



## **TWIN TRANSFORMATION PROJECT**

**Project No: 2024-1-TR01-KA220-VET-000255722**

# **INCREASING THE GREEN AND DIGITAL COMPETENCIES OF SME OWNERS AND EMPLOYEES IN THE SHOE MANUFACTURING AND LEATHER SECTOR**

## **CURRENT SITUATION AND GOOD PRACTICE EXAMPLES REPORT**

**OCTOBER, 2025**



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## **PREFACE**

### ***Purpose and Scope of the Report***

This report analyzes the twin transformation—the progress of green and digital agendas—in Italy, Spain, Portugal, and Türkiye. It assesses how countries align legal and institutional frameworks with international commitments while integrating sustainability and digitalization into industrial strategies. Special focus is given to SMEs and the footwear and leather sectors, which serve as both traditional industries and laboratories for innovation. The report identifies regulatory instruments, institutional practices, and sectoral initiatives, while highlighting good practices and policy recommendations to support a just and competitive transition.

### ***Methodology and Stakeholder Involvement***

The study is based on structured desk research, comparative policy analysis, and stakeholder mapping. It draws on primary legislation, national strategies, EU programs, and international frameworks to ensure a balanced and multi-level perspective. The roles of ministries, agencies, chambers, industry federations, NGOs, and academic institutions are considered, as their engagement is crucial to the effective implementation of twin transformation policies.

### ***Desk Research***

A review of primary and secondary sources, including environmental, energy, and digital legislation, national strategies, and sectoral reports, provided the foundation for the analysis.

### ***International Agreements Review***

Global and regional commitments such as the Paris Agreement, the UN Sustainable Development Goals, the European Green Deal, Kyoto Protocol, EU Digital Agenda and relevant OECD and WTO frameworks were examined to assess coherence with national policies.

### ***Comparative Analysis***

National approaches were systematically compared to identify convergence and divergence in legal, institutional, and sectoral responses. Special attention was given to SMEs and traditional industries adapting to digital and green imperatives.

### ***Institutional Mapping***

Identification and classification of national institutions and regulatory bodies responsible for the implementation and monitoring of green and digital policies.

### ***Policy Coherence Assessment***

The interlinkages between green and digital policies were evaluated to detect synergies, overlaps, and coordination gaps, especially in relation to financing, industrial modernization, and SME support.

# 1. THE CONCEPT OF TWIN TRANSFORMATION AND ITS RELATIONSHIP WITH GREEN-DIGITAL TRANSFORMATION AND SUSTAINABLE DEVELOPMENT

## 1.1. Definition and Importance of Twin Transformation

In a period of unprecedented environmental and technological challenges, the concept of **Twin Transformation** - pursuing green and digital innovation simultaneously - has emerged as an essential and strategic requirement for sustainable development. As vital contributors to inclusive growth, job creation, social cohesion, and sustainable business models, **SMEs** are central to this transition. Their small size grants them flexibility and innovative capacity, yet they remain vulnerable in terms of access to finance, skilled labor, digital tools, and knowledge networks (Pacciani, 2021). Within this context, twin transformation provides an important opportunity for SMEs to strengthen resilience, enhance inventive capabilities, and integrate into broader sustainability objectives. Supporting this transition is critical not only for their survival and growth but also for building competitive, adaptive, and future-ready economies at both local and global scales.

Twin Transformation can be defined as the integrated process of digital and green transformation. *The green dimension* focuses on minimizing environmental impacts, conserving resources, and promoting energy efficiency and low-carbon practices, while *the digital dimension* leverages technological innovation to optimize processes, increase efficiency, and reduce waste. Rather than parallel developments, these two dimensions are interdependent: digital tools accelerate sustainability efforts, while green imperatives shape the trajectory of digital technologies. This mutual reinforcement enables the creation of smarter, cleaner, and more sustainable business models, positioning twin transformation as a cornerstone of long-term economic and ecological resilience.

## 1.2. Green Transformation: Concepts, Strategies, and Impact

Green transformation refers to the comprehensive shift of economic and business activities toward sustainability by reducing carbon emissions, conserving natural resources, and minimizing ecological damage. It is often defined as green growth in a narrow sense, but more broadly as a process that combines economic, social, and environmental changes (Cheba et al., 2021, based on Berger, 2011; Gu et al., 2018).

The transformation is operationalized through renewable energy adoption, sustainable production and consumption models, circular economy practices, waste reduction, and ecosystem protection (Demirdag, 2021). At the global and regional level, initiatives such as the *UN Sustainable Development Goals (2015)* and the *EU Green Deal (2020)* set ambitious targets, including climate neutrality, green technology deployment, and sustainable industry and transport systems. These frameworks promote innovation, resource efficiency, and inclusive approaches to ensure that the transition remains just and equitable.

Green transformation reshapes production systems, consumption patterns, and fiscal structures. Firms are encouraged to invest in low-carbon technologies, governments adapt through carbon pricing and subsidies, and households experience changes in energy costs and consumption behaviors. While lower-income groups face disproportionate challenges, such as higher energy burdens and limited access to clean technologies, the long-term impacts include

reduced pollution, improved public health, job creation in green sectors, and enhanced competitiveness. Overall, the process represents a systemic shift with profound economic, social, and environmental consequences.

### 1.3. Digital Transformation: Key Technologies and Their Role

**Digital transformation** is the comprehensive integration of digital technologies into economic and social systems, fundamentally reshaping how businesses function, governments deliver services, and individuals interact. Rather than the mere adoption of tools, it represents a systemic rethinking of processes to enhance efficiency, innovation, and sustainability.

Key technologies such as artificial intelligence, big data, blockchain, the Internet of Things (IoT), and cyber-physical systems enable smarter and more energy-efficient operations, supporting automation and new business models. Emerging advances like quantum computing and DNA-based data storage further expand possibilities by addressing complex problems and reducing resource intensity (Muench et al., 2022).

Digital transformation strategies focus on inclusive and sustainable growth by improving digital public services, supporting digital economies, and fostering digital literacy, while addressing challenges such as the digital divide, data security, and accessibility (European Commission, n.d.).

### 1.4. Circular Economy and Sustainable Development

The **circular economy** is an economic model designed to minimize waste, maximize resource efficiency, and maintain materials in use for as long as possible, contrasting with the traditional linear model of “take, make, dispose.” It incorporates strategies such as reducing, reusing, recycling, remanufacturing, and designing durable, repairable products, aiming to decouple economic growth from virgin resource extraction (Kirchherr et al., 2017; McCarthy et al., 2018). By closing, slowing, and narrowing resource loops, the circular economy enhances environmental sustainability, reduces costs, and fosters innovative business models.

Beyond environmental benefits, circular practices support **economic sustainability** by creating new markets, improving competitiveness, and reducing dependence on finite resources. They also contribute to **social sustainability** by generating jobs, strengthening community resilience, and promoting equitable access to resources and services. The concept aligns closely with **sustainable development**, defined as meeting present needs without compromising the ability of future generations to meet their own, balancing economic growth, social inclusion, and environmental protection (Brundtland Report, 1987).

Digital technologies increasingly act as enablers of circular practices, enhancing resource efficiency, optimizing production, and supporting low-carbon transitions. The convergence of digital and green transformations—the **Twin Transitions**—further strengthens sustainability by reducing material consumption, improving recycling systems, and promoting more efficient production and logistics processes (Rosário & Dias, 2022; Compagnoni, 2024). However, realizing the full potential of circular economy strategies requires inclusive policies, bridging the digital divide, and ensuring equitable access to technological innovations.

Overall, the circular economy provides a practical framework for achieving sustainable development, integrating environmental, economic, and social objectives to create a more resource-efficient, resilient, and equitable world.

## **1.5. Sector-Specific Dynamics: Twin Transformation in SMEs and the Footwear Industry**

### **1.5.1. Twin Transformation Applications Across Various Sectors**

The twin transition—green and digital—has become a defining driver across multiple sectors, aiming to boost sustainability while enhancing competitiveness. In manufacturing, SMEs face persistent barriers including outdated infrastructure, limited financial and human resources, and compliance pressures, yet they also stand to gain long-term resilience through strategic investments and supportive EU frameworks.

Twin transformation is being applied intensively in energy, transport, agriculture, waste, manufacturing, finance, and food sectors. Examples include:

- **Energy:** Smart grids, digital monitoring, and renewable integration (e.g., digital wind farms in Turkey) reduce emissions and optimize supply.
- **Transport:** Electric and autonomous vehicles, digital ticketing, and smart traffic systems cut energy use and improve efficiency.
- **Agriculture & Livestock:** IoT sensors, digital monitoring, and smart irrigation optimize resources and minimize waste.
- **Waste Management:** AI-based sorting, smart bins, and digital product passports improve recycling and circularity.
- **Manufacturing:** Digital twins, IoT, and smart factories enhance efficiency, reduce waste, and support greener production.
- **Finance:** Digital banking and green finance tools channel resources toward sustainable projects.
- **Food:** Digital twins improve traceability, reduce waste, and enhance sustainability across the supply chain.

Overall, these applications show how **smart technologies and data analytics** are creating sustainable solutions across diverse domains, from energy conservation to financial services. By reducing environmental impacts and increasing efficiency, twin transformation not only accelerates the green and digital transitions but also strengthens long-term competitiveness. Reflecting this momentum, the global market size of twin transformation technologies is projected to reach **\$48.2 billion by 2026**, underscoring their growing economic and strategic significance.

### **1.5.2. Twin Transformation Applications in the Footwear and Leather Sector**

For the footwear and leather sector, the *EU's Strategy for Sustainable and Circular Textiles (2022)* and related tools such as *Digital Product Passports and Product Environmental Footprint (PEFCR)* have made the twin transition a market requirement. SMEs

must adapt to rising demands for traceability, deforestation-free sourcing, stricter chemical rules, and circular business models.

Digitalization underpins compliance and efficiency:

- **3D design and digital twins** reduce sampling and lead times.
- **Vision-based scanning and automated cutting** improve leather yield.
- **IIoT sensors and lab systems** strengthen process control and effluent management.
- **Chain-of-custody and item-level identifiers** enable traceability and reporting.

Green priorities focus on chemical stewardship, water and energy savings, and measurable footprint reduction, with data integrated into PLM/ERP/MES systems. A practical roadmap involves piloting traceability, digitizing cutting and shop-floor operations, and upskilling teams in 3D and chemical management.

Key progress indicators include higher material yields, reduced restricted substances, compliance in water/effluent, greater passport-ready SKUs, and faster product development. Aligning sustainability and digital capabilities thus secures compliance, buyer trust, and durable competitiveness.

## **2. LEGISLATION AND DEVELOPMENTS REGARDING GREEN AND DIGITAL TRANSFORMATION AT GLOBAL AND EU LEVEL**

### **2.1. International Legal Framework and Practices on Green and Digital Transformation**

International legal and policy frameworks provide the foundation for advancing green and digital transformation; below, key examples are outlined.

#### **A. Paris Agreement (2015)**

The Paris Agreement, adopted under the UNFCCC and ratified by 196 Parties, serves as the primary global framework on climate action. It commits states to limit global warming to well below 2°C—ideally 1.5°C—by guiding policies toward decarbonization, renewable energy, energy efficiency, and green technologies. Its main instruments include Nationally Determined Contributions (NDCs) and climate finance, supporting mitigation and adaptation pathways, particularly in developing countries. Although primarily climate-focused, it indirectly stimulates digital innovation through the monitoring, reporting, and verification systems required for tracking emissions and climate finance.

#### **B. United Nations Sustainable Development Goals (SDGs)**

Adopted in 2015, the 17 SDGs provide a comprehensive global agenda linking poverty reduction, climate action, and sustainable growth. Goals such as SDG 13 (Climate Action), SDG 7 (Clean Energy), and SDG 12 (Responsible Consumption and Production) establish a framework for embedding sustainability into national and corporate strategies through renewable energy, circular economy models, and resource-efficient production. Importantly, digital transformation is explicitly embedded in targets such as SDG 4.4 (ICT skills), SDG 9.c (access to ICT and internet), and SDG 17.8 (technology and knowledge sharing), emphasizing its enabling role for sustainability.

### C. European Green Deal (2019)

The European Green Deal is the EU's strategic roadmap for climate neutrality by 2050. It combines biodiversity protection with a circular, low-carbon economy and is operationalized through measures such as the Fit for 55 package—targeting a 55% emissions reduction by 2030—and the Carbon Border Adjustment Mechanism (CBAM), which addresses carbon leakage while safeguarding competitiveness. Crucially, it is framed as a “twin transition”, recognizing that green objectives must advance in parallel with digital transformation tools such as smart grids, digital product passports, and data-driven resource management.

### D. Convention on Biological Diversity (CBD, 1992)

The CBD promotes biodiversity conservation, sustainable use of resources, and equitable benefit-sharing. Through national biodiversity strategies, Parties integrate ecological protection into broader policies, ensuring that economic transformation respects environmental limits.

### E. General Data Protection Regulation (GDPR, 2018)

The GDPR provides the EU's framework for personal data protection, ensuring lawful, fair, and secure processing. By reinforcing trust in digital services and cross-border data flows, it underpins reliable and rights-based digitalization.

### F. Digital Markets Act (DMA) & Digital Services Act (DSA) (2020–2021)

These two EU regulations reshape online platforms and digital markets. The DMA sets obligations for dominant “gatekeeper” platforms to ensure fair competition, while the DSA modernizes rules on online content and intermediary responsibility, enhancing transparency, accountability, and user protection in the digital economy.

### G. United Nations E-Government Survey (2003–present)

The UN E-Government Survey benchmarks progress in digital governance, highlighting how ICTs enhance service delivery, institutional capacity, and accountability. It supports governments in aligning e-governance with inclusive and sustainable development goals.

### H. International Telecommunication Union (ITU) – Digital Transformation

As the UN agency for ICTs, the ITU promotes global digital inclusion through standards, infrastructure investment, and capacity-building. Its initiatives—ranging from broadband expansion to smart cities and digital health—help countries translate connectivity into measurable economic and social benefits.

Overall, digital technologies are increasingly recognized as integral enablers of environmental sustainability. Applications such as smart grids facilitate the integration of renewable energy sources, digital twins support predictive maintenance and resource optimization in manufacturing, and blockchain-based systems enhance supply-chain transparency and accountability in emissions reporting. These innovations illustrate a reciprocal dynamic in which digitalization accelerates the green transition, while sustainability imperatives shape the development and governance of digital systems. Taken together,

international regulatory and policy frameworks are converging toward an integrated paradigm that seeks to foster an inclusive, resilient, and competitively sustainable global economy.

## **2.2. EU Directives and Policies on Green and Digital Transformation**

The European Union has developed a broad set of interlinked policies and directives that position the green and digital transitions as mutually reinforcing pillars of long-term sustainability. On the environmental side, the *European Green Deal (2019)* sets out the Union’s overarching vision of climate neutrality by 2050, embedding decarbonization, biodiversity protection, and circularity at the core of economic transformation. This framework is given legislative effect through the *Fit for 55 Package (2021)*, which raises the level of ambition by tightening the EU Emissions Trading System, revising renewable energy and efficiency targets, and introducing the *Carbon Border Adjustment Mechanism* to address carbon leakage. Complementary initiatives such as the *Circular Economy Action Plan (2020)* promote durability, reuse, and high-quality recycling to reduce resource intensity, while the *EU Biodiversity Strategy for 2030* commits to restoring degraded ecosystems and protecting natural capital as a basis for resilience.

In parallel, the Union has advanced a digital policy architecture that emphasizes innovation, fairness, and rights protection. *The Digital Single Market Strategy (2015)* created the foundations for seamless cross-border digital trade and interoperability, while the *General Data Protection Regulation (2018)* provided a harmonized framework for privacy and trust in digital services. More recent initiatives—the *Digital Services Act (2020)* and the *Digital Markets Act (2020)*—redefine the responsibilities of large online platforms by enhancing transparency, safeguarding users, and ensuring open and contestable markets. To this, the *Artificial Intelligence Act (2021)* adds a forward-looking, risk-based framework designed to ensure that AI applications are deployed in a manner consistent with fundamental rights, transparency, and public accountability.

Taken together, these measures reflect a deliberate EU strategy to integrate the green and digital agendas within a single, coherent governance model. Digitalization is framed not only as a driver of competitiveness but also as a key enabler of environmental goals—for instance, through smart grids that balance renewable energy, digital tools that support circular product design, and e-mobility platforms that reduce emissions in transport. At the same time, sustainability imperatives are embedded within digital governance to ensure that infrastructures and services are efficient, resilient, and resource-aware. By aligning these two dimensions, the Union seeks to combine technological progress with ecological responsibility, strengthening competitiveness while advancing towards an inclusive and climate-neutral economy.

## **3. NATIONAL LEGISLATION REGARDING GREEN AND DIGITAL TRANSFORMATION**

### **3.1. Signed International Agreements/Protocols and Their Implementation**

International commitments—most prominently the Paris Agreement, the UN 2030 Agenda, and, for EU Member States, the European Green Deal and associated declarations—provide the overarching framework for national policies on green and digital transformation.

Italy, Portugal, Spain, and Türkiye have each adopted these obligations, but their institutional arrangements, sectoral emphases, and implementation tools reveal both convergences and differences.

All four countries are parties to the Paris Agreement and integrate its objectives into domestic climate and energy strategies. EU members (Italy, Portugal, and Spain) implement the European Green Deal and the EU Declaration on a Green and Digital Transformation, embedding decarbonization, renewable energy, and biodiversity targets alongside digital governance reforms. Türkiye ratified the Paris Agreement in 2021 and frames its response through the Climate Change Action Plan, voluntary mitigation efforts, and renewable-energy investment, complemented by participation in the Stockholm Convention for chemical and waste management.

Italy presents the close coupling of international commitments with both EU-level and national initiatives. During its G7 presidency in 2024, it advanced global debates on AI and sustainable development and initiated an AI Hub with UNDP to apply digital innovation in agriculture, health, infrastructure, and energy. Domestically, a four-party agreement among the foreign ministry, digital transformation department, AGID, and AICS strengthened digital identity, public infrastructures, and capacity-building in partner countries. In the leather-footwear sector, the voluntary Leather-Footwear Protocol integrates traceability, supplier audits, process digitalization, and emissions reduction, referencing ISO 14001, EMAS, ICEC, GRS, LWG, and CSR standards.

Portugal combines EU climate and digital objectives with a highly structured governance system. The Ministry of Environment and Energy leads climate neutrality initiatives, while the Ministry of Economy and Territorial Cohesion directs digital policy. Agencies such as IAPMEI deliver SME incentives, the Portuguese Environment Agency (APA) oversees emissions compliance, and the Digital Mission Structure coordinates skills and innovation. National instruments like the Climate Framework Law and PNEC 2030 provide grants for efficiency upgrades, electrification, and renewable installations, while circular-economy legislation enforces extended producer responsibility. In parallel, the Digital Transition Action Plan advances EU Digital Decade goals by promoting ERP, AI, and e-commerce adoption, alongside strengthened requirements for cybersecurity and data protection.

Spain demonstrates strong alignment between international commitments and sectoral practice. Alongside the Paris Agreement, Spain implements the Aarhus Convention, embedding transparency and public participation into its sustainability policies. In the footwear and leather industries, eco-materials, circular business models, and low-emission processes are supported by digital manufacturing, blockchain applications, and digital product passports, strengthening both traceability and compliance with consumer and regulatory expectations.

Türkiye follows a more differentiated path, balancing international obligations with domestic legal reforms. While not bound by EU directives, it aligns with the EU Digital Agenda and applies GDPR principles through its Personal Data Protection Law (KVKK). The expansion of the e-Government Gateway, participation in WTO e-commerce negotiations, adherence to OECD digital-economy guidelines, and active engagement with ITU standards

demonstrate how digital governance is institutionalized. Infrastructure investments, including nationwide fiber and 5G deployment, are also positioned as enablers of green policy goals.

In sum, the four countries converge on the recognition that the twin transition requires integrating climate commitments with digital innovation, yet their approaches differ in emphasis and institutional design. Italy emphasizes international leadership and sectoral protocols; Portugal operationalizes EU frameworks through a detailed governance model and SME-oriented instruments; Spain translates commitments directly into sectoral strategies that combine circularity with digital traceability; and Türkiye focuses on international cooperation, legal reforms, and infrastructure investment to align with global norms. Collectively, these movements demonstrate a common understanding that digital technologies are critical enablers of green goals, while sustainability criteria are increasingly shaping digital system governance. This convergence indicates the emergence of a unified policy rationale in Europe and its neighbors: promoting environmental and digital transitions as interdependent foundations of competitive and resilient economic modernization.

### **3.2. National Legal Regulations (Laws, Regulations, and Guidelines)**

Italy, Portugal, Spain, and Türkiye have each embedded international and EU-level commitments into domestic legal frameworks that combine climate legislation, circular-economy measures, and digital-governance reforms. They are characterized not only by commonalities, but also by differences in sectoral priorities and institutional arrangements.

Italy pursues a renewed industrial strategy aligned with the EU Green Deal, focusing on reindustrialization, sustainable sectors, and digital modernization. Italy has incorporated CSRD, ESPR, the Digital Product Passport, and CBAM, while domestic instruments such as the Environmental Code, waste legislation, and Minimum Environmental Criteria provide the regulatory basis for compliance. Fiscal tools like the Sustainable Growth Fund, IPCEI Fund, and Transizione 5.0 provide substantial tax credits and grants for renewables, digital/AI investments, and training, with targeted support for fashion, textiles, and footwear SMEs.

Portugal applies a structured governance model. The Climate Framework Law (98/2021) and PNEC 2030 set legally binding climate targets, complemented by Decree-Laws 102-D/2020 (waste/circularity) and 15/2022 (renewables and energy communities). The Digital Transition Action Plan and AI Portugal 2030 accelerate SME adoption of ERP, e-commerce, AI, and cloud, reinforced by cybersecurity law (46/2018) and GDPR oversight. Funding streams such as the Recovery and Resilience Plan (PRR) and Portugal 2030 facilitate compliance and modernization.

Spain advances green regulation and digital innovation with strong impact on footwear and leather. Royal Decree 1055/2022 (packaging) and Law 7/2022 (waste/soils) enforce EPR, eco-design, and safer tanning practices. Law 7/2021 mandates emissions reduction, renewable uptake, and eco-labelling, while Royal Decree 163/2014 introduces carbon-footprint reporting. Law 28/2022 on startups fosters innovation ecosystems relevant to fashion-tech. Together, these laws impose compliance duties while opening avenues for sustainable design, smart manufacturing, and traceability.

Türkiye follows a dual-track approach. The Climate Change Strategy, Green Deal Action Plan (2021), and the new Climate Law (2025) establish the basis for the 2053 net-zero goal, creating a carbon market, border adjustment mechanism, and obligations on just transition and climate justice. Supporting laws include the Environment Law, Renewable Energy Law, Energy Efficiency Law, and Zero Waste Regulation. On the digital side, the Eleventh and Twelfth Development Plans prioritize green-digital competitiveness, while the Digital Türkiye Roadmap and Digital Government Strategy expand e-government. Core laws—E-Commerce Law, KVKK (data protection), Electronic Signature Law, Internet Publications Law—are reinforced by cybersecurity strategies and major ICT investments in fiber and 5G.

All four countries are incorporating green and digital objectives into their national frameworks, though with differing priorities and instruments. While Italy and Spain stress sectoral measures, Portugal emphasizes coordinated governance and SME support, and Türkiye pursues broader climate and digital reforms. Taken together, these approaches point to a gradual alignment with the twin transition.

#### **4. NATIONAL LEVEL APPLICATIONS/RESPONSIBLE INSTITUTIONS AND ORGANIZATIONS/ROLES REGARDING GREEN AND DIGITAL TRANSFORMATION**

##### **4.1. Public Authorities Responsible for Green and Digital Transformation/Their Duties and Responsibilities**

Across Italy, Portugal, Spain, and Türkiye, the institutional landscape for green and digital transformation is organized around two main pillars: environmental and climate governance on the one hand, and digitalization and data governance on the other. While each country follows a distinct model, they all combine ministerial leadership with specialised agencies, research institutions, and SME-focused bodies to ensure policy coherence and implementation capacity.

Environmental responsibilities are typically anchored in central ministries: Italy's Ministry of the Environment and Energy Security (MASE), Portugal's Ministry of Environment and Energy, Spain's Ministry for the Ecological Transition and the Demographic Challenge (MITECO), and Türkiye's Ministry of Environment, Urbanization and Climate Change. These bodies design national decarbonization pathways, oversee environmental impact assessments, and coordinate alignment with EU or international commitments such as the Paris Agreement and the European Green Deal.

Supporting institutions reinforce implementation and sectoral outreach. In Italy, ENEA provides technical R&D expertise and ISPRA monitors environmental indicators; in Portugal, the Portuguese Environment Agency (APA) enforces standards while the National Innovation Agency (ANI) promotes eco-innovation; in Spain, the Institute for the Diversification and Saving of Energy (IDAE) offers technical assistance and financing for renewable deployment; and in Türkiye, TÜBİTAK supports green R&D while KOSGEB facilitates SME-level adoption of energy efficiency and resource management measures. Ministries of trade and industry also play a role—such as Italy's MIMIT, Spain's MINCOTUR, Portugal's Ministry of

Economy, and Türkiye’s Ministry of Industry and Technology—by linking environmental goals with industrial competitiveness and SME upgrading.

Digitalisation is coordinated through specialised departments and agencies, complemented by independent regulators and cybersecurity authorities. Italy relies on the Department for Digital Transformation (DTD) to implement the National Digital Strategy, with AgID ensuring interoperability and e-government standards; Portugal has the Agency for Administrative Modernization (AMA), the Portugal Digital Mission Structure, and INCoDe.2030 to coordinate skills, services, and business digitalisation; Spain assigns responsibility to the Ministry of Economic Affairs and Digital Transformation, which advances broadband, 5G, and SME integration of ERP and traceability tools; Türkiye’s Presidency Digital Transformation Office (CBDDO) steers public-sector digitalisation, AI, big data, and cybersecurity strategies.

Independent authorities provide safeguards for data protection and digital trust: Italy’s Garante, Portugal’s CNCS, and Türkiye’s KVKK. National cybersecurity agencies—such as Italy’s ACN, Portugal’s CNCS, and Türkiye’s CBDDO—ensure system resilience, protect critical infrastructures, and manage incident response. Complementary financial and advisory agencies (e.g., Invitalia, SIMEST, SACE in Italy; IAPMEI and AICEP in Portugal) also play a critical role in financing digital adoption and enabling SMEs to integrate digital tools into their operations.

Although institutional configurations differ, all four countries reflect a dual structure: environmental ministries and agencies driving decarbonisation, and digital authorities ensuring secure, compatible infrastructures.

<b>Country</b>	<b>Main Environmental Authorities</b>	<b>Industrial / SME Authorities</b>	<b>Digital &amp; Data Authorities</b>	<b>Specialised Agencies</b>
<b>Italy</b>	MASE (environment, climate, energy), CITE (coordination), MASAF (agriculture/forests)	MIMIT (industry, Made in Italy), Unioncamere/Chambers, Invitalia, SIMEST, SACE	DTD (digital strategy), AgID (ICT standards), Garante (data protection), ACN (cybersecurity)	ENEA (innovation & renewables), ISPRA (environmental monitoring)
<b>Portugal</b>	Ministry of Environment and Energy, APA (environmental compliance)	Ministry of Economy & Territorial Cohesion, IAPMEI (SME support), DGAE (sectoral policies)	AMA (e-government), Digital Mission Structure, INCoDe.2030 (digital skills), CNCS (cybersecurity)	ANI (innovation, R&D), AICEP (internationalisation)

<b>Spain</b>	MITECO (environment, circular economy)	MINCOTUR (industry, competitiveness, footwear/leather)	Ministry of Economic Affairs & Digital Transformation (digital agenda, broadband, cybersecurity)	IDAE (renewable energy & efficiency programmes)
<b>Türkiye</b>	Ministry of Environment, Urbanization & Climate Change (climate, circular economy)	Ministry of Industry & Technology (green industry, SMEs), Ministry of Trade (Green Deal, finance), KOSGEB (SME support)	Digital Transformation Office (AI, cybersecurity, e-gov), KVKK (data protection)	TÜBİTAK (R&D, innovation), Green Industry Project

#### **4.2. Professional Organizations and NGOs Representing Craftsmen and SMEs, Their Duties and Responsibilities Regarding Green and Digital Transformation**

Professional organizations and NGOs in Italy, Spain, Portugal, and Türkiye act as crucial intermediaries linking national and EU-level strategies with local enterprises, particularly SMEs, artisans, and micro-businesses. They operate through diverse functions—ranging from training and consultancy to certification, financing, and cross-border cooperation—and help translate broad sustainability and digital agendas into sector-specific practices and innovation pathways.

In Italy, organizations such as Confartigianato, CNA, Casartigiani, and Confindustria provide strong national networks for SMEs and artisans, offering training, digital hubs, and advisory services on eco-efficiency and Industry 4.0. Foundations and associations like Symbola and Sistema Moda Italia link traditional sectors such as fashion, footwear, and leather to sustainability standards and EU initiatives like the Digital Product Passport. Institutions such as the ICEC provide certification schemes, sectoral consortia develop traceability and digital passport standards, while local Chambers of Commerce (e.g., Marche) and interprofessional funds (e.g., Fondimpresa, Fondartigianato, Fonarcom) support SMEs with financing and workforce upskilling.

In Spain, umbrella confederations such as CEOE and CEPYME represent enterprises in national and EU policy dialogues, promoting SME competitiveness and digital adoption. Regional federations (FOACAL, FADA) connect artisans with eco-design and digital marketing practices, while PIMEC provides SME-focused services in Catalonia. Specialized entities such as CTIC support ICT adoption and interoperability, and IDAE provides technical and financial support for energy efficiency and renewable projects, including in leather and footwear supply chains.

In Portugal, confederations (CIP, CCP, AIP) shape national and EU-level policy advocacy, focusing on SME digitalization, eco-design, and sustainability. Sectoral organizations such as CEARTE specialize in vocational training for artisans, combining digital competencies with eco-design and online market access. Agencies like ANI support innovation through R&D funding, while NGOs such as ZERO emphasize environmental awareness, circular economy, and decarbonization pathways for SMEs. Together, these institutions build a coordinated support system that links skills, finance, and compliance.

In Türkiye, major organizations such as TESK and TOBB drive the transformation of artisans and SMEs, integrating green and digital priorities into training, e-commerce adoption, and recycling initiatives. NGOs such as the Industry 4.0 Digital Transformation Association and the Informatics Association of Türkiye (TBD) foster smart technologies, ICT literacy, and national digital policy alignment. Public-linked agencies like TUÇA embed digital tools into waste management and circular-economy programmes, while sector-specific bodies (TASEV, AYSAD) support the footwear industry through EU-linked projects, internships, and traceability initiatives.

In sum, these organizations complement state institutions by addressing practical challenges of the twin transition at the enterprise level. While some common functions, such as awareness-raising and skills development, are shared across countries, the emphasis and instruments differ according to national contexts and sectoral priorities. In a combined perspective, they highlight the variety of approaches through which intermediary organizations contribute to advancing green and digital transformation.

## **5. ECONOMIC AND SOCIAL IMPACTS OF GREEN AND DIGITAL TRANSFORMATION ON CRAFTSMEN AND SMES—CHALLENGES ENCOUNTERED AND WORKS TO BE DONE FOR SOLUTIONS**

### **5.1. Economic and Social Impacts of Twin Transformation**

Twin transformation—the integration of green and digital agendas—reshapes production systems, employment structures, and consumer expectations. For SMEs and craftsmen, it creates opportunities in competitiveness and innovation, but also imposes financial, organizational, and skills-related challenges.

Italy places the twin transition at the core of its National Recovery and Resilience Plan (PNRR), allocating €191 billion in total, of which 25% finances digital advancement and 37.5% supports climate action. Among the six missions, three directly underpin these priorities—“Digitalization, innovation, competitiveness and culture” (€40.32 billion), “Green revolution and ecological transition” (€59.47 billion), and “Infrastructure for sustainable mobility” (€25.40 billion)—establishing a systemic pathway for economic and social transformation. SMEs can access *Transizione 5.0* (>€6 billion) with tax credits up to 45% for energy-reducing, digital investments and training support up to €300,000, conditional on a minimum 3% reduction in energy consumption; a €200 million EIB–MCC facility (loans up to €12.5 million per firm, ≥30% climate-relevant); Simest blended instruments up to €1 million per SME (with up to 40% non-repayable in Southern regions); and the €250 million Green Transition Fund (CDP Venture Capital SGR, Mission 2). While these supports are substantial, high upfront costs for ERP,

IoT/blockchain, and CSRD/ISO compliance risk a dual-speed economy; conversely, firms that adapt realize efficiency gains, supply-chain integration, price premiums for certified goods, and stronger loyalty through service-oriented, traceable models.

Portugal combines climate legislation with a strong SME support ecosystem, somewhat resembling Italy's systemic approach but on a smaller scale. Through the PRR and Portugal 2030, SMEs access grants, soft loans, and advisory services to modernize. Portugal emphasizes reskilling and capacity building, with programs such as INCoDe.2030 and IAPMEI training initiatives. Benefits include productivity gains via ERP and e-commerce, internationalization through digital platforms, and innovation in eco-design. Challenges overlap with Spain—high upfront costs and rural–urban digital divides—but Portugal distinguishes itself by systematically linking digital and green reforms to SME competitiveness and by promoting traditional crafts through digital tools.

Spain's SMEs, particularly in leather and footwear, share Italy's challenge of financing eco-technologies and digital systems but have fewer large-scale incentives. Administrative complexity and limited access to EU funds hinder progress, echoing issues faced by Portuguese firms. Nevertheless, Spain benefits from strong consumer demand for sustainable and customized products, creating premium niches that artisans can exploit. This trend parallels Italy's emphasis on traceability but is more consumer-driven than state-driven. Digitalization, such as 3D modeling and online marketplaces, lowers barriers to global reach, resembling Portugal's focus on e-commerce for artisanal goods.

Türkiye faces constraints similar to those in Spain and Portugal: limited SME liquidity, scarce access to advanced technologies, and skills shortages. Unlike Italy, which relies heavily on fiscal incentives, Türkiye's approach emphasizes institutional support through KOSGEB, TÜBİTAK, and the Digital Transformation Office. Investment needs—ERP, 3D design, certifications, and training—mirror those identified in all three EU countries, but compliance with EU Green Deal–related standards place Turkish SMEs under added pressure. At the same time, opportunities align closely with European cases: eco-efficient production lowers costs, digitalization expands e-commerce, and certified products open export channels. Consumer expectations in Türkiye, as in Spain and Italy, increasingly prioritize transparency and sustainability, confirming a convergence in market dynamics.

Thus, while the trajectory of the twin transformation is shared, the pathways reflect distinct national priorities, capacities, and institutional frameworks.

## **5.2. Challenges Faced by SMEs and the Footwear Sector**

Across Italy, Portugal, Spain, and Türkiye, SMEs in the footwear sector confront a broadly similar set of barriers in pursuing the green and digital transition, though the depth and form of these challenges vary by national context. Key obstacles can be grouped under four headings: limited capital, skill shortages, fragmented supply chains, and complex certification systems.

*Limited capital* is a recurring problem. Italian artisans face high costs for certification, audits, and digital tools; Portuguese firms struggle with the price premiums of eco-materials and automation systems; Spanish SMEs, particularly in rural areas, often lack liquidity and find

EU funds difficult to access due to administrative complexity; and in Türkiye, financing constraints and weak access to support programs make investments in renewable energy and digital infrastructure especially challenging.

*Skill shortages* also cut across all four countries. Italian SMEs report acute mismatches, with more than half unable to recruit profiles combining digital and environmental expertise. Portugal's footwear clusters face an aging workforce and insufficient training in 3D design and sustainability reporting. Spain contends with limited digital literacy and a lack of specialized training outside urban hubs. Türkiye shows parallel gaps in both technical and managerial capabilities, with few structured training pathways to bridge them.

*Fragmented supply chains* exacerbate technological barriers. In Italy, only a small share of SMEs share data electronically with clients and suppliers, limiting traceability and integration. Portuguese producers often rely on legacy systems incompatible with ERP or CAD/CAM tools, while Spanish workshops still operate with outdated, manual processes that make Industry 4.0 adoption a steep leap. In Türkiye, insufficient infrastructure for supply-chain digitalization and weak cybersecurity frameworks further slow progress.

Finally, *complex certification systems* create uncertainty and raise costs. Portuguese SMEs struggle to navigate overlapping schemes such as ISO 14001, LWG, and REACH, while Italian firms face high audit and reporting expenses with limited in-house expertise. Spanish SMEs report confusion and compliance fatigue with evolving EU environmental rules, and Turkish exporters face additional pressures from aligning rapidly with European standards, often without adequate institutional support.

### **5.3. Solutions and Adaptation Strategies for SMEs and Craftsmen**

Adapting to the twin transition requires SMEs and craftsmen to combine digital modernization with sustainability-oriented business models. Across Italy, Portugal, Spain, and Türkiye, similar solution areas emerge.

#### ***Technological Integration***

All four countries shows the need for stepwise and modular adoption of digital tools. Cloud-based inventory systems, lightweight ERP, and e-commerce platforms are recommended entry points, while more advanced options—CAD/CAM in Portugal and Spain, AI-enabled quality control in Türkiye, or blockchain-based supply-chain traceability in Italy—represent later stages. While Italian strategies focus on interoperability and system-wide traceability, Portugal promotes diagnostics and phased adoption to avoid overinvestment. Spain relies on fab labs, incubators, and university partnerships to ease access, while Türkiye integrates production-level digitalization with IoT monitoring and carbon accounting.

#### ***Sustainable Business Models***

Embedding circular economy principles is a shared strategy. Repair services, reuse of offcuts, and product regeneration are proposed in Spain and Türkiye, while Italy emphasizes the integration of ESG goals and voluntary standards (e.g., ISO 20400). Portuguese firms are encouraged to combine eco-certifications, sustainable sourcing, and design-for-reuse practices with strong cluster support. Common elements include adoption of recycled or low-impact

materials, shorter supply chains, and transparent labeling—though implementation intensity differs, with Italy prioritizing certification, Spain emphasizing consumer-facing circular models, and Türkiye combining circularity with sector-specific solutions such as modular footwear design.

### ***Financing and Institutional Support***

High upfront costs make blended finance critical everywhere. Italy mobilizes large-scale PNRR funds, including Transition 5.0 tax credits and targeted green-transition funds. Portugal combines PRR and Portugal 2030 grants with innovation vouchers and chamber-level support. Spain lowers costs through publicly funded pilot projects and shared manufacturing facilities. Türkiye channels resources via KOSGEB, TÜBİTAK, development agencies, and export-linked incentives. The common challenge is ensuring SMEs can access and effectively navigate these instruments; differences lie in whether support is delivered primarily through large national funds (Italy, Portugal) or sector-focused agencies and development programs (Türkiye, Spain).

### ***Skills and Cultural Change***

Reskilling is recognized as essential but unevenly advanced. All four countries stress the need for training in digital tools, eco-design, and sustainability reporting. Italy and Spain face acute skill mismatches, with SMEs struggling to recruit hybrid profiles. Portugal contends with an aging workforce and succession pressures, while Türkiye highlights the need for structured training pathways and cultural change in traditional family-run enterprises. Awareness-raising and knowledge-sharing through clusters, innovation hubs, and interprofessional funds are widely seen as vehicles to bridge gaps, though levels of institutionalization differ.

Overall, strategies across the four countries converge on gradual digital integration, embedding circularity, blended financing, and workforce development. The diversity between their paths reflects differing industrial structures but collectively emphasize that an integrated approach—aligning technology, sustainability, finance, and skills—is key for SMEs to turn the twin transition into long-term competitiveness.

## **5.4. Support and Incentive Mechanisms to Accelerate the Twin Transformation of Craftsmen and SMEs**

The twin transition of SMEs is supported across Italy, Portugal, Spain, and Türkiye through a mix of EU funds, national programs, and industry initiatives.

In Italy, the PNRR and Transizione 5.0 provide major tax credits and grants for digitalization, energy efficiency, and training, with sectoral measures targeting textiles, fashion, and footwear. Regional chambers (e.g., Marche) and associations such as Assocalzaturifici add support through eco-incentives, training, and internationalization schemes.

Portugal combines Portugal 2030, PRR, and IAPMEI programs to finance innovation, eco-efficiency, and digital skills. Environmental and digital funds back renewables, circular pilots, and upskilling, while associations like APICCAPS and Digital Innovation Hubs (e.g., DIGI4FASHION) provide roadmaps, certification, and “test-before-invest” services.

In Spain, NextGenerationEU and the PRTR allocate substantial resources to green and digital transformation. The PERTE for Circular Economy funds eco-design and recycling in textiles and footwear, while the Digital Agenda 2026 and “Acelera Pyme” promote smart manufacturing and AI-enabled customization. Industry clusters and associations support SMEs with shared services and compliance tools.

Türkiye mobilizes KOSGEB, Development Agencies, and TÜBİTAK to finance SME projects in renewable energy, efficiency, and digitalization. İŞKUR provides vocational training, while OIZs and chambers of commerce foster collaboration, mentorship, and access to new technologies.

These mechanisms show how industry alliances and governmental policies are becoming more entangled, resulting in multi-layered ecosystems that allow SMEs to access resources, experiment, and progressively integrate digital and green practices into daily operations.

## **6. IMPACTS OF TWIN TRANSFORMATION ON THE LABOR MARKET**

The green and digital transitions are reshaping labor demand in Türkiye, Spain, Italy, and Portugal. Routine, manual, and carbon-intensive tasks are declining, while demand grows for hybrid roles that merge digital and sustainability skills. Countries that align investment, training, and employer demand through dual learning, micro-credentials, and active labor market programs adapt faster and more inclusively.

### **6.1 Changes in Labor Demand and Emerging Professions**

Across countries, labor demand is shifting toward roles in automation, data analysis, cybersecurity, eco-design, and life-cycle management. Craftsmanship remains valuable but increasingly tied to CAD/CAM, IoT, and environmental standards.

- Türkiye anticipates major green job growth by 2030 with roles such as AI and data specialists, cybersecurity analysts, energy managers, eco-auditors, and e-commerce experts. The main gap is the absence of a formal green-jobs taxonomy and limited SME participation in training.
- Spain is expanding dual vocational training (from 2024/25), linking curricula with CAD/CAM, robotics, digital quality control, and eco-design. New roles include digital fabrication technicians, circular-economy consultants, and supply-chain analysts.
- Italy forecasts millions needing green and digital skills by 2028, with demand for mechatronics, construction, software developers, industrial designers, and sustainability auditors. Recovery Plan investments reinforce these needs.
- Portugal is replacing low-skill manual roles with hybrid jobs in footwear and leather, combining craftsmanship with digital and green expertise. Roles include CAD footwear designers, additive manufacturing specialists, and compliance managers. Initiatives like BioShoes4All are already piloting such profiles.

## 6.2 Required Skills and Workforce Adaptation Strategies

SMEs need convergent skills:

- Digital: CAD/CAM, robotics, predictive maintenance, cloud systems, cybersecurity, digital sales, lifecycle tools.
- Green: eco-design, energy/water management, carbon accounting, circularity, supply-chain traceability.
- Transversal: problem-solving, adaptability, teamwork, project and change management.

Adaptation strategies vary:

- Türkiye: integrate green-job taxonomies, micro-credentials, and regional learning factories; link investment incentives to verified staff training.
- Spain: use Dual VET to build hybrid profiles; support older workers with targeted upskilling; employ “transition coaches” for SMEs.
- Italy: expand micro-credentials tied to collective agreements; leverage employer academies and apprenticeships; mobilize Digital Innovation Hubs for SME training.
- Portugal: scale formation-action models combining in-company coaching with pilot lines; expand e-learning and prior learning recognition; focus clusters on operator-to-technician pathways.

## 6.3 Educational Programs and Training Initiatives

The twin transition requires targeted education and training initiatives that equip SMEs and craftsmen with both green and digital skills. Across Türkiye, Spain, Italy, and Portugal, governments and social partners are adapting vocational systems, lifelong learning, and EU-supported programs to meet these needs.

Türkiye integrates climate and sustainability education into curricula, develops teacher training and micro-credentials, and expands vocational programs through the public employment agency. Lifelong learning is promoted with SME-focused workshops and certifications.

Spain strengthens company–school links via Dual Vocational Training and offers public courses in digital marketing, automation, and environmental management. EU programs (Erasmus+, NextGenerationEU) support apprenticeships and certification.

Italy combines accredited sectoral centers with Digital Innovation Hubs to deliver AI, cybersecurity, and sustainability training. Recovery Plan and ESF+ funds standardize micro-credentials and expand training for vulnerable groups.

Portugal uses sectoral technology centers and initiatives like BioShoes4All and FAIST to provide eco-design and digital manufacturing training. Adult reskilling is supported through the Qualifica program and modular, stackable credits.

In all four countries, current priorities focus on standardizing green-digital occupational taxonomies, scaling modular micro-credentials, and strengthening dual or work-based learning through regional “learning factories.” These initiatives are intended to align skills supply with emerging labor-market needs and to give SMEs and craftsmen practical, accessible pathways for adaptation. Although institutional frameworks and areas of emphasis differ, a common direction is visible: building training ecosystems that blend national investment, EU funding, and sectoral programs. The overarching goal is to equip the workforce with the capabilities required for sustainable and digital futures, while ensuring inclusiveness and competitiveness.

## **7. GOOD PRACTICE EXAMPLES**

### **7.1. Overview of Good Practices in Green and Digital Transformation**

Green transformation in the footwear sector has increasingly become a significant topic. The industry has adopted innovative approaches in production processes and material selection to ensure environmental sustainability and reduce its carbon footprint. The use of recycled and organic materials, integration of energy-efficient technologies, and implementation of waste management practices form the foundation of this green transition. Companies aim to gain a competitive edge both domestically and internationally by developing environmentally friendly production processes. Below are notable examples of good practices in the green transformation of footwear industry.

### **7.2. Good Practices in Green and Digital Transformation (General and Footwear-Specific)**

#### **7.2.1 FLO (FLO Retailing and Marketing Inc.)**

FLO Retailing and Marketing Inc. has embraced a sustainable and innovative business model through steps in digital and green transformation. As part of its digital transformation, ERP and automation systems have been integrated to make production processes more efficient and traceable. Additionally, investments in supply chain optimization and data analytics have enhanced operational efficiency and decision-making. Heavy investments in e-commerce platforms have also strengthened digital sales channels and offered customers an omnichannel shopping experience.

Under the green transformation, FLO launched its “FLO Earth” sustainable product line, reflecting an eco-conscious production approach. Recycled materials, water-based adhesives, and eco-friendly packaging are used in production, reducing natural resource consumption and environmental impact. The company has also made investments to improve energy efficiency in its facilities. These practices illustrate FLO’s transformation strategy, based on environmental awareness and digital competence, aiming for sustainable growth.

### **7.2.2 DESA Leather Industry and Trade Inc.**

DESA aims to establish a sustainable and innovative position in the sector through its initiatives in digital and green transformation. Digitally, digital quality control systems have been integrated into production processes to monitor product quality more precisely and efficiently. In the design phase, CAD/CAM software and 3D modeling technologies are used, accelerating design and reducing prototyping costs.

In terms of green transformation, DESA has prioritized eco-friendly production techniques, adopting methods that use less water and fewer chemicals in leather tanning. This contributes to reducing environmental impact and offers a more sustainable production model. The company also conducts sustainability reporting to transparently track its environmental performance and continues efforts to reduce its carbon footprint. These initiatives demonstrate DESA's holistic transformation strategy that integrates environmental responsibility with digital technologies.

### **7.2.3 Aegean Footwear Manufacturers' Association (EGEAYSAD)**

EGEAYSAD supports the adaptation of SMEs in the footwear sector to digital and green transformation at a regional level. In this context, training programs on digital transformation and environmentally friendly production are offered to manufacturers in Izmir, encouraging them to adopt new technologies and sustainable approaches. Additionally, a laboratory is planned to offer prototyping and 3D design opportunities to boost innovation capacity in the sector.

Furthermore, consulting projects are carried out to help SMEs comply with the requirements of the European Green Deal, thus supporting their competitiveness in international markets. These initiatives by EGEAYSAD represent concrete steps to accelerate sustainable and digital-focused transformation in the footwear sector at a regional level.

### **7.2.4 TURQUALITY Brand Support Program Companies**

Footwear brands under the TURQUALITY Brand Support Program have taken significant steps to accelerate their digital and green transformation. Thanks to the incentives provided by the program, brands such as Greyder and Polaris have increased their investments in digital infrastructure, enhancing efficiency and competitiveness across all operations, from production to marketing.

Sustainability has also become a focal point in brand management, product design, and corporate reporting. These firms are reducing their environmental impact and strengthening their sustainable brand perception in international markets. The support from TURQUALITY acts as a major lever helping footwear companies adopt an integrated approach to digitalization and sustainability.

### **7.2.5 Gentaş Footwear – Gaziantep Organized Industrial Zone Example**

Gentaş Footwear has implemented significant green transformation practices at its factory in Gaziantep's Organized Industrial Zone. Solar panels installed on the factory roof meet a substantial portion of its energy needs from renewable sources,

contributing to environmental sustainability. Additionally, waste management systems have been modernized, and the transition to a zero-waste policy has been initiated.

Industry-wide, especially in small workshops in Izmir and Istanbul, 3D printing is becoming common for sample production, providing speed and flexibility in design and manufacturing. For exporters to Europe, carbon footprint measurement is becoming a standard, and companies are increasingly building institutional capacity in this area. At the same time, e-commerce integrations, customer relationship management (CRM) systems, and digital design platforms are being adopted more widely, contributing to the widespread nature of digital transformation in the sector.

#### **7.2.6 Bursa Union of Chambers of Tradesmen and Craftsmen (BESOB)**

BESOB carries out various initiatives to enhance environmental sustainability and support green transformation among its member businesses. It organizes training programs on energy efficiency and environmental awareness, raising consciousness among artisans and small businesses to promote energy savings. These programs target businesses in diverse sectors such as bakeries, auto repair shops, and hair salons, encouraging efficient resource use.

Under the zero-waste initiatives, BESOB supports waste separation, collection of recyclable materials, and environmentally responsible waste management practices in workplaces. Information sessions are held to raise awareness of recycling among members.

To encourage renewable energy use, BESOB conducts outreach about solar energy systems, especially promoting rooftop solar systems for industrial zones and small enterprises. It also provides consulting services to help members access financial support from institutions like KOSGEB and BEBKA.

BESOB also informs and advises on environmentally friendly production methods that use less energy, water, and chemicals, particularly mentoring small enterprises in sectors like textiles, footwear, and dye houses.

In cooperation with EU projects and regional development agencies, BESOB is running initiatives to help SMEs comply with the European Green Deal. These projects focus on carbon footprint measurement, environmental impact analysis, and the development of sustainable business models.

All these activities are part of BESOB's goal to increase local environmental awareness and enhance the participation of tradesmen in green transformation.

#### **7.2.7 LIPOR Circular Economy for SMEs – Summary**

LIPOR, the public intermunicipal waste authority for Greater Porto, runs a circular-economy program that helps SMEs and artisans turn industrial by-products—such as leather offcuts, fabric remnants, and wood pieces—into new products instead of landfill waste. The initiative aggregates and classifies these materials, matches generators with local makers, and offers hands-on guidance on eco-design, waste

minimization, green supply chains, and basic certification readiness. It also supports market uptake through credible sustainability storytelling and simple digital tools for traceability and e-commerce. Delivered with sector associations, tech hubs, municipalities, maker spaces, and VET providers, the approach succeeds because it builds practical partnerships, couples funding and training with step-by-step tech adoption, and keeps requirements realistic for micro and small firms. Reported results include hundreds of tons diverted from landfill, dozens of SMEs launching circular product lines, new green jobs, stronger maker spaces and design labs, lower disposal costs, reduced use of virgin materials, and stronger brand value. Costs mainly involve sorting, logistics, prototyping, training, and select certifications; benefits include savings, new revenue, and measurable environmental gains. The model is readily transferable to other regions. More information: [www.lipor.pt](http://www.lipor.pt)

### **7.2.8 As Portuguesas – Eco Footwear Brand**

As Portuguesas is a Portuguese eco-footwear brand (ECOCHIC PORTUGUESAS – Footwear and Fashion Products, Lda) that set out to make stylish shoes with a much lower environmental footprint. Working in the footwear sector, the company redesigns products around renewable and recycled inputs—most notably local cork, plus recycled rubber and PET—uses low-impact dyes and biodegradable packaging, and powers production with solar energy. It pairs this with a circular mindset by encouraging customers to return worn-out shoes, and it strengthens operations and market reach through practical digital tools such as 3D design, automated order tracking, and a dedicated e-commerce platform. The brand collaborates with APICCAPS, CTCP, and cork suppliers to secure responsible materials and technical support.

Despite initial hurdles—higher costs for eco-materials, limited e-commerce know-how, and gaps in ESG reporting—the company advanced through step-by-step implementation, material certifications (e.g., FSC), clear eco-branding, and access to EU-cofunded innovation programs. Reported results include strong export performance in sustainability-minded markets (Germany, Scandinavia), about a 25% reduction in CO<sub>2</sub> emissions versus traditional models, a 25% cut in production waste through better materials planning, and roughly 30% growth in online sales. Overall, As Portuguesas demonstrates a practical, scalable good practice in green transformation: redesign the product, clean the energy mix, close material loops, digitize what matters, and tell the sustainability story clearly to customers.

### **7.2.9 Kyaia Group – Digital Manufacturing and Customization**

Kyaia Group is a Portuguese footwear manufacturer (~600 employees) that modernized its operations without losing its craft identity by building a “Footure Factory.” The company combined Industry 4.0 tools—automation, robotics, real-time monitoring, and digital twins—with a mass-customization model where customers design shoes online and orders flow directly to the shop floor. End-to-end ERP/MES integration and AI analytics synchronize design, production, stock, and logistics, while CRM and e-commerce deliver a personalized, traceable customer experience.

This build-to-order approach cuts overproduction and waste, shortens time-to-market, and reduces inventory and transport emissions, lowering the overall environmental footprint. Results include higher efficiency, less scrap and rework, faster delivery, and greater customer satisfaction through personalization and transparency. The transformation was enabled by partnerships with CTCP, APICCAPS, universities, and incubators, and by phased adoption tied to workforce upskilling. Kyaia's model is a clear good practice in green transformation: use interoperable digital systems to align production with real demand, embed traceability, and link operational efficiency to concrete sustainability outcomes.

#### **7.2.10 Localized, eco-responsible supply chains (Pedro García SLU – footwear)**

**Organization and context:** Pedro García SLU is a third-generation luxury shoemaker employing around 100–120 people and selling in nearly 40 countries. The company set out to reduce its environmental footprint while maintaining high-end positioning and traceability.

**Problem:** Rising demand for sustainable, traceable products and the need to align internal processes with circular economy principles, despite the risk of lower margins from local sourcing and the up-front cost of renewables.

**Intervention:** The firm prioritized local and EU sourcing (reported 96.61% EU-sourced raw materials), installed rooftop solar that covers about 20% of electricity needs, and introduced recovery and reuse of leather offcuts to close material loops. Materials emphasize lower-impact options (e.g., vegetable-tanned leather; natural cork; recycled inputs). Management embedded sustainability into design and procurement rather than treating it as a marketing add-on.

**Stakeholders:** EU and local suppliers, regional energy providers, internal production and design teams, and brand leadership.

**Success factors:** Executive commitment; acceptance of slimmer short-term margins in exchange for long-term brand value; credible traceability; visible renewable energy use; practical circularity measures.

**Results:** Lowered carbon footprint, partial self-generation of electricity, and systematic leather reuse. The company reports stronger reputation, customer loyalty in eco-conscious markets, and competitive positioning without diluting brand identity.

**Costs and benefits:** Costs included solar investment and potentially higher material costs; benefits included energy savings, reduced waste disposal, regional economic spillovers, and durable brand equity.

#### **7.2.11 Systematic integration of sustainability in vocational education (Valencian Region – general)**

**Organization and context:** The Regional Ministry of Education's Directorate-General for Vocational Training oversees VET policy and delivery. Green skills had been unevenly addressed across programs.

**Problem:** Graduates lacked structured exposure to environmental impact analysis, circular production, and sustainability innovation, creating a skills gap for firms undergoing green transition.

**Intervention:** New modules on sustainability in production systems were introduced across Intermediate and Advanced VET. Students now analyse environmental impacts in their sector (including footwear) and design targeted sustainability plans. Teacher upskilling is delivered through regional and national training bodies (CEFIRES and INTEF). Initiatives align with Spain's Circular Economy Strategy and involve industry input.

**Stakeholders:** VET schools, teachers, students, CEFIREs, INTEF, sector companies and associations.

**Success factors:** Policy alignment with EU and national strategies; investment in teacher capability; systematic curriculum changes linked to industry needs.

**Results:** Sustainability content embedded across multiple VET pathways; hundreds of teachers trained; thousands of students annually exposed to green competencies; improved pipeline of job-ready talent for regional industry.

**Costs and benefits:** Costs relate to curriculum development and teacher training; benefits include higher employability, improved firm readiness for sustainability compliance, and progress toward regional and EU targets.

#### **7.2.12 AI and data-driven processes for value creation (Pedro García SLU – footwear)**

**Organization and context:** A heritage brand seeking to raise agility while protecting artisanal identity.

**Problem:** Excess time spent on manual administrative tasks constrained creativity, design quality, and responsiveness.

**Intervention:** Cloud systems and AI tools were deployed to automate repetitive work (examples include inventory, order processing, and routine analytics). Management encouraged bottom-up experimentation with digital tools while ensuring fit with brand values. Workforce roles shifted toward decision-making, creative work, and higher-value tasks.

**Stakeholders:** Internal management and teams; external cloud and AI vendors; customers as downstream beneficiaries.

**Success factors:** Employee openness to innovation; leadership tolerance for iterative adoption; careful integration of digital tools into existing workflows; explicit protection of craftsmanship.

**Results:** Reduced administrative workload and cycle times, better production agility, stronger innovation capacity, and reinforced image as an “innovative heritage” brand. Competitiveness improved without eroding craft credentials.

Costs and benefits: Outlays for software and training; benefits in productivity, employee satisfaction and retention, faster service, and higher perceived quality.

### **7.2.13 Digital readiness support for SMEs via training and partnerships (FICIA – footwear)**

Organization and context: The International Footwear and Related Industries Fair Foundation (FICIA) is a private-sector foundation focused on design, marketing, and innovation in footwear and components.

Problem: Many SMEs face resource constraints, knowledge gaps, and complex value chains that impede digital adoption, leaving them vulnerable to disruption.

Intervention: FICIA runs targeted seminars, workshops, and consultancy tailored to SME realities (digital marketing, e-commerce, automation, data-driven management). It collaborates in European projects that forecast digital skills needs, builds networks connecting SMEs with technology providers and innovation hubs, and translates complex concepts into sector-specific guides and playbooks.

Stakeholders: SMEs and employees; European project consortia; local technology providers and consultants; industry associations; training institutions.

Success factors: Focus on SME constraints; combination of training, advisory, and networking; strong EU and local partnerships; hands-on, actionable delivery.

Results: Higher digital awareness and readiness among dozens of SMEs; stronger regional innovation networks; tangible steps toward new business models and tools.

Costs and benefits: Costs include program development and coordination; benefits include improved competitiveness and resilience, better career pathways for workers, and a more robust regional industrial fabric.

### **7.2.14 Green Transition – Sustainable Supply Chain Management (DIENPI SRL)**

Organization and context: DIENPI SRL - Design and production of fashion accessories, prints on leather and fabrics. Labels, hot-fix motifs. Screen printing, digital printing, engraving, laser cutting, reliefs on leather and synthetics, high frequency and embroidery.

Problem: DIENPI SRL implemented this best practice to tackle the risk of sourcing from suppliers that do not meet minimum environmental and social standards. This includes issues such as environmental pollution, child labor, and unsafe or unfair working conditions.

The company recognized that supply chain decisions could have serious ethical and ecological consequences. Therefore, a comprehensive strategy was developed to ensure that all suppliers operate in alignment with the company's values and broader sustainability goals.

Intervention: To address the risks associated with unethical and unsustainable suppliers, DIENPI adopted a structured strategy based on the principles of responsible sourcing. The approach consists of several integrated actions:

- **Supplier Selection:** Priority is given to suppliers with internationally recognized environmental and social certifications, ensuring baseline compliance with sustainability standards from the outset.
- **Contractual Clauses:** Supplier agreements are embedded with binding clauses mandating compliance with ethical standards—such as the prohibition of child labor, assurance of workplace safety, and promotion of equal treatment—as well as environmental standards related to waste management, resource efficiency, and emissions control.
- **Social Responsibility Management System (SA8000):** The company implemented a management system in line with the SA8000 standard. This system enables continuous monitoring of the supply chain through:
  - Periodic audits, both scheduled and unannounced
  - Risk assessments using ESG (Environmental, Social, and Governance) criteria
  - Required corrective action plans for identified non-compliances
  - Training and awareness activities to help suppliers improve their sustainability practices

These strategies collectively work to prevent ethical breaches and promote long-term improvements in supply chain sustainability.

Stakeholders: Several internal and external stakeholders contributed to the success of this best practice:

1. **Internal Teams:** DIENPI's procurement, sustainability, and compliance departments played a pivotal role in designing supplier criteria, monitoring performance, and managing supplier relationships.
2. **External Consultants:** Sustainability and corporate responsibility experts supported the company in developing its management system, conducting training programs, and carrying out supplier audits
3. **Suppliers:** Actively participated in the implementation process, conducting self-assessments, collaborating during audits, and adopting corrective measures when necessary.

Success factors: The success of the best practice was driven by several critical elements:

- Implementation of internationally recognized standards such as SA8000
- Continuous and structured monitoring of supplier performance
- Proactive involvement and collaboration with suppliers

- Strong commitment from company leadership
- Emphasis on preventive risk management rather than reactive solutions

Results: The introduction of this best practice has significantly enhanced the sustainability of DIENPI's supply chain. By applying rigorous selection and monitoring procedures, the company has ensured greater compliance with social and environmental standards among its suppliers.

The initiative has also reinforced DIENPI's corporate identity and reputation. Improved credibility in the eyes of clients and stakeholders has opened up new business opportunities, especially with partners who prioritize ESG performance.

Moreover, the practice has created a ripple effect by promoting a culture of sustainability both inside and outside the company. This cultural shift extends to industry peers and local communities, contributing to broader positive change.

Costs and benefits:

Costs:

- Economic Costs: Investments were required for consultancy services, staff training, audits, and the integration of ethical clauses into supplier contracts.
- Organizational Costs: Adjustments to internal processes and time dedicated to supplier engagement and monitoring.
- Initial Resistance: Some suppliers required significant support and time to meet the new standards.

Benefits:

- Social Benefits: Improved working conditions and greater awareness of ethical issues among suppliers.
- Environmental Benefits: Adoption of more sustainable practices by suppliers, leading to less waste, lower emissions, and better resource management.
- Economic Benefits: Reduced reputational and legal risks, enhanced brand value, and stronger relationships with ethically driven customers and partners. Additionally, the supply chain became more resilient and transparent, minimizing the risk of disruptions.

### **7.2.15 A Leading Example of Sustainability and Innovation in the Printing Industry (Gicherstampa Srl)**

Organization and context: Gicherstampa manufactures exceptional and personalized labels using special inks like glossy, hot and cold foil, dry embossing, glitter, tactile screen printing, sandblasting, pearlescent paints, perfumed inks, and much more.

**Problem:** This transformation was driven by a pressing need: the company's historically high energy consumption, further compounded by the steady rise in energy costs. In the face of this challenge, Gicherstampa made a bold decision to rethink its entire production model, embracing a more sustainable and energy-conscious approach to business operations.

**Intervention:** Gicherstampa has implemented several key initiatives that reflect its commitment to sustainability and innovation, including:

- Installation of a photovoltaic system that currently supplies approximately 50% of the company's energy needs. With a long-term vision, the company aims to achieve full energy self-sufficiency and zero environmental impact.
- Energy efficiency upgrades to production facilities, including thermal insulation with exterior cladding, replacement of windows and fixtures, and modernization of the heating plant. These interventions are designed to minimize heat loss and significantly reduce energy consumption.

Adoption of Environmentally Sustainable Materials and Processes, including:

- Use of FSC-certified substrates, along with recycled or recyclable materials, and water-based or solvent-free adhesives;
- Integration of low-impact printing technologies, such as state-of-the-art digital and screen-printing machines designed to reduce energy consumption and emissions;
- Preference for eco-friendly inks, including fast-curing UV inks, plant-based formulations, and those free from harmful volatile organic compounds (VOCs).

**Stakeholders:** Impact on the Local Area and Engagement with Local Stakeholders

A key element of Gicherstampa's exemplary approach lies in its deep connection with the local community. The success of this initiative has been driven by strong partnerships with local institutions and workforce, who have actively supported the adoption of innovations and helped cultivate a collective path of shared growth and development.

Impact on the Local Community and Engagement with Stakeholders

- Driving innovation in the local production ecosystem, positioning the company as a role model for other businesses;
- Raising environmental awareness both internally and across the broader community;
- Fostering a healthier, more sustainable workplace that provides direct benefits to employees and positive ripple effects throughout the community.

**Success factors:** Gicherstampa's journey illustrates how environmental sustainability can be effectively woven into corporate strategy, transforming challenges

like high energy consumption into opportunities for growth, innovation, and accountability. The company's commitment to reducing resource use and minimizing pollution—while actively promoting material reuse—has become a distinctive hallmark of its corporate identity.

In summary, Gicherstampa Srl has effectively balanced environmental responsibility, economic efficiency, and technological innovation, serving as a tangible and inspiring example of how a business can transition to a green model with positive economic, social, and environmental outcomes.

**Results:** The implementation of this integrated strategy has produced substantial benefits on both environmental and economic fronts. The marked reduction in energy costs has allowed the company to reinvest those savings into cutting-edge technologies and more advanced machinery, driving the continuous modernization and efficiency of its production processes.

**Costs and benefits:** In addition, the company's enhanced environmental performance has contributed to a stronger brand image, further supported by the attainment of key certifications such as:

- FSC and PSV, for the use of sustainable materials.

Gicherstampa has chosen to use FSC (Forest Stewardship Council)-certified materials, ensuring that the paper and wood used come from responsibly and sustainably managed forests, in line with strict environmental, social, and economic criteria. This certification guarantees full traceability of materials throughout the entire production chain.

The PSV (Packaging Sustainability Verification) certification, on the other hand, confirms the use of materials and processes that meet rigorous sustainability standards in the packaging sector, including criteria such as reduced environmental impact, recycling, and reuse.

- ISO 9001 Certification for Quality Management;

This internationally recognized certification validates the company's commitment to maintaining exceptional quality standards across its production and management processes. By implementing well-defined procedures and rigorous ongoing monitoring, Gicherstampa guarantees that its products consistently meet technical specifications, while driving continuous improvements in operational efficiency and customer satisfaction.

- Specialized certifications, including one issued by ICILA.

ICILA (Italian Certification Institute for the Food Industry) is an accredited body that certifies products and processes within the food sector. Gicherstampa has earned this certification by demonstrating that its labels and printing materials fully comply with food safety and hygiene regulations. This ensures that all materials used are safe for direct contact with food and do not emit harmful substances, thereby guaranteeing the highest level of safety throughout the entire supply chain.

### **Fluent summary of cross-cutting lessons**

The Spanish footwear ecosystem shows that credible green transformation starts with decisions that change day-to-day operations: local/EU sourcing to cut transport emissions, on-site renewables to reduce Scope-2 electricity, and real circular practices such as leather recovery and reuse. These choices are commercially viable when paired with equally practical digital moves—cloud systems, AI for routine tasks, and ERP-style visibility—to remove friction, sharpen forecasting, and let people focus on design, quality, and service.

Institutional reform amplifies firm-level action. By embedding sustainability modules and teacher training across VET, the Valencian Region is creating a steady pipeline of technicians and operators who understand energy, materials, and circularity. Sector platforms like FICIA then translate this capability into company outcomes by de-risking adoption for SMEs through targeted training, advisory services, and partnerships.

Across cases, four enablers recur: leadership commitment that tolerates near-term costs for long-term value; phased technology adoption aligned with brand and process realities; structured collaboration among schools, associations, and firms; and transparent storytelling that turns sustainability and traceability into customer value. Together, these practices demonstrate a pragmatic path to twin transformation in a craft-intensive industry: decarbonize supply, digitize what matters, upskill the workforce, and connect SMEs to the right partners so that environmental performance and competitiveness rise in tandem.

## **8. CONCLUSION**

The analysis across Italy, Portugal, Spain, and Türkiye reveals that the twin transformation, the integration of green and digital transitions, has become a decisive factor for industrial modernization, competitiveness, and sustainability. For SMEs in the footwear and leather sectors, it represents both a challenge and a unique opportunity to innovate, reduce environmental impacts, and enhance market resilience.

While progress varies by country, the direction is consistent: policies, technologies, and skills must converge to achieve a just and inclusive transformation. Good practice examples show that when sustainability, digitalization, and craftsmanship are aligned, traditional industries can evolve into dynamic, future-oriented ecosystems. Moving forward, success will depend on strong coordination between public authorities, business networks, and education systems to ensure that green and digital advances translate into real benefits for enterprises, workers, and society as a whole.