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Shaping the Future of Eastern Bavaria: Policy Recommendations

D7.2 Policy Recommendation Plan

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Summary

Several structural challenges are hindering digital transformation in Eastern Bavaria. These include, in particular, varying levels of digital maturity amongst Small and Medium Enterprises (SMEs), a pronounced shortage of skilled workers, and an ageing population. Moreover, uneven digital infrastructure in rural areas, limited financial and organizational resources, and a lack of strategic direction are complicating the implementation of new technologies. Another key obstacle is the fragmentation and complexity of the funding landscape, which makes accessing support schemes difficult due to bureaucratic requirements and a lack of transparency.

To address these challenges, this analysis highlights several potential solutions. Successful regions rely on integrated innovation strategies that combine financial support with advisory training and technology transfer services. Intermediary actors such as innovation hubs, clusters and technology transfer centres play a key role by facilitating knowledge transfer and improving access to technologies. Cooperation between SMEs, start-ups and research institutions is also identified as an important driver of innovation and learning.

Clear recommendations can be derived from the findings: Firstly, funding structures should be simplified, consolidated and reliable in the long term. Secondly, the targeted strengthening of networks and collaborations is essential. Thirdly, low-threshold advisory and support services should be expanded, particularly to encourage smaller enterprises to get involved. Fourthly, inter-company employee exchange programmes should be promoted to strengthen digital skills, knowledge transfer and cooperation among SMEs. Overall, it is becoming apparent that, rather than new instruments, better coordination, visibility and integration of existing measures are crucial to the success of the digital transformation.

Introduction

Digital transformation is a key driver of competitiveness, innovation, and resilience for SMEs and public sector organisations (PSOs). However, many organisations face persistent challenges in adopting digital technologies, particularly in rural regions, where limited infrastructure, skills shortages, and structural constraints hinder transformation processes. In this context, the European Digital Innovation Hubs (EDIHs), established under the Digital Europe Programme, aim to support SMEs, mid-caps, and PSOs by providing access to technological expertise, training, and innovation services at regional level. As intermediaries, EDIHs connect businesses, research institutions, and public actors, thereby fostering

knowledge transfer and supporting the diffusion of key technologies such as artificial intelligence and cybersecurity (European Union, 2023).

While the importance of digitalisation for SME competitiveness is widely acknowledged (Organisation for Economic Co-operation and Development, 2021), less is known about how regional innovation ecosystems and intermediary organisations can effectively support digital transformation in predominantly rural and industrial regions. Existing research frequently focuses either on firm-level determinants of digitalisation or on national policy frameworks, whereas comparatively little attention has been paid to the interaction between regional support structures, innovation networks, and SME transformation processes. Research on rural innovation ecosystems suggests that intermediary actors and regionally embedded innovation hubs can play an important role in supporting digital transformation, yet evidence regarding the effectiveness of these support structures in rural-industrial regions remains limited (Stojanova et al., 2022).

Against this background, this Policy Recommendation Plan investigates the key challenges and enabling factors of digital transformation among SMEs in Eastern Bavaria. The study aims to identify barriers to digitalisation, assess the effectiveness of existing support structures, and derive evidence-based policy recommendations for regional, national, and European stakeholders. Particular attention is given to the interaction between public funding programmes, intermediary organisations, regional innovation ecosystems, and firm-level capabilities. To achieve this objective, a mixed-methods approach is applied.

EDIH DInO operates within this framework in Eastern Bavaria, a predominantly rural region characterised by a strong SME base and a well-developed research and innovation ecosystem. The region combines a highly industrialised economic structure with a large number of micro, small, and medium-sized enterprises that contribute substantially to regional value creation and employment. At the same time, Eastern Bavaria faces structural challenges associated with demographic change, skills shortages, and uneven access to digital infrastructure, particularly in more peripheral rural areas (Industrie- und Handelskammer Niederbayern, 2024a). Existing evidence further suggests that many SMEs continue to face challenges related to digital strategy, skills development, and the adoption of advanced technologies, while levels of digital maturity remain highly heterogeneous across organisations (Bayerischer Industrie- und Handelskammertag, 2026).

Eastern Bavaria therefore provides a particularly relevant case for analysing SME digitalisation in rural-industrial regions. By acting as intermediaries between businesses, research institutions, and public actors, organisations such as EDIH DInO facilitate access to technological expertise, innovation networks, funding opportunities, and knowledge transfer activities. In regions characterised by geographical dispersion and heterogeneous digital capabilities, these intermediary functions can help reduce information asymmetries, lower barriers to technology adoption, and strengthen the overall innovation capacity of SMEs. Examining the interaction between firms, support structures, and regional innovation ecosystems therefore offers valuable insights into how digital transformation can be supported more effectively in comparable rural-industrial regions.

By combining comparative regional analysis, EDIH project data, and qualitative interview evidence, this study applies a multi-perspective approach to explore the factors that facilitate or hinder digital transformation among SMEs in Eastern Bavaria. The study thereby contributes

to a better understanding of digital transformation processes in rural-industrial regions and provides an evidence base for the development of policy recommendations aimed at strengthening regional innovation ecosystems and improving support structures for SME digitalisation.

Regional Context and Structural Conditions in Eastern Bavaria

Eastern Bavaria, comprising the administrative regions of Lower Bavaria and Upper Palatinate, is located along the borders with the Czech Republic and Austria (Regierung von Niederbayern, n.d., Regierung der Oberpfalz, n.d.). The region covers approximately 20,000 square kilometres and around 480 municipalities and is predominantly characterised by rural areas with low population density (Industrie- und Handelskammer Niederbayern, 2024a, Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie, 2026a, Bundesinstitut für Bau-, Stadt- und Raumforschung, 2025). Large parts of Eastern Bavaria lie at considerable distances from major transport and infrastructure corridors and the region includes only a few medium-sized urban centres such as Regensburg, Passau and Landshut, which function as economic and innovation hubs (Industrie- und Handelskammer Niederbayern, 2024a, Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie, 2026a). This spatial structure creates distinct challenges for regional development and digital transformation, particularly in more peripheral areas (Bayerisches Staatsministerium für Familie, Arbeit und Soziales, 2022, Bundesinstitut für Bau-, Stadt- und Raumforschung, 2025).

Within Eastern Bavaria is a strong industrial base as well as a high concentration of SMEs (Industrie- und Handelskammer Niederbayern, 2024b, Industrie- und Handelskammer Regensburg für Oberpfalz / Kelheim, n.d., Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie, 2025a). The economic structure is characterised by strong manufacturing sectors such as automotive supply, mechanical engineering, electrical engineering, plastic processing, and metalworking, who play a crucial role in regional value creation (Industrie- und Handelskammer Niederbayern, 2024b, Industrie- und Handelskammer Regensburg für Oberpfalz / Kelheim, n.d.). In Lower Bavaria alone industrial enterprises generated a turnover of around €54.4 billion in 2024, with more than half attributable to the automotive sector, and employ more than 130,000 workers in almost 1,000 firms (Industrie- und Handelskammer Niederbayern, 2024b). Nonetheless, other sectors such as tourism, agriculture, craft-based industries, and service activities remain important pillars of the regional economy, particularly in more rural and peripheral parts of Eastern Bavaria (Industrie- und Handelskammer Niederbayern, 2024b, Industrie- und Handelskammer Regensburg für Oberpfalz / Kelheim, n.d.).

Despite the notable strength of Eastern Bavaria's industrial sector and its specialisation in knowledge-intensive manufacturing, regional indicators suggest a comparatively low level of digital and academic qualifications in the region (Bundesinstitut für Bau-, Stadt- und Raumforschung, 2025). With regard to its innovation potential, Lower Bavaria performs below the average of the other Bavarian administrative regions, while Upper Palatinate is classified as a strong innovator by the Regional Innovation Scoreboard (European Commission, n.d.). Overall, Eastern Bavaria combines a strong performance in terms of knowledge-intensive manufacturing activities with comparatively weak performance in key indicators such as employment in the Information and Communications Technology (ICT) sector, participation in international research collaborations, and public expenditure on Research and Development

(R&D) (Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie, 2022, 2025a). Innovation in Eastern Bavaria therefore does not automatically take a digital form. Instead, the region's industrial strengths are only partially supported by broad digital skills and specialised ICT capacities. As a result, SMEs face additional barriers when adopting advanced digital technologies, and the existing innovation potential cannot be fully translated into high levels of digital transformation.

In addition to its strong industrial foundation, Eastern Bavaria has developed a dynamic regional innovation ecosystem. Higher education institutions, among others the Deggendorf Institute of Technology, and the University of Regensburg, as well as specialised technology campuses and applied research institutes, serve as important drivers of knowledge creation, collaborative research, and technology transfer within the region (Industrie- und Handelskammer Niederbayern, n.d.). Furthermore, the presence of digitalisation centres, innovation networks, and cross-border initiatives such as EDIH DInO or "Zukunftszentrum Süd" function as an important enabler of digital transformation among SMEs ((European Commission, n.d.a, Organisation for Economic Co-operation and Development, 2021, Arbeit und Leben Sachsen, n.d.).

These regional conditions are linked to the structure of the corporate landscape in Eastern Bavaria. It is characterised by the predominance of SMEs, with a significant presence of family-owned businesses (Industrie- und Handelskammer Niederbayern, 2024a, Industrie- und Handelskammer Regensburg für Oberpfalz / Kelheim, n.d., Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie, 2026b). These enterprises often have a strong connection to their local communities and are typically characterised by long-term orientation, close relationships between owners and employees, and a robust, values-based corporate culture rooted in family traditions, which can foster resilience but may also lead to cautious decision-making in periods of rapid technological change (Miller & Le Breton Miller, 2005). Simultaneously, these firms play a crucial role in employment, local value chains and regional identity (Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie, 2022, 2025a, Industrie und Handelskammer Niederbayern, 2024a, Industrie und Handelskammer Regensburg für Oberpfalz / Kelheim, n.d.). Nevertheless, they frequently operate with limited organisational capacity and management resources, which constrains their ability to respond to structural change and invest in digital transformation (Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie, 2025a, Kreditanstalt für Wiederaufbau, 2025).

The regional economy is increasingly influenced by demographic changes. Whilst population dynamics are comparatively stable in the more urbanised western parts of Eastern Bavaria, rural and peripheral regions are more strongly affected by an ageing population, lower birth rates, and, in some cases even net out-migration of younger people (Bayerisches Staatsministerium für Familie, Arbeit und Soziales, 2022, Bundesinstitut für Bau-, Stadt- und Raumforschung, 2025, Bayerisches Landesamt für Statistik, 2026).

These trends impact the tightening of labour markets and the intensification of the challenges associated with the recruitment of skilled workers, particularly for SMEs located outside the main urban centres (Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie, 2025a). The demographic shift towards an ageing population has become a significant challenge for business succession, as an increasing number of owners of family-owned and smaller enterprises reach retirement age while the pool of potential successors remains limited (Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie, 2026b).

Recent years have shown progress in the development of digital infrastructure in Eastern Bavaria. However, deficiencies persist, particularly in more isolated rural areas (Vereinigung der Bayerischen Wirtschaft & IW Consult, 2026). Although digital infrastructure has improved in recent years, access to high-speed internet connections remains unevenly distributed, and network expansion in sparsely populated areas is often associated with higher costs and lower commercial attractiveness for providers (Vereinigung der Bayerischen Wirtschaft & IW Consult, 2026). Enterprises operating within rural district, a complex interplay of infrastructural constraints, skills shortages, limited digital competencies, and restricted structural capacities emerges. This creates structural barriers for the adoption of advanced digital technologies and innovation activities.

Taken together, these structural conditions contribute to a heterogeneous digitalisation landscape. Eastern Bavaria benefits from a strong industrial base, a dense SME sector, and an increasingly developed innovation ecosystem comprising universities, research institutions, technology campuses, digitalisation centres, and regional innovation networks. At the same time, demographic change, shortages of qualified personnel, uneven digital infrastructure, and constrained organisational capacities continue to pose substantial challenges to the digital transformation of many enterprises, especially in rural areas. As a result, firms are caught between growing competitive demands for modernisation and persistent structural constraints that hinder the uptake of digital technologies.

The Bavarian Innovation and Digitization Policy Landscape

The funding landscape for digitalization and innovation in Germany, and particularly in Bavaria, has evolved since the 1990s into a complex, multi-level system of strategic frameworks, funding instruments, and regional ecosystem development. This system operates across three interconnected levels, European Union, federal government, and federal states, and is particularly relevant for structurally weaker regions such as Eastern Bavaria, where targeted innovation policies aim to compensate for structural disadvantages and strengthen regional competitiveness.

Governmental Strategies of Bavaria

In the 1990s, the Bavarian state government began implementing a proactive innovation policy focused on strengthening technology-driven development. The core objective was to expand both basic research at universities and applied research in companies and research institutes, while fostering technology-oriented entrepreneurship to create new jobs (Berger, 2002). This systemic approach—linking research, technology transfer, and start-up support—remains a defining characteristic of Bavarian innovation policy until today.

A key milestone was the “Offensive Zukunft Bayern” (1994–2005), which invested approximately €4.3 billion in higher education, research infrastructure, and technology centres (Berger 2002, Falck, Kipar, 2010). Later phases increasingly focused on specific technological fields such as information and communication technologies, environmental technologies, and mechatronics, with a strong emphasis on cluster development and specialisation (Falck, Kipar, 2010). These initiatives laid the foundation for a decentralized innovation system that continues to shape Bavaria's regional development.

Building on this, subsequent programs such as Bayern.FIT (2008–2011) further strengthened research institutions, cluster initiatives, and start-up financing, including targeted investments in high-risk technology ventures and the expansion of higher education capacities (Bayerische Staatsregierung, 2008). Since 2015, initiatives under “Gründerland Bayern” have focused

particularly on supporting digital start-ups through a network of incubators and funding programs (Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie. n.d.). More recently, the Hightech Agenda Bavaria (since 2019) has significantly expanded investments in future technologies, research infrastructure, and regional innovation centers, with a strong emphasis on digital technologies and decentralization (Bayerische Staatsregierung, 2020).

This decentralized approach is especially visible in Eastern Bavaria, where universities and technology transfer institutions play a central role. Institutions such as the University of Passau, OTH Regensburg, and the Deggendorf Institute of Technology act as regional innovation hubs, combining research, education, and collaboration with industry (Universität Passau, 2026).

A distinctive feature of the Bavarian approach is the establishment of decentralized technology transfer centres (TTZ), which are deliberately located in rural areas to facilitate knowledge transfer to local SMEs. These centres provide application-oriented research and act as interfaces between academia and industry (Bayerisches Staatsministerium für Wissenschaft und Kunst, n.d.). Complementary institutions such as start-up centres and innovation hubs support the commercialization of research results and the development of digital business models (Technische Hochschule Deggendorf, n.d.a). In addition, initiatives like the EDIH DIInO provide SMEs with access to testing environments, training, and digital expertise, illustrating the integration of EU and regional funding structures (Technische Hochschule Deggendorf, n.d.b).

Governmental Strategies of Germany

At the federal level, the High-Tech Strategy (introduced in 2006) marked a shift toward a long-term, mission-oriented innovation policy, aiming to increase R&D expenditure to around 3% of Gross Domestic Product (Bundesministerium für Bildung und Forschung, 2006). Subsequent strategies evolved into continuous frameworks without fixed budgets, focusing on key technologies, SMEs, and societal challenges (Deutscher Bundestag, 2010). More recent initiatives further emphasize technological sovereignty, digital transformation, and the acceleration of innovation processes (Bundesministerium für Forschung, Technologie und Raumfahrt, 2025).

Funding Instruments supporting the presented Strategies in Germany

These strategic frameworks are implemented through a broad portfolio of funding instruments. Direct funding programs for SMEs and start-ups play a central role, reflecting the importance of the “Mittelstand” as the backbone of the German economy. At the federal level, programs such as “EXIST” support academic start-ups, while “ZIM” funds collaborative R&D projects between SMEs and research institutions (Bundesministerium für Wirtschaft und Klimaschutz 2023a; Bundesministerium für Wirtschaft und Energie 2024). Financial instruments such as bank loans with special conditions provide capital for digital transformation projects, ranging from software development and automation to cloud migration (Kreditanstalt für Wiederaufbau, n.d.).

In addition to these long-standing instruments, temporary programs have addressed specific digitalization needs. For example, the “Digital Jetzt” program (2020–2023) provided direct grants for investments in digital technologies and employee training, while “go-digital” supports SMEs through consulting services on digital business processes, market development, and IT security (Bundesministerium für Wirtschaft und Klimaschutz 2021, Bundesministerium für Wirtschaft und Klimaschutz 2023b). At the state level, programs such as Digitalbonus Bavaria complement federal funding by supporting investments in digital infrastructure and applications within SMEs.

Beyond individual firm support, a wide range of programs promotes collaborative innovation and infrastructure development. These include international initiatives such as “EUREKA” and EU-funded programs like “Interreg”, which support cross-border cooperation. At the national level, initiatives such as “Mittelstand-Digital” and regional “Zukunftszentren” provide support for digital transformation, particularly through knowledge transfer and training (Bundesministerium für Wirtschaft und Energie, n.d., Arbeit und Leben Sachsen, n.d.).

European Strategic Frameworks and Funding Instruments

At the European level, the funding landscape is embedded within broader strategic frameworks such as the 2030 Digital Compass, which defines targets for digital infrastructure, skills, and business transformation. Implementation takes place through major funding programs, including Horizon Europe, the Digital Europe Programme, and the Connecting Europe Facility (European Commission 2021a, European Commission 2023). These programs provide substantial funding for research, innovation, and infrastructure, particularly in areas such as artificial intelligence, high-performance computing, cybersecurity, and broadband expansion. For rural regions like Eastern Bavaria, these investments are crucial in enabling access to digital technologies and markets.

Strengths and Challenges of multi-layered funding systems

The landscape is often characterized by fragmentation and administrative complexity, making it difficult, especially for smaller firms, to identify and access suitable funding opportunities. In addition, while public funding is significant, a large share of innovation investment in Germany still originates from the private sector, which can reinforce regional disparities. There is also an ongoing gap between strategic ambitions and practical implementation, particularly regarding bureaucratic procedures and coordination across governance levels.

At the same time, the strengths of the system are evident. Germany and Bavaria benefit from long-term strategic policy goals, high funding volumes, and a strong integration of research, industry, and policy. In regions like Eastern Bavaria, the focus on decentralized innovation structures, such as TTZs, regional networks, and digital innovation hubs, has proven particularly effective in fostering technology transfer and supporting SMEs in adopting digital technologies.

Looking ahead, innovation policy is increasingly shaped by the need for technological sovereignty, resilience, and the development of key digital technologies such as artificial intelligence and data-driven systems. Recent strategies emphasize not only technological advancement but also improved knowledge transfer and reduced bureaucratic barriers (Bundesministerium für Forschung, Technologie und Raumfahrt, 2025). For Eastern Bavaria, this creates significant opportunities to further strengthen its position as a decentralized innovation region within the broader German and European innovation system.

Methodology

To comprehensively assess the digital transformation challenges of SMEs in Eastern Bavaria and identify appropriate policy responses, a mixed-methods approach is applied. First, a comparative regional analysis is conducted. Building on the regional indicators and structural characteristics identified in the preceding chapters, regions with a comparable economic and spatial profile are selected and examined through a systematic analysis of policy documents, strategic frameworks, funding programmes, and literature. The objective is to identify governance approaches, support instruments, and innovation ecosystem configurations that

have proven effective in comparable rural-industrial regions and may provide policy lessons for Eastern Bavaria.

Second, project-related data from EDIH DInO are analysed. This includes enterprise data obtained from the EDIH reporting portal, Digital Maturity Assessment (DMA) results, and several regional SME surveys. While the EDIH portal data provides information on the structural characteristics of supported firms, the DMA enables an assessment of digital maturity levels across different dimensions of digital transformation. The surveys complement these data by capturing perceived challenges, support needs, and attitudes towards digitalisation. Together, these sources provide a quantitative evidence base on who the supported organisations are, how digitally mature they are, and which barriers they encounter. Third, qualitative interviews are conducted with SMEs as well as representatives of SME and start-up networks. The interviews provide deeper insights into firm-level experiences, digitalisation strategies, perceived barriers, and expectations regarding existing support structures and policy measures. In addition, they enable the interpretation and contextualisation of the quantitative findings by capturing perspectives that cannot be fully reflected through survey and DMA data alone.

Finally, the results from all three methodological components are integrated and comparatively evaluated. Through the combination of comparative regional evidence, project data, and qualitative insights, the analysis applies methodological triangulation and identifies recurring patterns across different sources of evidence. These findings form the basis for the subsequent policy recommendations aimed at strengthening digital transformation and innovation capacity among SMEs in Eastern Bavaria.

Selection of Comparable Regions

The analysis of comparable regions is based on a comparative, theory-driven case study design and aims to identify factors and governance approaches that support the digital transformation of rural-industrial regions, and to derive policy options for Eastern Bavaria. The systematic selection of structurally similar regions and their analysis is based on theoretically derived criteria in order to identify context-sensitive yet transferable policy approaches (Eisenhardt & Graebner, 2007, Yin, 2018). The central question guiding this analysis is to identify which combinations of infrastructure, skills development measures, financing, and innovation networks are effective in comparable contexts and how these can be transferred to the specific conditions of Eastern Bavaria.

On this basis three main research questions are addressed:

- (1) Which policy and institutional instruments do comparable regions employ to promote digital transformation in SMEs?
- (2) How are these instruments embedded within overarching strategies and multi-level governance frameworks?
- (3) Which elements are transferable to Eastern Bavaria, and where are context specific adaptations required?

Case Selection Criteria and Regional Profiles

Eastern Bavaria as an economically solid, predominantly rural region with a high share of SMEs, a distinctive medium-sized industrial base, a polycentric settlement structure and specific digitalisation challenges serves as a comparator region for other rural industrial areas within the selection process (Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie, 2025a, 2026a; Industrie- und Handelskammer Niederbayern, 2024a, 2024b, Bundesinstitut für Bau-, Stadt- und Raumforschung, 2025). Comparable regions are therefore selected on the basis of a similar spatial and economic structure. The analysis is designed as

a multiple-case study in which Eastern Bavaria serves as the reference case and East Württemberg, Upper Austria and Emilia-Romagna are examined as comparative cases in a cross-case perspective. Following a theory-driven case study approach (Eisenhardt & Graebner, 2007; Yin, 2018), a common set of criteria is applied across all four regions and patterns are identified that can inform policy options for Eastern Bavaria.

The selection process was based on a combination of quantitative screening and qualitative assessment. At the quantitative level, NUTS-2 indicators from the Regional Innovation Scoreboard and Eurostat, together with national and regional statistics on manufacturing, exports, and SME prevalence, were used to identify candidate regions with profiles comparable to Eastern Bavaria (European Commission, n.d., Eurostat, n.d.). Regional innovation ecosystems and governance approaches were assessed at the qualitative level based on regional strategy documents as well as information on universities, technology transfer centres, clusters, and innovation hubs.

The selected regions demonstrate a polycentric or moderately polycentric settlement structure, characterised by the presence of several medium-sized urban centres. Manufacturing constitutes a fundamental component of their regional economies. Key quantitative indicators included the share of manufacturing in regional gross value added and employment, export ratios, the prevalence of SMEs and family-owned firms, and selected innovation indicators, including research and development expenditure and regional innovation performance. A strong industrial orientation in sectors such as mechanical engineering, automotive, and precision engineering, combined with a pronounced role of export-oriented SMEs, also constituted part of the selection criteria.

In addition to spatial and economic factors, the configuration of the regional innovation ecosystem was adopted as an additional key criterion for case selection. Regions were included in the sample where universities and application-oriented research institutions occupy a central position within the regional innovation system and are closely linked to business through technology transfer centres, cluster organisations, and start-up and innovation centres. A particular focus was placed on the existence of decentralised, practice-oriented structures that facilitate SMEs' access to knowledge, technology, and funding.

The selected regions function as analytical reference cases to systematically compare different governance logics and combinations of policy instruments aimed at promoting digital transformation in SMEs with those in Eastern Bavaria. Given the similarity of their industrial structures, strong export orientation and robust SME base, they provide a basis for a context-sensitive analysis of key dimensions of digital transformation. The comparative case analysis focuses on four core dimensions: (1) the strategic embedding of digitalisation in multi-level governance frameworks, (2) the configuration of funding and policy instruments, (3) the role of intermediary actors, and (4) regional innovation systems.

Data Sources and Indicators

The comparative analysis draws on key strategic and programmatic frameworks at the European, national, and regional levels, which serve as reference points for digital and industrial transformation processes. At the European level, major digital and innovation strategies and funding programmes were considered, including overarching frameworks for infrastructure, skills, and business transformation. At the national level, the analysis examined core digitalisation and innovation strategies that define priorities, funding lines, and governance structures for digital transformation in Germany, Austria, and Italy. At the regional level, selected digital agendas, innovation strategies, and smart specialisation frameworks were analysed for East Württemberg, Upper Austria, Emilia-Romagna and Eastern Bavaria. In addition, programme and funding documents related to key SME support instruments formed

a second group of data sources, covering financial support schemes, advisory programmes, and transfer initiatives for digital transformation in SMEs.

In instances where comparable indicators were available at the regional level, statistical data were used to characterise and compare the regions. This included indicators on population structure and employment, the share of industry and SMEs in value creation and employment, export ratios, and digital infrastructure data such as broadband coverage and 5G rollout. In addition, indicators on the level of digitalisation in the economy and public administration, as well as composite innovation indices such as the Regional Innovation Scoreboard, were considered (European Commission, 2025).

A context-sensitive qualitative interpretation of the findings was employed in order to address the differences in data availability, spatial delineations, and indicator definitions across countries and regions. Rather than aiming for full statistical harmonisation, the analysis focuses on the identification of patterns and governance approaches that demonstrate robustness across diverse data contexts. The combination of quantitative indicators, qualitative document analysis, and expert interpretations enables methodological triangulation and strengthens the robustness and validity of the results (Yin, 2018).

EDIH Project Data and Regional Evidence Base

EDIH Digital Innovation Ostbayern (DInO) serves as the central empirical case study. As the European Digital Innovation Hub for Eastern Bavaria, DInO supports SMEs through advisory services, technology transfer activities, networking formats, training measures, and Digital Maturity Assessments (DMAs). Through its direct interaction with firms across different sectors and stages of digital development, DInO provides valuable insights into regional digitalisation challenges, support needs, and transformation processes. The project data generated through these activities therefore constitute an important evidence base for understanding digital transformation among SMEs in Eastern Bavaria (European Commission, n.d.a).

To better understand the digital transformation challenges and support needs of SMEs in Eastern Bavaria, this analysis combines three complementary sources of project-related evidence: enterprise data from the EDIH reporting portal, Digital Maturity Assessment (DMA) results, and regional SME surveys. Together, these datasets provide information on the structural characteristics of supported organisations, their level of digital maturity, and their perceived challenges and support requirements.

The EDIH reporting portal dataset contains information on 276 SMEs supported by DInO, including enterprise size, sector, geographical location, and foundation year. These data provide contextual information on the characteristics of organisations engaging with DInO services and serve as a basis for the interpretation of subsequent DMA and survey results. The DMA provides a standardised framework developed by the European Commission's Joint Research Centre (JRC) for assessing the digital maturity of organisations supported by EDIHs (Kalpaka et al., 2023). The framework evaluates digital maturity across six dimensions: Digital Business Strategy, Digital Readiness, Human-Centric Digitalisation, Data Governance, Automation and Artificial Intelligence, Data Management, and Green Digitalisation. Each dimension is scored on a scale from 0 to 100, where higher values indicate a higher level of digital maturity. Based on the dimension scores, an overall DMA score is calculated, providing a summary measure of an organisation's digital maturity profile (Kalpaka et al., 2023). The DMA dataset used in this study consists primarily of T0 assessments conducted before support activities and is used to identify digital maturity profiles, strengths, and areas for improvement among participating SMEs. To complement these structural and maturity-related data, DInO conducted several regional SME surveys in cooperation with regional stakeholders. Across the different surveys, almost 200 complete responses were collected. The surveys provide

additional insights into digitalisation activities, perceived barriers, collaboration behaviour, technological interests, and support needs among regional organisations.

The three data sources fulfil complementary analytical functions within this study. The EDIH reporting portal data provide information on the structural characteristics of supported SMEs, the DMA captures digital maturity levels, and the surveys offer insights into perceived barriers and support needs. Combining these sources enables a more comprehensive analysis of digital transformation processes and strengthens the robustness of the findings.

Limitations of the Project Data

Several limitations should be considered when interpreting the results. First, the DMA framework relies on a structured questionnaire and therefore remains partly subjective. While assessments are conducted with the support of trained EDIH experts, the results still depend on self-reported information and respondents' interpretation of the assessment criteria. Differences in organisational self-awareness, familiarity with digital technologies, and assessment behaviour may therefore influence the comparability of results across firms (Kalpaka et al., 2023).

A further limitation concerns the concept of digital maturity models themselves. Although the DMA provides a harmonised framework for assessing digital transformation across six dimensions, digitalisation remains a highly context-dependent process that cannot be fully captured through standardised indicators alone. Previous research has highlighted that maturity models may oversimplify organisational transformation processes and overlook factors such as company culture, leadership quality, or sector-specific characteristics (Schumacher, Erol & Sihm, 2016; Teichert, 2019). Similarly, implementation experience within the EDIH network suggests that the DMA should primarily be understood as a diagnostic and guidance instrument rather than a direct measure of productivity gains or causal intervention effects (EDIHDO Consortium, 2024).

Furthermore, the limited number of longitudinal DMA observations restricts the ability to draw robust conclusions regarding the impact of support measures over time. The EDIH portal data and survey data are subject to additional limitations. Both datasets primarily consist of organisations that have actively engaged with DInO services or related activities and therefore do not necessarily represent the entire SME population of Eastern Bavaria. As a result, organisations with a pre-existing interest in digitalisation may be overrepresented. In addition, the survey results are based on self-reported perceptions and are intended to identify general patterns rather than establish causal relationships. Many respondents expressed broad support needs without specifying concrete implementation requirements, limiting the degree to which detailed policy measures can be directly derived from survey responses alone.

SME Interview Analysis

Based on the identified regional indicators and the literature review, a structured interview protocol was developed to capture the perspectives of SMEs. The primary objective was to gain a comprehensive understanding of their current level of digitalisation, their interest in further digital transformation, and their main areas of technological application, as well as the associated challenges. In addition, the interviews explored SMEs' awareness of existing support infrastructures, with a particular focus on funding schemes and general assistance in developing digital solutions tailored to firm size and industry context. Further thematic blocks addressed satisfaction with current policy measures and desired changes, as well as patterns of networking and collaboration with other SMEs, start-ups, universities, and related institutions.

In total, nine structured interviews were conducted with SMEs varying in size, age, and industry background. To complement firm-level insights with a broader SME perspective, one interview was conducted with the Chamber of Crafts for Eastern Bavaria and one with a regional start-up network. Interview partners were selected based on their location and their role within the SME. The sampling strategy aimed to ensure heterogeneity in terms of firm characteristics in order to capture a comprehensive picture of the regional SME landscape rather than focusing on a single subgroup. Participants were recruited via direct email contact by the researchers. The interviews were conducted partly via video conferencing and partly in person, with durations ranging from 35 to 50 minutes. All participants provided informed consent to the recording and transcription of the interviews.

The data were analysed using the qualitative content analysis approach developed by Philipp Mayring (2023). The analysis followed a three-step procedure: first, categories and subcategories were developed both deductively, based on theoretical considerations, and inductively, grounded in the empirical material. Second, the entire dataset was coded according to these categories, which were iteratively refined to reduce the material to its essential meanings. Third, the remaining coded material was further examined to ensure interpretative depth and to clarify any ambiguities, thereby enabling a comprehensive understanding of the identified categories.

The results provide in-depth insights into SME perspectives and contribute to a nuanced understanding of regional digitalisation processes. However, the interviews are subject to several limitations. The relatively small sample size limits the generalisability of the findings, and the purposive sampling approach may introduce selection bias. Furthermore, self-reported data may be affected by social desirability bias.

Results

The following chapter presents the results of each methodological component separately. These components cover the comparative regional cases, the analysis of project data and surveys, and the interview findings. These strands are subsequently synthesised to identify key patterns, forming the basis for policy recommendations that consider both the regional context and the situation of SMEs.

Comparative Regional Cases: East Württemberg, Upper Austria, Emilia-Romagna

Based on the methodological approach outlined above, the following section presents the main findings of the comparative analysis of East Württemberg, Upper Austria, and Emilia-Romagna as reference cases for Eastern Bavaria. The analysis examines how different governance and policy approaches support digital transformation in rural-industrial regions and identifies implications for Eastern Bavaria.

East Württemberg is located in the German federal state of Baden-Württemberg, close to the border with Bavaria. The region is characterised by medium-sized industrial centres such as Aalen and Heidenheim and is economically embedded in the wider Stuttgart based metropolitan and industrial region (Regionalverband Ostwürttemberg, n.d.). Upper Austria is a federal province in northern Austria, bordered by Bavaria and the Czech Republic. The region, with Linz and the surrounding industrial corridors, represents one of Austria's key industrial and manufacturing hubs (Land Oberösterreich, n.d.). Emilia Romagna is a northern Italian region stretching from the Po plain to the Apennines and the Adriatic coast, with strong

industrial clusters around cities such as Bologna, Modena, Reggio Emilia and Parma (Organisation for Economic Co-operation and Development, 2022). These regions represent different governance models and support logics, while exhibiting sufficiently similar structural conditions to allow for systematic and context sensitive comparison with Eastern Bavaria.

The comparative analysis suggests that digital transformation in rural-industrial regions is supported by different but functionally comparable governance and funding approaches. Despite varying institutional arrangements, these approaches appear to follow similar underlying intervention logics. Across all three regions, digitalisation is embedded as a cross-cutting objective within broader innovation, industrial, and regional development strategies rather than being treated as an isolated policy field. Within their respective national contexts, the regions demonstrate comparatively strong economic and industrial profiles, a high export orientation, and a pronounced focus on innovation, making them suitable reference cases for Eastern Bavaria (WiRO – Wirtschaftsförderungsgesellschaft mbH Region Ostwürttemberg, 2023, Land Oberösterreich, n.d., Organisation for Economic Co-operation and Development, 2022). Available innovation and digitalisation indicators, including the Regional Innovation Scoreboard, suggest that East Württemberg, Upper Austria and Emilia-Romagna tend to perform more strongly on average in digitalisation- and innovation-related metrics than Eastern Bavaria, particularly in dimensions linked to ICT-intensive activities, research collaborations and the diffusion of advanced technologies (European Commission, n.d., 2025).

Building on the analytical framework described in the methodology, the comparative case analysis focuses on four core dimensions of digital transformation in rural-industrial regions: (1) the strategic embedding of digitalisation in multi-level governance frameworks, (2) the configuration of funding and policy instruments, (3) the role of intermediary actors, and (4) regional innovation systems. The following subsections present the results along these four dimensions.

Strategic embedding of digital transformation

In all three cases, digitalisation is embedded in overarching national and regional strategies that frame digital transformation as part of broader economic and societal change. This includes European-level frameworks such as the 2030 Digital Compass, Horizon Europe, and the Digital Europe Programme, national strategies including Germany's Hightech Strategy, Austria's Digital Action Plan, and Italia Digitale, as well as regional digital and innovation strategies (European Commission, 2021a, 2021b, 2023, Bundesministerium für Bildung und Forschung, 2021, Bundesministerium für Finanzen, n.d., Presidenza del Consiglio dei Ministri, 2021).

In the German state of Baden-Württemberg, the digitalisation strategy “digital.LÄND” positions digitalisation as a cross-cutting issue across the economy, public administration and society (Ministerium des Inneren, für Digitalisierung und Kommunen Baden-Württemberg, 2022). In East Württemberg, this state-level strategy is complemented by regional initiatives such as “Zukunft Ostwürttemberg” and by the integration of digitalisation into regional development policies and selected cluster strategies (Industrie- und Handelskammer Ostwürttemberg, n.d.a). In Upper Austria, the economic and research strategy “#upperVISION2030” serves as a key framework, conceptualising digital transformation as an enabler of efficient and sustainable industry, human-centred technologies and networked mobility (Business Upper Austria – OÖ Wirtschaftsagentur GmbH & Amt der Oö. Landesregierung, n.d.). In Emilia-Romagna, digitalisation is embedded within a broader development model that links industrial competitiveness, innovation policy and cultural and creative dynamics,

operationalised through the regional “Digital Agenda Emilia-Romagna 2025–2029” (Regione Emilia-Romagna, 2025). Taken together, these strategies show that digitalisation is addressed as a horizontal objective across sectors, while differing in the extent to which coordination and implementation at regional level are emphasised.

While there are some similarities, the regions differ less in the existence of strategic frameworks than in how these strategies are operationalised and coordinated across governance levels. Digitalisation is commonly positioned as a horizontal policy objective that cuts across sectoral strategies and is closely integrated into innovation, industrial, and regional development agendas.

Policy mix and support instruments

Across all four regions, a broad and partly overlapping set of instruments exists to support digital transformation in SMEs, which can be grouped into four main categories: (1) financial support, (2) advisory and training services, (3) innovation and transfer structures and (4) networks and cluster initiatives.

In the field of financial support, functionally similar policy instruments can be observed, although they are embedded in different institutional contexts. In Germany, programmes such as “Digital Jetzt” and „Digitalbonus Bayern“ provide financial support to SMEs for investments in digital technologies and related organisational and process transformations (Bundesministerium für Wirtschaft und Klimaschutz, 2023b, Bayerisches Staatsministerium für Wirtschaft, Landesentwicklung und Energie, 2025b). In Austria and Upper Austria, policy approaches combine advisory and implementation-oriented support for SMEs, reflected at the federal level through programmes such as “KMU.DIGITAL” and at the regional level in Upper Austria’s programme “DIGITAL.PLUS”, which supports consultancy and implementation phases within a single integrated funding framework (Bundesministerium für Wirtschaft, Energie und Tourismus & Wirtschaftskammer Österreich, n.d.; Land Oberösterreich & Wirtschaftskammer Oberösterreich, 2025). In Italy, investments in Industry 4.0 technologies are primarily supported through the “Transizione 4.0” tax incentive scheme, which provides tax credits for eligible digital and automation investments (Ministero delle Imprese e del Made in Italy, n.d.).

Advisory and training services represent a secondary core component of the policy mix, supporting SMEs in strategy development, technology selection, and capability building. These services are predominantly delivered by intermediary organisations, including chambers of commerce, economic development agencies and specialised transfer centres, and are closely aligned with business practice and needs. Typical formats include digital readiness assessments, individual consultancy, training courses and thematic workshops customised to specific sectors or technologies.

A third category comprises innovation and transfer structures, which provide application-oriented environments for experimentation and knowledge transfer. In East Württemberg and Upper Austria, application-oriented research institutions, technology transfer centres, and innovation hubs play a central role, notably in the form of technology and start-up centres, demonstration facilities, and specialised laboratories. In Emilia-Romagna, this function is supported by a dense network of technopoles, innovation centres, and clusters that are closely aligned with regional industrial needs and integrate research, training, and technology transfer activities (Industrie- und Handelskammer Ostwürttemberg, n.d.b, Business Upper Austria –

OÖ Wirtschaftsagentur GmbH, n.d., Confederazione Nazionale dell'Artigianato e della Piccola e Media Impresa Emilia-Romagna, n.d.).

Network and cluster initiatives constitute a fourth category, fostering collaboration between firms, research institutions, and public actors, and supporting joint innovation projects. These initiatives facilitate knowledge diffusion, the initiation of cooperation, and the acceleration of innovation processes, particularly where individual SMEs have limited internal resources.

Overall, the regions differ less in the types of instruments employed than in their institutional embedding, accessibility, and integration within the broader policy mix. The effectiveness of support structures appears to depend not only on the availability of funding, but also on the systematic combination of financial instruments with advisory, training, and transfer services.

Intermediary actors and regional innovation ecosystems

Intermediary actors and innovation ecosystems play a key role across all three regions. Universities, research institutions, and transfer organisations serve as key interfaces between science and industry, while cluster and network structures connect firms, knowledge providers, and public actors.

In East Württemberg, regional networks, cluster structures, and transfer organisations such as the “Digitalisierungszentrum Ostwürttemberg” (digiZ) and initiatives like “Zukunft Ostwürttemberg” play a particularly important role (digiZ Ostwürttemberg, n.d., Industrie- und Handelskammer Ostwürttemberg, n.d.a). This suggests an intermediary-driven regional innovation model in which the density and accessibility of regional support structures are identified as key enabling factors for digital transformation in SMEs. In Upper Austria, Business Upper Austria plays a central role in coordinating cluster activities, funding programmes, and innovation services, ensuring their alignment with the strategic objectives of “#upperVISION2030” (Business Upper Austria – OÖ Wirtschaftsagentur GmbH & Amt der Oö. Landesregierung, n.d). In Emilia-Romagna, technopoles, cluster organisations, and innovation centres form a territorially embedded innovation system that supports firms across different stages of the innovation process, from research and development to technology adoption and internationalisation (Confederazione Nazionale dell'Artigianato e della Piccola e Media Impresa Emilia-Romagna, n.d.).

Of particular relevance across all three regions are decentralised, application-oriented structures that operate in close spatial and thematic proximity to firms' needs. They facilitate access to knowledge, technologies, and funding opportunities and help to reduce structural access barriers for SMEs within regional innovation systems. Rather than functioning as mere providers of individual services, these structures operate as coordinating interfaces that serve to reduce information asymmetries, build trust, and accelerate the diffusion of digital technologies. Institutionalised forms of cooperation, such as cluster organisations, innovation networks and regional partnerships, further pool competencies and support the development of joint innovation projects. In doing so, they assist in compensating for the limited resources of SMEs, share risks and enable collective benefits that would be difficult to achieve for individual firms alone.

Ideal typical governance logics and implications for Eastern Bavaria

On the basis of the strategies, programmes, and actor constellations described, three ideal-typical governance logics of digital transformation can be distinguished. The approach adopted in East Württemberg is characterised by an intermediary-driven model, whereby a dense

network of regional intermediaries, comprising clusters, development agencies and digitalisation centres, functions as a central implementation infrastructure for SMEs. Upper Austria follows a programmatically coordinated, cluster-based model in which strategic objectives are translated into structured funding lines and cluster initiatives, with a strong coordinating role played by Business Upper Austria. Emilia-Romagna exemplifies an integrated, multi-level governance approach in which regional innovation ecosystems, technopoles, and clusters are embedded within a broader strategy that links industrial policy, innovation, and digital transformation. While Eastern Bavaria shares key structural features with these regions, including a strong manufacturing base, a dense SME sector and decentralised innovation structures, its support and funding landscape is less clearly embedded within a coherent governance logic, with multiple programmes and intermediaries operating in parallel rather than within a systematically coordinated framework.

The findings from the three cases converge into three key dimensions of success. Firstly, coherent multi-level governance appears to be essential, with European, national and regional strategies aligned to provide clear guidance for regional implementation. Secondly, the effectiveness of support measures depends strongly on a coordinated policy mix, where financial support is systematically combined with advisory, training, and knowledge transfer services rather than being delivered as isolated instruments. Thirdly, regional proximity and dense, institutional innovation ecosystems are highly relevant as they facilitate access for SMEs and support learning processes through decentralised, application-oriented structures.

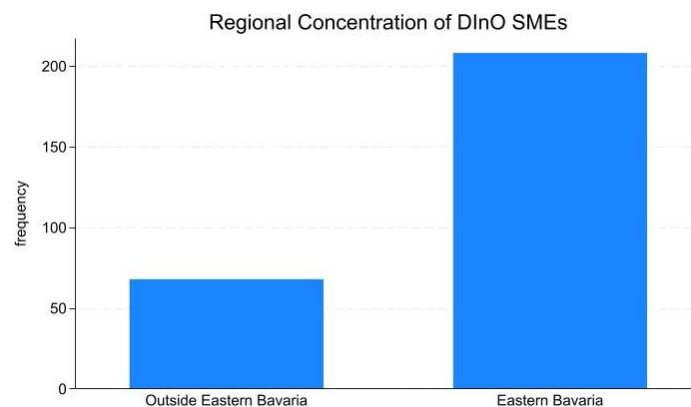
A direct causal attribution of individual measures to Eastern Bavaria is not possible due to differences in indicators, data availability and national institutional contexts. Nonetheless, the comparative analysis reveals consistent patterns across East Württemberg, Upper Austria and Emilia-Romagna, suggesting that well-coordinated, institutionally embedded innovation ecosystems are associated with higher levels of digital transformation. Eastern Bavaria shares key structural features with the reference regions, including a strong manufacturing base, a dense SME sector and decentralised innovation structures. However, in contrast to the reference regions, the regional support and funding landscape in Eastern Bavaria is less systematically coordinated and communicated, resulting in a complex and partly fragmented environment in which smaller firms struggle to identify and access suitable programmes. Against this backdrop, the findings indicate that improving coordination, visibility and strategic alignment of existing structures in Eastern Bavaria is likely to yield greater benefits than introducing additional, isolated support instruments.

The results of the comparative analysis thus point to three priority areas for action in Eastern Bavaria:

- (1) the more systematic integration of regional strategies and programmes into national and European digitalisation strategies, in order to reduce gaps between strategic ambitions and practical implementation within the multi-level governance framework that shapes Eastern Bavaria's innovation policy;
- (2) the targeted further strengthening of intermediary actors, particularly cluster organisations, technology transfer centres and European Digital Innovation Hubs, as key implementation agents for SMEs, building on existing structures such as TTZs and EDIH DInO and enhancing their coordinating and signposting functions for smaller firms;
- (3) institutional consolidation and improved alignment of the regional innovation system, with the coordination and visibility of existing support structures taking precedence over the introduction of additional individual programmes, thereby addressing the fragmentation and complexity of the current funding landscape and improving accessibility for SMEs.

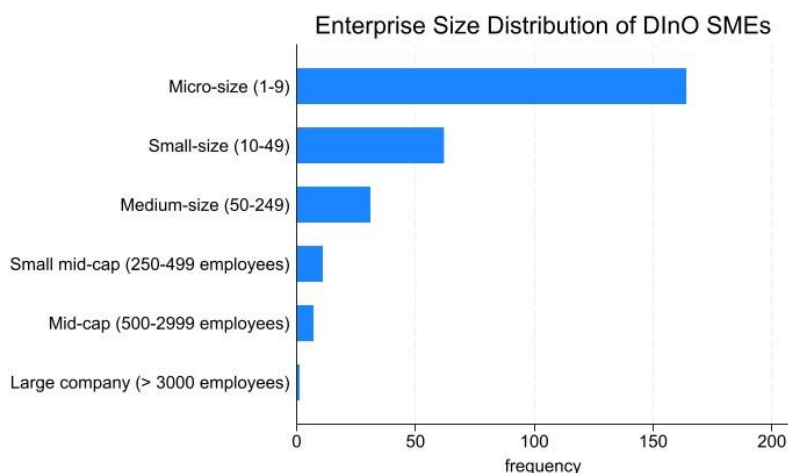
Project Data - Characteristics, Digital Maturity and Needs of SMEs

The analysis of SME data from the EDIH reporting portal provides an overview of the organisations supported by DInO and serves as a basis for interpreting subsequent digital maturity and survey results. Figure 1 illustrates the regional distribution of supported SMEs. The customer base is strongly concentrated within Eastern Bavaria, with 44.9% of all supported firms located in Upper Palatinate and 30.4% in Lower Bavaria. Together, these two regions account for more than three quarters of all organisations in the dataset. While DInO also reaches firms from other German regions and a small number of organisations from neighbouring European countries, the results confirm the hub's primary role as a regional support structure for Eastern Bavarian SMEs.



*Figure 1. Regional Concentration of DInO-Supported SMEs.
Source: Authors' own calculations based on DInO portal data.*

Figure 2 further shows that the supported organisations are predominantly micro and small enterprises. Micro-enterprises account for 59.4% of all SMEs, while small enterprises represent an additional 22.5%. Medium-sized firms constitute 11.2% of the sample, whereas larger organisations are only marginally represented. Consequently, more than four out of five supported firms belong to the micro and small enterprise categories. This finding is particularly relevant for the interpretation of digital maturity results, as smaller firms are generally more constrained in terms of financial resources, personnel capacity, and specialised digital expertise.



*Figure 2 . Enterprise Size Distribution of DInO-Supported SMEs.
Source: Authors' own calculations based on DInO portal*

The sectoral distribution presented in Figure 3 demonstrates that DInO serves a highly diverse customer base. Personal services constitute the largest sector (19.6%), followed by telecommunications (13.4%), transport and mobility (9.4%), cultural and creative industries (7.3%), and construction and assembly (6.5%). Manufacturing, education, healthcare, energy, retail, and tourism are also represented. The results indicate that digital transformation challenges in Eastern Bavaria are not confined to manufacturing industries but affect a broad range of economic sectors.

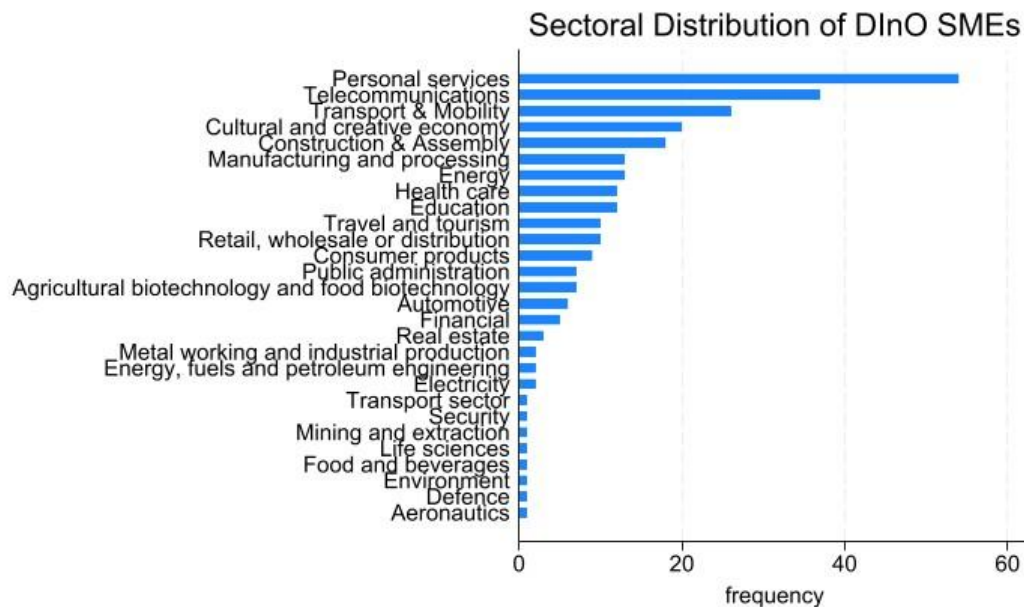


Figure 3. Sectoral Distribution of DInO-Supported SMEs.
Source: Authors' own calculations based on DInO portal data.

The structural characteristics of the supported SMEs provide important context for interpreting digital maturity levels within the region. The predominance of micro and small enterprises, combined with the broad sectoral diversity of the customer base, indicates that the organisations supported by DInO differ considerably in their structural characteristics and operating environments. These differences provide important context for interpreting the digital maturity results presented in the following section. However, it should be noted that DMAs are only conducted for organisations that receive more substantial consulting or support services through DInO. Consequently, the DMA dataset represents a subset of the organisations recorded in the EDIH reporting portal and focuses on firms that engaged more intensively with the hub's services. Building on this understanding of the supported organisations, the following section analyses their digital maturity profiles using the DMA framework and identifies key strengths, weaknesses, and development needs across different dimensions of digital transformation. Before analysing the digital maturity results, it is useful to consider the composition of the DMA sample. Figure 4 shows the distribution of firms by size among organisations that completed a DMA assessment. Similar to the overall DInO customer base, the sample is dominated by micro-enterprises, which account for approximately 65% of all assessed firms. Small enterprises represent 17%, while medium-sized firms account for 10% of the sample. Larger organisations are only marginally represented. As a result, the DMA findings primarily reflect the digital maturity of micro and small enterprises, which constitute the majority of firms supported by DInO. The predominance of these firms should be considered when interpreting the DMA results, as the digital maturity profiles presented in the following analysis largely reflect the characteristics of smaller organisations.

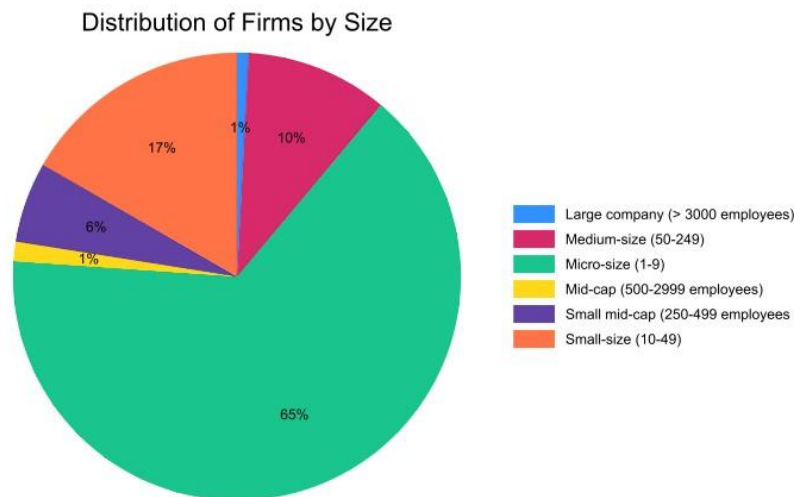


Figure 4. Firm Size Distribution of DMA Participants
.Source: Authors' own calculations based on DInO DMA data

The DMA results reveal substantial differences in digital maturity across SMEs supported by DInO. As illustrated in Figure 5, overall digital maturity scores vary considerably between organisations, indicating that SMEs in Eastern Bavaria are at very different stages of their digital transformation journeys. While some firms achieve comparatively high maturity levels, a large share of organisations remains within the low to medium maturity range. This considerable variation reflects differences in organisational resources, strategic orientation, digital capabilities, and prior experience with digital technologies.

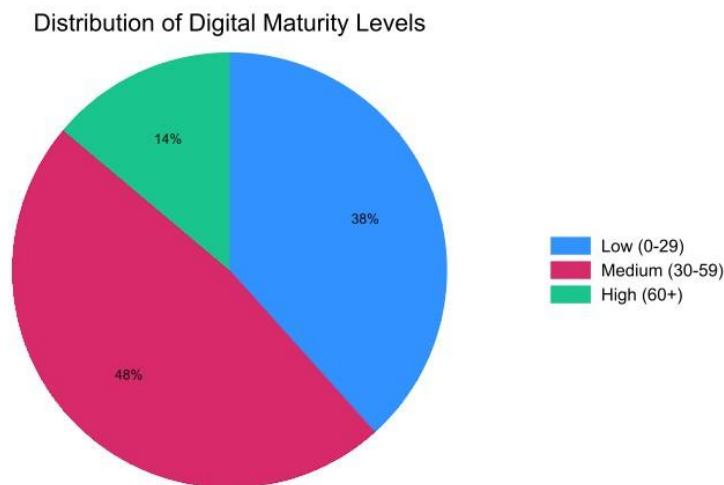


Figure 5. Distribution of Digital Maturity Scores.
Source: Authors' own calculations based on DInO DMA data.

A consistent pattern emerges when analysing digital maturity by company size (Figure 6). Digital maturity increases with firm size, with micro-enterprises generally achieving the lowest DMA scores and medium-sized firms reporting substantially higher levels of maturity. Given that micro and small enterprises account for more than 80% of all supported organisations, this finding is particularly relevant for understanding digitalisation challenges within the region. The results suggest that organisational size is associated with differences in digital maturity among the surveyed firms. In contrast to company size, organisational age does not appear to be a major determinant of digital maturity within the analysed sample, as shown in Figure 7. Both younger and older firms can be found across the entire range of DMA scores, indicating that digital maturity is not systematically related to organisational age.

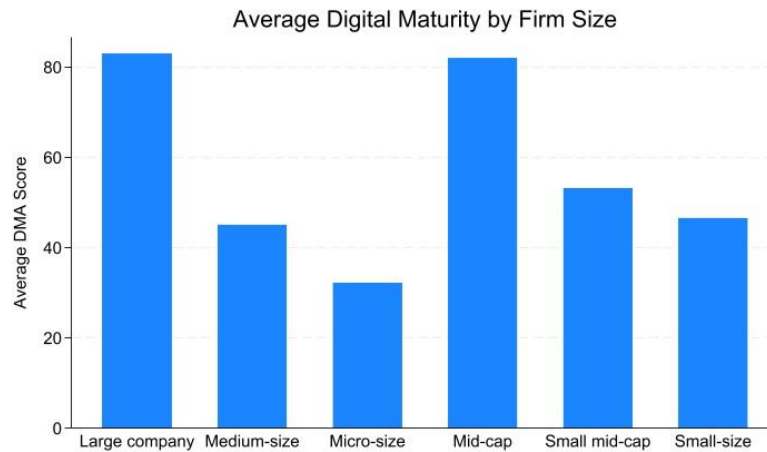


Figure 6. Average Digital Maturity by Firm Size.
Source: Authors' own calculations based on DInO DMA data

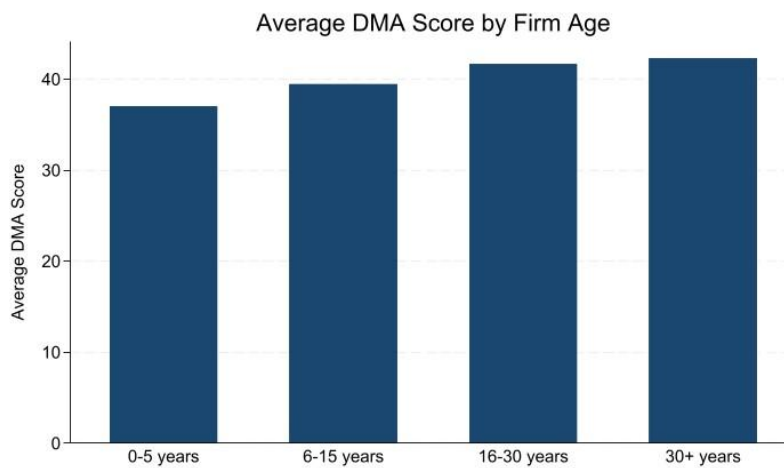
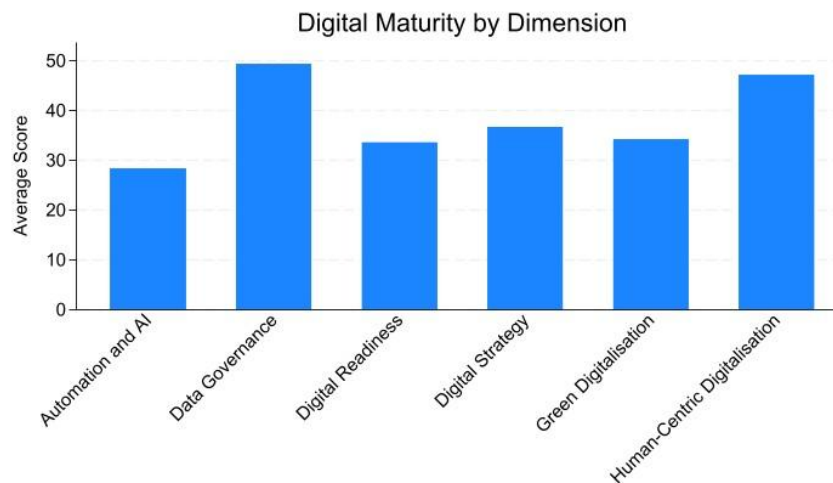


Figure 7. Average Digital Maturity by Firm Age.
Source: Authors' own calculations based on DInO DMA data.

Further insights can be derived from the analysis of the six DMA dimensions as displayed in Figure 8. Across the sample, the strongest results are observed in Data Governance and Human-Centric Digitalisation, suggesting that many SMEs have already implemented basic digital tools, communication systems, and digitally supported work processes. However, considerably weaker results are visible in the dimensions Automation and Artificial Intelligence, Data Management, and Digital Business Strategy. Many organisations have not yet integrated digital technologies into a wider strategic framework and often lack data-driven decision-making structures. The particularly low maturity levels in Automation and Artificial Intelligence indicate that the adoption of advanced digital technologies remains limited among many SMEs in Eastern Bavaria. Green Digitalisation displays a more heterogeneous pattern, reflecting different levels of awareness and varying strategic priorities regarding sustainability-related digital applications.



*Figure 8. Average Digital Maturity by Dimension.
Source: Authors' own calculations based on DInO DMA data.*

Beyond the baseline assessments, a limited number of follow-up assessments (T1 and, in some cases, T2) are available. These observations generally indicate positive developments in digital maturity following participation in DInO services. Improvements are particularly visible in dimensions directly addressed through consulting, training activities, and technology transfer services. However, due to the limited number of longitudinal observations, these findings should be interpreted as indicative developments rather than robust evidence of causal intervention effects. The DMA results reveal a heterogeneous digitalisation landscape among SMEs in Eastern Bavaria. While basic digital infrastructures and digitally supported work processes are already established in many organisations, substantial deficits remain in strategic digitalisation, data utilisation, automation, and artificial intelligence. The findings further suggest that digital maturity is strongly linked to organisational capacities and available resources, particularly among micro and small enterprises that constitute the majority of the regional SME landscape.

The survey results complement the DMA findings by providing insights into how organisations perceive digitalisation and regional support structures. Overall, respondents expressed a positive attitude towards digitalisation and strong interest in technologies such as artificial intelligence, automation, digital business processes, and paperless office solutions. However, many organisations struggled to define concrete implementation projects or articulate specific support needs. The most frequently cited barriers include limited time resources, insufficient internal expertise, uncertainty regarding technological developments, and concerns related to data protection and IT security. As a result, many SMEs require guidance and orientation before prioritising and implementing digitalisation initiatives. Correspondingly, respondents expressed demand for financial support, advisory services, training opportunities, and assistance in identifying suitable use cases. A particularly notable finding is the strong interest in networking and knowledge exchange. Many organisations emphasised the value of learning from practical examples, sharing experiences, and connecting with regional support institutions. This suggests that digital transformation is perceived not only as a technological challenge but also as a collective learning process.

Taken together, the EDIH portal data, DMA results, and survey findings paint a consistent picture. DInO primarily supports micro and small enterprises operating across diverse sectors. While many SMEs have adopted basic digital technologies and demonstrate a clear

willingness to engage in digital transformation but often lack the resources, strategic orientation, and practical guidance needed to translate digital ambitions into concrete projects. These findings provide the foundation for the subsequent interview analysis, which explores these challenges and support needs in greater depth.

SME Interview Perspectives

To best understand what needs and demands regional SMEs have, the interviews were held with business people from Eastern Bavaria. All participating firms are located in predominantly rural areas and a central issue concerns the heterogeneity of digital infrastructure: while most respondents report high satisfaction, others experience significant limitations depending on their specific location. In addition, mobility requirements constitute a substantial burden, as reliance on private vehicles, along with rising fuel costs and travel time, affects daily operations. At the same time, rurality is associated with certain advantages, including lower competitive pressure, reduced labor costs, and a comparatively high level of employee loyalty and quality of life. Despite typical structural disadvantages, the region is characterized by a robust craft and commerce sector, suggesting that rural contexts should not be understood solely in deficit terms but also as environments with distinct economic strengths.

Digital Maturity and Heterogeneity

The level of digitalization across the interviewed companies varies considerably, revealing a pronounced heterogeneity. While some firms exhibit only minimal adoption (“low to medium, what on earth should we digitize”) - primarily limited to external tools such as marketing platforms or booking systems - others have achieved a high degree of digital integration, in some cases operating entirely paperless (“almost every one of our processes is digitally mapped”). This contrast highlights a significant divide within the sample, suggesting that digital transformation in rural SMEs does not follow a linear or uniform trajectory but is instead highly contingent on firm-specific conditions. In particular, the variation points to differing levels of awareness regarding digital potential, as well as differing strategic orientations toward innovation.

Drivers of Digitalization

A key finding is that digitalization efforts are strongly dependent on the commitment of top management. In all cases, initiatives are driven by the owner, without their support, little to no progress occurs. Conversely, when leadership actively promotes digital transformation, employees are generally willing to contribute. However, the workforce can be broadly divided into two groups: those resistant to change, often due to established routines or age-related factors, and those who are open to and supportive of digital innovation. This internal tension represents a critical factor influencing the speed and success of digital transformation processes.

In terms of implementation, digitalization typically begins in administrative functions and, to a lesser extent, extends into production processes. Initial steps include relatively simple applications such as digital time tracking, while more advanced implementations involve tools such as maintenance scheduling systems. Notably, most companies lack a comprehensive digitalization strategy, instead, decisions are made on an ad hoc basis, often in response to immediate needs or regulatory requirements.

The primary objectives of digitalization are to enhance efficiency and productivity, particularly by increasing output without expanding the workforce (“increase the workload with the existing

team of staff”) and reducing dependency on scarce skilled labor (“to be less influenced and more independent from potential shortage of skilled workers”). This indicates that digitalization is primarily perceived as a pragmatic response to operational constraints rather than as a strategic innovation process.

Future Perspectives and the Role of Artificial Intelligence

Looking ahead, many interviewees expressed the intention to intensify digitalization by leveraging existing internal data more effectively. However, perspectives on future development paths diverge considerably. Approximately half of the respondents identified artificial intelligence as the next major step in their digital transformation, indicating a forward-looking orientation and a willingness to engage with emerging technologies. In contrast, the other half remain uncertain about future directions, suggesting a lack of strategic clarity or limited awareness of potential innovation pathways. This divergence reflects a broader tension between proactive and reactive approaches to innovation and may be linked to existing levels of digital maturity, resource availability, or managerial competencies.

Perceived barriers to Digital Transformation

The most frequently cited challenge relates to the current volatility of the political and regulatory environment. Respondents perceive frequent policy changes as a source of uncertainty, leading to delayed decision-making and a more cautious investment approach. This highlights a clear relationship between external instability and reduced organizational willingness to innovate.

Additionally, there is a perceived lack of guidance and support regarding the implementation of digital technologies, particularly in the field of artificial intelligence. Many firms struggle to keep pace with rapid technological developments and express a need for best practices. Time constraints and limited human resources further hinder digital transformation, as companies must balance daily operations with organizational change. This challenge is exacerbated by a workforce that is not uniformly digitally skilled, with many employees lacking familiarity with new technologies. Overall, these findings illustrate that barriers to digitalization are not solely technological but also organizational and institutional in nature.

Skilled Labor Shortage as a Structural Constraint

Regarding the shortage of skilled labor, respondents reported two main difficulties: finding qualified personnel with appropriate vocational training and sufficient experience to work independently, and recruiting individuals with adequate digital competencies. Both aspects are increasingly challenging and create significant operational risks when employees leave the company. Importantly, this shortage is closely linked to digitalization efforts. On the one hand, it acts as a key driver, motivating firms to automate processes and increase efficiency. On the other hand, it simultaneously constrains digital transformation due to the lack of personnel capable of implementing and managing digital systems. In the current economic and political climate, firms are hesitant to create new positions, further intensifying this tension.

Collaboration and Knowledge Exchange

Collaboration among companies appears to be limited, although some partnerships and joint initiatives exist or are planned. This limited level of cooperation suggests untapped potential for collective learning and innovation. Several respondents explicitly emphasized the need for more structured exchange within their industries, for example through informal or moderated

formats, indicating a demand for platforms that facilitate knowledge sharing and mutual support.

Cooperation with universities and universities of applied sciences is generally regarded as important for fostering innovation. Regional academic institutions are seen as key drivers of knowledge transfer; however, some respondents highlighted a mismatch in objectives, noting that universities prioritize open research rather than direct economic value creation. This divergence in institutional logics can complicate collaboration and reduce its perceived practical relevance.

Awareness and Use of Support Structures

Awareness and utilization of regional support structures vary significantly. Interviewees who had previously engaged with such services demonstrated a high level of awareness, whereas those who had not were often unfamiliar with available support. This suggests that access to support structures is not only a matter of availability but also of visibility and prior engagement.

The reasons for non-use are twofold: either firms perceive no need due to sufficient internal expertise, or they acknowledge potential benefits but assign low priority due to operational demands. In some cases, there is even general reluctance (“Even if there are offers, I probably would not have gone”). This indicates that time constraints and perceived relevance are critical factors influencing the uptake of support services.

Financial Support and Bureaucratic Barriers

Financial support for digitalization and innovation emerged as a critical issue. Interviewees called for increased support through tax incentives and less bureaucratic funding mechanisms. While existing programs such as the “Digitalisierungsbonus” and the “Innovationsbonus” are widely known and considered relatively accessible, they are still perceived as administratively burdensome (“It takes quite a bit of effort to fill everything out (...) to get the funding. It can easily take half a day.”) and limited in scope.

Funding levels are often insufficient and restricted to narrowly defined areas, requiring companies to finance most digitalization efforts independently or through loans. This is particularly problematic when digital investments are driven by regulatory compliance. Respondents also emphasized the need for clearer funding criteria (“The crucial thing is that the funding is clearly defined, specifying exactly what is being funded, rather than being vague.”), pointing to a lack of transparency as an additional barrier.

Political Environment and Governance

In relation to political engagement, interviewees expressed a strong desire for improved communication between policymakers, industry, and research institutions. Many criticized the lack of direct dialogue, arguing that effective policymaking requires a better understanding of on-the-ground challenges (“How are they supposed to know if no one talks to the people anymore?”). Proposed solutions include regular roundtable discussions involving all stakeholders, which could help align expectations and improve policy responsiveness. Equally important is the reduction of bureaucratic complexity, which was identified as a major barrier. Despite political commitments, respondents reported little tangible progress and emphasized the urgency of reform (“Reducing bureaucracy, streamlining, and simplification would be among the most important issues for me.”).

Overall, the findings reveal a complex interplay between internal organizational factors and external structural conditions. Digitalization in rural SMEs is characterized by high heterogeneity, strong dependence on individual leadership, and a predominantly pragmatic orientation toward efficiency gains. At the same time, structural challenges - such as skilled labor shortages, political uncertainty, and limited support accessibility - significantly constrain transformation processes.

The results further highlight important tensions, particularly between innovation potential and resource limitations, as well as between the perceived necessity of digitalization and the lack of strategic direction. Addressing these tensions requires not only technological solutions but also improved coordination between firms, policymakers, and support institutions, as well as a stronger focus on knowledge transfer and capacity building.

Synthesised Results and Policy Recommendations

The combination of findings from the literature review, data analysis, and expert interviews reveals several recurring challenges that are consistently visible across all applied research methods.

Rapid Technological and Political Change

One of the central challenges identified is the speed of technological and political development. SMEs, particularly smaller firms, often struggle to keep pace with ongoing digital transformation processes. The continuous emergence of new technologies, combined with the rapid evolution of existing digital solutions, creates uncertainty and frequently delays adoption decisions.

In many cases, the time required for implementation, organizational restructuring, and employee training exceeds the innovation cycle of the technologies themselves. As a result, companies are often unable to integrate digital technologies before newer solutions already emerge. This creates a structural mismatch between the speed of innovation and the adaptation capacity of SMEs, causing many firms either to postpone digitalization initiatives or to avoid them entirely.

Ageing Workforce and Skills Gap

A further challenge concerns the ageing workforce and the shortage of employees who combine practical expertise with digital competencies. This issue is particularly visible in non-IT sectors such as manufacturing and crafts industries. Companies are typically able to recruit either highly experienced employees who can independently manage customer projects, or digitally skilled workers who possess knowledge related to digital tools and process optimization. However, finding employees who combine both practical occupational expertise and digital capabilities remains difficult within the region.

This skills gap limits the ability of SMEs to implement digital transformation effectively, as firms often prioritize operational continuity over organizational innovation.

Fragmented Support Structures and Limited Accessibility

Although numerous funding programmes and support services for digitalization exist, SMEs frequently perceive the support landscape as fragmented, bureaucratic, and difficult to navigate.

Many firms lack awareness of available support opportunities, while others consider the administrative requirements too time-consuming relative to the expected benefits. In addition,

support structures and funding conditions often change rapidly, reducing long-term planning security and limiting trust in the reliability of public support mechanisms.

As a result, two distinct groups of SMEs emerge: firms that have already learned how to strategically utilize funding and support systems, and firms that have had little or no contact with such infrastructures and therefore remain hesitant to engage with them. This reluctance is primarily driven by uncertainty regarding costs, time investment, and potential benefits of support services or insufficient knowledge about existing support infrastructures and access points.

Internal SME Characteristics and Strategic Orientation

The findings further indicate that the degree of digitalization strongly correlates with company size. Smaller SMEs are generally less digitally developed. They mentioned in some interviews that they are primarily occupied with day-to-day operational activities within their core business areas. Most companies included in the sample do not follow a structured digitalization strategy. Instead, digital initiatives are often reactive and opportunistic, focusing on technologies that appear easiest to implement or most immediately useful at a given moment.

Moreover, digital transformation processes are highly dependent on individual actors within the company. In many SMEs, progress only occurs when owners or members of top management actively promote digitalization initiatives. Without such internal drivers, little organizational change takes place.

Need for Networking and Cooperation

Across all interviews and analyses, there was a clear demand for stronger networking opportunities, exchange of best practices, and mutual learning between companies. However, despite this expressed interest, actual participation in networks, joint ventures, and collaborative initiatives remains limited. The main barriers to cooperation include concerns about revealing internal knowledge, losing competitive advantages, or appearing weak in front of competitors. Consequently, many SMEs prefer isolated approaches rather than collaborative learning and innovation processes.

Following these results, several recommendations for policies can be drawn. The following suggested policies, are not fully developed to meet every juristical standard but shall rather stand for new ideas that need further thought, especially in the juristical field before implementing them. The suggestions are made with the goal to meet the most pending issues identified in the applied methods and focus on three core fields: simplification, cooperation and incentivizing to digitize.

1. Simplification and Stabilization of Funding Programmes

Funding programmes targeting SMEs should provide greater long-term stability and easier accessibility. Current funding structures are often highly fragmented, with separate programmes supporting hardware investments, employee training, infrastructure, or consulting services independently.

A more integrated funding framework would significantly reduce complexity for SMEs. Ideally, companies should be able to access a single programme covering multiple dimensions of digital transformation under clearly structured and transparent conditions. The funding output should be less strict in terms of specific key performance indicators (KPI) that need to be reached (e.g. 5 Digitization Workshops with 10 Participants each) and rather focus on the underlying goal of the funding without needing to reach concrete numbers (e.g. employees gather a general understanding for Digitization and subsequent processes through Workshops, Mentoring and peer learning groups).

In addition, funding criteria, application procedures, and co-financing requirements should be easier, less bureaucratic in the application process and remain stable over longer periods in order to enable strategic planning and investment security for SMEs.

2. Promotion of SME–Startup Cooperations

Although many SMEs express interest in networking opportunities, existing networks are currently underutilized. Therefore, rather than creating additional networking structures, policies should focus on facilitating targeted cooperation and effective matchmaking between firms.

Particularly beneficial are collaborations between SMEs and startups. Startups benefit from access to first customers and practical industry environments, while SMEs gain exposure to innovative perspectives and digital expertise.

In addition, joint ventures and collaborative projects can enable the sharing of costs, personnel, and knowledge. However, such cooperations are often perceived as risky, especially when involving smaller firms or startups.

To encourage participation, targeted incentive structures and risk-reduction mechanisms should be introduced. Financial support schemes, matchmaking services, and pilot cooperation programmes could lower entry barriers and increase willingness to engage in collaborative innovation processes. Existing initiatives such as the EU-LAC digital accelerator, a programme that matches SMEs and startups from Latin America, the Caribbean and Europe (EU-LAC Digital Accelerator, 2026) may serve as useful models for the development of regional initiatives.

3. Activating SMEs

For many SMEs, the initial step toward digitalization represents the greatest barrier. The rapid pace of technological development, combined with the large number of available solutions, often creates uncertainty and decision paralysis.

Many firms are aware of the increasing pressure to digitalize but lack the knowledge required to identify suitable starting points and develop long-term roadmaps.

Therefore, accessible and individualized consultation services are essential. Existing initiatives such as the “Zukunftszentren” and regional economic development agencies already provide valuable support; however, current demand exceeds available capacities.

Strengthening these institutions through additional personnel and long-term financing could significantly improve their ability to function as reliable first contact points for SMEs seeking orientation and support during digital transformation processes.

4. Facilitation of inter-company employee exchange

In many traditional industries, particularly manufacturing and crafts sectors, companies face a structural trade-off in recruitment decisions. Firms often must choose between highly experienced workers capable of independently managing customer projects and digitally skilled employees who can support organizational modernization and process optimization. Since both groups are scarce, companies typically prioritize operationally experienced workers in order to maintain ongoing business activities. At the same time, these employees are often less interested in organizational change and digital restructuring processes.

One potential policy response would be the facilitation of inter-company employee exchange programmes. Such programmes could promote knowledge transfer, cooperation, and gradual digital capability development across firms. Currently, however, bureaucratic and cultural barriers significantly limit the feasibility of such exchange models. Successful implementation would therefore require risk-reduction measures, including contractual security for employees,

protection of company-sensitive information, and administrative support for participating SMEs. Increasing awareness of such exchange opportunities and supporting initial pilot experiences could contribute to alleviating skilled labour shortages while simultaneously strengthening digital competencies and inter-firm cooperation.

Conclusions

Analysing the digital transformation of Eastern Bavaria reveals a structurally robust yet highly diverse SME landscape. Micro and small enterprises in particular face persistent barriers to digital adoption in this environment. These constraints are driven more by demographic change, skills shortages, uneven digital infrastructure and limited organisational and strategic capacities than by technological limitations.

At the same time, the region benefits from a well-developed and dense ecosystem of universities, technology campuses, transfer centres and intermediary organisations, which already provide important entry points for innovation and knowledge transfer. However, empirical evidence from service data of the regional EDIH, as well as from surveys and interviews, shows that many SMEs still find it difficult to turn their digital ambitions into concrete projects. This is often due to a lack of visibility regarding support offers, time constraints, and administrative complexity.

Comparative insights from East Württemberg, Upper Austria and Emilia-Romagna suggest that successful rural industrial regions do not rely on the proliferation of new flagship programmes. Rather, they rely on coherent multi-level governance, integrated policy mixes and territorially embedded innovation ecosystems. Financial instruments are consistently combined with advisory, training and demonstration services in these regions, and intermediary actors play a key coordinating and enabling role for SMEs.

Against this background, the central policy challenge for Eastern Bavaria is not to expand the number of instruments, but to improve the coordination, accessibility and long-term stability of existing support structures. Particular emphasis should be placed on strengthening intermediary organisations, encouraging collaboration between SMEs and start-ups, and expanding low-threshold advisory and transfer services to enable smaller firms, in particular, to engage in digital transformation.

Overall, Eastern Bavaria has the potential to further consolidate its role as a decentralised innovation region within the German and European multi-level governance system. To realise this potential, there needs to be a sustained shift away from fragmented, project-based interventions towards more integrated, coherent and user-oriented support structures. This must be accompanied by a reduction in bureaucratic complexity and stronger strategic alignment across governance levels.

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