An interactive big-data application “TechMeter® Regional Analyzer” is outlined in this paper. It supports development agencies and delivers live-dashboards with key metrics needed to develop high-impact action plans and to track the success of Smart Specialization initiatives.

Smart Specialization Strategies are key to foster Europe’s innovation strength. They are characterized by its regional technology focus and are conducted in a closed-loop process of (i) regional performance analysis (status quo and success tracking of implemented measures), (ii) assessment of peer-regions (global benchmark), (iii) SWOT analysis and action plan and (iv) implementation.

Live-dashboards of the TechMeter® Regional Analyzer support the first three process steps with easy-to-interpret, robust and current information.

1. Measurement of the Current Status

The first process step of smart specialization strategies is to measure the current performance of the innovation ecosystem of a region. Performance indicators may provide pure output-related metrics (such as patent applications or scientific publications per inhabitant) or even describe the regional mechanisms of the innovations (such as interdisciplinary networks or cross-regional connectivity from international cooperation). Five indicators are described that support the measurement of the current status of the innovation eco-system.

1.1 Dual Strength Analysis

The balance of industrial and academic research/education is essential for sustainable technology leadership of a region. Hence, the relative strength of the innovation output of industry and academia need to be measured and optimized. With the TechMeter® Regional Analyzer those two essential parameters - i.e. relative industrial innovation strength and relative academic strength - are compared in the dual strength analysis.

Figure 1.1: Dual Strength Analysis for a region

1.2 Innovation Output Benchmark

The innovation output ranking for defined technology areas and regions is derived from inventor density and the patent density. It is recorded over time to show up trends.

Figure 1.2: Benchmark Analysis of a region for a technology area

From the periodical analysis, trends in the relative performance of a region can be depicted. Importantly, this benchmark is scaled by the size of the region, performing a ranking of patent densities (patents per inhabitant). Further, characteristic patent intensities of topics (some technologies are patented more intensively than others) are not effecting the result of the ranking, because each benchmark compares the patent densities in particular technology for each year and every region.

Therefore the indicator is independent on the patent intensity characteristic of the technology and takes the size (i.e. the population) of the regions into account.

1.3 Connectivity of Technology-Areas

Technology diffusion is a key characteristic of innovation. New solutions are very often achieved through combinations of certain technologies. This mechanism of “innovation through combination” can be visualized in technology networks. Essentially, all technologies in scope are plotted in a network graph and all patents in either of the class are analyzed for their multiple association to technologies. Whenever a patent is allocated to more than one technology (“interdisciplinary patents”), a line between those technologies is drawn in the graph. The higher the number of interdisciplinary patents, the thicker the connecting line (edge between connected technology nodes).
The local connectivity of technologies, combined by inventors in a target region, is derived. It shows the current status of regional inter-disciplinary innovations.

![Global Technology Network](image)

**Figure 1.3: Global Technology Network**

1.4. Inter-regional Connectivity

The interdisciplinary character of innovations is not the only network aspect which can be evaluated. Also geographical data is highly interlinked. Not only is the place of innovation very often different to the place of commercialization, but also the location distribution of inventors is a relevant information to gain understanding in the relative performance of regions and – even more important – about the characteristic mechanisms, whether research is conducted locally or in inter-regional networks.

A visualization for the co-inventor network in a certain technology area across Europe is shown. As a regional granularity NUTS-2 regions are used.

![Inter-regional Connectivity of Co-Inventors](image)

**Figure 1.4: Inter-regional Connectivity of Co-Inventors**

Each inventor is allocated to the NUTS-2 region of his residence and the co-inventors of patents are connected by lines. The higher the regional-interconnectivity of one region, the more lines are sourced from the region.

1.5 Worldwide Innovation Hubs

Not only for NUTS-2 regions, but also for all countries worldwide, the patent- and inventor densities are determined. In a corresponding chart the worldwide distribution of patents in technologies of focus are plotted.

![Worldwide Innovation Hubs](image)

**Figure 1.5: Worldwide Innovation Hubs**

2. Real-time assessment of peer-regions

From the five information elements, (1) Dual Strength Analysis, (2) Innovation Output Benchmark, (3) Connectivity of Technology Areas, (4) Inter-Regional Connectivity and (5) Worldwide Innovation Hubs, performance indicators can be derived and integrated in the process control loop. The efficiency of improvement actions can be measures. Beyond the performance tracking, also valuable qualitative information to generate specific improvement measures is obtained from the evaluations.

The information elements are updated periodically. Therefore, a continuous feedback loop is established and supports the second step of smart specialization strategies (assessment of peer-regions and global benchmarks).

2.1 Dual Strength Analysis

Both dimensions of the dual strength analysis are easy to interpret and include a benchmark to the global average with a quantitative factor of the regions over- or underperformance in the relative strength of industry and academia. Beyond that, also the top-regions in Europe are listed to serve as an additional benchmark.

Hence, the dual strength analysis provides goes beyond mere measurement of the current status. It serves as a robust benchmark indicator of relative strength industry and academia and gives insight in the position versus the global average as well as it links to the most innovative regions in Europe.

Changes in the relative strength of academia and industry show the progress in setting research priorities or in attracting innovative companies in the particular technology.
2.2 Innovation Output Benchmark

The innovation output benchmark is directly comparing the patent densities of all NUTS-2 regions. Therefore, it immediately serves as a benchmark indicator for the focus region.

As an additional orientation, the top-regions in terms of patent densities are listed for the last period. Links to the interactive map of Europe (“Inter-regional Connectivity”) enable the reader to learn more about the metrics and mechanisms of the innovation eco-system of top-regions.

2.3 Connectivity of Technology-Areas

The connectivity of technologies is determined for all patents globally and for the focus region.

In present (regional) context, the direct comparison of global and local connectivity indicates the potential for inter-disciplinary innovations.

2.4. Inter-regional Connectivity

Comparing the links between regions from distant co-inventors shows a wide spread in the level of inter-regional cooperation from co-inventor distribution.

This information is useful to understand the relative cooperation intensity of the particular region in comparison to all other NUTS-2 regions.

2.5 Worldwide Innovation Hubs

As an additional information – beyond the focused evaluations for Europe’s NUTS-2 regions, also the distribution of patents worldwide on continental and national level are shown to identify the most active innovation hubs worldwide and to compare the local output accordingly.

3. Specific Improvement Measures

Beyond analysis of the status quo and benchmarks with other regions, all information elements derived also provide valuable input to develop strategic action plans to improve the regions innovation eco-systems. They directly contribute to the SWOT analysis in the course of the process.

3.1 Dual Strength Analysis

By comparing the relative academic strength with the relative industry strength, possible imbalances of the academic and industrial sector become transparent. In case a technology is strongly represented by industry whilst academia is not prioritizing particular technology, a strategy to foster academic research in this field is recommended.

In the opposite case, when academia has a high relative strength and industry is not present in particular topic, this information may be used as an argument to attract technology companies in particular technology.

Hence, the dual strength analysis serves to measure the balance of industrial and academic strength and thereby suggests enhancements for smart specialization strategies.

3.2 Innovation Output Benchmark

Due to the periodical analysis, trends in the relative performance of a region are made transparent and show the evolution of patent output relative to peer regions. Corrective measures can be derived based on deviations from intended changes in the regions ranking relative to others.

The changes in the innovation output benchmark as well as the knowledge about currently leading regions provides feedback on the wealth of the local innovation eco-system in creating patent output.

3.3 Connectivity of Technology-Areas

From the comparison of global and regional technology connectivity, valuable information can be depicted. Promising new inter-disciplinary cooperations become transparent and can be stimulated as part of the action plan.

As technology diffusion changes globally over time, permanently updated technology networks provide new opportunities. Whether present locally or integrated in cross-border cooperation, know-how of different technologies may be connected to yield innovation through combination.

3.4. Inter-regional Connectivity

For regions with under-proportional cooperation intensity, a recommendable strategy is to foster cooperation with other regions (and thereby take part of essential know-how exchange). From the evaluation of the inter-regional connectivity, specific opportunities can be derived and often yield in strengthening the co-work of innovators in different regions. Not only this reflects the European spirit, but also it catalyzes the generation of new ideas from cross-fertilization.

3.5 Worldwide Innovation Hubs

Periodically updated distributions of the patent output on national and continental level ensure that the global picture is not overlooked. The relative position – which also reflects future global competitiveness – is depicted. Potential threats from upcoming regions serve as an important indicator in the regions SWOT analysis.

The TechMeter® Regional Analyzer is optimized to support Development Agencies continuously to identify opportunities for smart specialization strategies and to track the success of the measures taken.

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