CHAPTER 8

Measuring National Innovation Performance: The Case of Austria

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Innovation performance has become increasingly important for governments as they search for ways to stimulate the economy and to address pressing societal challenges (Androsch & Gadner 2015). Thus, in recent years, a variety of innovation performance rankings have been applied to measure performance levels in relation to other countries. These are, thus, closely watched by policy makers and are frequently perceived as a neutral gauge of a country's innovation performance (Schibany & Streicher 2008). However, standard rankings such as the European Innovation Scoreboard (EIS) or the Global Innovation Index (GII) in general apply a standardised set of indicators to all countries ranked without regard of country-specific weaknesses or strengths. For example, the Austrian government has been using the benchmark defined by the EIS to compare the Austrian innovation performance in relation to leading countries in Europe. Yet, the EIS should not be regarded as the only way of assessing the effects of innovation efforts due to evident and well-known shortcomings (for example Edquist et al. 2018; Janger et al. 2017).[1]

In this chapter, we sketch the framework applied by the Austrian Council for Research and Technology Development – the central advisory body of the Austrian Government for education, science, research and innovation policy affairs – for measuring and evaluating the performance of Austria's national innovation system in international comparison. The chapter aims to present an overview of the development of the framework in cooperation with the Austrian Institute of Economic Research and in accordance with the responsible ministries. The chapter also intends to describe its application in the context of the Council's annual reports on Austria's scientific and technological capability.

The applied measurement framework for innovation performance takes into account country-specific conditions and provides information on both the current distance to strategic benchmarks as well as information on the distance to the benchmark at a given time horizon, based on extrapolating past growth trends. A matrix composed of the juxtaposition of current and future distance to targets provides information to guide the setting of policy priorities, in terms of a measure of the effort required to reach targets (or the likelihood of reaching them). Using this approach, the Austrian Council has been providing a sound source of evidence for international comparison of Austria's innovation performance which supports evidence-based policy-making.

Note: A similar version of this chapter will also be published in the July 2020 issue of the fteval Journal for Research and Technology Policy Evaluation.

1 For example, it underestimates the effects of innovation activities because it does not include indicators for improvement in the existing sectors, for example intra-sectoral structural change or sectoral upgrading; see also the more detailed explanations further below in this chapter. The EIS also aggregates input and output indicators, so that ample inputs can compensate for weak outputs.

Towards a framework to measure innovation performance

On 31 August 2009, the Austrian cabinet ministers agreed to set up an interdepartmental working group to devise a strategy for research, technology and innovation (RTI strategy). The aim was to define strategic goals and measures for Austrian RTI policy for the period up to 2020. The RTI strategy, with the title *Becoming an Innovation Leader,* was adopted in March 2011. In its title, the document reflects the priority goal to be reached by 2020.[2] The government has commissioned the Austrian Council for Research and Technology Development with the task of measuring the progress of the implementation of the strategy and monitoring Austria's performance in RTI compared to that of the leading countries in Europe and the world. Since then, the council has been drawing up a yearly *Report on Austria's Scientific and Technological Capability*,[3] to present the main findings of its monitoring activities. The first report was presented in June 2012.

The reports apply a framework to measure innovation performance that relies upon a thorough analysis of the RTI system, strategic goals set by the government and standardised indicators to operationalise target achievement. Thus, in a first step, a detailed country-specific analysis of strengths and weaknesses of Austria's innovation performance was conducted, which was intended as groundwork for the subsequent definition of strategic goals compiled in a comprehensive RTI strategy. This multi-year process of discussions and analyses consisted of three pillars:

1. The *Austrian Research Dialogue*[4] (2007–2008) (Ministry of Science and Research 2008) was designed to be a broad, nationwide process of discourse and consultations with Austrian stakeholders for the purpose of further developing the innovation system and our knowledge-based society.
2. The evaluation of Austrian research funding[5] (Ministry of Transport, Technology and Innovation 2009) provided a profound assessment of the entire system, along with recommendations for improvement by experts.
3. The Council for Research and Technology Development (2009) discussed evidence-based strategic proposals and recommendations for further development of the Austrian research and innovation system.[6]

Based upon the results of these analytical processes, strategic goals for improving the Austrian innovation system were adopted in the aforementioned RTI strategy. In a next step, a set of crucial performance areas to be monitored by indicators had to be defined. Basically, the size of this set could be unlimited, but an analysis focusing on weaknesses or bottlenecks would address only a restricted number of specific performance areas. Then target values were set for each performance area. Some of

2 Austrian Federal Government (2011): Becoming an Innovation Leader. Strategy for research, technology and innovation. Vienna, MEV-Verlag publishers. The priority goal of the strategy to become an Innovation Leader by 2020 is informed by the European Innovation Scoreboard (EIS). As a Strong Innovator, Austria currently ranks among the top 10 member states of the European Union. Austria's score amounted to 120 points according to EIS 2018, while the group of Innovation Leaders reached an average score of 135. For details see https://ec.europa.eu/growth/industry/innovation/facts-figures/scoreboards_en

3 All reports can be downloaded from https://www.rat-fte.at/performance-reports.html

4 The Research Dialogue was initiated by the Ministry of Science and Research. A synopsis (in German) can be downloaded here: https://bmbwf.gv.at/forschung/national/standortpolitik-fuer-wissenschaft-forschung/oesterreichischer-forschungsdialog/

5 The 'Evaluation of Government Funding in RTDI from a Systems Perspective in Austria' was commissioned by the Ministry of Transport, Technology and Innovation. The Synthesis Report (in English) can be downloaded here: https://www.bmvit.gv.at/service/publikationen/innovation/forschungspolitik/downloads/systemevaluierung/synthesis_report.pdf

6 The *Strategy 2020* was elaborated by the Austrian Council with the support of a Web-based discussion platform in order to deepen and intensify the process through virtual interaction with all relevant stakeholders and the RTI community. For the community-based innovation approach for strategy development see Gadner & Leo (2010). The *Strategy 2020* (in English) can be downloaded here: https://www.rat-fte.at/strategy-2020.html

them were derived directly from the RTI strategy, for example, the goal to reach a research and development (R&D) quota of 3.76% by 2020. Others were constructed from the average values of the group of Innovation Leaders (according to the EIS at which the RTI strategy is oriented).[7] In fact, any target value can be used; while an absolute value will be static, the average of a number of freely chosen peer countries will be dynamic in the sense that the target value changes according to the performance of the peer countries. This is similar to standardised rankings, with the exception that for our tailor-made approach, peer countries can be chosen freely, presumably from a set of countries whose structures and performances are not too different from the country to be monitored.

Once performance areas and target values were set, appropriate indicators had to be selected, in terms of relevance and reliability, but also data availability. For the purpose of measuring Austria's innovation performance, a set of 75 indicators were developed in cooperation with the Austrian Institute of Economic Research and discussed with the responsible ministries.[8] The selected indicators are based on internationally used classifications of the OECD, Eurostat and others, and corresponding data portfolios. These are accessible to the public and are collected on a regular basis on a national as well as on an international level.[9] Every indicator corresponds to a strategic target of the RTI strategy to operationalise goal achievement.[10]

For the development of the set, it was important to focus on indicators suitable for better representing the conditions of the Austrian RTI system than, for example, those used by the EIS or other standardised rankings. This was deemed to be important by the Council since the EIS strongly focuses on inter-sectoral structural change and captures the economic effects of innovation mainly by the growth of high-tech sectors; in contrast to this, the EIS underestimates effects of innovation activities on medium-tech-sectors, as intra-sectoral upgrading – improving innovation within a sector, rather than growing the share of innovation-intensive sectors – is seldom captured (Janger et al. 2017).

In fact, the EIS does not show sensible indicators for improvement across all existing sectors, for example intra-sectoral structural change or sectoral upgrading in less R&D-intensive sectors such as steel or automobile parts. Austria performs very well in less R&D-intensive sectors, which is why a picture that does not take this aspect into account is somewhat incomplete. Moreover, the respective EIS indicators are based on the *Community Innovation Survey* (CIS).[11] As the CIS indicators are very volatile, their

7 The term Innovation Leader refers to those EU countries in the top group in the annual *European Innovation Scoreboard* (EIS) of the European Commission. Today, the group comprises Denmark, Germany, Finland, Luxembourg, the Netherlands and Sweden. For the calculations, the 'innovation leaders' actual value' is used for every performance area.

8 It must be mentioned that the processes of country analysis, target-setting and indicator choice enable collective learning and discussion processes at the national level, something which is completely absent from standardised innovation rankings but fosters the legitimacy of S&T indicators (Barré 2010). In our case, six ministries were involved in the process: the Federal Chancellery (BKA), the Ministry of Finance (BMF), the Ministry of Education, Art and Culture (BMUKK), the Ministry of Transport, Innovation and Technology (BMVIT), the Ministry of Science and Research (BMWF) and the Ministry of Economic Affairs, Family and Youth (BMWFJ).

9 A detailed explanation of the indicators (including the strategic goals which they operationalise) as well as the underlying data and the calculations can be found in the Appendices of every *Report on Austria's Scientific and Technological Capability*.

10 It has to be noted that quantitative indicators cannot display all the objectives of the RTI strategy. This particularly applies to the performance area of governance structures of the RTI system. Thus, the indicator-based analysis has always been complemented with a qualitative evaluation of implemented measures and goal achievement.

11 The *Community Innovation Survey* (CIS) is a survey of innovation activity in enterprises. It is carried out with two years' frequency by EU member states and a number of ESS member countries. Although it is designed to provide information on the innovativeness of sectors by type of enterprises, on the different types of innovation and on various aspects of the development of an innovation, such as the objectives, the sources of information, the public funding, the innovation expenditures, etc., the compiling of the data is voluntary for the countries. This therefore means that in different surveys or years different countries are involved. For details see https://ec.europa.eu/eurostat/web/microdata/community-innovation-survey

explanatory power is limited. Statistically, more stable indicators, for example the export quality in technology-oriented sectors or R&D intensity adjusted for the structural composition of an economy, demonstrate only a relatively low shortfall compared to the leading innovation countries (for details see Austrian Council for Research and Technology Development 2014: 10ff). Consequently, the indicators used within the framework adopted by the Austrian Council rely on more suitable indicators representing the country-specific characteristics. This does not prevent international comparison as these indicators are also available for other countries and in fact, the whole framework rests on international comparison with leading countries.

Visualising innovation performance

The applied framework focuses on the degree to which the goals set out in the strategy have been achieved (static component, current distance to the goal) and on the degree to which the goals may be achieved in the future (dynamic component, probability of achieving the goal). While the current distance to the target simply reflects Austria's current performance relative to the target value (either as set by the RTI strategy or as the average level of the Innovation Leaders), the probability of achieving the goal extrapolates past growth trends to indicate where Austria's performance might be by the time horizon 2020. This can be graphically displayed as the example in Figure 8.1 shows. Figure 8.1 provides a comprehensive overview of the performance within the analysed areas of the RTI system in relation to the selected peer countries. The goal distance on the horizontal axis in Figure 8.1 illustrates the current Austrian value and the distance to the respective target. It shows the ratio and the distance of the last available Austrian value to the national set target according to the RTI strategy and the *European Education and Training 2020 Strategy* (Council of the European Union 2009).[12] If there is no national goal, the target is constructed out of the last available average value of the current Innovation Leaders according to EIS. This is because catching up with the group of Innovation Leaders is a priority goal for Austria, as established in the RTI strategy.

The distance to the goal exhibits Austria's current performance level and reveals some information on the difference between where Austria is compared to the goal, but it says nothing about the changes or dynamics that are required for the goal to be achieved. Thus, an indicator which currently lies just below the target level could therefore deteriorate again due to a negative dynamic. To put it another way, the exclusive comparison of the goal distances does not allow any conclusions on the prospect of goal achievement. For this reason, the probability of reaching the target on the vertical axis was selected as the second dimension. It shows whether or not the past growth of the indicator is sufficient for goal achievement. It indicates the ratio of the average annual growth rate of the respective data series in the past and the projected value for Austria in 2020 to the target value for 2020 (under a business-as-usual assumption). As a target value for the calculation of growth (if no national goal is set) the projected value for 2020 will be used and not the actual value of the Innovation Leaders. This, in turn, is determined on the basis of the average growth rates of the comparison countries in the past.

12 Following the suggestion of the Federal Ministry of Education, Arts and Culture at the time, target values of the *European Education and Training 2020 Strategy* have been used for some indicators operationalising targets within the education system.

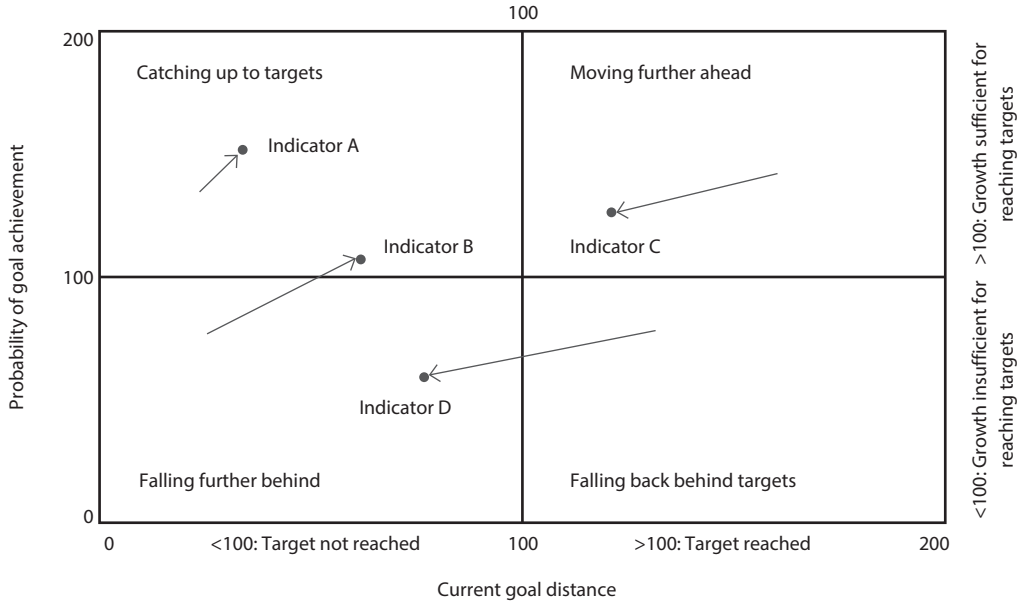

FIGURE 8.1*: Visualising innovation performance: Outcomes over time based on the combinations of current and future goal distance*

Source: Austrian Council for Research and Technology Development (2018: 103)

All indicators can be interpreted in the same direction, that is, values above 100 signal goal achievement; values below 100 a corresponding distance to the goal. Indicators with a probability of reaching the goal below 100 – below the horizontal line at 100 – are based on past growth trends that are unlikely to reach the target by the end of the time horizon; indicators with a value above 100 – above the horizontal line – are likely to reach the target value. The standardisation of the values is achieved as follows: the Austrian value is divided by the respective target value and multiplied by 100. If performance improvements are accompanied by a decline in the indicator values, such as with the unemployment rate, for example, the values would be inverted (that is, target value in the numerator, Austrian value in the denominator), in order to retain the interpretation of 'greater equal to 100 = goal achievement'. Values above 200 are limited in the figures to 200.

If an indicator is located in one of the two quadrants on the left side, this means that Austria has not yet achieved the set goal. For indicators in the bottom left corner, this will most probably also remain unchanged. Hence, due to the weak growth rate in these performance areas, Austria will not achieve the goal by 2020. Consequently, without additional measures, the Innovation Leaders are very likely to remain out of reach. Measures that are suitable to increase performance in these areas should therefore be handled as a special priority. Indicators in the top left area are catching up, which could result in achieving the goal by 2020, as the Austrian development dynamic is greater than that of the comparison countries. In these performance areas, no further measures would be required, always assuming that trends continue as in the past.

Indicators located in the two right-hand quadrants show that the corresponding goals have already been achieved. Indicators in the top right corner signify that Austria has achieved the goal and, in all likelihood, will also remain ahead until 2020 due to the high growth rates, provided the growth of the

comparison countries remains within the expected range. Thus, there is currently no need for further action. For indicators in the quadrant on the bottom right, Austria's growth is insufficient to maintain its edge ahead of the Innovation Leaders in the long term. Accordingly, the development should be observed very closely here, either to counteract or adjust the indicators in good time where required.

Illustrating the use of the framework with a practical example

To illustrate how the sketched framework is used in practice, an example from the *Report on Austria's Scientific and Technological Capability 2015* is presented below.[13] Figure 8.2 shows the indicator-based results of the described approach for the area of research and innovation in the corporate sector for the current distance to the target and the probability of reaching the target. The tail of each indicator depicts the past development from 2010 until 2015.

At a glance, the figure reveal the developments of both the current distance to the goal and the probability of reaching the goal by 2020 in the performance area of research and innovation in the corporate sector within the Austrian RTI system. It becomes clear that in 2015 there was still considerable potential to optimise performance and increase efficiency in the corporate sector. While the six green indicators in the right upper quadrant had indeed already reached their target or the level of Innovation Leaders, the majority of indicators continued to be within the bottom left quadrant, indicating a performance below the average level of comparison countries and were expected to fall

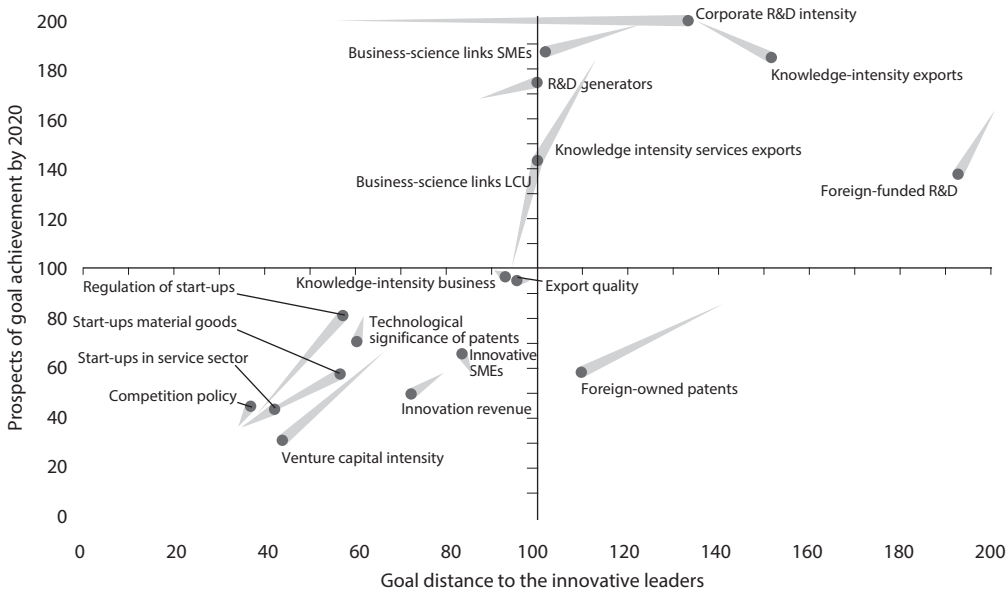

FIGURE 8.2: *Development of distance to targets and probability to reach the target in the area of research and innovation in the corporate sector, 2010–2015*
Source: Austrian Council for Research and Technology Development (2015: 47)

13 This figure has been chosen as an example because it contains indicators in all four quadrants.

further behind. Judging by the current trends, and with no additional measures taken, the indicator in the bottom right corner will deteriorate and fall below the target level by 2020. The yellow coloured indicators in the top right quadrant display dynamic developments and will most likely continue catching up and reach the target level by the year 2020.

In sum, the performance area of research and innovation in the corporate sector at the given time had the third smallest goal distance of the six areas analysed and the highest probability of achieving the goal. Overall, goal distance was deemed to be within reach by 2020 – providing the trends continued to develop as they had in the past. However, many indicators, such as 'Competition policy' or 'Venture capital intensity', were well below the target level and displayed insufficient or retrogressive dynamics to catch up with the group of leading countries. Furthermore, performance in key sub-areas, such as start-up dynamics and growth of innovation-intensive early-stage businesses, remained extremely weak in comparison to the Innovation Leaders. Based on this picture, the relevant fields of action were addressed in the Council's report – including concrete policy recommendations for improving Austria's innovation performance within the specific areas.

It is important to mention that the Council of Ministers commissioned the Council for Research and Technology Development to provide the annual *Reports on Austria's Scientific and Technological Capability* in order to send them to the Austrian Parliament. There they are debated in the parliamentary committee on RTI. They are also presented publicly and published on the Council's website. With this approach, it was intended to put the political and public debate of education, science, research and innovation policy affairs on a sound evidence-based footing.

It would be straightforward to adapt this measurement framework to other countries, although it requires more work than using standard indicators as outlined above. First, goals have to be set, possibly within a strategy-building exercise which requires an analysis of the strengths and weaknesses of a country. Once goals are set, suitable indicators can be drawn from available sources, such as OECD data; when no ready-made indicators exist, new indicators would have to be built, which needs more effort. Once goals and indicators are in place, progress over time can be monitored, assessing the impact of any policies implemented to reach the goals.

Concluding remarks

As we have demonstrated, the outlined framework for measuring innovation performance not only refers to Austria's country-specific conditions but also facilitates a dynamic view of past and future developments. While standard rankings merely give a static snapshot of one performance point in time, the presented approach makes it possible to show where the current dynamics of innovation performance may lead to in future. Growth trends of single indicators may be positive or negative so that a yearly snapshot on its own is of little use to policy makers. Different policy priorities are needed to address the performance of areas where a country lags behind but can catch up quickly compared to those where a country lags behind with an indication that it will to continue to do so. In the first case, no further action is needed; in the second, alarm bells should be ringing.

The limitations of the proposed framework for policy makers are that the framework needs to be custom-made for national content and it requires more resources, first for the analysis of national performance and then for national target-setting or strategy-building. Like a tailor-made suit, the framework fits better but is more expensive and time-consuming. The benefits of appropriately reflecting country strengths and weaknesses may however outweigh the costs of not only relying on standardised indicator frameworks. Moreover, common to all indicator-based measurement

frameworks, it is a quantitative framework, meaning that international benchmarking relies on available data for indicator-building. Country-specific challenges lacking internationally comparable data can only be addressed in a qualitative way.

For the Austrian Council, the described framework and the indicator-based measurement of innovation performance has been a basis from which to draw conclusions about Austria's scientific and technological capability in relation to leading innovation nations. With this evidence-based analysis of strength and weaknesses of the Austrian RTI system, the most urgent fields of action were identified and dealt with in the Council's annual reports and policy recommendations. Additionally, the Council uses the described approach for the strategic monitoring of the realisation of the Federal Government's RTI strategy as well as the assessment of efficiency and effectiveness of the implemented measures. A similar approach by other advisory boards or policy makers is strongly recommended.

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