

## Research Conference on “Doing, Using and Interacting – Innovation in lagging Regions”:

### Conference report

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Venue:	Conference Center at the Historic Observatory of the University of Göttingen Geismar Landstraße 11b 37085 Göttingen
Date:	November 21-22, 2024
Hosts:	<i>Prof. Dr. Kilian Bizer</i> , Georg August University of Göttingen <i>Prof. Dr. Uwe Cantner</i> , Friedrich Schiller University Jena <i>Prof. Dr. Rolf Sternberg</i> , Leibniz University Hannover
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Göttingen, September 2025

## Contents

Introduction.....	1
Keynote: Unlocking Innovation in Lagging European Regions: A Path to Economic Development and Cohesion .....	3
Session 1: Innovation modes from a spatial perspective .....	5
Measuring non R&D-drivers of innovation: The case of SMEs in lagging regions .....	5
Innovation modes and knowledge interactions: a micro-geographic approach. ....	6
Session Discussion: Innovation modes from a spatial perspective .....	8
Session 2 .....	9
The regional context of innovation processes of SMEs in lagging regions: empirical evidence and implications for innovation policy .....	9
The DUI mode of innovation: Past – Present – Future.....	10
Session Discussion: The regional context specificity of DUI innovation .....	12
Session 3: Implications for structural policy.....	13
Policy selection & R&D additionality.....	13
Regional Knowledge Infrastructure and Innovation in SMEs in Lagging Regions .....	14
Session Discussion: Implications for structural policy.....	16
Keynote: The DUI innovation mode in catching-up and developing countries and regions.....	17
Panel discussion: DUI as a policy target in lagging regions .....	19
Conclusion .....	20
References.....	21
Appendix: Conference Program .....	22

## Introduction

Innovation is one of the keys to bringing lagging regions forward. The two-day conference in Göttingen on the role of the DUI mode for innovation in lagging regions provided valuable insights in this regard. There were two inspiring keynote speeches, a number of interesting presentations from the field of innovation mode research and an exciting panel discussion. Overall, it was confirmed that an innovation mode perspective, which underlies this DUI concept, is helpful to better understand and potentially better promote the economic development of lagging regions.

Over the two days of the conference, it became clear not only that the DUI mode is particularly important for innovation in these regions – at least in relative terms. Both keynote speakers, Raquel Ortega-Argiles from the University of Manchester and Mario Davide Parrilli from Bournemouth University, rightly emphasized that it is also the combination of DUI and STI modes that is needed to effectively stimulate innovation in lagging regions. In a sense, therefore, the debate on innovation in lagging regions should too narrowly focused on the DUI mode alone; STI must also be taken into account. This is certainly one of the important outcomes of the conference. And, of course, it leads to a major challenge for policy-makers in trying to first identify the DUI potential in lagging regions and then gradually complement it with STI inputs, be it from within or from outside the region.

At the same time, the discussions during the conference showed that it was not just only DUI enthusiasts being in the room. And that was a good thing. On the one hand, there seems to be a general agreement that there is indeed something to this DUI mode. But whether this is really good, important, relevant or whatever for lagging regions was a matter of debate. Of course, it is precisely this healthy skepticism that motivates researchers to continue working on the DUI mode in the future. And the conference showed what this future research should address:

### **Takeaway #1: Sharpen our understanding of what DUI is and perhaps what it is not.**

A clear distinction between the different dimensions of the DUI mode, their full coverage in empirical measurement approaches and the use of indicators that are as precise as possible, as is currently the focus of the DUI.REG project, will certainly help. But we need to go further: Tom Brökel from the University of Stavanger raised the question of what we are really talking about. Are we really talking about innovation or perhaps more about adaptation or diffusion? Such things certainly need to be clarified in order to work out more clearly the relevance of the DUI mode for regional economies. It may be helpful to distinguish between different types of DUI, e.g: DUI application, DUI technological and DUI interaction, as Raquel Ortega-Argiles highlighted in her keynote.

Looking at related concepts such as non-R&D innovation or the knowledge-based approach, as was shown in the presentations by Oliver Som (MCI Innsbruck) and Björn Asheim (University of Stavanger),

can also help to clarify the picture. It may then become clearer that STI and DUI are not as clearly separated as was often assumed in the discussions at the conference. For example, DUI can also take place in the context of R&D ("the D of R&D"). Or, to take another example, a synthetic knowledge base can also contain a certain amount of R&D. This leads to the second take-away from the conference.

**Take away #2: Consider the dynamic nature of the interplay between DUI and STI.**

The discussions during the conference showed that skepticism about the DUI approach often comes from looking at STI and DUI in isolation, i.e. as if there were pure DUI companies and pure STI companies. An interesting outcome of the conference was that this can be a trap because this view is in a sense rather static. Therefore, future research should look at the dynamic continuum between these two modes. Applied to lagging regions, this may mean that firms first need to build up basic competences in the DUI mode in order to be better able to grow into the STI mode, in other words: perhaps SMEs in lagging regions need DUI to get to STI in order to stimulate a real catching-up process. Such a perspective would help to move away from the deficit perspective that sometimes surrounds discussions of the DUI mode. DUI is more than just a lack of STI. DUI also makes STI companies better. It is a systematic finding of innovation mode research that STI firms that integrate DUI perform better than pure STI firms. Therefore, researchers on innovation in lagging regions should pay more attention to this dynamic nature of innovation modes in the future.

**Take away #3: Clarify whether or not DUI should be a policy objective in lagging regions.**

The panel discussion on the second day of the conference addressed this important question. As expected, there were very different views and controversial perspectives among the conference participants on this. However, several presentations at the conference provided empirical evidence that there are regional differences in terms of innovation modes that could be taken into account by policy in one way or another. The question, of course, is whether there is a convincing policy rationale for doing so. Perhaps the classic market failure approach will not help, but perhaps, as Oliver Som from MCI Innsbruck argued, looking at systemic failures will.

In any case, policy analysis studies, such as the one presented by Uwe Cantner, Tobias Hädrich and Martina Buratti from the University of Jena, are needed to find out whether policy measures to support lagging regions actually work, also with regard to the DUI mode or its combination with the STI mode. And perhaps, as was also briefly discussed on the first day of the conference, it may also be necessary, for example, to look beyond the traditional focus of innovation policy and ask whether good education and labor market policies that focus on skills development and reducing skills shortages might even be the best DUI innovation policy in lagging regions.

**Take away #4: Much more research is needed on the regional dimensions of DUI.**

Several conference participants saw the need for more research into the geography of STI and DUI modes, such as Mario Davide Parrilli in his presentation on the microgeography of STI and DUI and the corresponding role of geographical proximity. According to him, research on the spatial contextualization of innovation modes has only just begun and there is much room for more. Here, and this was also addressed at the conference, qualitative research methods still have great potential, as shown by the results presented by Rolf Sternberg (University of Hanover) on the spatial context of DUI and STI in the context of lagging regions.

A related avenue for future research on the regional dimensions of DUI relates to the contribution of DUI to regional growth and development. In the discussions at the conference, it was suggested that DUI in lagging regions might have something to do with log-in effects, low value added or low economic relevance. These are all valid questions. For this reason, studies are needed that actually show that DUI is economically beneficial for lagging regions, i.e. that it represents real economic value for them to build on.

Finally, it is important to highlight a key point made by several speakers at the conference: The DUI mode is not only about the past, it is also about the future of lagging regions. On the basis of profound research efforts – for example, Raquel Ortega-Argilés mentioned digitalization and the green transition in this context – it would be important to show that it is precisely the DUI mode and its combination with the STI mode that helps the lagging regions not to be left behind in the course of such comprehensive transformation processes, in the sense that the DUI mode strengthens the necessary adaptability in companies of lagging regions. Thus, the Göttingen conference on innovation in lagging regions showed that research in the innovation mode concept faces major challenges, but also has promising prospects, especially from a regional perspective. The DUI mode therefore remains an exciting area of research.

## Keynote: Unlocking Innovation in Lagging European Regions: A Path to Economic Development and Cohesion

In her keynote, Raquel Ortega-Argiles from the University of Manchester sheds light on the complexities of innovation and industrial transitions in Europe's lagging regions. Despite the success of European cohesion policy in reducing interregional and intraregional inequality over the last decades, recent challenges such as automation, globalization, migration, and the COVID-19 pandemic have exacerbated disparities, with innovation being of paramount importance for economic

development, productivity, and socio-economic cohesion. The European Union's smart specialization strategy, a cornerstone of cohesion policy, aims to achieve spatially balanced economic benefits. However, there are still regions lagging behind, characterized by low productivity growth rates and hourly productivity levels. Based on these parameters, regions can be classified into four groups: catching up, falling behind, steaming ahead, and losing ground. Categorizing regions into groups obscures the fact that each region has its own reality. For example, the concentration of innovation in urban areas, as observed in the US (where five cities account for 90% of innovation-related job growth between 2005 and 2017), raises questions about the geography of innovation. However, the US and South Korea appear to be outliers in terms of a high concentration of innovation in urban areas, as the concentration is much less pronounced elsewhere. Institutional factors can facilitate a more balanced distribution of innovation, as exemplified by Germany's knowledge and innovation dissemination approach. Both developed and less-developed areas exhibit distinct advantages and disadvantages, necessitating two complementary innovation strategies: system-wide and localized innovation. Their combination ultimately shapes regional innovation policy and leads to different regional profiles and innovation strategies.

To address regional challenges, ex-ante evaluations of public support for R&D highlight the potential of public funding redistribution programs to rebalance national economies through improved subnational productivity and job creation. Empirical analyses show that prioritizing historically underfunded regions yields the highest overall returns. In addition, highly interconnected regions benefit from these investments as spillovers occur through interregional trade linkages. This suggests that investment in disadvantaged regions can be a catalyst for growth rather than an obstacle. These results are also confirmed with respect to technological interdependence. This can raise regional productivity, but only up to a certain point. Once a region has reached an average level of productivity, further increases in relatedness can actually lead to negative "lock-in" effects. Thus, the research suggests that these strategies may be more effective in economically weaker regions or those far from the technological frontier, where investments in local knowledge and innovation can help improve technological coherence and resilience.

Furthermore, the world is facing two major transition challenges: a digital transition driven by new technologies and a green transition aimed at reducing environmental impacts. These transitions are characterized by path-dependency, technological adoption, and industrial evolution, and are becoming increasingly important in economic geography due to their significant implications for regional development and productivity. However, the twin transitions may lead to increasing spatial inequalities, and understanding their geographic distribution is a major challenge. To address this, a new framework is proposed to identify local diversification opportunities in green and digital sectors

using firm microdata and a novel measure of relatedness. This framework uses an innovative Real-Time Industry Classification (RTIC) system to capture the evolving landscape of these sectors, and analyzes spatial inequalities to inform place-specific strategies that can reap the benefits of the twin transitions in different regions. The key results of this analysis indicate that:

- Enhancing twin-relatedness can foster both green and digital specialization
- Investing in middle-skills development and local knowledge multipliers is crucial
- For lagging regions local and regional collaboration is essential for progress in these transformations

In conclusion, innovation is essential to ensure economic development, cohesion, and resilience in EU regions. Regional disparities and the diverging growth patterns in Europe, exacerbated by the digital and green transitions, necessitate:

1. Acknowledging regional differences: EU regions face distinct challenges
2. Mitigating negative effects of green and digital transitions: Policy support should focus on enhancing readiness in less developed areas
3. Tailored innovation approaches: Novel, region-specific strategies are necessary
4. Optimizing innovation capabilities: Combining Learning by Doing, Using, Interacting- (DUI) and Science, Technology, Innovation- (STI) mode is key for underperforming regions

## Session 1: Innovation modes from a spatial perspective

### Measuring non R&D-drivers of innovation: The case of SMEs in lagging regions

In their research, Dr. Jörg Thomä and Leonie Reher from the Institute for Small Business Economics examine the innovation modes of small and medium-sized enterprises (SMEs) in lagging regions, with a particular focus on the DUI mode of innovation. This framework contrasts with the more traditional STI mode, which emphasizes formal research and development. By empirically testing the comprehensive framework of DUI indicators developed by Alhusen et al. (2021), the study aims to assess the predictive power with respect to innovation outcomes in SMEs. This framework provides a detailed conceptualization of DUI dimensions, with 47 indicators grouped into three primary dimensions: DUI Internal, which focuses on internal processes and capabilities within firms; DUI Using, which involves the use of existing knowledge and resources; and DUI External, which pertains to interactions with external entities such as customers, suppliers, and competitors.

The study outlines two primary research questions: Can the DUI indicators predict innovation outcomes in SMEs, and which indicators should be included in a concise DUI measurement scale for surveys? To address these questions, the researchers conducted a quantitative online survey, targeting

SMEs in Germany. The first sample consisted of 400 SMEs nationwide, while the second sample focused on 530 SMEs specifically located in ten lagging regions. To assess the predictive power of the DUI indicators, a lasso regression was used to effectively handle the large set of ordinal variables while reducing dimensionality. To reduce the number of indicators, a Confirmatory and Exploratory Factor Analysis aimed to identify underlying constructs related to DUI dimensions, and Ant Colony Optimization was used to develop short scales for DUI measurement (DUI-10, DUI-15, DUI-20), optimizing model fit and reliability.

The study confirms the effectiveness of Alhusen et al.'s (2021) indicator set for quantitative innovation measurement. The findings indicate that the DUI mode is more productive in lagging regions and includes various elements beyond external actor interactions, regardless of context. In particular, internal DUI factors were consistently selected as significant predictors of innovation outcomes, especially in lagging regions. This suggests that SMEs in these regions rely more heavily on internal processes for innovation, compensating for limited external resources by enhancing their internal capabilities. In addition, the research successfully proposes short scales for measuring DUI indicators, which can facilitate future quantitative surveys while balancing the need for comprehensive coverage with practical constraints. However, the short scale still requires further research in order to be widely applicable.

The results have significant implications for both policymaking and future academic research. Policy makers are encouraged to consider the importance of internal DUI factors when designing innovation policies, which could help address regional disparities by fostering local capabilities. Further empirical studies are needed to validate the proposed short scales and explore their applicability across different contexts. In addition, a better understanding of how internal processes can compensate for external constraints is crucial. Ultimately, the research contributes to a deeper understanding of the DUI mode of innovation, enables its quantitative measurability, and paves the way for future studies to validate and refine the proposed short scales for measuring DUI indicators.

### [Innovation modes and knowledge interactions: a micro-geographic approach.](#)

The study, presented by David Doloreux from HEC Montréal, addresses a significant gap in innovation research by examining the geography of knowledge exchange across two distinct “ideal types” of learning: Scientific and Technology-based Innovation (STI) and DUI. This research highlights the importance of understanding the spatial dynamics of knowledge exchange in shaping innovation outcomes.



The primary objective of the study is to explore the factors and antecedents that shape the geography of different types of knowledge exchange at both macro-geographic (regional, national, international) and micro-geographic (neighborhood) scales, with a particular focus on the different modes of knowledge exchange. This approach is grounded in the recognition that a micro-geographic perspective is crucial for several reasons. Firstly, clusters and productive systems can be organized at the micro level within metropolitan areas, facilitating localized innovation ecosystems. In addition, micro-geographic proximity has been shown to enhance inter-organizational knowledge transfer, while actors' external relations often exhibit a very local specificity, thereby promoting community-based learning and innovation. In particular, the benefits of agglomeration economies tend to extend only marginally beyond a 5 km radius.

Building on this theoretical foundation, the study posits four key hypotheses. First, it is proposed that firms oriented towards STI or DUI will exhibit distinct geographical patterns of knowledge interactions (mode-specific geography). Second, the study suggests that geographical patterns of interaction depend on the type of knowledge being exchanged (scientific or practical), regardless of the firm's orientation towards STI or DUI (knowledge-type contingency). Two additional hypotheses extend this logic to the realm of innovation strategies, positing that firms adopting different innovation strategies will exhibit distinct geographical patterns of knowledge interactions (innovation strategy-specific geography), and that these patterns are again contingent on the type of knowledge being exchanged (knowledge-type contingency, innovation strategy).

To test these hypotheses, the researchers employed a mixed-methods approach, combining an original firm-level survey conducted in Montreal in 2022 (capturing innovation activity and knowledge exchange) with 75 semi-structured interviews in different neighborhoods (providing contextual insights). The data was subsequently analyzed using an ordered logit model, to examine the perceived importance of different geographic scales for scientific and practical knowledge sourcing, while controlling for location, size, and sector.

The main findings suggest that both external scientific and practical knowledge are sought at different geographical scales, regardless of the innovation mode adopted by firms. Furthermore, a distinct geography of knowledge salience emerges that differs by organizational learning mode, but not by type of knowledge exchanged. Significant associations are observed between knowledge exchange at different scales and firms engaged in STI (internal and external) and external DUI modes, as well as between process innovations (new-to-firm and new-to-market) and knowledge exchange across multiple scales. Interestingly, the local neighborhood does not stand out as a uniquely important scale, but rather is considered important in combination with broader scales, highlighting an overlap and underscoring the interconnectedness between modes.

This study challenges prevailing assumptions in the literature on innovation modes, particularly regarding the transmissibility of scientific knowledge over distance. By highlighting the limitations of a simple local/non-local dichotomy, the research emphasizes the need to consider the interconnectedness between modes, ultimately contributing to a more nuanced understanding of the complex relationship between innovation, knowledge exchange, and geographic scale.

### Session Discussion: Innovation modes from a spatial perspective

The subsequent discussion is led by Oliver Som from MCI Innsbruck, who highlights four points:

- Recent studies have shed light on the complexity of innovation and highlighted the importance of non-R&D modes, in particular the DUI approach. A key contribution of this research lies in its empirical examination of scale in practice, moving beyond the traditional R&D-centric perspective. However, this raises an intriguing question: Is DUI merely synonymous with non-R&D, or do these concepts encompass distinct practices? In particular, DUI encompasses a wide range of practices, some of which may also be part of non-R&D activities, while R&D may represent a more formalized aspect of innovation.
- Rather than perpetuating a dichotomous split between STI and DUI, it is important to recognize them as two equally important and complementary dimensions of innovation. This nuanced understanding prompts further inquiry: How do SMEs in developed regions navigate the choice between STI and DUI, and is this decision indeed a rational, strategic one, driven by market pressures and the need to balance investments? Empirical evidence suggests that SMEs rarely rely solely on STI, underscoring the need to explore how firms balance these approaches.
- A pertinent question is the appropriateness of targeting DUI in innovation policy. The primary rationale behind such policies is to incentivize companies to take actions that they would otherwise refrain from due to high risk or uncertainty. However, given the apparent effectiveness of DUI modes in certain contexts, it is legitimate to ask: Is policy intervention truly necessary in this domain?
- While the current research effort is commendable in its pursuit of understanding the evolution of innovation modes, several avenues for future exploration emerge. First, the distinction between internal and external components of DUI warrants further development, potentially revealing the leader's role in repeating practices and driving innovation. Moreover, recognizing the overlap between STI and DUI, especially in industries such as chemicals where scientific products are developed through tacit learning processes, may provide a more realistic understanding of innovation dynamics.

To sum up, the discussion underscores the complexity of innovation modes and emphasizes the need to recognize both STI and DUI as complementary dimensions of innovation. Finally, further research is needed to explore the nuances of DUI, its relationship with STI, and the role of policy interventions in supporting innovation, particularly in the context of SMEs.

## Session 2

### The regional context of innovation processes of SMEs in lagging regions: empirical evidence and implications for innovation policy

The recent study conducted by Rolf Sternberg, Christoph Friedrich, and Anne-Sophie Kagel from the Institute of Economic and Cultural Geography at Leibniz University Hannover sheds light on the innovation processes of SMEs in lagging regions. The research, which is part of the joint DUI.REG project of the Universities of Göttingen, Jena, and Hannover and funded by the Federal Ministry of Education and Research from 2022 to 2025, aims to provide empirical evidence and explanations for innovation intensity and behavior in structurally weak German regions, with a particular focus on the DUI mode of innovation.

The study addresses two primary research questions: the relevance of different DUI learning dimensions in SMEs and the impact of regional context on DUI innovation. To investigate these questions, the researchers conducted 209 qualitative interviews in 12 German regions, including 10 structurally weak regions and two strong reference regions. The main findings reveal that in structurally weak regions, innovations based on the DUI innovation mode are generally more frequent and more important for SMEs than STI innovations. In particular, the differences were more pronounced for the "doing" and "internal interacting" dimensions than for the "using" dimension, while no such differences were found for the external dimension. The spatial context was found to have a stronger influence on DUI innovations in structurally weak regions compared to STI innovations, although negative effects were more frequent for DUI innovations. Furthermore, the study uncovers regional differences in DUI innovation patterns, with DUI learning dimensions being more prevalent in weak West German regions compared to East German ones. In addition, rural regions demonstrate comparative advantages in the "doing and internal interacting" learning dimension compared to urban regions.

The researchers identified several core mechanisms behind regional context effects on different aspects of DUI learning. For example, the availability of local customers and value-added networks, as well as the infrastructure to reach these customers, play a crucial role in "learning by using". The presence of clusters, local network organizations, and cultural-cognitive institutions influence

"learning by external interacting", while the region's cultural readiness for innovation and the availability and embeddedness of skilled labor affect "learning by doing and internal interaction".

The study highlights significant differences between East and West German regions, as well as between urban and rural areas, in terms of the impact of regional context on DUI innovations. Western regions show greater heterogeneity in context effects, while urban regions predominantly exhibit strong positive effects compared to rural areas, which more often display strong negative or no context effects. Based on these findings, the researchers propose six key takeaways for regional innovation policies:

1. Supporting DUI innovations in structurally weak regions is crucial for promoting an equalization-oriented regional policy.
2. Since east-west differences in DUI learning are more relevant than urban-rural differences eastern Germany should be focused.
3. Strengthening the comparative advantage of learning by external interacting is crucial in lagging regions.
4. Since urban-rural differences are more relevant for context effects, on structurally weak rural regions across Germany should be focused.
5. It is crucial to recognize the strong influence of spatial context on DUI innovation in lagging regions and the potential for high-impact innovation policies.
6. Innovation policies should be tailored to the type of structural weakness rather than the settlement structure, acknowledging that not all rural regions are structurally weak and not all urban regions are strong.

In summary, the study uncovers significant regional differences in innovation patterns and showed how spatial context influences different dimensions of learning, with notable differences between West and East German regions as well as between urban and rural areas. This more nuanced understanding of the heterogeneity among structurally weak regions has important implications for policymakers seeking to foster innovation and economic development in lagging regions through more targeted policies.

### The DUI mode of innovation: Past – Present – Future

Professor Bjørn T. Asheim from the University of Stavanger provides a comprehensive overview of the DUI concept in innovation studies and his research in this area. The DUI-concept emerged from research in the 1980s and was formally introduced by Jensen et al. (2007). The DUI mode of innovation is one of three primary modes, along with STI and a combined STI/DUI approach. These innovation modes are used in different industries depending on the desired outcome, with the DUI mode

increasingly used in application development, while the STI mode remains the primary focus in the development of new technologies.

In conjunction with the analysis of these modes of innovation, a research project in Norway aimed to promote learning work organizations and encourage bottom-up, experience-based strategies for innovation in firms and regional networks. Traditionally, the focus in innovation research has been on research and development (R&D) expenditures, resulting in the overlooking of many innovations that could be classified as such. To address this issue, the concept of non-R&D expenditures has evolved to capture aspects of the DUI mode of innovation. Firms innovate differently due to their different underlying knowledge bases, which can be categorized into analytical (science-based), synthetic (engineering-based), and symbolic (art-based) knowledge bases. The analytical knowledge base relies on scientific laws to develop "know why," while the synthetic knowledge base focuses on "know how" by applying or combining existing knowledge in new ways. The symbolic knowledge base creates meaning and emphasizes knowing who. The synthetic knowledge base encompasses both application and technology research, corresponding to the "doing" aspect of DUI. Hence, depending on the type of knowledge available, firms innovate differently.

An empirical study of a manufacturing cluster in northwest Norway, focusing on the maritime industry in Sunnmøre, used a path tracing methodology with interviews conducted at three different points in time: 2014, 2019, and 2021. These interviews involved a range of stakeholders, including companies, local and regional government representatives, intermediaries, and higher education institutions. The study revealed two contrasting perspectives within the industry: the traditional perspective and the progressive perspective. The traditional view emphasizes a business-oriented approach, with price and cost as the primary drivers, and advocates outsourcing low-skill, labor-intensive activities within global production networks. This view argues that oil and gas will continue to be critical in the future and views sustainability primarily in terms of increasing fuel efficiency. In contrast, the progressive perspective takes a broader societal view, considering environmental and social impacts as well as supply chain security. It argues for regional value chains and insourcing to build competence, suggesting that producing steel structures regionally could significantly reduce CO<sub>2</sub> emissions compared to purchasing from distant sources.

The emergence of these perspectives can be attributed to specific events and market conditions. The traditional perspective emerged primarily in response to disappointing financial returns from diversification efforts following the oil price crisis. Companies had invested heavily in new markets but struggled with profitability due to high costs and limited experience. The progressive perspective has its roots in pre-2014 investments in automation, which were made in response to difficulties in recruiting skilled foreign workers. After the crisis, some actors involved in automation efforts became active in new business ventures and cluster organizations, focusing on cross-industry technological

cooperation. By 2021/2022, the progressive perspective had evolved into a more clearly articulated vision, with some actors investing in new facilities using automated production processes (Industry 4.0) and successfully delivering orders outside the maritime industry. This study highlights that, unlike many industries where production is at the end of the innovation process, engineering and manufacturing are integrated into the innovation processes in the maritime industry. The absence of manufacturing can lead to reduced innovation, highlighting the importance of proximity between companies and suppliers in a value chain. In addition, the global dispersion of production and knowledge can hinder new combinations and technological progress.

Looking ahead, the importance of physical infrastructure in our digital economy is often overlooked, despite its critical role in supporting digital and AI technologies. Recent events, such as the flooding in North Carolina that affected high-purity quartz mining, have highlighted the fragility of our economic foundations. This underlines the continued and increasing importance of manufacturing and mining in a sustainable transition, potentially giving Europe's manufacturing-based economy a competitive edge. As synthetic, engineering-based knowledge remains vital in manufacturing industries, the DUI mode of innovation will continue to play a key role in the future, particularly in peripheral regions where much of the manufacturing sector is located.

### Session Discussion: The regional context specificity of DUI innovation

The discussion, led by Tom Brökel from University of Stavanger, explores the complex relationship of DUI and STI, highlighting that the distinction between the two is not so clear cut. Instead, they are seen as two ends of a continuum, with many industries and firms exhibiting characteristics of both. The most effective approaches often combine elements of both DUI and STI, so it is important to consider the nature of the industries involved, whether they are high value-added or low value-added. This distinction is crucial, as policies to support innovation may differ significantly depending on the industry in question. For example, if the industries in question are low value-added, it's worth considering whether regional development initiatives are truly effective in promoting economic growth by funding these industries.

The context-specific nature of DUI is another critical aspect to consider as the economy continues to evolve and a focus on specific industries or technologies may be outdated. Instead, it is important to prioritize the development of new, innovative solutions that can drive growth and competitiveness. However, it is also important to distinguish between truly innovative approaches and mere adaptations of existing technologies, as innovation support policies may need to be tailored to these different scenarios.

Geographic proximity also plays a significant role in the discussion surrounding DUI and STI. While it is often assumed that DUI is more pronounced in rural areas, where access to STI may be limited, the reality is more nuanced. In fact, many urban areas exhibit strong characteristics of DUI, particularly in industries where digitalization has enabled the decentralization of production. For example, a company may design and develop products in an urban hub, while the actual manufacturing takes place in a rural area or even overseas.

The classification of certain industries, such as software development, also raises interesting questions. While some may view software development as a prime example of STI, others argue that it is actually a classic example of DUI. In practice, software development often involves a high degree of interaction and collaboration, which are hallmarks of DUI. However, when broken down into its constituent parts, software development can also exhibit characteristics of STI, particularly in terms of the scientific and technological expertise required.

In conclusion, this ambiguity, as well as the geographical division of development and production, and the context specificities highlight the need for a more nuanced understanding of the relationship between DUI and STI, and how they can be leveraged to drive innovation and economic growth in different contexts. By recognizing these relevant factors, policymakers and practitioners can work toward a more effective and sustainable approach to promoting economic growth and competitiveness.

## Session 3: Implications for structural policy

### Policy selection & R&D additionality

The study by Martina Buratti, Uwe Cantner, and Tobias Hädrich from Friedrich Schiller University Jena addresses two research questions: how to promote innovation in structurally weak regions through ex-ante policy selection of actors and modes of innovation, and how to assess the ex-post preliminary impact of firms accepted for funding.

There is an increasing interest in supporting SMEs, especially in economically disadvantaged regions, in order to promote economic growth and development in these regions (Bernini & Pellegrini, 2011; Alecke et al., 2021). In Germany, several funding programs exist, but it has not yet been addressed which actors and types of innovation have been selected. Therefore, the study examines two German funding programs: WIR! ("Change through innovation in the region") and RUBIN (Regional entrepreneurial consortia for innovation). These programs aim to strengthen regional innovation capacity and foster innovation-based structural change in economically disadvantaged areas. The researchers analyze the selection criteria used by policymakers to choose actors for funding within these innovation policy programs. They consider various criteria that could underlie the selection

process, including "picking-the-winners" (selecting applicants with proven economic or innovative performance), marginal actors (those with low private returns but high social returns), best ideas/applications, innovation modes (with or without formal R&D), and random selection. The study uses data from funding applications, including both funded and rejected project proposals, and combines it with information from the Mannheim Innovation Panel.

The researchers employed a conceptual framework that distinguishes between two modes of innovation: STI and DUI. For the analysis, the researchers used random effects panel probit regression for the firm-specific analysis and probit regression for application-specific analysis. The dependent variable is acceptance in the concept phase, while independent variables include productivity, innovation performance, innovation modes, and various quality indicators derived from the program guidelines. The results of the company-specific analysis show that most of the criteria do not have a systematic influence on the probability of funding. However, there is evidence of "picking-the-winners" based on innovation in RUBIN and productivity in WIR!. The study finds no systematic selection of marginal companies or preference for certain types of innovation, except for intensive STI. Larger consortia are systematically selected in both programs. The sketch analysis shows that both programs evaluate and select applications on the basis of quality criteria aligned with their respective program objectives. For WIR!, innovation is particularly important, while RUBIN emphasizes external structures and the entrepreneurial skills of researchers. In addition, the researchers have conducted a preliminary impact analysis of the WIR! program (Round 1) using propensity score matching and difference-in-difference estimation. The analysis examines the impact on R&D expenditures and revenues. However, the researchers note that the short time span between the funding decision in 2019 and the observation of the variables of interest limits the analysis, particularly for the revenue outcomes. The preliminary results suggest a negative additionality effect on R&D expenditure in the post-implementation period, suggesting that the immediate increase in R&D due to the funding is reduced. The outcome analysis for revenues shows no significant impact overall, although there is a significant negative coefficient for the post-treatment interaction effect.

In conclusion, the study provides insights into the selection processes of innovation funding programs for structurally weak regions and offers preliminary findings on their impact. They show that ideas are mostly selected on the basis of defined quality criteria in the decision process. Regarding the impact analysis, more time is needed to make a statement about the impact.

### Regional Knowledge Infrastructure and Innovation in SMEs in Lagging Regions

The research, conducted by Christian Rammer, Jakob Ehlich, and Linus Strecke from ZEW, focuses on the impact of regional knowledge infrastructure (rKI) on innovation and productivity in SMEs, especially in Germany's lagging regions. It builds on and extends a previous study conducted by Meier



(2024). The study is motivated by the understanding that knowledge infrastructure, such as universities and research institutions, plays a crucial role in regional development. These institutions provide a skilled workforce, new research, and access to cutting-edge technology. The researchers hypothesize that such infrastructure could be particularly important for lagging regions, where other sources of knowledge may be scarce. The research aims to address several key questions, including whether the positive effects of rKI hold when more detailed and comprehensive data is used, whether the relationship is positive for lagging regions, and how proximity to rKI affects outcomes. In addition, the study seeks to understand whether the impact varies by field and type of institution, and how it differs along the "knowledge value chain" from R&D to innovation to productivity. Methodologically, the study employed a model similar to Meier's (2024) research, but with several enhancements. The researchers used data from the Mannheim Innovation Panel, covering 55,253 independent SMEs from 1994 to 2023. They also collected extensive data on universities and research institutes, including the number of graduates and scientific staff by field and type of institution.

The results of the study reveal several interesting patterns:

- Regional knowledge infrastructure is positively associated with firm R&D and innovation in firms, which appears to drive the positive effects on productivity found in Meier's 2024 study.
- The effects on R&D are stronger for scientists than for graduates, while the effects on innovation are similar for both sources of knowledge flow.
- The geographical impact of rKI is limited to a radius of 20km, which is about the average size of a district.
- Lagging regions benefit strongly from rKI, both in terms of R&D and innovation. However, peripheral regions do not seem to benefit at all, suggesting that the positive effect in lagging regions may be concentrated in central areas within these regions.
- The impact varies by field and type of institution. For example, natural sciences and medicine show strong positive effects on continuous R&D, while social sciences have a negative effect.

The researchers conclude with several policy implications, such as reconsidering the definition of lagging regions, possibly focusing more on geographic characteristics such as location centrality, accessibility, and density. It remains unclear how to promote innovation in peripheral regions, whether the focus should be on DUI infrastructure or rKI, and how to leverage rKI for productivity in areas with a DUI mode of innovation. Furthermore, the study acknowledges some limitations, including potential endogeneity issues and the use of binary measures for R&D and innovation. Some of these limitations are suggested to be addressed in future research, such as the inclusion of more regional controls and the use of quantitative measures of R&D and innovation output.

Overall, this research provides valuable insights into the complex relationship between regional knowledge infrastructure and SME innovation, particularly in lagging regions. It highlights the need for

nuanced policy approaches that take into account the specific characteristics and needs of different types of regions.

### Session Discussion: Implications for structural policy

The ensuing discussion, led by Dirk Fornahl from Office for Regional Development Braunschweig, includes several points specific to the conducted research. The main issues that emerge from the first study were related to the definition of "best ideas", in particular the relevance of objective criteria in recognizing and selecting these ideas. Concerns were raised about the potential bias of selecting the wrong stakeholders and defining criteria for the best story, implying that the selection criteria assess the quality of the proposal rather than the actual idea. Hence, the best writer would be rewarded. In addition, it was noted that the selection strategy works well when an idea is submitted by one company, but since consortia have entered the proposals the heterogeneity of the companies within a consortium might be a problem for the evaluation.

Meanwhile, the second study sparks a debate on the merits of including qualitative measures in the assessment of rKIs. Participants argue for analyzing the specific offerings and expertise of rKIs, emphasizing the importance of their content and contributions to companies beyond their immediate geographic proximity. However, this deeper level of scrutiny using data at finer granularity levels has the drawback that historical data may pose challenges due to lack of accessibility or matching issues, and additionally, a discipline split does not lead to a significant effect. Discussions also highlight the need to examine the impact of newly established institutions, to assess the influence of digital innovation on location dynamics, and to incorporate more geographical considerations into the indicators. With regard to geographical considerations, the 20 km threshold is discussed, suggesting that it may not be sufficient in peripheral regions. However, it is also noted, that SMEs do not travel. For this reason, a distance of 20 km appears to be a suitable threshold for measuring proximity effects. However, it's important to consider the varying scopes of research institutions, as some operate on a national level while others have a more regional focus.

In summary, several issues are identified for more in-depth data analysis. However, these investigations are often limited by the lack of availability of appropriate data to conduct such further in-depth analyses.

## Keynote: The DUI innovation mode in catching-up and developing countries and regions

The keynote by M. Davide Parrilli from Bournemouth University provides a nuanced exploration of the complex landscape of innovation modes in catching-up and developing countries and regions. Building on Lundvall's (2007) original framework of innovation modes, Parrilli's research explores the theoretical intersections of clusters, innovation systems, global value chains, and firm innovation modes, with a particular focus on SMEs in regional economic development. The study aims to shed light on the innovation landscape in catching-up countries and regions where the combination of STI and DUI modes is less understood. Previous research has shown that in advanced countries firms can effectively combine STI and DUI modes, while in catching-up countries and regions the innovation landscape is more complex and heterogeneous. Parrilli's earlier study identified a triple trajectory in emerging regions, where most firms are low learners producing no innovations, a large group of companies uses the DUI mode ineffectively, and a small group of firms uses the STI mode effectively. To further explore regional differences, a comparative regional analysis was conducted, highlighting various innovation patterns in different regions. For example, the Baltic countries, especially Estonia, emerged as a unique case due to significant R&D investments, while Central and Eastern European countries showed a lower impact of STI and DUI modes.

The study also examines the African and Chinese contexts, where there has been limited research on this topic. In Africa, most countries have a low to medium human capital index, and their industries are primarily focused on food and beverages, furniture and textiles, and leather products. Using data from the World Bank's Enterprise Survey, the study analyzed 43,141 firms in 30 African countries and found surprising results. Contrary to initial expectations, both the STI and DUI modes work effectively, with the STI mode proving to be more impactful than expected. The combination of STI and DUI modes is found to be the most effective, with no preponderance of effects on process versus product innovation. This suggests that African SMEs are caught in a technological swing, with large margins for improvement in the DUI mode and limited use of the STI mode in terms of the number of firms using this mode.

In contrast, China is no longer considered an emerging economy, with 1.5 million patent applications in 2020, accounting for 45% of the world total. A dataset collecting data at the regional level in China was used to test the DUI and STI variables in this country. The results show that the STI mode has a strong impact on product innovation but a weak impact on process innovation, while the DUI mode only has an impact on product innovation. Regions with the highest use of STI and DUI modes produce the highest impact on product innovation, with STI having a stronger impact than DUI.

The results of the study have significant implications for global considerations, highlighting the importance of context-specific innovation strategies. In leading and moderately innovative regions, the DUI mode is highly effective, often outperforming the STI mode in terms of impact. In catching-up or lagging contexts, however, a technological swing emerges, with the STI mode showing significantly greater impact than DUI. Surprisingly, in these contexts, product innovation may take precedence over process innovation, contrary to initial expectations. The presence of dual or triple innovation pathways calls for tailored policy approaches and business strategies that take into account the diversity of firms and industries in catching-up regions.

The research also highlights methodological implications, noting that current measures to identify DUI practices are limited. Despite these limitations, the study confirms the DUI mode as a viable alternative to the STI approach, with significant policy implications. For low-tech users, the primary goal should be to foster a new mindset through events and workshops that showcase different modes of innovation, especially low-cost ones, and their potential impact. For STI users and low-tech industries, policies should focus on highlighting diverse opportunities both inside and outside the firm, emphasizing their prospective impact to increase effectiveness. For STI users and high-tech industries, policies should highlight the potential benefits of incorporating DUI drivers and emphasize the value of broader employee involvement in the innovation process. This nuanced approach recognizes the different innovation landscapes in different contexts and aims to optimize innovation strategies for each segment.

Following the keynote, the audience revisited several key issues, including the limitations inherent in measuring DUI indicators. A critical point of discussion is the original definition of STI, which emphasizes the involvement of academics as a defining characteristic. However, it is acknowledged that not all interactions with universities can be categorically classified as STI. In some cases, such interactions may be more accurately described as external interactions, highlighting the need for a less decisive approach. In addition, the unexpected research findings on the importance of DUI outside Europe may be due to different understandings of the concept of innovation. For example, in countries such as China, where imitation is prevalent, the perception of what constitutes a novel innovation may differ. This discrepancy poses a challenge, especially when relying on self-reported data. The lack of objective data that comprehensively captures the extent of DUI exacerbates this problem. To address this limitation, a hybrid approach that integrates quantitative and qualitative survey methods can be used to provide a more robust and multifaceted understanding of DUI dynamics.

## Panel discussion: DUI as a policy target in lagging regions

The panel discussion on "DUI as a policy target in lagging regions" brings together experts from academia and government to explore the role of the DUI mode of innovation in regional development. The panel, moderated by Uwe Cantner from Friedrich Schiller University Jena, featured insights from Gisela Philipsenburg from the Federal Ministry of Education and Research, Friederike Welter from the IfM Bonn, Robert Hassink from the University of Kiel, and Hanna Hottenrott from the Technical University of Munich and the ZEW, Leibniz Center for European Economic Research.

To fully understand the concept of DUI as a policy objective, it's important to consider the broader context of innovation policy. In countries such as Germany, for example, social innovation and the STI and DUI modes of innovation are strongly emphasized. However, most research institutions tend to work with large companies, leaving SMEs in need of targeted support. The challenge is to effectively support innovation in SMEs, which operate differently from their larger counterparts. Research has shown that bottom-up approaches that empower individuals and organizations to generate ideas are the most effective way to foster innovation in SMEs in lagging regions. However, to identify and support the most promising concepts, it's critical to set clear goals and ensure that all strategies are aligned and coordinated. In addition, ongoing transformation processes, such as the green and digital transitions, have a profound impact on innovation and must be taken into account.

To foster innovation in lagging regions, it's important to have an open discussion about how regions can leverage their unique strengths and overlaps. SMEs are not the only drivers of innovation; the regional ecosystem and environment also play a crucial role. In fact, a single pioneering SME can often serve as a catalyst for regional transformation, raising questions about the optimal number of SMEs needed to trigger meaningful change and whether policy can stimulate the generation of more innovative ideas. However, developing effective policies to address DUI modes of innovation pose significant challenges due to their substantial overlap with everyday business operations. Policymakers face the complex dilemma of avoiding subsidizing routine business activities while recognizing the critical role of DUI in fostering innovation, particularly in lagging regions. The complexity of this challenge is further compounded by the potential for outsourcing of STI activities, which may blur the lines of classification. The central strategic question revolves around the use of DUI as a catalyst for regional transformation. Perspectives on this issue vary widely. Some experts argue that DUI does not require separate funding, viewing it as the starting point of a continuous spectrum with STI and suggesting that support should focus on firms that are transitioning to the STI mode. Alternatively, other researchers suggest that DUI should be more fully integrated into support systems, enabling firms to innovate based on a stronger starting point. Historical evidence, such as the development experience in East Germany, show that externally imposed development strategies often fail, with

endogenous growth models showing more promising outcomes. Ultimately, addressing regional innovation challenges requires a sophisticated approach that goes beyond simple financial interventions. While funding remains important, alternative strategies such as regional policy managers that fully understand and address the unique characteristics of DUI, its relationship to STI, and the specific contextual needs of lagging regions may be more effective.

Another key question in the debate is whether businesses have a better understanding of their own needs and priorities, or whether policymakers can provide more effective guidance. At present, there is a tendency to intervene frequently in companies, which may not always be beneficial. On the one hand, companies operating in less developed regions often lack the necessary resources, expertise and knowledge to effectively use scientific research and translate it into successful business outcomes. This is where business-based funding can play a critical role in bridging the gap. On the other hand, some argue that companies are in the best position to determine their own needs and priorities, since they are ultimately responsible for their own survival and success. From this perspective, businesses simply need a supportive environment in which to thrive, rather than direct intervention or guidance from policymakers. Science has yet to provide a clear answer to the question of how much innovation must come from within a company or region and how much can be stimulated from outside.

In conclusion, addressing the complex challenges of fostering innovation in lagging regions through DUI requires a nuanced and multifaceted approach that balances the needs of SMEs, regional ecosystems, and taxpayers, and recognizes the intricate relationships between STI, DUI, and everyday business operations.

## Conclusion

The closing remarks by Kilian Bizer synthesize the key takeaways from the research conference. Three main points emerge:

1. The need to move beyond a dichotomous view of DUI and STI towards a combinatorial approach.
2. The ongoing challenge of measuring DUI and the potential for this to inform policy approaches for regional development.
3. The complexity of crafting effective policies to support lagging regions, recognizing that while DUI is inherently present, its support must be carefully considered

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## Appendix: Conference Program

### Research Conference on "Doing, Using and Interacting – Innovation in lagging Regions"

**Date & Time:** Thursday, November 21, 2024 until Friday, November 22, 2024

**Venue:** Conference Center at the Historic Observatory of the University of Göttingen, Geismar Landstraße 11b, 37085 Göttingen

#### Program

##### Thursday, November 21, 2024

12:00 – 12:30    *Arrival and Registration*

12:30 – 13:15    *Lunch*

13:15 – 13:30    **Introductory words by the conference hosts**  
Kilian Bizer | Georg August University of Göttingen  
Rolf Sternberg | Leibniz University Hannover  
Uwe Cantner | Friedrich Schiller University Jena

13:30 – 14:30    **Keynote Lecture**  
*No place left behind - understanding innovation and industrial transitions in lagging regions*  
Raquel Ortega-Argilés | The University of Manchester

14:30 – 16:00    **Session 1: Innovation modes from a spatial perspective**  
*Measuring non-R&D drivers of innovation: The case of SMEs in lagging regions*  
Leonie Reher, Jörg Thomä | ifh Göttingen, Georg August University of Göttingen  
  
*Innovation modes and knowledge interactions: a micro-geographic approach*  
David Doloreux | HEC Montreal  
  
*Discussion*  
Oliver Som | MCI Innsbruck

16:00 – 16:30    *Coffee Break*

16:30 – 18:00    **Session 2: The regional context specificity of DUI innovation**  
*The regional context of innovation processes of SMEs in lagging regions: empirical evidence and implications for innovation policy*  
Rolf Sternberg, Christoph Friedrich, Anne-Sophie Kagel | University Hannover  
  
*The DUI mode of innovation: Past - Present – Future*  
Bjørn Asheim | University of Stavanger  
  
*Discussion*  
Tom Brökel | University of Stavanger



19:30      *Dinner at Restaurant Bullerjahn, Markt 9, 37073 Göttingen*

**Friday, November 22, 2024**

09:00 – 10:30	<b>Session 3: Implications for structural policy</b> <i>Policy selection &amp; R&amp;D additionality</i> Uwe Cantner, Tobias Hädrich, Martina Buratti   University Jena
	<i>Regional Knowledge Infrastructure and Innovation in SMEs in Lagging Regions</i> Christian Rammer   ZEW, Leibniz Centre for European Economic Research, Mannheim
	<i>Discussion</i> Dirk Fornahl   Amt für regionale Landesentwicklung Braunschweig
10:30 – 11:00	<i>Coffee Break</i>
11:00 – 12:00	<b>Keynote Lecture</b> <i>The DUI innovation mode in catching-up and developing countries and regions</i> Mario Davide Parrilli   Bournemouth University
12:00 – 12:45	<i>Lunch</i>
12:45 – 14:00	<b>Panel discussion: DUI as a policy target in lagging regions</b> Gisela Philipsenburg   Federal Ministry of Education and Research, Berlin Friederike Welter   IfM Bonn Robert Hassink   University of Kiel Hanna Hottenrott   Technical University of Munich; ZEW, Leibniz Centre for European Economic Research, Mannheim  Moderator: Uwe Cantner   Friedrich Schiller University Jena
14:00 – 15:00	<b>Closing remarks</b> Kilian Bizer   Georg August University of Göttingen
15:00	Farewell

**Arrival**

26 mins walk (12 mins by bus numbers 21 or 155) from the main train station

[GoogleMaps-Link](#)

**Wi-Fi**

eduroam or GuestOnCampus

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