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Enabling skills and technologies for the circular transition: training, digital innovation and recommendations

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Executive Summary

Circular innovation is a strategic tool for the competitiveness, resilience, and sustainability of Italian SMEs, particularly in the manufacturing regions of Veneto and Emilia-Romagna. This policy brief, developed as part of the GRINS project, analyses the results of the "Skills for the Circular Economy" survey, which included over 1,500 companies, highlighting the main determining factors and obstacles influencing the transition to circular production models and aims to provide an interpretation of the evidence gathered from the survey in order to propose operational recommendations to consolidate and implement the skills and technological infrastructures necessary to support a more circular transition.

The evidence shows that around one-third of companies have introduced at least one circular innovation in the three-year period 2020-2022. In particular, the most significant interventions relate to raw materials and energy, the adoption of renewable sources, and waste management. The most innovative companies are often small, flexible, with a strong presence of young people (22.35% compared to 13,87%) and women in management (42.05% compared to 33.41%, with an average of 0.62 female managers per company versus 0.49), integrated into networks (24.24% versus 10.25%) and production chains (25.38% compared to 11.58%), and oriented towards international markets (70.08% versus 36.91%)[1].

However, significant obstacles remain: difficulty in accessing dedicated funding, bureaucratic complexity, lack of specific skills, limited collaboration with external

[1] In all these cases, the comparison is made between firms that have implemented both circular innovations and Industry 4.0 technologies ("Green & Digital") and those that have implemented neither; the first percentage always refers to the Green & Digital firms.

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bodies, and uncertainty about the demand for circular products. These factors risk slowing down the large-scale adoption of circular practices and accentuating inequalities between businesses and territories.

The policy brief proposes a series of operational recommendations for regional policy makers and stakeholders:

- Strengthen incentives and funding dedicated to circular innovation, with simplified procedures that are also accessible to micro-enterprises.
- Follow data-driven administrative practices and update the regulatory and administrative framework to promote one-stop shops and clear guidelines.
- Encourage the creation of circular networks, districts, and supply chains, promoting collaboration among businesses, universities, and research centers.
- Invest in technical and managerial training, valuing generational and gender diversity.
- Support the adoption of enabling technologies and the digitalisation of production processes.
- Improve communication and awareness of the benefits of the circular economy.

Only through an integrated, inclusive, and action-oriented approach will it be possible to accelerate the transition to the circular economy, contributing to sustainable growth and the reduction of inequalities across regions, in line with the objectives of the GRINS project and European strategies.

Context and significance of the issue

The transition to a circular economy requires not only changes in production models but also a profound renewal of companies in terms of technology and skills. In particular, the challenge for manufacturing SMEs in Veneto and Emilia-Romagna is to integrate digital and sustainable solutions into their processes, all within a rapidly evolving competitive and regulatory environment.

The report "Skills for the Circular Economy" highlights how the adoption of enabling technologies – such as robotics, artificial intelligence, cloud computing, big data, and IoT – is closely related to the ability of businesses to innovate in a circular way, but also data shows how heterogeneous is the diffusion of these technologies between and within the two regions, as illustrated in figure 1 and figure 2.

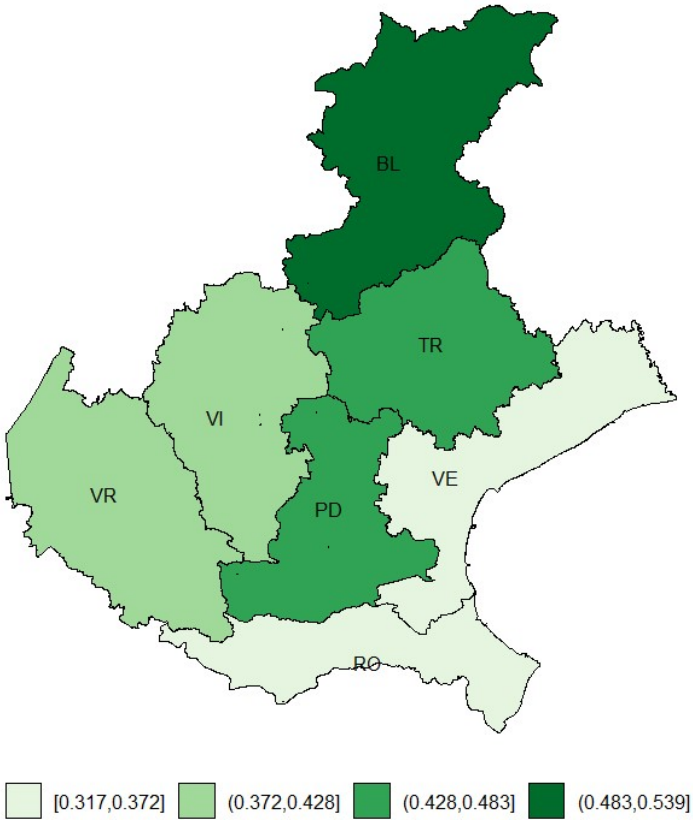

Figure 1: Share of firms in Veneto adopting enabling technologies (2020-2022)

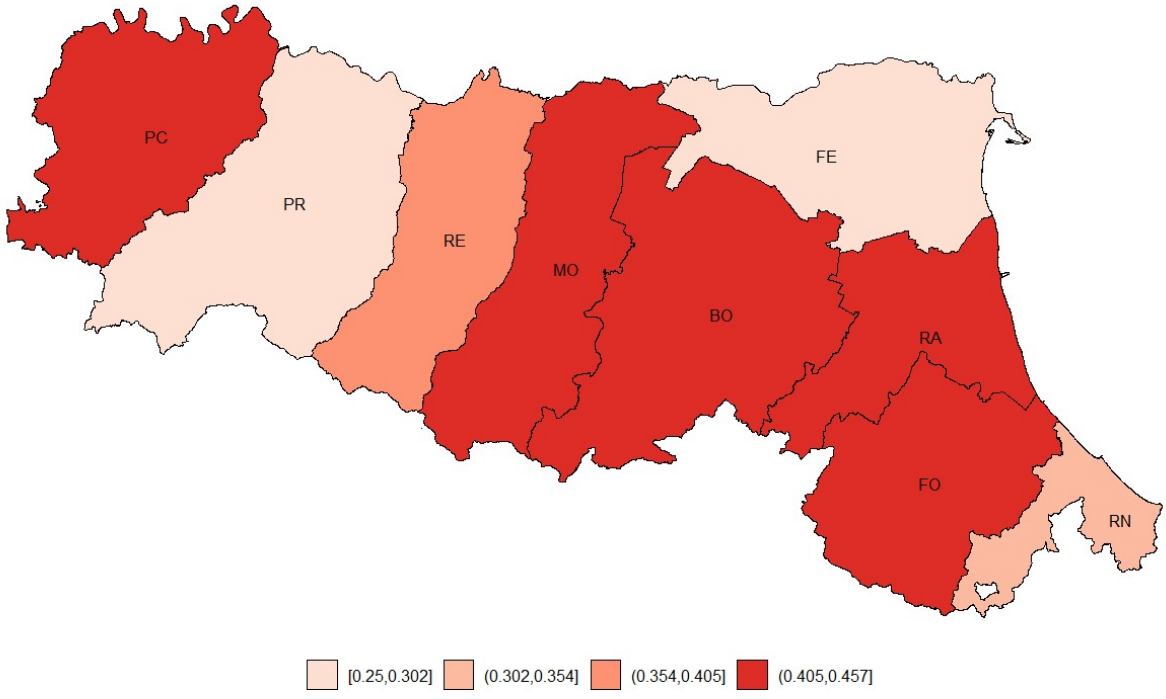

Figure 2: Share of firms in Emilia-Romagna adopting enabling technologies (2020-2022)

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However, the spread of these technologies is still limited (40.09% firms that introduced or invested in technologies 4.0) and is often hindered by a lack of internal skills, difficulties in accessing training, and a lack of synergies with research and training institutions (43.24% firms that did not consider any consultancy or external support useful during their innovation process).

Among firms that introduced product, process, or organisational innovations, the most useful supporting actors were category associations (29.38% in Veneto and 22.9% in Emilia-Romagna) and universities (24.79% and 21.21%, respectively), while public administrations were mentioned by 14.38% of firms in Veneto and 17.17% in Emilia-Romagna. Conversely, a significant share of firms (41.04% and 46.8%) did not consider any external actor useful during their innovation process.

In this scenario, regional policies and local actors play a crucial role in supporting the upskilling and reskilling of the workforce, promoting the adoption of 4.0 technologies, and fostering the creation of collaborative ecosystems between businesses, universities, competence centres, and institutions.

Empirical evidence: skills and enabling technologies

The 'Skills for the Circular Economy' report highlights a correlation between the use of enabling technologies and the ability of companies to move towards circular innovation. Digital technologies – such as robotics, cloud computing, big data, artificial intelligence and the Internet of Things – are fundamental tools for optimising resource use, reducing waste and improving the traceability of production processes.

Despite their potential, the diffusion of these technologies among SMEs in Veneto and Emilia-Romagna is still limited. This is demonstrated by the fact that only a minority of the companies interviewed stated that they had introduced technological innovations 4.0 in the last three years. It is precisely these companies that adopt circular practices to a significant extent. Companies that have invested in digital technologies, for example, show a greater propensity for environmental innovation, particularly in reducing energy consumption, waste management, and sustainable product design.

A critical issue that emerged from the survey concerns the skills gap. Many companies struggle to identify suitable professional profiles to entrust with managing the digital and circular transition.

The skills required range from data management to eco-friendly design, from predictive maintenance to environmental communication. Companies that are smaller and less structured are further disadvantaged by both a lack of qualified

personnel and limited capacity to invest in internal training, compared to larger companies.

Collaboration with training institutions, universities and research centres is still not widespread. Only a small percentage of companies have entered into partnerships with the aim of developing and acquiring skills or adopting enabling technologies. This figure shows that there is still considerable room for improvement, especially in regions where there are universities, research centres and technology hubs. The creation of structured relationships between businesses and training providers would lay the foundations for the development of shared upskilling and innovation pathways.

In summary, the evidence shows that the adoption of enabling technologies and the development of digital and green skills are key factors for the circular transition but require targeted support from regional policies in terms of training, guidance and collaborative infrastructure.

Policy options and analysis

The aforementioned survey highlights how the transition to circular production models in SMEs is influenced by a variety of factors, requiring the use of an integrated and multi-level approach by regional policies. The main lines of action are analysed below, with reference to the critical issues and opportunities that emerged from the sample of companies in the area examined.

Option #1 - Targeted financial support and access to credit

For those firms that adopted product, process or organisational innovation, the report shows that most circular economy businesses have used internal resources (86% in Veneto and 80% in Emilia-Romagna and ordinary bank loans, while the use of public funds and innovative instruments is still marginal.

- ➔ **Policy option:** Strengthen regional and national calls for proposals dedicated to the circular economy, simplify access procedures and promote innovative financial instruments (green bonds, crowdfunding, public guarantees), with a particular focus on micro and small enterprises.

Option #2 - Regulatory and administrative simplification

Bureaucratic complexity and regulatory uncertainty are among the obstacles most frequently cited by businesses.

- ➔ **Policy option:** Introduce regional one-stop shops for circular innovation, provide clear and up-to-date guidelines on environmental regulations, digitise procedures for obtaining authorisations, and encourage experimentation with new business models.

Option #3 - Promotion of collaborations, networks, districts and supply chains

Belonging to industrial districts and production chains promotes the spread of circular practices, thanks to networking effects and knowledge sharing, as demonstrated by the good practices of the Smart Specialisation Strategy (S3).

- ➔ **Policy option:** facilitate collaborative and PPP partnership projects between SMEs, large enterprises, universities and research centres, leveraging the experiences of clusters that have already started a circular transition pathway and encouraging new forms of aggregation.

Option #4 - Training and skills development

There is a positive correlation between the presence of young people and women in management and the propensity for circular innovation.

- ➔ **Policy option:** Invest in specific technical and managerial training courses for the highly skilled circular economy, promote upskilling and reskilling programmes, value diversity in strategic roles and encourage collaboration between businesses and training institutions.

Option #5 - Spread of enabling technologies

The adoption of 4.0 technologies (robotics, IoT, cloud, big data) is a key factor in moving towards circular innovation. However, this clashes with the reality that most companies say they have not introduced new enabling technologies in the three-year period 2020-2022.

- ➔ **Policy option:** Support investment in enabling technologies through vouchers and grants, raise awareness of the opportunities offered by digitalisation, and facilitate access to consulting and technological support services.

Option #6 - Communication and market awareness

The market response to circular products is still uncertain, and communicating the added value of these products to the public is often ineffective.

➔ **Policy option:** Support environmental certification through sustainability protocols, promote B2B and B2C communication campaigns, and encourage companies to participate in trade fairs, conferences, and events dedicated to circular innovation.

Operational recommendations

Evidence from the 'Skills for the Circular Economy' survey and international literature suggests that promoting circular innovation in SMEs requires a set of interventions capable of acting on several fronts simultaneously.

Firstly, it is essential to simplify incentives and funding for circular innovation, by making access procedures simpler and more transparent and by supporting micro and small enterprises in the funding procurement process. To significantly reduce the bureaucratic obstacles that characterise the transition, creating single regional contact points and disseminating clear guidelines would help simplify the regulatory and administrative framework.

The creation and consolidation of circular networks, districts, and supply chains are a powerful driver for the dissemination and sharing of knowledge and experiences that have achieved good results. In this sense, collaboration between businesses, universities, research centres, and trade associations must be encouraged and supported with appropriate tools, easily managed.

Technical and managerial training is another key element: investing in skills development, promoting diversity in terms of age and gender (according DEI principles), is an essential step towards changing current production and management models. The improvement of skills and retraining workers, especially in the field of circular innovation, must become an integral part of each regional strategy.

The spread of enabling technologies, such as robotics (12.01%), the IoT (8.78%), the cyber-security (4.84%) and 3D printing (4.78%), must be supported on the one hand by financial contributions and on the other by advisory and support services, thereby achieving a simpler and more effective integration of these technologies within SMEs. Furthermore, effective communication and targeted awareness-raising on the benefits of the circular economy can help to strengthen demand for sustainable products and services, which can increase the competitiveness of businesses on national and international markets.

Only through a multi-integrated, inclusive and pragmatic approach will it be possible to accelerate the transition to the circular economy, contributing to sustainable growth and the reduction of inequalities in the territories.

Conclusion

The transition to a circular economy represents one of the main challenges and opportunities for the Italian production system, particularly for SMEs in areas with a strong manufacturing tradition such as Veneto and Emilia-Romagna. The results of the "Skills for the Circular Economy" survey confirm a growing focus on environmental issues and the widespread adoption of certain circular practices; however, this is still hampered by financial, regulatory, technological and cultural factors.

What emerges is that smaller companies are moving more effectively towards circular innovation, thanks to their greater flexibility, greater attention to generational and gender diversity in management positions, and their participation in networks and production chains that orient them towards international rather than local markets. However, the fragmentation of initiatives, the lack of specific skills and the difficulty of accessing dedicated financial instruments risk slowing down the large-scale spread of circular models.

The European Commission emphasises that the full implementation of the Green Deal and the Circular Economy Action Plan requires a strong commitment from national and regional institutions to support innovation, training and collaboration between public and private actors (European Commission, 2020). Similarly, the OECD points out that circularity policies must be integrated with those for digitalisation, competitiveness and the reduction of inequalities (OECD, 2022).

At European level, it is recognised that circular transition is a complex process that requires not only technological innovation but also changes in business models, skills and corporate culture. In this policy brief, the operational recommendations put forward aim to strengthen the capacity of SMEs to innovate, collaborate and compete in an increasingly sustainability-oriented global context.

To sum up, in order to accelerate the transition to a circular economy, it is necessary to:

- Strengthen coordination between regional and national policies, avoiding fragmentation of interventions and implementing European directives.
- Support training and skills development, with a particular focus on the younger generation and diversity.
- Facilitate access to innovative financial instruments and promote collaboration between businesses, universities and research centres.
- Constantly monitor the impact of policies and build dialogue with local ecosystems, adapting policy instruments to the real needs of businesses.

The opportunities offered by the circular economy can only be achieved through an integrated and inclusive approach that contributes to the resilient and sustainable growth of regions, in line with the objectives of the GRINS project and European strategies.

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