available, but it also introduces the risk of partiality toward the narratives and perspectives dominant within the cluster's leading firms. The author has sought to maintain analytical distance through the consistent application of the theoretical frameworks and the explicit qualification of interpretive claims, but readers engaging critically with the conclusions should bear this positionality in mind.

6.6 Directions for Future Research

The limitations identified in the preceding section point toward several productive directions for future research on the Inox Valley and on the broader questions of cluster knowledge dynamics and adaptive capacity that this thesis has engaged.

The most immediately productive direction would be a primary firm-level survey of the Inox Valley cluster's digital technology adoption, servitization progress, human capital dynamics, and inter-firm knowledge exchange patterns. Such a study could directly measure the density and productivity of inter-firm social networks, the role of labor mobility in knowledge diffusion, the relationship between network participation and innovation performance, and the differential access costs to digital and sustainability knowledge domains across firms of different sizes and ownership structures. A second

important direction is a longitudinal study of the cluster's response to the digital and sustainability transitions over the coming decade. The institutional initiatives described in Section 6.4 are all too recent to assess in terms of their competitive impact. A follow-up study conducted in five to ten years' time, drawing on both quantitative performance data and qualitative fieldwork, could assess whether the Parco Industriale initiative, the IUAV territorial plan, the NATIVA Benefit framework, and the university-industry partnership ecosystem have succeeded in addressing the structural vulnerabilities identified in this thesis.

A third direction is a more systematic comparative analysis of the Inox Valley and the Shunde cluster, addressing the asymmetry of evidence identified as a limitation of the present work. Such a study would require primary fieldwork in both clusters — interviews with firm managers, workers, and institutional actors in both Treviso and Shunde — and the systematic application of a comparable analytical framework to primary data collected in both contexts.

A fourth direction is the application of the Mokyr–Schumpeter–complexity framework developed in this thesis to other Italian industrial districts facing analogous challenges of technological transition. The Inox Valley is one of many Italian districts confronting simultaneously the pressures of digital transformation, sustainability regulation, and human capital drain. A comparative study of how districts with different productive specializations and institutional endowments are navigating these pressures could generate broader insights into the conditions that determine adaptive capacity in the Italian district model.

6.7 Policy Implications

The cautious interpretive register maintained throughout this thesis requires that any discussion of policy implications be equally cautious. The analytical conclusions are

interpretive propositions rather than empirically tested causal claims, and the policy implications that can be derived from them are correspondingly tentative. They are offered as directions for reflection rather than prescriptions for action.

The first direction concerns the recognition that territorial quality is a productive input, not merely a quality-of-life amenity. For a cluster whose competitive advantage is grounded in human knowledge that circulates through social proximity, the physical and environmental conditions of the industrial territory — connectivity, worker services, green infrastructure, public space — directly affect the cluster's capacity to attract and retain the skilled practitioners on whom its knowledge architecture depends. The IUAV scenario treats these conditions as strategic investments; regional and national policy actors who recognize the collective competitive value of the Italian district model should engage with this framing and provide the institutional and financial support that makes it actionable.

The second direction concerns the design of collective governance institutions. The B Corporation framework proposed by NATIVA for the Parco Industriale represents one possible model for moving beyond the traditional industry association toward a more structured, transparent, and strategically coherent form of collective governance. The broader direction — toward governance forms that can coordinate collective investment in shared infrastructure, digital platforms, talent attraction, and university-industry partnerships at the cluster level — is analytically well-grounded and deserves sustained policy attention.

The third direction concerns the policy environment at the regional and national level. The structural challenges facing the Inox Valley — human capital drain, digital capability gaps, sustainability investment requirements — cannot be addressed by cluster-level institutional initiatives alone. They require a broader policy framework that takes seriously the competitive value of the Italian district model and invests accordingly in the educational, research, and infrastructure conditions that allow distributed knowledge

architectures to sustain themselves under the pressures of the current technological transition.

6.8 Closing Reflection

The Inox Valley cluster began with an act of dispersal: the exit of skilled workers from the Zoppas factories in the 1950s and 1960s, carrying with them the tacit knowledge of stainless-steel fabrication and the entrepreneurial energy to apply it in new ventures. That founding dispersal — decentralized, organic, and cumulative — created the epistemic commons that has sustained the cluster's competitive advantage for seven decades. Each subsequent generation of entrepreneurs has drawn on and enriched those commons, each episode of creative destruction has tested and renewed it, and each expansion of the relevant knowledge base has added new layers of prescriptive capability to a foundation that has remained materially and institutionally consistent.

Seventy years later, the cluster faces a transition that challenges this founding dynamic in ways that previous transitions did not. The knowledge required for the digital and sustainability frontier — software engineering, AI systems integration, circular economy design, IoT connectivity — is not tacit knowledge that workers carry in their hands and their engineering instincts. It is formal, codified, and globally mobile knowledge that does not naturally accumulate in a geographically concentrated community of stainless-steel fabricators through the social mechanisms of apprenticeship and inter-firm exchange. Acquiring it requires new institutions, new investments, and new forms of collective action that the cluster's founding dynamic did not generate and cannot generate alone.

This is the structural challenge that the institutional initiatives and market responses described in Section 6.4 are attempting to address: not by replicating the social mechanisms of the past, which cannot be transplanted to a different knowledge domain, but by creating new collective infrastructure — territorial, organizational, governance-

based, and epistemic — that can reduce the access costs to the new knowledge the cluster needs. Whether these attempts will prove sufficient — whether the investments planned for 2025–2040 will generate the human capital renewal and knowledge base expansion that the cluster’s competitive position requires — is a question that honest analysis cannot answer in advance.

What the analytical framework developed in this thesis does suggest is that the question is the right one to ask. The future of the Inox Valley depends not only on the individual strategies of its leading firms, however sophisticated, but on the collective capacity of the cluster’s institutional actors to maintain and renew the social infrastructure on which its distributed knowledge architecture depends. In a cluster whose most distinctive competitive asset is collective rather than proprietary, the quality of collective institutions is not peripheral to competitive strategy — it is central to it.

APPENDIX A

Quantitative Dataset: The Inox Valley and Shunde Clusters

This appendix presents a quantitative overview of the two clusters examined in Chapter 5, structured around five dimensions: territorial scale, industrial structure, productive specialization, economic output, and international orientation. Data are drawn from the most recent available institutional sources for each cluster. The two clusters are not directly comparable in all dimensions: they differ substantially in territorial perimeter, institutional definition, and statistical reporting conventions. Where direct comparison is not possible, this is noted explicitly.

Table A.1 — Territorial and Demographic Profile

Indicator	Inox Valley	Shunde
Territorial perimeter	Conegliano–Vittorio Veneto corridor, Province of Treviso	Shunde District, Foshan Municipality, Guangdong Province
Area	~200 km ² (core perimeter per DGRV 2415/2014)	806 km ²
Resident population	~180,000 (core cluster municipalities)	~2.9 million (2023)
District GDP	n/a at cluster level; Treviso province GDP: ~€19.5 billion (2022)	RMB 416.6 billion (€58.8 billion) in 2022; RMB 431.7 billion (€56.4 billion) in 2023

Sources: Camera di Commercio Treviso-Belluno (2022); CEIC/National Bureau of Statistics of China (2023); GDToday (2025).

Table A.2 — Industrial Structure

Indicator	Inox Valley	Shunde
Number of firms (cluster perimeter)	32 active headquarters under ATECO 27.5; 23 dependent units (2022)	3,000+ home appliance production and supporting enterprises; ~400 above designated size threshold
Dominant firm(s)	Electrolux Professional, De'Longhi, ALI Group North-East, Irinox, Lainox	Midea Group, Galanz, Hisense Kelon
Firm size structure	32 headquarters; De'Longhi: €3.5 billion turnover (2022); Electrolux Professional: ~€1 billion (2022); majority of firms: turnover data not published at cluster level	Midea Group: RMB 409.1 billion (€53.7 billion) revenue (2024); ~400 firms above designated size threshold; 3,000+ total enterprises
Listed companies	De'Longhi S.p.A. (BIT: DLG); Electrolux AB parent (NASDAQ Stockholm: ELUX B)	8 home appliance companies listed on China A-share market (2023)

Sources: Camera di Commercio Treviso-Belluno (2022); GDToday/Xinhua (2023); 21jingji.com (2024); Midea Group Annual Report (2024).

Table A.3 — Productive Specialisation

Indicator	Inox Valley	Shunde
Core specialisation	Stainless steel professional food service equipment and domestic appliances	Home appliances (air conditioners, microwave ovens, rice cookers, washing machines, refrigerators, small appliances)

Share of national output	21.5% of Italian national appliance exports (2022)	~15% of China's total home appliance output
Global product leadership	Leading European exporter of professional food service equipment; Italian producers hold ~25% of European professional food equipment market	World's largest producer of microwave ovens (Galanz: ~48% global market share); 25% of global rice cooker market; 33% of global range hood market; 43% of global water heater market
5-year output CAGR	n/a at cluster level	~13.9% (home appliance output value, 2018–2023)

Sources: Camera di Commercio Treviso-Belluno (2022); Pontarollo, Martelli and Prandini (2002); sourcingfairs.com (2024); kchuhai.com (2024); GDToday (2025).

Table A.4 — Economic Output

Indicator	Inox Valley	Shunde
Total cluster output/turnover	>€6.3 billion (Intesa Sanpaolo sample of 164 firms, 2021)	RMB ~370 billion (~€52.3 billion) home appliance industry output value (2022)
Anchor firm revenue	De'Longhi: €3.5 billion (2022); Electrolux Professional: ~€1 billion (2022)	Midea Group: RMB 409.1 billion (~€53.7 billion) (2024)
Median revenue growth	+9.5% (2021 vs. 2019, Intesa Sanpaolo sample)	+5.9% YoY home appliance output value (2022)
Employment (cluster level)	~3,900 (core ATECO 27.5 perimeter, 2022); broader ecosystem not quantified	Not available at cluster level; Midea Group globally: 190,000 employees (2024)

Sources: Camera di Commercio Treviso-Belluno (2022); Intesa Sanpaolo (2025); sourcingfairs.com (2024); Midea Group Annual Report (2024).

Table A.5 — International Orientation

Indicator	Inox Valley	Shunde
Export value	€1.47 billion (Treviso province ATECO 27.5, 2022); -1.9% vs. 2021	~10% of China's national home appliance exports; Chinese national total: ~\$98.6 billion (~€91.3 billion) in 2023
Share of national exports	21.5% of Italian national appliance exports (Treviso province, 2022)	n/a at district level
Principal export markets	Germany: €287 million (19.5%); France: €128 million (8.7%); USA: 6.5%; UK: 4.9% (2022)	Midea overseas revenue: >40% of total sales (2023); OBM share of international sales: 43% (2023, up from 29% in 2018)
Export model	Own-brand manufacturing (OBM); €1.47 billion exports under own brand names (2022)	OEM and OBM; Midea OBM share rising from 29% to 43% of international sales (2018–2023)

Sources: Camera di Commercio Treviso-Belluno (2022); TMTPOST (2024); kchuhai.com (2024); sourcingfairs.com (2024); Midea Group Annual Report (2024).

Currency Conversion Note

All RMB figures have been converted to euros using the average annual EUR/CNY exchange rates published by exchange-rates.org: 1 EUR = 7.0802 RMB (2022 annual average) and 1 EUR = 7.6583 RMB (2023 annual average). For the Midea Group 2024 revenue figure, a rate of 1 EUR = 7.62 RMB has been applied, derived from the average annual CNY/USD and EUR/USD rates reported for 2024. All euro equivalents are

indicative and provided for comparative reference only; they should not be treated as precise valuations given exchange rate volatility within each reference year.

Comparability Note

The two datasets are not directly comparable for four reasons. First, perimeter definitions differ: the Inox Valley statistics are based on the formally recognised DGRV 2415/2014 perimeter and the ATECO 27.5 sectoral classification, which excludes a substantial portion of the cluster's supply chain and professional equipment firms classified under different codes. The Shunde figures cover the district's home appliance industry broadly, including both anchor firms and the SME supply chain. Second, Italian and Chinese statistical reporting conventions differ: Italian data are firm-headquarter-based, while Chinese data typically cover firms above a designated size threshold. Third, cluster-level employment data for Shunde are not available in published sources; only Midea's global headcount is publicly reported, which includes operations across more than 200 countries and is therefore not a cluster-level figure. Fourth, the most significant structural finding from the comparison is the extreme scale asymmetry: Shunde's home appliance industry output value (~€52 billion) exceeds the Inox Valley's estimated cluster turnover (~€6.3 billion) by approximately eightfold, and Midea's revenues alone (~€54 billion) exceed the entire Inox Valley cluster output by a similar factor. This asymmetry should be read not as a measure of competitive superiority but as an indicator of the qualitatively different organisational logics underpinning the two clusters — one built on distributed SME networks, the other on the scale economies of a global anchor firm.

References

- 21 Invest (2025). TheNiceKitchen acquires Krupps. Press release. Available at: <https://www.21invest.com/en/thenicekitchen-acquires-krupps/>
- Akcigit, U. (2024). The Innovation Paradox. *Finance & Development*, 61(3). International Monetary Fund.
- Ali Group (2024a). Our History. Available at: <https://www.aligroup.com/history/>
- Ali Group (2024b). About. Available at: <https://www.aligroup.com/about/>
- Ali Parts (2024). Company overview. Available at: <https://parts-alicr.com/>
- Area-arch.it (2018). Falmec, sistemi evoluti d'aspirazione. Available at: <https://www.area-arch.it/falmec-sistemi-evoluti-daspirazione/>
- Arrow, K. J. (1962). Economic Welfare and the Allocation of Resources for Invention. In R. Nelson (Ed.), *The Rate and Direction of Inventive Activity*. Princeton: Princeton University Press.
- Arthur, W.B. (1989). Competing Technologies, Increasing Returns, and Lock-In by Historical Events. *The Economic Journal*, 99(394), 116–131.
- Audretsch, D. B., & Feldman, M. P. (1996). R&D Spillovers and the Geography of Innovation and Production. *American Economic Review*, 86(4), 253–273.
- Basile, R., & Cicerone, G. (2022). Economic Complexity and Productivity Polarization: Evidence from Italian Provinces. *German Economic Review*, 23(4), 567–594. <https://doi.org/10.1515/ger-2021-0070>
- Baumol, W. J. (1990). Entrepreneurship: Productive, Unproductive, and Destructive. *Journal of Political Economy*, 98(5), 893–921.
- Becattini, G. (1979). Dal 'Settore' industriale al 'distretto' industriale. Alcune considerazioni sull'unità d'indagine dell'economia industriale. *Rivista di economia e politica industriale*, 1, 7–21.
- Becattini, G. (1987). Mercato e forze locali. Il distretto industriale. Il Mulino.
- Belussi, F., & Caldari, K. (2009). At the Origin of the Industrial District: Alfred Marshall and the Cambridge School. *Cambridge Journal of Economics*, 33(2), 335–355.

Boschma, R. (2015). Towards an Evolutionary Perspective on Regional Resilience. *Regional Studies*, 49(5), 733–751.

Boschma, R.A., & Lambooy, J.G. (1999). Evolutionary Economics and Economic Geography. *Journal of Evolutionary Economics*, 9(4), 411–429.

Breschi, S., Malerba, F., & Orsenigo, L. (2000). Technological Regimes and Schumpeterian Patterns of Innovation. *The Economic Journal*, 110(463), 388–410.

Breschi, S., & Lissoni, F. (2001). Knowledge Spillovers and Local Innovation Systems: A Critical Survey. *Industrial and Corporate Change*, 10(4), 975–1005.
<https://doi.org/10.1093/icc/10.4.975>

Brusco, S. (1982). The Emilian Model: Productive Decentralisation and Social Integration. *Cambridge Journal of Economics*, 6, 167–184.

Buciuni, G. (2024). *Innovatori Outsider. Il Mulino*.

Buciuni, G., & Corò, G. (2023). *Periferie competitive. Lo sviluppo dei territori nell'economia della conoscenza. Bologna: Il Mulino*.

Buciuni, G., Corò, G., & Micelli, S. (2013). Rethinking Manufacturing in Global Value Chains: An International Comparative Study in the Furniture Industry. *Industrial and Corporate Change*, 23(4), 967–996.

Buciuni, G., & Pisano, G. (2018). Knowledge Integrators and the Survival of Manufacturing Clusters. *Journal of Economic Geography*, 18(5), 1069–1089.

Camagni, R. (1995). The Concept of Innovative Milieu and Its Relevance for Public Policies in European Lagging Regions. *Papers in Regional Science*, 74(4), 317–340.

Camera di Commercio Treviso-Belluno (2022). *Elettrodomestici ed Inox di Conegliano e del Trevigiano. Consistenza al 31.12.2022 delle unità locali attive per tipologia e dei relativi addetti. Ufficio Studi e Statistica, Camera di Commercio di Treviso – Belluno*.

Catering Insight (2024). Rational implements major revamp of technical service platform. Available at: <https://www.cateringinsight.com/rational-implements-major-revamp-of-technical-service-platform/>

China Daily HK (2022). Innovation key to high-quality development in Guangdong. Available at: <https://www.chinadailyhk.com/hk/article/339303>

Confindustria Veneto Est (2024). Vittorio Veneto/Conegliano: nasce l'Associazione delle imprese della Zona Industriale Prealpi Trevigiane. Katia Da Ros presidente. Comunicato stampa, 16 ottobre 2024. Available at: <https://www.confindustriavenest.it/stampa-e-media/comunicati-stampa/vittorio-veneto-conegliano-nasce-lassociazione-delle-imprese-della-zona-industriale-prealpi-trevigiane-katia-da-ros-presidente>

Corò, G., & Borsato, R. (2026). Technological Complexity and Global Capabilities in SMEs: A Survey in an Italian Industrial Region. *Industry and Innovation* (ahead of print). <https://doi.org/10.1080/13662716.2026.2637174>

Corò, G., Pejčić, D., & Volpe, M. (2017). Enabling Factors in Firms' Adoption of New Digital Technologies: An Empirical Inquiry on a Manufacturing Region. Ca' Foscari University of Venice, Department of Economics, Working Paper No. 16/WP/2017. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3038307

Crédit Agricole Nordest (2023). Crédit Agricole, nasce il Comitato territoriale Nordest. Available at: <https://www.telefriuli.it/cronaca/credit-agricole-comitato-territoriale-nordest/>

CUOA Business School (2025). Governance. Available at: <https://www.cuoa.it/cuoa-business-school/>

CUOA Foundation (2024). La Scuola CUOA. Available at: <https://www.cuoa.it/la-scuola/>

David, P.A. (1985). Clio and the Economics of QWERTY. *American Economic Review* (Papers and Proceedings), 75, 332–337.

De Marchi, V., Di Maria, E., & Gereffi, G. (2017). *Local Clusters in Global Value Chains: Linking Actors and Territories Through Manufacturing and Innovation*. London: Routledge.

Duranton, G. (2011). California Dreamin': The Feeble Case for Cluster Policies. *Review of Economic Analysis*, 3(1), 3–45.

Eisenhardt, K.M., & Graebner, M.E. (2007). Theory Building from Cases: Opportunities and Challenges. *Academy of Management Journal*, 50(1), 25–32.

Ferrari, M., Bortolotto, E., & Mantelli, G. (2024). Nord-est Produttivo: Studi e ricerche per la valorizzazione degli spazi pubblici dell'area produttiva delle Prealpi Trevigiane — Relazione finale e Scenario 2025–2040. Contratto di ricerca rep. n. 1237/2022. Dipartimento di Culture del Progetto, Università IUAV di Venezia. Committente: Confindustria Veneto Est.

Frenken, K., Van Oort, F., & Verburg, T. (2007). Related Variety, Unrelated Variety and Regional Economic Growth. *Regional Studies*, 41(5), 685–697.

GDToday / Xinhua (2023). Pearl River Delta transforms from world factory to technology hub. Available at: <https://www.newsgd.com>

GDToday (2025). Key Industrial Clusters. Available at: https://www.newsgd.com/node_70f9eb139d/43ac401793.shtml

Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The Governance of Global Value Chains. *Review of International Political Economy*, 12(1), 78–104. <https://doi.org/10.1080/09692290500049805>

Grabher, G. (1993). The Weakness of Strong Ties: The Lock-In of Regional Development in the Ruhr Area. In G. Grabher (Ed.), *The Embedded Firm: On the Socioeconomics of Industrial Networks* (pp. 255–277). Routledge.

Grand View Research (2024). Commercial Kitchen Appliances Market Size, Share & Trends Analysis Report. Grand View Research.

Griliches, Z. (1979). Issues in Assessing the Contribution of Research and Development to Productivity Growth. *Bell Journal of Economics*, 10(1), 92–116.

Harvard Growth Lab (2024). Economic Complexity Rankings 2024. Center for International Development, Harvard Kennedy School. Available at: <https://atlas.hks.harvard.edu/rankings/>

Hausmann, R., & Hidalgo, C.A. (2014). *The Atlas of Economic Complexity: Mapping Paths to Prosperity*. MIT Press.

Hidalgo, C.A., & Hausmann, R. (2009). The Building Blocks of Economic Complexity. *Proceedings of the National Academy of Sciences*, 106(26), 10570–10575. <https://doi.org/10.1073/pnas.0900943106>

Hidalgo, C.A., Klinger, B., Barabási, A.L., & Hausmann, R. (2007). The Product Space Conditions the Development of Nations. *Science*, 317(5837), 482–487.

Humphrey, J., & Schmitz, H. (2002). How Does Insertion in Global Value Chains Affect Upgrading in Industrial Clusters? *Regional Studies*, 36(9), 1017–1027. <https://doi.org/10.1080/0034340022000022198>

Intesa Sanpaolo Research Department (2024). Monitor dei distretti industriali del Triveneto, terzo trimestre 2024. Intesa Sanpaolo.

Intesa Sanpaolo Research Department (2025). Economia e finanza dei distretti industriali, Rapporto annuale n. 17. Intesa Sanpaolo, aprile 2025.

Iriox SpA (2025). Bilancio di sostenibilità.

ISTAT (2011). 9° Censimento generale dell'industria e dei servizi. Istituto Nazionale di Statistica.

ISTAT (2015). I distretti industriali. 9° Censimento dell'industria e dei servizi. Istituto Nazionale di Statistica.

Jaffe, A., Trajtenberg, M. L., & Henderson, R. (1993). Geographic Localization of Knowledge Spillovers as Evidenced by Patent Citations. *Quarterly Journal of Economics*, 108(3), 577–598.

Kondratiev, N.D. (1935). The Long Waves in Economic Life. *Review of Economics and Statistics*, 17, 105–115.

Krugman, P. (1991). *Geography and Trade*. Cambridge, MA: MIT Press.

Krugman, P. (2011). The New Economic Geography, Now Middle-Aged. *Regional Studies*, 45(1), 1–7.

Le Village by CA Triveneto (2026). Ecosistema Business Internazionale. Available at: <https://www.levillagebycatriveneto.it/about/ecosistema-internazionale>

Liu, Y., & Yang, C. (2014). Strategic Coupling of Local Firms in Global Production Networks: The Rise of the Home Appliance Industry in Shunde, China. *Eurasian Geography and Economics*, 54(4), 444–463. <https://doi.org/10.1080/15387216.2014.883286>

Loasby, B. J. (1999). Marshall's Theory of the Firm. In R. E. Backhouse & J. Creedy (Eds.), *From Classical Economics to the Theory of the Firm*. Cheltenham: Edward Elgar.

Market Data Forecast (2024). *Kitchen Robotics and Automation Market Report*. Market Data Forecast.

Marshall, A. (1890). *Principles of Economics* (8th ed., 1920). London: Macmillan.

Marshall, A. (1919). *Industry and Trade*. London: Macmillan.

Martin, R. (2010). Rethinking Regional Path Dependence: Beyond Lock-in to Evolution. *Economic Geography*, 86(1), 1–27.

Martin, R., & Sunley, P. (2003). Deconstructing Clusters: Chaotic Concept or Policy Panacea? *Journal of Economic Geography*, 3(1), 5–35.

Martin, R., & Sunley, P. (2011). Conceptualizing Cluster Evolution: Beyond the Life Cycle Model? *Regional Studies*, 45(10), 1299–1318.

Midea Group (2024). *Annual Report and Press Releases FY 2024*. Available at: <https://www.midea.com.cn/en/about-midea/news/>

Mokyr, J. (2002). *The Gifts of Athena: Historical Origins of the Knowledge Economy*. Princeton University Press.

Moretti, E. (2012). *The New Geography of Jobs*. Boston: Houghton Mifflin Harcourt.

Morningstar Asia (2025). *China Home Appliance Industry Landscape*. Available at: <https://global.morningstar.com/en-ea/stocks/china-home-appliance-industry-landscape>

NATIVA (2026). *La prima associazione industriale Benefit in Europa: NATIVA per il Parco Industriale Prealpi Trevigiane*. Documento interno, maggio 2026. Per concessione del Parco Industriale Prealpi Trevigiane.

Nelson, R.R., & Winter, S.G. (1982). *An Evolutionary Theory of Economic Change*. Harvard University Press.

OECD (2021). Veneto: A Manufacturing Region with a Cultural and Creative Edge. OECD Local Economic and Employment Development (LEED) Papers, 2021/04. OECD Publishing.

Perez, C. (2002). Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages. Edward Elgar.

Perroux, F. (1955). Note sur la notion de pôle de croissance. *Économie Appliquée*, 8, 307–320.

Peters, M. (2024). America Must Rediscover Its Dynamism. *Finance & Development*, 61(3). International Monetary Fund.

Piore, M., & Sabel, C. F. (1984). *The Second Industrial Divide: Possibilities for Prosperity*. New York: Basic Books.

PitchBook (2026). Gico (Italy) Company Profile. Available at: <https://pitchbook.com/profiles/company/422770-60>

Pontarollo, E., Martelli, A., & Prandini, A. (2002). *Libro Bianco dell'Industria degli Apparecchi Domestici e Professionali*. ANIE – Associazione Nazionale Industrie Apparecchi Domestici e Professionali, Milano.

Porter, M. E. (1990). *The Competitive Advantage of Nations*. New York: Free Press.

Porter, M. E. (1998). Clusters and the New Economics of Competition. *Harvard Business Review*, 76(6), 77–90.

Porter, M. E. (2000). Location, Competition, and Economic Development: Local Clusters in a Global Economy. *Economic Development Quarterly*, 14(1), 15–34.

Public Sector Catering (2023). Unox drives standards with updated digital service area. Available at: <https://www.publicsectorcatering.co.uk/news/unox-drives-standards-updated-digital-service-area>

Rational AG (2024a). Annual Report FY 2024. Available at: <https://www.rational-online.com/media/investor-relations/>

Rational AG (2024b). Digitalisation in the professional kitchen: 150,000 users rely on ConnectedCooking. Press release. Available at: <https://www.rational->

online.com/en_xx/news/digitalisation-in-the-professional-kitchen-150-000-users-rely-on-connectedcooking.php

Salvador, G. (2020). Le due Zeta dall'alba al tramonto: Innovazione, profitto e delocalizzazione a Nordest. Tesi di Laurea Magistrale in Storia dal Medioevo all'età contemporanea, Università Ca' Foscari Venezia. Relatore: Prof. Alessandro Casellato.

Saxenian, A. L. (1990). Regional Networks and the Resurgence of Silicon Valley. *California Management Review*, 33(1), 89–112.

Saxenian, A. (1994). *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*. Harvard University Press.

Schön, D.A. (1983). *The Reflective Practitioner*. Basic Books.

Schumpeter, J.A. (1934 [1911]). *The Theory of Economic Development: An Inquiry into Profits, Capital, Credit, Interest, and the Business Cycle*. Harvard University Press.

Schumpeter, J.A. (1942). *Capitalism, Socialism and Democracy*. Harper & Brothers.

Scott, A. J. (1990). *Technopolis: High-Technology Industry and Regional Development in Southern California*. Berkeley: University of California Press.

SMACT Competence Center (2018). Atto costitutivo. Available at: <https://www.smact.cc>

Somec Group (2024). Professional Kitchen Equipment. Available at: <https://www.somecgruppo.com/en/business-segments/professional-kitchen-equipment/>

Storper, M. (1989). The Transition to Flexible Specialisation in the US Film Industry. *Cambridge Journal of Economics*, 13(2), 273–305.

The European House – Ambrosetti / EFCM Italia (2024). La filiera della ristorazione in Italia: sfide evolutive e raccomandazioni. Rapporto finale.

The Nice Kitchen (2024). Company overview. Available at: <https://www.thenicekitchen.com/en>

The Nice Kitchen (2025). TheNiceKitchen gets stronger. Available at: <https://www.thenicekitchen.com/en/news/blog-1/thenicekitchen-gets-stronger>

TMTPOST (2024). China's Appliance Giants Power Global Expansion with Record Overseas Sales in 2024. Available at: <https://en.tmtpost.com/post/7582277>

- Treviso Belluno System (2026). Digital and Sustainable SMEs – Veneto Chamber System, Region and Universities Unveil a Collaborative Model for the Twin Transition. Press release, 30 March 2026. Available at: <https://www.trevisobellunosystem.com/en/news/digital-and-sustainable-smes-veneto-chamber-system-region-and-universities-unveil-a-collaborative-model-for-the-twin-transition/>
- University of Padova (2019). SMACT Competence Center. Available at: <https://www.unipd.it/smact-competence-center>
- University of Udine (2018). È nato SMACT, il competence center del Triveneto. Available at: <https://qui.uniud.it/ricerca-e-innovazione/e-nato-smact-il-competence-center-del-triveneto/>
- Unox (2024). CHEFTOP-X: The future of combi oven technology. Available at: https://www.unox.com/us_us/blog/unox-cheftop-x-launch/
- Vandermerwe, S., & Rada, J. (1988). Servitization of Business: Adding Value by Adding Services. *European Management Journal*, 6(4), 314–324.
- Vicente, J. (2018). *Economics of Clusters: A Brief History of Cluster Theories and Policy*. Cham: Palgrave Macmillan.
- Weitzman, M. L. (1996). Hybridizing Growth Theory. *American Economic Review*, 86(2), 207–212.
- Yang, C. (2013). From Strategic Coupling to Recoupling and Decoupling: Restructuring Global Production Networks and Regional Evolution in China. *European Planning Studies*, 21(8), 1046–1063.
- Yin, R.K. (2003). *Case Study Research: Design and Methods*. Sage.

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