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# Five Steps for Digital Collaboration in Industrial Clusters

BRIEFING PAPER  
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# Introduction

**Imagine a future** where industrial clusters – geographical areas where co-located companies, public institutions and organizations operate – become collaboration hubs, seamlessly linking stakeholders into smart, connected ecosystems.

**Digital twins** simulate shared infrastructure operations, enabling scenario analysis, optimizing electricity loads and clean fuel supply networks and assessing the impact on local value chains. Inputs and outputs are tracked from production to recycling using **digital labels and 5G** to ensure full transparency. **Big data** uncovers new ways to trade and monetize by-products, trace its ESG attributes and connect companies in intelligent ways.

Energy is smarter too—**AI and IoT** forecast and balance renewable energy production and optimize usage and storage, cutting costs and emissions. Manufacturers, suppliers, transport and logistic operators together with regulators collaborate through **secure platforms**, exchanging real-time data to ensure energy resilience and security, boost industrial competitiveness, mitigate environmental risks and enhance the local value chain.

This future isn't far-off. Leading clusters are already showing how digital technologies can boost efficiency and sustainability for all while supporting the creation of jobs and fostering local economic development.

This paper explores how digital collaboration can transform clusters, offering real-world examples and practical guidance. Section 1 highlights digitalization as a foundation for cross-industry collaboration. Section 2 outlines a five-step digitalization roadmap for industrial clusters.



## Digital matters

Emissions in hard-to-abate sectors are largely driven by poor efficiency, waste and byproduct, and indirect emissions across value chains.

20%

Fewer emissions could result from scaling digital solutions in hard-to-abate industries.

87%

Of companies say digital will disrupt their industry but only half say they're prepared.

## 1 The case for digital collaboration in industrial clusters

As industries face mounting pressures from resource constraints, energy security, emission regulations and environmental impact in a fast-changing global economy, collaboration becomes key to manage risks and overcome challenges in a coordinated, systemic way. [Digital collaboration](#) at the cluster level – a paradigm where stakeholders leverage digital technologies to enable information sharing, improve insights and coordinate efforts – offers a powerful tool to improve competitiveness, resiliency and security while delivering broader environmental and societal benefits.

By shifting from isolated digital adoption to collaborative approaches – such as data collaboration and digital integration – industrial clusters can leverage the benefits of scale, diverse supply and demand profiles as well as enhanced operational efficiencies to achieve outcomes that no single organization could accomplish alone. Figure 1 highlights five strategic areas of application and key technologies that enable digital collaboration at cluster level.

Yet this potential remains largely untapped, as many industrial clusters operate as simply co-located businesses, missing the opportunity to create greater [system value](#) through collaboration.

Source: [Digital solutions to power decarbonization](#), World Economic Forum.

FIGURE 1 Digital technologies to unlock value in five strategic areas for digital collaboration



## 2 Five steps to drive the digital transformation

Advancing digital collaboration in industrial clusters is a complex process, with early stages being often the most challenging. Securing buy-in from different stakeholders while aligning on a shared vision can be difficult. Digital initiatives typically require data exchange between companies that can be both partners and competitors, raising concerns on cybersecurity, data privacy and trust issues. Commercial and legal risks – including IP protection, antitrust compliance and liability concerns – may create hesitation among participants, while different levels of digital maturity complicate system integration. Successful

clusters have navigated these challenges by focusing on key enablers and adopting a structured, phased approach.

Drawing on insights from global leaders—including industrial cluster representatives, technology providers, research institutions, start-ups and industry associations—the World Economic Forum, in collaboration with Accenture, developed the Digital Maturity Framework as a structured guide for industrial clusters. The framework outlines 10 enablers and five key steps to enhance digital capabilities at the cluster level.

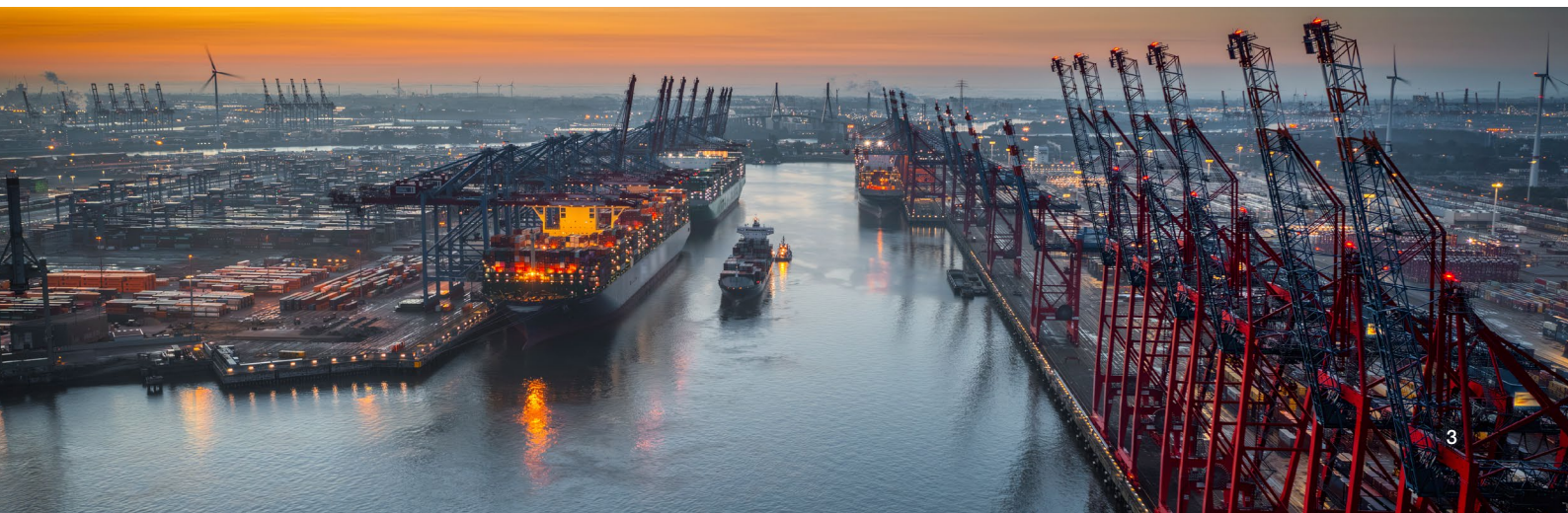


FIGURE 2 Organizational and technology enablers that support the cluster digital transformation



**Organizational enablers** align stakeholders, build trust and coordinate action within an industrial cluster. For example, establishing **strategic alignment and a shared vision** early on ensures that participants work towards common goals. Likewise, a well-defined **governance framework for data and digital collaboration** facilitates project execution, fostering accountability among stakeholders. While particularly critical for digital collaboration, many of these enablers are foundational for any collaborative initiative within industrial clusters.

**Technology enablers** provide the foundations to develop digital initiatives at the cluster level. For instance, robust **privacy and security** measures – such as encryption, access controls and shared cybersecurity protocols – protect sensitive operational and trade information enabling data collaboration.

Similarly, **interoperability and connectivity** facilitate the efficient exchange and integration of data across systems and stakeholders.

While these and the other enablers shown in Figure 2 remain crucial throughout the cluster digital transformation journey, their prioritization and implementation will naturally evolve over time as needs and priorities shift. To effectively navigate this evolution, a phased approach is essential for managing complexity, addressing challenges incrementally and fostering sustained digital maturity.

Each step of the Digital Maturity Framework is explored in detail below, accompanied by real-world examples of practical applications.

FIGURE 3 The five steps of the Digital Maturity Framework



# Step 1: Initiating

Building on a shared vision and clear governance structure, the cluster lays the foundation for initiating digital initiatives. This step ensures a structured and informed approach to digitalization, setting the stage for the next phases.

## Recommendations

- **Prioritize system value outcomes:** Focusing on value beyond cost and prioritizing outcomes that benefit multiple stakeholders ensure sustainable progress and build trust.
- **Understand internal data and processes first:** Before initiating digital collaboration initiatives, key players should map and audit their data across internal systems and processes. This includes assessing the availability, accuracy and interoperability of critical data sources, such as metering and operational data, to ensure a solid foundation for digital integration.
- **Learn from the network:** Engaging with a broader network and exchanging best practices with other industrial clusters can offer insights into successful strategies and help demonstrate the art of the possible, guiding the cluster towards effective digital transformation.
- **Establish data collaboration and digital governance:** A shared vision, well-defined targets and a strong governance are essential for fostering collaboration among stakeholders within the cluster and ensure smooth integration of digital initiatives. The governance should ensure stakeholder alignment, define responsibilities, oversee risk management policies and compliance monitoring, and set principles for value distribution.

## CASE STUDY 1

### Strong governance and digital foundations enable large-scale collaboration in industrial ecosystems



The Tianjin Economic-Technological Development Area (TEDA) is a prime example of large-scale collaboration, connecting over 1,000 companies through a circular economy and waste-free platform. This initiative reduces landfill waste, emissions and regulatory costs while enhancing value chain risk resilience.

“Connecting over 1,000 companies across the cluster would not be possible without digital technologies. They provide the foundation for seamless data exchange, intelligent resource

matching and real-time traceability, enabling collaboration at a scale that drives both economic value and environmental impact.

Song Yuyan, Director and Secretary,  
Green Partnership of Industrial Parks (GPIP)

While TEDA represents an advanced use case, it all began with establishing the right foundations: setting up governance for data collaboration and implementing robust digital solutions to address data privacy concerns related to sensitive waste and production information.

#### Tianjin Economic-Technological Development Area (TEDA):

Circular economy and waste-free digital platform

Background and objectives	Digital technologies	Results
<p>The TEDA cluster developed and operates a circular economy and waste-free digital platform enabling cluster members to visualize and facilitate industrial symbiotic relationships to increase resilience, reduce landfill waste, taxes and related costs.</p>	<ul style="list-style-type: none"> <li>– <b>Visualization and Collaboration Platforms</b> enable users to input standardized by-product exchange and emission data, simplifying carbon tracking and compliance procedures</li> <li>– <b>Big Data and Analytics</b> identify connections between waste by-products and resource demand, enabling intelligent matching between cluster companies</li> <li>– <b>Digital Labels</b> ensure waste traceability with real-time tracking from generation to recycling</li> </ul>	<p>Since launching the platform four years ago, the TEDA cluster has:</p> <ul style="list-style-type: none"> <li>– Connected 1,000+ enterprises</li> <li>– Enabled 150+ industrial symbiosis relationships</li> <li>– Reduced landfill waste by 0.98m tons</li> <li>– Cut CO<sub>2</sub>e emissions by 170,000 tons</li> </ul>



## Step 2: Scoping

The cluster starts exploring digital collaboration to address specific challenges (e.g., insufficient clean power capacity), enhance existing synergies (e.g., create a digital view of by-product exchange), or create new collaboration opportunities (e.g., explore the development of shared infrastructure and the impact on social and economic dimensions).

### Recommendations

- **Prioritize key impact areas and pilot projects:** Identifying priority areas for digital collaboration that align with cluster goals, along with targeted pilot projects addressing shared challenges, strengthens stakeholder engagement. To sustain this engagement and build lasting momentum, it is essential to establish a long-term, scalable vision – reinforced by short-term wins – that demonstrates progress and drives commitment. **Innovation**, both technological and non-technological, should be a major consideration in this phase, ensuring that pilot projects explore novel solutions to maximize impact.
- **Demonstrate tangible value and ensure transparency:** Clear proof points are essential for securing stakeholder buy-in, particularly in economically challenging contexts. Crafting system-value cases – beyond just business cases – and prioritizing projects that demonstrate tangible benefits, such as emissions reduction and operational efficiency, is important. **Leveraging public data and preliminary analyses** is useful to create compelling, transparent value cases that build trust, engage stakeholders and showcase the real-world impact of the initiatives through **visualization tools**.
- **Assess risks and develop a risk-management strategy:** The implementation of a structured, proactive risk-management strategy is essential to fully unlock the benefits of digital collaboration while protecting competitive interests, legal compliance and operational resilience. This involves **regulatory compliance** – adhering to GDPR, IP protection and antitrust regulations to mitigate legal risks – **security frameworks** that define access rights while protecting confidential business intelligence, and **cybersecurity networks** to enable real-time threat detection and mitigation.
- **Accommodate the varying levels of readiness or digital maturity across cluster members:** Adopting a flexible, iterative approach that minimizes the need for costly technology upgrades is essential for effectively onboarding stakeholders in the initial phase.

## CASE STUDY 2

# Open data and smart visualization help overcome data-collaboration barriers



In complex industrial projects, data-sharing barriers can stall progress. The Zero Carbon Humber (ZCH) project in the UK tackled this by leveraging public data to map hydrogen demand and key infrastructure needs in the region. Instead of requesting sensitive data upfront, the University of Sheffield Advanced Manufacturing Research Centre (AMRC), Microsoft, Avanade and Accenture used digital visualization to illustrate the ecosystem, helping stakeholders see opportunities without sharing sensitive information. Validation workshops were conducted to refine data and insights, enabling more accurate analysis

and fostering a trust-based approach that streamlined decision-making.

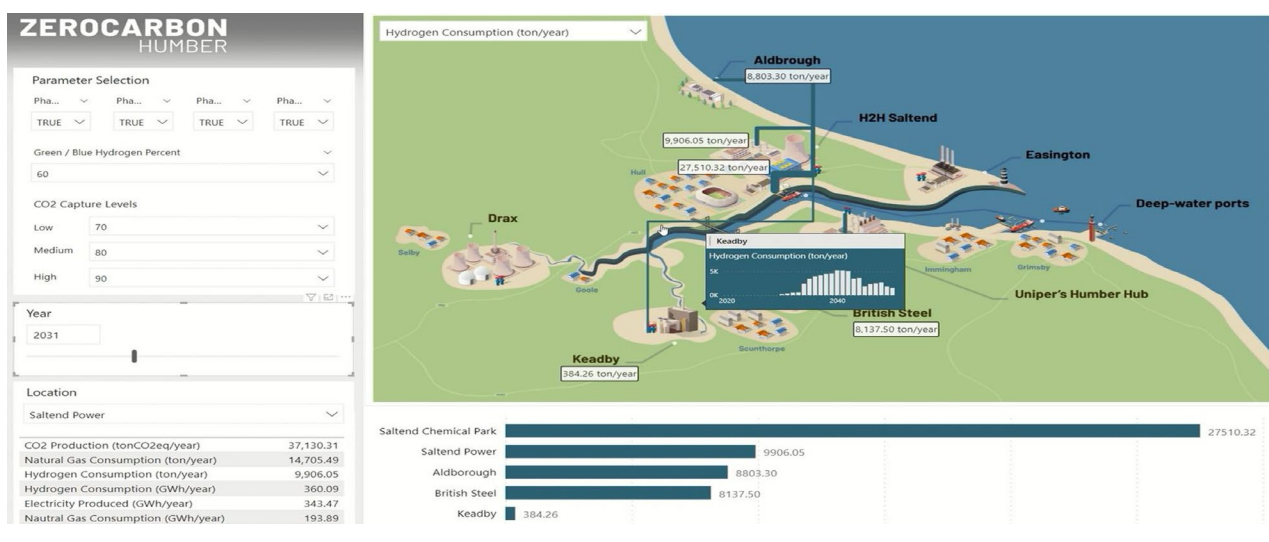
🕒 **Public data and smart visualization simplify collaboration. By mapping the ecosystem first, we engaged stakeholders faster, built trust and drove informed decisions – without compromising sensitive information.**

Victor Guang Shi, Supply Chain Resilience Lead, Advanced Manufacturing Research Centre (AMRC), University of Sheffield

### Zero Carbon Humber: Digital twin for shared H2 infrastructure

Background and objectives	Digital technologies	Results
<p>The ZCH Digital Twin models green and blue hydrogen and CCS-enabled decarbonization scenarios to assess infrastructure and supply chain impacts in the Humber region. Leveraging open data from the Open Data Initiative (ODI) to power the digital test-bed accelerator, the project supports data-driven decision making in reaching the UK's net-zero goals and provides visibility for supply chain and industrial development opportunities.</p>	<ul style="list-style-type: none"> <li>– <b>Digital Twins and Simulation Technologies</b> are used to model and optimize H2 infrastructure, carbon storage and system-wide integration across the cluster</li> <li>– <b>Visualization and Collaboration Platforms</b> help local communities and government stakeholders understand the project's benefits</li> </ul>	<p>The project has brought various benefits:</p> <ul style="list-style-type: none"> <li>– Improved stakeholder engagement providing precise data highlighting the economic, social and supply chain benefits of hydrogen investments in the region. This facilitated informed discussions with government and regulators</li> <li>– Assessed over 300 manufacturing companies across 728 components required for the project; seven manufacturing areas were found to provide significant investment opportunity through capacity scale-up</li> <li>– The digital testbed project was recognized by the ZCH consortium members as a potential replicable model for decarbonising other industrial clusters</li> </ul>

Source: Advanced Manufacturing Research Centre (AMRC), University of Sheffield.



## Step 3: Piloting

At this stage, clusters initiate pilot projects in selected areas, leveraging digital solutions to drive progress. Effective cluster governance plays a key role in demonstrating value and fostering collaboration by ensuring transparency throughout the process. Success requires clear procedures to assess project feasibility and impact while building trust among participants through open collaboration and measurable results.

### Recommendations

- **Start small and then scale:** Effective collaboration begins with a small group of stakeholders, enabling other members to join later once the project has demonstrated impact. Identifying an **initiative champion** to lead the pilots can accelerate progress and drive the transition to the next phases.
- **Identify capability gaps and map stakeholders:** Uncovering capability gaps and mapping key stakeholders is crucial to ensure alignment and preparedness for successful collaboration. **Preparing a roadmap and a plan to build or acquire the required skillsets is recommended**, including training and awareness programmes for the workforce.
- **Secure early investment to derisk projects:** Initial funding by an orchestrator (e.g., a public entity or port authority) can derisk projects and attract broader participation in subsequent phases. **Encouraging private or public parties to invest** in initial pilots can build momentum and kick-start projects.
- **Adopt an iterative approach for refinement:** Pilots serve as learning opportunities to validate initial assumptions, refine data collaboration processes, enhance project outcomes and prove value. **Designing pilots with scalability in mind** is key for a seamless transition from trials to full-scale implementations.

### CASE STUDY 3

## Securing stakeholders buy-in requires more than just a business case



Given the high costs of digitalization and resistance to change, securing early buy-in is essential. Traditional business cases often focus on cost savings and efficiency but may overlook broader benefits such as carbon reduction, resilience and local economic development. Demonstrating multidimensional value helps attract public-private support, unlock cross-industry partnerships and drive systemic change.

To address grid congestion issues, high energy costs and decarbonization targets, the Port of Rotterdam invested €2 million in a pilot solution to test and showcase tangible value from multi-utility optimization. This approach

de-risked innovation, making it easier for companies to commit to the next phase and invest independently. Acting as an orchestrator, the port played a key role in facilitating collaboration and ensuring alignment across industries.

🗣️ **For businesses to collaborate, they need proof of value. By investing in pilots and demonstrating real benefits, we help pave the way for broader adoption and industry-wide transformation. Recognizing digital's importance, we invested in a digital transformation layer to accelerate our 2050 carbon-neutrality goal.** Saskia Mureau, Director Customer Digital, Port of Rotterdam

### Port of Rotterdam: Starlings Project to unlocking multi-utility flexibility

Background and objectives	Digital technologies	Results
<p>Launched by the Port of Rotterdam Authority, the Starlings project involves six industrial plants and two grid operators to explore multi-utility (electricity, natural gas and heat flows) optimization across company borders. The project aims to enhance resource flexibility, lower utility costs and emissions and strengthen industrial resilience.</p>	<ul style="list-style-type: none"> <li>– <b>Digital Twins and Simulation Technologies</b> model in real-time the cluster energy systems for visualization, analysis and optimization</li> <li>– <b>AI and Machine Learning</b> forecast and optimize energy flow exchanges within the cluster</li> <li>– <b>Visualization and Collaboration Platforms</b> with single participants and project-level dashboards show user-specific information. A marketplace/ auction system supports trading within the cluster and with the external energy market</li> </ul>	<p>As part of the pilot phase, participants use shadow operations to simulate real-world scenarios, while monthly planning cycles evaluate the impact on efficiency, costs and emissions. Industrial companies that participated retain control over their own flexibility, using an auction system to allocate resources where they provide the most value.</p> <p>A feasibility study conducted by the Port of Rotterdam indicated the project could:</p> <ul style="list-style-type: none"> <li>– Achieve up to 5% energy cost savings</li> <li>– Reduce 50 to 100 kilotons of CO<sub>2</sub> emissions annually</li> <li>– Provide 15MW of demand flexibility</li> </ul>

## Step 4: Scaling

Scaling involves expanding pilots, adding features, involving more stakeholders and replicating successful projects. Success relies on continuous learning cycles to build a “cluster memory” that supports collaboration and business case development. Scaling can be approached as a one-off effort or as a systematic process where lessons learned from early stages make replication smoother and more efficient.

### Recommendations

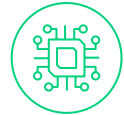
– **Develop customized and inclusive strategies:**

Scaling efforts should accommodate the diverse needs of participants joining at different stages. This includes integrating industry, or cluster-specific requirements – whether shaped by regulations, technological maturity, or data availability – into the design, ensuring flexibility without compromising project success.

- **Strengthen capacity building and incentives:** As projects scale, there needs to be enough capacity and appropriate incentives to support deployment across a broad range of cluster members of different sizes and sectors. This can be facilitated by the cluster convener or coordinated through the governance structure.
- **Embed learning cycles and standardization to enable replication:** Embedding learning cycles and a replicability mindset makes scaling systematic and sustainable. Institutionalizing knowledge-sharing and learning frameworks can create a “cluster memory”, making future scaling efforts more efficient.

### CASE STUDY 4

## Standardization is the bridge between innovation and large-scale impact



Embedding learning cycles and a replicability mindset is key to scaling digital initiatives systematically. By institutionalizing knowledge-sharing and creating a “cluster memory” future scaling efforts become more efficient and impactful.

One example of this is the collaboration between Envision and the China National Institute of Standardization (CNIS) in developing the Construction Specification of Zero-Carbon Industrial Park, now an official local standard. Building on the cluster’s success, CNIS is working to establish national

and international standards, ensuring global best practices can be replicated across industrial clusters.

🔗 **Standardization is the bridge between innovation and large-scale impact. By codifying best practices, we ensure that learnings from one project can drive transformation across entire industries – accelerating the transition to zero-carbon industrial ecosystems.**

Glenn Gu, Product and Development Senior Director, Envision Net-Zero Industrial Park

### The Ordos-Envision Net Zero Industrial Park: AIoT-enabled energy and carbon platform

Background and objectives	Digital technologies	Results
<p>The Ordos-Envision Net Zero Industrial Park is attracting industries (such as EV and batteries manufacturing, renewable energy and hydrogen) to establish a green industrial park powered 80% by green electricity. The cluster uses an AIoT-integrated digital “Ark” platform to optimize energy production, storage and consumption in the cluster, cutting emissions and costs.</p>	<ul style="list-style-type: none"> <li>– <b>Internet of Things (IoT)</b> data is integrated in real-time for energy-carbon accounting and analysis</li> <li>– <b>AI and Machine Learning</b> optimizes subsystem coupling, renewable redispatch, demand response and electricity trading to cut emissions and support net-zero goals</li> <li>– <b>A Visualization and Collaboration Platform</b> aggregates data from electricity, water and gas meters, enabling precise carbon accounting and full-process energy monitoring</li> </ul>	<p>Thanks to a digitally integrated energy system with 12 large-scale enterprises participating, the cluster:</p> <ul style="list-style-type: none"> <li>– Reduced by 10% energy costs for tenants</li> <li>– Cut CO<sub>2</sub> by 100 million tons per year</li> <li>– Increased GDP by 300 billion yuan per year</li> <li>– Attracted industrial activity, providing tens of thousands of employment opportunities</li> </ul>

## Step 5: North Star

Digital collaboration is fully embedded in the cluster’s culture, transforming it into a self-sustaining ecosystem of innovation, with initiatives – such as digital labs – supporting broad collaboration. Clusters continuously scale digital capabilities, building on lessons learned and foundational enablers, driving long-term impact, economic growth and sustainability.

### Recommendations

- **Establish institutionalized innovation hubs:** Institutionalized innovation hubs and processes – like digital labs or the digital factory model – can accelerate cluster-wide digital transformation by fostering a safe space for testing ideas and experimenting new projects.
- **Invest in workforce transformation:** Training programmes bridge skills gaps and prepare for future roles, ensuring long-term ecosystem resilience. **Institutionalizing training and awareness programmes** help ensure workforce readiness for ongoing industrial transitions. Effective change management is essential to drive adoption, align stakeholders, and foster a culture of continuous learning.
- **Strengthen ecosystem synergies:** Collaboration with diverse stakeholders, including startups, SMEs and academia, drives innovation and builds robust local ecosystems. **Strengthening partnerships** across sectors sustains innovation and addresses dual transformation challenges effectively.

### CASE STUDY 5

## Digital labs drive ecosystem-wide transformation



ArcelorMittal has deployed a private 5G network at its Dunkirk site, to enable real-time data transmission and digital tracking for its steel recycling project. The initiative enhances efficiency, safety, and sustainability across processes. Through this project, ArcelorMittal serves as an industrial example demonstrating how digitalization and 5G can be used to improve production processes and develop circular economy approaches.

Recognizing the value of these innovations, ArcelorMittal has established the digital lab, a space for sharing and developing innovative projects with other industries, startups, academia, and local authorities, strengthening collaborations within the local and regional ecosystem. This case study demonstrates how ArcelorMittal’s

involvement in the Dunkirk territory and city goes beyond individual company gains. By promoting collaboration, investing in workforce development, and strengthening local partnerships, the initiative addresses short-term transformation needs while building long-term resilience in the ecosystem.

🗣️ **By engaging communities and accelerating innovation locally, we have created a ‘totem’ for transformation—a local hub for innovation, training and collaboration. This integrated approach has been essential in driving significant change within the steel industry and beyond.**

David Glijer, Chief Digital Officer, ArcelorMittal France

### Dkarbonation Cluster and ArcelorMittal: Steel recycling with 5G

Background and objectives	Digital technologies	Results
<p>ArcelorMittal has established a roadmap around industry transformation, fostering collaboration between industry players, universities, startups and local governments. The initiative aims to stimulate innovation, accelerate industrial transformation and build a sustainable local ecosystem through the creation of a Digital Lab, serving as a digital factory for strategy, collaboration and innovation, and a Digital Academy.</p>	<ul style="list-style-type: none"> <li>– <b>Advanced connectivity and 5G</b> are used to ensure seamless data integration across industrial systems</li> <li>– <b>Visualization and Collaboration Platforms</b> are leveraged for knowledge sharing and decarbonization roadmaps development</li> </ul>	<p>Since its launch in 2021, the Digital Lab fosters over 120 projects annually and has:</p> <ul style="list-style-type: none"> <li>– Established partnerships with universities and engineering schools, enhancing knowledge exchange</li> <li>– Created a “light industry campus” to share technology and foster talent synergies</li> <li>– Launched the Digital Academy, and created a training center “Défi4” which participates in an industry-wide training program on digitization and decarbonization</li> </ul>

# Conclusion

By collectively advancing their digital maturity, industrial clusters can unlock transformative value that individual stakeholders cannot achieve alone. This includes strengthening energy resilience and security, boosting industrial competitiveness, mitigating risks, enhancing local value chains, and accelerating decarbonization—as demonstrated by [numerous real-world examples](#). These case studies, together with the enablers and Digital Maturity Framework outlined in this paper, offer inspiration and actionable steps to strengthen digital collaboration within industrial clusters. By fostering adoption and scaling, clusters worldwide can unlock value, driving economic growth, job creation and decarbonization.

This work is part of the Transitioning Industrial Clusters initiative which aims to improve collaboration and develop a shared vision among co-located companies and public institutions to drive economic growth, employment and reduce CO<sub>2</sub> emissions. Launched in November 2021 by the World Economic Forum, in collaboration with Accenture and EPRI, at the Conference of the Parties (COP) 26, the initiative has become the largest coalition of co-located companies and public institutions pledging to reduce their GHG emissions while driving economic growth and employment.

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