11 Scoreboards and indicator reports
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1. INTRODUCTION

Innovation scoreboards are an attempt to summarize innovation indicators and to compare innovation performance of countries, regions or sectors. Although they are becoming more and more popular and relevant for policy making, there still seems to be no standard definition of a scoreboard. Do scoreboards include rankings by several and/or single (composite) indicators? Do they include profiles of countries or regions? Do they include benchmarking against the average, best practice and/or others?

In this chapter the term scoreboard is used in a very broad sense and includes international comparative reports that do not use the term. Similar to the review of innovation scoreboards by Arundel and Hollanders (2008), we do not restrict the comparison to innovation scoreboards and reports, but include more general international reports, especially competitiveness reports, if they include an important innovation dimension. This survey partly updates the information collected in Arundel and Hollanders (2008) as well as in Weissenberger-Eibl et al. (2011), but using the perspective of innovation surveys and illustrating how innovation surveys are used (or not used) in selected reports.

This chapter is structured as follows. In Section 2 the most prominent innovation scoreboards and international innovation indicator reports are presented: the *Innovation Union Scoreboard* (formerly *European Innovation Scoreboard*), the *OECD Science, Technology and Industry Scoreboard* as well as the *OECD Science, Technology and Industry Outlook* and INSEAD's *Global Innovation Index*. To these is added a recently modified German attempt, *Innovationsindikator*, because of its methodological approach.

Section 3 follows with more general reports including an important innovation dimension: the *Innovation Union Competitiveness Report*, the *European Competitiveness Report*, the World Economic Forum's *Global Competitiveness Report* as well as *Europe 2020 Competitiveness Report* and the *Atlantic Century* by ITIF in the USA and the European–American Business Council (Atkinson and Andes 2009, 2011).

For each scoreboard or report summarized in Table 11.1, there is a brief presentation of the approach, indicators and data sources. Comments

Table 11.1   Overview and summary of innovation scoreboards

Name	Short	Editing institution	Preparing institution	First edition	Latest edition	Frequency
Innovation Union Scoreboard (European Innovation Scoreboard)	IUS (EIS)	European Union	MERIT	2001	2011	Annual
OECD Science, Technology and Industry Scoreboard	STI Scoreboard	OECD	OECD	1991	2011	Biennial
OECD Science, Technology and Industry Outlook	STI Outlook	OECD	OECD	1998	2010	Biennial
Global Innovation Index	GII	INSEAD, WIPO	INSEAD, WIPO	2007	2012	Annual
Innovationsindikator	II	Telekom Stiftung, BDI	Fraunhofer ISI, ZEW, MERIT	2005	2011	Annual
Innovation Union Competitiveness Report	IUC	European Union	European Commission	2011	2011	Biennial
European Competitiveness Report	ECR	European Union	European Commission	1997	2011	Annual
Global Competitiveness Report	GCR	World Economic Forum	Centre for Global Competitiveness and Performance	1979	2011	Annual
Europe 2020 Competitiveness Report	E2020-CR	World Economic Forum	Global Competitive Network	2012	2012	Annual
Atlantic Century	ITIF-AC	ITIF, EABC	ITIF	2009	2011	Biennial
Knowledge Assessment Methodology	KAM	World Bank	World Bank	2001	2012	Regularly updated

Notes:
a. Country profiles.
b. Country fiches ECR 2009.

Source: Summary of the authors based on respective reports (see references).

Standard structure	Target countries	Number of indicators	thereof based on innovation surveys	Selection criteria	Composite indicator	Sensitivity analysis	Special feature
Yes	EU member states	25	6	Reasoning, correlation analysis	Yes	Yes (EIS)	Innovation growth performance interactive visualization tool
No	OECD member countries	~180	34	Reasoning	No		
No	OECD member countries	13[a]	3[a]	Not available	No		
Yes	World	84	None		Yes	Yes	Innovation efficiency index
Yes	Germany and selected European countries	38	None	Model, regression analysis	Yes	Yes	Regression model based
Unknown	EU member states	51	None		No		
No	EU member states	25[b]	2[b]	Depending on focus	No		
Yes	World	117	None		Yes		
Yes	EU member states	65	None		Yes		
Yes	USA	16	None	Reasoning	Yes		
Yes	World	148	None		Yes		Interactive visualization tool

follow on the usage of innovation surveys as well as on special features, strengths and weaknesses with respect to reports on innovation. Recent attempts to improve scoreboards by providing interactive tools are presented in Section 4. A general comparison as well as a general outlook is given in the final section.

2.   INNOVATION SCOREBOARDS AND INTERNATIONAL INNOVATION REPORTS

Innovation Union Scoreboard/European Innovation Scoreboard

The vision of an innovation union as part of the EU was announced and communicated by the European Commission in 2010 as a strategic approach to tackle the challenges of the rapidly changing global economy (EC 2010a). *The Innovation Union Scoreboard* (*IUS*) as a performance scoreboard for research and innovation is part of the monitoring system of the European Commission included in the resulting agenda and task list.

Results of the first IUS were published in 2011 (EC 2011a). The annual *IUS* is based on and closely related to the previous *European Innovation Scoreboard* (*EIS*) dating back to 2000 (EC 2001). The *EIS* started with a set of 17 indicators covering at that time 15 member states of the EU. From the very beginning, benchmarking EU member countries against major global competitors such as the USA and Japan was an integral part of the EIS concept.

Thus the most recent second edition of the *IUS* (EC 2012) is in fact the eleventh edition. If the first outline (EC 2000) is included, twelfth. Using a set of 25 indicators predefined in the EC communication announcing the Innovation Union (EC 2010b), the *IUS* defines three main groups of indicators divided into a total of eight innovation dimensions: Enablers (with dimensions Human resources, Research systems and Finance & support), Firm activities (Firm investments, Linkages & entrepreneurship, Intellectual assets) and Outputs (Innovators, Economic effects).

Four of these dimensions make use of six indicators based on innovation surveys (EC 2012: figure 1 and annex C). These indicators mainly refer to small and medium-sized enterprises (SMEs) as the target population (see Table 11.2) and provide a better picture of the innovative status of SMEs than business R&D. Separate data for SMEs are worthwhile because they form the majority of firms in most countries and can play a vital role in innovation, for example as developers of new ideas and as adopters of new technologies. Innovation-survey-based indicators are accompanied by indicators based on R&D surveys, patent statistics, publication statistics,

Table 11.2   Use of innovation-survey-based indicators in a selected number of innovation scoreboards

	IUS	STI Score	STI Outlook
Recent edition	2011	2011	2010
Innovation-survey-based indicators			
Technological innovation	Yes	Yes	Yes
Non-technological innovation	Yes	Yes	Yes
In-house innovation	Yes		
Innovation expenditure	Yes		
Sales with product innovation	Yes		
R&D in innovation		Yes	
Training for innovation		Yes	
Public support for innovation		Yes	
Collaboration for innovation	Yes	Yes	Yes
Sources of knowledge for innovation		Yes	
Main reference groups			
All firms			Yes
Innovative firms		Yes	
All SMEs	Yes		

Source: Authors.

population statistics and export data, among others. Eurostat provides the main data source, supplemented by sources of the OECD, of UN institutions and of a few others (EC 2012: annex C).

Focusing on a set of well-defined 24 indicators, the IUS provides a ranking of countries using composite indicators at differing levels of aggregation (see Table 11.3). The results are used to identify four groups of countries: Innovation leaders (ranks 1 to 4 in Table 11.3), Innovation followers (ranks 5 to 14), Moderate innovators (ranks 15 to 23) and Modest innovators (ranks 24 to 27) among the EU-27 (EC 2012: ch. 3). These countries as well as the EU average are compared to and benchmarked against global competitors (EC 2012: ch. 4).

Performance rankings and benchmarks are supplemented by country profiles highlighting their relative strengths and weaknesses in innovation performance (EC 2012: ch. 5). As a special feature, the use of a limited set of indicators, relatively stable over time, allows the calculation of innovation growth performance. Adding this dynamic dimension of innovation performance leads to another category grouping countries into Growth leaders, Moderate growers and Slow growers (EC 2012: ch. 3 and technical annex).

Table 11.3 *Ranking of EU-27 member countries in innovation scoreboards*

	IUS 2011	GII 2011–12	GCR 2011–12	E2020CR 2012	II 2011	ITIF-AC 2011	KAM 2012
Sweden	1	1	1	1	1	2	1
Denmark	2	5	5	3	7	4	3
Germany	3	8	3	6	2	9	5
Finland	4	2	2	2	3	1	2
Belgium	5	11	7	9	6	6	8
UK	6	3	6	7	9	3	7
Netherlands	7	4	4	4	4	5	4
Austria	8	12	9	5	5	10	9
Luxembourg	9	7	10	8	–	–	11
Ireland	10	6	11	12	10	8	6
France	11	13	8	10	8	7	13
Slovenia	12	14	22	13	–	15	16
Cyprus	13	16	19	17	–	20	22
Estonia	14	10	12	11	–	12	10
Italy	15	21	16	21	12	18	17
Portugal	16	20	18	14	–	15	21
Czech Republic	17	15	14	16	–	11	14
Spain	18	17	13	15	11	14	12
Hungary	19	19	20	24	–	13	15
Greece	20	27	27	25	–	22	23
Malta	21	9	21	18	–	–	18
Slovakia	22	23	24	22	–	16	20
Poland	23	25	15	23	–	21	25
Romania	24	26	26	26	–	–	26
Lithuania	25	22	17	20	–	19	19
Bulgaria	26	24	25	27	–	–	27
Latvia	27	18	23	19	–	17	24

Source: Authors.

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The set of indicators used in the *IUS* is a reduced set of the indicators used in the latest EIS based on 'rational reasoning' (Hollanders and Tarantola 2011). The selection of indicators for the EIS is based on various statistical correlation analyses (EC 2003). Composite indicators are calculated as the unweighted average of rescaled scores of all indicators contained in the composite indicator. Rescaling includes normalization as well as transformation of skewed data (EC 2011a: technical annex). Sensitivity analyses of differing weighting schemes have been produced for the preceding *EIS* (EC 2003). Growth performance is calculated as the geometric average of outlier-adjusted indicator growth rates (EC 2012: technical annex).

The relatively stable and clearly arranged set of indicators avoiding redundancies is the main advantage of the IUS. Moreover, the IUS relies on high-quality established data sets including innovation surveys following the *Oslo Manual* (OECD/Eurostat 2005). Relatively reliable analysis, comparisons and benchmarks including dynamic dimensions are the result. Because of demanding data requirements, possibilities of comparisons with countries outside EU and OECD are limited.

OECD *STI Scoreboard* and OECD *STI Outlook*

On a biennial basis the OECD publishes its broad *Science, Technology and Industry (STI) Scoreboard* alternating with its *Science, Technology and Industry (STI) Outlook*. The most recent, eleventh, *STI Scoreboard* (2011) makes use of some 180 indicators to illustrate and analyse trends in innovation performance of countries (OECD 2011: executive summary).

In contrast to the *Innovation Union Scoreboard* (*IUS*), the *STI Scoreboard* does not rank or benchmark country performance using composite indicators. Nevertheless, using graphical presentation, the *STI Scoreboard* ranks countries with respect to several innovation dimensions relevant for policy decision making. Analyses in the *STI Scoreboard 2011* are summarized in five thematic chapters: Building knowledge, Connecting to knowledge, Targeting new growth areas, Unleashing innovation in firms and Competing in the global economy (OECD 2011: executive summary). Four of the five thematic chapters make use of a total of 34 indicators based on innovation surveys. They are most prominently used in 'Connecting to knowledge' and 'Unleashing innovation in firms' (OECD 2011: chs 3 and 5). Compared to the *IUS*, these indicators have a different target population: mostly innovative firms, including large firms and SMEs. They have a strong focus on interactions within the innovation system and less on innovation output and outcome (see Table 11.2). Thus there is only very limited overlap with the *IUS*.

Other indicators used in the *STI Scoreboard* are based on R&D, education, occupation, employment and trade data as well as on specialized information, for example biotechnology, health innovation or broadband data. In addition to OECD and Eurostat, sources from, among others, the International Monetary Fund (IMF), the World Bank, different patent offices and the International Labour Organization (ILO) are used (OECD 2011: data sources). The very broad set of indicators is used to compare the 20 founding and thereafter 14 joining OECD member countries with each other and with invited (Russia) and cooperating countries, especially South East Asian countries, resulting in up to 59 countries (OECD 2011: reader's guide). The selection of indicators is based on reasoning, with policy relevance as a factor (OECD 2011, foreword).

Published in years when the *STI Scoreboard* is not, the *STI Outlook* supplements the *STI Scoreboard*, especially with country profiles of the OECD member countries. The most recent eighth edition, *STI Outlook 2010*, applies a set of 13 indicators to benchmark them against the OECD average. Three of these indicators are based on innovation surveys (OECD 2010: table 3.A1.3). Again the target population is different: all firms (see Table 11.2). Thus these indicators show little overlap with the *IUS* or even with the *STI Scoreboard*.

In most parts of the *STI Outlook* aggregates of countries, for example eurozone countries, EU-27 or OECD countries, are compared to Japan and the USA. If possible, developments over time are presented. Time series of indicators based on innovation surveys are rarely available. In consequence, only a few of these indicators are used and mostly for illustrative purposes. Referring to indicators, the *STI Outlook* has a less stringent approach than the *STI Scoreboard* and is more focused on the comparison of innovation policies.

The strength of OECD's *STI Scoreboard* is the combination of a complete coverage of developed economies with the use of a broad set of high-quality data stemming mainly from statistical institutions in charge of the official statistics for the topic under consideration. Among existing scoreboards it uses the largest number of indicators based on innovation surveys. However, reports on single indicators are only loosely connected, hampering the development of a comprehensive view. This is partly overcome by the accompanying *STI Outlook*, which, however, is not very closely connected to the indicators presented in the *STI Scoreboard*.

Global Innovation Index

The annual *Global Innovation Index* published by INSEAD and WIPO started with a pilot study in 2007 (Dutta and Caulkin 2007) before its

regular introduction with its second edition in 2009 (INSEAD 2009). The most recent fifth edition, *Global Innovation Index 2012*, is a joint report of INSEAD and the World Intellectual Property Organization (Dutta 2012).

The *Global Innovation Index* (*GII*) covers the largest number of countries of all existing innovation scoreboards. The recent *GII 2012* has accomplished an innovation ranking of 141 countries, from Switzerland and Sweden as the top-ranked to Niger and Sudan as the bottom-ranked countries (see Table 11.3 for ranking of EU members). The *GII 2012* ranking is based on a hierarchy of two sub-indexes, seven pillars and 21 sub-pillars utilizing a total number of 84 indicators (Benavente et al. 2012). Rankings for the two sub-indexes, the Innovation Input Sub-Index and the Innovation Output Sub-Index, are provided, too.

The two sub-indexes have the same weight in the creation of the *GII*, although the Innovation Output Sub-Index is based on only two pillars (Knowledge and Technology Outputs and Creative Outputs) with six sub-pillars and 25 indicators. The Innovation Input Sub-Index is based on five pillars (Institutions, Human Capital and Research, Infrastructure, Market Sophistication, Business Sophistication). Scores for sub-indexes, pillars and sub-pillars are calculated as weighted averages of the score of the next lower level (Dutta 2012: appendix IV).

In addition to the *GII*, an Innovation Efficiency Index as a ratio of the Innovation Output Sub-Index to the Innovation Input Sub-Index is created. This is a unique feature compared to other innovation scoreboards. Rankings are provided by pillars, sub-pillars and each single index. Indicators used for the *GII* change over time (Benavente et al. 2012). Rankings are accompanied by country profiles (Dutta 2012: appendix I). Using statistical methods, the impact of weighting schemes as well as modelling assumptions referring to, for example, missing values on index scores and the resulting ranking are extensively analysed (Saisana and Philippas 2012).

A large variety of indicators and data sources is used: from the World Bank's Political Stability and Absence of Violence/Terrorism Index to electricity consumption provided by the International Energy Agency to the number of videos uploaded on YouTube provided by Google. The majority of indicators are collected from publications of international institutions such as UNESCO, the OECD, the World Bank or the IMF.

None of the 84 indicators used is actually based on innovations surveys. Indicators close to the innovation-survey-based indicators mentioned above, such as R&D collaboration between universities and industry as part of the pillar Business Sophistication, are based on the Executive Opinion Survey of the World Economic Forum (Dutta 2012, appendix III). Thus there is little overlap of the *GII* with the IUS or OECD's STI

Scoreboard and Outlook, but more with the *Global Competiveness Report* (see Section 3, subsection on the *Global Competitiveness Report* and the *Europe 2020 Competitiveness Report*).

Using OECD and Eurostat sources, selected information from innovation surveys is used for additional illustration and the investigation of special aspects of the *GII*, such as indicators on collaboration for innovation (Wunsch-Vincent 2012) or on innovation expenditure (Gokhberg and Roud 2012).

The large number of countries covered by the *GII* is both its strength and weakness. Availability of reliable data on innovation activities and innovative performance is limited. Thus the *GII* has to rely on opinion survey data where cross-country comparability is questionable and answers reflect perception and satisfaction more than expectation. Comparison of opinion survey with innovation survey data for those countries where both are available would be helpful for decision makers.

Innovationsindikator (Innovation Indicator)

The project Innovationsindikator (German for innovation indicator, but combined into one word) started in 2005 as a joint attempt of Deutsche Telekom Stiftung (a German corporate foundation dealing with telecommunication services) and BDI (the Federation of German Industries representing mainly manufacturing firms). In 2011, the project was fundamentally restructured and prepared in an international collaboration of three research institutes: Fraunhofer ISI, UNU-MERIT and ZEW Centre for European Economic Research (Schubert et al. 2011).

The Innovationsindikator 2011 uses a set of 38 indicators to benchmark Germany against 11 other EU member countries and another 14 international competitors of advanced and emerging economies. The selection of indicators is based on the socioeconomic model of Systems of Innovation where the specific variables used were selected by using econometric regression models. The composite indicator was created as the unweighted mean of standardized indicators. Simulation analyses using random weights are used to analyse the sensitivity of the composite indicator and the resulting ranking (Schubert et al. 2011).

Following the innovation system approach, the indicators are grouped into five subsystems: Education (consisting of nine indicators), Society (four indicators), State (eight indicators), Enterprises (16 indicators) and Public research (eight indicators). Some of the indicators are also used in differing subsystems. None of these indicators is based on innovation surveys. In fact, none of the indicators is close to information collected in innovation surveys.

Table 11.4   Rank correlations of EU-27 member countries' ranking in innovation scoreboards

	IUS 2011	GII 2011–12	GCR 2011–12	E2020CR 2012	II 2011	ITIF-AC 2011	KAM 2012
IUS 2011	1	0.84	0.87	0.91	0.78	0.84	0.90
GII 2011–12	0.84	1	0.84	0.91	0.63	0.92	0.90
GCI 2011–12	0.87	0.84	1	0.91	0.89	0.87	0.91
ECI2020 2012	0.91	0.91	0.91	1	0.85	0.89	0.91
II 2011	0.78	0.63	0.89	0.85	1	0.55	0.73
ITIF-AC 2011	0.84	0.92	0.87	0.89	0.55	1	0.93
KAM 2012	0.90	0.90	0.91	0.91	0.73	0.93	1.00

Source: Authors.

Most of the indicators are based on statistics published by international institutions such as the OECD, the World Bank, the European Patent Office or United Nations institutions. Seven of the 38 indicators are, like the Global Innovation Index, based on the World Economic Forum's Executive Opinion Survey (see previous section) and are thus open to criticism with respect to international comparability.

The main strength of the Innovationsindikator is its model-based and econometrically tested selection of variables. But the selection of variables is, like the Global Innovation Index, closer to competitiveness than to innovation. Because of this, Innovationsindikator shows the highest rank correlation with the Global Competitiveness Index (see Table 11.4). Moreover, innovation-survey-based variables on linkages within the innovation system are missing.

3.   INNOVATION INDICATORS IN COMPETITIVE REPORTS

Innovation Union Competitiveness Report

The very first of the prospectively biennial *Innovation Union Competitiveness* (*IUC*) reports was published in 2011 by the European Commission under the guidance of the Directorate-General for Research and Innovation (EC 2011b). In contrast to the established *European Competitiveness Report* (see next subsection), the term competitiveness refers more to the competitiveness of the research and innovation system of a country than to that of the economy as a whole. The *IUC* report is meant

to be an analytical strategic report building partly on the *Innovation Union Scoreboard* (*IUS*) and trying to identify causes for possibly insufficient performance (EC 2011b: executive summary).

The *IUC* report is a strongly indicator-based report. Each step of analysis is based upon an accurate investigation of relevant available indicators. The *IUC* report lists 51 indicators used to produce extended profiles of member and associated countries and to benchmark these countries and the total EU against its international competitors: the USA, Japan, China and South Korea. None of these indicators used for benchmarking is based on innovation surveys (EC 2011b: section II and annex).

But the introducing statement of the performance of the European research and innovation system directly refers to the results of the *IUS*, which intensively uses innovation-survey-based indicators (EC 2011b: overall picture). Subsequent detailed analysis uses only few innovation-survey-based indicators, such as extent and structure of innovation expenditure (EC 2011b: analysis part III). However, the overwhelming majority of indicators build on traditional indicators from R&D statistics, statistics on human resources devoted to science and technology, patent statistics accompanied by specialized information on, for example, university rankings and participation in EU framework programmes.

European Competitiveness Report

The *European Competitiveness Report* (*ECR*) is not an indicator-based report or scoreboard and follows an approach different to the *IUC* report (previous subsection). It is composed under the Directorate General for Enterprise and Industry of the European Commission. As an annual report starting in 1997, the *ECR* analyses the competitiveness of European industries with respect to recent economic trends and developments (EC 2011c: foreword).

The report does not follow a standardized structure every year. Utilization of innovation-survey-based indicators depends heavily on the main focuses of the particular report.

The *ECR 2010* in its section on Foreign Corporate R&D and Innovation in the European Union draws heavily on the results of the Community Innovation Survey, especially its German version the Mannheim Innovation Panel (EC 2010a: ch. 3; see Chapter 6 of this volume). The *ECR 2009* benchmarks member country performance to the EU average in its 'Microeconomic Data – Country Fiche'. From the 25 indicators used, two are based either directly or indirectly, through the IUS, on innovation surveys (EC 2009: ch. 6).

Other editions occasionally make use of innovation survey data. The most recent *ECR 2011* draws attention to eco-innovation using special questions of the European Community Innovation Survey 2008 (EC 2011c: ch. 5).

Global Competitiveness Report **and** Europe 2020 Competitiveness Report

In 1979 the World Economic Forum managed to establish the first acknowledged attempt of a worldwide comparison and benchmarking of countries' competiveness: the *Global Competitiveness Report* (*GCR*). The most recent *GCR 2011–12* (Schwab 2011) covers and ranks 142 countries.

Ranking in the *GCR 2011–12* is based on 117 indicators divided into 12 sections called 'pillars' (Schwab 2011: ch. 2.2). The twelfth pillar is called 'Innovation', but covers mainly aspects of R&D and patenting. Information that could be collected by innovation surveys is contained in the ninth pillar, 'Technological readiness' and the eleventh pillar, 'Business sophistication'. Actually, none of the indicators is based on innovation surveys.

Half of the 78 indicators are based on the World Economic Forum's 'Executive Opinion Survey' (Browne and Geiger 2011), especially nearly all variables on aspects of innovation. In the *GCR 2011–12*, indicators at the country level are calculated as a weighted average of the referring opinion surveys of 2010 and 2011 where the annual value of the variable is a sector-weighted average of individual responses assuming a four-sector economy.

Rankings are provided by the *GCI*, sub-indexes, pillars and indicators. Each composite indicator is calculated as a weighted average of the lower level indexes or indicators (Sala-i-Martin et al. 2011). Country profiles complete the *GCR*.

In 2012, the *GCR* was for the first time supplemented by the *Europe 2020 Competitiveness Report* (World Economic Forum 2012), a reduced version using 65 indicators and focusing on the EU member states, candidate countries and a few international competitors. The vast majority of 41 indicators are based on the above-mentioned opinion survey, especially the innovation-related indicators. None of the indicators is based on innovation surveys, although they would be available for the countries analysed. Based on the set of indicators grouped into seven pillars, a composite competitiveness index is calculated. Each pillar has the same weight in the composite competitiveness index although the number of variables contained differs. Additionally, three sub-indexes are produced (World Economic Forum 2012: appendix A). Rankings in the *Europe 2020 Competitiveness Report* are relatively highly correlated to all country

rankings covered in this chapter (see Table 11.4), which complicates the identification of the value added.

The main weakness of both reports is the predominant reliance on opinion surveys where cross-country comparability is questionable (see Section 2, subsection on the Global Innovation Index).

The Atlantic Century

The Atlantic Century, published by the Information Technology and Innovation Foundation (ITIF) in cooperation with the European– American Business Council (EABC), claims to be an assessment of global innovation-based competitiveness and especially a benchmarking of the USA against its major global competitors. *The Atlantic Century II*, published in 2011, is the second edition of this relatively new approach (Atkinson and Andes 2011).

Competitiveness of the USA is benchmarked against 23 of the 27 EU member states, omitting the small member states Luxembourg and Malta as well as new member states Bulgaria and Romania (see Table 11.3). This is completed by benchmarks against EU aggregates EU-10, EU-15 and EU-25, as well as East Asian and Latin American competitors.

Analyses and benchmarks within the *Atlantic Century* are based on 16 indicators, which is the smallest number of indicators in the reports under consideration. The selection of indicators is based on 'rational reasoning' (Atkinson and Andes 2009, 2011). Scores of single indicators are standardized. The composite indicator is a weighted average of single indicators where weights depend on 'rational reasoning' (Atkinson and Andes 2009, 2011). Rankings are provided by both the composite indicator and each of the single indicators. The composite indicator is relatively highly correlated with the Global Competitiveness Index (see Table 11.4).

The main data sources are official statistics from international organizations such as the OECD, UNESCO and the World Bank. None of the 16 indicators is based on innovation surveys. Moreover, non-R&D innovation activities are only summarily covered.

4.　INTERACTIVE SOFTWARE TOOLS

Access to and use of innovation data can be improved by providing interactive benchmarking tools. The purpose of interactive tools is to allow users to explore data in further detail than possible in a written report or static Excel files. Such tools should be intuitive and easy to use. Two such

interactive tools are the Knowledge Assessment Methodology (KAM) developed by the World Bank and the Innovation Union Scoreboard (IUS) Dashboard.

The Knowledge Assessment Methodology (KAM) measures the performance of countries in four Knowledge Economy pillars: 'Economic Incentive and Institutional Regime', 'Education', 'Innovation', and 'Information and Communications Technologies'. KAM uses data for 148 indicators for 146 countries and provides two summary indexes: the Knowledge Economy Index (KEI) and the Knowledge Index (KI). None of the 29 indicators used for measuring the innovation system uses innovation survey data; indicators used include R&D expenditures and researchers, royalty and licence fees, scientific publication, patents and exports. KAM does not provide a report, as do the scoreboards described in Sections 2 and 3, but it does provide users with a wide range of scorecards and other data visualization tools on its website.[1] The KAM interactive tool gives users the flexibility to construct their own personal country-to-country benchmarks and thereby greatly contributes to improving the accessibility to and use of innovation-related data. 'Basic scorecards' can be used to compare up to three countries on their performance on 12 key variables for 1995, 2000 and the most recent available year. 'Custom scorecards' can be used to compare up to three countries on any combination of the 148 indicators for 2000 and the most recent available year. 'Cross-country comparisons' provide bar-chart comparisons of KEI and KI indexes for up to 20 countries.

The Innovation Union Scoreboard (IUS) is supported by a visualization tool, the 'IUS Dashboard', providing an interactive user interface with four modules allowing customer-made comparisons of the data used in the *IUS 2011* report.[2] Yearly historical data back to 2007 are also included to study innovation performance over time.

The 'Overview module' provides a comparison of the performance on each of the IUS innovation dimensions and indicators, showing current performance, performance over a five-year time period and a direct comparison of any pair of European countries. The tool encourages interactive exploration and provides different options for the user to change the content of the display. The 'Country profile module' provides detailed information for each country and shows the performance relative to EU-27 performance for each of the indicators and their time trends. The 'Compare profiles module' provides a direct comparison using spider diagrams between any two European countries on their current and growth performance. The 'Scatter plots module' provides direct comparisons between each pair of indicators showing the correlation between these indicators.

5.   COMPARISON AND GENERAL OUTLOOK

Selection of Indicators

Arundel and Hollanders (2008: 33) identified four criteria for the selection of indicators: '1) the indicators should be of similar importance as measures of the drivers of innovative activity; 2) the indicators should be based on reliable statistics; 3) the indicators should hold their value over time; and 4) the indicators should be of relevance to medium and long-term policy issues'.

An innovation scoreboard should capture different types of indicators using both so-called hard statistical data and softer survey data, but hardly any indicator will meet all four criteria. Indicators that are relevant for policy issues require recent data, whereas reliable statistics using non-survey data usually become available with at least a two- to three-year lag. Opinion-survey-based data can be less reliable due to differences in perceptions between respondents in different countries and industries. Innovation survey data are more reliable than opinion survey data and should be included for two reasons (Arundel and Hollanders 2008): they can signal relevant areas for innovation and as such trigger policy support for future improvements in data quality; and, due to a lack of hard data for many aspects of innovation, it might be better to include data perceived to be of lesser quality than no data at all, in particular for measuring the outputs of innovation.

Innovation Output Indicators

One of the main purposes of an innovation scoreboard is to measure the innovation performance of countries, regions or sectors. Performance is directly related to measuring outputs or the results of innovation. Indicators measuring inputs such as R&D expenditure or throughputs such as patents are relevant but not sufficient for measuring innovation performance. In addition, scoreboards need to include indicators capturing the success of innovation. Edquist and Zabala (2009: box 1) identify possible output indicators using innovation survey data from the CIS. Their list can be revised taking into account changes in more recent versions of the CIS (see Table 11.5) capturing shares of enterprises with different types of innovation distinguishing between more incremental (product innovations new to the innovating firm) and radical innovations (product innovations new to the innovating firm's market) and sales due to incremental and radical product innovations. Innovation output indicators are not included in the competitiveness reports including an

Table 11.5   Innovation output indicators using innovation survey data

Enterprises with product innovation (% relative to all enterprises)
Enterprises with process innovation (% relative to all enterprises)
Enterprises with marketing innovations (% relative to all enterprises)
Enterprises with organizational innovations (% relative to all enterprises)
Share of firms that have introduced new to the firm products (% of enterprises with innovation activities)
Share of firms that have introduced new to the market products (% of enterprises with innovation activities)
Turnover of new or significantly improved products new to the firm (% of total turnover)
Turnover of new or significantly improved products new to the market (% of total turnover)

Source: Revised from Edquist and Zabala (2009).

innovation dimension and as such these reports do not properly capture innovation performance. The innovation scoreboards using innovation survey data do capture output indicators, in particular the IUS and STI Scoreboards (see Table 11.2).

6.   CONCLUSION

The discussion of innovation scoreboards and competitiveness reports has shown that there is a wide variety in the number of indicators, type of data and coverage of countries. Scoreboards differ depending on their objectives, for example where the *IUS* focuses on European countries, the *GII* takes a global perspective. But despite these differences, innovation scoreboards should try to capture all the relevant dimensions of innovation for which data are available.

NOTES

1.   The Knowledge Assessment Methodology interactive tool is available at http://web. worldbank.org/WBSITE/EXTERNAL/WBI/WBIPROGRAMS/KFDLP/EXTUNIK AM/0,,menuPK:1414738~pagePK:64168427~piPK:64168435~theSitePK:1414721,00. html.
2.   The IUS Dashboard is available at http://ec.europa.eu/enterprise/archives/IUS2011/ IUS2011.html.

REFERENCES

Arundel, A. and H. Hollanders (2008), 'Innovation scoreboards: indicators and policy use', in C. Nauwelaers and R. Wintjes (eds), *Innovation Policy in Europe: Measurement and Strategy*, Cheltenham, UK and Northampton, MA, USA: Edward Elgar, pp. 29–52.

Atkinson, R. and S. Andes (2009), *The Atlantic Century: Benchmarking EU & US Innovation and Competitiveness*, Washington, DC: The Information Technology & Innovation Foundation.

Atkinson, R. and S. Andes (2011), *The Atlantic Century II: Benchmarking EU & US Innovation and Competitiveness*, Washington, DC: The Information Technology & Innovation Foundation.

Benavente, D., S. Dutta and S. Wunsch-Vincent (2012), 'The Global Innovation Index 2012: stronger innovation linkages for global growth', in S. Dutta (ed.), *The Global Innovation Index 2012: Stronger Innovation Linkages for Global Growth*, Fontainebleau: INSEAD, ch. 1, pp. 3–41.

Browne, C. and T. Geiger (2011), 'The Executive Opinion Survey: an indispensable tool in the assessment of national competitiveness', in K. Schwab (ed.), *The Global Competitiveness Report 2011–12*, Geneva: The World Economic Forum, chapter 1.3, pp. 75–83.

Dutta, S. (ed.) (2012), *The Global Innovation Index 2012: Stronger Innovation Linkages for Global Growth*, Fontainebleau: INSEAD.

Dutta, S. and S. Caulkin (2007), 'The world's top innovators: globalization has pushed innovation to the top of the agenda, but which countries respond best to the new challenges', *World Business*, January–February, 26–37.

EC (2000), 'Innovation in a knowledge driven economy', Communication from the Commission to the Council and the Parliament, COM (2000) 567, Brussels: European Commission.

EC (2001), *European Innovation Scoreboard 2001*, Cordis Focus Supplement 18, Brussels: European Commission.

EC (2003), *2003 Innovation Scoreboard, Technical paper no. 6, Methodology report*, European Trend Chart on Innovation, Luxembourg: European Union.

EC (2009), *European Competitiveness Report 2009*, Commission Staff Working Document SEC (2009), 1657, Luxembourg: European Commission.

EC (2010a), *European Competitiveness Report 2010*, Commission Staff Working Document SEC (2010) 1276, Luxembourg: European Commission.

EC (2010b), 'Europe 2020 Flagship Initiative Innovation Union', Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of Regions, COM (2010) 546, Brussels: European Commission.

EC (2011a), *Innovation Union Scoreboard 2010: The Innovation Union's Performance Scoreboard for Research and Innovation*, Brussels: European Commission.

EC (2011b), *Innovation Union Competitiveness Report 2011*, Brussels: European Commission.

EC (2011c), *European Competitiveness Report 2011*, Luxembourg: European Union.

EC (2012), *Innovation Union Scoreboard 2011: Research and Innovation Union Scoreboard*, Brussels: European Commission.

Edquist, C. and J.M. Zabala (2009), 'Outputs of innovation systems: a European perspective', Lund: CIRCLE Electronic Working Paper 2009/14.

Gokhberg, L. and V. Roud (2012), 'The Russian Federation: a new innovation policy for sustainable growth', in S. Dutta (ed.), *The Global Innovation Index 2012: Stronger Innovation Linkages for Global Growth*, Fontainebleau: INSEAD/WIPO, ch. 6, pp. 121–30.

Hollanders, H. and S. Tarantola (2011), 'Innovation Union Scoreboard 2010, methodology report', ProInno Europe, Innometrics, mimeo.

INSEAD (2009), *Global Innovation Index 2008–2009*, Fontainebleau: INSEAD.

OECD (2010), *OECD Science, Technology and Industry Outlook 2010*, Paris: OECD.

OECD (2011), *OECD Science, Technology and Industry Scoreboard 2011*, Paris: OECD.

OECD/Eurostat (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, Paris: OECD.

Saisana, M. and D. Philippas (2012), 'Statistical tests on the Global Innovation Index', in S. Dutta (ed.), *The Global Innovation Index 2012: Stronger Innovation Linkages for Global Growth*, Fontainebleau: INSEAD, annex 3, pp. 71–80.

Sala-i-Martin, X., B. Bilbao-Osorio, J. Blanke, M. Drzeniek Hanouz and T. Geiger (2011), 'The Global Competitiveness Index 2011–2021: setting the foundations for strong productivity', in K. Schwab (ed.), *The Global Competitiveness Report 2011–12*, Geneva: The World Economic Forum, ch. 1.1, pp. 3–49.

Schubert, T., P. Neuhäusler, R. Frietsch, C. Rammer and H. Hollanders (2011), 'Innovation Indicator, Methodology Report 2011', mimeo.

Schwab, K. (ed.) (2011), *The Global Competitiveness Report 2011–12*, Geneva: The World Economic Forum.

Weissenberger-Eibl, M., R. Frietsch, H. Hollanders, P. Neuhäusler, C. Rammer and T. Schubert (2011), *Innovationsindikator 2011*, Bonn: Deutsche Telekom Stiftung and Bundesverband der Deutschen Industrie.

World Economic Forum (2012), *The Europe 2020 Competitiveness Report: Building a More Competitive Europe, 2020*, Geneva: The World Economic Forum.

Wunsch-Vincent, S. (2012), 'Accounting for science–industry collaboration in innovation: existing metrics and related changes', in S. Dutta (ed.), *The Global Innovation Index 2012: Stronger Innovation Linkages for Global Growth*, Fontainebleau: INSEAD/WIPO, ch. 4, pp. 97–107.