European Manufacturing Landscape

The Creation of a Composite Capability Index for Future Manufacturing in Europe

Master's Thesis
Department of Production Economics,
Linköping Institute of Technology
&
the Fraunhofer-institute
for Systems and Innovation Research

by

Björn Johansson & Rebecca Stanworth

LITH-IPE-EX--5/734--SE

European Manufacturing Landscape

- The Creation of a Composite Capability Index For Future Manufacturing in Europe

Master's Thesis carried out at the
Department of Production Economics,
Linköping Institute of Technology
&
the Fraunhofer-institute
for Systems and Innovation Research

by

Björn Johansson & Rebecca Stanworth

LITH-IPE-EX--5/734--SE

Supervisors

Prof. Jan Olhager (IPE)
Dr. rer. pol. Carsten Dreher (Fraunhofer ISI)
Dr.phil. Philine Warnke (IPTS)

Avdelning, Institution
Division, Department
Institutionen för produktionsekonomi (IPE)
Tekniska högskolan
581 83 Linköping

Datum
Date
2005-02-17

Språk
Language

☐ Svenska/Swedish
☒ Engelska/English
☐

Rapporttyp
Report Category

☐ Licentiatavhandling
☒ Examensarbete
☐ C-uppsats
☐ D-uppsats
☐ Övrig rapport

ISBN
_____

ISRN
LITH-IPE-EX--05/734--SE

Serietitel och serienummer **ISSN**
Title of series, numbering _____

URL för elektronisk version
URL for electronic version
http://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-477

Titel
Title
European Manufacturing Landscape. The Creation of a Composite Capability Index for Future Manufacturing

Författare
Author
Björn Johansson
Rebecca Stanworth

Sammanfattning
Abstract

This thesis explores the aspects considered by the European Commission to be of key importance to the Future of Manufacturing in Europe. The areas selected for study are Workforce, Research & Development, and Operating Environment for Innovation. Furthermore, a methodology for measuring a country's inherent capabilities within these areas is proposed and carried out for twenty-three European countries.

Fifty indicators have been selected, and used to analyse the inherent capabilities of the countries at a country level, key area level, and finally at a composite capability index level.

The resulting composite capability index enables the creation of a landscape or 'map' of Europe, highlighting countries which are outperforming and those which are underperforming in the areas considered to be important for the future of manufacturing.

The resulting index has been compared with the European Innovation Scoreboard Summary Innovation Index (European Commission), the Growth Competitiveness Index (World Economic Forum) and the Lisbon Review Rankings 2004 (World Economic Forum), and there proves to be a strong correlation with all three.

A brief discussion about the challenges associated with composite indices has been included.

Nyckelord
Keyword
Europe, Manufacturing, Composite index, Workforce, Innovation

Acknowledgements

Thanks to our supervisors for their input and advice, and to our families for their ongoing support.

Summary

On a European political level, it has been recognised that manufacturing-related activities are vital for prospering economies and societies. Not only does the manufacturing industry itself employ workers and create wealth in its surrounding communities, but it creates an important node in the value creation chain bringing many other spin-off effects and related business (including services) to the nation.

For European success in this ever intensifying and vital battle for future shares of the world's manufacturing activities, the European Commission has identified the urgent need to develop and strengthen Europe's competitive manufacturing base. It is clear that a transformation of the manufacturing industry must occur in order to overcome the challenges and attain the knowledge and manufacturing capabilities required to make Europe a future leader in the field.

The department "Innovations in Production" at the Fraunhofer Institute for Systems and Innovation Research (ISI) in Karlsruhe, Germany, proposed this thesis. Carrying out the project "Manufacturing Visions" (ManVis) in support to the European Commission in their pursuit to create a shared vision and strategy for future European manufacturing, a need arose for the revelation of the current positioning of individual nations, with respect to inherent capabilities for future manufacturing. This stems from the premise that the countries in Europe have unique starting points in terms of manufacturing, and that this must be reflected in any discussion of policy recommendations for future manufacturing.

This thesis has identified areas considered by the European Commission to be of key importance for the future of manufacturing in Europe, and developed and carried out a methodology for measuring the inherent capabilities of individual European countries within these key areas.

The areas selected for study are Workforce, Research & Development, and Operating Environment for Innovation. In total fifty indicators have been selected, and used to analyse the inherent capabilities of the countries at a country level, key area level, and finally at a composite level.

The resulting composite capability index reveals a European Manufacturing Landscape, highlighting countries which are outperforming (Finland, Sweden, Denmark, France, and United Kingdom) and those which are underperforming (Latvia, Czech Republic, Estonia, Poland, and Romania) in the areas considered to be important for the future of manufacturing.

The character of the task gave this study its explorative nature, in as much as there was no existing methodological approach, and no specific theories to be applied to 'solve the problem'. However, the study is nevertheless founded in extensive research and takes guidance from existing studies. The study further covers important issues arising during the creation of a composite index.

The resulting index has been compared with the European Innovation Scoreboard Summary Innovation Index (European commission), the Growth Competitiveness Index (World Economic Forum) and the Lisbon Review Rankings 2004 (World Economic Forum), and there proves to be a strong correlation with all three.

Table of Contents

Table of Figures

1 Introduction

1.1 Scope and Objectives

The aim of this thesis is to select areas considered by the European Commission to be of key importance for the future of manufacturing in Europe, and to develop and carry out a methodology for measuring the inherent capabilities of individual European countries within these key areas. The resulting composite index should reveal a European Manufacturing Landscape (EML).

1.2 Background

The authors of this thesis were based at the Fraunhofer Institute for Systems and Innovation Research (ISI) in Karlsruhe, Germany. The objectives of this institute are to complement the techno-scientific spectrum of the Fraunhofer organisation with economic and societal aspects. With its national and international research and consulting activities, the institute anticipates risks, opportunities and barriers associated with technology developments. Specifically, the authors were based in the department of Innovations in Production, working closely with a team of scientists involved with a project called Manufacturing Visions (ManVis). This project, its significance, and its role in the creation of the Manufuture initiative launched by the European Commission (EC) are all explained in the following chapter.

This thesis was proposed by the ManVis team to complement their work. It was hoped that a EML might be used a tool to point out and or distinguish countries' different stages of developments and strengths regarding their inherent capabilities for future manufacturing. Distinct differences between countries or regions, might call for diversified policies and priorities for the countries/ regions respectively.

The authors of this thesis were given the task of proposing a suitable methodology, and then carrying it out to reveal the European Manufacturing Landscape mentioned above. The character of the task gave this study its explorative nature, in as much as there was no existing methodological approach, and no specific theories to be applied to 'solve the problem'. However, the study is nevertheless founded in extensive research and takes guidance from existing studies.

1.3 Reader’s Guide

Chapter two of this report (entitled **Background – Manufacturing in Europe**); describes the overall context and setting within which the study

should be viewed. Particular reference is made to the state of manufacturing in Europe, and political initiatives, targets, and activities, which have attempted to influence this.

Leading on from this description, **chapter three** (**Project description**) highlights where this project fits into the overall context, and lays out the general approach to the study.

Chapter four (**Methodology**) describes the chosen methodology in detail, and points out notable complications and issues when seeking to create a composite index.

Part of the methodology involves researching relevant literature to determine areas considered by the EC to be of key importance to the future of manufacturing. The results of this research are presented in **chapter five** (**Key Areas and Foci for Manufacturing**), under three sub-headings representing the three areas found to be of key importance (key areas).

The methodology also involves selecting and using certain indicators, in order to compare countries' performances in each of the key areas. The indicators are presented in **chapter six** (**Indicators**), along with some discussion about indicator coverage and its importance and implications.

Chapter seven (**Results**) presents the results (of combining the indicators in various ways) in the form of graphs and descriptive paragraphs. The culmination of these results is a composite value being allocated to each country, thus revealing a European Manufacturing Landscape. The following chapter (**chapter eight – Discussion and Analysis**) takes the results and presents them in various lights, as well as discussing the graphs in more depth. This chapter also attempts to compare the resulting EML index with other recognised indices

Finally, **chapter nine** (**Conclusions**) includes a presentation of the key achievements, criticism and limitations of the study, and proposes further areas for study.

2 Background – Manufacturing in Europe

2.1 Where is European manufacturing today?

In 2003 the EU manufacturing sector represented a declining 18% of employment spread over some 2.5 million manufacturing companies. (ESN 2004) It is a sector that is facing increased competition from inside and outside Europe. Low-wage countries are competing in the traditional manufacturing sectors, whilst other developed countries are showing progress at the high-tech end of manufacturing. (DG Research 2003)

On a European political level, it has been recognised that manufacturing-related activities are vital for prospering economies and societies (PROD*EU 2004). Not only does the manufacturing industry itself employ workers and create wealth in its surrounding communities, but it also creates an important node in the value creation chain bringing many other spin-off effects and related business to the region/ nation. A large and growing variety of service industries owe their existence to manufacturing; without a healthy manufacturing base there is nothing to build a service/ knowledge based society upon (HLG (Manufuture High Level Group) 2004b).

In the last industry policy communication from the European Commission (EC (European Commission) 2004a), it was stated that: "Manufacturing industry still plays a key role in Europe's prosperity. It is, however, facing challenges and there is a real concern about the risk that the Union is facing a process of deindustrialisation" (p2) In many regions and nations this is already feared to be the case on public and political levels. (EC (European Commission) 2003b)

It is a clear fact EC (European Commission) 2004a) that the "relative share of total added value (of manufacture) has decreased, while that of services has steadily increased", (p6) however it is not yet possible to speak about an ongoing de-industrialisation. What has actually taken place (EC (European Commission) 2003b) is a "rapid growth in productivity in manufacturing, the consequent increase in real incomes, and the rising demand for the output of the service sectors".(p8) This has caused a natural "reallocation of resources to services in developed countries (Europe, the United States and Japan) which has been taking place since the end of the 1950s". (EC (European Commission) 2004a) (p6)

This "structural transformation of our economies, with an ever increasing role of the services sector, is inevitable" and "with this, some de-localisation and other adjustments are bound to come". However, "the increasing importance of services in the economy does not imply that industrial output should decline. Indeed, this process has so far been associated with a continuous growth in industrial output, despite decline in industrial employment, which has been

made possible by the steady increase of industrial productivity". (EC (European Commission) 2003b) (p17)

Alarming in this context is the fact that "the European Union is experiencing a slowdown in the growth of industrial productivity" and that the R&D intensity of European enterprises is clearly below those of the US and Japan. (EC (European Commission) 2004a) (p8) This slowdown represents a loss of competitiveness (EC (European Commission) 2003b), and during an extended period of slow growth and poor productivity and innovation performance, the preconditions for a real de-industrialisation may emerge (EC (European Commission) 2004a).

"Clearly, better cost conditions abroad will inevitably attract industries that are unable to produce in the high-wage environment of modern industrial economies". Up to 2003, the delocalisation has been limited to "low-technology, labour-intensive activities" and such losses of jobs in Europe are often accompanied by the "retention or creation of new jobs in the service area". However, Europe will have to work a lot harder to retain "those jobs that are human capital- and technology –intensive, and characterised by high productivity and corresponding to high real wages" and to defend its former competitive advantage. (EC (European Commission) 2003b) (p10) It has been noted that the delocalisation of industrial activities also includes research and service activities (EC (European Commission) 2004a) (p2). This development, according to the Commission (EC (European Commission) 2003b) "constitutes a general threat to Europe's future." (p10)

For European success in this ever intensifying and vital battle for future shares of the world’s manufacturing activities "Europe must develop and strengthen further its competitive manufacturing base"(EC (European Commission) 2003b) (p10). Thus continuous innovation and continuous productivity gains are eminent (EC (European Commission) 2004d). Furthermore, it will also be necessary to improve the public image of manufacturing in order to attract and retain future talent capable of generating and applying the new knowledge(ESN 2004).

It is clear that a transformation of the manufacturing industry must occur in order to overcome the challenges and attain the knowledge and manufacturing capabilities required to make Europe a future leader in the field. According to the Manufuture High Level Group (HLG (Manufuture High Level Group) 2004a), the challenges are not merely quantitative (e.g. increased research spending), but also comprise challenges such as moving "towards a new structure…founded on knowledge and capital". "This implies a move from an economy of 'quantity' to one of 'quality', from an economy of 'use and waste' to a 'sustainable' economy." (p13)

It has been concluded (DG Research 2003) that "an important goal in fighting against the perceived trend of 'decline in manufacturing' is to help generate long-term visions for the development of new manufacturing approaches in Europe." (p5). Such shared visions for future manufacturing are missing in today's Europe.

Formulating visions for manufacturing and EU Research activities on new forms of manufacture, one has to make sure "to support the strategies and targets set out at the European Councils of Lisbon 2002, proposing the shift towards a knowledge-based economy and society; of Gothenburg 2001, formulating a European strategy for sustainable development; and of Barcelona 2002, targeting funding equal to 3% of GDP for research throughout the European Union. " (DG Research 2003) (p51)

The remaining challenge at this point and natural starting point for future policy making and action, is for the manufacturing Europe to unite behind the answer to the following question:

2.2 Where will European Manufacturing be in 2020?

In response to this question the European Commission officially launched its reflections on the future of manufacturing in Europe in October 2003 (ESN 2003b). The importance of European research being supportive to manufacturing and the need for establishment of a manufacturing technology action plan (MATAP) was stressed.

Earlier, in February 2003, at a joint Commission/Eureka workshop, the Commission was briefed on the findings of two foresight studies dedicated to manufacturing in Europe: the FutMan ("Future of Manufacturing in Europe 2015-2020: the Challenge for Sustainability") and the Eureka Factory Informan (Information for Manufacturing) 2000+ projects.

The FutMan study (IPTS (the Joint Research Centre DG Institute for Prospective Technological Studies 2004) did not see any "insurmountable social or technological barriers" that would hinder European manufacturing " to remain both competitive and sustainable by the year 2020", however it was pointed out that "it would mean the development and adoption of new paradigms of production and consumption." requiring "a quantum leap in resources to enable manufacturing research and implementation.", and furthermore the "…willingness and capability by Europe's leaders to persuade its own people and the rest of the world that sustainability was worth pursuing seriously".

The two studies involved leading academics, researchers and industrialists, and at the workshop a bright future for manufacturing in Europe as part of a

sustainable, knowledge-based society (EC (European Commission) 2003f) was pictured. This was well in line with the European Parliament strategies of the Lisbon (towards a knowledge-based society) (European Parliament 2000) and Gothenburg (sustainability) (European Parliament 2001) summits. Furthermore, consistent and effective long-term research, supporting the strategy of the European Parliament summit in Barcelona to achieve "funding equal to 3% of GDP for EU research" (European Parliament 2002), was being stated as a precondition.

In the summer of 2003, following up on the February 2003 workshop, an expert group appointed by the Research DG met to discuss the future of manufacturing in Europe. They drew on various background and policy documents published on the topic, and brought conclusions together from workshops on European industrial research and manufacturing (DG Research 2003), (EC (European Commission) 2003e). Their work resulted in the "Working document for the Manufuture 2003 Conference" – a first draft of a proposal for an action plan to manage the transition of Europe's manufacturing industry (EC (European Commission) 2003f). It also appeared to be seen as a first reflection document on the future of European Manufacturing from the Commission.

At the Manufuture 2003 conference in December 2003 in Milan (Italy) four hundred industrialists, academics, bankers and politicians met to "examine the future of European manufacturing and the role of research and education for European leadership", and to debate the above mentioned working document. (EC (European Commission) 2003g)

This was the first gathering of European expertise after the Commission's official launch in October of its reflections regarding future European manufacturing, and it sought to "help catalyse the dialogue between the major stakeholders in Europe on scientific, technological, organisational and industrial issues related to manufacturing", as well as to "seek to verify interest in forming a common European vision on the future of manufacturing technologies". (EC (European Commission) 2003e)

The two days of wide-ranging debate on the future of European manufacturing industry showed strong political and industrial consensus on the need for a detailed manufacturing technology action plan (MATAP) to boost European competitiveness in this key area of the economy. (EC (European Commission) 2003g)

Shortly after the Manufuture conference, a Manufuture High Level Group (HLG) of experts (from industry and research) was appointed by the Commission and it had its first meeting in June 2004 (ESN 2004) "to prepare a Manufuture vision"; a shared vision for the manufacturing in Europe" (p2).

According to the Commission (EC (European Commission) 2004c) "The Manufuture vision is to transform European manufacturing from a resource-intensive to a knowledge-intensive, innovative sector with all the strengths necessary to achieve and maintain leadership in the global marketplace. The resulting Strategic Research Agenda will set the scene for manufacturing in the Seventh Framework Programme." (p1).

The HLG's final work is to be presented in the Netherlands, on the 6th and 7th of December at the Manufuture 2004 conference (EC (European Commission) 2004b). At this conference the first results of the Manufacturing Visions (ManVis) foresight project will also be presented. ManVis was originally launched independently, but is now actively supporting the HLG and Commission experts with the gathered opinions of experts and stakeholders of European manufacturing. After this conference (Dreher, Warnke, & Schirrmeister 2004) the Commission will make a final decision on the implementation of a manufacturing technology action plan (MATAP), which would realise the Manufuture vision and be the "blueprint for holistic industrial research and human capital policies fostering European manufacturing" (p 9, 10) .

2.3 Manufacturing Visions

As mentioned above, the Manufacturing Visions project aims to provide input to the Manufuture vision, by gathering the opinions of experts and stakeholders.

The specific support action "Manufacturing Visions – Integrating Diverse Perspectives into Pan-European Foresight (ManVis)" began at the beginning of 2004, and its broad aim is to "accompany the ongoing policy process of enhancing European competitiveness in manufacturing industries and to feed the views of manufacturing experts and stakeholders across Europe, into the process" (Dreher, Warnke, & Schirrmeister 2004). The project is funded by the European Commission, and is scheduled to run from December 2003 to July 2005.

The lead partners in the project are:

- Fraunhofer Institute Systems and Innovation Research (ISI),
- Ascamm foundation Technology centre,
- Fundacion Observatorio de Prospectiva Tecnologia Industrial (OPTI),
- Institute for Strategy Technology and Policy STB (TNO),
- University of Cambridge, Institute for Manufacturing,
- University of Lodz, Department of Entrepeneurship and Industrial Policy,

- Institute for Prospective Technological Studies (ipts),
- Industrial Research and Development Corporation (ivf).

2.3.1 ManVis methodology

Since some of the results of the ManVis project are used as a data source for this project, a discussion of the methodology used is pertinent. The ManVis project is primarily based on a series of European workshops and a pan-European Delphi survey dealing with manufacturing issues. The Delphi methodology, the most widely established tool for generating long term visions among a heterogeneous and widespread community, is employed in the form of an online survey carried out by experts in twenty-two countries. An example page of the survey can be found in the appendices. The project is carried out by a core team of researchers from the institutes listed above, along with national partners from the twenty-two European nations taking part. The project also includes the involvement of overseas experts and stakeholders (users, consumers, and other societal groups concerned with manufacturing). (Dreher, Warnke, & Schirrmeister 2004;ISI (Fraunhofer-Institut für Systemtechnik und Innovationsforschung) 2003)

Figure 1.1 gives an overview of the ManVis approach:

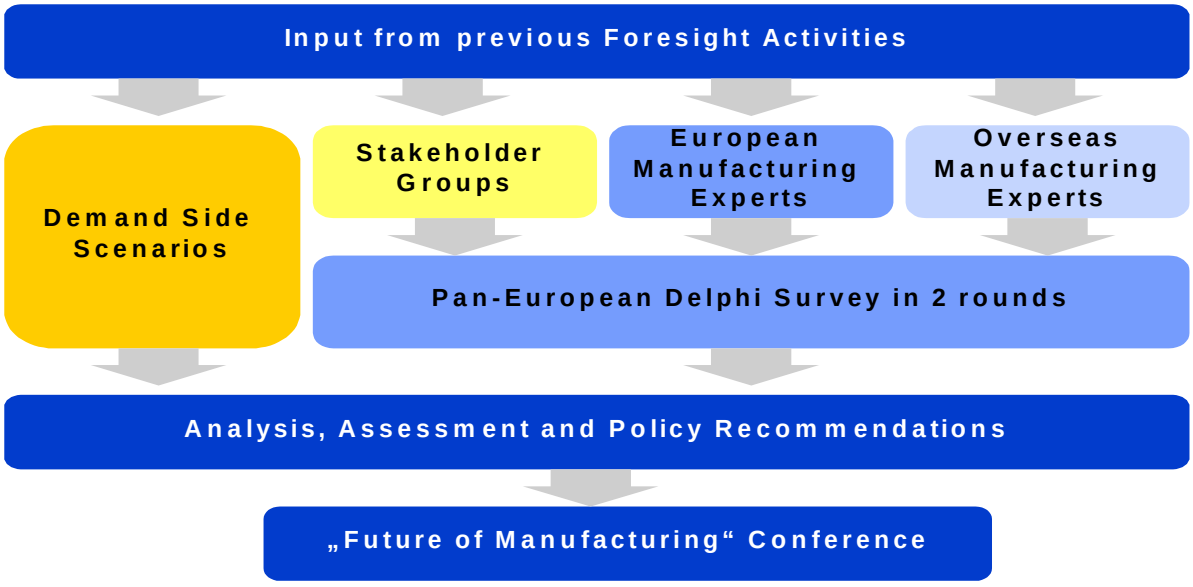


Fig. 1.1 The ManVis Approach

The first round of the survey began at the beginning of September 2004, and closed in October 2004, with 2993 experts taking part. The resulting database is used a source of information for this project. It is worth noting that distribution of the expert participation across the twenty-two countries was not comparable with the size of the manufacturing industry in some countries, and so a weighting factor was deployed in order to avoid misinterpretation of the data.

3 Project Description

Regarding the Manufuture vision, a need arises for the revelation of the current positioning of individual nations, with respect to inherent capabilities for future manufacturing. This stems from the premise that the countries in Europe have unique starting points in terms of manufacturing, and that this must be reflected in any discussion of policy recommendations for future manufacturing. This project aims to highlight the differences between the countries by creating a composite index of inherent capabilities. This index will enable an overview or ‘map’ of the European manufacturing landscape.

Obviously for a country comparison of this type, the factors to be compared must be chosen carefully, in order to ensure relevance for all countries. For example, comparing the countries based on their use of a particular technology might prove to be an unfair assessment, given that some countries might predominately manufacture goods that do not require that type of technology. For this reason, the factors to be compared have been deliberately chosen to give, as far as possible, a fair comparison of the background or inherent capabilities of the countries in Europe, i.e. they are factors which apply to every country. Also, the necessity for the factors to be relevant for future manufacturing, regardless of the realisation of different possible scenario outcomes, was also taken into account. It is worth noting at this point that no attempt has been made to prove or disprove the views of the commission and various associated experts. Using existing EC policies, studies, and preliminary results of the Manufuture High Level Group, along with consultation with the ManVis project coordination team, three key areas emerged as being both important for the future of Manufacturing in Europe and relevant to all countries. These key areas are "Manufacturing Workforce", "Operating Environment for Innovation" and "Research and Development for Manufacturing", and as such form the basis for this study.

Within each of the three areas, certain foci have been identified as being relevant to, or an issue of concern for, the particular key area. For example, within the key area "Manufacturing Workforce", a focus is placed upon "careers for women", as this is considered one of the determining factors in the issue of adequate workforce provision for the manufacturing industry in Europe. For each of the foci, a number of indicators are identified as suitable measures of that focus within a country. For example, for the focus "careers for women", one of the indicators used is number of women graduating in the "field science, mathematics and computing", or "engineering, manufacturing and construction", as a percentage of the total number graduating from those fields.

The study aims to take the results of all of these indicators, and combine them (see methodology) to provide an overview of each country’s performance in

each key area, and furthermore to propose a composite capability index for each country, in order that they might be compared against each other, with patterns or groups of countries within Europe becoming evident.

4 Methodology

The nature of this study is very much exploratory. The foundations of the study are based on extensive (although not exhaustive) desk research. Relevant information provided by the EU and EC has been covered, as well as other related studies and articles produced by independent persons or groups.

The study depends on the premise that the individual countries do in fact differ in their inherent positioning regarding the three areas defined previously. In this respect, one of the aims of the project is to establish this fact.

The project consists of four main phases, as outlined below:

- Identification of key areas and foci.
- Identification of indicators and collection of data.
- Data treatment and analysis.
- Conclusions.

The following sections discuss the methodology in detail.

4.1 Identification of key areas and Foci

As discussed previously, the three key areas "Manufacturing Workforce", "Operating Environment for Innovation" and "Research and Development for Manufacturing", have been chosen following study of various EC policy documents, consultation with the ManVis coordination team, and with particular reference to the Manufuture reports. However, these choices needed to be further justified through a more comprehensive study of the literature. Also, the foci within each key area needed to be identified, justified, and defined.

The approach to this literature study was somewhat structured, with the starting points of Manufuture documents, EC working papers and policy documents, the Informan and FutMaN projects being used as a basic framework often leading to other relevant sources. Furthermore, sources recommended by colleagues at Fraunhofer ISI were also exploited. The results of this research are shown in chapter five, in the form of a discussion and literature review.

The following table (fig 4.1) gives an overview of selected key areas and the foci within the key areas respectively:

Manufacturing Workforce	
Careers for Women	Age of workforce
Educating the Future Workforce	Workforce Training
Research & Development for Manufacturing	
R&D Spending	International Cooperation
Human Resources	Links between industry & academia
Operating Environment for Innovation	
National Policies & Government	Entrepreneurship
SME	ICT

Fig. 4.1 The key areas and their foci

Initially three additional foci were identified, one in each key area: "Output" (Research), "Image of Manufacturing Industry" (Workforce) and "Networks & Clusters" (Operating Environment). However, these were subsequently discarded due to the lack of suitable indicators.

4.2 Data collection & choice of indicators and countries

Due to the time restrictions imposed on this study, only existing data was used, and little or no attempt was made to gather completely new information. Indicators were sought to represent each foci, with a particular emphasis on relevance to manufacturing where possible.

Through Eurostat, it was often possible to withdraw data for indicators used in the European Innovation Scoreboard (EC 2005) for example, but for the economical activity manufacturing (NACE D) only. When, for example, the sub-category manufacturing was not available, or it did not make sense to break down the data, the value representing the total parent population was used.

Indicators were mainly chosen for their suitability to represent their focus. At a later stage, indicators were removed if they did not represent a sufficient number of countries. Towards the end of the collection phase, some countries were also discarded, since they could not be represented by enough indicators.

Each focus has a unique set of indicators, and a unique criterion on fulfilment rate (number of indicators through which a country is represented, out of the maximum number of indicators for that focus) was set.

At its final stage, the study covers 23 countries, represented by the three key areas (each with 4 foci) constituted by a total of 50 indicators. Approximately 1300 values have been recorded and used (see appendix for further information on individual data). Indicators representing a focus are listed under each focus respectively as they are discussed in chapter 5.

The final countries covered in this study are:

Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Latvia, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom.

4.3 Creation of Indicators & Indicator Values

The purpose of the selected indicators is that combined, they give a fair representation of their respective focus area for each country. Obviously, when selecting a limited number of indicators, it is impossible to get a fully accurate representation, but by choosing key indicators of key importance, a rough overview can be achieved.

In this study, the number of indicators for each focus varies from three to six as follows. A lower number of indicators for a focus usually signify that it has been hard to find enough good indicators for that particular focus. The original goal was to aim at around four indicators per foci.

The following table (fig. 4.2) shows the key areas and their foci, and the number of indicators representing each:

Workforce	Careers for Women	**3**
	Age of Workforce	**5**
	Educating the future Workforce	**4**
	Workforce Training	**5**
Research	R&D Spending	**4**
	International Cooperation	**3**
	Human Resources	**4**
	Links between industry & academia	**4**
Operating Environment	National Policies & Government	**3**
	Entrepreneurship	**6**
	SME	**5**
	ICT	**4**

Fig. 4.2 Number of indicators for each focus

It was necessary that all indicators were (or could be transformed into) quantitative values. Furthermore, it was necessary to define for each indicator, whether a high or low value was to be seen as positive.

Where possible, indicator values were taken from the same study and the same year. When an indicator value for a country was not available for the selected year (most often the year with the highest number of countries represented, alternatively the most recent year available), the closest reference year was chosen (e.g. if selected year was 2001, year 2000 would be selected before 2004). Selected years and exceptions for indicator values are all recorded in the appendices

For a few indicators, own calculations have been carried out. These and the partial values used are explained in the appendices.

4.3.1 Relaxed restrictions and estimations

In a few cases the indicator value for a particular country has not been possible to find. This was, for example, the case for some of the ICT indicators for France. If the country has been able to reach the required number of indicators within the particular focus, no further action has been taken. However, if the lacking data results in the country failing to fulfil the demanded number of completed indicators and thus fails to satisfy the demands stated for each foci, this value has been estimated or the restriction relaxed. The following table (Fig 4.3) gives an overview of the foci, their number of indicators and the number of indicators required for a country to be included in the study:

Key Area	Foci	Num. of ind. / foci	Min req. ind. / foci
Workforce	Careers for Women	3	2
	Age of Workforce	5	3
	Educating the future Workforce	4	3*
	Workforce Training	5	3
Research	R&D Spending	4	3
	International Cooperation	3	3
	Human Resources	4	3
	Links between industry & academia	4	3**
Operating Environment	National Policies & Government	3	2
	Entrepreneurship	6	5***
	SME	5	3****
	ICT	4	3

Fig. 4.3 Indicator requirements

* *Apart from Greece which only has 2 indicators.*

** *Apart from Norway which only has 2 indicators.*

*** *Apart from Czech Republic, Latvia, Lithuania and Romania which only have 4 indicators.*

**** *Apart from Latvia which only has 2 indicators.*

4.3.2 Normalisation & Grading

Following the selection of countries, and gathering of indicator values, the indicator values (IV) are normalised. The normalisation is performed by letting each value take a value in the range [0; 1], where the best performing country's indicator value (IV_{MAX}) receives a value of 1 for that indicator (and consequently the indicator value of the worst performing country (IV_{MIN}) is converted into a "0"). The normalisation is done with the following algorithm:

$$X_c \in [0,1] \quad X_c = \frac{IV_c}{IV_{MAX} - IV_{MIN}}$$

Hence, if two countries have the same initial value (IV_c), they will also receive the same normalised value (X_c).

One of the criticisms of this method is that even if all countries perform relatively well in a given indicator, there will still be a country receiving the lowest value (0). Furthermore, if there is one country that is outperforming

compared to all other countries, it will be rewarded with a 1, while it is possible for all the rest to receive <0.2 for example. However, the clear benefit of this system is its simplicity and transparency.

The European Commission, when calculating the Summary Innovation Index as part of their European Innovation Scoreboard also uses this method. For details, see page 37 of the commission staff working paper (EC(European Commission), 2004e)

4.4 Foci Values

A country's foci values are calculated from its available indicator values for each focus respectively. The lowest number of indicator values that each country must be represented by for each focus is given in Figure 4.3 above.

A country's foci values are calculated as the arithmetic average of the country's available indicator values for each focus respectively.

It could be argued that different indicator values may hold different importance with respect to the focus area they are representing. However, in this study we have chosen to give participating indicators the same weight (hence arithmetic average) within their focus.

Naturally, it is desirable to have all countries' foci values represented and derived from all suggested indicator values for each focus area. Nevertheless, due to lack of data this is not always possible. A full overview of the available number of indicator values for each country and foci is available in the appendices.

4.5 Key Area Values

Each country is given an aggregated value for each of the three key areas. This is calculated as the arithmetic average of the key area's foci – i.e. there is no weighting between the foci. If key area values were to be calculated using the indicator values directly (with no weighting) this would result in foci being given different importance (since the foci values are not based on the same number of indicators).

An average for the participating 23 countries, abbreviated "ave-23", has also been calculated. This is the arithmetic average of the participating countries results for each key area. This does not take into account the relative importance/ size of the manufacturing industries within the participating countries. An alternative methodology might include an appropriate weighting factor to overcome this.

To distinguish the different countries from each other, with regard to their over-all key area performance, they have been divided into three different groups. These groups are: countries out-performing the average (ave-23) result with 20% or more, countries within the span (+20, -20) % from the average, and countries performing worse or equal to -20% of the average.

This is the same deviation from the average result in use by the European Innovation Scoreboard 2004, when attempting to show discrepancies between countries.

4.6 Composite Capability Index Values

The composite capability index values for each country are arithmetic averages calculated from all key area values for each country respectively. Since the number of foci in each key area is the same, this procedure will not favour any individual focus.

Obviously, the "capability values" are a very rough representation of a lot more detailed and complex reality, and as such, should be treated and interpreted with a degree of caution.

It is arguable whether minor differences between capability values are of any significance, given the methods, simplifications, and assumptions employed. However, larger differences between the countries may be observed, and the countries will be grouped into the same three categories described under the section "key area values". It is hoped that this will represent differences in the relative strength of the participating countries inherent capability for future manufacturing (based on prerequisites high-lighted by the European Commission).

For an analysis of individual countries, this value is of little interest on its own. For this purpose the key area values (in relation to other countries') and the foci values will be investigated instead. To identify drivers behind foci results, it may be interesting to examine individual indicators' values (and to question them and predict their future development).

5 Key Areas for Future Manufacturing

The three key areas of this study are: "Manufacturing Workforce", "Operating Environment for Innovation" and "Research and Development for Manufacturing", as explained at the end of the background chapter. Henceforth, these are known as Workforce, Operating Environment for Innovation, and Research.

The following sections describe the three key areas in more detail, giving reasoning for the importance of the area, both for Europe as a whole, and in most cases for the manufacturing industry in particular. As well as a general description of each key area, its background and its importance, four foci are identified. These foci are defined as issues of interest within each key area. They are not necessarily an exhaustive collection of the relevant issues within each key area. In most cases, the foci have been chosen with aim of this project (to measure and compare on a national basis) in mind. Hence, there may well be important issues within a key area, which are not identified as foci, since it may not be possible or relevant to look at these issues on a national level. The following diagram (Figure 5.1) gives and overview of the key areas and their respective foci:

Workforce	**Careers for Women**
	Age of Workforce
	Educating the future Workforce
	Workforce Training
Research	**R&D Spending**
	International Cooperation
	Human Resources
	Links between industry & academia
Operating Environment	**National Policies & Government**
	Entrepreneurship
	SME
	ICT

Fig. 5.1 Key areas and foci

5.1 Key area - Workforce

Many concerns have been expressed by many different parties, concerning the future workforce of Europe, particularly fuelled by the strategy goal set at the Lisbon European Council, for Europe to become "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion" (European Parliament 2000). The level of take-up by European's of lifelong learning is low, and levels of failure at school and of social exclusion, which have a high individual, social and economic cost, remain too high. Also, in 2003 there had been no signs of any substantial increase in overall investment in human resources(EC (European Commission) 2003a). This has led to strategies which focus on the implementation of concepts such as lifelong learning within Europe (EC & Cedefop 2003). Europe is not alone in establishing the importance of developing the workforce. In America, the dean of the Yale School of Management made the following comment in the Herald Tribune: "In an advanced economy like ours, price should be less of a selling point than the quality and sophistication of a product. This isn't going to happen unless we improve the fundamentals underlying competitiveness – our education system and labor-force skills." (Garten 2004)

These concerns surrounding workforce, education and training are also found to be particularly relevant to manufacturing. The FutMan project highlighted the importance of demographics and education and skills as factors significantly impacting the context for manufacturing (Flanagan et al. 2003). The European Commission's communication on Industrial policy in an enlarged Europe highlighted one of the crosscutting factors underpinning competitiveness and growth to be:

'A high level of social cohesion and a well-trained, highly educated and adaptable workforce, which, even though it needs constant improvement, in particular through lifelong learning and retraining, is a core aspect of the knowledge economy.' (EC (European Commission) 2002a)

It has also been stated that one of the main drivers towards successful future manufacturing in Europe is the 'key role of education and training'. This is justified by the explanation that skills shortages in Europe, in the areas of expertise needed by manufacturing industry have a significant impact on European companies and, as a consequence on economic growth and employment (DG Research 2003). Indeed, the ManuFuture document supported this view by stating that there is a 'significant and growing shortage of high calibre apprentices, qualified workers, technicians, engineers and researchers in most European countries and sectors.' (DG Research

2003)Alongside this, the Informan project database (IFM University of Cambridge 2003) contains several statements from European experts concerning the future manufacturing workforce:

"The industry will increasingly rely on a more diverse range of skills and will need to address the image that it portrays to ensure that it can capture enough people with the quality of skills necessary…"

"Employees are becoming the most important capital of the company. Motivation and release of creativity are goals of staff development"

"We must start by attracting the right people to work in manufacturing. We must raise public awareness of what our industry is about..."

"The demographic shift will accentuate competition for good staff"

"Science and maths students are becoming less common and (this) will lead to a shortage".

The concerns surrounding the future manufacturing workforce are so great that the ManuFuture document suggests that the issue must be seen as "critical for the medium to long-term potential of manufacturing industry in the EU" (DG Research 2003).

The FutMaN project concluded that Europe's strength will diminish in the future due to 'demographic change, reduced investment in education and a lack of enthusiasm for Science and Technology among European youth.' Concerns were also expressed about the possibility of shortages in adequately qualified and skilled personnel. It was suggested that although demographic trends of ageing are partly responsible for causing the fears, the perceived unattractiveness of manufacturing industry as a career poses on of the biggest problems. The study also proposed that there is a need to reverse the trend that has seen top Science and Technology graduates choosing career paths in financial services etc (IPTS (the Joint Research Centre DG Institute for Prospective Technological Studies 2004).

5.1.1 Focus: Careers for Women

As well as improving the image of the manufacturing industry in general, it is also generally considered important to broaden the appeal to women of working in manufacturing. According to the Manufuture vision "more effort needs to be made to attract women to technical jobs, which too often have been dominated by male employment."

According to one report, the percentage of female scientists and engineers in the EU-25 countries in 2002 was 31.4%. In some countries it was considerably less than this (France 22.1%, Germany 20.8%) (Götzfried 2004). Phillippe

Busquin, the EC Commissioner for Research stated (in his preface to a report about statistics and indicators for women and science) that: "indeed, we will not reach the 3% objective if we fail to recruit, retain and promote the women who constitute an important share of Europe's pool of trained scientists." (EC (European Commission) 2003d)

Another report, commissioned by the General Directorate of Research concluded that the under-representation of women "threatens the goals of science in achieving excellence, as well as being wasteful and unjust" (ETAN Expert Working Group on Women and Science 1999). The report suggests that there is a challenge for education, and that the sex-stereotyping of scientists needs to be tackled through curriculum, pedagogy and the media. Certain strategies are suggested in order to encourage women to enter and remain in science, such as 'role models, mentoring, networks, schemes for parents returning after career breaks, and encouragement to women to apply for fellowships and posts. " It is also proposed that improvements in the quality of science could be brought about through more gender-aware research, and that a stronger presence of women in research would "improve the utilisation of human resources whilst enriching the scientific enterprise by bringing in new themes and perspectives".

5.1.2 Focus: Age of workforce

The average age of Europe's population is increasing. The working-age population was 225 million in 1995, and is expected to remain fairly constant at around 223 million in 2025. However, the over-65 population is anticipated to rise from 15.4% of the EU population in 1995 to 22.4% by 2025 (Geddes 2002). Also, as can be seen in the following graph (fig. 5.2), the rate of population growth in Europe is falling:

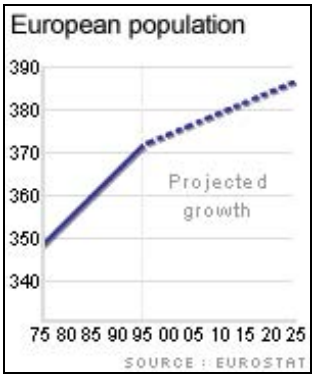


Fig. 5.2 Projected European population growth (Geddes 2002)

It has also been considered that EU enlargement 'promises relatively little respite from the age curve: most candidate countries show similar trends to those of the existing 15'. (Flanagan, Green, Malik, Miles, Leitner, Dachs, Wagner, & Weber 2003)

The FutMaN report states that "in a Knowledge Economy the quantity and quality of Human Capital, and its deployment, will prove crucial to the EU's rate of development. (IPTS (the Joint Research Centre DG Institute for Prospective Technological Studies 2004). The ManuFuture report supports this statement by saying that there is "No progress without a skilled workforce". Furthermore the report argues that in the short-term it is necessary to "increase the available skilled workforce in order to bridge existing gaps" (DG Research 2003). One of the challenges faced in order to achieve this increase is to create more opportunities for employees to have longer careers, by reversing the existing trend for people to take early retirement. At a time when the service content of manufactured goods is increasing, it is extremely important to retain employees who have acquired, developed and maintained the vital skills needed in the Manufacturing industry (DG Research 2003).

It has been found, for example, that in France a comprehensive set of measures has been put in place to reduce the incidence of early retirement, including management of the skill and employment demographics of the firm to allow for timely retraining, using older workers as mentors for younger colleagues. (Arundel & Hollanders 2003) In Finland a National Programme on ageing Workers was developed with the aim of encouraging older workers to remain in work and help them to cope therein, and also to improve their chances of finding work in the first place. (Finnish Ministry of Social Affairs and Health 2002)

However Richard Greenhalgh, Chairman of the UK division of one of the world's largest manufacturers of Fast Moving Consumer Goods (Unilever), urged EU member states to "show their political will by translating more of their fine words into concrete measures, grasp the nettle more resolutely on the long term impact of Europe's ageing populations." (Greenhalgh 2003)

There have been suggestions by some analysts that immigration could solve Europe's labour market problems, and this view seems to have been backed by a United Nations report on replacement migration. (UN 2000) Both the UK and Germany announced schemes to attract skilled immigrant workers. The Italian government however, put restrictive immigration laws in place (Geddes 2002). The ManuFuture report concludes that more flexible immigration policies for skilled workers from other countries would enable replenishment of the reservoir of skilled personnel. However, it also points out that this should only be seen as a partial solution. Also, the necessity to avoid a brain-drain in the candidate countries, which could cause economic and political destabilisation, is highlighted (DG Research 2003).

5.1.3 Focus: Educating the Future Workforce

Many of the concerns surrounding the future of the manufacturing workforce in Europe focus on Education at schools and universities. The ManuFuture report highlighted that in the longer-term perspective, the steps to be taken in order to increase the quantity and quality of the manufacturing workforce were mostly related to education at schools, universities, higher education institutes and vocational schools. Some of these steps are shown in figure .5.3below. Also, the general lack of private sector investment in higher education and vocational training in Europe compared to its main competitors has been cited as a reason for Europe's innovation performance continuing to 'lag behind' (EC (European Commission) 2003b)

- To reinforce formal scientific education from primary schools up to university level, as well as informal education at all ages, in order to increase scientific, technical, and holistic literacy among Europeans;
- To adapt existing national education structures, making them more flexible to cope with the ever-changing conditions on the labour market. This needs to be done through a better coordination between national and regional authorities and industry;
- To open up many more universities and higher education institutions to foreign students who could play a key role in helping to fulfil the future needs of the European manufacturing industry. This tradition has been lost in many countries (often to the benefit of the USA) and needs to be reinstated;
- To ensure that there are enough teachers in general educational and vocational schools, plus professors at universities, who are sufficiently highly qualified and have the ability to teach pupils in the required subjects (a major concern is the ageing population of teachers in Europe; more that 60% are over 40 years old);
- To (re-) develop and permanently adapt the apprenticeship/vocational schools' curricula to reflect the needs of manufacturing industry. The loss of the apprenticeship tradition in many sectors and countries is at the root of the problems we face today. This will need concrete action at a national or regional level.

Fig. 5.3 Increasing quality and quantity of Manufacturing Workforce(DG Research 2003)

The problems seem to stem from the fact that "the development of educational curricula has not kept pace with the growing complexity of industry and the

economy, and even less with the rapid development of new technologies" (DG Research 2003).

However, it is not just the quality of education that is a cause for concern. The poor image of manufacturing in today's society means that less young people are interested in studying manufacturing related subjects:

"Despite the key role of manufacturing in the economy and our society, its common image - especially among the younger generation – is one of an old-fashioned, dirty and polluting industry providing insecure, unhealthy employment than that of a sector providing desirable jobs and real sustainable development. This creates a vicious circle: young people do not see their future in manufacturing. Universities have difficulties in getting new engineering students. Companies have difficulties finding the right people and tend to either decrease their expectations and potentially the quality and added value of their services, or look for other investment opportunities elsewhere." (DG Research 2003) (p 49)

Along a similar theme, a foresight exercise carried out in the UK pinpointed the need to 'raise public awareness of what our industry is about'. It also made a strategic recommendation to 'Improve Public Understanding of Industry and Attract Young People'. It is suggested that a raised awareness of manufacturing industry across society, improved image of manufacturing industry, and attraction of highly qualified young people, can be achieved through the participation of industry in providing all school children and teachers with "direct experiences of industry, closely related to the national curriculum and with classroom activities encouraging innovation and creativity, revealing industry as an exiting place to work." (M2020 Foresight panel - Department of Trade and Industry 2000) (p14)

The link between education and manufacturing's future has also been noted in the US, where the society of Manufacturing Engineers has created an Education Foundation. The director of the foundation made the following statement:

"The strength of manufacturing's future is dependent on the ability of all levels of the educational structure to respond to the needs of industry and develop and maintain a skilled workforce." (Maires 2001)

The foundation aims to 'fill the pipeline' with individuals interested in manufacturing, and prepare students to graduate with the skills industry seeks.

The FutMaN project concluded that: 'In general, students are arguably less that fully prepared to meet the challenges of the future:

The ManuFuture report points out the argument that manufacturing as a subject cannot be efficiently handled inside a university classroom, and that this poses a strategic challenge for manufacturing related education in Europe. The conclusion drawn is that 'integrating the factory environment with the classroom concept' might be the only way forward (DG Research 2003). In Germany, Volkswagen has made the strategic decision to spend € 300 million on a new corporate University, which is to be opened next year near the headquarters in Wolfsburg. The company's chief executive said that the role of the University would be to "systematically channel innovation impulses from the outside to the inside, and pump the knowledge of the future into our company". Of the students, he said "we don't want them to learn textbook cases by heart. We want them to generate value by working on real cases." Volkswagen is not alone. Companies increasingly feel the need to train their staff in a specific way, and some have lost faith in the official educational system. (Becker 2004)

The professor of Economic Policy in Spain's University of Ramon Llull (Punset Casals, Andreta, & Kroto 2003), also believes that there is a need for forging a stronger relationship between academia and industry, and suggests that the outcome of fruitful collaboration will be a future workforce with the necessary qualities to work together in multi-disciplinary teams, to show leadership and to think creatively. The FutMan report also highlighted the increasing importance of teamwork under multicultural circumstances, and pointed out that educational institutions do not often adequately provide the necessary training and education to foster communication skills across the cultural frontiers (DG Research 2003).

5.1.4 Focus: Workforce Training

Since the European Year of Lifelong Learning (1996), when the Council first adopted conclusions on the subject, the idea of lifelong learning (LLL) has grown considerably in importance both at Community and national level. (EC & Cedefop 2003) At the Lisbon summit 2000 and Barcelona Summit 2002, lifelong learning was acknowledged to have a key role within the European social model (Popper 2004).

Lifelong learning is defined, within the European Employment Strategy, as all purposeful learning activity, undertaken on an ongoing basis with the aim of improving knowledge, skills and competence (Nijhof 2004). Following the conclusions of the Lisbon European Council, which confirmed that the move towards lifelong learning must accompany a successful transition to a knowledge-based economy and society, the commission staff produced a memorandum on lifelong learning. This working paper highlighted six key messages, which offered 'a structured framework for an open debate on

putting lifelong learning into practice'. These key messages suggested that a lifelong learning strategy for Europe should aim to:

- Guarantee universal and continuing access to learning for gaining and renewing the skills needed for sustained participation in the knowledge society.
- Visibly raise levels of investment in human resources in order to place priority on Europe's most important asset – its people.
- Develop effective teaching and learning methods and contexts for the continuum of lifelong and lifewide learning.
- Significantly improve the ways in which learning participation and outcomes are understood and appreciated, particularly non-formal and informal learning.
- Ensure that everyone can easily access good quality information and advice about learning opportunities throughout Europe and throughout their lives.
- Provide lifelong learning opportunities as close to learners as possible, in their own communities and supported through ICT-based facilities wherever appropriate. (EC (European Commission) 2000)

It is considered that lifelong learning is not just a general European concern, but also a concern specifically relevant to the manufacturing industry. The ManuFuture project concluded that "for (manufacturing) companies to maintain and increase their innovative potential, it is essential that they have access to a highly skilled committed and adaptable workforce." It also pointed out that in the context of an ageing demographic, and trend for early retirement, "it is vital to ensure that the conditions exist to foster lifelong learning": (DG Research 2003) The FutMaN final report stated that the concept of lifelong learning cannot be stressed enough. It also suggested that vocational training is still a difficult issue, due to the unhelpful attitudes of some employers and employees. It is apparently not uncommon for an organisation to concentrate most of its vocational training on a limited number of specially selected people, and this is an approach, which may have to 'widen' if European manufacturing firms want to be competitive in the future. (IPTS (the Joint Research Centre DG Institute for Prospective Technological Studies 2004)

The Industrial approaches section of the FutMan project also had several comments and recommendations concerning the great importance of a workforce that is not only highly skilled, but also committed to perpetual learning and development, for the manufacturing sector. (Flanagan, Green, Malik, Miles, Leitner, Dachs, Wagner, & Weber 2003) The report stressed that although a focus on secondary education and pre-employment training and conditioning is essential, this preparatory learning must be reinforced continuously with intensive job-related training and upskilling. It was also highlighted that employers are reporting deficits in key skills such as

communications, numeracy, IT, teamwork, problem solving and worker-led performance improvement. However, because of the importance of the work environment to much adult learning, employers have a significant role to play. The value of experience and tacit knowledge has increased, thus learning must be an integral part of each individual's everyday activity, with perpetual up-skilling (and periodic re-skilling) replacing training for a particular job (Flanagan, Green, Malik, Miles, Leitner, Dachs, Wagner, & Weber 2003).

It is predicted that in the future, manufacturing firms will recognise the positive returns from investment in human resource development in terms of productivity, and will provide specific training and enabling conditions for organisational learning. Enterprises will implement policies and practices, which facilitate the process of 'learning by doing' which lead to effective learning organisations characterised by flexible workplace organisation. (Flanagan, Green, Malik, Miles, Leitner, Dachs, Wagner, & Weber 2003)

In terms of the individual employees, a state should exist where workers view their skills and qualifications as a long-term investment, i.e. a strategic asset that not only assists them in forging a career path, but also in strengthening their employability throughout the whole working life-cycle. For highly skilled workers, personal management targeted at reconciling or synchronising working and non-working time/life will become a key life skill. Also, a strong entrepreneurial attitude is required for knowledge workers to cope with risk and uncertainty in the workplace.

5.2 Key area – Research and Development

"If the manufacturing sector is to survive over the next two decades, it will have to undergo dramatic changes in technological, environmental, economic, and social terms." (DG Research 2003) In order to achieve these changes, a significant increase in research actions is required, particularly those driving towards a 'Manufuture' of high-tech, flexible, clean, safe, highly skilled and society-driven manufacturing organisations.

At the March 2002 Barcelona European Council, the EU agreed that overall spending on Research and Development in the Union should be increased with the aim of approaching 3% of GDP by 2010. It was also agreed that two thirds of this new investment should come from the private sector (European Parliament 2002).

With this background, three of the five drivers for stimulating the transformation of the manufacturing industry, highlighted at the Manufuture conference, were specifically related to research. The first concerned increasing research actions and research infrastructures, the second concerned international cooperation in manufacturing research, and the third, an increased competitiveness of European research (DG Research 2003).The mere fact that three of the five drivers focussed on research, highlights the important role it has to play in the future of manufacturing. Due to the nature of this project (a comparison at national level), the third driver (increased competitiveness of European research) is not taken into account here. However, the first two drivers mentioned form the basis for the choice of this key area. The Informan foresight project also resulted in a large amount of statements concerning research, a sample of which is given below:

"There must be an emphasis on greater research collaboration between the higher education system, research institutions and companies that cross the boundaries between fields of knowledge and between industries."

"Public support for Research and Technology in the defence and aerospace industries is vital to its success."

"Cooperation between industry and research and technological centres is essential"

"Research has to be subjected to structural changes to meet the new framework"

"There is an increasing need for research to be conducted by cross-functional and multi-disciplinary teams"

(IFM University of Cambridge 2003)

Although these statements come from individual countries' foresight activities, and hence can't necessarily be taken to be true for all countries in Europe, the fact that so many of the statements concern research (be it support for research, research infrastructures, or cooperation between research institutions and other bodies) stands as testament to the importance of the field (and hence its inclusion as a key area in this study).

The ManuFuture conference (DG Research 2003;European Parliament 2002) highlighted the fact that the Barcelona 3% objective implies a drastically growing number of researchers by 2010. It was also pointed out that the gap in research investment between the EU and the United States is already in excess of €120 billion per year, and that this will possibly lead to serious long-term consequences for innovation, growth and employment creation potential in Europe.

The Manufuture high level group concluded that "research and the application of research in the form of commercially exploitable innovations are central to realisation of the Manufuture vision" (HLG (Manufuture High Level Group) 2004a) (p 8)

With respect to achieving the Lisbon objective, the high level group pointed out the importance of the establishment of "appropriate research infrastructure" as well as the encouragement of the "mobility of researchers" as being key aspects. (HLG (Manufuture High Level Group) 2004a) (p3)

The importance of the human resources aspect of research was highlighted in a commission communication (EC (European commission) 2003a) which suggested that both the number of researchers and their mobility need to be increased.

It has been suggested that several factors concerning the current state of research in Europe are discouraging investments in the field, thus creating a vicious cycle. These factors are said to include: "the shortcomings and rigidities of research careers, leading excellent human resources to move out of research or out of Europe; the dispersion and lack of visibility of Europe's often excellent research; the difficulties encountered by technology-intensive SMEs to find financing for their research and innovation projects; and the lack of awareness of researchers and research managers regarding the protection and management of intellectual property." (EC (European commission) 2003b)

Before looking at the individual foci in detail, it is perhaps necessary to ask the question "what is research?", or more pertinently, "what is a researcher?" According to the internationally recognised Frascati definition:

"Research and experimental development (R&D) comprise creative work undertaken on a systematic basis in order to increase the stock of knowledge,

including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications"

Hence, researchers can be described as:

Professionals engaged in the conception or creation of the new knowledge, products, processes, methods and systems, and in the management of the projects concerned.

Research is carried out in a variety of settings, primarily Universities, public or private research organisations or academies of science, certain large-scale industrial actors, and technologically based SMEs.

5.2.1 Focus: R&D Spending

As discussed above, the goal set by the European Council at Barcelona was to increase the EU's R&D investment to 3% of GDP in 2010, with two-thirds of the total coming from the private sector. According to a commission communication in 2004, Europe is still well below the levels required to meet the 3% objective. In particular, it is pointed out that private-sector research spending remains well below the necessary level, with the EU far behind Japan and the United States. (EC (European Commission) 2004a) The commission report gave the following four factors as explanations for Europe's disappointing performance:

- The greater difficulty is accessing private research financing funds for research in Europe compared to the US.
- A culture which is – sometimes – too prudent towards risk (as evidenced by the difficulties of the biotechnology industry)
- An insufficient collaboration between public research bodies, including universities and the industrial sector.
- A much lower proportion of researchers in the active population.

(EC (European Commission) 2004a)

In 2003, Europe produced an action plan for investing in research. (EC (European commission) 2003b) In this plan, it was stated that one of the main priorities was to increase public funding for research, both at member state and EU national levels. Another priority was 'to improve the framework conditions for offering businesses an environment which lends itself to investment in research and which encourages them to increase their investments in Europe.' The plan outlines that in order to reach the Barcelona objective, research investment should grow at an average rate of 8% every year, shared between a 6% growth rate for public expenditure and a 9% yearly growth rate for private investment. It is explained that while this is an ambitious

target, it is not entirely outside the bounds of reality, given the importance of, and support for, the objective.

The Manufuture conference working document also discussed the need for increased private and public investment in research, and also the necessity for an improved mix and effectiveness of public-private financing instruments (DG Research 2003;EC (European Commission) 2004a). The important relationship between investments in manufacturing capacities, and innovation and growth was also noted. The document also includes the following information (Fig. 5.4) about the trend in government and industry funding of research observed by the OECD between 1990 and 2000:

Funding\ year	1990	2000
Government	39,60%	28,90%
Industry	57,50	63,90%

Fig. 5.4 Trends in research funding

It is suggested that industries must endeavour to continue this trend, by increasing their investment in research, with a particular emphasis on a shift towards more long-term research investment.

The two areas where private sector investment is most needed are trans-European networks, and major R&D projects. It is believed that there are many complex obstacles to be removed before this will happen and that the member states must take a long-term view and develop credible policies to remove regulatory and technical obstacles that hinder an acceleration of investment in these fields. (ESN 2003b)

From September 2002 onwards, the Commission undertook a consultation of European institutions, Member States, acceding and candidate countries, as well as of stakeholders, notably European industry and the financial sector. According to a commission communication (EC (European commission) 2003b), the responses were overwhelmingly supportive o the 3% objective and of its emphasis on business investment in research. All the Member States, acceding and candidate countries agreed on the importance of increasing investment in research, and most indicated that they had already put in place policies and concrete measures to that effect, or were in the process of doing so. At the time of the responses, France, Germany and Slovenia had actually adopted the 3% objective for themselves.

5.2.2 Focus: International Cooperation

International cooperation in research is generally regarded to be very important. In the words of the ManuFuture conference working document, it is a 'means of acquiring synergy in the common interest'. (DG Research 2003) According to the document, the reason for the continued need for research activities to attract international partners is two fold. Firstly it is necessary in order to benchmark research and to raise S&T standards, and secondly it promotes the spread of EU excellence. With regard to the enlargement of the European Union, it is suggested that a lot of potential exists for the manufacturing industry, and that the cultures of other countries bring complementary views to those perceived by EU industry so far (DG Research 2003).

Regarding FP6, international co-operation is highly relevant, in accordance with the strategic objectives of an ERA (European Research Area) that is open to the world. According to a commission publication on industrial research in Europe (ESN 2003a), research needs appropriate critical mass, and therefore benefits dramatically from an international dimension. For this reason, all the thematic areas of the FP6 are open to third countries.

Another sign of the recognised need for international cooperation in research is Eureka, a pan-European organisation that promotes and coordinates research and development co-operation. (Eureka! 2004)

5.2.3 Focus: Human Resources

"Human resources are, to a large extent, the key of research efforts, excellence, and performance. The numbers of researchers, as well as their mobility, are two important aspects of this issue". (EC (European commission) 2003a)

The document for the Manufuture conference highlights the inherent implication of the Barcelona objective, that a drastically growing number of researchers are needed if the objective is to be achieved. This is particularly poignant when one takes into account the fact that many current researchers will be retired by 2010. (DG Research 2003) The document also points out that the issue of gaining more researchers is a 'very complex' one, and that one of the main challenges to be tackled concerns stimulating young people to chose a career in engineering or technology research.

In January 2000, the Commission adopted a Communication proposing the creation of a European Research Area (ERA) which appealed, amongst other things, for more abundant and more mobile human resources (EC (European commission) 2000). When setting up the ERA, the Commission emphasised

the importance of Human Resources and mobility, for the creation of a knowledge-based Europe. In effect, they intended to mobilise abundant and adequate Human Resources for the fulfilment of Europe's ambitions in the scientific area. Mobility represents one of the essential factors of this mobilisation, by "facilitating the acquisition of the necessary skills and their adjustment to the needs of research".

This concern for increased mobility of researchers in the ERA, led to the creation of "A Mobility Strategy for the European Research Area" (EC (European Commission) 2003a). This strategy aims at enhancing the living and working environments of researchers in Europe in order to attract and maintain a high level of Human Resources in research, both quantitatively and qualitatively. A further concern is the growing tendency to "dispose of mid-career researchers through early or forced retirement schemes or transfer to non scientific posts…leading to a waste of talents and experience" (EC (European commission) 2003a).

It is clear that the mobility of researchers is of high value, and of fundamental importance for the efficient operation of the ERA. However, it is necessary to perceive mobility in its complete sense, thus understanding that it is a dynamic process, incorporating both "sources and sinks" (Faegri et al. 2002). It has been noted that while mobility is in general a positive feature for the Europeanization of research, it also has a more problematic face in respect to competition for human resources. In short, *one nation's brain drain is another nation's brain gain.*

A useful measure of the migration within Europe can be obtained from the EU Marie Curie fellowship schemes,(EC (European commission) 2004) which provide substantial resources within Europe for the mobility of young researchers amongst Member States and Associated States. For example, the United Kingdom stands out as being the net beneficiary of the scheme, followed by the Netherlands, Sweden and Belgium. For Germany and France, there is more or less a balance between incoming and outgoing Marie Curie Fellows. What is interesting is the migration of researchers from the New Member States. Currently they choose the UK, France, Germany and the Netherlands as host countries, although their long-term status is, as yet, unclear.

The obstacles to researcher mobility can be said to fall under the following four headings:

1. Legal and administrative obstacles to trans-national mobility

2. Social, cultural and practical obstacles to trans-national mobility

3. Obstacles to a European dimension in research careers

4. Obstacles to inter-sectoral mobility.

In addition, social, cultural, linguistic and economic factors, often resulting from a lack of recognition of qualifications and of relevant social and economic information, constitute further barriers (Faegri, Findlay, Burke, Pancheri, Scholz, & Schütte 2002).

5.2.4 Focus: Industry/academia/institutional cooperation

Collaborative partnerships between academia and industry, or private and public funded research organisations have emerged as a critical imperative necessary to sustain transfer of knowledge and innovation (EC (European commission) 2003a). Indeed, a report to the commission (PREST 2003) suggested that 'linkages between the research actors and industry have to be established or strengthened, universities and research institutes need to get more involved in the innovation sphere through networking/clustering, and the establishment of innovative university spin-offs should be supported.'

According to a report by the ESF (ESF (European Science Foundation) 2002), one of the weaknesses of Europe's academic research system is its 'frequent inability to engage itself fully with industry'. Bridging the gap between academia and industry is, according to the report, an essential requirement in the creation of the European Research Area, and for the continuing development of Europe's economy. The report is based on a meeting of industry leaders, which took place in Stockholm, and outlines an action agenda for change. The objectives of the proposed agenda are to:

- Help academia to prepare the best and the brightest for careers in industrial research.
- Develop mechanisms for Europe's academic institutions to be able to reward excellence in a public manner.
- Seed the creation of public databases that would compare research departments in universities, thereby empowering industry and graduating students to seek the best.
- Lay the foundations for strengthened and improved industry/academic partnerships across Europe.

The first section of the action plan deals specifically with increasing the interaction between academia and industry, and highlights four action items as summarised in the following box (Figure 5.5):

Bring more industrialists into universities

Appoint industrial scientists to adjunct faculty positions in universities.

Introduce real problems from industry into the lecture theatre, allowing young scientists to gain a better understanding of the practice of commercial science and its quality.

Offer young scientists access to mentors in industry, thus demonstrating that leaving academia for industrial research needs to be seen as a success and not a failure.

Provide more opportunities for academics to spend time in industry

Support sabbatical fellowships to allow academics to spend short periods working in industrial laboratories.

Support the creation of new professorial chairs and centres of excellence within universities that explicitly involve cooperation with industry.

Create opportunities for academic scientists to interact with industrialists

Make special funding available to enable PhD students and postdoctoral fellows to attend meetings in which academic researchers can interact with scientists working in different disciplines, as well as with journalists and politicians.

Get companies to encourage their scientists to present their work at academic meetings.

Encourage Universities to develop informal platforms for bringing together their researchers with local industry scientists.

Encourage companies to undertake and publish 'knowledge –sharing reporting' – annual audits of the efforts they have made to share their research findings with a wider scientific audience.

Develop opportunities for scientists-in-training to interact with industry.

Develop more joint academia/industry research projects so that many more postgraduate students have the opportunity to spend at least part of their PhD training period in industry labs.

Use Web sites frequented by students and postdoctoral fellows to display the excitement of careers in industry.

Fig. 5.5 How to increase interaction between industry and academia (adapted from ESF 2002)

However, despite these and other suggestions, there still exist systemic weaknesses in Europe's academic system, and its tenuous links to industry. Perhaps one of the reasons for this is the concept of academic freedom, which researchers are so keen to preserve (EC (European commission) 2003a). According to the commission, social, political and financial pressures have grown to justify the practical relevance of research carried out in academia. Despite this, applied research projects are still granted a lower status, and academics involved in industry are not seen as serious candidates for academic promotion. Within this context, a job in industry might be regarded as a second-class option and conversely, the formal requirement (a doctoral degree) for an academic position makes it difficult for industrial researchers to move to academia.

5.3 Key area - Operating Environment for Industrial Innovation

It has been highlighted (DG Research 2003) that one of the key drivers in stimulating the transformation of the manufacturing industry in Europe is the need for a stimulating operating environment for industrial innovation. Furthermore, the theory of National Innovation Systems proposes that the key to improving technology performance lies with understanding and improving the "complex set of relationships among actors in the system, which includes enterprises, universities and government research institutes." (OECD 1997) (p7) The importance of the innovation environment as a driver for success is given further support by the move towards a knowledge driven economy, where innovation has become central to achievement. Within the framework of a knowledge driven economy, it has been proposed that the traditional view of innovation has been replaced by a "social network theory of innovation", where knowledge plays a crucial role in fostering innovation.(European Commission 2004) (p5) Reid et al, (Reid et al. 2003) highlighted that while research is a major contributor to innovation, entrepreneurial innovation is essential for value-creation, and innovation policies must foster a positive institutional and economic framework for innovation in its many and diverse forms.

In the EU it has been found that innovation activity is too weak. It is not so much that people do not have innovative ideas, but Europe falls short in transforming these ideas into new products or processes. A widespread opinion is that this is due to the (poor) framework conditions for manufacturers operating in Europe.

"For innovation to flourish in manufacturing it is vital to establish frame conditions that motivate individuals and enterprises, encourage the sharing of knowledge, and promote public awareness and enthusiasm." (HLG (Manufuture High Level Group) 2004a) (p17)

At the Manufuture 2003 conference in Milan the importance of providing a supportive framework for future manufacturing was stressed (DG Research 2003). Not only does this concern the research community or the supply of sufficient and qualified workforce (both areas covered in detail elsewhere in this report), but also conditions which motivate, help and favour innovative and entrepreneurial individuals and enterprises.

Naturally, the nature of the operating environment for industrial innovation is determined by a number of frame conditions/ factors. These factors and conditions can be regulated (directly or indirectly) through political initiatives seeking to establish a favourable economic and regulatory climate encouraging entrepreneurship, investments, and motivation for innovative enterprises. Examples of factors more directly influenced by political decisions are: the regulatory environment, funding by public bodies, government tax and

fiscal incentives, and the availability of government funding. Factors, such as the lack of interest and shortage of knowledge of how to start up a company, are more long-term problems that call for more holistic solutions.

The ongoing transformation towards a knowledge driven society puts new emphasis on the so-called knowledge value chain, through which knowledge moves from theory to being put into practice. (REF HLG documents, Manufuture) With universities and academia at one end, SMEs in the middle and larger industries at the other, the knowledge value chain links research with the cooperate world. With this set-up, it is critical that all parties in the chain enable flow of knowledge and embrace the idea of collaboration. SMEs in particular, are expected to play an important role in this form of collaboration taking the role of the mediator and the transformer of research knowledge into manufacturing practice. The vision is that with an agile and flexible structure and a global mindset, SMEs will be taking part in international projects, supporting larger manufacturing firms through their specialisation in certain areas, and keeping themselves up-to-date with research advances through direct connections with research centres. In other words, a happy and well functioning body of innovative SMEs will be of key importance to a nation's industrial success. (Ref HLG documents)

The above argued links between the well-being of SMEs, their operating environment and the future success of the manufacturing industry, are given further support in the EC communication "*Industrial Policy in an Enlarged Europe".(EC (European Commission) 2002a)*. There it is stated that "the performance of large firms depends increasingly on the competitiveness of their small and medium suppliers, which in turn depend on the economic situation of these larger partners"*(EC (European Commission) 2002a)* (p12). This also stresses the inter-dependencies between all parties well being, and the whole supply chain's success. Close cooperation is vital.

With the "new organisational patterns under which large firms often operate through EU-wide production and subcontracting networks" (EC (European Commission) 2004a) (p12) the above sought cooperation and furthermore the capability to share knowledge and information will be in high demand. This development will give increased emphasis on the use of ICT and its role as an enabling technology. The use of ICT in manufacturing businesses are predicted to spread and find increased use along the entire production value chain – from the placing of orders to simulation/ design of a new process/ product. With the complexity of the manufacturing industry and the many uses of ICT, the EU foresee a great need to help SMEs in the manufacturing sector "to define their e-business strategies, with a view to optimising their use of ICT, help them select the most suitable technology, adapt their practices and

implement the necessary organisational changes." (EC (European Commission) 2004a) (p29)

Nevertheless, and as pointed out above and in the European Communication (EC (European Commission) 2002a) "it is the combination of ICT, new managerial and organisational techniques and a skilled labour force that gives rise to significant competitiveness improvements."(p15). Regarding knowledge transfer and communication of information, not even ICT can solve all tasks. The diffusion of so-called tacit knowledge (knowledge held by a person that can not be easily codified e.g. a certain skill or an understanding) is not easily done due to its nature – it cannot easily be stored or transmitted. The spreading of tacit knowledge is best carried out through networking and close collaboration through face-to-face meetings. It calls for interaction.

This motivates and opens up for the creation of clusters where entrepreneurs and firms with common interests or holding complimentary knowledge can network and collaborate. "Innovative clusters, while relying on regional sources for their competitiveness, are also increasingly involved in supranational knowledge and production networks. Companies in such clusters, mostly SMEs, are becoming the dynamic part of Europe's industrial landscape and a source of innovative ideas. (EC (European Commission) 2002a) (p12)

The importance of regional clusters is further stressed in a paper by Allan S. Carrie, who reaches the conclusion that future competition for shares of multi-nationals economic activity will be "between regional clusters of inter-related organisations that add value through cooperation, rather than between individual firms and their supply chains". (Carrie 2000) (p10)

It is clear that an "Operating environment for industrial innovation" for manufacturing industries is determined by many inter-relating factors and conditions.

5.3.1 Focus: Entrepreneurial spirit

The European Commissions Green Paper on Entrepreneurship states "entrepreneurship is first and most a mindset. It covers the capacity, independently or within an organisation, to identify an opportunity and to pursue it in order to produce new value or economic success." (EC (European Commission) 2003c) (p5) This description very well describes the complexity involved in promoting and supporting entrepreneurial activities. Entrepreneurial spirit is held by individuals, and there are many personal judgements and preferences determining whether a person will take the action of e.g. starting a business or not. However there are certain factors and conditions in the surrounding operating environment that can be improved to support entrepreneurial activities in general.

The Manufuture 2003 report (DG Research 2003) recognises the importance of entrepreneurship for the future of European manufacturing industry and further stresses the importance of entrepreneurship being promoted and taught throughout European educational systems. Young people being familiar with the concept of entrepreneurs and entrepreneurial activities are more likely to become entrepreneurs. Today the educational system in Europe is not seen as a facilitator of entrepreneurship. (EOS Gallup 2004)

In Europe 37% of the populations considered becoming entrepreneurs, while only 17% have done so. (EC (European Commission) 2003c) Risks (failure resulting in loose of job and reputation), administrative burdens (red tape) and financial pressure (taxation rules, lack of financing) are three of the most deterring factors (EOS Gallup 2004). Financing being the main reason why "relatively few small and micro companies in Europe grow to the necessary critical size to compete effectively with large incumbents or to enter foreign markets." (EC (European Commission) 2002a) (p 13)

The societal importance of entrepreneurs is closely linked to the fact that "it is increasingly new and small firms…that are the major providers of new jobs". (EOS Gallup 2004) (p6) Furthermore risk-taking entrepreneurs are needed to create new agile firms or/ and to help existing companies to follow the rapid technological developments – this is "key for adjusting to new market opportunities and achieving innovation and productivity growth" (EC (European Commission) 2002a) (p16) With the undergoing and foreseen challenges within and developments of the European Manufacturing industry, the maintenance and improvement of the entrepreneurial spirit within this industry an important issue.

In the 2003 EC Industrial Policy focusing on Europe's manufacturing sector the emerging of an action plan for entrepreneurship was heralded. It will seek its foci within the general areas "reducing barriers for Europe's entrepreneurs", "unlocking entrepreneurs' ambitions to growth" and "encouraging more people to start a business". (EC (European Commission) 2003b) (p24)

5.3.2 Focus: National policies and government

In the OECD report "Dynamising national innovation systems" (OECD) (p10) it is concluded that "innovation patterns are highly country- and even, to a large extent, cluster specific, depending on the individual country's economic specialisation and institutional set-up." (EC (European Commission) 2002a) (p25) This specialisation and set-up creates a country's competitive edge and is often determined through national policies and political decisions.

For Europe and its individual countries it will be crucial to improve the framework offered to businesses giving them confidence and enable them to

invest in research and other activities within Europe. There is a number of critical competitiveness factors determining a nation's attractiveness from a business perspective, for example start-up procedures, access to finance, business support services, business incubators, innovation and research development, to mention a few." (EC (European Commission) 2002a) (p25) In the European Commission industry policy "*Fostering structural change: an industrial policy for an enlarged Europe*" the commission elaborates on such factors and identifies a few areas where actions have to be taken to strengthen and achieve necessary conditions for the future. These areas are "the protection of intellectual property, market regulation, competition rules, financial markets and tax regimes" (EC (European Commission) 2004a) (p26)

The EU charter for small enterprises gives further support to the factors already given above and it is stated as necessary to e.g. educate and train for entrepreneurship, enable cheaper and faster start-up of companies, improve current legislation and regulation, review taxation and financial matters, and to help companies to adopt use of enabling technologies such as ICT.

OECD has in its turn pointed out that "Innovation-friendly financial systems, in particular venture capital, and more generally a corporate governance that favours innovation and up-grading, are crucial to the development of clusters" (OECD) (p 28), which in their turn have proven to be very important corner-stone in creating an operating environment for industrial innovation.

Naturally, and as hinted above, all these factors and necessary conditions have to be active concerns of a nation's or region's policy makers. (EC (European Commission) 2002a) (p31) To attract foreign companies and testify an authority's "desire to develop the country's industrial potential" technology parks can be and has been created in important locations. (EC (European Commission) 2004a) (p 12)

5.3.3 Focus: SMEs

European manufacturing businesses are to 99% SMEs, which "typically exhibit greater flexibility, agility, innovative spirit and entrepreneurship than more monolithic organisations".(HLG (Manufuture High Level Group) 2004a) (p20) European SMEs further represent two thirds of employment and 60 % of total value added (EC (European Commission) 2002a) (p12), thus it is not hard to understand why SMEs are regarded to be the backbone of European industry (see table 7.1 ,(EC (European Commission) 2002b) p 28)

In Europe, 4% of innovative SMEs give rise to the creation of 50% of new jobs. Through their mere existence such companies boost overall competitiveness of the economy by strengthening the innovation potential of larger economic actors, which can start a partnership with or buy such companies. SMEs are

therefore a priority for the European Union in its research activities" and industrial policies. (DG Research 2003) (p39)

With SMEs' foreseen role as crucial transmitters of knowledge and initial implementations of emerging manufacturing technologies and organisational practices, as a result of the shift to knowledge-based manufacturing, it is clear that their operating environment have to be improved as much as possible to make it possible for them to adapt to their expected roles and stay innovative.

Expert groups claim that in a near future the "sharing of knowledge within and between organisations becomes the norm" and that supply chains will take the form of flexible collaborations with networks of SMEs functioning together in the structure of a 'virtual enterprise' (HLG (Manufuture High Level Group) 2004a) (p4) European wide networks will enable the diffusion of knowledge where SMEs will be increasingly important links in the value chain, "transforming knowledge produced by applied research into products and services for manufacturing industry".(HLG (Manufuture High Level Group) 2004a) (p16)

In this new era of manufacturing "SMEs deserve special attention since they have generally a low propensity to network or face obstacles to doing so." (OECD) (p 70),(p20) It is already recognised that "it is very often smaller and informal organisations that are at the origin of the most innovative thinking" but that "SMEs still tend to face a number of difficulties in realising their innovative potential. Lack of necessary skills, finance, management capabilities or limited access to external networks often hampers SME development and innovation." (Navarro 2003) (p9)

5.3.4 Focus: ICT - an enabling technology

An enabling technology supports and makes major developments in other technologies possible and further enables new ways for applying technologies across several industry sectors. Furthermore "due to its (an enabling technology's) pervasive effect, an enabling technology is bound to have a profound impact on society, industry, policy, products and processes, as well as on the life of every individual." (HLG (Manufuture High Level Group) 2004a) (p23)

The advances of ICT have certainly influences many industries and the society on a whole. The OECD states that "the rapid developments in information and communication technologies have contributed profoundly to the way knowledge is created and diffused and have influenced the innovation process itself to an exceptional extent." It is concluded that ICT has allowed codified knowledge to be spread and shared cheaply all around the world, a development which is "revolutionising the innovation process in many areas,

notably in high-skilled areas like research, knowledge-intensive business services, and many others." (OECD) (p 9), (p 57)

With the current developments within manufacturing (productions networks spread geographically over the world and highly information dependent supply chains) the adoption of ICT is very important. "Recent productivity increases in many countries, notably the United States in the second half of the 1990s, are to a great extent linked to the adoption of ICT in a variety of business processes." (OECD) (p 13)

In relation to this, the European Commission has pointed out that the "adoption and efficient use of ICT in all industries, including those regarded as traditional" as a key challenge" in order not to lag further behind e.g. the USA in terms of productivity. (EC (European Commission) 2002a) (p16)

In many ways ICT is the key technology breeding emerging manufacturing and organisational concept, enabling actors to cope with information sharing and increased complexity of the working environment and demand on ever shorter time to market. At the Manufuture 2003 conference the situation was described in the following way: "Today, it (ICT) permeates nearly all activities of an enterprise. On the shop-floor, information technology has been used in product design and machine control for quite some time. Industrial automation is a good example of the successful migration of ICT into established sectors. In recent years, many traditional companies have also made significant investments in e-business applications, such as supply chain management systems." (DG Research 2003) (p24)

The Manufuture High Level Group (appointed by the European Commission) (HLG (Manufuture High Level Group) 2004a) (p 5) points out that "Tomorrow's solution will be holistic, identifying multiple perspectives and linkages between novel approaches to customisation, customer response, logistics and maintenance. Special emphasis will be put on the integration of information and communication technologies (ICT) with other techno-organisational developments, as this is perceived to be crucial in the development of the knowledge base and networked enterprises." This transformation will call for and be eased by "additional competences in ICT for engineering, logistics, information management, factory management, production management and simulation technologies." (HLG (Manufuture High Level Group) 2004b) (p13)

6 Indicators

This chapter covers the indicators selected to represent each foci and consequently the three key areas. The following diagram (Fig 6.1) shows diagrammatically how the indicators are linked to the key areas through the Foci.

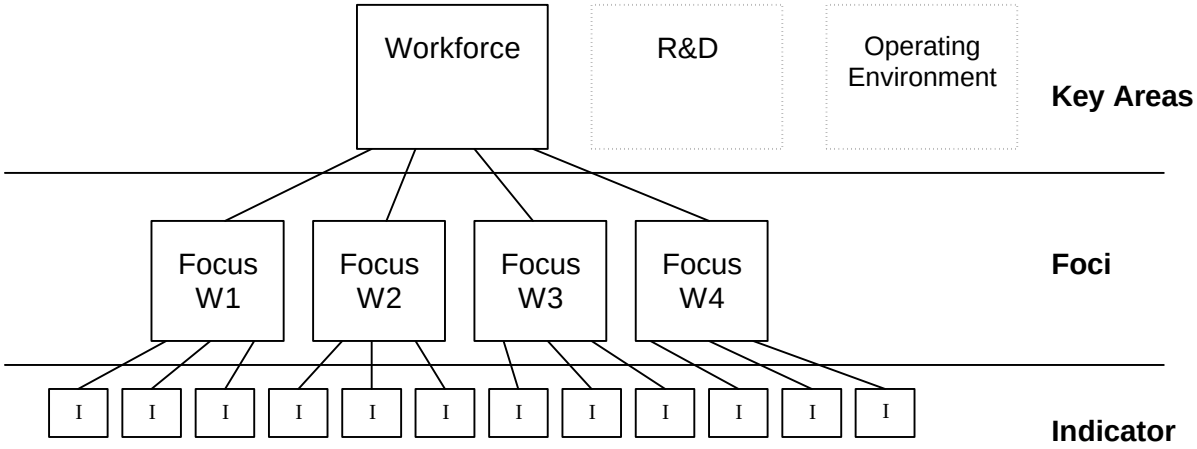


Fig. 6.1 Key area/Foci/Indicator structure

It is first on the indicator level that actual values come into the picture, and it is hence important to treat them (indicators) with care, and to understand how they affect the final outcome in studies aiming at reaching an aggregated / composite value at foci, key area or over-all level. (This is elaborated upon in section 6.2 - “Coverage by Indicators”)

A sound understanding of the different challenges faced when striving towards a composite index of any kind, is not so much needed for interpretation of the final results (often just an index value ranking participating units – in this case countries), but it is critical for comprehending which circumstances might have affected the final outcome, and to what extent the final results are reliable.

The number and variety of indicators available has been limited, due to the restrictions imposed by the use of data only from existing studies. In the search for suitable indicators for the different foci, several different sources were exploited, including online databases covering data from several surveys and questionnaires, as well as specific surveys, papers and projects.

It has been sought to find the most recent source for an indicator covering as many countries as possible, leaving only a few to be supplemented with additional sources.

6.1 Indicators by key area

The following three subsections present tables of the Indicators for each key area, separated into foci. All the indicators have been allocated a code (also given in the tables) to ease analysis. A more thorough description of the indicators, along with their values, detailed sources, and definitions can be found in the appendices.

6.1.1 Indicators – Workforce

WE	Educating the Future Workforce	
We1	Graduates in maths, science and technology	(Eurostat - 1)
We2	Public expenditure on education	(Eurostat - 1)
We3	Availability of Scientists and Engineers	(Thematic TrendChart - 2)
We4	Erasmus Engineering and Technology student mobility	(EU/ Erasmus home page - 3)
WA	**Age of workforce**	
Wa1	Proportion of workforce aged 50-64	(Eurostat - 1)
Wa2	Proportion of 50-64 year olds who are employed	(Eurostat - 1)
Wa3	Work-Life balance	(ManVis 2004 - 4)
Wa4	Average exit age from the workforce	(Eurostat - 1)
Wa5	Barrier-free manufacturing	(ManVis 2004 - 4)
WW	**Workforce Training**	
Ww1	Qualification Certification	(ManVis 2004 - 4)
Ww2	Life Long Learning	(Eurostat - 1)
Ww3	Learning in the company	(ManVis 2004 - 4)
Ww4	Manufacturing enterprises offering CVT	(Eurostat - 1)
Ww5	Manufacturing employees participating in CVT	(Eurostat - 1)
WC	**Careers for Women**	
Wc1	Attitude towards women in science	(ManVis 2004 - 4)
Wc2	Female graduates in maths, science and technology	(Eurostat - 1)
Wc3	Women Scientists and Engineers	(Eurostat - 1)

Fig. 6.2 Workforce Indicators

1) Eurostat Online Database (Eurostat)

2) TrendChart home page (EC EDG Innovation Policy Unit 2005)

3) EU Socrates Erasmus home page (EC EDG Education & Culture 2005)

4) Manufacturing Visions Project (Fraunhofer ISI 2005)

6.1.2 Indicators – Research & Development

RL	Links between industry & academia	
Rl1	Priority given to ISR (Industry - Science Relations)	(Thematic TrendChart - 1)
Rl2	University/ Industry Research Collaboration	(Thematic TrendChart - 1)
Rl3	Availability of specialised research services	(Thematic TrendChart - 1)
Rl4	Manuf. enterprises use of Universities as sources of info. for innovation	(Eurostat - 2)
RR	**R&D Spending**	
Rr1	Manufacturig companies receiving public funding for innovation	(Eurostat - 2)
Rr2	Public R&D expenditure	(EIS 2004 - 3)
Rr3	Business R&D expenditure	(EIS 2004 - 3)
Rr4	Innovation expenditure for Manufacturing companies	(EIS 2004 - 3)
RH	**Human Resources**	
Rh1	Priority given to moblity schemes	(Thematic TrendChart - 1)
Rh2	Number of researchers	(EU Key Figures - 4)
Rh3	HRST Job-to-job mobility	(Eurostat - 2)
Rh4	Female Phds in Science, Engineering, manufacturing, and construction	(She Figures 2003 - 5)
RI	**International Cooperation**	
Ri1	Eureka participation	(Eureka home page - 6)
Ri2	Preferred co-publication partners	(EU Key Figures - 4)
Ri3	Cooperation Links in FP5	(ERA 2003 - 7)

Fig. 6.3 Research and Development Indicators

1) TrendChart home page (EC EDG Innovation Policy Unit 2005)

2) Eurostat Online Database (Eurostat)

3) European Innovation Scoreboard Online (EC 2005)

4) EU KeyFigures – Edition 2003-2004 (EC EDG Research 2005a)

5) EU Women and Science home page (EC EDG Research 2005b)

6) Eureka home page (Eureka 2005)

7) European Research Area 2003 (EC EDG Research 2004)

6.1.3 Indicators – Operating Environment for Innovation

.

OI	ICT	
Oi1	Manufacturing Enterprises access to the Internet	(Eurostat, IPTS - 1, 2)
Oi2	Manuf Enterprises using Internet f. interaction w. public authorities	(Eurostat, The NRI 03-04 - 1, 3)
Oi3	Business ICT readiness	(The NRI 03-04 - 3)
Oi4	Manufacturing Enterprises receiving order via ICT	(Eurostat, eEurope - 1, 4)
OE	**Entrepreneurship**	
Oe1	Self-employment	(ManVis 2004 - 5)
Oe2	Manufacturing self-employed	(Eurostat - 1)
Oe3	Influence of edu. sys. in promoting young people to start businesses	(Flash Eurobarometer - 6)
Oe4	Cost to start a company	(Thematic TrendChart, World Bank - 7, 8)
Oe5	Willingness to start a business if there is a risk it might fail.	(Flash Eurobarometer - 6)
Oe6	Procedures and duration to start a company	(Thematic TrendChart, World Bank - 7, 8)
OS	**SME**	
Os1	Employees with higher education in Manufacturing SMEs	(Eurostat - 1)
Os2	Manufacturing SMEs involved in innovation co-operation	(EIS 2004 - 9)
Os3	Manufacturing SMEs innovating in-house	(TrendChart - 10)
Os4	Manufacturing SMEs -sales of "new to market" products	(EIS 2004 - 9)
Os5	SME networks	(ManVis 2004 - 5)
ON	**National Policies & Government**	
On1	Economic climate favourable for starting own business	(Flash Eurobarometer - 6)
On2	Priority given to "Establishing a Framework conducive to Innovation"	(Thematic TrendChart - 7)
On3	Manuf. Enterprises using Government as source of information for innovation	(Eurostat - 1)

Fig. 6.4 Operating Environment for Innovation Indicators

1) Eurostat Online (Eurostat)

2) IPTS Online (IPTS 2005)

3) The Networked Readiness Index 2003-2004 (World Economic Forum (WEF) 2003)

4) eEurope home page (EC EDG Information Society 2005)

5) Manufacturing Visions Project (Fraunhofer ISI 2005)

6) Flash Eurobarometer – Entrepreneurship (EC EDG Enterprise 2005)

7) TrendChart home page (EC EDG Innovation Policy Unit 2005)

8) World Bank Online (World Bank 2005)

9) European Innovation Scoreboard Online (EC 2005)

10) TrendChart home page (EC EDG Innovation Policy Unit 2005)

6.2 Coverage by Indicators

This study uses a total of 50 indicators, and aims to cover 23 European countries. Ideally all indicators should focus on the NACE D (manufacturing) sector, be based on recent data and surveys, and be available for all participating countries. As shown by the table below (Fig. 6.5) this has not been possible to achieve. For instance, only five countries are represented by values for all 50 indicators.

50	Belgium, Finland, Germany, Italy, Spain	(5)
49	Austria, Denmark, France, United Kingdom	(4)
48	Netherlands, Sweden	(2)
47	Estonia, Poland	(2)
46	Hungary, Norway, Slovenia	(3)
45	Greece, Slovakia	(2)
43	Portugal	(1)
42	Romania	(1)
41	Czech Republic	(1)
40	Lithuania	(1)
39	Latvia	(1)

Fig. 6.5 Indicator coverage

Unsurprisingly, the participating EU-15 countries (Luxemburg and Ireland were omitted), are the best represented. They all have 48 or more indicator values, apart from Portugal, which only has 43. It should be noted that countries not being covered by the ManVis study (Fraunhofer ISI 2005) - Portugal, Czech Republic, Latvia and Lithuania – all lack values for the seven indicators where ManVis data are used as a base for an indicator.

It can be argued (which has been done by Grupp and Mogee in their article "Indicators for national science and technology policy: how robust are composite indicators?" (Grupp & Mogee 2004)), that no composite index can be fair unless all countries are represented by all indicators. Diversions from such an ideal situation is nevertheless accepted, even by recognised scoreboards using far less indicators than this study.

The argument of unfairness builds on the idea of what could be called an indicator’s "contributory value". The meaning of a “contributory value” is explained in the following paragraphs.

The point of discussion is that three values (e.g. indicator values) used to create an aggregated value (e.g. a foci value) have higher individual weight

(one third) than if four values were to be used instead (the weighting would then only be a fourth). It is not necessarily a problem that different foci have a different number of indicators – more indicators give a better picture of a focus, and foci are still weighted equally when calculating the composite capability index. However, allowing countries to "lack" indicator values within a foci, will give the same remaining indicators different weightings for different countries.

It has been determined that the composite capability index is calculated as the mean of the three key area values. In other words the composite capability index can also be described as the sum of a third of each key area value. Since each key area is represented by four foci, analogous with the case of the composite capability index, a key area can in turn be described not only as mean value of the values of its foci, but also as the sum of a fourth of each of its foci values. It is thus clear that the composite capability index can be calculated as a sum of twelfths (1/3 * 1/4) of all foci values. This is possible in the case of this study, since all participating countries have to be represented through all foci values, and all key areas (of which there are three) have four foci.

Take, as an example, a focus with 4 indicators. If country A has only values for three indicators (I1, I2, and I3) each of them will contribute with a third of their values to the focus value. In the case of a country B with all indicators for the same foci (I1, I2, I3, and I4) each of them will contribute with a fourth to the focus value. Looking closer at "I1", it comes clear that it will contribute to the composite capability value for each country with (1/3*1/12=) one thirty-sixth of its normalised value for country A, but only a (1/4*1/12=) one forty-eighth of its normalised value for country B.

These "imposed" weightings (1/36, 1/48 etc.) multiplied by an indicator's normalised value for a country, is what this study refers to as an indicator's contributory value (to the composite capability index) for each country respectively. Obviously it is not only the performance within an indicator (ranging from 1 to 0) that determines an indicator value's contribution to the over all picture, but also how well/ or poor a country is represented through its indicators – deliberately or unintentionally.

As Grupp and Mogee (Grupp & Mogee 2004) point out, a country could make sure that only values for which it performs well are released to international scoreboards. This would ensure that "good" values would get a higher contributory value than otherwise, and the country would do better in a comparison with other countries. Furthermore, a country could deliberately keep values asked for high, or confidential (which is the case with Greece and

the indicator Os1 "Employees with higher education in manufacturing SME". Where the information has not been released due to confidentiality).

To ensure a somewhat fair image of the nations' capabilities for manufacturing a high number of indicators have been used together with restrictions on how many indicators may be lacking within a focus before it is discarded.

In comparison it can be said that the European Innovation Scoreboard (EC 2005) uses less that half the number of indicators of this study, and have several of the participating countries missing more than forty percent of the values asked for.

In the chart below (Fig 6.6), indicators are grouped according to how many countries' values they hold. It should be noted that in a few cases (but then only for the focus ICT within the key area “Operating Environment for Innovation), estimations have been made in order to allow for a few countries to remain in the study. Such estimations have only been made in nine cases (three in Oi1, and one in Oi2, and seven in Oi4 – shown in the appendices), and the rest of the 1060 indicator values are either directly taken from published surveys, the ManVis study or calculated using such information. The most common estimation is to take the corresponding value for a whole industry, when a value for NACE D only has been missing.

In the appendices, an overview of all indicator representations, values, and indicators’ contributory values is given for each country respectively.

23	Oe2, Oe4, Oe6, Oi3, Oi4, On2, On3, Os2, Rh1, Rh2, Ri1, Ri2, Ri3, Rl1, Rl4, Rr2, Rr3, Wa1, Wa4, Ww2	(20)
22	Oe5, Oi1, On1, Rl2, Rl3, Rr1, Wa2, Wc2, Wc3, We1, We2, We3, We4, Ww4, Ww5	(15)
21	Os3, Os4, Rh3, Rh4, Rr4	(5)
19	Oe1, Os5, Wa3, Wa5, Wc1, Ww1, Ww3	(7)
16	Oi2	(1)
14	Oe3	(1)
11	Os1	(1)

Fig. 6.6 Number of countries for each indicator

7 Results

7.1 Country Results

Some results and graphs for each of the twenty-three countries are presented in the following pages. Three spider graphs are given for each country, one to represent each of the three key areas. Each spider graph has four axes, one for each of the foci within that key area. Each axis has a scale from zero to one, and the value that the country has been awarded for that focus, along with the average value (of the 23 countries) for that focus is marked on the axis. An example of a spider graph is shown in figure 7.1 (In this case, the graph representing the results for Austria in the workforce key area), with the shape created by joining up the values for the average, shaded grey. From the graph, the following conclusion could be made: Austria has a value above the average for the foci 'workforce training' and 'educating the future workforce', and a value below the average for the foci 'careers for women', and 'age of workforce'.

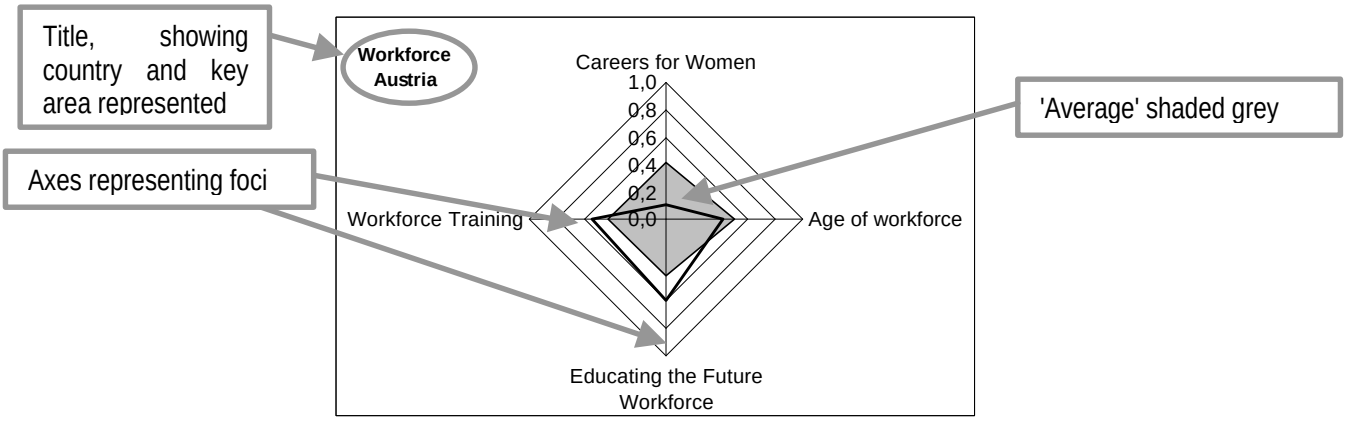


Fig. 7.1 example spider graph

As well as the spider graph, a table, such as the one in figure 7.2, is presented for each key area. The table shows the actual indicator values awarded to each country (in this case Austria), displayed under the headings of each of the foci codes.

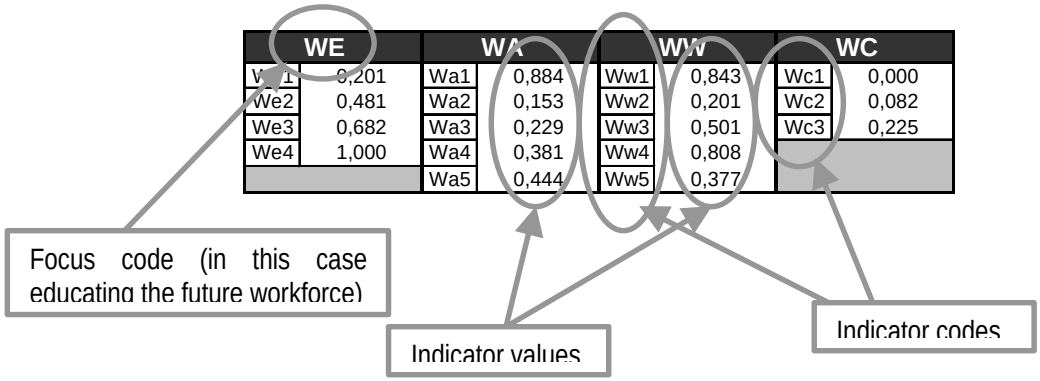


Fig .7.2 Example country indicator table

The indicator titles and their codes are given in section 6.1. When an indicator value is given as 'n', this denotes that no data was available for that indicator for that particular country.

For each country, a short description of the graphs and results has been included, to aid the reader. For simplification, the following definitions were generated for use in these descriptive paragraphs:

Outperforming

Used to describe a country that has a value greater than or equal to the average plus twenty percent of the average (for a particular focus).

Underperforming

Used to describe a country that has a value less than or equal to the average minus twenty percent of the average (for a particular focus).

Strong

Used to describe a country that has a value between the average and twenty percent above the average (for a particular focus).

Weak

Used to describe a country that has a value between the average and twenty percent below the average (for a particular focus).

(Please note that the figures in the following pages have not been labelled, but that each two-page spread covers an individual country)

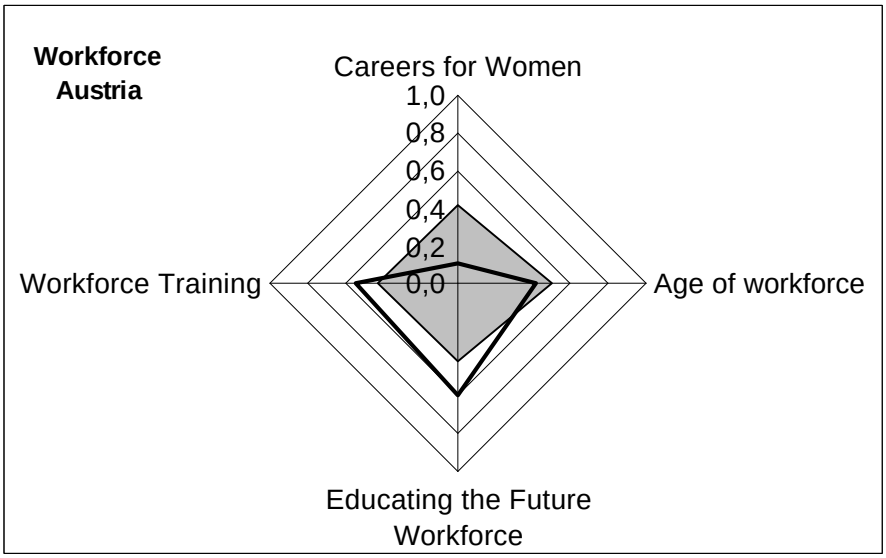
7.1.1 Austria

As can be seen from the graphs, Austria is outperforming in the following foci: educating the future workforce, workforce training, Links between industry and academia, R&D spending, and ICT. The country is also significantly under-performing in the focus careers for women. Of the six remaining foci, two are strong and four are weak.

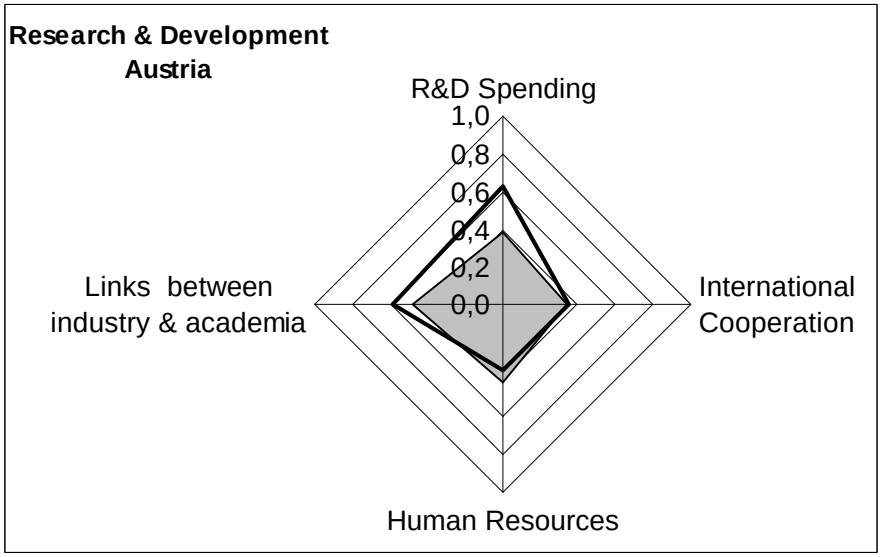
Of the outperforming foci, R&D spending in the Research and Development key area stands out as significantly outperforming the average. This focus is composed of four indicators (Rr1, Rr2, Rr3, Rr4), however there is no data available for Austria for the indicator Rr4 (innovation expenditure for Manufacturing companies). The remaining indicator values show that part of Austria's success is this focus can be ascribed to the very high value for Rr1 (Manufacturing companies receiving public funding for innovation).

Overall, Austria has one indicator where it has achieved the highest value of 1.0 (i.e. the top country in that indicator): We4 – Erasmus Engineering and Technology student mobility, with 11.1% of students studying in the mathematics, science and technology fields going abroad for and Erasmus exchange (in the same field) in 2002/2003.

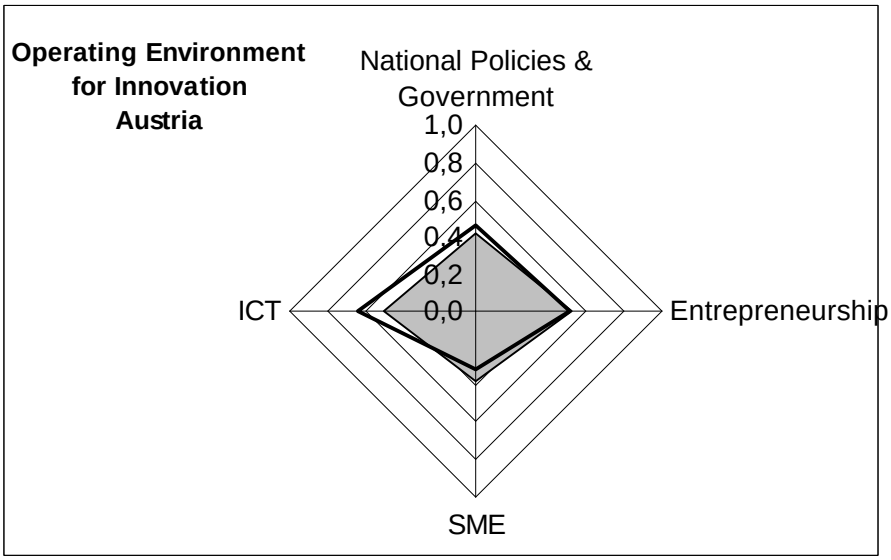
Also, the lowest score (0.0) was awarded to Austria for two of the indicators: Wc1 (attitude towards women in science), and Os1 (Employees with higher education in Manufacturing SMEs).



WE		WA		WW		WC	
We1	0,201	Wa1	0,884	Ww1	0,843	Wc1	0,000
We2	0,481	Wa2	0,153	Ww2	0,201	Wc2	0,082
We3	0,682	Wa3	0,229	Ww3	0,501	Wc3	0,225
We4	1,000	Wa4	0,381	Ww4	0,808		
		Wa5	0,444	Ww5	0,377		



RL		RR		RH		RI	
Rl1	0,465	Rr1	0,995	Rh1	0,371	Ri1	0,368
Rl2	0,778	Rr2	0,562	Rh2	0,263	Ri2	0,500
Rl3	0,815	Rr3	0,313	Rh3	0,398	Ri3	0,176
Rl4	0,293	Rr4	n	Rh4	0,356		



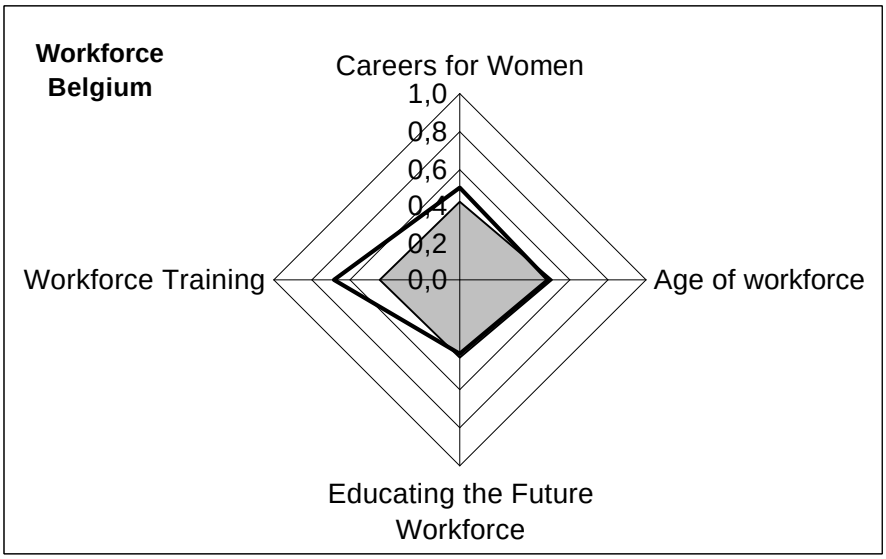
OI		OE		OS		ON	
Oi1	0,914	Oe1	0,094	Os1	0,000	On1	0,577
Oi2	0,750	Oe2	0,150	Os2	0,249	On2	0,571
Oi3	0,628	Oe3	0,826	Os3	0,616	On3	0,227
Oi4	0,237	Oe4	0,905	Os4	0,255		
		Oe5	0,481	Os5	0,462		
		Oe6	0,604				

7.1.2 Belgium

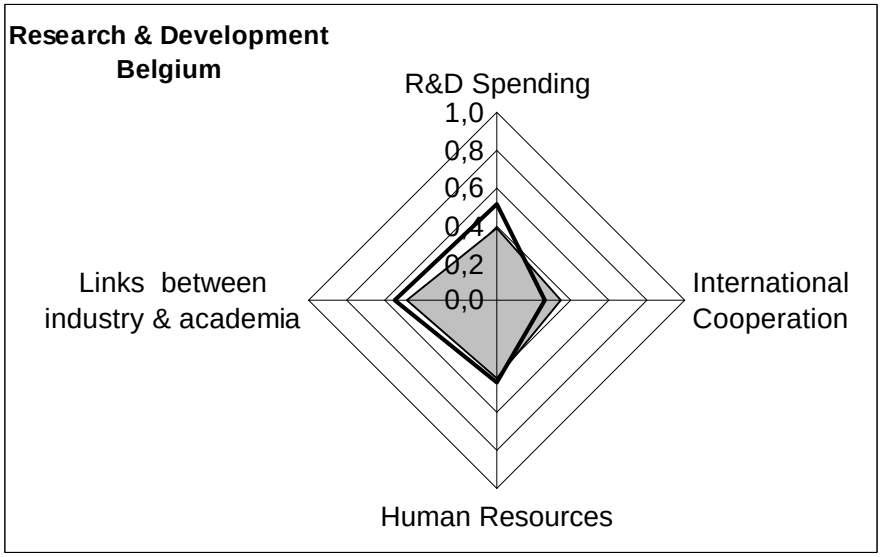
Belgium is outperforming in the following foci: Workforce Training (WW), R&D Spending (RR), ICT (OI), and SME (OS). The only focus in which Belgium is underperforming is International Cooperation (R&D). Of the remaining six foci, Belgium is weak in two and strong in four. Of the foci in which Belgium outperforms, the SME focus in the operating environment key area is the highest performing. It is perhaps not surprising that one of the indicators in this focus (Os5 – SME networks) has been given a value of 1.0. This indicator is taken from the ManVis database, and in fact 83% of experts questioned in Belgium thought that the statement "Networks of specialised SMEs compete successfully in the global marketplace" would be realised by 2015. It is perhaps of note that this indicator is based on soft, rather than hard data.

Also achieving a value of 1.0 (i.e. highest possible) were the indicators Ww1 (Qualification Certification), Ww3 (Learning in the company), and Oe3 (Influence of education system in promoting young people to start businesses). It is perhaps worth noting that three of the four indicators where Belgium has been awarded a value of one are from the ManVis survey.

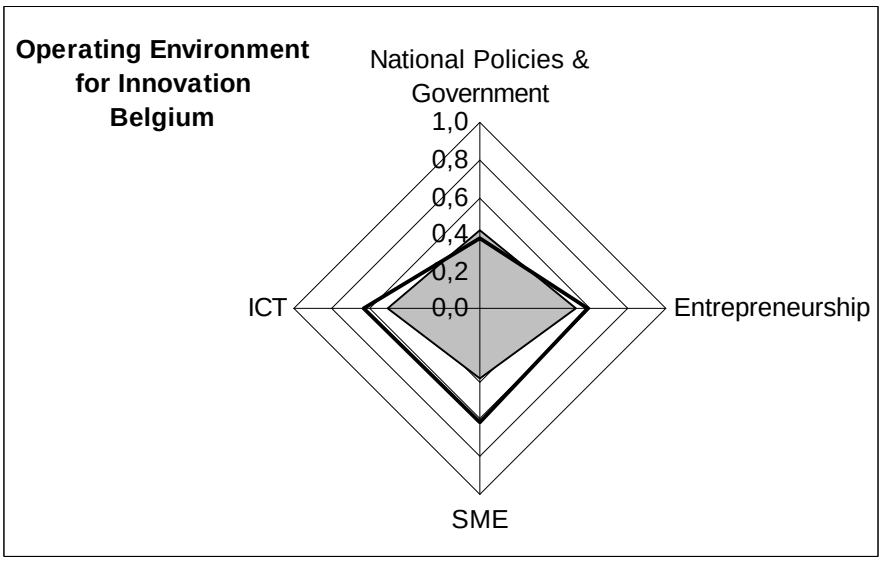
As mentioned above, the only focus where Belgium is underperforming is International cooperation in the R&D key area. A look at the respective indicators (Eureka participation - Ri1, Preferred co-publication partners – Ri2, and Cooperation links in FP5 – Ri3) shows that they have all been assigned relatively low values.



WE		WA		WW		WC	
We1	0,328	Wa1	0,826	Ww1	1,000	Wc1	0,575
We2	0,544	Wa2	0,102	Ww2	0,219	Wc2	0,236
We3	0,273	Wa3	0,483	Ww3	1,000	Wc3	0,686
We4	0,440	Wa4	0,254	Ww4	0,513		
		Wa5	0,688	Ww5	0,642		



RL		RR		RH		RI	
Rl1	0,302	Rr1	0,611	Rh1	0,429	Ri1	0,347
Rl2	0,844	Rr2	0,472	Rh2	0,434	Ri2	0,125
Rl3	0,667	Rr3	0,473	Rh3	0,367	Ri3	0,291
Rl4	0,354	Rr4	0,506	Rh4	0,511		



OI		OE		OS		ON	
Oi1	0,948	Oe1	0,183	Os1	0,551	On1	0,512
Oi2	0,269	Oe2	0,224	Os2	0,473	On2	0,371
Oi3	0,719	Oe3	1,000	Os3	0,825	On3	0,241
Oi4	0,553	Oe4	0,838	Os4	0,189		
		Oe5	0,699	Os5	1,000		
		Oe6	0,545				

7.1.3 Czech Republic

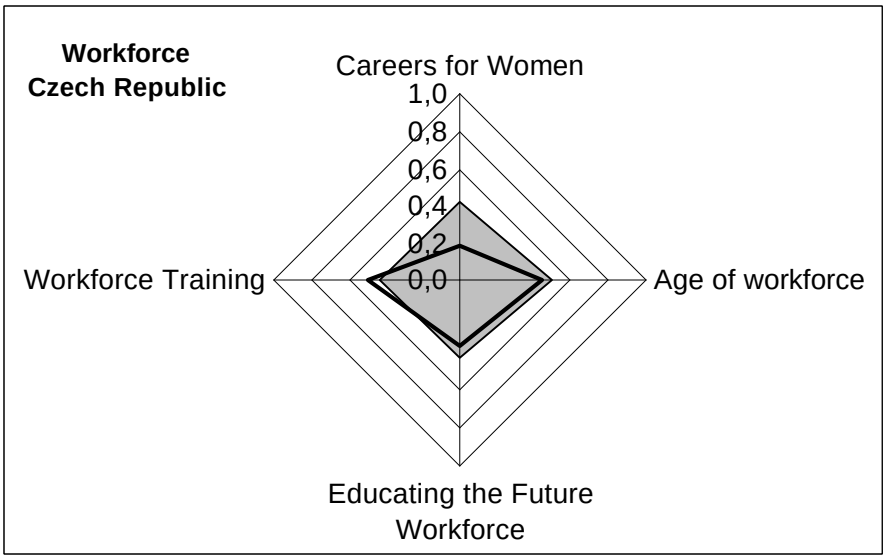
The Czech Republic is not outperforming in any of the foci. It is underperforming in the following six foci: Careers for Women, R&D spending, Human Resources, International Cooperation, ICT, and National Policies & Government. Of the remaining six foci, two are strong, and four are weak.

The focus which is underperforming the most is National Policies and Government, in the Operating Environment for Innovation key area. The three indicators for this focus: Economic climate favourable for starting own business (On1), Priority given to "Establishing a framework conducive to innovation" (On2), and Manufacturing enterprises using government as a source of information for innovation (On3) have all been allocated low values. Indeed, On2 has been given a value of 0.0.

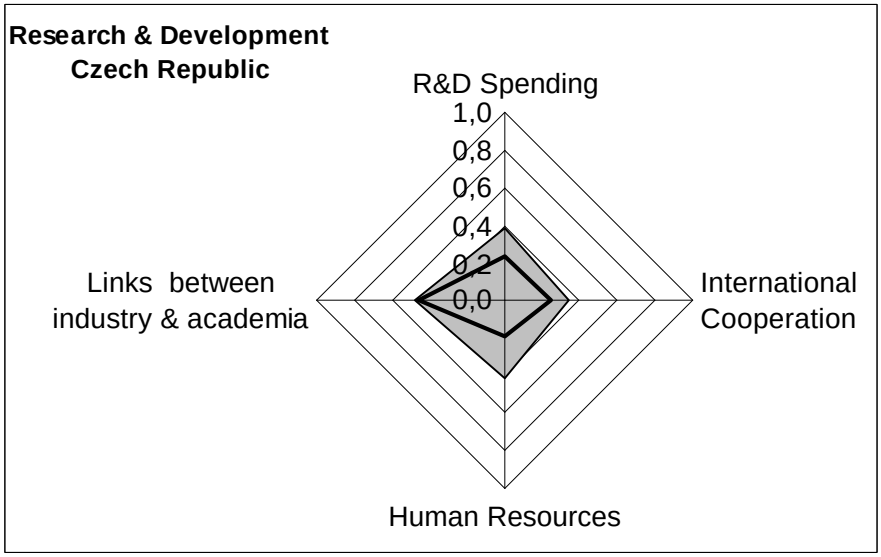
It should perhaps be noted that nine indicators were not available for this country.

Although many of the indicators have been given low values, only two (Rh1 and On2) were given a value of 0.0.

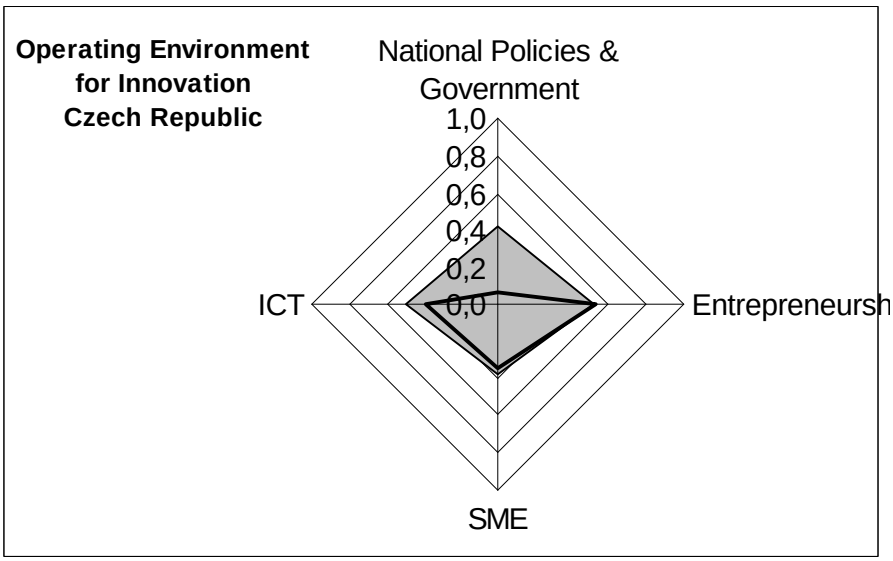
The strongest focus is Workforce training in the Workforce key area, due to the relatively high values allocated for indicators Ww4 and Ww5 (Manufacturing enterprises offering CVT, and Manufacturing employees participating in CVT respectively).



WE		WA		WW		WC	
We1	0,092	Wa1	0,369	Ww1	n	Wc1	n
We2	0,169	Wa2	0,417	Ww2	0,125	Wc2	0,109
We3	0,682	Wa3	n	Ww3	n	Wc3	0,247
We4	0,489	Wa4	0,524	Ww4	0,705		
		Wa5	n	Ww5	0,642		



RL		RR		RH		RI	
Rl1	0,302	Rr1	0,320	Rh1	0,000	Ri1	0,420
Rl2	0,556	Rr2	0,360	Rh2	0,101	Ri2	0,250
Rl3	0,667	Rr3	0,194	Rh3	0,279	Ri3	0,079
Rl4	0,288	Rr4	0,069	Rh4	0,389		



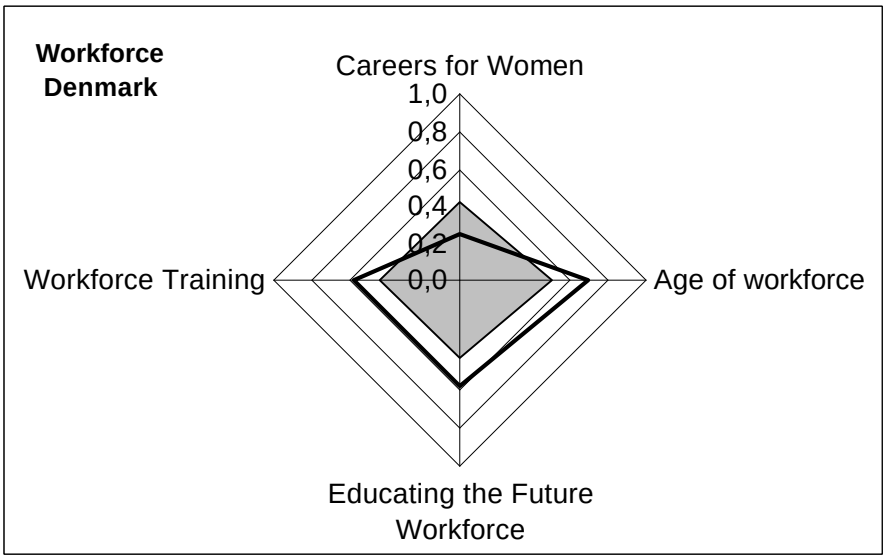
OI		OE		OS		ON	
Oi1	0,862	Oe1	n	Os1	n	On1	0,132
Oi2	0,154	Oe2	0,604	Os2	0,204	On2	0,000
Oi3	0,292	Oe3	n	Os3	0,425	On3	0,050
Oi4	0,237	Oe4	0,832	Os4	0,406		
		Oe5	0,481	Os5	n		
		Oe6	0,208				

7.1.4 Denmark

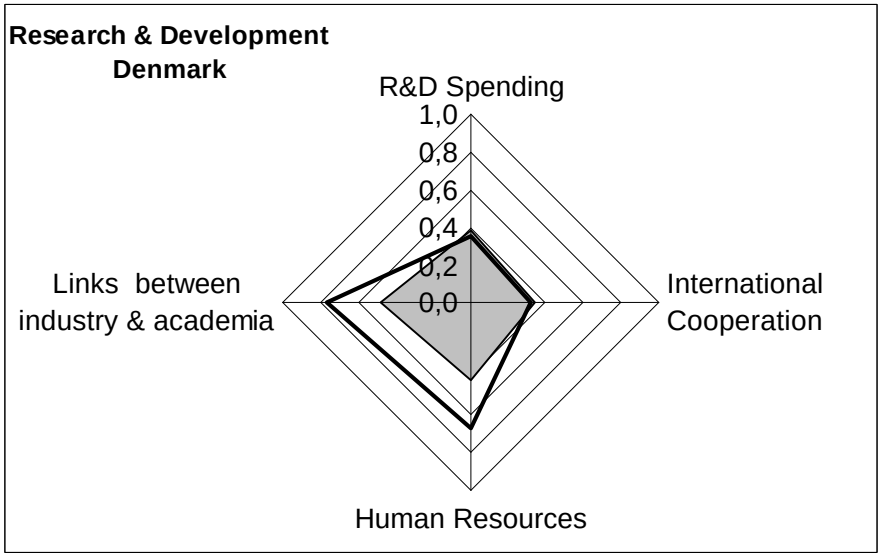
Denmark is outperforming in seven of the twelve foci as follows: Educating the Future Workforce, Age of Workforce, Workforce Training, Links between Industry and Academia, Human Resources (R&D), ICT, and National Policies & Government. It is only underperforming in the Careers for Women focus. Of the remaining four foci, two are strong and two are weak. The focus which outperforms the most is National Policies & Government in the Operating Environment for Innovation key area. This focus comprises the three indicators On1, On2, and On3, (Economic climate favourable for starting own business, Priority given to "establishing a framework conducive to innovation", and manufacturing enterprises using government as source of info. for innovation), of which On2 has been assigned a value of 1.0 (i.e. highest), and On1 a value of 0,9 (i.e. high).

In total, Denmark has been achieved a value of 1.0, for nine of its indicators, and a value of 0.0 for none of its indicators.

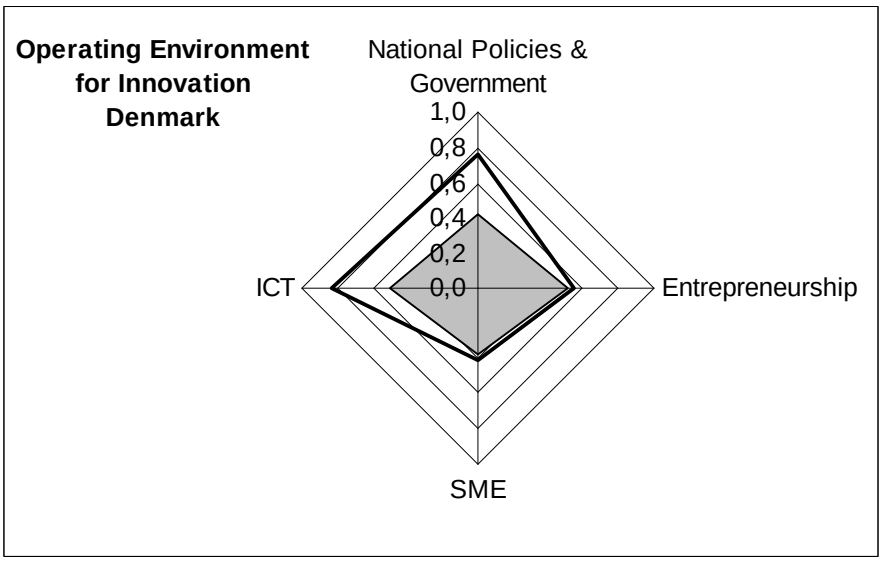
The focus representing the area requiring the most improvement (i.e. underperforming) is Careers for Women. All three indicators representing this focus (Attitude towards women in science, female graduates in maths science and technology, and women scientists and engineers) have been assigned rather low values.



WE		WA		WW		WC	
We1	0,425	Wa1	0,245	Ww1	0,098	Wc1	0,176
We2	1,000	Wa2	0,814	Ww2	0,535	Wc2	0,409
We3	0,636	Wa3	0,734	Ww3	0,482	Wc3	0,161
We4	0,221	Wa4	0,635	Ww4	1,000		
		Wa5	1,000	Ww5	0,736		



RL		RR		RH		RI	
Rl1	1,000	Rr1	0,180	Rh1	0,800	Ri1	0,130
Rl2	0,756	Rr2	0,697	Rh2	0,427	Ri2	0,625
Rl3	0,741	Rr3	0,508	Rh3	1,000	Ri3	0,192
Rl4	0,549	Rr4	0,000	Rh4	0,473		



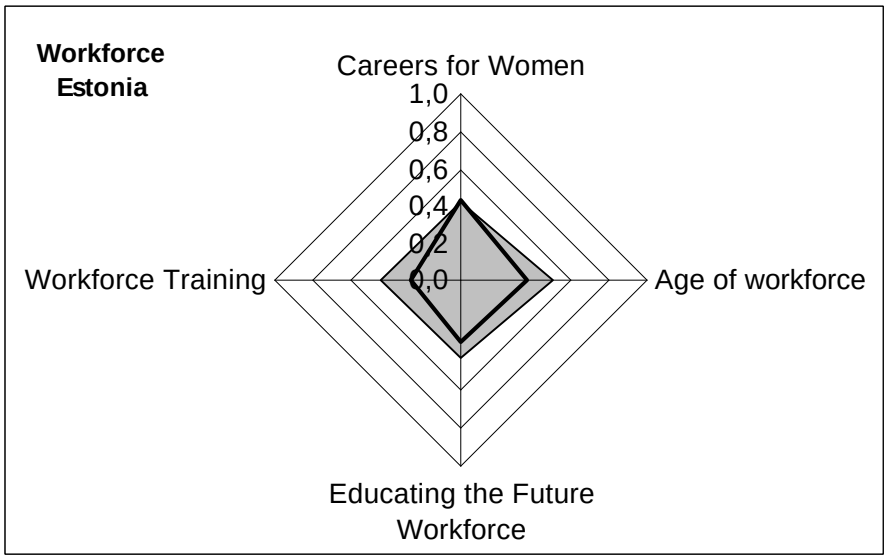
OI		OE		OS		ON	
Oi1	1,000	Oe1	0,145	Os1	0,172	On1	0,883
Oi2	n	Oe2	0,118	Os2	0,843	On2	1,000
Oi3	0,814	Oe3	0,304	Os3	0,247	On3	0,402
Oi4	0,658	Oe4	1,000	Os4	0,434		
		Oe5	0,723	Os5	0,328		
		Oe6	1,000				

7.1.5 Estonia

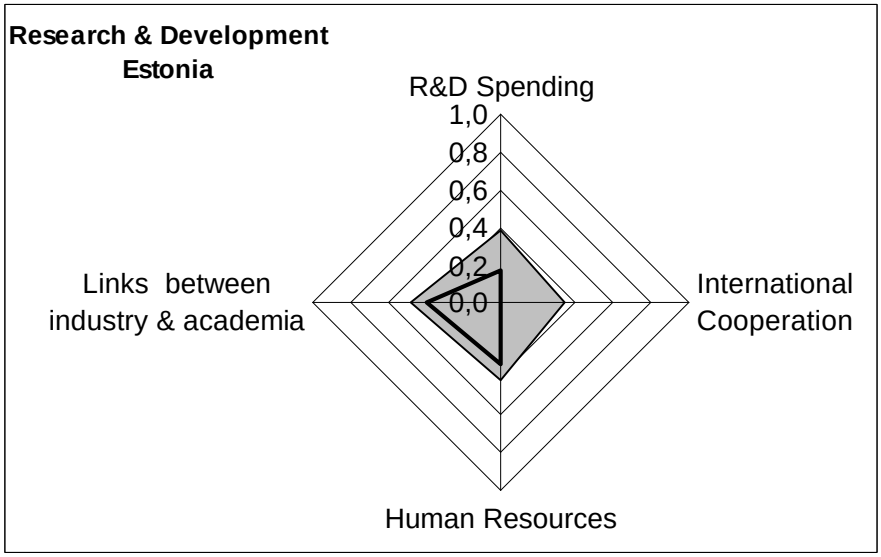
Estonia is not outperforming in any of the foci, and is underperforming in the following seven foci: Age of Workforce, Workforce Training, R&D Spending, Human Resources, International Cooperation, Entrepreneurship, and National Policies & Government. Of the remaining, three are strong, and two are weak. The three strongest foci are Careers for Women, ICT, and SME, with ICT marginally scoring the highest. A closer look at the indicators for the ICT focus shows that of the three indicators available (Oi1, Oi3, and Oi4), Oi1 (Manufacturing Enterprises access to the Internet) has been given a relatively high value of 0.983.

By far the most underperforming focus is International Cooperation in the R&D key area. A closer look at the three indicators Ri1, Ri2, Ri3, (Eureka participation, preferred co-publication partners, and cooperation links in FP5) shows that each has been allocated a very low score. It could perhaps be argued, that the three indicators are not a sufficient measure for this foci, and that some other, more comprehensive measure should be found in order to avoid discrimination of the accession countries.

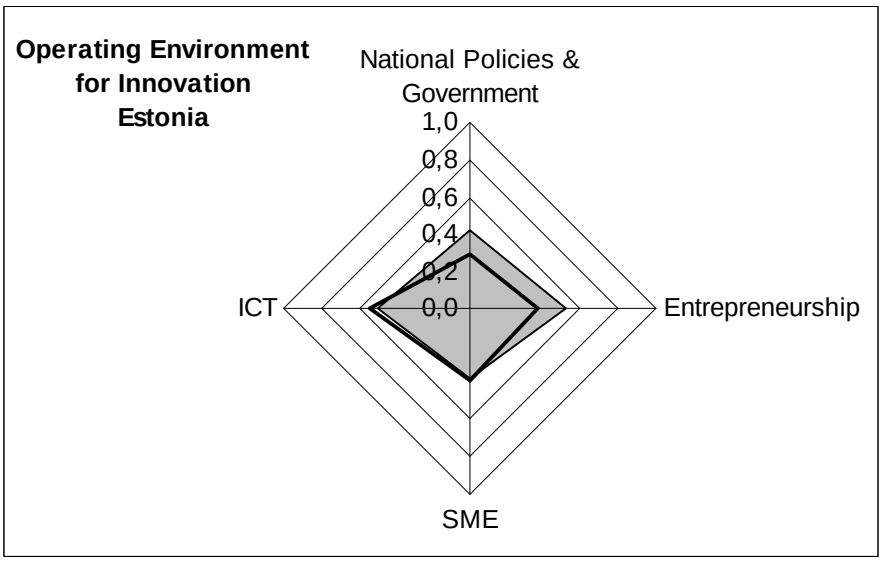
Three indicators are not available for the Operating Environment for Innovation key area.



WE		WA		WW		WC	
We1	0,103	Wa1	0,251	Ww1	0,382	Wc1	0,175
We2	0,421	Wa2	0,639	Ww2	0,149	Wc2	0,255
We3	0,545	Wa3	0,000	Ww3	0,213	Wc3	0,853
We4	0,272	Wa4	0,746	Ww4	0,487		
		Wa5	0,115	Ww5	0,113		



RL		RR		RH		RI	
Rl1	0,465	Rr1	0,023	Rh1	0,229	Ri1	0,000
Rl2	0,556	Rr2	0,449	Rh2	0,176	Ri2	0,000
Rl3	0,556	Rr3	0,028	Rh3	0,610	Ri3	0,009
Rl4	0,010	Rr4	0,183	Rh4	0,299		



OI		OE		OS		ON	
Oi1	0,983	Oe1	0,000	Os1	n	On1	0,587
Oi2	n	Oe2	0,208	Os2	0,476	On2	0,286
Oi3	0,455	Oe3	n	Os3	0,686	On3	0,007
Oi4	0,184	Oe4	0,786	Os4	0,200		
		Oe5	0,316	Os5	0,196		
		Oe6	0,502				

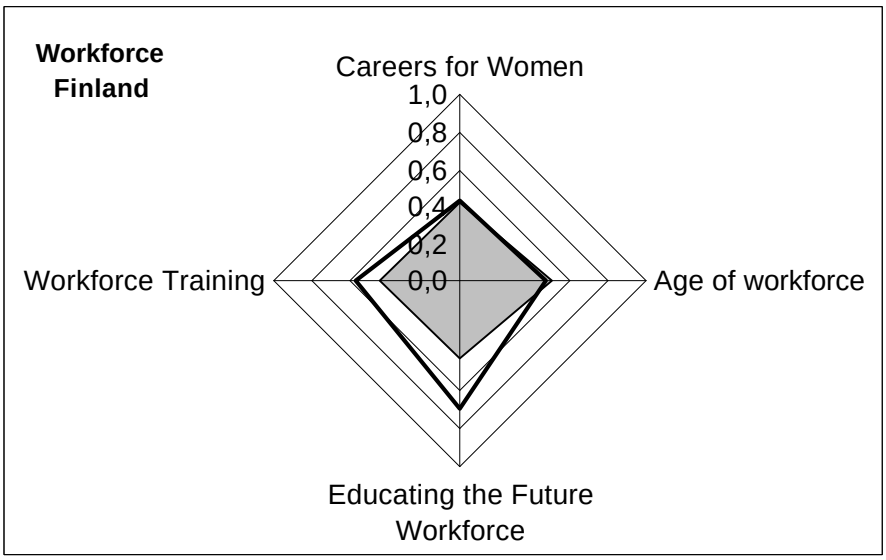
7.1.6 Finland

Finland is outperforming in nine of the twelve foci, and is not underperforming in any of the foci. In the Operating Environment for Innovation key area, Finland outperforms in all four foci. The only weak focus for Finland is Age of workforce, where the two indicators Wa1 and Wa5 (Proportion of workforce aged 50-64, and Barrier-free manufacturing) have been assigned particularly low values.

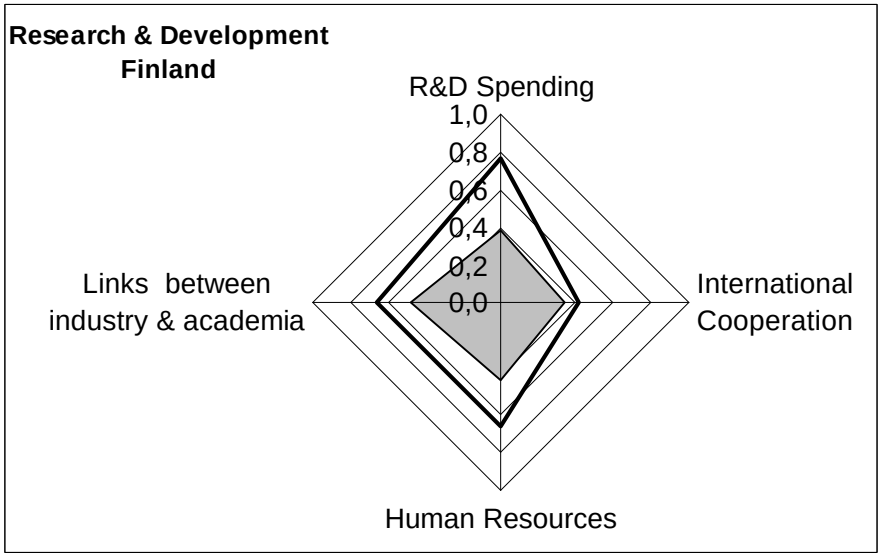
Nine of the indicators have a value of 1.0 (five of which can be found in the Research and development key area), and none of the indicators have a value of 0.0.

The two foci where Finland outperforms by the most are R&D Spending, and SME.

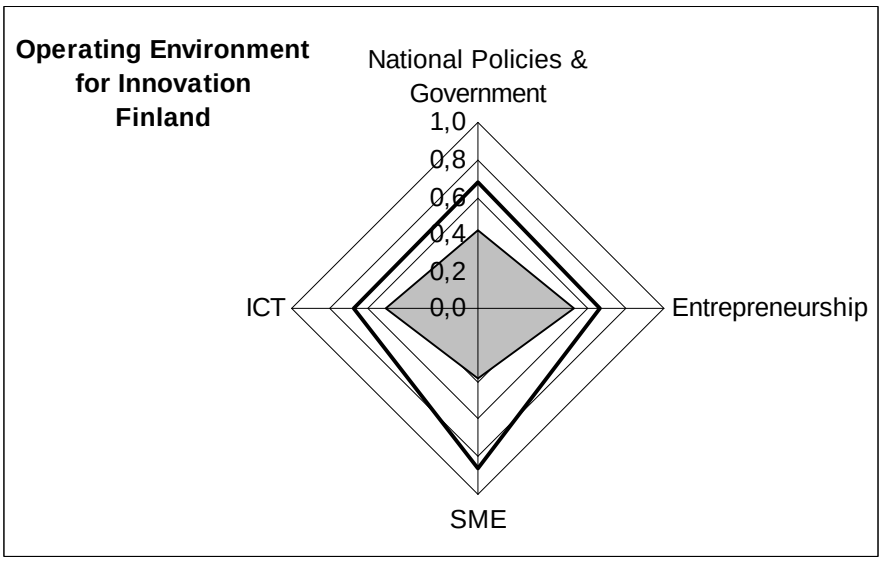
The high performance in the SME focus can be attributed to Finland being given the top score of 1.0 for the three indicators Os1, Os2, and Os4 (Employees with higher education in Manufacturing SMEs, Manufacturing SMEs involved in innovation co-operation, and Manufacturing SMEs sales of "new to market" products, respectively).



WE		WA		WW		WC	
We1	0,724	Wa1	0,258	Ww1	0,323	Wc1	0,387
We2	0,567	Wa2	0,579	Ww2	0,495	Wc2	0,664
We3	0,955	Wa3	0,734	Ww3	0,459	Wc3	0,225
We4	0,510	Wa4	0,571	Ww4	0,744		
		Wa5	0,197	Ww5	0,755		



RL		RR		RH		RI	
Rl1	0,535	Rr1	1,000	Rh1	0,286	Ri1	0,166
Rl2	1,000	Rr2	1,000	Rh2	1,000	Ri2	0,875
Rl3	1,000	Rr3	0,702	Rh3	0,845	Ri3	0,191
Rl4	0,120	Rr4	0,377	Rh4	0,526		



OI		OE		OS		ON	
Oi1	0,810	Oe1	0,397	Os1	1,000	On1	0,969
Oi2	0,404	Oe2	0,221	Os2	1,000	On2	0,629
Oi3	1,000	Oe3	0,565	Os3	0,722	On3	0,421
Oi4	0,474	Oe4	0,955	Os4	1,000		
		Oe5	0,945	Os5	0,597		
		Oe6	0,830				

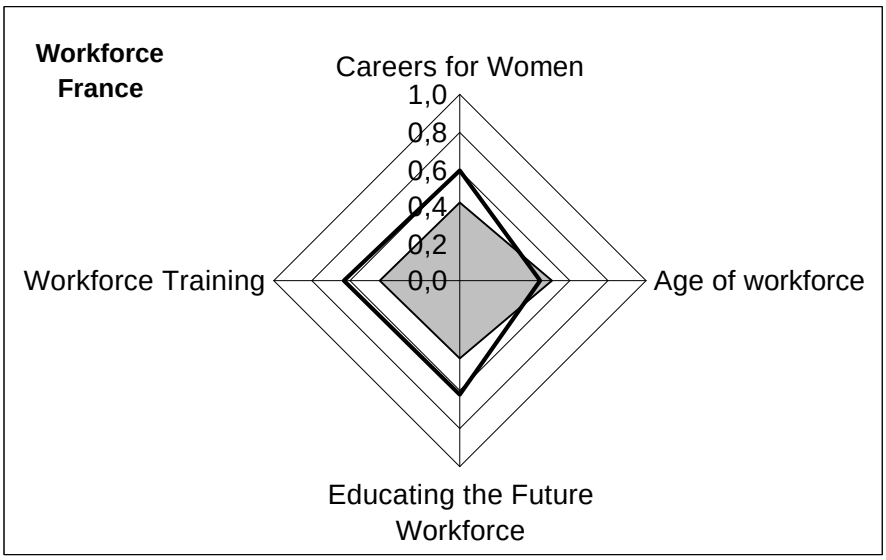
7.1.7 France

France outperforms in the following foci: educating the future workforce, workforce training, careers for women, links between industry and academia, R&D spending, human resources, international cooperation, and SME. Indeed, in the key area Research and Development, France outperforms in all four foci. In addition, France does not under-perform in any of the foci.

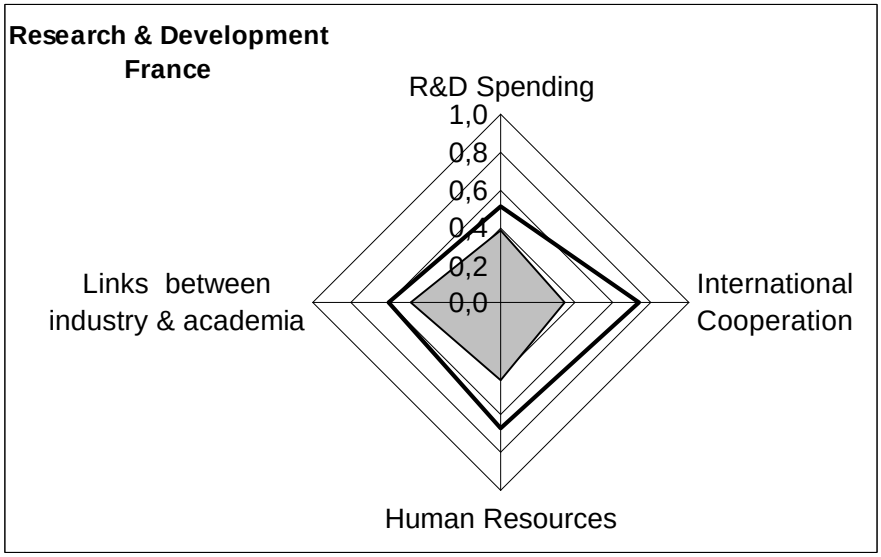
Of the remaining four foci, one is strong (ICT) and three are weak (Age of Workforce, Entrepreneurship, and national Policies & government). The weakest of the foci is Entrepreneurship

The focus in which France is outperforming the most is RI, International Cooperation in the Research and Development Key Area. One of the indicators within the focus,Ri1 (Eureka participation), has been given a value of 1.0. France was a partner in, or leader of, 196 Eureka projects in the year 2003/2004. However, it should be noted that this was the year of the French chairmanship.

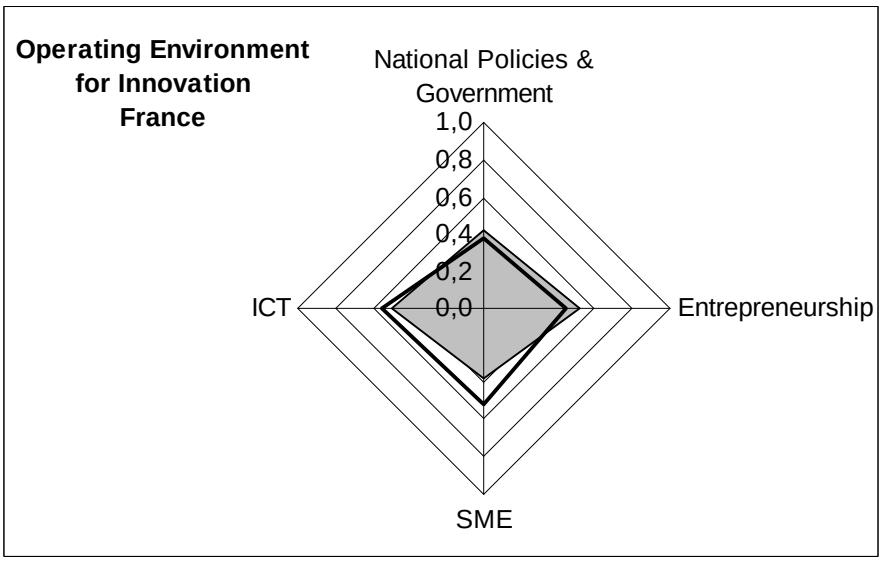
Three of the indicators have been given a value of 1.0, one of the indicators has been given a value of zero, and one of the indicators is not available.



WE		WA		WW		WC	
We1	1,000	Wa1	0,610	Ww1	0,677	Wc1	0,733
We2	0,469	Wa2	0,295	Ww2	0,185	Wc2	1,000
We3	0,773	Wa3	0,331	Ww3	0,751	Wc3	0,035
We4	0,204	Wa4	0,302	Ww4	0,821		
		Wa5	0,626	Ww5	0,660		



RL		RR		RH		RI	
Rl1	0,581	Rr1	0,599	Rh1	0,800	Ri1	1,000
Rl2	0,778	Rr2	0,764	Rh2	0,401	Ri2	0,375
Rl3	0,963	Rr3	0,386	Rh3	0,686	Ri3	0,821
Rl4	0,080	Rr4	0,284	Rh4	0,776		



OI		OE		OS		ON	
Oi1	0,879	Oe1	0,207	Os1	n	On1	0,416
Oi2	0,096	Oe2	0,141	Os2	0,502	On2	0,571
Oi3	0,763	Oe3	0,000	Os3	0,576	On3	0,146
Oi4	0,474	Oe4	0,957	Os4	0,243		
		Oe5	0,938	Os5	0,744		
		Oe6	0,413				

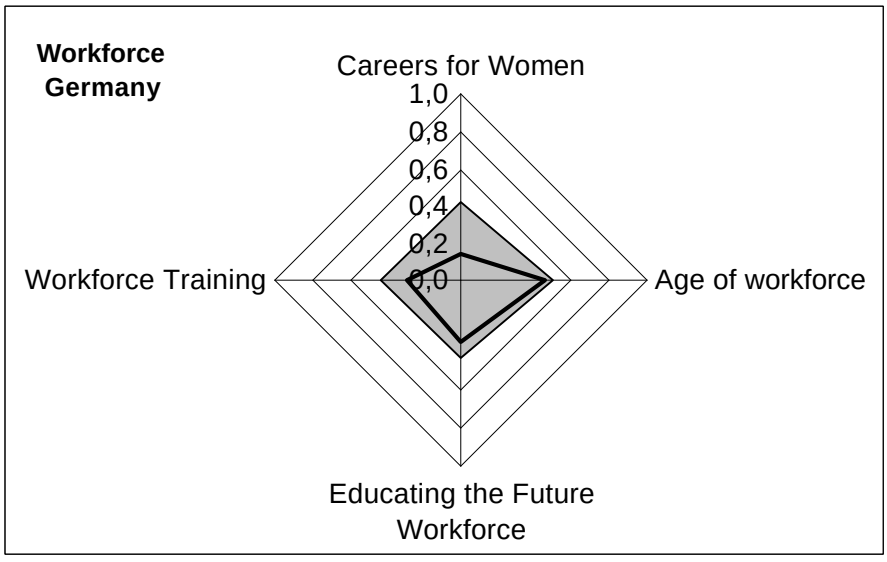
7.1.8 Germany

Germany is outperforming in the following four foci: R&D spending, Links between industry and academia, International Cooperation, and SME. Three of the four foci are in the Research and Development key area. Indeed, a rough observation of the three graphs might lead one to conclude that Germany is outperforming in Research & Development, Underperforming in Workforce, and performing roughly equal to the average in Operating Environment for Innovation.

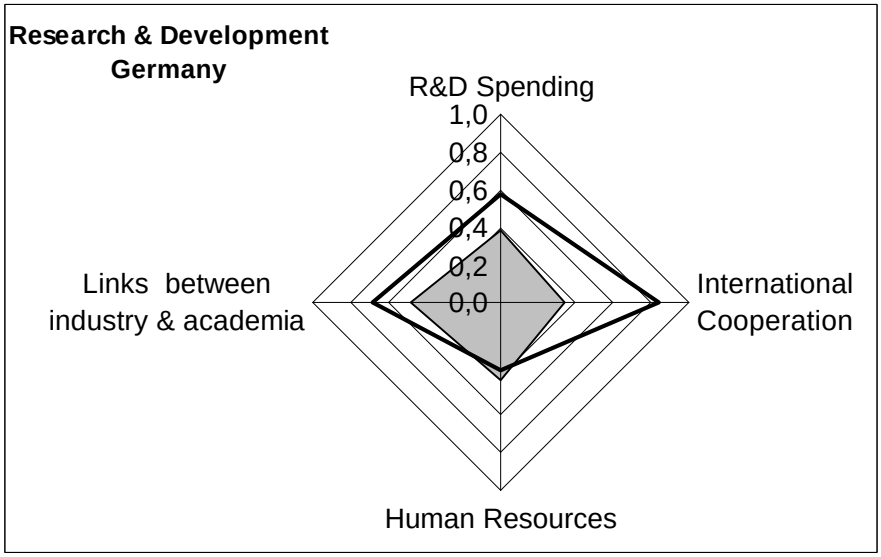
In fact, Germany is underperforming in educating the future workforce, workforce training, and careers for women. Of the remaining five foci, one is strong, and four are weak.

Germany has been awarded a value of 1.0, for two of its indicators, Ri3 and Os3 (cooperation links in FP5 and Manufacturing SMEs innovation in-house). Conversely, it has been awarded a value of zero for two of its indicators, Ww1 and Wc3 (Qualification Certification and Women Scientists and Engineers).

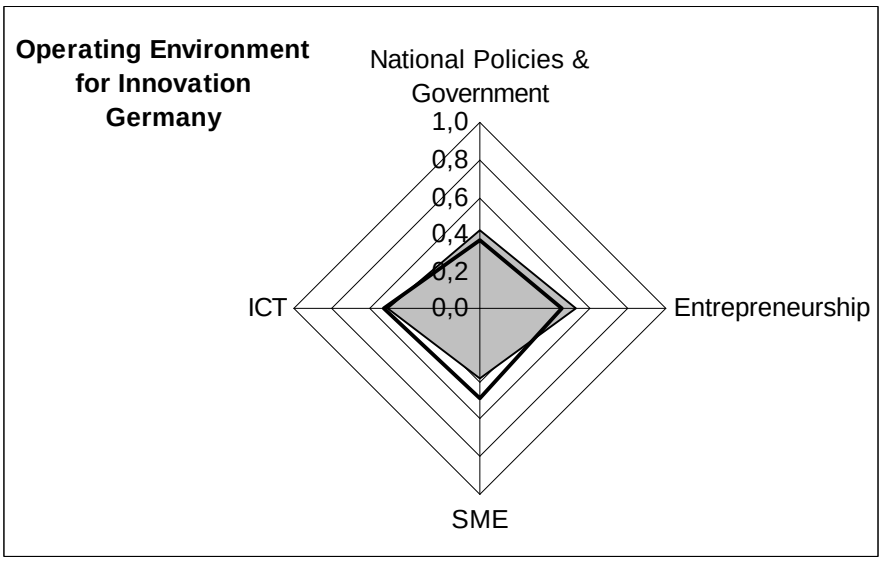
The focus in which Germany is underperforming the most is Careers for Women, in the Workforce key area. This focus consists of the three indicators: Attitude towards women in science, female graduates in maths science and technology, and women scientists and engineers. As the table shows, Germany has been awarded relatively low score in all three of these indicators.



WE		WA		WW		WC	
We1	0,207	Wa1	0,492	Ww1	0,000	Wc1	0,306
We2	0,247	Wa2	0,355	Ww2	0,143	Wc2	0,127
We3	0,545	Wa3	0,207	Ww3	0,161	Wc3	0,000
We4	0,315	Wa4	0,603	Ww4	0,718		
		Wa5	0,627	Ww5	0,415		



RL		RR		RH		RI	
Rl1	0,535	Rr1	0,565	Rh1	0,286	Ri1	0,772
Rl2	0,778	Rr2	0,697	Rh2	0,401	Ri2	0,750
Rl3	0,963	Rr3	0,502	Rh3	0,426	Ri3	1,000
Rl4	0,451	Rr4	0,520	Rh4	0,313		



OI		OE		OS		ON	
Oi1	0,707	Oe1	0,132	Os1	0,391	On1	0,292
Oi2	0,096	Oe2	0,212	Os2	0,352	On2	0,657
Oi3	0,783	Oe3	0,348	Os3	1,000	On3	0,160
Oi4	0,474	Oe4	0,915	Os4	0,256		
		Oe5	0,496	Os5	0,412		
		Oe6	0,510				

7.1.9 Greece

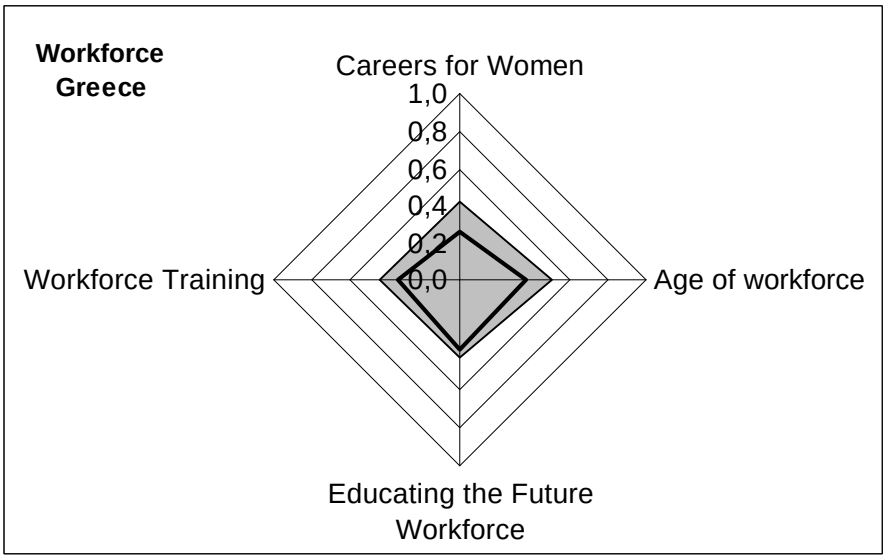
Greece does not outperform in any of the foci. However, it underperforms in the following foci: workforce training, age of workforce, careers for women, links between industry and academia, R&D spending, and human resources. Of the remaining six foci, one is strong, and five are weak.

The focus where Greece shows a strong performance is International cooperation, with Ri2 (Preferred co-publication partners) being the strongest indicator within that focus.

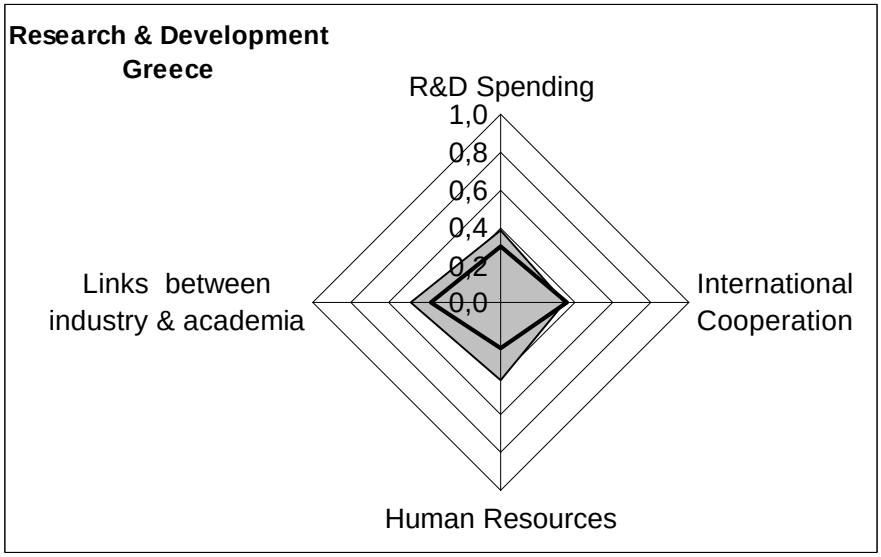
Five of the indicators are not available for Greece, most notably two of which are in the focus educating the future workforce.

The focus in which Greece is underperforming the most is Human Resources, in the Research and Development key area.

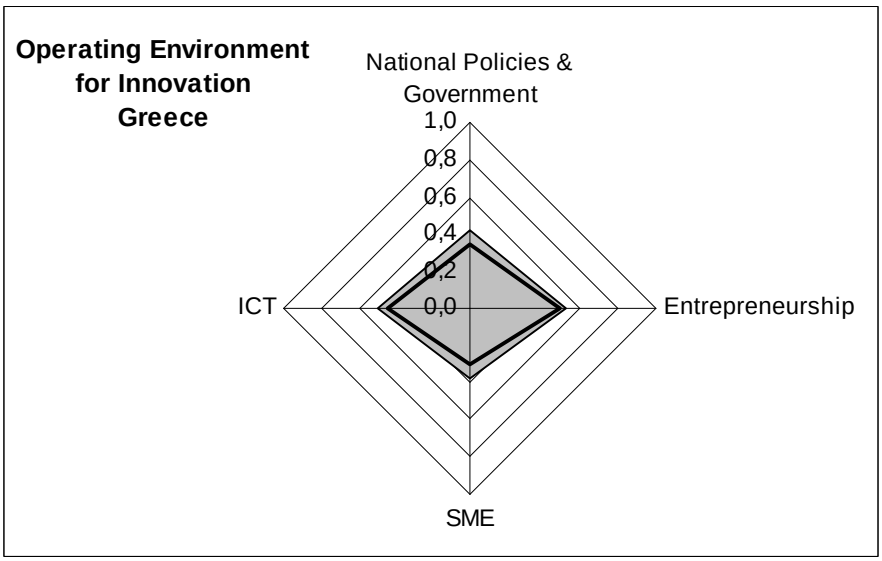
A value of 0.0 has been awarded to Greece for the indicators Oe4 and Os4 (cost to start a company, and manufacturing SMEs sales of "new to market" products).



WE		WA		WW		WC	
We1	n	Wa1	0,246	Ww1	0,916	Wc1	0,251
We2	0,121	Wa2	0,412	Ww2	0,073	Wc2	n
We3	0,636	Wa3	0,177	Ww3	0,625	Wc3	0,268
We4	n	Wa4	0,397	Ww4	0,013		
		Wa5	0,532	Ww5	0,057		



RL		RR		RH		RI	
Rl1	0,419	Rr1	0,700	Rh1	0,371	Ri1	0,275
Rl2	0,511	Rr2	0,315	Rh2	0,132	Ri2	0,500
Rl3	0,185	Rr3	0,025	Rh3	0,242	Ri3	0,294
Rl4	0,359	Rr4	0,162	Rh4	n		



OI		OE		OS		ON	
Oi1	0,603	Oe1	0,224	Os1	n	On1	0,135
Oi2	0,788	Oe2	0,880	Os2	0,125	On2	0,629
Oi3	0,300	Oe3	0,696	Os3	0,249	On3	0,284
Oi4	0,053	Oe4	0,000	Os4	0,000		
		Oe5	0,938	Os5	0,820		
		Oe6	0,160				

7.1.10 Hungary

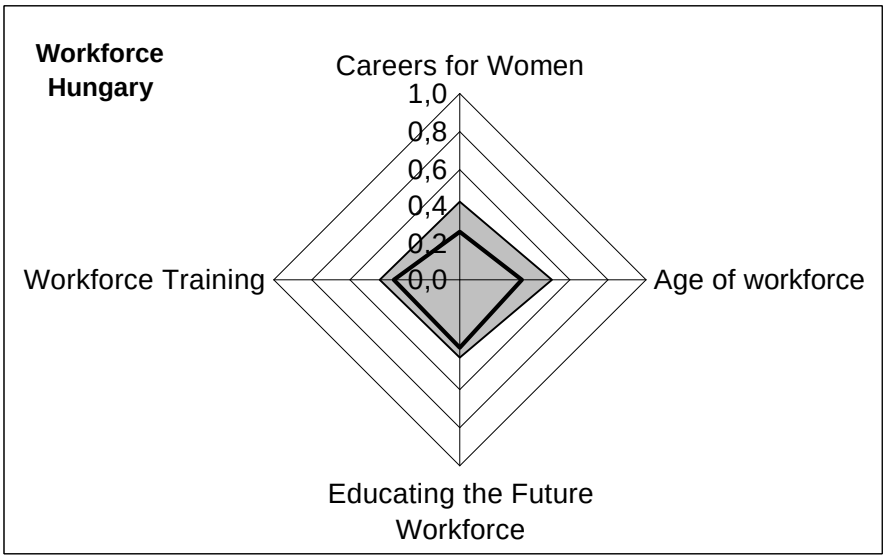
Hungary is outperforming in the links between industry and academia focus. This focus is composed of four indicators, all of which have been assigned a value above 0.50.

There are four foci in which Hungary is underperforming: Age of workforce, Careers for women, human resources, and entrepreneurship. The latter of the four, entrepreneurship, is the one in which Hungary is underperforming the most.

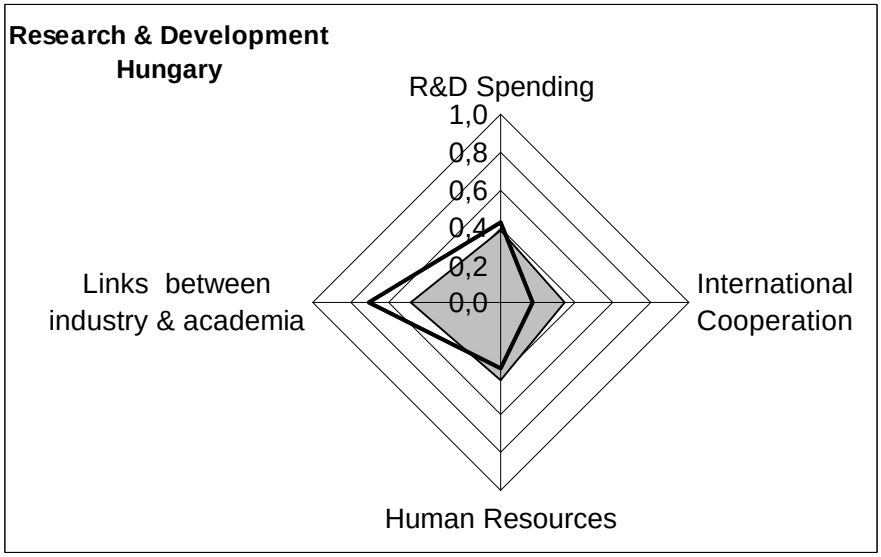
Of the remaining seven foci, two are strong and five are weak.

Hungary has been allocated a value of 0.0 for three of the indicators, We1, Wc2, and Oe5 (Graduates in maths science and technology, female graduates in maths science and technology, and willingness to start a business even if it might fail).

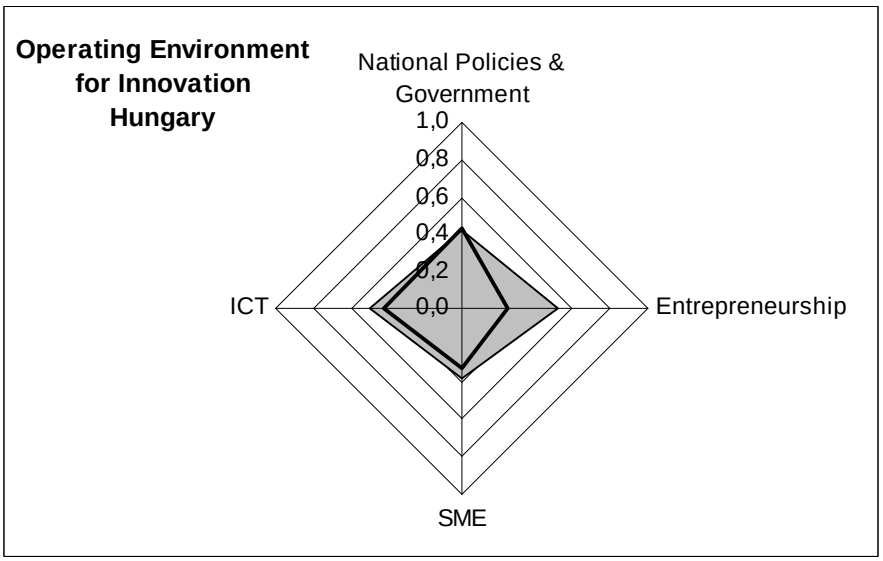
None of the indicators have been given a value of 1.0, and four of the indicators are not available.



WE		WA		WW		WC	
We1	0,000	Wa1	0,672	Ww1	0,588	Wc1	0,409
We2	0,358	Wa2	0,120	Ww2	0,143	Wc2	0,000
We3	0,864	Wa3	0,163	Ww3	0,827	Wc3	0,357
We4	0,219	Wa4	0,365	Ww4	0,154		
		Wa5	0,361	Ww5	0,057		



RL		RR		RH		RI	
Rl1	0,930	Rr1	0,859	Rh1	0,514	Ri1	0,073
Rl2	0,711	Rr2	0,573	Rh2	0,158	Ri2	0,375
Rl3	0,593	Rr3	0,072	Rh3	n	Ri3	0,068
Rl4	0,569	Rr4	0,206	Rh4	0,394		



OI		OE		OS		ON	
Oi1	0,966	Oe1	0,213	Os1	n	On1	0,406
Oi2	0,327	Oe2	0,364	Os2	0,608	On2	0,114
Oi3	0,289	Oe3	n	Os3	n	On3	0,778
Oi4	0,105	Oe4	0,076	Os4	0,040		
		Oe5	0,000	Os5	0,321		
		Oe6	0,593				

7.1.11 Italy

Italy is outperforming in two of the foci: International cooperation, and Entrepreneurship. Indeed, one of the indicators in the Entrepreneurship focus (Oe2 – Manufacturing self-employed) has been awarded a value of 1.0.

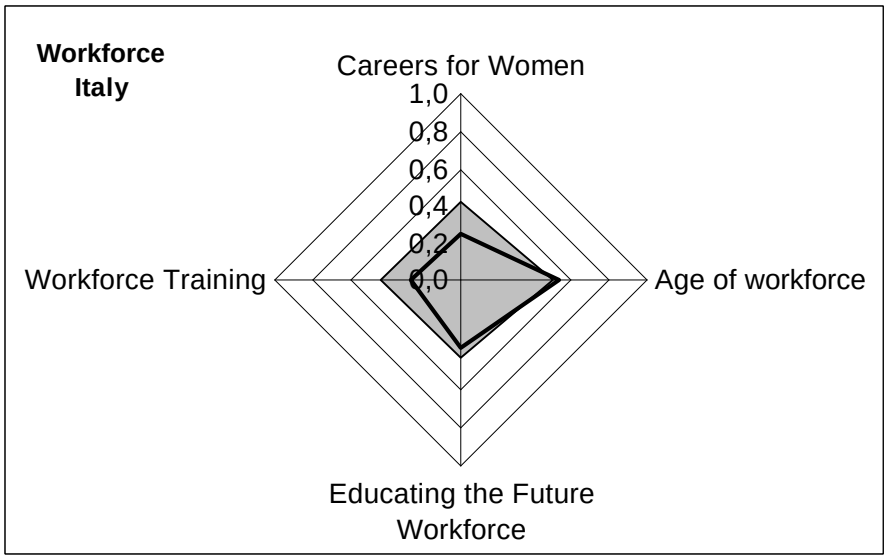
However, the country is underperforming in four foci: Workforce training, Careers for women, ICT, and national policies & government.

Of the remaining six foci, three are strong and three are weak.

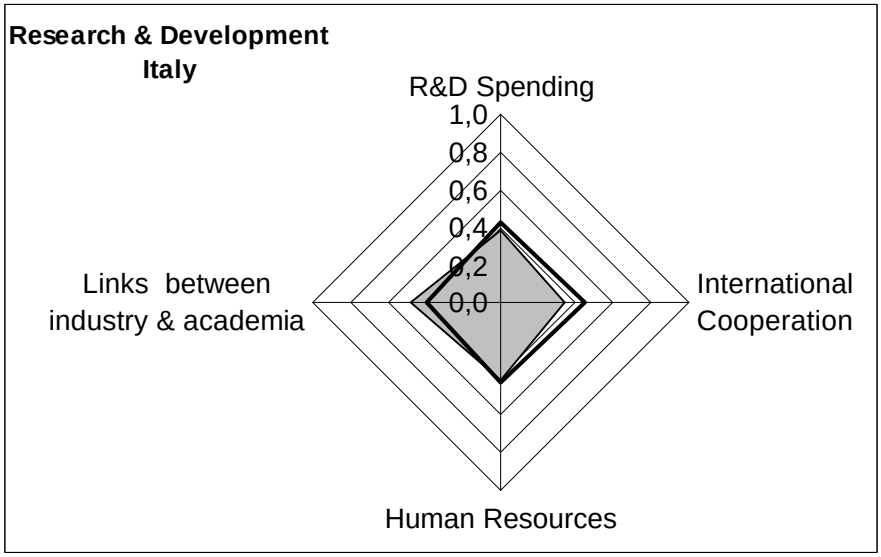
The indicator value 0.0 has only been awarded once, to the indicator Oi4 (manufacturing enterprises receiving order via ICT).

The Research and Development key area is arguably the strongest of the three key areas, with none of its foci underperforming, and one if the (International cooperation) outperforming.

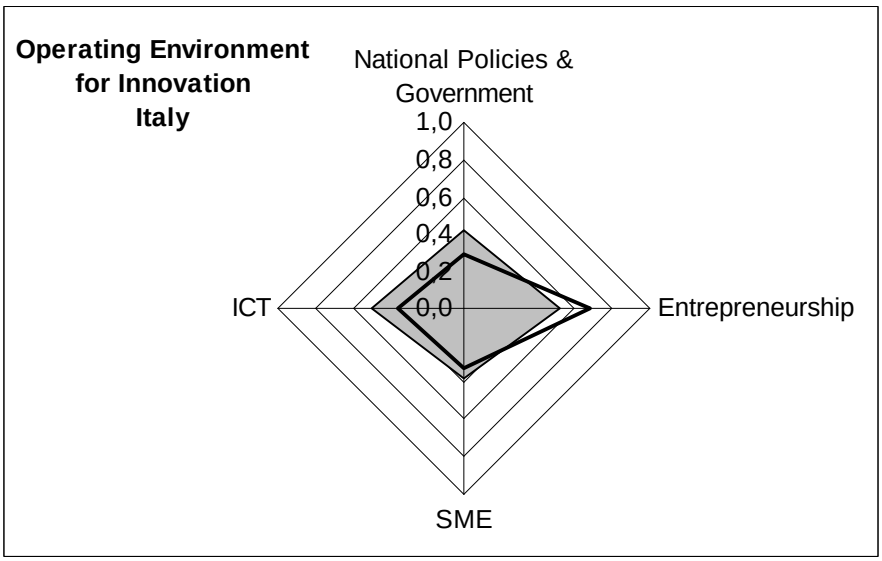
Data is available for every indicator for this country.



WE		WA		WW		WC	
We1	0,149	Wa1	0,639	Ww1	0,585	Wc1	0,251
We2	0,326	Wa2	0,151	Ww2	0,103	Wc2	0,255
We3	0,500	Wa3	0,467	Ww3	0,231	Wc3	0,252
We4	0,505	Wa4	0,476	Ww4	0,179		
		Wa5	0,897	Ww5	0,226		



RL		RR		RH		RI	
Rl1	0,349	Rr1	0,880	Rh1	0,429	Ri1	0,430
Rl2	0,578	Rr2	0,449	Rh2	0,092	Ri2	0,250
Rl3	0,556	Rr3	0,132	Rh3	0,294	Ri3	0,653
Rl4	0,079	Rr4	0,256	Rh4	0,900		



OI		OE		OS		ON	
Oi1	0,586	Oe1	0,639	Os1	0,023	On1	0,110
Oi2	0,481	Oe2	1,000	Os2	0,013	On2	0,657
Oi3	0,368	Oe3	0,391	Os3	0,604	On3	0,112
Oi4	0,000	Oe4	0,654	Os4	0,478		
		Oe5	0,760	Os5	0,509		
		Oe6	0,639				

7.1.12 Latvia

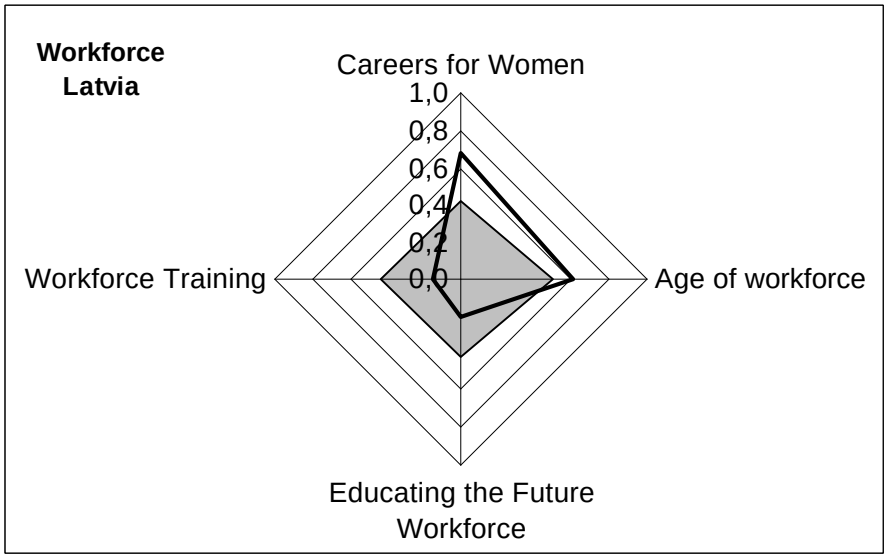
Latvia is outperforming in three foci: Age of workforce, Careers for Women, and Human resources. Of the three, Careers for women is the focus in which the country shows the greatest performance. No data is available for one of the indicators in this focus (Wc1 – attitude towards women in science). The indicator Wc3 (women scientists and engineers) has been awarded a very high value of 0,997.

The country is underperforming in seven foci: Educating the future workforce, workforce training, links between industry & academia, R&D spending, International cooperation, SME, and National policies & government.

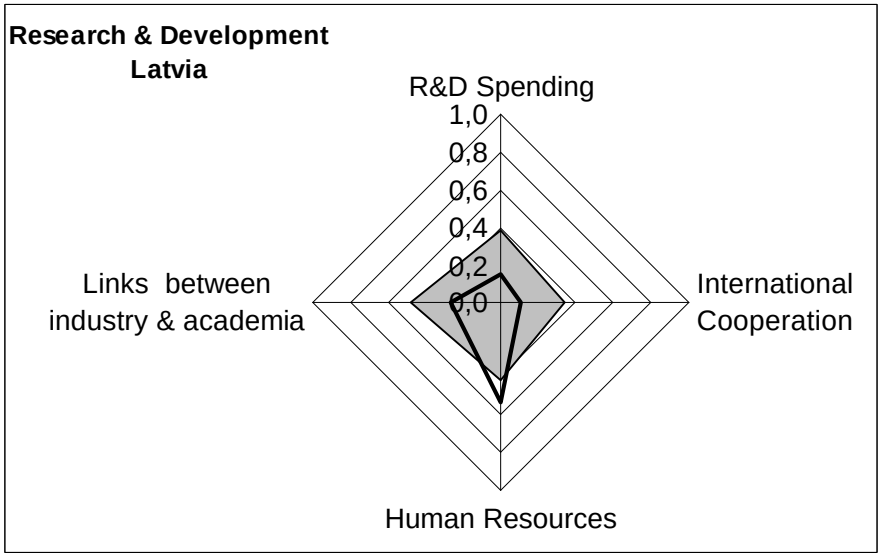
Of the remaining two foci, one is strong (Entrepreneurship) and one is weak (ICT).

A total of eleven indicators are not available for this country, five in the workforce key area, and six in the operating environment for innovation key area.

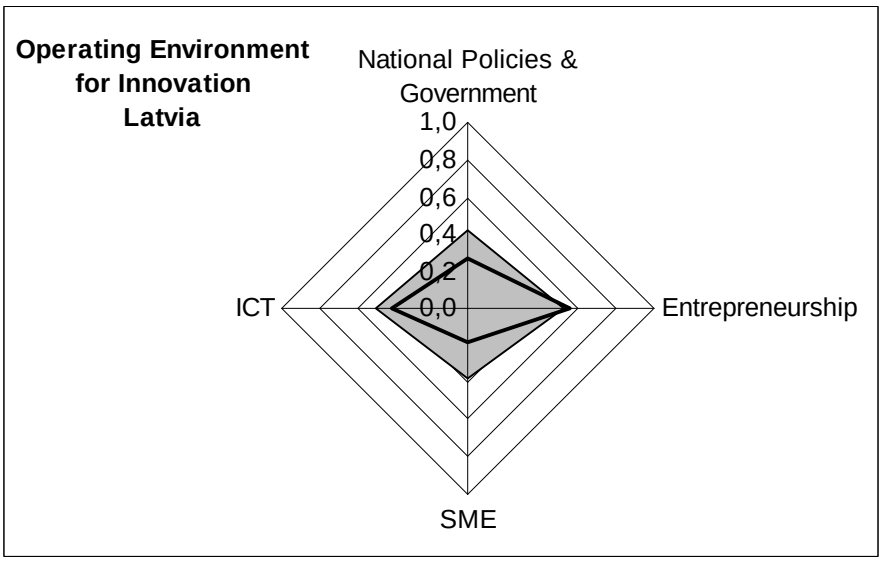
Three indicators have been awarded a value of 0.0. These are RI4 (Manufacturing enterprises use of universities as sources of info. for innovation) , Ri3 (Cooperation links in FP5), and On3 (Manufacturing enterprises using government as source of information for innovation)-



WE		WA		WW		WC	
We1	0,218	Wa1	0,474	Ww1	n	Wc1	n
We2	0,431	Wa2	0,457	Ww2	0,207	Wc2	0,364
We3	0,136	Wa3	n	Ww3	n	Wc3	0,997
We4	0,050	Wa4	0,873	Ww4	0,205		
		Wa5	n	Ww5	0,038		



RL		RR		RH		RI	
Rl1	0,186	Rr1	0,129	Rh1	0,571	Ri1	0,078
Rl2	0,467	Rr2	0,112	Rh2	0,119	Ri2	0,250
Rl3	0,407	Rr3	0,013	Rh3	0,562	Ri3	0,000
Rl4	0,000	Rr4	0,344	Rh4	0,863		



OI		OE		OS		ON	
Oi1	0,759	Oe1	n	Os1	n	On1	0,374
Oi2	n	Oe2	0,134	Os2	0,081	On2	0,429
Oi3	0,265	Oe3	n	Os3	0,294	On3	0,000
Oi4	0,211	Oe4	0,789	Os4	n		
		Oe5	0,441	Os5	n		
		Oe6	0,809				

7.1.13 Lithuania

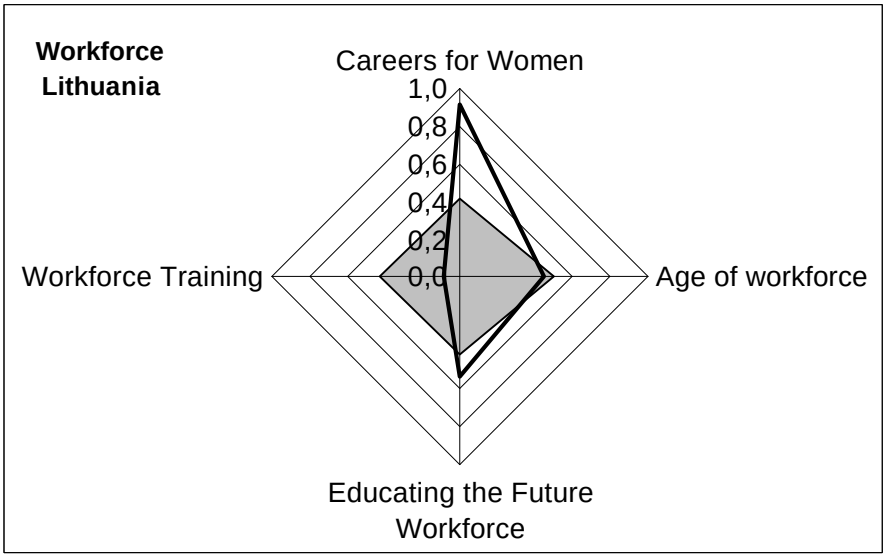
Lithuania is outperforming in three foci: Educating the future workforce, careers for women, and national policies & government. Most notable, is the out-performance in the Careers for Women focus. In this focus, one indicator is not available (Wc1-attitude towards women in science), and the other two (Wc2 – Female graduates in maths science & engineering, and Wc3 – Women scientists and engineers) have scored very highly.

The country is underperforming in the following foci: Workforce training, R&D spending, International cooperation, and ICT.

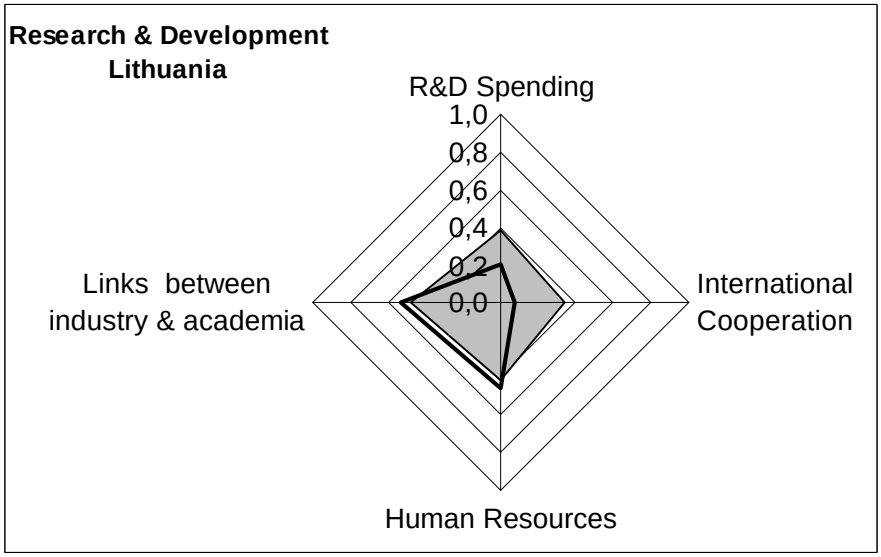
Of the remaining five foci, two are strong (Links between industry & academia and human resources) and three are weak (age of workforce, Entrepreneurship, and SME).

Data is not available for ten of the indicators.

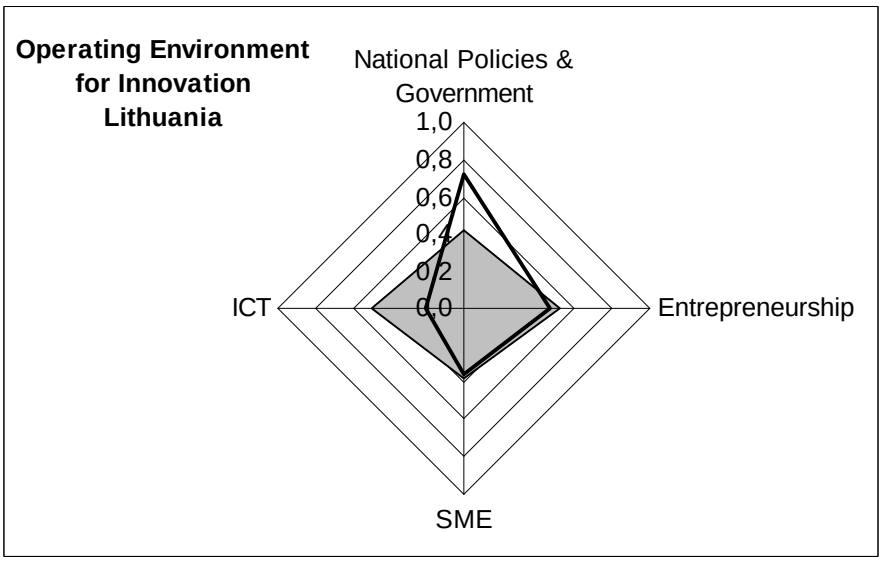
Indicators Wc3 (Women scientists and Engineers), Rl4 (Manufacturing enterprises use of universities as sources of info. for innovation), and On3 (Manufacturing enterprises using government as source of information for innovation) have all been allocated a score of 1.0.



WE		WA		WW		WC	
We1	0,661	Wa1	0,542	Ww1	n	Wc1	n
We2	0,506	Wa2	0,470	Ww2	0,097	Wc2	0,836
We3	0,636	Wa3	n	Ww3	n	Wc3	1,000
We4	0,324	Wa4	0,317	Ww4	0,154		
		Wa5	n	Ww5	0,019		



RL		RR		RH		RI	
Rl1	0,349	Rr1	n	Rh1	0,514	Ri1	0,093
Rl2	0,378	Rr2	0,438	Rh2	0,235	Ri2	0,125
Rl3	0,407	Rr3	0,003	Rh3	0,333	Ri3	0,016
Rl4	1,000	Rr4	0,171	Rh4	0,742		



OI		OE		OS		ON	
Oi1	0,362	Oe1	n	Os1	n	On1	0,235
Oi2	0,096	Oe2	0,081	Os2	0,466	On2	0,914
Oi3	0,320	Oe3	n	Os3	0,429	On3	1,000
Oi4	0,053	Oe4	0,909	Os4	0,168		
		Oe5	0,252	Os5	n		
		Oe6	0,621				

7.1.14 Netherlands

The Netherlands is outperforming in the following foci: Age of workforce, workforce training, Links between industry & academia, and R&D spending. The only two foci where the country is underperforming are Careers for women, and Human resources.

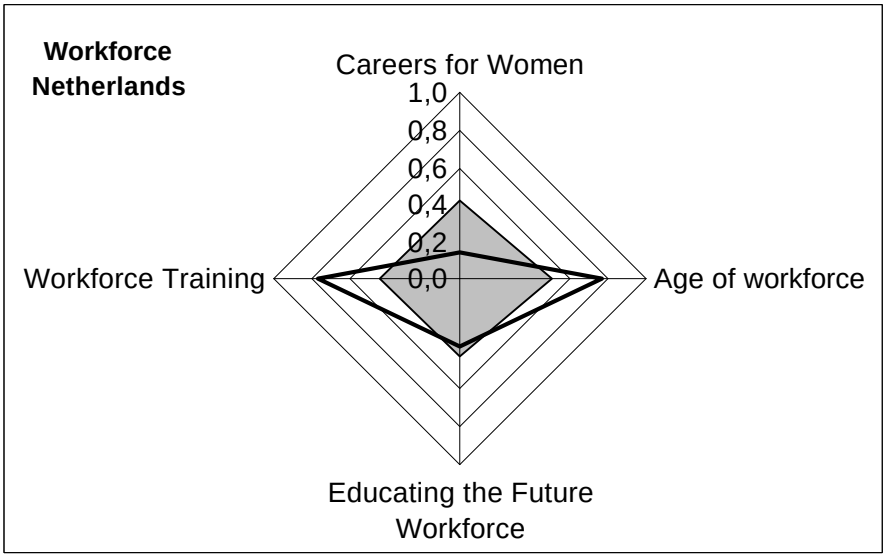
Of the remaining six foci, three are strong (International cooperation, entrepreneurship and SME) and three are weak (Educating the future workforce, ICT, and national policies & government).

Although the operating environment for innovation key area has no foci in which The Netherlands is underperforming, it also has no foci in which the country is outperforming.

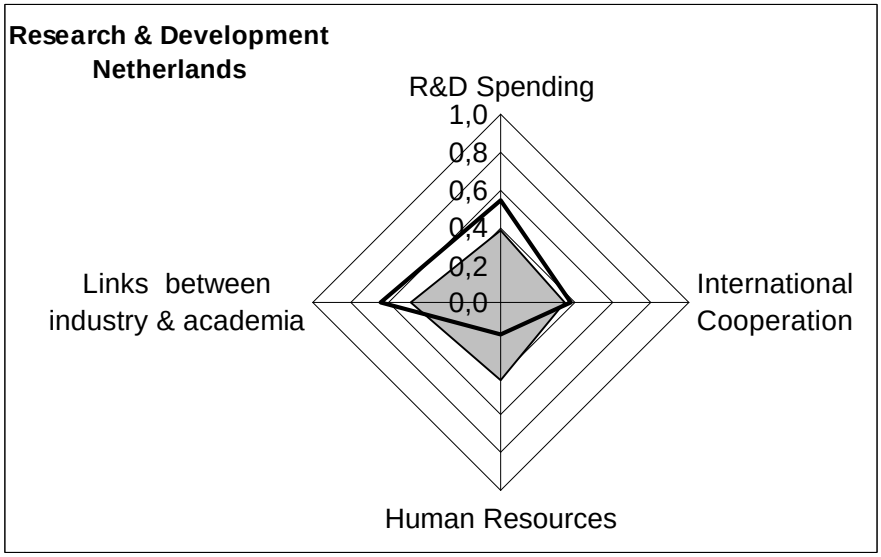
There are five indicators where data is not available for The Netherlands.

The highest outperforming focus is Workforce training, closely followed by age of workforce.

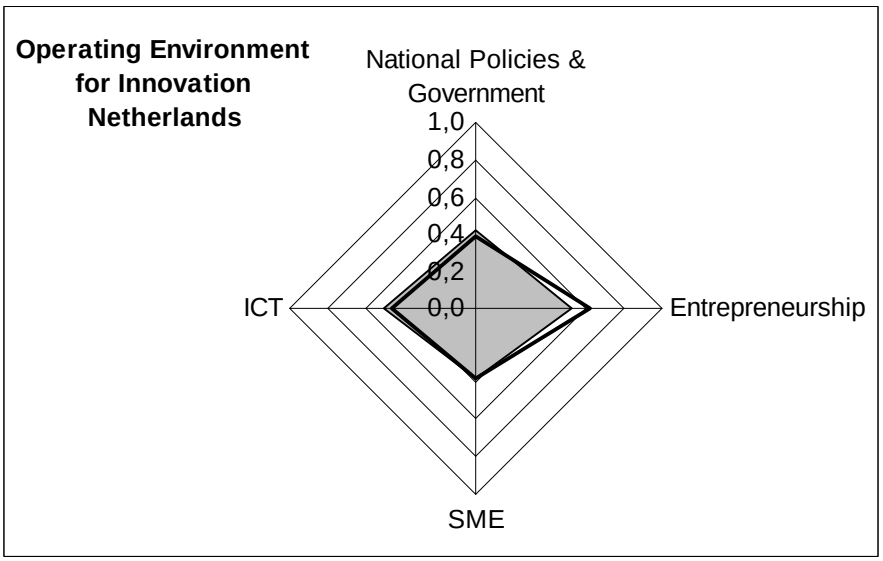
The indicator Rh4 (female Phds in science engineering manufacturing and construction) has been allocated a value of 0.0, i.e. the lowest possible score.



WE		WA		WW		WC	
We1	0,259	Wa1	0,295	Ww1	0,493	Wc1	0,279
We2	0,713	Wa2	n	Ww2	0,608	Wc2	0,227
We3	n	Wa3	0,430	Ww3	0,352	Wc3	0,319
We4	0,275	Wa4	0,889	Ww4	0,897		
		Wa5	0,521	Ww5	0,604		



RL		RR		RH		RI	
Rl1	0,070	Rr1	0,559	Rh1	0,143	Ri1	0,249
Rl2	n	Rr2	0,629	Rh2	0,550	Ri2	0,500
Rl3	n	Rr3	0,260	Rh3	0,404	Ri3	0,171
Rl4	0,211	Rr4	0,141	Rh4	0,000		



OI		OE		OS		ON	
Oi1	n	Oe1	0,703	Os1	0,042	On1	0,555
Oi2	0,212	Oe2	0,048	Os2	0,440	On2	0,457
Oi3	0,708	Oe3	0,435	Os3	0,753	On3	0,164
Oi4	0,447	Oe4	0,803	Os4	0,274		
		Oe5	0,904	Os5	0,365		
		Oe6	0,809				

7.1.15 Norway

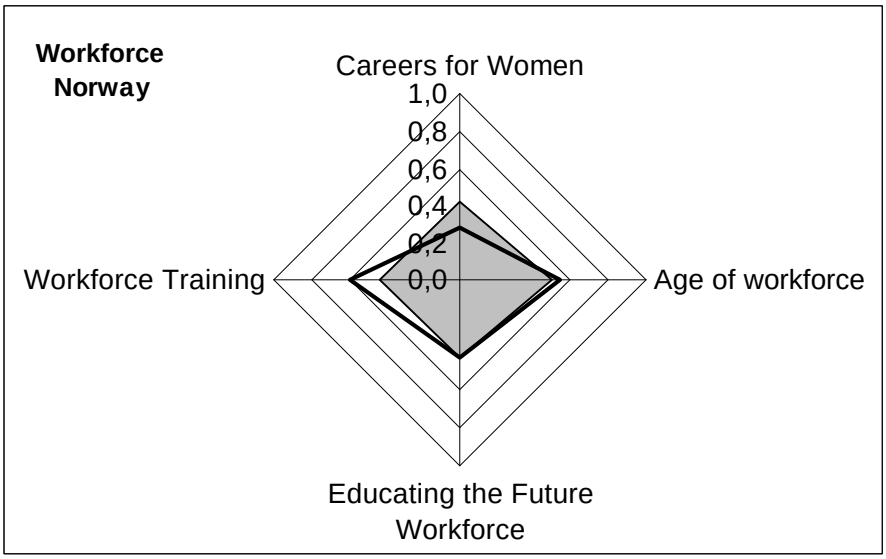
Norway is outperforming in two foci: workforce training, and national policies & government. However, the country is underperforming in careers for women, links between industry and academia, and human resources. It should be noted that two indicators are not available for the links between industry and academia focus (Rl2 – University/Industry research collaboration, and Rl3 – availability of specialised research services).

Of the remaining seven foci, five are strong, and two are weak (educating the future workforce and international cooperation).

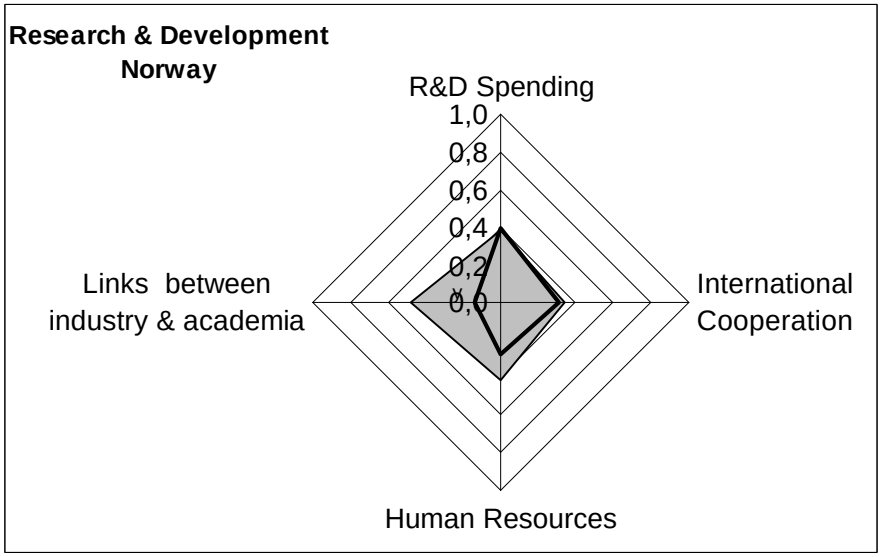
In total, four indicators are not available for this country.

Two indicators have been given a value of 1.0: Oe5 (Willingness to start a business if there is a risk it might fail) and On1 (economic climate favourable for starting own business).

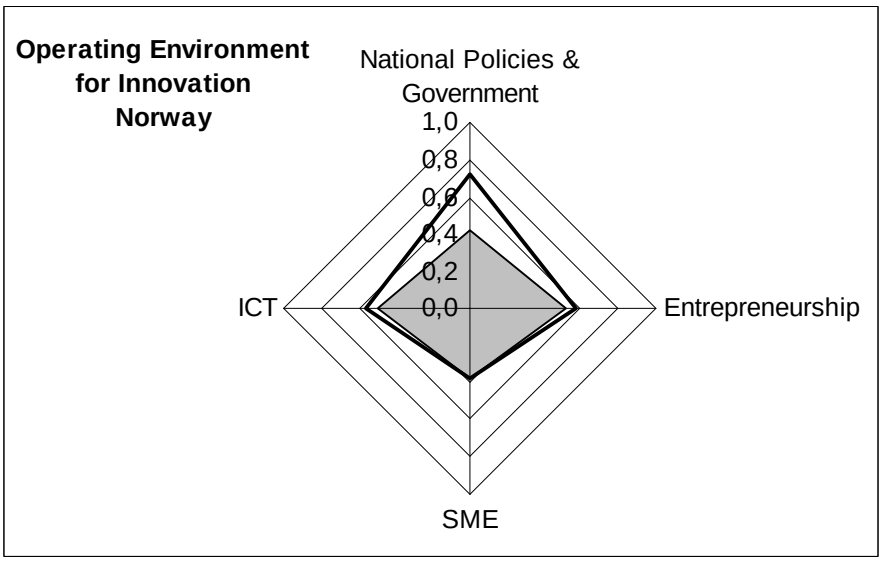
Conversely, one indicator (Oe2 – Manufacturing self-employed) has been given a value of 0.0.



WE		WA		WW		WC	
We1	0,259	Wa1	0,295	Ww1	0,493	Wc1	0,279
We2	0,713	Wa2	n	Ww2	0,608	Wc2	0,227
We3	n	Wa3	0,430	Ww3	0,352	Wc3	0,319
We4	0,275	Wa4	0,889	Ww4	0,897		
		Wa5	0,521	Ww5	0,604		



RL		RR		RH		RI	
Rl1	0,070	Rr1	0,559	Rh1	0,143	Ri1	0,249
Rl2	n	Rr2	0,629	Rh2	0,550	Ri2	0,500
Rl3	n	Rr3	0,260	Rh3	0,404	Ri3	0,171
Rl4	0,211	Rr4	0,141	Rh4	0,000		



OI		OE		OS		ON	
Oi1	0,862	Oe1	0,145	Os1	0,567	On1	1,000
Oi2	0,231	Oe2	0,000	Os2	0,519	On2	0,743
Oi3	0,794	Oe3	0,435	Os3	0,553	On3	0,427
Oi4	0,342	Oe4	0,944	Os4	0,059		
		Oe5	1,000	Os5	0,185		
		Oe6	0,883				

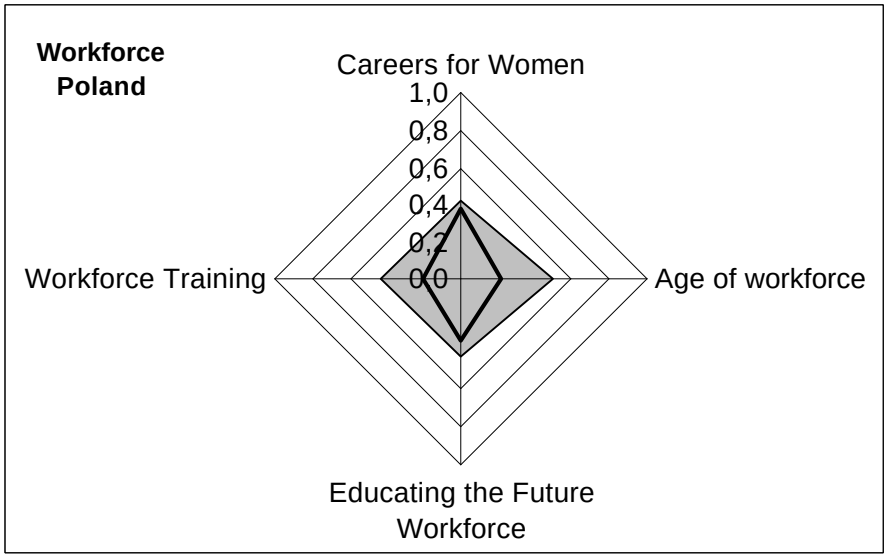
7.1.16 Poland

Poland is outperforming in the national policies & government focus. However, the country is underperforming in the following foci: age of workforce, workforce training, links between industry and academia, R&D spending, human resources, and SME.

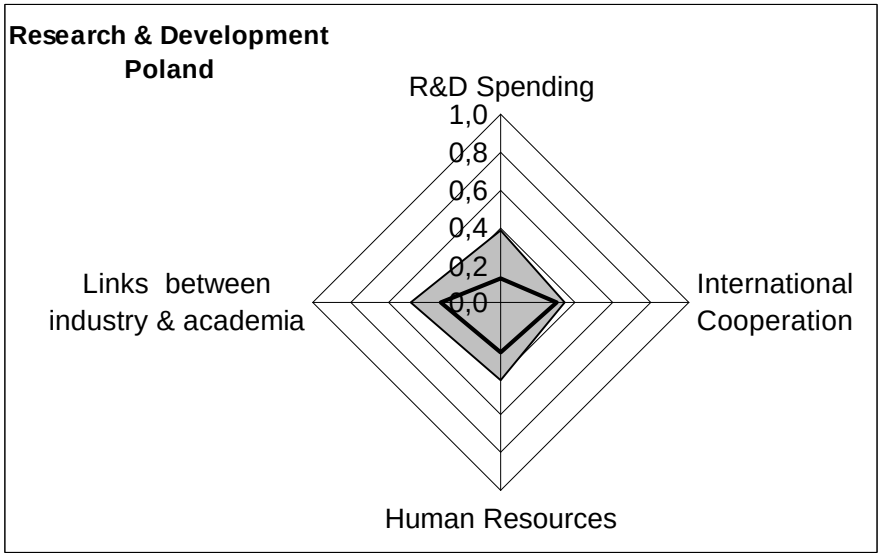
Of the remaining five foci, one is strong (ICT), and four are weak (Educating the future workforce, careers for women, international cooperation, and entrepreneurship).

Three indicators are not available for this country, all of which are in the operating environment for innovation key area.

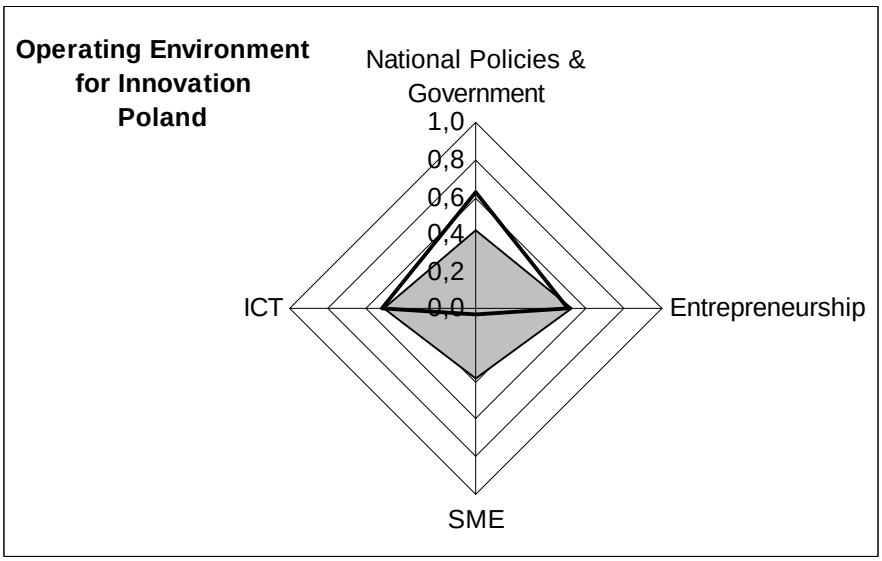
A value of 0.0 has been awarded nine times, for the following indicators: Wa4 (average exit age from the workforce), Wa5 (Barrier-free manufacturing), Ww3 (learning in the company), Rl1 (Priority given to ISR), Rr1 (Manufacturing companies receiving public funding innovation), Rr3 (Business R&D expenditure), Rh1 (Priority given to mobility schemes), and Os5 (SME networks).



WE		WA		WW		WC	
We1	0,241	Wa1	0,778	Ww1	0,555	Wc1	0,418
We2	0,437	Wa2	0,075	Ww2	0,112	Wc2	0,318
We3	0,455	Wa3	0,244	Ww3	0,000	Wc3	0,399
We4	0,212	Wa4	0,000	Ww4	0,179		
		Wa5	0,000	Ww5	0,170		



RL		RR		RH		RI	
Rl1	0,000	Rr1	0,000	Rh1	0,000	Ri1	0,275
Rl2	0,489	Rr2	0,348	Rh2	0,129	Ri2	0,500
Rl3	0,593	Rr3	0,000	Rh3	0,329	Ri3	0,126
Rl4	0,215	Rr4	0,175	Rh4	0,615		



OI		OE		OS		ON	
Oi1	0,845	Oe1	0,389	Os1	n	On1	0,298
Oi2	n	Oe2	0,329	Os2	0,067	On2	0,857
Oi3	0,198	Oe3	n	Os3	0,000	On3	0,707
Oi4	0,474	Oe4	0,708	Os4	0,067		
		Oe5	0,588	Os5	0,000		
		Oe6	0,442				

7.1.17 Portugal

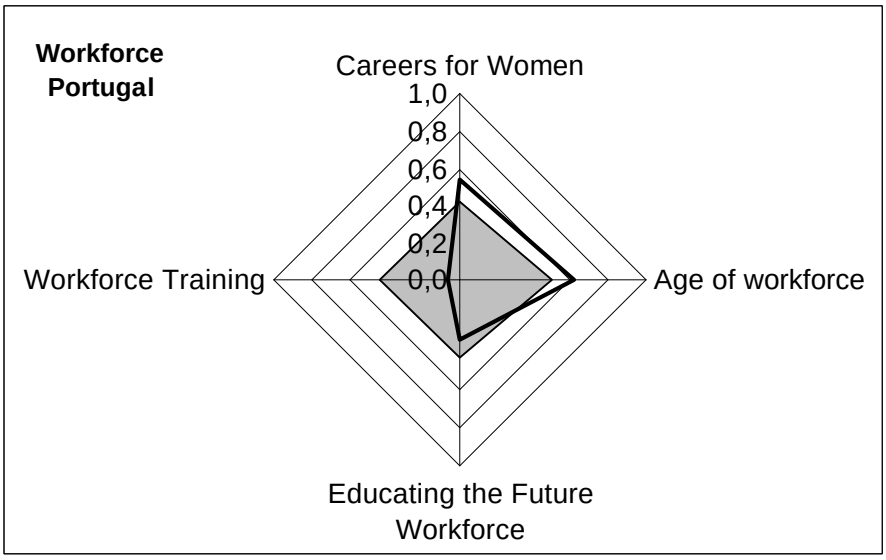
Portugal is outperforming in two foci: age of workforce, and careers for women (both in the workforce key area). The country is underperforming in four foci: educating the future workforce, workforce training, International cooperation, and national policies & government.

Of the remaining six foci, three are strong (R&D spending, human resources, and ICT) and three are weak (links between industry & academia, Entrepreneurship, and SME).

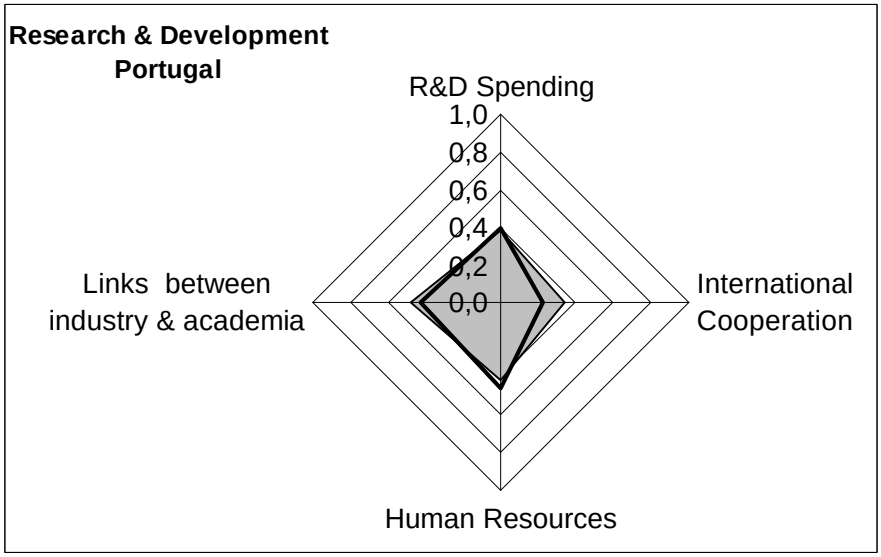
The weakest of the underperforming foci is workforce training in the workforce key area. It is perhaps worth noting that two out of the five indicators for this focus are not available (Ww1 and Ww3).

In total, seven indicators are not available for this country (Wa3, Wa5, Ww1, Ww3, Wc1, Oe1, and Os5), five of which are from the Workforce key area.

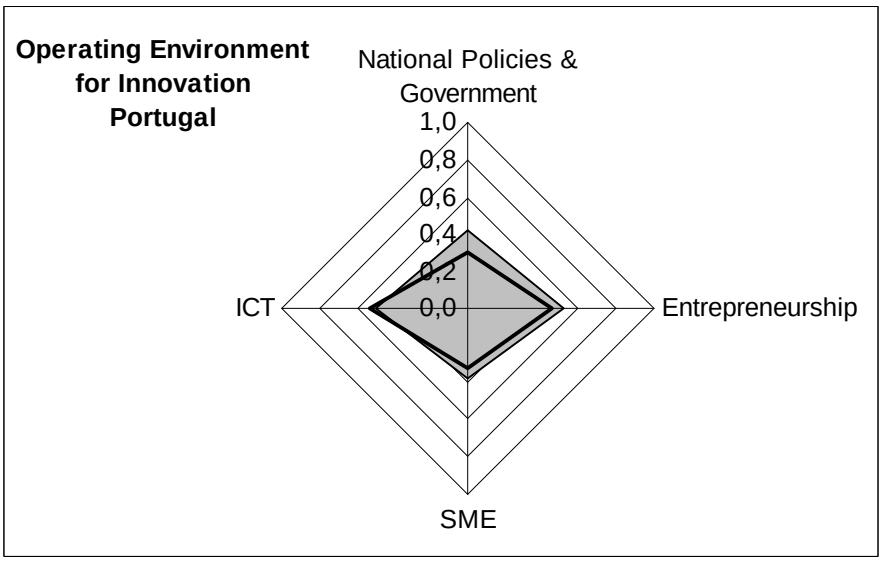
Two indicators (Rh4 – female PhDs in science engineering manufacturing and construction, and Oi2 – Manufacturing enterprises using the internet for interaction with public authorities) have the value 1.0 (i.e. the highest possible).



WE		WA		WW		WC	
We1	0,195	Wa1	0,271	Ww1	n	Wc1	n
We2	0,502	Wa2	0,612	Ww2	0,073	Wc2	0,391
We3	0,000	Wa3	n	Ww3	n	Wc3	0,684
We4	0,589	Wa4	0,952	Ww4	0,013		
		Wa5	n	Ww5	0,113		



RL		RR		RH		RI	
Rl1	0,581	Rr1	0,754	Rh1	0,286	Ri1	0,140
Rl2	0,489	Rr2	0,517	Rh2	0,149	Ri2	0,375
Rl3	0,370	Rr3	0,060	Rh3	0,405	Ri3	0,163
Rl4	0,265	Rr4	0,243	Rh4	1,000		



OI		OE		OS		ON	
Oi1	0,621	Oe1	n	Os1	0,048	On1	0,000
Oi2	1,000	Oe2	0,775	Os2	0,184	On2	0,714
Oi3	0,364	Oe3	0,087	Os3	0,616	On3	0,203
Oi4	0,132	Oe4	0,820	Os4	0,435		
		Oe5	0,441	Os5	n		
		Oe6	0,117				

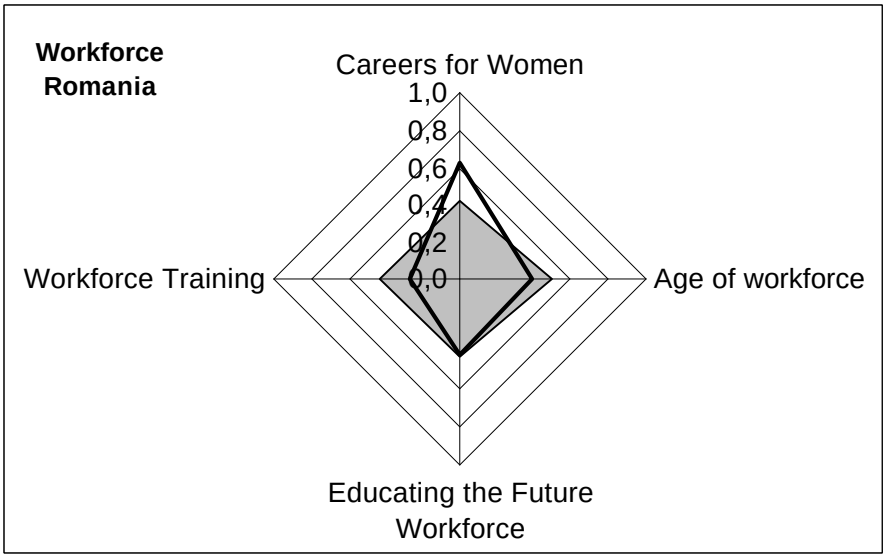
7.1.18 Romania

Romania outperforms in two foci: careers for women, and Entrepreneurship. The country underperforms in seven foci, namely workforce training, age of workforce, links between industry & academia, R&D spending, international cooperation, ICT, and SME.

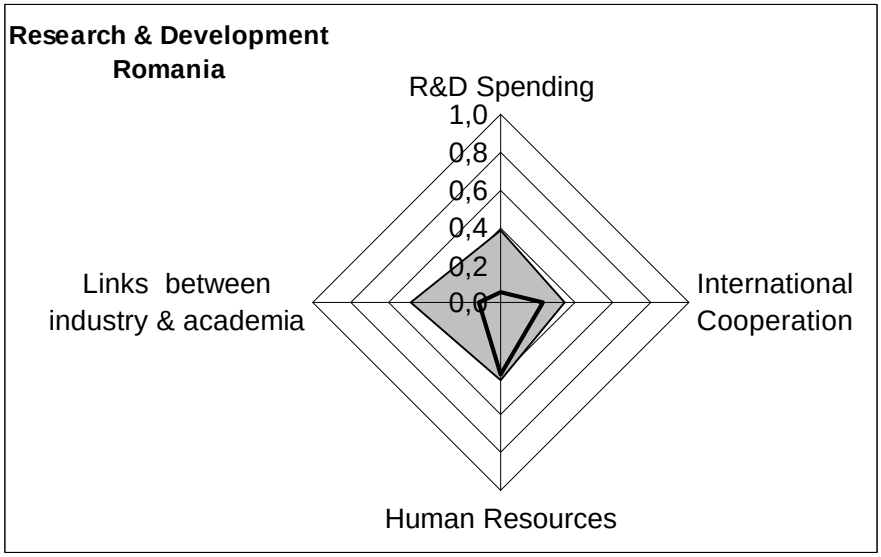
The remaining three foci are all weak.

Eight indicators are not available for Romania, with six of them in the operating environment for innovation key area.

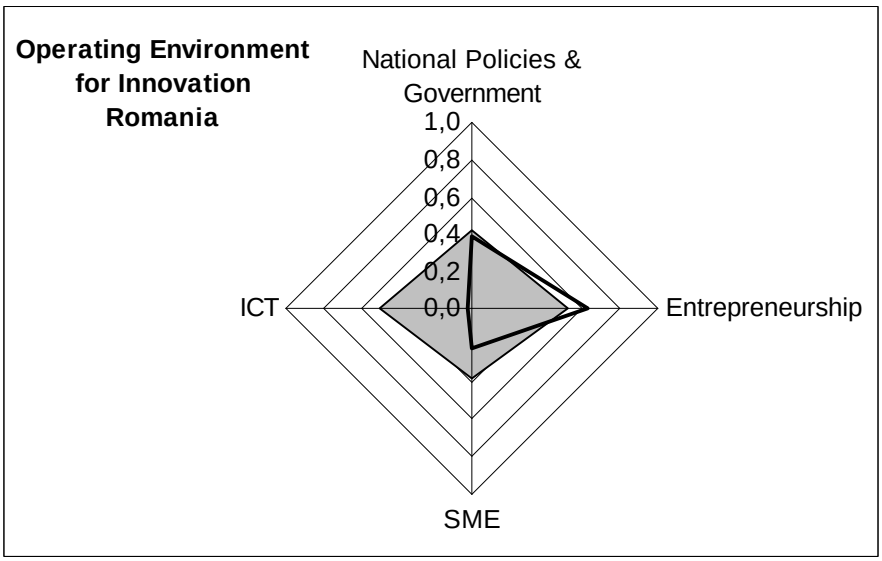
The focus that underperforms the most is ICT. This focus is made up of four indicators, one of which is not available (Oi2 – Manufacturing enterprises using the internet for interaction with public authorities), two of which have been awarded a value of 0.0 (Oi1 – Manufacturing enterprises access to the internet and Oi3 – business ICT readiness), and one which has been awarded a rather low value (Oi4 – manufacturing enterprises receiving order via ICT).



WE		WA		WW		WC	
We1	0,230	Wa1	0,397	Ww1	0,813	Wc1	0,812
We2	0,000	Wa2	0,324	Ww2	0,000	Wc2	0,445
We3	1,000	Wa3	0,730	Ww3	0,544	Wc3	n
We4	0,409	Wa4	0,460	Ww4	0,000		
		Wa5	0,048	Ww5	0,000		



RL		RR		RH		RI	
Rl1	0,233	Rr1	0,080	Rh1	1,000	Ri1	0,135
Rl2	0,000	Rr2	0,000	Rh2	0,000	Ri2	0,500
Rl3	0,000	Rr3	0,031	Rh3	0,160	Ri3	0,022
Rl4	0,242	Rr4	0,085	Rh4	n		



OI		OE		OS		ON	
Oi1	0,000	Oe1	0,850	Os1	n	On1	n
Oi2	n	Oe2	0,063	Os2	0,000	On2	0,600
Oi3	0,000	Oe3	n	Os3	n	On3	0,181
Oi4	0,053	Oe4	0,829	Os4	0,413		
		Oe5	n	Os5	0,229		
		Oe6	0,765				

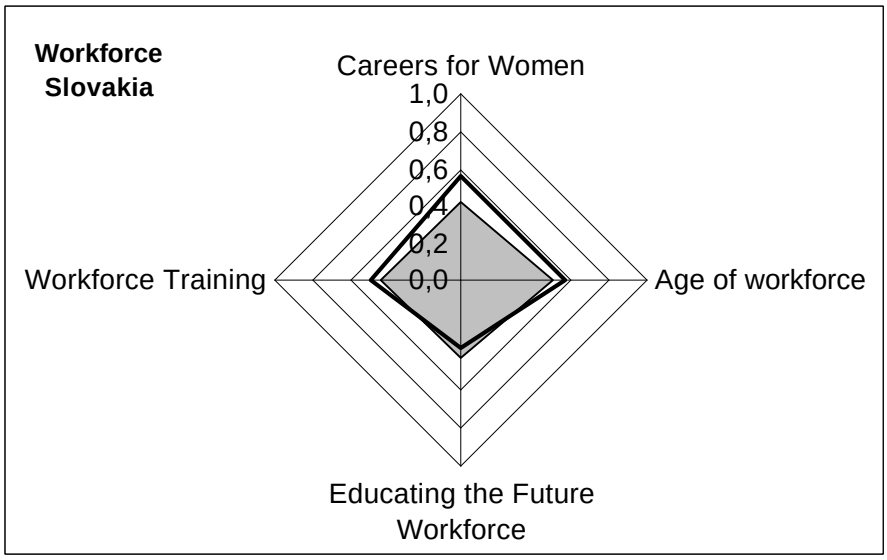
7.1.19 Slovakia

Slovakia is outperforming in the focus careers or women. However, the country is underperforming in the following foci: human resources, international cooperation, ICT, SME, and national policies & government.

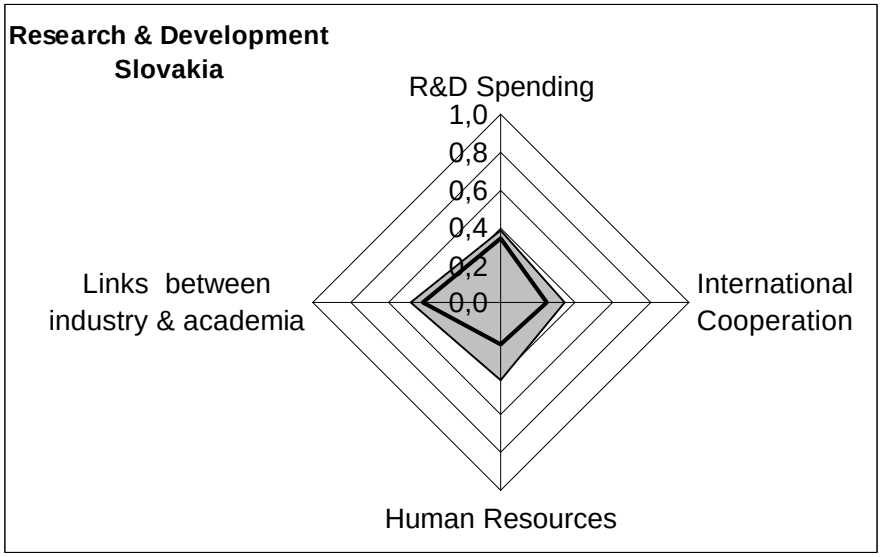
Of the remaining six foci, three are strong (age of workforce, workforce training, and ICT) and three are weak (educating the future workforce, links between industry and academia, and R&D spending).

Five indicators are not available for this country.

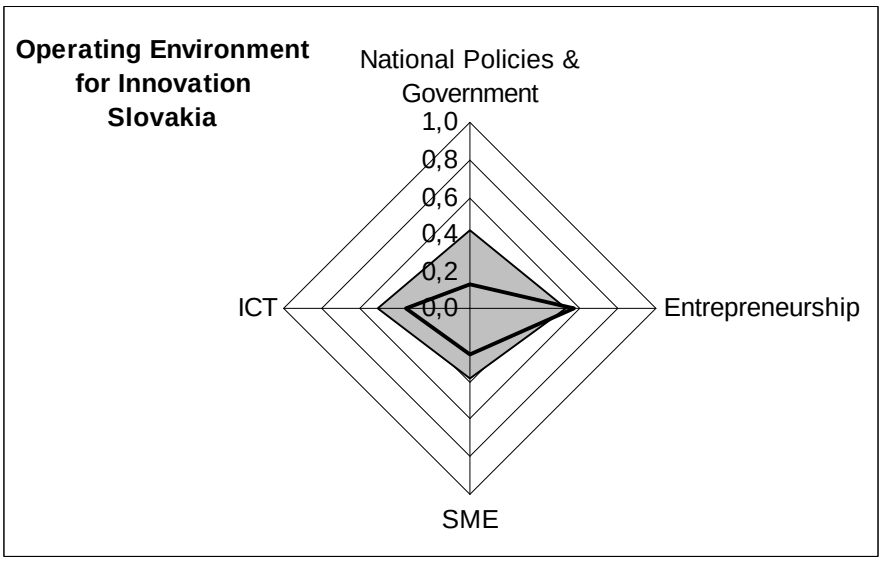
A closer look at the focus in which Slovakia is outperforming (careers for women), shows that it is made up of the three indicators Wc1, Wcc2, and Wc3 (attitude towards women in science, female graduates in maths science and technology, an women scientists and engineers). Only one of the indicators (Wc1 – attitude towards women in science) has received an exceptionally high value (1.0), whilst the other two have both received values below 0.5.



WE		WA		WW		WC	
We1	0,201	Wa1	1,000	Ww1	0,810	Wc1	1,000
We2	0,144	Wa2	0,024	Ww2	0,106	Wc2	0,291
We3	0,955	Wa3	0,744	Ww3	0,545	Wc3	0,378
We4	0,156	Wa4	0,095	Ww4	n		
		Wa5	0,948	Ww5	n		



RL		RR		RH		RI	
Rl1	0,116	Rr1	0,189	Rh1	0,000	Ri1	0,083
Rl2	0,667	Rr2	0,124	Rh2	0,161	Ri2	0,625
Rl3	0,593	Rr3	0,056	Rh3	0,000	Ri3	0,022
Rl4	0,299	Rr4	1,000	Rh4	0,743		



OI		OE		OS		ON	
Oi1	0,317	Oe1	1,000	Os1	n	On1	0,180
Oi2	n	Oe2	0,360	Os2	0,097	On2	0,086
Oi3	0,375	Oe3	n	Os3	0,196	On3	0,111
Oi4	0,342	Oe4	0,853	Os4	0,384		
		Oe5	0,459	Os5	0,291		
		Oe6	0,150				

7.1.20 Slovenia

Slovenia is outperforming in the foci workforce training, international cooperation, and ICT.

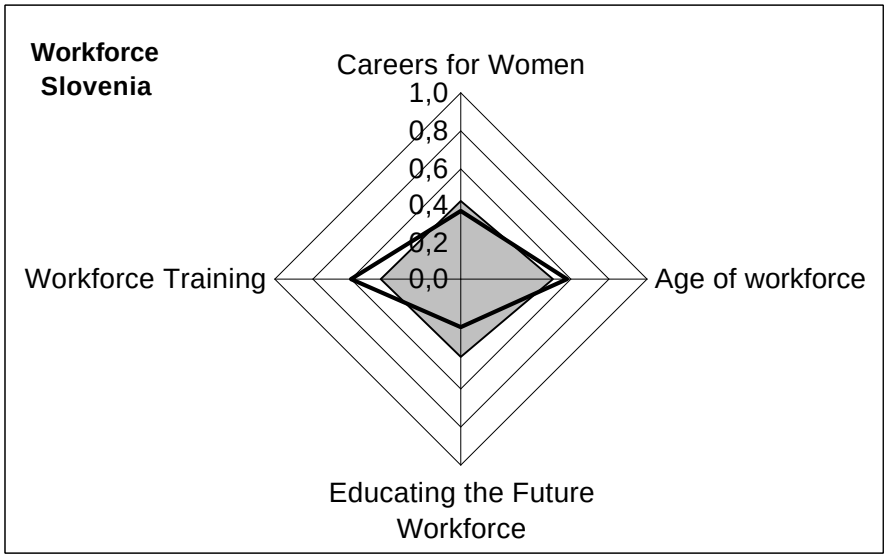
However, the country is underperforming in the foci educating the future workforce, links between industry & academia, and Entrepreneurship.

Of the remaining six foci, three are strong (age of workforce, human resources, and SME), and three are weak (careers for women, R&D spending, and National policies & government)

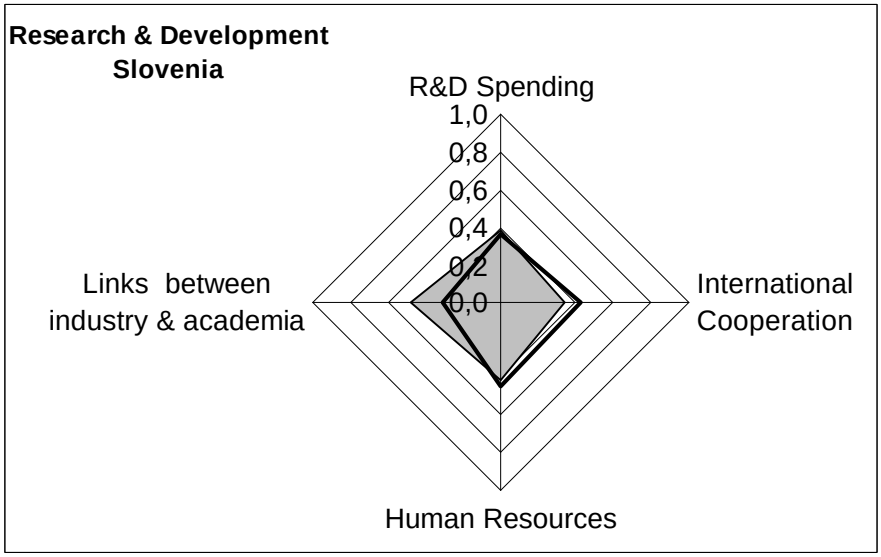
The focus in which Slovenia most outperforms is workforce training.

Four indicators are not available for this country, three of which are in the operating environment for innovation key area.

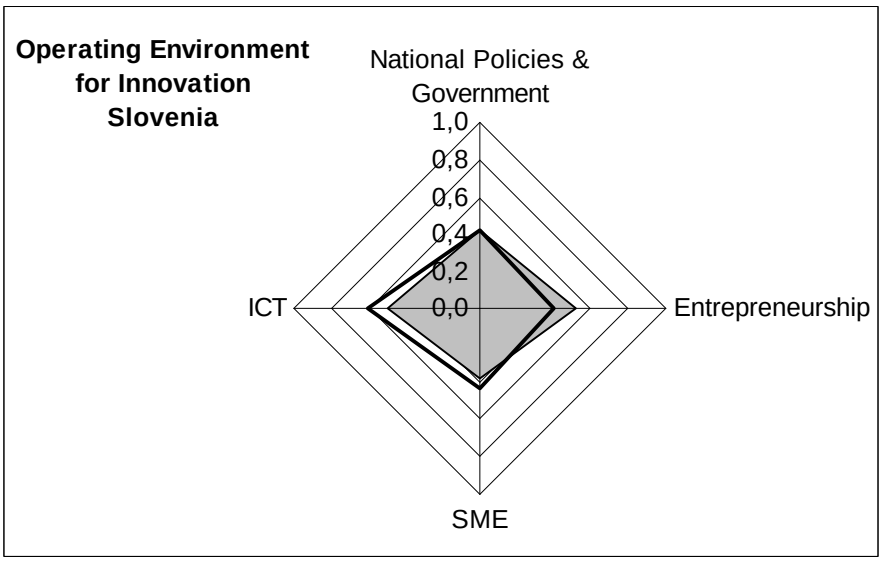
One indicator (Wa2 – Proportion of 50-60 year olds who are employed) has received a value of 0.0, and one indicator (Ri2 – Preferred co-publication partners) has received a value of 1.0.



WE		WA		WW		WC	
We1	0,224	Wa1	0,878	Ww1	0,762	Wc1	0,582
We2	n	Wa2	0,000	Ww2	0,419	Wc2	0,182
We3	0,409	Wa3	0,615	Ww3	0,831	Wc3	0,327
We4	0,128	Wa4	0,730	Ww4	0,397		
		Wa5	0,612	Ww5	0,547		



RL		RR		RH		RI	
Rl1	0,116	Rr1	0,560	Rh1	0,429	Ri1	0,254
Rl2	0,489	Rr2	0,528	Rh2	0,243	Ri2	1,000
Rl3	0,333	Rr3	0,245	Rh3	0,448	Ri3	0,035
Rl4	0,280	Rr4	0,101	Rh4	0,688		



OI		OE		OS		ON	
Oi1	0,914	Oe1	0,481	Os1	n	On1	0,242
Oi2	n	Oe2	0,320	Os2	0,377	On2	0,686
Oi3	0,498	Oe3	n	Os3	0,351	On3	0,326
Oi4	0,395	Oe4	0,777	Os4	0,268		
		Oe5	0,234	Os5	0,719		
		Oe6	0,191				

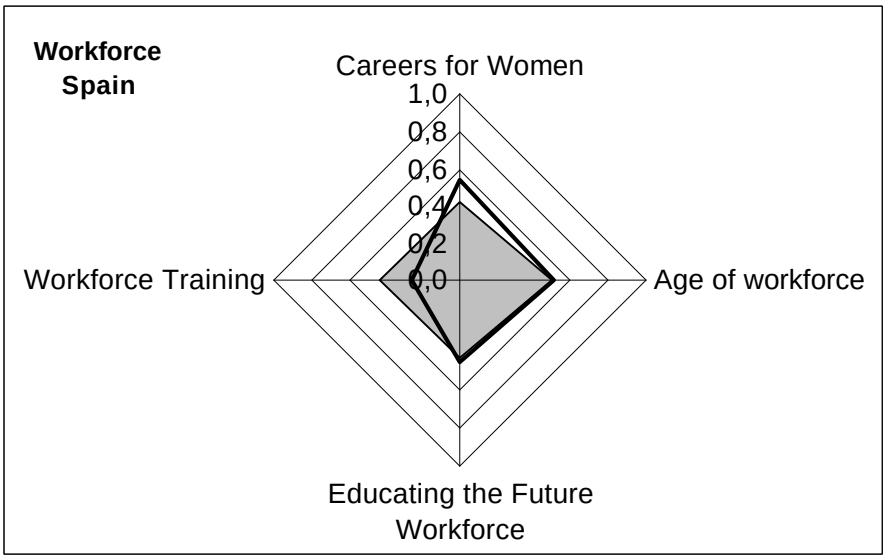
7.1.21 Spain

Spain is outperforming in four foci: careers for women, human resources, and international cooperation. The country is underperforming in only one focus, workforce training. Of the remaining seven foci, three are strong (educating the future workforce, age of workforce, and links between industry & academia), and four are weak (R&D spending, ICT, Entrepreneurship, and SME).

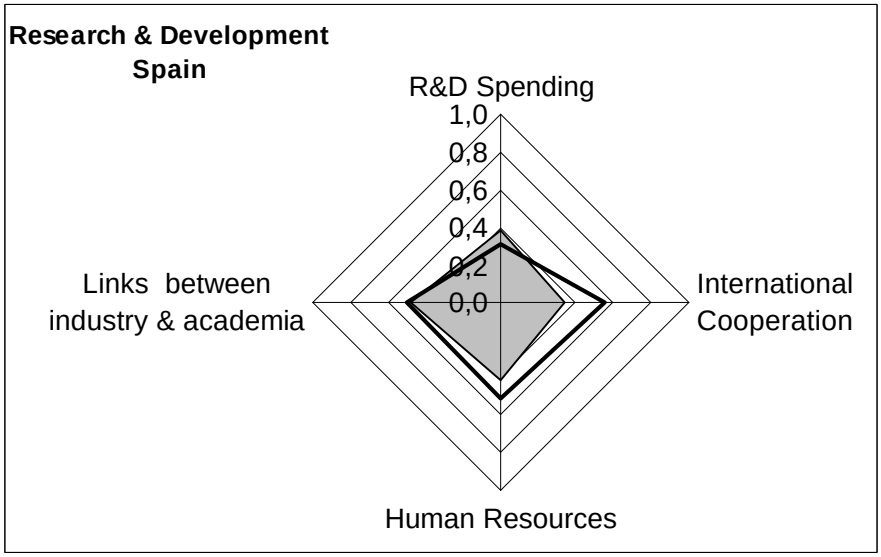
The focus in which Spain shows the best performance is International cooperation.

The focus in which Spain is underperforming (workforce training), is composed of five indicators, all of which have received a value of less than 0.5.

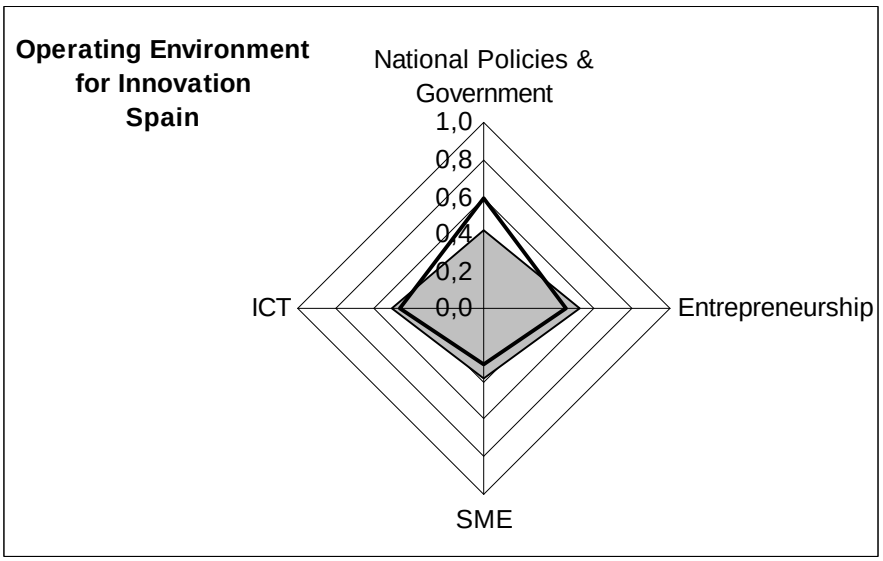
Only one indicator (Oe6 – procedures and duration to start up a company) has been awarded a value of 0.0.



WE		WA		WW		WC	
We1	0,425	Wa1	0,801	Ww1	0,405	Wc1	0,575
We2	0,216	Wa2	0,384	Ww2	0,137	Wc2	0,464
We3	0,591	Wa3	0,385	Ww3	0,137	Wc3	0,563
We4	0,516	Wa4	0,730	Ww4	0,269		
		Wa5	0,227	Ww5	0,340		



RL		RR		RH		RI	
Rl1	0,581	Rr1	0,637	Rh1	0,429	Ri1	0,751
Rl2	0,578	Rr2	0,360	Rh2	0,233	Ri2	0,375
Rl3	0,704	Rr3	0,135	Rh3	0,511	Ri3	0,525
Rl4	0,130	Rr4	0,117	Rh4	0,856		



OI		OE		OS		ON	
Oi1	0,759	Oe1	0,220	Os1	0,259	On1	0,579
Oi2	0,500	Oe2	0,511	Os2	0,037	On2	0,829
Oi3	0,522	Oe3	0,348	Os3	0,490	On3	0,369
Oi4	0,026	Oe4	0,731	Os4	0,293		
		Oe5	0,859	Os5	0,421		
		Oe6	0,000				

7.1.22 Sweden

Sweden is outperforming in eight foci in total: educating the future workforce, age of workforce, workforce training, links between industry & academia, R&D spending, ICT, entrepreneurship, and SME.

The country is only underperforming in the focus national policies and government.

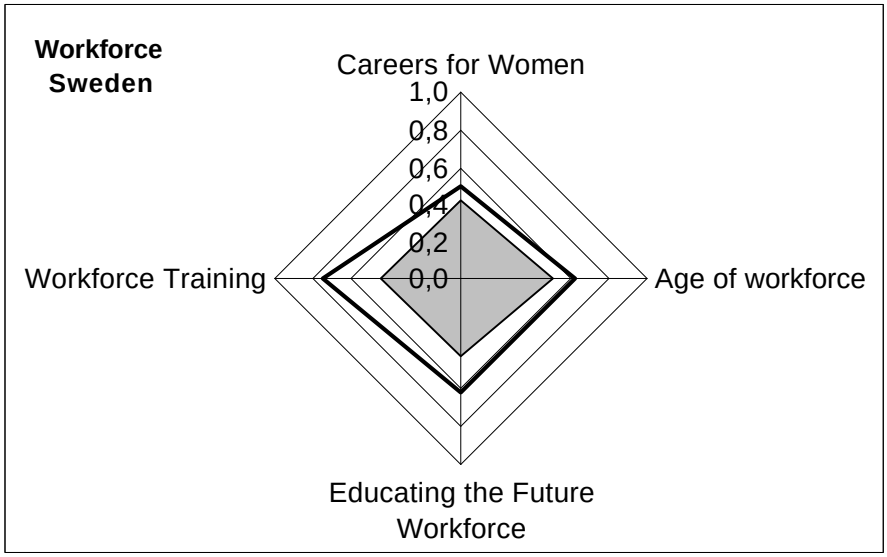
The remaining three foci (careers for women, human resources, and ICT) are strong.

Two indicators are not available (Rr4 and Os4).

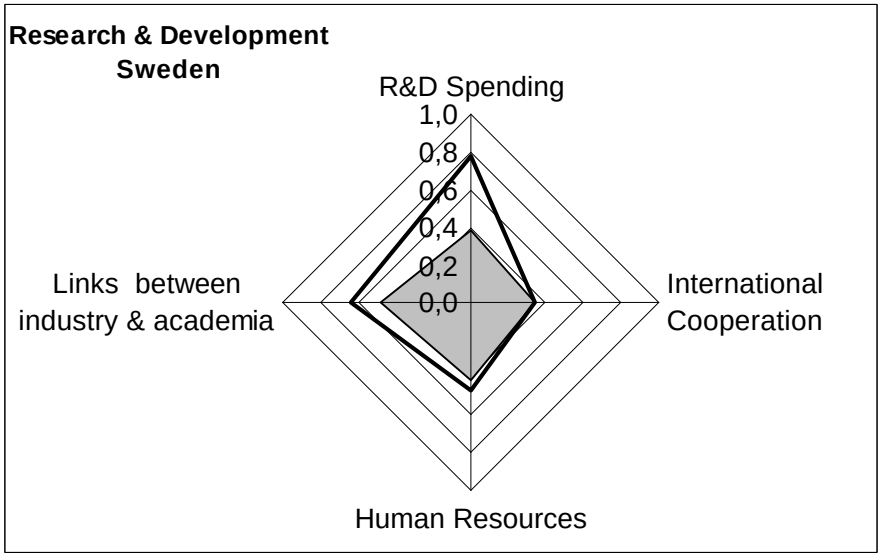
The following five indicators have been allocated a score of 1.0: Wa2 (Proportion of 50-64 year olds who are employed), Wa4 (average exit age from the workforce), Ww2 (life long learning), Ww5 (Manufacturing employees participating in CVT), and Rr3 (Business R&D expenditure).

Only one indicator received a value of 0.0: Wa1 (Proportion of workforce aged 50-64).

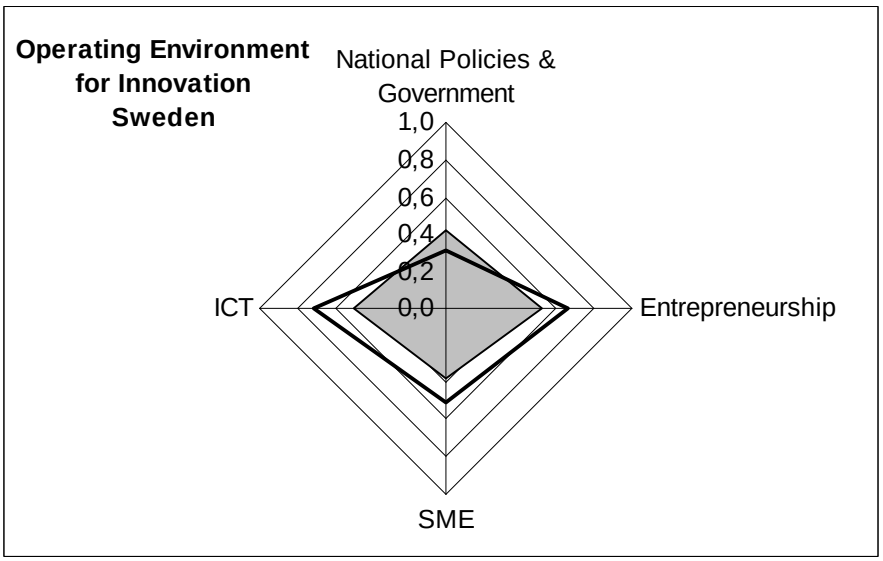
The highest of the outperforming foci is R&D Spending in the Research & Development key area.



WE		WA		WW		WC	
We1	0,523	Wa1	0,000	Ww1	0,384	Wc1	0,440
We2	0,772	Wa2	1,000	Ww2	1,000	Wc2	0,645
We3	0,773	Wa3	0,702	Ww3	0,386	Wc3	0,397
We4	0,363	Wa4	1,000	Ww4	0,923		
		Wa5	0,385	Ww5	1,000		



RL		RR		RH		RI	
Rl1	0,581	Rr1	0,425	Rh1	0,571	Ri1	0,404
Rl2	0,911	Rr2	0,899	Rh2	0,696	Ri2	0,375
Rl3	0,852	Rr3	1,000	Rh3	0,131	Ri3	0,257
Rl4	0,226	Rr4	n	Rh4	0,479		



OI		OE		OS		ON	
Oi1	0,966	Oe1	0,252	Os1	0,277	On1	0,465
Oi2	0,308	Oe2	0,162	Os2	0,594	On2	0,371
Oi3	0,945	Oe3	0,739	Os3	0,616	On3	0,093
Oi4	0,605	Oe4	0,989	Os4	n		
		Oe5	0,796	Os5	0,548		
		Oe6	0,980				

7.1.23 United Kingdom

The UK is outperforming in the following foci: age of workforce, workforce training, careers for women, links between industry & academia, human resources, international cooperation, and ICT. The country is not underperforming in any of the foci.

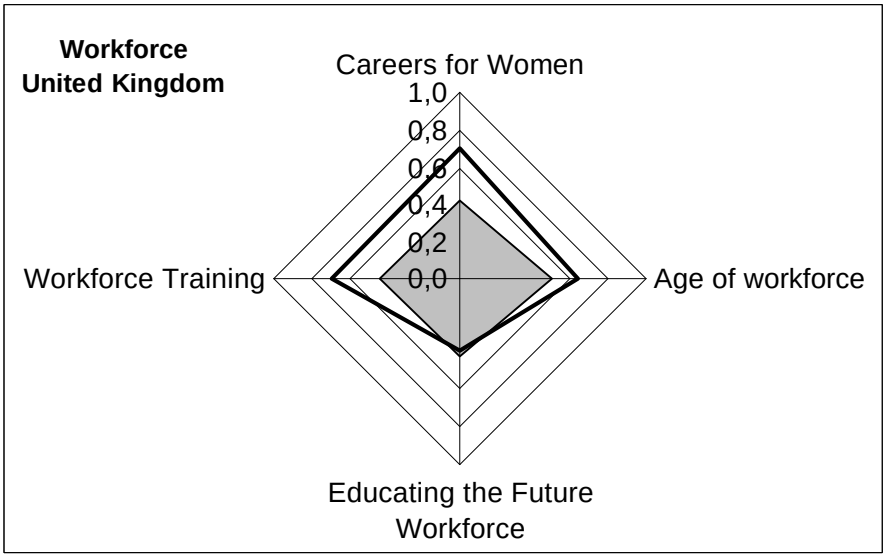
Of the remaining five foci, two are strong (Entrepreneurship, and national policies & government), and three are weak (educating the future workforce, R&D spending, and SME).

The highest of the outperforming foci is International cooperation.

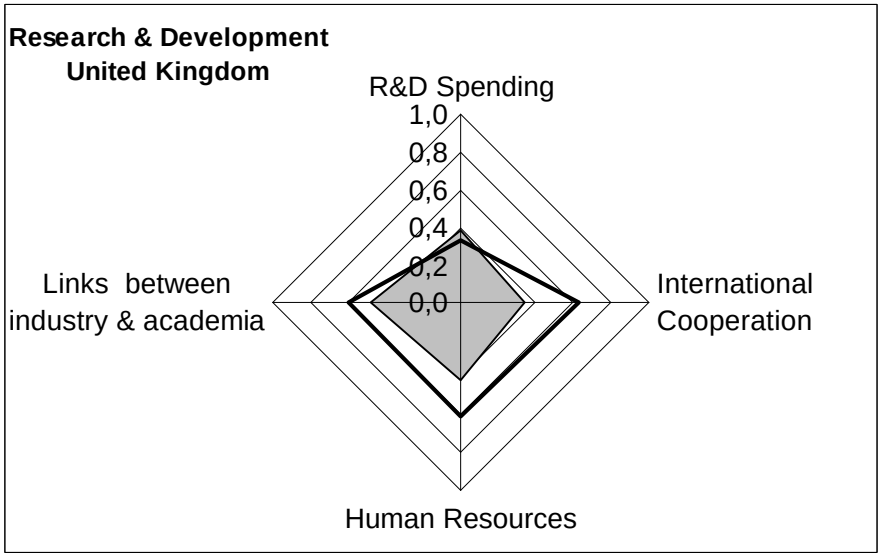
Only one indicator is unavailable for this country (Os1 – Employees with higher education in manufacturing SMEs).

Two indicators have been allocated a value of 0.0 (We4 – Erasmus engineering and technology student mobility, and Oi2 – Manufacturing enterprises using internet for interaction with public authorities).

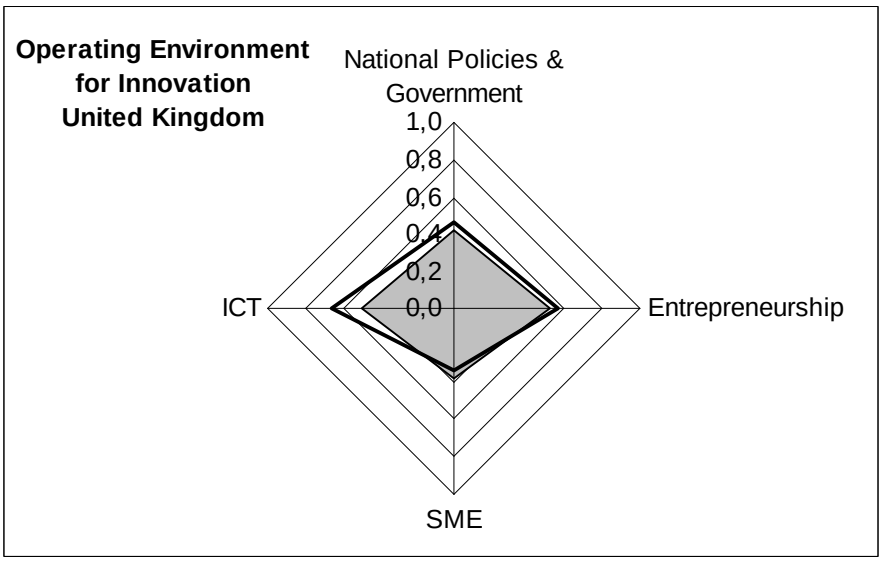
One indicator (Oi4 – Manufacturing enterprises receiving order via ICT) has been allocated a value of 1.00.



WE		WA		WW		WC	
We1	0,845	Wa1	0,437	Ww1	0,665	Wc1	0,714
We2	0,270	Wa2	0,710	Ww2	0,608	Wc2	0,964
We3	0,455	Wa3	0,552	Ww3	0,736	Wc3	0,426
We4	0,000	Wa4	0,857	Ww4	0,808		
		Wa5	0,610	Ww5	0,623		



RL		RR		RH		RI	
Rl1	0,581	Rr1	0,253	Rh1	0,571	Ri1	0,539
Rl2	0,733	Rr2	0,517	Rh2	0,313	Ri2	0,500
Rl3	0,963	Rr3	0,354	Rh3	0,920	Ri3	0,847
Rl4	0,095	Rr4	0,208	Rh4	0,635		



OI		OE		OS		ON	
Oi1	0,914	Oe1	0,023	Os1	n	On1	0,983
Oi2	0,000	Oe2	0,144	Os2	0,289	On2	0,343
Oi3	0,715	Oe3	0,478	Os3	0,406	On3	0,059
Oi4	1,000	Oe4	0,986	Os4	0,015		
		Oe5	0,907	Os5	0,616		
		Oe6	0,818				

7.2 Key Area Results

In this section, graphs are presented showing an overall value for each country, for each key area. This enables a comparison of the countries' performance in each of the key areas. Furthermore, the graphs show those countries that are outperforming and underperforming, according to the following definitions:

Outperforming

Used to describe a country that has a value greater than or equal to the average plus twenty percent of the average (for a particular key area).

Underperforming

Used to describe a country that has a value less than or equal to the average minus twenty percent of the average (for a particular key area).

Average Classification

Used to describe countries that lie between ‘outperforming’ and ‘underperforming’. No attempt has been made in this case to further classify these countries as strong or weak.

It should be noted that the values assigned to the countries are merely relative values, i.e. they do not say anything about an individual country's actual performance. Rather, they show how that country is performing in relation to the other countries. Hence, a country that is outperforming is not necessarily achieving a good actual performance in a certain area, merely a better performance than other countries in the study.

The bars on the graph are shaded according to their classification. Those representing countries that are outperforming are shaded with sots, those underperforming are shaded black, and those in the average classification are shaded with diagonal lines.

Note that the average of the 23 countries (labelled Ave 23) is also shown on the graph.

Readers are warned against making specific conclusions about countries placed close together on the graphs (i.e. "Austria is doing 'better' than Germany"), but rather to look at the wider picture. This is one of the reasons for the outperforming, underperforming, and average classifications.

7.2.1 Workforce

The workforce value combines the values of the following foci, as detailed in previous chapters: Educating the Future Workforce, Age of Workforce, Workforce Training, and Careers for Women.

Of the twenty three countries represented, four have been classified as outperforming, five as underperforming, and hence fourteen as 'average'.

A point of interest in this key area is that the majority of countries (14) lie in the 'average' classification.

The graph shows that Sweden, UK, France, and Finland are all outperforming in this key area. Conversely, Poland, Germany, Hungary, Greece, and Estonia are all underperforming in this key area.

Of the five underperforming countries, three are underperforming in two foci (Estonia, Hungary and Poland), and two are underperforming in three foci (Germany and Greece).

Of the four outperforming countries, three are outperforming in three of the four foci (France, Sweden and UK), whereas Finland only outperforms in two of the four foci.

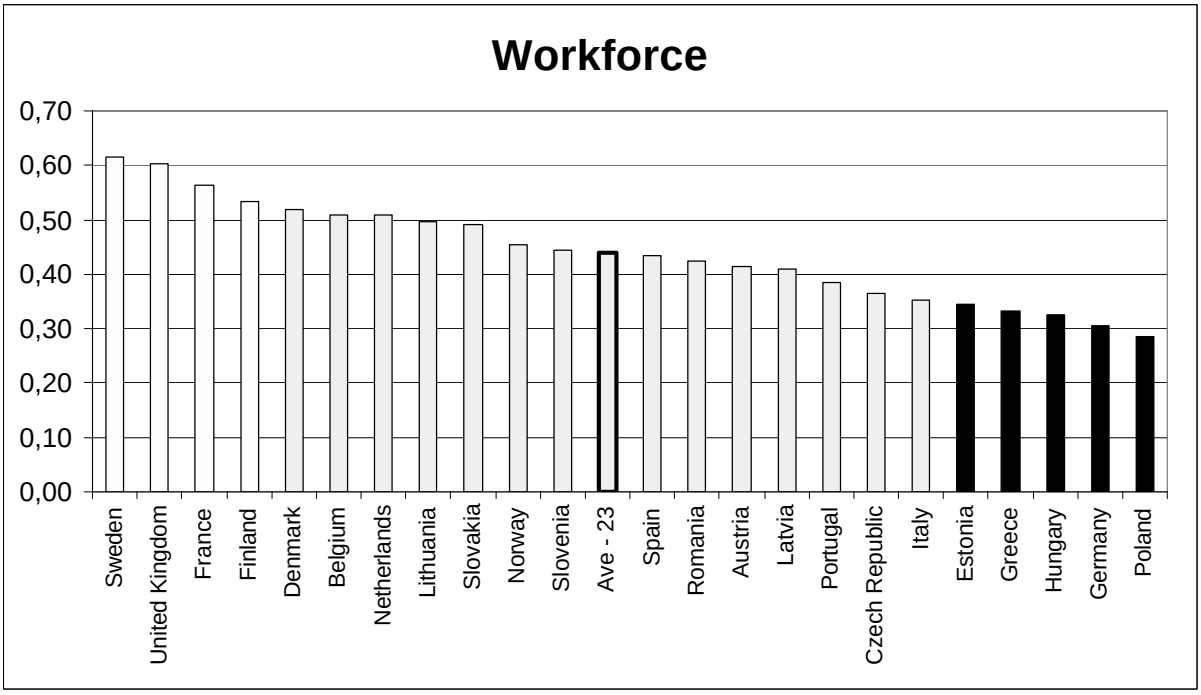


Fig. 7.3 Results for Workforce key area

7.2.2 Research & Development

The research and development value combines the values of the following foci, as outlined in previous chapters: R&D Spending, International Cooperation, Human Resources, and Links between Industry & Academia.

Of the twenty-three countries, six have been classified as outperforming; nine as underperforming and eight countries fall in the middle or 'average' classification. The graph shows that Finland, France, Germany, Sweden, UK, and Denmark are all outperforming, whilst Romania, Estonia, Poland, Latvia, Norway, Czech Republic, Slovakia, Lithuania, and Greece are all underperforming.

Of the group of nine underperforming countries, six are underperforming in three of the four foci (Czech Republic, Estonia, Greece, Latvia, Romania and Poland), and three are underperforming in two of the four foci (Lithuania, Norway, and Slovakia). Only one country in this group has actually outperformed in one of the R&D foci (Latvia – Human Resources).

Of the group of six outperforming countries, France outperforms in all four foci, three countries outperform in three of the four foci (Finland, Germany and UK), and the remaining two outperform in two of the four foci (Sweden and Denmark).

One thing the six outperforming countries have in common is that they all outperform in the foci "links between industry and academia".

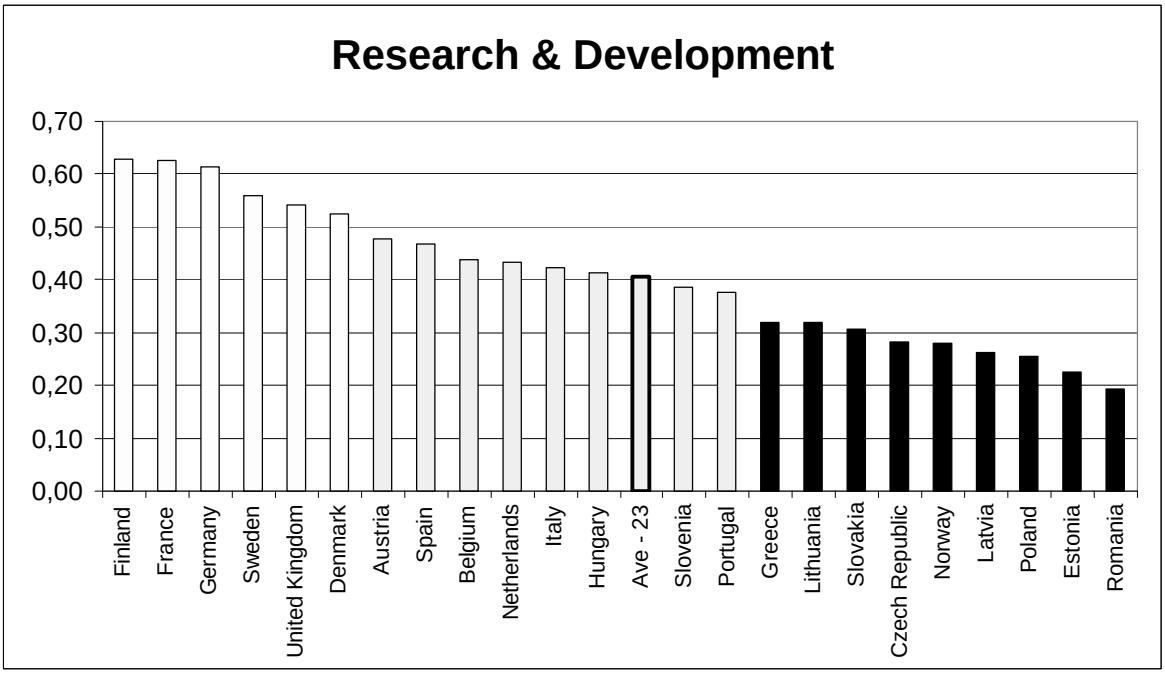


Fig. 7.4 Results for R&D key area

7.2.3 Operating Environment for Innovation

The operating environment or innovation value combines the values of the following foci, as outlined in previous chapters: ICT, Entrepreneurship, SME and National Policies & Government.

Of the twenty three countries, five have been classified as outperforming, five as underperforming, and hence thirteen fall in the 'average' bracket.

The graph shows that Finland, Denmark, Norway, Belgium and Sweden are all outperforming, whilst Romania, Slovakia, Czech Republic, Latvia and Hungary are all underperforming.

Of the group of five underperforming countries, Slovakia is underperforming in three of the four foci, three countries are underperforming in two of the four foci (Czech Republic, Latvia and Romania), and Hungary is underperforming in just one of the four foci.

Interestingly, Romania is the only underperforming country to outperform in any of the foci (Entrepreneurship).

Of the five outperforming countries, Finland is outperforming in all four foci, Sweden is outperforming in three of the four foci (but underperforming in the national policies & government foci), and Belgium and Denmark are outperforming in two of the four foci.

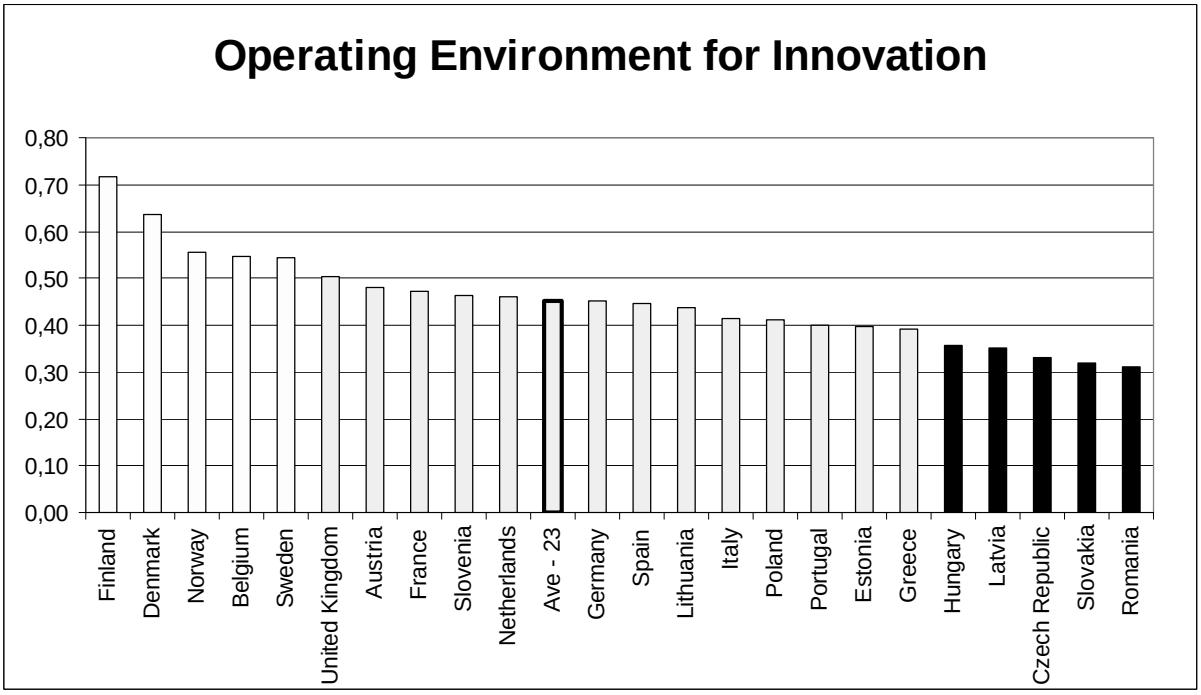


Fig. 7.5 Results for Operating Environment for Innovation key area

7.3 European Manufacturing Landscape Index

These values represent the mean of the three key areas (Workforce, Research & Development, and Operating Environment for Innovation). In a sense, this presents the final result of this study, since the data can be said to reveal a European Manufacturing Landscape.

The graph shows that five countries are outperforming, thirteen countries have fallen into the 'average' classification, and five countries are underperforming.

The outperforming countries are Finland, Sweden, Denmark, France and UK. The underperforming countries are Romania, Poland, Estonia, Czech Republic and Latvia.

An interesting observation is that all of the outperforming countries outperform in the Research and Development key area, and all of the underperforming countries fall into the underperforming group in the Research and Development key area.

Finland and Sweden are the only two countries that outperform in all three key areas. No countries are underperforming in all three key areas.

Of the countries that fall into the 'average' classification, Belgium, Germany and Norway each outperform in one key area. Interestingly, Germany and Norway are also underperforming in one of the key areas.

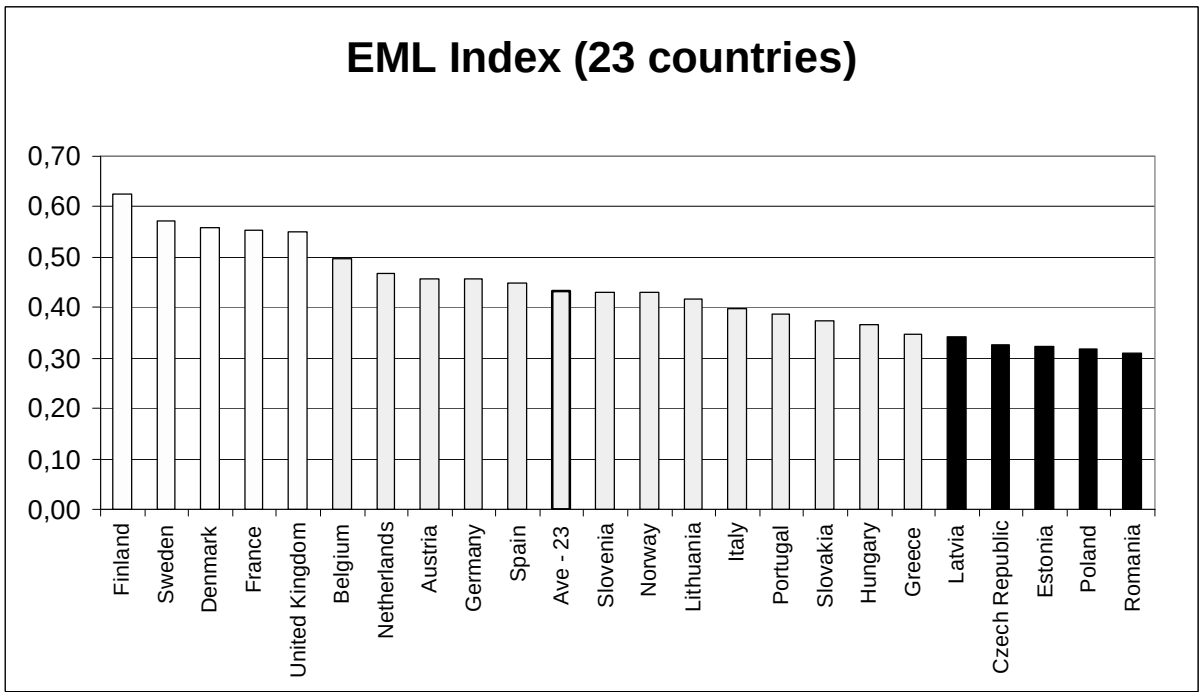


Fig. 7.6 Results of composite (EML) index

8 Discussion and Analysis

8.1 Observations

Perhaps the most important (and also most unsurprising) observation is that there are differences between the countries studied. Although the results do not (and should not) allow for direct comparison of countries with values close to each other, or for quantitative statements about the actual performance of a country, they do show groups of countries that are outperforming and underperforming relative to the mean. This observation confirms the basic assumption upon which this study is based.

Certain additional observations have been made about the results as follows:

No country underperforms in all key areas (although Greece, Slovakia, Hungary, Czech Republic, Latvia, Poland, Estonia and Romania are all underperforming in two of the three). Finland and Sweden outperform in all three key areas.

Some countries show quite different performance in each of the three key areas (Germany, for example, is outperforming in Research and Development, in the 'average classification' for Operating Environment for Innovation, and underperforming in Workforce). All of the outperforming countries in the EML index are also outperforming in the workforce training focus (from the Workforce key area). All of the underperforming countries in the EML index are also underperforming in the R&D spending focus (from the Research and Development key area).

On a foci level, the largest number of underperforming and outperforming countries can be observed in the workforce training focus (see Figure 8.1), with only three countries being classified as 'average'.

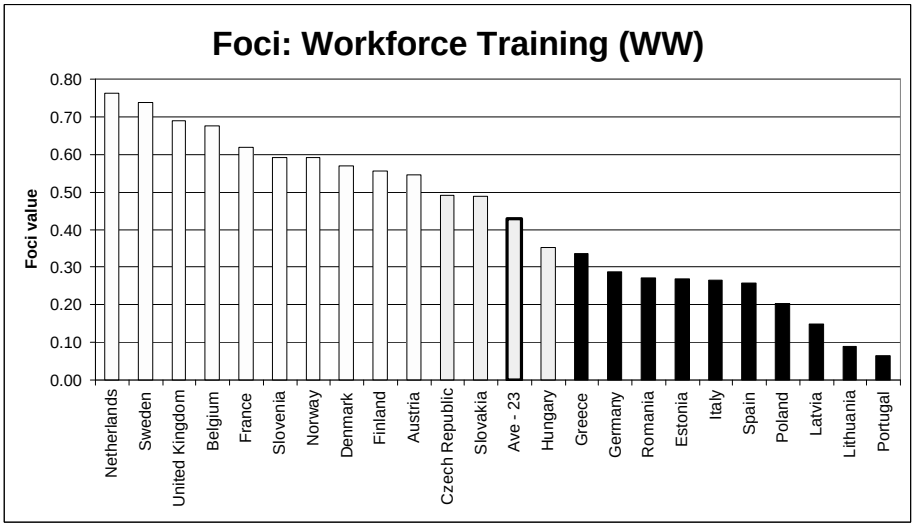


Fig. 8.1.Graph of the workforce training foci

8.2 Geographical Representation

Instead of viewing the results in the form of a graph, it is perhaps useful to view them on a map, as shown in fig 8.2, which depicts the results of the EML composite index. The countries are shaded according to their classification, in much the same way as they were on the graphs.

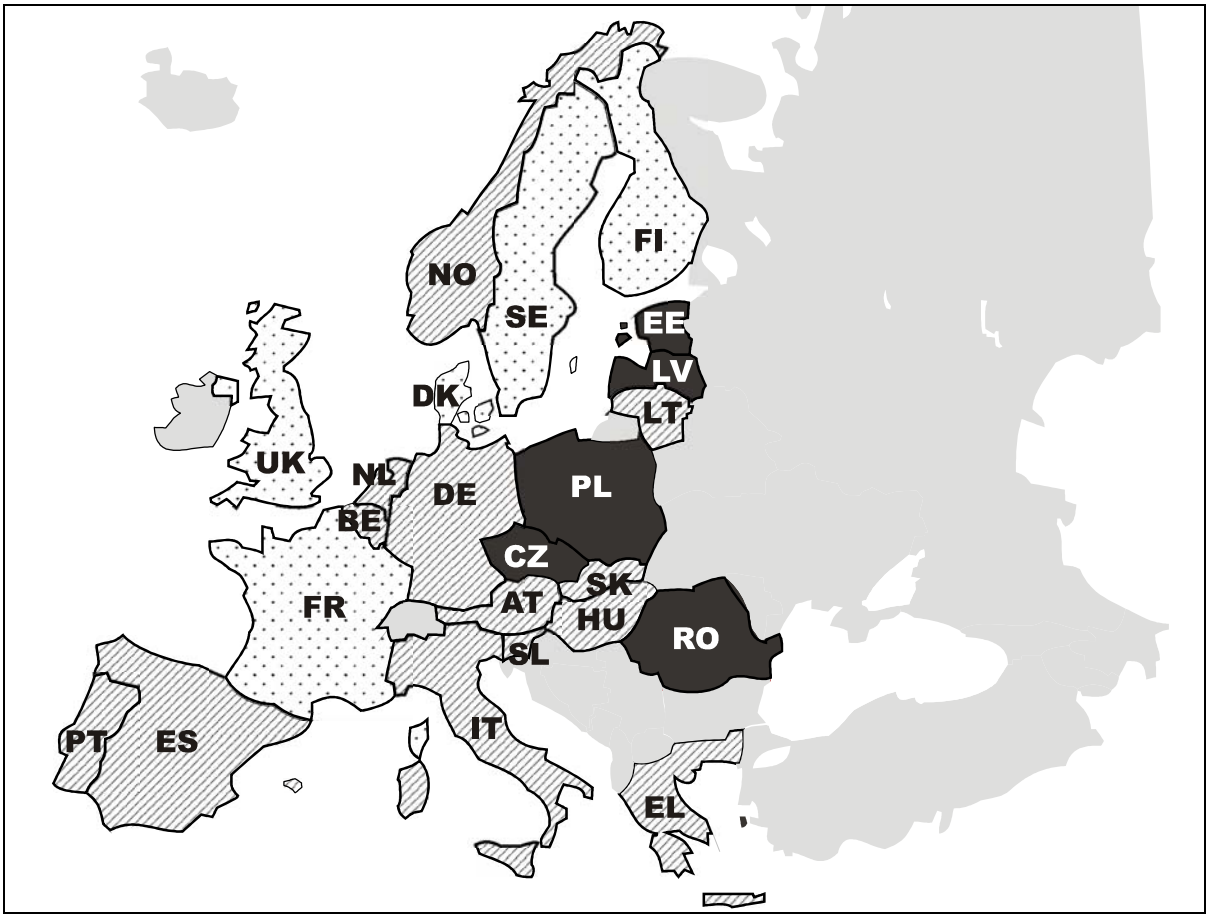


Fig. 8.2 Graphical representation of results

The map shows that all of the underperforming countries lie in East Europe, whereas three of the outperforming countries lie in what is often termed 'the Nordic region'.

8.3 Tightening the Constraints

In the chapter 6.2 (Coverage by Indicators) the problems with missing indicator values for some countries was discussed. Missing values naturally decrease the number of indicators representing a country (through a weaker foci and hence key area representation). In this study certain restrictions were set on the least number of indicator values representing a country in each focus with respect to the maximal number of indicator values (e.g. three of five etc., see table in section 4.3.1)

Having revealed a European Manufacturing Landscape with the somewhat relaxed restrictions and with all 23 countries, it could be of interest to see what outcome a stricter evaluation would deliver.

The restriction on the methodology and search for an EML can be made tighter in two ways. Either indicators, for which many countries have no values, are taken away, or countries that are not represented by the present indicators have to go. Ideally all countries should be represented by all indicators.

With the material of this study at hand the only option is to reduce the countries compared. Starting a "new" comparison with a new set of countries, it is impossible to compare new scores with old. However, trends and relative positions can be compared. It is not possible to reduce the indicators taken into account, since only using the indicators where all (23) countries are represented would lead to some foci not being represented at all. This would lead to areas being missed out, and the study would not truly represent the capabilities crucial for future manufacturing. Hence, the option to reduce the number of countries was chosen.

Tightening the constraint to the level that each country must be represented by at least 48 indicators, leads to the following eleven countries: Austria (49 indicators), Belgium (50 indicators), Denmark (49 indicators), Finland (50 indicators), France (49 indicators), Germany (50 indicators), Italy (50 indicators), Netherlands (48 indicators), Spain (50 indicators), Sweden (48 indicators) and the United Kingdom (49 indicators).

With this (close to) ideal set of countries and 50 indicators, the same calculations were made. Note that since this is a new (and different) set of countries compared to "EML 23", the exact scores cannot be compared between EML-23 and EML-11.

However, the outcome of EML-11 gives room for less suspicion and errors since all countries have less missing indicator values (less than 1 indicator per country on average compared to 3,5 missing indicators per country in EML-

23). Furthermore the maximal number of missing indicators for a participating country has changed from 11 (Latvia) to 2 (Sweden and the Netherlands).

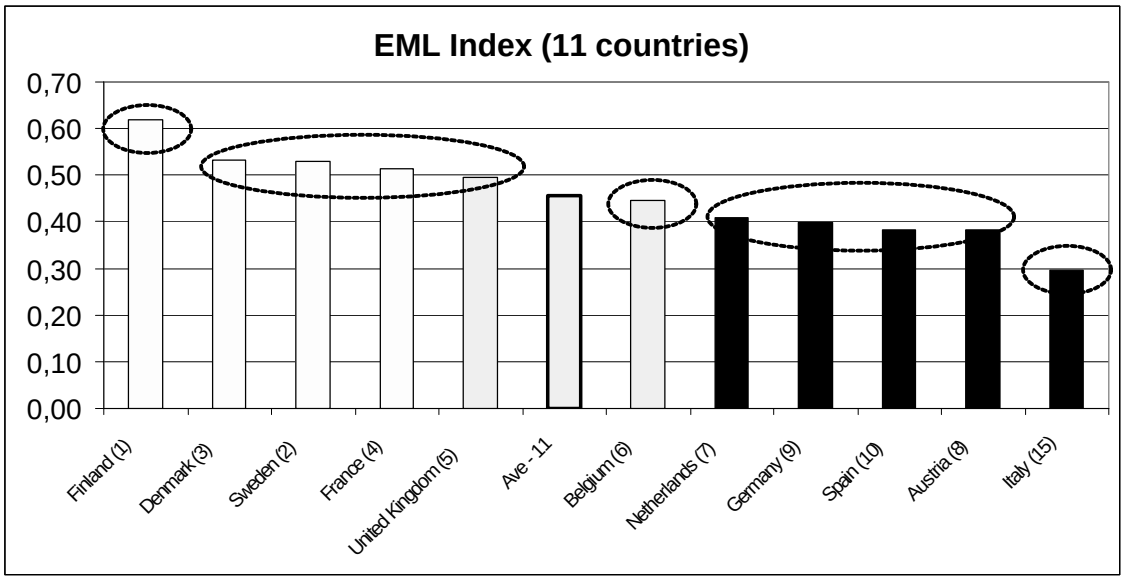


Fig. 8.3 EML-11 graph

Looking closer at the EML-11 graph in figure 8.3 (where countries have been rated "outperforming", "average" and "underperforming" according to the definitions given previously with respect to Ave-11), it becomes obvious that one can not compare scores, nor outcomes (e.g. "underperforming") between different cases (e.g. EML-23 or EML-11). In EML-11 the UK is ranked as "average", whilst "outperforming" in EML-23.

However, the relative order and groupings are still of interest. Notably, comparable patterns are present between the two cases, which have been circled in the Graphs (fig 8.3 and 8.4). Finland is ahead of all countries in both cases, and with a margin. It is followed by a group of four, which is present in both the EML-23 and EML-11, though Denmark overtakes Sweden in the EML-11 context. Belgium is on its own of the EML-11 countries, followed by the group of Austria, Germany, the Netherlands and Spain. Similar patterns can be observed in EML-23. Italy is clearly "behind" the EML-11 countries in both the EML-11 and EML-23 case.

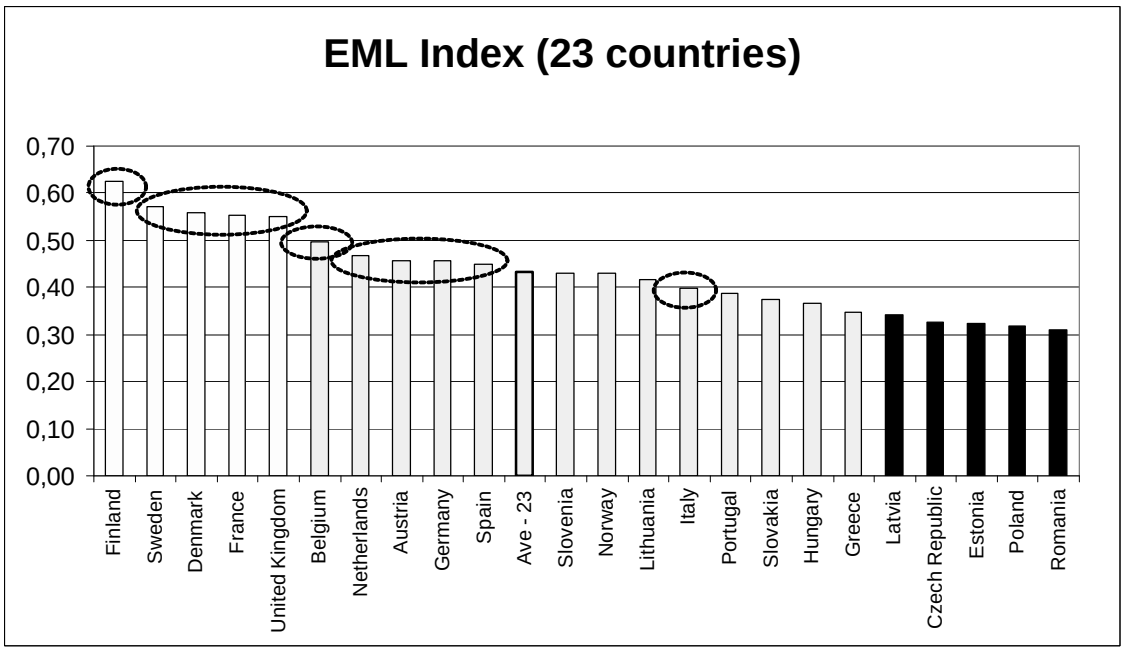


Fig. 8.4 EML-23 graph

In some respects, the EML-11 case supports and reconfirms the results of the EML-23 study. It can be discussed whether Belgium is better or worse "prepared" for future manufacturing (with respect to the key areas identified and the frame conditions imposed on this study) than the two clusters of countries positioned above and below it in the table. It is clear however, that there is a difference in relative strength between Finland and e.g. Italy. In the EML-11 case, Finland could (roughly speaking) have at least seven indicator scores (a normalised value between 0 to 1) set to 0 (equal to performing the worst out of the chosen countries for an indictor), and would still get a higher EML score than Italy.

8.4 Comparisons with Other Indices

Another way to test this study's methodology is to compare the results against other relevant indices. For this, the European Innovation Scoreboard Summary Innovation Index (EC 2005), the Growth Competitiveness Index (World Economic Forum (WEF) 2004b) and the Lisbon Review Rankings 2004 (World Economic Forum (WEF) 2004a) have been chosen.

By choosing indices which measure capabilities or strengths that have been pinpointed as integral to a healthy manufacturing society, a stronger correlation might be taken as a sign that the choice of indicators, foci, and key areas in this study, are somewhat justified.

The innovation index was chosen because of the many claimed links between an innovation friendly environment and a prosperous (manufacturing) industry sector. Please see the section on the key area "Operating Environment for

Innovation" for further motivation supporting the importance of innovation. The ISS only uses 22 indicators to measure the innovation performance of the member states, ascending and candidate countries.

The correlation between the Growth Competitiveness Index and the EML-23 index is of interest since "few things matter more for the welfare of a country's citizens than the aggregate growth rate of the economy" (World Economic Forum (WEF), 2004) (p1). It should be kept in mind that the issue of economic growth is one of the underlying reasons for the EC's concern over its member states' industry sectors. The GCI "aims specifically to gauge the ability of the world's economies to achieve sustained economic growth over the medium to long term". (World Economic Forum (WEF), 2004c) (p2)

Finally, the Lisbon Review 2004 Index is brought in, to see how well the EML-23 index correlates with "the progress made by the 15 EU member states in implementing the far-reaching goals contained in the Lisbon Strategy" (World Economic Forum (WEF), 2004b). Again, this is a strategy seeking to make the EU-region "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion." (World Economic Forum (WEF), 2004b)

Studying the graphs presented in the following sections, the correlation between the different indices and the EML-23 Index is clear (0,89 – SII 2004, 0,80 – GCI 2004, 0,89 – Lisbon Review 2004). It should be mentioned at this point that there is a certain amount of overlap between the indicators used in this study and the ones used for SII (although this study uses data specifically relating to NACE D when possible). This might also be the case for the Lisbon Review 2004 (although the authors have not presented information about the indicators used, it is likely that some of the indicators are shared with this study). Nevertheless a clear majority of the EML indicators will not have been used in any of the three other studies.

On a methodological note, the three studies are all based on a mixture of 'soft' (opinions) and 'hard' (factual) data. Furthermore, concepts equivalent to the key areas and foci used in this study are often aggregated together without weightings.

Also perhaps of note (following the previous discussion on missing indicators – 6.2 Coverage of Indicators – and the section 8.3 Tightening the Constraints) is that the Summary Innovation Index does not use a complete set of data. Out of the participating EU-25, there are only 9 countries, which are represented by all 22 indicators.

8.4.1 Comparison with EIS Summary Innovation Index (SII)

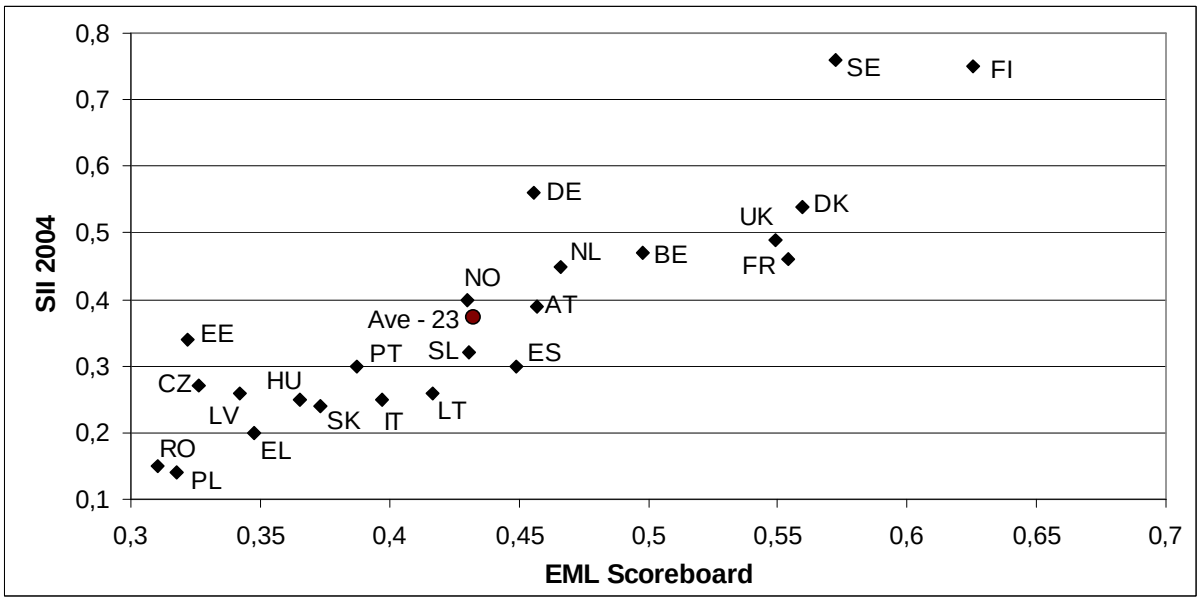


Fig. 8.5 EML vs SII2004 graph

The countries that divert from the trend are notable – for example Estonia and France. Estonia scores relatively better in the SII 2004 (this is also the case for Germany) and France worse compared to the EML-23 Index. Looking back at the key area for "Operating Environment for Innovation", one can see however, that it is the best key area of Estonia and the worst for France.

8.4.2 Comparison with Growth Competitiveness Index 2004

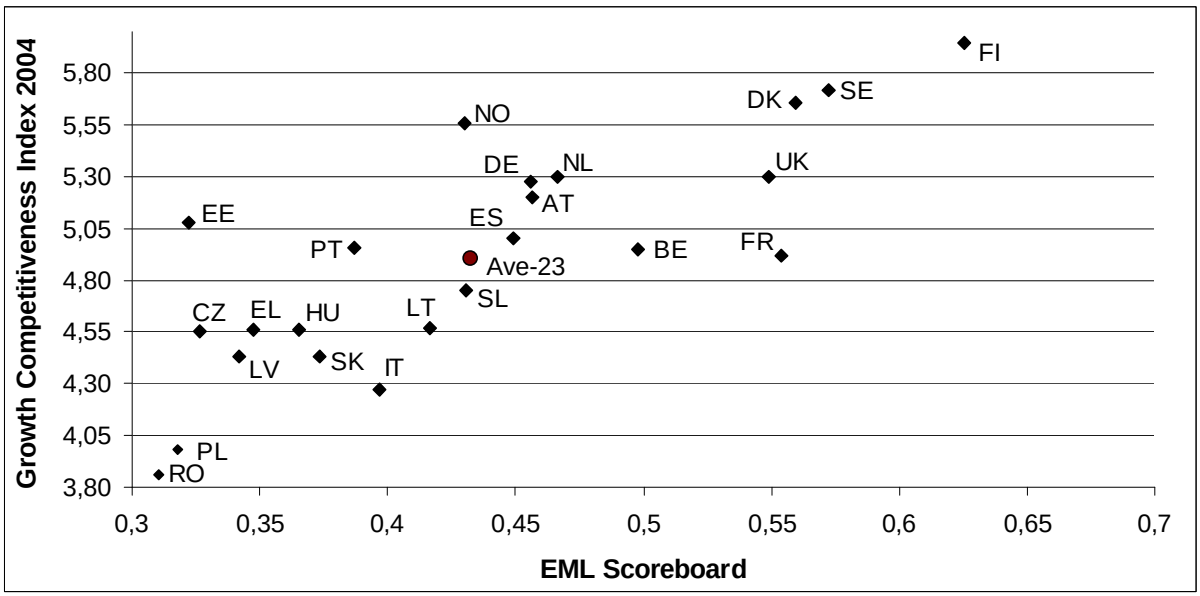


Fig. 8.6 EML vs. Growth Competitiveness Index 2004 graph

Here the picture is somewhat more scattered, with a correlation between the two indices of 0,80. For example Estonia and Norway are out-performing in the

GCI compared to the EML-23, whereas for France and Italy the opposite is true.

8.4.3 Comparison with the Lisbon Review Rankings 2004

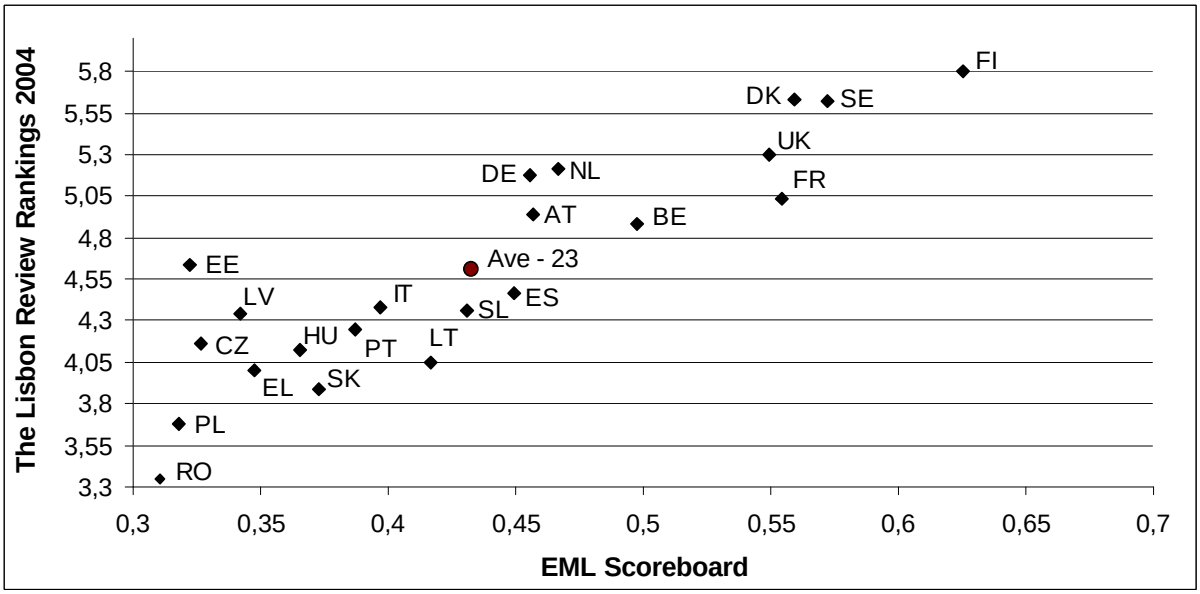


Fig. 8.7 EML vs. Lisbon Review Rankings 2004 graph

Estonia (EE) and France (FR) once again stand out in each direction, a pattern observed in all three comparisons. An explanation may be that the Lisbon Review Rankings are based on indicators falling into eight different categories (which are given equal weighting), which are more in the direction of the key area "Operating Environment for Innovation" than the other two key areas. It is the "Operating Environment for Innovation" key area in which Estonia is not underperforming (and the only area in which France is not outperforming).

9 Conclusions

9.1 Achievements

Several things have been achieved through this explorative study.

Firstly, a thorough review of available literature has highlighted three key areas, which, in the opinion of the European Commission, are considered to be important for the future of manufacturing in Europe. Furthermore, an in-depth study of these three key areas has revealed four important foci within each area.

Secondly, a methodology has been proposed and carried out, for the creation of a composite capability index, and a large, comprehensive database of indicators relating to these key areas and foci has been created. This database alone may prove to be very useful for third parties.

Results have been presented on a country by country level, in order to highlight individual countries' relative strengths, weakness, and possible areas for improvement.

Also, a composite manufacturing index has been created which, in turn, has revealed a European Manufacturing Landscape, as well as European landscapes for each of the key areas.

The European Manufacturing Landscape Index has been benchmarked against recognised indices (measuring nations': innovation performance, ability to achieve sustained economic growth, and their progress in reaching the goals set out by the Lisbon Agenda), and there appears to be a strong correlation between them.

9.2 Limitations and Criticisms

The following sections highlight the limitations of this study, along with some possible criticisms of the method.

9.2.1 Methodology

There are two general limitations of the methodology:

1. The study is based wholly on desk research, with no attempts made by the authors to gather original data for the indicators. This is primarily due to the exploratory nature of the study, and the limited time frame and resources available.

2. Originally five foci were identified as being important for each key area, but due to the difficulty of measuring or quantifying three of them (research output, image of the manufacturing industry, and networks & clusters), they were excluded from the study. Hence, one might argue that at present, the key areas are not fully representative of the challenges or issues faced by countries regarding future manufacturing.

9.2.2 Indicators

The indicators used are based upon data available, rather than being 'ideal' measures of the foci within the key areas. In a few cases estimations have been used.

9.2.3 Weighting

This study uses no weighting between the different foci and key areas. This has in effect the consequence that different indicators have different contribution to the final "EML Index". This effect further increased by a country lacking an indicator value in a focus with few indictors – discussed in detail in section 6.2 Coverage of Indicators.

The fact that a straight weighting has been used on foci and key area level can be discussed, however this is common practice (e.g. in Lisbon Review and GCI), and when diverting from this (partly the case in SII), it is a cause for discussion (Grupp & Mogee 2004) and is poorly motivated.

9.2.4 Countries

The study is limited to coverage of twenty-three countries. The reason for this is that the chosen indicators were not available for all countries. Also, not all the countries have a complete set of indicators (in fact only five countries have a complete set), which might lead to some uncertainty of the comparability of the countries. This is further elaborated in section 8.3 - Tightening the Constraints, where an EML Index for 11 countries is calculated and compared to the original EML-23.

9.2.5 Scope

Due to restrictions on time and resources, the scope of the study is limited in so far as the results have been presented, but no attempt has been made to research or explain the reasons behind the results.

9.3 Suggestions for Further Study

Throughout the course of this study, several thoughts have arisen as to areas that might be interesting for future study. Some of these suggestions refer to extensions of this work, whereas some propose a need for new studies.

As mentioned previously, a comprehensive database has been created whilst compiling the indicators. Many of the indicators used come from sources which are regularly updated, thus making it a fairly simple task to update the database in one or two years and reassess the European Manufacturing Landscape. Doing this might create an opportunity to establish the progress and effects of the Manufuture initiative.

It would be desirable to include more countries in the study, for example Croatia, Switzerland, Turkey and Ireland, as well as perhaps including the USA and Japan. Obviously in order to do this, the choice of indicators would have to be revised, or some attempt to supplement the lacking data with additional information would have to be made.

The results of the study (i.e. the composite index) could serve as the basis for a further investigation into the underlying reasons for the observations made. For example, what do the outperforming countries (or underperforming countries) have in common? Do they share any common historical, geographical, political, or economic similarities? Also, the anomalies observed in the comparison between the EML index and the other indices could be investigated further.

The search for appropriate indicators highlighted certain areas where simply not enough information exists. Examples of these are as follows:

- A measure of the image of manufacturing within a country (or importance placed on improving the image)
- Data relating to the number of women in management positions within a country's manufacturing industry
- Recent, comprehensive measures of scientists' participation in international conferences and cooperation with scientists from other countries

These areas could certainly be usefully covered by further investigation.

10 References

Arundel, A. & Hollanders, H. 2003, 2003 Innovation Scoreboard: Technical Paper No 6 Methodology Report.

Becker, M. Driving ambition. The Guardian . 2004. 28-9-2004.

Carrie, A. 2000, From integrated enterprises to regional clusters: the changing basis of competition.

DG Research. Working document - ManuFuture 2003 conference. 2003.

Dreher, C., Warnke, P., & Schirrmeister, E. 2004, *ManVis Report No1*, Fraunhofer Institute for System and Innovation Research, Karlsruhe.

EC. European Innovation Scoreboard 2004 Online. http://trendchart.cordis.lu/scoreboards/scoreboard2004/index.cfm .2004. 1-1-2005.

EC & Cedefop 2003, Implementing lifelong learning strategies in Europe:progress report on the follow-up to the Council resolution of 2002 on lifelong learning Brussels.

EC (European Commission) 2000, *(SEC 1832) Memorandum on lifelong learning*, Commission of the European Communities, Brussels.

EC (European commission) 2000, COM(2000)6 Towards a European research area Brussels.

EC (European Commission) 2002a, (COM 714) Industrial Policy in an Enlarged Europe.

EC (European Commission) 2002b, (SEC 1340) Statistical elements in support of the Communication on Industrial Policy in an enlarged Europe.

EC (European Commission) 2003a, (COM 685) "Education & Training 2010" The Success of The Lisbon Strategy Hinges on Urgent Reforms Brussels.

EC (European Commission) 2003b, (COM 704) Some Key Issues in Europe's Competitiveness - Towards an Integrated Approach, European Commission, Brussels.

EC (European commission) 2003a, COM(2003) 436 Researchers in the european research area:one proffesion, multiple careers Brussels.

EC (European commission) 2003b, COM(226) Investing in research: and action plan for Europe Brussels.

EC (European Commission) 2003c, Green paper Entrepreneurship in Europe.

EC (European Commission) 2003d, *Women and Science - Statistics and Indicators - She Figures 2003*, Office for Official Publications of the European Communities, Luxembourg, (EUR 20733).

EC (European Commission). Defining the future of European manufacturing. http://europa.eu.int/comm/research/industrial_technologies/articles/article_241_en.html . 1-12-2003e. 1-10-2004e.

EC (European Commission). February workshop sets agenda for future of manufacturing. http://europa.eu.int/comm/research/industrial_technologies/articles/article_402_en.html . 22-4-2003f. 4-10-2004f.

EC (European Commission). Strong political and industrial consensus on future of European manufacture. http://europa.eu.int/comm/research/industrial_technologies/articles/article_377_en.html . 15-12-2003g. 4-10-2004g.

EC (European Commission) 2004a, (COM 274) Fostering structural change: an industrial policy for an enlarged Europe.

EC (European commission). Marie Curie Fellowship information. http://www.cordis.lu/improving/fellowships/home.htm 3.12. 2004.

EC (European Commission). Experts meet to prepare MANU*FUTURE* vision. http://europa.eu.int/comm/research/industrial_technologies/articles/article_1179_en.html . 2004b. 4-10-2004.

EC (European Commission). Research Industrial technologies - the future of manufacturing in Europe. http://europa.eu.int/comm/research/industrial_technologies/manufuture/introduction_en.html . 2004c. 4-10-2004.

EC (European Commission). Manufuture - the future of manufacturing in Europe. http://europa.eu.int/comm/research/industrial_technologies/manufuture/home_en.html . 2004d. 23-8-2004

EC (European Commission) 2004e European Innovation Scoreboard 2004 Comparative Analysis of Innovation Performance SEC(2004) 1475, Brussels

EC EDG Education & Culture. Socrates - Erasmus home page. http://europa.eu.int/comm/education/programmes/socrates/erasmus/erasmus_en.html . 2005.

EC EDG Enterprise. EC Enterprise Policy (Entrepreneurhip) Online. http://europa.eu.int/comm/enterprise/enterprise_policy/survey/eurobarometer83.htm . 2005.

EC EDG Information Society. eEurope - An Information Society for all. http://europa.eu.int/information_society/eeurope/2005/index_en.htm . 2005.

EC EDG Innovation Policy Unit. Thematic TrendChart home page. http://trendchart.cordis.lu/index.cfm . 2005.

EC EDG Research. Annex to EU ERA Annual Report 2003. http://europa.eu.int/comm/research/reports/2003/index_en.html . 2004. 4-10-2004

EC EDG Research. EU Key Figures Online. http://europa.eu.int/comm/research/era/keyfigures_en.html . 2005a. 23-1-2005

EC EDG Research. EU Women and Science home page. http://europa.eu.int/comm/research/science-society/women-science/women-science_en.html . 2005b. 23-1-2005.

EOS Gallup 2004, Flash Eurobarometer 146 - Entrepreneurship.

ESF (European Science Foundation) 2002, Agents for change. Bringing industry and academia together to develop career opportunities for young researchers, ESF, Strasbourg.

ESN. (1 /2003) European Industrial Research - FP6 focuses on breakthrough technologies. European Industrial Research 2003[1]. 2003a.

ESN. (2 /2003) European Industrial Research - Future of manufacturing. European Industrial Research 2003[2]. 2003b.

ESN. (2 /2004) European Industrial Research - A material approach. European Industrial Research 2004[2]. 6-8-2004.

ETAN Expert Working Group on Women and Science 1999, *Science policies in the European Union: Promoting excellence through mainstreaming gender equality*, Office for Official Publications of the European Communities, Luxembourg.

Eureka. Eureka home page. http://www.eureka.be/ . 2005. 4-01-2005

Eureka! Eureka! A network for market oriented R&D. http://www3.eureka.be/ifs/files/ifs/jsp-bin/eureka/ifs/jsps/publicAboutEureka.jsp . 2004. 4-11-2004.

European Commission, D. f. E. 2004, Innovation Management and the Knowledge-Driven Economy.

European Parliament. Lisbon European Council 23 and 24 March 2000 - Presidency Conclusions. http://www.europarl.eu.int/summits/lis1_en.htm . 2000. 3-10-2004.

European Parliament 2001, Gothenburg European Council 15 and 16 June 2001 - Presidency Conclusions.

European Parliament 2002, Barcelona European Council 15 and 16 March 2002 - Presidency Conclusions.

Eurostat. Eurostat Online. europa.eu.int/comm/eurostat/ .

Eurostat 2002, European social statistics. Continuing vocational training survey (CVTS2), European Communities, Luxembourg.

Faegri, K., Findlay, J., Burke, E., Pancheri, G., Scholz, B., & Schütte, G. 2002, Benchmarking national R&D policies - STRATA-ETAN expert working group - Human Resources in RTD (including attractiveness of S&T professions.

Finnish Ministry of Social Affairs and Health 2002, The Many Faces of the National Programme on Ageing Workers - The concluding Report on the Programme, Edita Prima Ltd, Helsinki.

Flanagan, K., Green, L., Malik, K., Miles, I., Leitner, K., Dachs, B., Wagner, P., & Weber, M. 2003, The Future of Manufacturing in Europe 2015-2020, The Challenge For Sustainability, Industrial Approaches, Final Report.

Fraunhofer ISI. Manufacturing Visions home page. http://www.manufacturing-visions.org/ . 2005. 23-1-2005.

Garten, E. J. The buck should stop here. International Herald Tribune . 2004. 9-12-2004.

Geddes, A. Europe's ageing workforce. BBC News . 2002.

Götzfried, A. Women, science and technology: Measuring recent progress towards gender equality. 2004. Luxembourg, Eurostat.

Greenhalgh, R. The 2003 Warick University Public Lecture. http://www.unilever.co.uk/speeches/Warwick%20Speech.doc . 2003. 6-10-2004.

Grupp, H. & Mogee, M. E. 2004, "Indicators for national science and technology policy: how robust are composite indicators?", *Research Policy*, vol. 33, no. 9, pp. 1373-1384.

HLG (Manufuture High Level Group). Manufuture - a vision for 2020 - revised draft. 14-9-2004a.

HLG (Manufuture High Level Group). Manufuture - Strategic Research Agenda - revised draft. 14-9-2004b.

IFM University of Cambridge. Informan Knowledge Database. internet . 2003. 3-10-2004.

IPTS. Institute for Prospective Technological Studies (IPTS) Online. http://www.jrc.es/home/index.html . 2005. 4-02-2005

IPTS (the Joint Research Centre DG Institute for Prospective Technological Studies 2004, FuTMaN - The Future of Manufacturing in Europe 2015-2020 - the challenge for sustainability.

ISI (Fraunhofer-Institut für Systemtechnik und Innovationsforschung). Manufacturing Visions - Integrating Diverse Perspectives into Pan-European Foresight. 2003.

M2020 Foresight panel - Department of Trade and Industry 2000, *UK Manufacturing: We can make it better*, Findlay Publications, Kent.

Maires, R. D. Preparing The Workforce Of Tomorrow. Manufacturing's Future...Dependant On A Skilled Workforce. Modern Machine Shop . 2001. 1-2-2001.

Navarro, L. 2003, Industrial policy in the economic literature Recent theoretical developments and implications for EU policy, EDG, Eureopean Commission, Enterprise Papers No 12, 2003.

Nijhof, W. J. Lifelong learning as a European skill formation policy. http//www.gw.utwente.nl/gw/cbb/nijhof.pdf . 2004. University of Twente. 20-10-0004.

OECD Dynamising national innovation systems OECD Publ. Service, Paris.

OECD 1997, National Innovation Systems, OECD, Paris.

Popper, R. 2004, *The Knowledge society Delphi: Main results Summary.*, European Foundation for the Improvement of Living and Working Conditions, Dublin.

PREST 2003, Raising EU R&D Intensity. Improving the Effectiveness of Public Support Mechanisms for Private Sector Research and Belgium.

PROD*EU 2004, The Manufacturing Technology Action Plan and German Manufacturing Research in the European Research Area, BMBF (The German Federal Minestry for Education and Reasearch).

Punset Casals, E., Andreta, E., & Kroto, H. 2003, "Acheiving longer-lasting effects in industrial research", *European Industrial Research*, vol. 1, no. 1, pp. 4-5.

Reid, A., Walendowski, J., Strogylopolous, G., Kaloumenou, P., & Radosevic, S. Innovation policy in 7 candidate countries: The challenges. 2003. Innovation Directorate. Innovation papers No 34.

UN 2000, *Replacement Migration: Is it a solution to declining and ageing populations?*, Population Division, Department of Economics and Social Affairs, UN Secretariat, New York.

World Bank. Starting a Business - Online resource. http://rru.worldbank.org/DoingBusiness/ExploreTopics/StartingBusiness/ . 2005. 09-12-2004

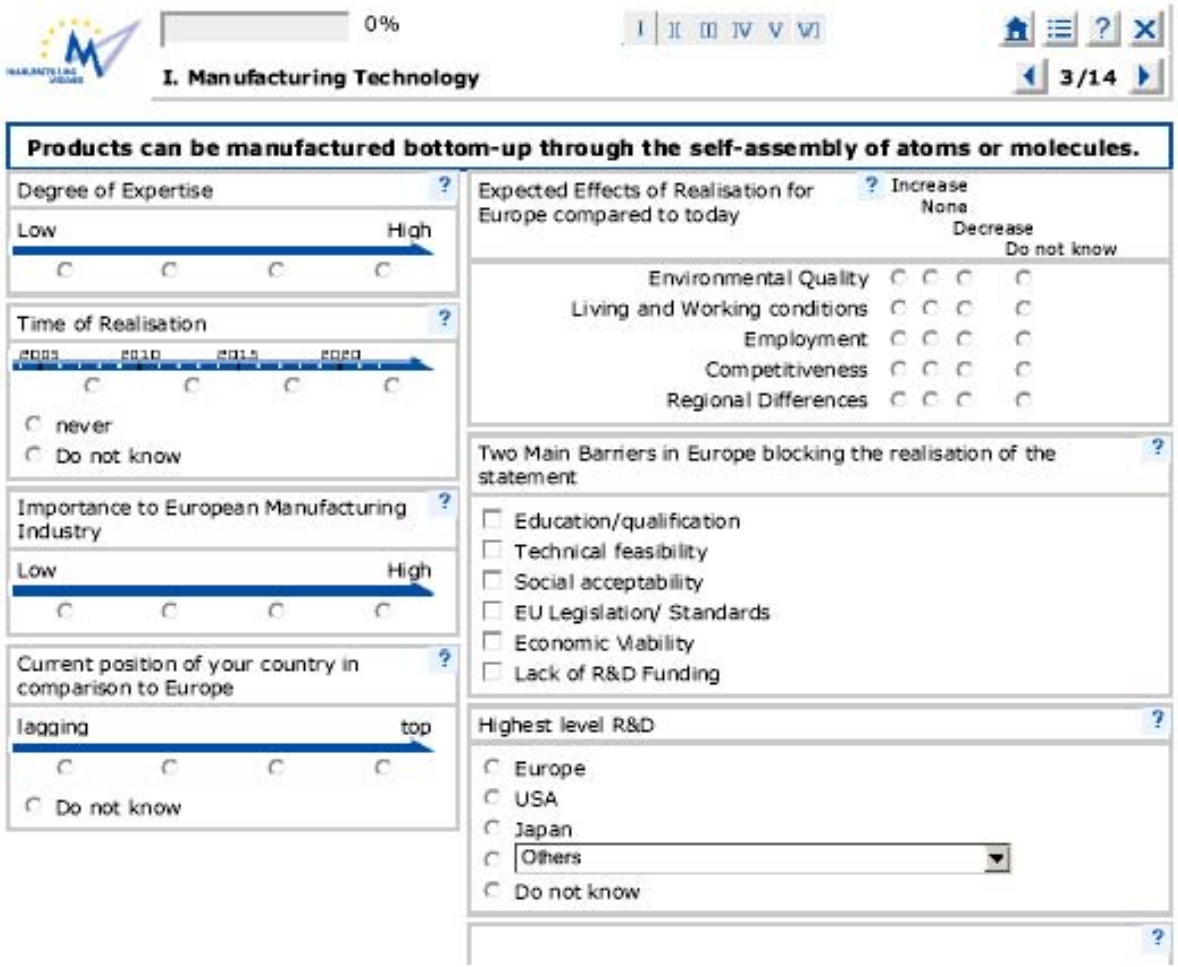
World Economic Forum (WEF). The Network Readiness Index 2003-2004 (part of Global Information Technology Report 2002-2003). http://www.weforum.org/ . 2003. 23-1-2005.

World Economic Forum (WEF) The Lisbon Review 2004. http://www.weforum.org/site/homepublic.nsf/Content/Global+Competitiveness+Programme%5CLisbon+Review. 2004. 05-2-2005

World Economic Forum (WEF). The GCR Report 2003-2004 Chapter 1. (http://www.weforum.org/pdf/Gcr/GCR_2003_2004/GCI_Chapter.pdf. 2004b. 05-2-2005

World Economic Forum (WEF). The GCR Executive Summary. http://www.weforum.org/pdf/Gcr/Executive_Summary_GCR_04. 2004c. 03-2-2005

APPENDICES


0%
I II III IV V VI
I. Manufacturing Technology
3/14
Products can be manufactured bottom-up through the self-assembly of atoms or molecules.
Degree of Expertise
Low
High
Time of Realisation
2005
2010
2015
2050
never
Do not know
Importance to European Manufacturing Industry
Low
High
Current position of your country in comparison to Europe
lagging
top
Do not know
Expected Effects of Realisation for Europe compared to today
Increase
None
Decrease
Do not know
Environmental Quality
Living and Working conditions
Employment
Competitiveness
Regional Differences
Two Main Barriers in Europe blocking the realisation of the statement
Education/qualification
Technical feasibility
Social acceptability
EU Legislation/ Standards
Economic Viability
Lack of R&D Funding
Highest level R&D
Europe
USA
Japan
Others
Do not know

Workforce (17)

WE	Educating the Future Workforce
We1	Grad. in maths, science and tech.
We2	Public expenditure on education
We3	Availability of Scientists and Engineers
We4	Erasmus Eng. & Tech. student mobility
WA	**Age of workforce**
Wa1	Proportion of workforce aged 50-64
Wa2	Prop. of 50-64 year olds who are employed
Wa3	Work-Life balance
Wa4	Average exit age from the workforce
Wa5	Barrier-free manufacturing
WW	**Workforce Training**
Ww1	Qualification Certification
Ww2	Life Long Learning
Ww3	learning in the company
Ww4	Manufacturing enterprises offering CVT
Ww5	Manuf. employees participating in CVT
WC	**Careers for Women**
Wc1	Attitude towards women in science
Wc2	Female grad. in maths, science and tech.
Wc3	Women Scientists and Engineers

Research & Development (15)

RL	Links between industry & academia
Rl1	Priority given to ISR (Industry - Science Relations)
Rl2	University/ Industry Research Collaboration
Rl3	Availability of specialised research services
Rl4	Manuf. enterp. use of Uni. as sources of info. for innovation
RR	**R&D Spending**
Rr1	Manuf. companies receiving public funding for innovation
Rr2	Public R&D expenditure
Rr3	Business R&D expenditure
Rr4	Innovation expenditure for Manufacturing companies
RH	**Human Resources**
Rh1	Priority given to moblity schemes
Rh2	Number of researchers
Rh3	HRST Job-to-job mobility
Rh4	Female Phds in Science, Eng., manuf., and construction
RI	**International Cooperation**
Ri1	Eureka participation
Ri2	Preferred co-publication partners
Ri3	Cooperation Links in FP5

Operating Environement (18)

OI	ICT
Oi1	Manufacturing Enterprises access to the Internet
Oi2	Manuf. enterp. using Internet for interaction w public auth.
Oi3	Business ICT readiness
Oi4	Manufacturing Enterprises receiving order via ICT
OE	**Entrepreneurship**
Oe1	Self-employment
Oe2	Manufacturing self-employed
Oe3	Influence of edu. sys. in promoting young people to start businesses
Oe4	Cost to Start a company
Oe5	Willingness to start a business if there is a risk it might fail.
Oe6	Procedures and duration to start a company
OS	**SME**
Os1	Employees with higher education in Manufacturing SMEs
Os2	Manufacturing SMEs involved in innovation co-operation
Os3	Manufacturing SMEs innovating in-house
Os4	Manufacturing SMEs -sales of "new to market" products
Os5	SME networks
ON	**National Policies & Government**
On1	Economic climate favourable for starting own business
On2	Priority given to "Establishing a Framework conducive to Innovation"
On3	Manuf. Enterp. using Government as source of info. for innovation

Appendix C

Oe1	Self-employment
Definition	
Percentage of asked experts believing that the statement: "The majority of workers in production are self-employed and offer their services to a number of customers in different places." will be realised before <2015. Out of all respondents answering either, "never", "<2010", "2010-2015", "2015-2020", or ">2020". The higher the better.	
Source	
This indicator has been calculated using the results from the first ManVis delphi survey, as presented at the Manufuture 2004 conference (www.manufuture.org). For detailed information contact the Fraunhofer ISI, department for Innovations in Production. www.isi.fraunhofer.de Year: 2004	
Notes	
In our calculations we have included (diverting from the results presented in the participants area of the ManVis portal and the results presented at the Manufuture 2004 conference) the "never" rate in the total base.	

Oe2	Manufacturing self-employed
Definition	
This indicator measures the degree of self-employed and employers within the manufacturing industry (NACE D) as a percentage of the total workforce. (For the age group 15 years old and above.) The higher the better.	
Source	
Eurostat (Sun, 16 Jan 05 03:44:52) europa.eu.int/comm/eurostat/ table esgana Self-employment by sex, age groups and economic activity (1000) Years: 2002-2004	
Notes	
Own calculations: (Self employment in NACE D, in 1000)/(Total employment, in 1000)*100. Years are matching between numerator and the denominator.	

Oe3	Influence of educational system in promoting young people to start businesses
Definition	
Percentage of the surveyed people agreeing to the statement that "The educational system develops a state of mind in young people that encourages them to create a firm". The higher the better.	
Source	
EOS Gallup 2004 Eurobarometer 146-'Entrepreneurship', http://europa.eu.int/comm/enterprise/enterprise_policy/survey/eurobarometer146_en.pdf Accessed: 02 Feb 2005	
Notes	
EOS Fieldwork: 10th - 23rd September, released January 2004	

Oe4	Cost to Start a company

Definition

This indicator measures the relation between the cost of starting a business to the Gross Net Income per capita, given in percentage.
The lower percentage the better, since it will then be affordable to start a company for more people.

Source

European Trend Chart on Innovation: Thematic Report - Start-up of technology-based small firms (Oct 2002 - Sept. 2003)
Available: http://trendchart.cordis.lu/tc_trendreport.cfm
Last accessed: 6 Feb 2005

For Estonia - (World Bank, 2005)
World Bank, 2005
World Bank - Starting Business - Online Resource
http://rru.worldbank.org/DoingBUsiness/ExploreTopics/StartingBusiness/
Accessed: 02 Jan 2005

Notes

Estonia has been calculated using World Bank data. For other countries the "start-up" cost as a percentage of GNI was already available in the Thematic Report.

Oe5	Willingness to start a business if there is a risk it might fail.

Definition

Percent of people who disagree to the following statement "One should not start a company if there is a risk one might fail". The higher the better.

Source

EOS Gallup - Flash Eurobarometer 160
Survey April 2004, report June 2004
http://europa.eu.int/comm/public_opinion/flash/fl160_en.pdf
Last accessed: 2 February 2005

Notes

We have calcualated the "total" as the percentage answering "agree" or "disagree". The group of people not answering (n/a) and "don't know" was already grouped, and has thus been omitted.

Oe6	Procedures and duration to start a company

Definition

A weigthed figure of number of days and procedures to start a company. The lower the better.

This indicator has been calculated through normalising the number of days to start a company and the number of procedures to start a company. Shortest time has been rewarded with a 1 and the longest time with a 0, likewise has been done for each country for the number of procedures required. These two figures have thereafter been summed, and thus has each country received a value between 2 and 0. This value has been used as an input for this indicator, and has been normalised in the same way as other indicators.

Source

European Trend Chart on Innovation: Thematic Report - Start-up of technology-based small firms (Oct 2002 - Sept. 2003)
Available: http://trendchart.cordis.lu/tc_trendreport.cfm
Last accessed: 6 Feb 2005

For Estonia - (World Bank, 2005)
World Bank, 2005
World Bank - Starting Business - Online Resource
http://rru.worldbank.org/DoingBUsiness/ExploreTopics/StartingBusiness/
Accessed: 02 Jan 2005

Notes

See appendix with "real indicator values" and the columns 72_b and 72_c

Oi1	Manufacturing Enterprises access to the Internet

Definition

Percentage of manufacturing (NACE D) enterprises (+10 employees) with access to internet. The higher the better.

Source

Eurostat Online, europa.eu.int/comm/eurostat/
Accessed: Mon, 20 Dec 04 06:31:51
http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en

Notes

Years: 2003-2004
table polindb2 Percentage of enterprises having access to the Internet / indic_is e_iacc Percentage of enterprises having access to the Internet / unit Percentage of enterprises / sizenace Manufacturing (10 employed persons or more)

Overview of Eurostat tables Jan 2005:
http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html

Oi2	Manufacturing Enterprises using Internet for interaction with public authorities
Definition	
Percentage of manufacturing companies with more than 10 employees, which use internet for full interaction (receiving information, sending information etc.) with public authorities. The higher the better.	
Source	
Eurostat Online, Mon, 20 Dec 04 06:42:54 http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en	
Notes	
indic_is Percentage of enterprises using Internet for interaction with public authorities - for full electronic case handling / unit Percentage of the enterprises with Internet access / sizenace Manufacturing (10 employed persons or more) Overview of Eurostat tables Jan 2005: http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html	

Oi3	Business ICT readiness
Definition	
The Networked Readiness Index (NRI) is defined as a nation's or community's degree of preparation to participate in and benefit from information and communication technology (ICT) developments. A higher value indicates a higher degree of preparation and readiness.	
Source	
World Economic Forum (WEF), The Netwrok Readiness Index 2003-2004 (part of Global information Technology Report 2002-2003) http://www.weforum.org/ Last accessed: 23 January 2005	
Notes	
We have just their index, please refer to the WEF report for methodology. Their index has been normalised like any other value.	

Oi4	Manufacturing Enterprises receiving order via ICT
Definition	
Percentage of Manufacturing (+10) received order via ICT (using a computer). The higher the better.	
Source	
Eurostat Online Last accessed: Mon, 20 Dec 04 06:46:37 http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en	
Notes	
table polindg3 Percentage of enterprises having received orders on-line / unit Percentage of enterprises / indic_is e_esell Percentage of enterprises having received orders on-line / sizenace Manufacturing (10 employed persons or more) Overview of Eurostat tables Jan 2005: http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html	

On1	Economic climate favourable for starting own business
Definition	
Percentage of people disagreeing to the statement "The economic climate is not favourable for people who want to start their own business". The higher the better.	
Source	
EOS Gallup - Flash Eurobarometer 160 Survey April 2004, report June 2004 http://europa.eu.int/comm/public_opinion/flash/fl160_en.pdf Last accessed: 2 February 2005	
Notes	
A positive attitude towards the economic climate is favourable for all economic activities. This is seen as a measure of the over-all state of the different countries, as perceived by the survey participants, with respect to the economic climate.	

On2	Priority given to "Establishing a Framework conducive to Innovation"

Definition

Average from 3 readings (April 2001, Nov 2002, Sept 2003) covering nations' priority given to the sub- area "Establishing a Framework conducive to Innovation" (II) (action lines: Competition (II.1), Protection of IPR (II.2), Administrative simplifications (II.3), Amelioration of legal and regulatory environments (II.4), Innovation financing (II.5), and Taxation (II.6)) The higher priority the better. No weighting between the action lines. The higher the better - more actions taken, and higher priority given.

Source

European Trendchart on Innovation

http://trendchart.cordis.lu/tc_trendreport.cfm
http://194.78.229.48/extranettrend/reports/documents/synthesis_report_on_national_policy_2001.pdf
http://194.78.229.48/extranettrend/reports/documents/synthesis_report_2002.pdf
http://194.78.229.48/extranettrend/reports/documents/synthesis_report_2003.pdf
All latest accessed: 5 Feb 2005

Notes

Though the validity of country to country comparison based on only one reading, an average over 3 readings and 3 years give a better understanding for which priority each sub-area and key line has been given. This indicator looks closer at the priority given to the sub-area - " Establishing a Framework conducive to Innovation".
The average is based on own calculations of the three mentioned readings.

For further information on the term "priority" in this context, please refer to the Annex II in the "European TrendChart on Innovation - Synthesis report 2003", page 107.
http://194.78.229.48/extranettrend/reports/documents/synthesis_report_2003.pdf, accessed: 5 Feb 2005

On3	Manufacturing Enterprises using Government as source of information for innovation

Definition

Percentage of manufacturing establishments receiving and claiming high use of information from government and non-profit bodies for innovation in the time period (1998-2000). The higher percentage, the better.

Source

Eurostat Online, Mon, 29 Nov 04 12:30:14
http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en

Notes

table inn_sou Source of information for innovation during 1998-2000 / nace Manufacturing / sizeclas Total / unit Percentage / time 2000a00 / type_inn Enterprises with innovation activities & "High use of Sources for innovation from Government or private non-profit research institutes"

Overview of Eurostat tables Jan 2005:
http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html

Os1	Employees with higher education in Manufacturing SMEs

Definition

Measured as a ratio: employees with higher education per employee. The higher the better.

Source

Eurostat Online, Fri, 19 Nov 04 02:54:53
http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en

Notes

table inn_bas Basic economic information on the enterprises / nace Manufacturing / sizeclas Between 10 and 249 / unit Percentage / time 2000a00 / type_inn Total enterprises

Overview of Eurostat tables Jan 2005:
http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html

Os2	Manufacturing SMEs involved in innovation co-operation
Definition	
Numerator: Sum of manufacturing SMEs (NACE D) with innovation co-operation activities. Firms with co-operation activities are those that had any co-operation agreements on innovation activities with other enterprises or institutions in the three years of the survey period. Denominator: Total number of manufacturing SMEs (NACE D). The higher the better.	
Source	
European Innovation Scoreboard 2004 Database Available via: http://trendchart.cordis.lu/scoreboards/scoreboard2004/pdf/eis_2004_database.xls Last accessed: 5 Feb 2005	
Notes	
Stated sources in the EIS report: Source: EUROSTAT: NewCronos/Science and technology/ Survey on innovation in EU enterprises/ Results of the third community innovation survey (CIS3)/ The European Innovation scoreboard indicators	

Os3	Manufacturing SMEs innovating in-house
Definition	
Numerator: Sum of all manufacturing SMEs with in-house innovation activities. Innovative firms are defined as those who introduced new products or processes either 1) in-house or 2) in combination with other firms. Denominator: Total number of manufacturing SMEs. The higher the better.	
Source	
Eurostat Online, 3rd Community Innovation Survey (CIS-3). National sources. Available: http://trendchart.cordis.lu/scoreboards/scoreboard2003/indicators_3.1.cfm Accessed: 29 Nov 2004	
Notes	
This indicator measures the degree to which manufacturing/services SMEs, that have introduced any new or significantly improved products or production processes during the period 1998-2000, have innovated in-house. This indicator does not include new products or processes developed by other firms.	

Os4	Manufacturing SMEs -sales of "new to market" products
Definition	
Numerator: Sum of total turnover of new or significantly improved products for all manufacturing enterprises. Denominator: Total turnover for all manufacturing enterprises. The higher the better.	
Source	
European Innovation Survey (EIS) 2004, page 45/47 Available: http://trendchart.cordis.lu/scoreboards/scoreboard2004/pdf/eis_2004.pdf Last access: 5 Feb 2005	
Notes	
Source stated by EIS 2004: Source: EUROSTAT: NewCronos/Science and technology/ Survey on innovation in EU enterprises/ Results of the third community innovation survey (CIS3)/ The European Innovation scoreboard indicators	

Os5	SME networks
Definition	
Percentage of experts believing that the statement "Networks of specialised SMEs compete successfully in the global marketplace." will be realised before <2015 (out of all respondents, also people answering "never" - "<2010","2010-2015", "2015-2020", ">2020") The higher the better.	
Source	
This indicator has been calculated using the results from the first ManVis delphi survey, as presented at the Manufuture 2004 conference (www.manufuture.org). For detailed information contact the Fraunhofer ISI, department for Innovations in Production. www.isi.fraunhofer.de Year: 2004	
Notes	
In our calculations we have included (diverting from the results presented in the participants area of the ManVis portal and the results presented at the Manufuture 2004 conference) the "never" rate in the total base.	

Rh1	Priority given to moblity schemes
Definition	Average number of mobility schemes running July 2000 - Sept 2003. The higher the better.
Source	Available: http://trendchart.cordis.lu/tc_trendreport.cfm All last accessed: 5 Feb 2005 Thematic Trend Report: Industry-Science Relations: 2003 http://194.78.229.48/extranettrend/reports/documents/TR_ISR_september_2003.pdf 2002 http://194.78.229.48/extranettrend/reports/documents/TR_ISR_report_february_2003.pdf 2001 http://194.78.229.48/extranettrend/reports/documents/industry_science_relationships_april2001.pdf 2000 http://194.78.229.48/extranettrend/reports/documents/industry_science_relationship_dec2000.pdf
Notes	

Rh2	Number of researchers
Definition	Number of researchers (FTE) per 1000 labour force. The higher the better.
Source	Source: DG Research Key Figures 2003-2004, page 44 Available: http://europa.eu.int/comm/research/era/pdf/indicators/ind_kf0304.pdf Accessed: 5 Feb 2005
Notes	

Rh3	HRST Job-to-job mobility

Definition

Data on job-to-job mobility of highly qualified personnel (employed HRST) aged 25-64 at the national level. This indicator shows the percentage of total, that change jobs between year t-1 an t. The higher the better.

Motivation

A higher percentage, indicates a higher proportion of the researcher body being mobily, which is seen as a positive thing.

Source

Eurostat Online, Mon, 29 Nov 04 01:29:39
Available:
http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en

Notes

table hrst_mob Annual data on job-to-job mobility of highly qualified personnel (employed HRST) aged 25-64 at the national level, by gender / unit Thousands / category emp_hrst Employed / Human Resources in Science and Technology / sex Total

Overview of Eurostat tables Jan 2005:
http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html

Rh4	Female Phds in Science, Engineering, manufacturing, and construction

Definition

Proportion of female ISCED 6 graduates in the two field of study - "Science, Mathemtics and Computing" and "Engineering, Manufacturing adn construction". The higher the better.

Source

Women and science statistics and indicators, She figures 2003, p.82-83
Available: http://europa.eu.int/comm/research/science-society/pdf/she_figures_2003.pdf
Last accessed: 5 Feb 2005

Notes

All countries' values are from 2001, exceptions to the reference year: DK, FR, IT, FI: 2000

ISCED 6 = Advanced research programmes at the tertiary level, equivalent to PhD programmes.
(http://www.irdes.fr/ecosante/OCDE/941.html, 5 Feb 2005)

Ri1	Eureka participation
Definition	
This indicator is based on the sum of projects were a country has leadership of one or more partners. The higher the better.	
Source	
The Eureka Initiative Annual report 2003-2004, p 17/20 Available: http://www.eureka.be/files/:70404 Last access: 5 Feb 2005	
Notes	
The sum of the occasions when a country was "main contact" or "partner" has been estimated from a graph on the home page.	

Ri2	Preferred co-publication partners
Definition	
This indicator is based on the sum of times a country has been mentioned as prefered co-publication partner. The higher the better.	
Source	
Source: DG Research Key Figures 2003-2004, page 64 Available: http://europa.eu.int/comm/research/era/pdf/indicators/ind_kf0304.pdf Accessed: 5 Feb 2005	
Notes	
"If actual co-publication numbers are related to expected numbers for a given group of countries, it is possible to generate a list indicating a country's most preferred partners in this group. Table II-1b shows such a list constructed for 34 countries. It should be understood that the most preferred countries in this table are not necessarily the most important partners in terms of total numbers of co-publications." from Key Figures p64	

Ri3	Cooperation Links in FP5

Definition

This indicator is based on the sum of co-operation links made within FP5 in 2002. The higher the better.

"A cooperation link is considered to have been established between two bodies if they are participating in the same project. This cooperation link is counted once if the two bodies are from the same country (diagonally on the cooperation links matrix) and twice if the bodies are from different countries - once as a link from country A to country B and once as a link from country B to country A. The net number of cooperation links is, therefore, the sum of the number of links between bodies from the same country plus half the number of links between bodies from different countries." Source - see below.

Source

Annex to the report from the European Commission on "Research and technological development activities of the European Union Annual Report 2003", p. 60/64, Table 6
Available: http://europa.eu.int/comm/research/reports/2003/pdf/report-working-doc-2004_en.pdf
Last accessed: 5 Feb 2005

Notes

The data in the table given in the annex has obviously been partly shifted. This has been taken into account for before calculating the total number of co-operation links.

RI1	Priority given to ISR (Industry - Science Relations)

Definition

Average of running schemes for cooperation betwen research institutes, universities and companies. The higher the better.

Source

Available: http://trendchart.cordis.lu/tc_trendreport.cfm
All last accessed: 5 Feb 2005

Thematic Trend Report: Industry-Science Relations:
2003
http://194.78.229.48/extranettrend/reports/documents/TR_ISR_september_2003.pdf
2002
http://194.78.229.48/extranettrend/reports/documents/TR_ISR_report_february_2003.pdf
2001
http://194.78.229.48/extranettrend/reports/documents/industry_science_relationships_april2001.pdf
2000
http://194.78.229.48/extranettrend/reports/documents/industry_science_relationship_dec2000.pdf

Notes

RI2	University/ Industry Research Collaboration
Definition	
This indicator is based on the response to the following question "In its R&D activity, business collaboration with local universities is (1=minimal or non-existent, 7=intensive and ongoing)". A higher number indicates larger degree of collaboration, which is encouraged.	
Source	
Thematic Trend Report - Industry-Science Relations (Sept. 02 -Sept. 03), p. 9 / 59 Available: http://194.78.229.48/extranettrend/reports/documents/TR_ISR_september_2003.pdf Last accessed: 5 Feb 2005	
Notes	
Their stated source: The Global Competitiveness Report 2001-2002 (Porter M., Sach E., Cornelius P., McArthur J.W., Schwab K.)	

RI3	Availability of specialised research services
Definition	
This indicator is based on the response to the following question "In your industry, specialized research and training services are (1=not available in the country, 7=available from worldclass local institutions)" The higher the better.	
Source	
Thematic Trend Report - Industry-Science Relations (Sept. 02 -Sept. 03), p. 9 / 59 Available: http://194.78.229.48/extranettrend/reports/documents/TR_ISR_september_2003.pdf Last accessed: 5 Feb 2005	
Notes	
Their stated source: The Global Competitiveness Report 2001-2002 (Porter M., Sach E., Cornelius P., McArthur J.W., Schwab K.)	

RI4	Manufacturing enterprises use of Universities as sources of information for innovation

Definition

Percentage of manufacturing (NACE D) companies who have claim "High" use of Sources for innovation from Universities or other higher education institutes during 2000. The higher the better.

Source

Eurostat Online, Mon, 29 Nov 04
http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en

Notes

table inn_sou Source of information for innovation during 1998-2000 / nace Manufacturing / sizeclas Total / unit Percentage / time 2000a00 / type_inn Enterprises with innovation activities & "High use of Sources for innovation from Universities or other higher education institutes"

Overview of Eurostat tables Jan 2005:
http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html

Rr1	Manufacturig companies receiving public funding for innovation

Definition

Percentage of manufacturing companies (NACE D) with innovation activities, having received public funding of innovation in 2000. The higher the better.

Source

Eurostat Online, Thu, 2 Dec 04 12:09:00
http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en

Notes

Own calculations - (Answers: Y, N, n/a => Y/(n+y)*100)

table inn_pub Public funding of innovation / nace Manufacturing / sizeclas Total / unit Percentage / time 2000a00 / type_inn Enterprises with innovation activities

Overview of Eurostat tables Jan 2005:
http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html

Rr2	Public R&D expenditure

Definition

Numerator: Difference between GERD (Gross domestic expenditure on R&D) and BERD (Business enterprise expenditure on R&D). Both GERD and BERD according to Frascatimanual definitions, in national currency and current prices. Note that this definition is a proxy of public R&D expenditures as it also includes the R&D expenditures from the Private Non Profit (PNP) sector.

Denominator: Gross domestic product as defined in the European System of Accounts (ESA 1995), in national currency and current prices.
The higher the better.

Source

European Innovation Survey (EIS) 2004, page 34-35 (/47)
Available: http://trendchart.cordis.lu/scoreboards/scoreboard2004/pdf/eis_2004.pdf
Last access: 5 Feb 2005

Notes

Stated source by EIS 2004:
Source: EUROSTAT: NewCronos/Science and Technology/Research and development/Statistics on research and development/R&D expenditure/National R&D expenditure/ Total intramural R&D expenditure (GERD) by sectors of performance. OECD: Main Science and Technology Indicators.

Rr3	Business R&D expenditure

Definition

Numerator: All R&D expenditures of the business sector (manufacturing and services), according to Frascati-manual definitions, in national currency and current prices.

Denominator: Gross domestic product as defined in the European System of Accounts (ESA 1995), in national currency and current prices.
The higher the better.

Source

European Innovation Survey (EIS) 2004, page 34-35 (/47)
Available: http://trendchart.cordis.lu/scoreboards/scoreboard2004/pdf/eis_2004.pdf
Last access: 5 Feb 2005

Notes

Sources stated by EIS 2004:
EUROSTAT: NewCronos/Science and Technology/Research and development/Statistics on research and development/R&D expenditure/National R&D expenditure/ Total intramural R&D expenditure (GERD) by sectors of performance. OECD: Main Science and Technology Indicators.

Rr4	Innovation expenditure for Manufacturing companies

Definition

Numerator: Sum of total innovation expenditure for enterprises. Innovation expenditures includes the full range of innovation activities: in-house R&D, extramural R&D, machinery and equipment linked to product and process innovation, spending to acquire patents and licenses, industrial design, training, and the marketing of innovations.

Denominator: Total turnover for all enterprises. This includes firms that do not innovate, whose innovation expenditures are zero by definition.
The higher the better.

Source

European Innovation Survey (EIS) 2004, page 37/47
Available: http://trendchart.cordis.lu/scoreboards/scoreboard2004/pdf/eis_2004.pdf
Last access: 5 Feb 2005

Notes

Sources stated by EIS 2004:
EUROSTAT: NewCronos/Science and technology/ Survey on innovation in EU enterprises/ Results of the third community innovation survey (CIS3)/ The European Innovation scoreboard indicators

Wa1	Proportion of workforce aged 50-64

Definition

Percentage of the working population aged 50 or above out of total working population (15< years of age). The lower the better.

Source

Eurostat Online, Sun, 16 Jan 05 02:40:57
http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en

Notes

table egan Employment by sex, age groups and nationality (1000) / sex Total / time 2003q02 / citizen Total

Overview of Eurostat tables Jan 2005:
http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html

Wa2	Proportion of 50-64 year olds who are employed

Definition

The employment rate of older workers is calculated by dividing the number of persons aged 55 to 64 in employment by the total population of the same age group. The indicator is based on the EU Labour Force Survey. The survey covers the entire population living in private households and excludes those in collective households such as boarding houses, halls of residence and hospitals. Employed population consists of those persons who during the reference week did any work for pay or profit for at least one hour, or were not working but had jobs from which they were temporarily absent. The higher the better.

Source

Eurostat Online
http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=detailref&language=en&product=STRIND_EMPLOI&root=STRIND_EMPLOI/emploi/em014
Last access: 5 Feb 2005

Notes

Wa3	Work-Life balance

Definition

Percentage of experts believing that the statement "Tailored configurations of working conditions and benefits reflecting age and family situation are the norm in manufacturing companies." will be true <2015 (out of all respondents, also people answering "never" - "<2010","2010-2015", "2015-2020", ">2020") The higher the better.

Source

This indicator has been calculated using the results from the first ManVis delphi survey, as presented at the Manufuture 2004 conference (www.manufuture.org). For detailed information contact the Fraunhofer ISI, department for Innovations in Production. www.isi.fraunhofer.de Year: 2004

Notes

In our calculations we have included (diverting from the results presented in the participants area of the ManVis portal and the results presented at the Manufuture 2004 conference) the "never" rate in the total base.

Wa4	Average exit age from the workforce

Definition

The indicator gives the average age at which active persons definitely withdraw from the labour market. It is based on a probability model considering the relative changes of activity rates from one year to another at a specific age. The activity rate represents the labour force (employed and unemployed population) as a percentage of the total population for a given age. The indicator is based on the EU Labour Force Survey. The survey covers the entire population living in private households. The definitions used follow the guidelines of the International Labour Office. The higher the better.

Source

Eurostat Online
http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=detailref&language=en&product=STRIND_EMPLOI&root=STRIND_EMPLOI/emploi/em021
Last accessed: 5 Feb 2005

Notes

Wa5	Barrier-free manufacturing

Definition

Percentage of asked experts believing that the statement "Manufacturing systems, where people aged 60 and above can work without difficulty, are in widespread use." will be true <2015 (out of all respondents, also people answering "never" - "<2010","2010-2015", "2015-2020", ">2020") The higher the better.

Source

This indicator has been calculated using the results from the first ManVis delphi survey, as presented at the Manufuture 2004 conference (www.manufuture.org). For detailed information contact the Fraunhofer ISI, department for Innovations in Production. www.isi.fraunhofer.de Year: 2004

Notes

In our calculations we have included (diverting from the results presented in the participants area of the ManVis portal and the results presented at the Manufuture 2004 conference) the "never" rate in the total base.

Wc1	Attitude towards women in science

Definition

Percentage of experts believeing that the statement "The proportion of female employees amongst technical specialists and management in the manufacturing sector has reached their share of the population." will be true <2015 (out of all respondents, also people answering "never" - "<2010","2010-2015", "2015-2020", ">2020") The higher the better.

Source

This indicator has been calculated using the results from the first ManVis delphi survey, as presented at the Manufuture 2004 conference (www.manufuture.org). For detailed information contact the Fraunhofer ISI, department for Innovations in Production. www.isi.fraunhofer.de Year: 2004

Notes

In our calculations we have included (diverting from the results presented in the participants area of the ManVis portal and the results presented at the Manufuture 2004 conference) the "never" rate in the total base.

Wc2	Female graduates in maths, science and technology

Definition

Number of female graduates (ISCED 5-6) in maths, S&T per 1000 of female population aged 20-29, since 1993 The higher the better.

Source

Eurostat Online, Thu, 16 Dec 04 06:22:45
http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en

Notes

table edtertc Tertiary education graduates / indic_ed Female graduates (ISCED 5-6) in mathematics, science and technology per 1000 of female population aged 20-29, since 1993

Overview of Eurostat tables Jan 2005:
http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html

Wc3	Women Scientists and Engineers

Definition

Percentage of women among scientists and engineers in the fields ISCO' 88 COM code 21 or 22. The higher the better.

Source

"Women, science and technology: Measuring recent progress towards gender equality" (ISSN 1609-5995) p. 4-5 (/8)
Available: http://europa.eu.int/comm/research/science-society/women/wssi/pdf/stat-focus_en.pdf
Last accessed: 5 Feb 2005

Notes

S&E: Scientists and Engineers
physical, mathematical and engineering occupations (ISCO '88 COM code 21); life science and health occupations (ISCO '88 COM code 22). Note that according to the Canberra Manual, the seven broad S&T fields of study are Natural Sciences, Engineering and Technology, Medical Sciences, Agricultural sciences, social sciences and humanities, other fields — Canberra Manual, § 71. (Source, same as for indicator values)

We1	Graduates in maths, science and technology

Definition

Number of graduates (ISCED 5-6) in mathematics, science and technology per 1000 of population aged 20-29, since 1993. The higher the better.

Source

Eurostat Online,Thu, 16 Dec 04 04:07:04
http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en

Notes

table edtertc Tertiary education graduates / Indic_ed Graduates (ISCED 5-6) in science, mathematics and computing field (1000)

Overview of Eurostat tables Jan 2005:
http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html

We2	Public expenditure on education
Definition	
Total public expenditure on education as % of GDP, for all levels of education combined. The higher the better.	
Source	
Eurostat Online, Thu, 18 Nov 04 03:35:50 http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en	
Notes	
table edgdp Expenditure on education as % of GDP or public expenditure / indic_ed Total public expenditure on education as % of GDP, for all levels of education combined	

We3	Availability of Scientists and Engineers
Definition	
Scientists and engineers in your country are (1=nonexistent or rare, 7=widely available) (1=minimal or non-existent, 7=intensive and ongoing) The higher the better.	
Source	
Thematic Trend Report - Industry-Science Relations (Sept. 02 -Sept. 03), p. 9 / 59 Available: http://194.78.229.48/extranettrend/reports/documents/TR_ISR_september_2003.pdf Last accessed: 5 Feb 2005	
Notes	
Their stated source: The Global Competitiveness Report 2001-2002 (Porter M., Sach E., Cornelius P., McArthur J.W., Schwab K.)	

We4	Erasmus Engineering and Technology student mobility

Definition

Percentage of students going abroad for an erasmus exchange in the field of mathematics, science and technology in 2002/2003. Students leaving home country / total students in the same field of home country.

Numerator: Students leaving to study engineering and technology related subjects abroad within Erasmus. (only category corresponding to the denominator's)
Denominator: Number of graduates (ISCED 5-6) in mathematics, science and technology. The higher the better.

Source

(Numerator)
TABLE 1: ERASMUS STUDENT MOBILITY 2002/2003: Total number of students by country
Available (numerator):
http://europa.eu.int/comm/education/programmes/socrates/erasmus/statisti/stat14.pdf, p 3 (/7)
Last accessed: 5 Feb 2005

(Denominator)
Eurostat Online, Thu, 16 Dec 04 04:07:04
Available:
http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en

Notes

For denominator:
table edtertc Tertiary education graduates
indic_ed Graduates (ISCED 5-6) in science, mathematics and computing field (1000)

Overview of Eurostat tables Jan 2005:
http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html

Ww1	Qualification Certification

Definition

Percentage of asked experts claiming the statement "Occupational training certificates for production workers which can be acquired at any point of the professional career are developed throughout Europe" to be true <2015. The higher the better.

Source

This indicator has been calculated using the results from the first ManVis delphi survey, as presented at the Manufuture 2004 conference (www.manufuture.org). For detailed information contact the Fraunhofer ISI, department for Innovations in Production. www.isi.fraunhofer.de Year: 2004

Notes

In our calculations we have included (diverting from the results presented in the participants area of the ManVis portal and the results presented at the Manufuture 2004 conference) the "never" rate in the total base.

Ww2	Life Long Learning

Definition

Life-long learning refers to persons aged 25 to 64 who stated that they received education or training in the four weeks preceding the survey (numerator).

The denominator consists of the total population of the same age group, excluding those who did not answer to the question 'participation to education and training'.
The higher the better.

Source

Eurostat Online
Available:
http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=detailref&language=en&product=STRIND_EMPLOI&root=STRIND_EMPLOI/emploi/em051
Last accessed: 5 Feb 2005

Notes

Both the numerator and the denominator come from the EU Labour Force Survey. The information collected relates to all education or training whether or not relevant to the respondent's current or possible future job.
Values for 2003, too many values were "provisional" for 2004.

Ww3	Learning in the company
Definition	
Percentage of the asked experts claiming that the statement "A fixed part of working time is used for acquiring new competencies, using resources provided by the employer." will be true <2015. The higher the better.	
Source	
This indicator has been calculated using the results from the first ManVis delphi survey, as presented at the Manufuture 2004 conference (www.manufuture.org). For detailed information contact the Fraunhofer ISI, department for Innovations in Production. www.isi.fraunhofer.de Year: 2004	
Notes	
In our calculations we have included (diverting from the results presented in the participants area of the ManVis portal and the results presented at the Manufuture 2004 conference) the "never" rate in the total base.	

Ww4	Manufacturing enterprises offering CVT
Definition	
Percentage of manufacturing enterprises that offer Continuning Vocational Training. The higher the better.	
Source	
Eurostat Online, Sat, 5 Feb 05 10:28:20 (last accessed) http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en	
Notes	
table tent03n Training enterprises as % of all enterprises, by type of training and NACE / time 1999a00 / unit pc_tot Percentage of total / typtrai CVT courses Overview of Eurostat tables Jan 2005: http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html	

Ww5	Manufacturing employees participating in CVT
Definition	
Percentage of manufacturing employees participating in Continuing Vocational Training, as a percentage out of total. The higher the better.	
Source	
Eurostat Online, Thu, 18 Nov 04 03:35:50 http://europa.eu.int/comm/eurostat/newcronos/reference/display.do?screen=welcomeref&open=/&product=EU_MAIN_TREE&depth=1&language=en	
Notes	
table tpart01n Percentage of employees (all enterprises) participating in CVT courses, by sex and NACE / time 1999a00 / unit pc_tot Percentage of total / sex Total Overview of Eurostat tables Jan 2005: http://europa.eu.int/comm/eurostat/newcronos/reference/notes/en/table_of_contents.html	

Real indicator values - for definitions see appendices
(negative values indicates the relation "the lower the better")

estiamted with value for all industry instead of just for NACE D

n = not available

estimated with the country's value which had closest NRI index (Oi3)

Name		We1	We2	We3	We4	Wa1	Wa2	Wa3	Wa4	Wa5	Ww1	Ww2	Ww3	Ww4	Ww5	Wc1	Wc2	Wc3	Rl1	Rl2	Rl3	Rl4	Rr1	Rr2	Rr3
		3	4	5	6	10	11	12	13	14	16	17	18	19	20	21	22	23	26	27	28	29	30	31	32
		value	%	index	%	%	%	%	age	%	%	%	%	%	%	%	value	%	value	value	value	%	%	fractio	fractio
Austria	10	8.3	5.79	5.8	11.1%	-19%	30.4	21%	59.3	48%	78%	7.9	70%	71.0	28.0	6%	3.5	29.2	3.5	5.1	5.6	4.8%	33.9	0.7	1.1
Belgium	13	10.5	6.12	4.9	5.2%	-20%	28.1	33%	58.5	58%	86%	8.5	90%	48.0	42.0	33%	5.2	46.4	2.8	5.4	5.2	5.6%	22.8	0.6	1.6
Czech Rep.	18	6.4	4.16	5.8	5.7%	-26%	42.3	n	60.2	n	n	5.4	n	63.0	42.0	n	3.8	30.0	2.8	4.1	5.2	4.8%	14.4	0.5	0.8
Denmark	19	12.2	8.5	5.7	2.8%	-28%	60.2	45%	60.9	71%	40%	18.9	69%	86.0	47.0	14%	7.1	26.8	5.8	5.0	5.4	8.1%	10.3	0.8	1.8
Estonia	20	6.6	5.48	5.5	3.4%	-28%	52.3	10%	61.6	35%	54%	6.2	58%	46.0	14.0	14%	5.4	52.6	3.5	4.1	4.9	1.2%	5.8	0.6	0.2
Finland	21	17.4	6.24	6.4	5.9%	-28%	49.6	45%	60.5	38%	51%	17.6	68%	66.0	48.0	24%	9.9	29.2	3.8	6.1	6.1	2.6%	34.1	1.0	2.4
France	22	22.2	5.73	6.0	2.7%	-23%	36.8	26%	58.8	55%	69%	7.4	80%	72.0	43.0	41%	13.6	22.1	4.0	5.1	6.0	2.1%	22.5	0.8	1.4
Germany	23	8.4	4.57	5.5	3.8%	-24%	39.5	20%	60.7	55%	35%	6.0	56%	64.0	30.0	21%	4.0	20.8	3.8	5.1	6.0	6.9%	21.5	0.8	1.7
Greece	24	n	3.91	5.7	n	-28%	42.1	19%	59.4	52%	81%	3.7	75%	9.0	11.0	18%	n	30.8	3.3	3.9	3.9	5.7%	25.4	0.4	0.2
Hungary	25	4.8	5.15	6.2	2.8%	-22%	28.9	18%	59.2	45%	65%	6.0	83%	20.0	11.0	25%	2.6	34.1	5.5	4.8	5.0	8.4%	30.0	0.7	0.4
Italy	28	7.4	4.98	5.4	5.8%	-22%	30.3	33%	59.9	66%	65%	4.7	59%	22.0	20.0	18%	5.4	30.2	3.0	4.2	4.9	2.1%	30.6	0.6	0.6
Latvia	29	8.6	5.53	4.6	1.0%	-25%	44.1	n	62.4	n	n	8.1	n	24.0	10.0	n	6.6	58.0	2.3	3.7	4.5	1.0%	8.8	0.3	0.2
Lithuania	30	16.3	5.92	5.7	3.9%	-24%	44.7	n	58.9	n	n	4.5	n	20.0	9.0	n	11.8	58.1	3.0	3.3	4.5	14.0%	n	0.5	0.1
Netherlands	35	7.3	4.99	5.6	4.7%	-21%	44.8	58%	62.2	62%	84%	16.5	83%	82.0	40.0	15%	2.7	28.7	5.0	5.2	5.6	2.7%	31.1	0.8	1.0
Norway	36	9.3	7	n	3.4%	-27%	n	31%	62.5	51%	60%	21.3	64%	78.0	40.0	19%	5.1	32.7	1.8	n	n	3.8%	21.3	0.7	1.0
Poland	37	9	5.56	5.3	2.7%	-20%	26.9	22%	56.9	30%	63%	5.0	50%	22.0	17.0	26%	6.1	35.7	1.5	3.8	5.0	3.8%	5.1	0.5	0.1
Portugal	38	8.2	5.9	4.3	6.7%	-28%	51.1	n	62.9	n	n	3.7	n	9.0	14.0	n	6.9	46.3	4.0	3.8	4.4	4.5%	27.0	0.6	0.3
Romania	39	8.8	3.28	6.5	4.8%	-26%	38.1	45%	59.8	32%	76%	1.3	72%	8.0	8.0	45%	7.5	n	2.5	1.6	3.4	4.2%	7.4	0.2	0.2
Slovakia	42	8.3	4.03	6.4	2.2%	-17%	24.6	46%	57.5	68%	76%	4.8	72%	n	n	54%	5.8	34.9	2.0	4.6	5.0	4.9%	10.6	0.3	0.3
Slovenia	43	8.7	n	5.2	1.9%	-19%	23.5	40%	61.5	55%	74%	15.1	83%	39.0	37.0	34%	4.6	33.0	2.0	3.8	4.3	4.7%	21.3	0.6	0.9
Spain	44	12.2	4.41	5.6	6.0%	-20%	40.8	29%	61.5	39%	56%	5.8	55%	29.0	26.0	33%	7.7	41.8	4.0	4.2	5.3	2.7%	23.6	0.5	0.6
Sweden	45	13.9	7.31	6.0	4.3%	-31%	68.6	44%	63.2	46%	55%	34.2	65%	80.0	61.0	27%	9.7	35.6	4.0	5.7	5.7	4.0%	17.4	1.0	3.3
UK	49	19.5	4.69	5.3	0.5%	-25%	55.5	37%	62.3	55%	69%	21.3	79%	71.0	41.0	40%	13.2	36.7	4.0	4.9	6.0	2.3%	12.4	0.6	1.3

estiamted with value for all industry instead of just for NACE D

estimated with the country's value which had closest NRI index (Oi3)

Real indicator values - for definitions see appendices

(negative values indicates the relation "the lower the better")

Rr4	Rh1	Rh2	Rh3	Rh4	Ri1	Ri2	Ri3	Oi1	Oi2	Oi3	Oi4	Oe1	Oe2	Oe3	Oe4	Oe5	Oe6	Os1	Os2	Os3	Os4	Os5	On1	On2	On3			
33	34	35	36	37	38	39	40	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	67	68	69	72_b	72_c	
																	(ave 72_b & 72_c)									Sources: see Oe6		
%	value	index	%	%	value	valu	value	%	%	value	%	%	%	%	%	%	(index	%	%	%	%	%	%	value	%			
n	2.3	4.9	5.5	24%	74	6	6091	94	40	5.6	11	11%	0.8%	34	-6.6	37%	1.3	2.6%	7.4	35.5	7.5	67%	36%	12.7	3.1	-9	-29	Austria
4.9	2.5	7.0	5.2	29%	70	3	9793	96	15	5.8	23	17%	1.0%	38	-11.3	46%	1.2	13.2%	11.7	46.2	6.0	83%	33%	10.3	3.3	-7	-56	Belgium
1.5	1.0	2.9	4.4	25%	84	4	2960	91	9	4.7	11	n	2.1%	n	-11.7	37%	0.7	n	6.5	25.8	10.8	n	18%	6.0	1.2	-10	-88	Czech Republic
1.0	3.8	6.9	10.9	28%	28	7	6592	99	n	6.0	27	14%	0.7%	22	0.0	47%	1.9	5.9%	18.9	16.7	11.4	63%	48%	17.7	5.1	-4	-4	Denmark
2.4	1.8	3.8	7.4	23%	3	2	720	98	n	5.1	*9*	5%	1.0%	n	-14.9	30%	1.2	n	11.8	39.1	6.2	58%	36%	9.3	0.7	-6	-72	Estonia
3.9	2.0	13.8	9.5	30%	35	9	6583	88	22	6.5	20	30%	1.0%	28	-3.1	57%	1.7	21.9%	22.0	40.9	23.9	71%	52%	13.3	5.3	-4	-33	Finland
3.2	3.8	6.6	8.1	37%	196	5	26858	92	**6**	5.9	**20**	18%	0.8%	15	-3.0	57%	1.0	n	12.3	33.5	7.2	75%	29%	12.7	2.2	-10	-53	France
5.0	2.0	6.6	5.7	23%	152	8	32624	82	6	5.9	20	14%	1.0%	23	-5.9	38%	1.2	10.2%	9.4	55.1	7.5	65%	24%	13.7	2.4	-9	-45	Germany
2.2	2.3	3.3	4.1	n	56	6	9903	76	42	4.7	4	19%	2.9%	31	-69.6	57%	0.6	n	4.9	16.8	1.8	78%	18%	13.3	3.8	-16	-45	Greece
2.6	2.8	3.6	n	26%	17	5	2617	97	18	4.7	6	19%	1.4%	n	-64.3	17%	1.3	n	14.3	n	2.7	62%	29%	7.3	9.2	-5	-65	Hungary
3.0	2.5	2.8	4.6	41%	86	4	21435	75	26	4.9	2	45%	3.3%	24	-24.1	49%	1.4	3.1%	2.8	34.9	12.4	68%	17%	13.7	1.8	-9	-23	Italy
3.7	3.0	3.2	7.0	40%	18	4	421	85	n	4.6	*10*	n	0.8%	n	-14.7	35%	1.6	n	4.1	19.1	n	n	28%	11.0	0.6	-7	-11	Latvia
2.3	2.8	4.6	4.9	36%	21	3	950	*62*	6	4.8	4	n	0.6%	n	-6.3	27%	1.3	n	11.6	26.0	5.5	n	22%	16.7	11.7	-9	-26	Lithuania
3.1	1.0	5.2	n	21%	114	3	13796	n	12	5.8	19	49%	0.5%	25	-13.7	55%	1.6	3.4%	11.1	42.5	7.9	64%	35%	11.3	2.4	-7	-11	Netherlands
2.1	1.5	8.3	5.5	13%	51	6	5933	91	13	6.0	15	14%	0.4%	25	-3.9	59%	1.7	13.5%	12.6	32.3	3.1	58%	53%	14.7	5.3	-4	-24	Norway
2.3	1.0	3.3	4.9	32%	56	6	4470	90	n	4.5	*20*	30%	1.3%	n	-20.3	42%	1.1	n	3.8	4.1	3.3	52%	25%	16.0	8.5	-12	-31	Poland
2.9	2.0	3.5	5.6	44%	30	5	5677	77	53	4.9	7	n	2.6%	17	-12.5	35%	0.6	3.5%	6.1	35.5	11.4	n	13%	14.3	2.9	-11	-95	Portugal
1.6	4.5	1.7	3.3	n	29	6	1131	*41*	n	4.0	*4*	58%	0.6%	n	-11.9	n	1.6	n	2.5	n	10.9	59%	n	13.0	2.6	-6	-27	Romania
8.8	1.0	3.7	1.9	36%	19	7	1131	59	n	4.9	*15*	68%	1.4%	n	-10.2	36%	0.6	n	4.4	14.1	10.3	61%	20%	7.0	1.8	-10	-98	Slovakia
1.7	2.5	4.6	5.9	35%	52	10	1545	94	n	5.2	17	35%	1.3%	n	-15.5	27%	0.7	n	9.8	22.0	7.7	75%	22%	14.0	4.2	-10	-91	Slovenia
1.9	2.5	4.5	6.5	40%	148	5	17318	85	27	5.3	3	19%	1.9%	23	-18.7	53%	0.4	7.6%	3.2	29.1	8.3	65%	36%	15.7	4.7	-11	-115	Spain
n	3.0	10.1	3.1	28%	81	5	8701	97	17	6.4	25	21%	0.9%	32	-0.8	51%	1.9	8.0%	14.1	35.5	n	69%	31%	10.3	1.6	-3	-16	Sweden
2.6	3.0	5.5	10.2	33%	107	6	27708	94	1	5.8	40	7%	0.8%	26	-1.0	55%	1.6	n	8.1	24.8	2.2	71%	52%	10.0	1.3	-6	-18	United Kingdom

Indicator values - normalised [0,1] n = not available/ confidential

Country	We1	We2	We3	We4	Wa1	Wa2	Wa3	Wa4	Wa5	Ww1	Ww2	Ww3	Ww4	Ww5	Wc1	Wc2	Wc3	Rl1	Rl2	Rl3	Rl4	Rr1	Rr2	Rr3	Rr4	Rh1
Austria	0.20	0.48	0.68	1.00	0.88	0.15	0.23	0.38	0.44	0.84	0.20	0.50	0.81	0.38	0.00	0.08	0.23	0.47	0.78	0.81	0.29	0.99	0.56	0.31	n	0.37
Belgium	0.33	0.54	0.27	0.44	0.83	0.10	0.48	0.25	0.69	1.00	0.22	1.00	0.51	0.64	0.57	0.24	0.69	0.30	0.84	0.67	0.35	0.61	0.47	0.47	0.51	0.43
Czech Rep.	0.09	0.17	0.68	0.49	0.37	0.42	n	0.52	n	n	0.12	n	0.71	0.64	n	0.11	0.25	0.30	0.56	0.67	0.29	0.32	0.36	0.19	0.07	0.00
Denmark	0.43	1.00	0.64	0.22	0.25	0.81	0.73	0.63	1.00	0.10	0.53	0.48	1.00	0.74	0.18	0.41	0.16	1.00	0.76	0.74	0.55	0.18	0.70	0.51	0.00	0.80
Estonia	0.10	0.42	0.55	0.27	0.25	0.64	0.00	0.75	0.12	0.38	0.15	0.21	0.49	0.11	0.18	0.25	0.85	0.47	0.56	0.56	0.01	0.02	0.45	0.03	0.18	0.23
Finland	0.72	0.57	0.95	0.51	0.26	0.58	0.73	0.57	0.20	0.32	0.50	0.46	0.74	0.75	0.39	0.66	0.23	0.53	1.00	1.00	0.12	1.00	1.00	0.70	0.38	0.29
France	1.00	0.47	0.77	0.20	0.61	0.29	0.33	0.30	0.63	0.68	0.19	0.75	0.82	0.66	0.73	1.00	0.03	0.58	0.78	0.96	0.08	0.60	0.76	0.39	0.28	0.80
Germany	0.21	0.25	0.55	0.32	0.49	0.35	0.21	0.60	0.63	0.00	0.14	0.16	0.72	0.42	0.31	0.13	0.00	0.53	0.78	0.96	0.45	0.56	0.70	0.50	0.52	0.29
Greece	n	0.12	0.64	n	0.25	0.41	0.18	0.40	0.53	0.92	0.07	0.63	0.01	0.06	0.25	n	0.27	0.42	0.51	0.19	0.36	0.70	0.31	0.03	0.16	0.37
Hungary	0.00	0.36	0.86	0.22	0.67	0.12	0.16	0.37	0.36	0.59	0.14	0.83	0.15	0.06	0.41	0.00	0.36	0.93	0.71	0.59	0.57	0.86	0.57	0.07	0.21	0.51
Italy	0.15	0.33	0.50	0.50	0.64	0.15	0.47	0.48	0.90	0.59	0.10	0.23	0.18	0.23	0.25	0.25	0.25	0.35	0.58	0.56	0.08	0.88	0.45	0.13	0.26	0.43
Latvia	0.22	0.43	0.14	0.05	0.47	0.46	n	0.87	n	n	0.21	n	0.21	0.04	n	0.36	1.00	0.19	0.47	0.41	0.00	0.13	0.11	0.01	0.34	0.57
Lithuania	0.66	0.51	0.64	0.32	0.54	0.47	n	0.32	n	n	0.10	n	0.15	0.02	n	0.84	1.00	0.35	0.38	0.41	1.00	n	0.44	0.00	0.17	0.51
Netherlands	0.14	0.33	0.59	0.39	0.72	0.47	1.00	0.84	0.80	0.96	0.46	0.83	0.95	0.60	0.20	0.01	0.21	0.81	0.80	0.81	0.13	0.90	0.72	0.28	0.27	0.00
Norway	0.26	0.71	n	0.28	0.30	n	0.43	0.89	0.52	0.49	0.61	0.35	0.90	0.60	0.28	0.23	0.32	0.07	n	n	0.21	0.56	0.63	0.26	0.14	0.14
Poland	0.24	0.44	0.45	0.21	0.78	0.08	0.24	0.00	0.00	0.56	0.11	0.00	0.18	0.17	0.42	0.32	0.40	0.00	0.49	0.59	0.21	0.00	0.35	0.00	0.17	0.00
Portugal	0.20	0.50	0.00	0.59	0.27	0.61	n	0.95	n	n	0.07	n	0.01	0.11	n	0.39	0.68	0.58	0.49	0.37	0.26	0.75	0.52	0.06	0.24	0.29
Romania	0.23	0.00	1.00	0.41	0.40	0.32	0.73	0.46	0.05	0.81	0.00	0.54	0.00	0.00	0.81	0.45	n	0.23	0.00	0.00	0.24	0.08	0.00	0.03	0.09	1.00
Slovakia	0.20	0.14	0.95	0.16	1.00	0.02	0.74	0.10	0.95	0.81	0.11	0.54	n	n	1.00	0.29	0.38	0.12	0.67	0.59	0.30	0.19	0.12	0.06	1.00	0.00
Slovenia	0.22	n	0.41	0.13	0.88	0.00	0.61	0.73	0.61	0.76	0.42	0.83	0.40	0.55	0.58	0.18	0.33	0.12	0.49	0.33	0.28	0.56	0.53	0.24	0.10	0.43
Spain	0.43	0.22	0.59	0.52	0.80	0.38	0.38	0.73	0.23	0.40	0.14	0.14	0.27	0.34	0.57	0.46	0.56	0.58	0.58	0.70	0.13	0.64	0.36	0.13	0.12	0.43
Sweden	0.52	0.77	0.77	0.36	0.00	1.00	0.70	1.00	0.38	0.38	1.00	0.39	0.92	1.00	0.44	0.65	0.40	0.58	0.91	0.85	0.23	0.42	0.90	1.00	n	0.57
UK	0.84	0.27	0.45	0.00	0.44	0.71	0.55	0.86	0.61	0.67	0.61	0.74	0.81	0.62	0.71	0.96	0.43	0.58	0.73	0.96	0.09	0.25	0.52	0.35	0.21	0.57
Countries per ind.:	22	22	22	22	23	22	19	23	19	19	23	19	22	22	19	22	22	23	22	22	23	22	23	23	21	23

Indicator values - normalised [0,1] n = not available/ confidential

Rh2	Rh3	Rh4	Ri1	Ri2	Ri3	Oi1	Oi2	Oi3	Oi4	Oe1	Oe2	Oe3	Oe4	Oe5	Oe6	Os1	Os2	Os3	Os4	Os5	On1	On2	On3	Available Ind.	Country
0.26	0.40	0.36	0.37	0.50	0.18	0.91	0.75	0.63	0.24	0.09	0.15	0.83	0.91	0.48	0.60	0.00	0.25	0.62	0.26	0.46	0.58	0.57	0.23	49	Austria
0.43	0.37	0.51	0.35	0.13	0.29	0.95	0.27	0.72	0.55	0.18	0.22	1.00	0.84	0.70	0.55	0.55	0.47	0.83	0.19	1.00	0.51	0.37	0.24	50	Belgium
0.10	0.28	0.39	0.42	0.25	0.08	0.86	0.15	0.29	0.24	n	0.60	n	0.83	0.48	0.21	n	0.20	0.43	0.41	n	0.13	0.00	0.05	41	Czech Rep.
0.43	1.00	0.47	0.13	0.63	0.19	1.00	n	0.81	0.66	0.14	0.12	0.30	1.00	0.72	1.00	0.17	0.84	0.25	0.43	0.33	0.88	1.00	0.40	49	Denmark
0.18	0.61	0.30	0.00	0.00	0.01	0.98	n	0.45	0.18	0.00	0.21	n	0.79	0.32	0.50	n	0.48	0.69	0.20	0.20	0.59	0.29	0.01	47	Estonia
1.00	0.84	0.53	0.17	0.88	0.19	0.81	0.40	1.00	0.47	0.40	0.22	0.57	0.96	0.94	0.83	1.00	1.00	0.72	1.00	0.60	0.97	0.63	0.42	50	Finland
0.40	0.69	0.78	1.00	0.38	0.82	0.88	0.10	0.76	0.47	0.21	0.14	0.00	0.96	0.94	0.41	n	0.50	0.58	0.24	0.74	0.42	0.57	0.15	49	France
0.40	0.43	0.31	0.77	0.75	1.00	0.71	0.10	0.78	0.47	0.13	0.21	0.35	0.92	0.50	0.51	0.39	0.35	1.00	0.26	0.41	0.29	0.66	0.16	50	Germany
0.13	0.24	n	0.27	0.50	0.29	0.60	0.79	0.30	0.05	0.22	0.88	0.70	0.00	0.94	0.16	n	0.13	0.25	0.00	0.82	0.13	0.63	0.28	45	Greece
0.16	n	0.39	0.07	0.38	0.07	0.97	0.33	0.29	0.11	0.21	0.36	n	0.08	0.00	0.59	n	0.61	n	0.04	0.32	0.41	0.11	0.78	46	Hungary
0.09	0.29	0.90	0.43	0.25	0.65	0.59	0.48	0.37	0.00	0.64	1.00	0.39	0.65	0.76	0.64	0.02	0.01	0.60	0.48	0.51	0.11	0.66	0.11	50	Italy
0.12	0.56	0.86	0.08	0.25	0.00	0.76	n	0.26	0.21	n	0.13	n	0.79	0.44	0.81	n	0.08	0.29	n	n	0.37	0.43	0.00	39	Latvia
0.24	0.33	0.74	0.09	0.13	0.02	0.36	0.10	0.32	0.05	n	0.08	n	0.91	0.25	0.62	n	0.47	0.43	0.17	n	0.24	0.91	1.00	40	Lithuania
0.29	n	0.23	0.58	0.13	0.42	n	0.21	0.71	0.45	0.70	0.05	0.43	0.80	0.90	0.81	0.04	0.44	0.75	0.27	0.36	0.55	0.46	0.16	48	Netherlands
0.55	0.40	0.00	0.25	0.50	0.17	0.86	0.23	0.79	0.34	0.14	0.00	0.43	0.94	1.00	0.88	0.57	0.52	0.55	0.06	0.18	1.00	0.74	0.43	46	Norway
0.13	0.33	0.62	0.27	0.50	0.13	0.84	n	0.20	0.47	0.39	0.33	n	0.71	0.59	0.44	n	0.07	0.00	0.07	0.00	0.30	0.86	0.71	47	Poland
0.15	0.40	1.00	0.14	0.38	0.16	0.62	1.00	0.36	0.13	n	0.77	0.09	0.82	0.44	0.12	0.05	0.18	0.62	0.44	n	0.00	0.71	0.20	43	Portugal
0.00	0.16	n	0.13	0.50	0.02	0.00	n	0.00	0.05	0.85	0.06	n	0.83	n	0.77	n	0.00	n	0.41	0.23	n	0.60	0.18	42	Romania
0.16	0.00	0.74	0.08	0.63	0.02	0.32	n	0.38	0.34	1.00	0.36	n	0.85	0.46	0.15	n	0.10	0.20	0.38	0.29	0.18	0.09	0.11	45	Slovakia
0.24	0.45	0.69	0.25	1.00	0.03	0.91	n	0.50	0.39	0.48	0.32	n	0.78	0.23	0.19	n	0.38	0.35	0.27	0.72	0.24	0.69	0.33	46	Slovenia
0.23	0.51	0.86	0.75	0.38	0.52	0.76	0.50	0.52	0.03	0.22	0.51	0.35	0.73	0.86	0.00	0.26	0.04	0.49	0.29	0.42	0.58	0.83	0.37	50	Spain
0.70	0.13	0.48	0.40	0.38	0.26	0.97	0.31	0.94	0.61	0.25	0.16	0.74	0.99	0.80	0.98	0.28	0.59	0.62	n	0.55	0.47	0.37	0.09	48	Sweden
0.31	0.92	0.64	0.54	0.50	0.85	0.91	0.00	0.72	1.00	0.02	0.14	0.48	0.99	0.91	0.82	n	0.29	0.41	0.02	0.62	0.98	0.34	0.06	49	UK
23	21	21	23	23	23	22	16	23	23	19	23	14	23	22	23	11	23	21	21	19	22	23	23		

Foci values - average of a country's indicator values

Key Area Values - ave. Foci values

Country	WE	WA	WW	WC	RL	RR	RH	RI	OI	OE	OS	ON	W	R	O	Composite Capability Index
Austria	0.591	0.418	0.546	0.102	0.588	0.623	0.347	0.348	0.632	0.510	0.316	0.459	*0.414*	0.477	**0.479**	0.457
Belgium	0.396	0.471	0.675	0.499	0.542	0.516	0.435	0.254	0.622	0.582	0.608	0.375	0.510	*0.437*	**0.547**	0.498
Czech Rep.	0.358	0.437	0.490	0.178	0.453	0.236	0.192	0.250	0.386	0.531	0.345	0.061	**0.366**	*0.283*	0.331	0.326
Denmark	0.571	0.686	0.570	0.249	0.761	0.346	0.675	0.315	0.824	0.548	0.405	0.762	*0.519*	0.524	**0.635**	0.559
Estonia	0.336	0.350	0.269	0.427	0.397	0.171	0.328	0.003	0.541	0.362	0.390	0.293	0.346	*0.225*	**0.397**	0.322
Finland	0.689	0.468	0.555	0.425	0.664	0.770	0.664	0.411	0.672	0.652	0.864	0.673	*0.534*	0.627	**0.715**	0.626
France	0.612	0.433	0.619	0.589	0.601	0.508	0.666	0.732	0.553	0.443	0.516	0.378	0.563	**0.627**	*0.472*	0.554
Germany	0.329	0.457	0.287	0.145	0.682	0.571	0.356	0.841	0.515	0.436	0.482	0.370	*0.304*	**0.612**	0.451	0.456
Greece	0.379	0.353	0.337	0.260	0.368	0.300	0.248	0.356	0.436	0.483	0.299	0.349	0.332	*0.318*	**0.392**	0.347
Hungary	0.360	0.336	0.354	0.255	0.701	0.428	0.355	0.172	0.422	0.249	0.323	0.433	*0.326*	**0.414**	0.357	0.366
Italy	0.370	0.526	0.265	0.252	0.390	0.429	0.428	0.444	0.359	0.680	0.325	0.293	*0.353*	**0.423**	0.414	0.397
Latvia	0.209	0.601	0.150	0.680	0.265	0.149	0.529	0.109	0.411	0.543	0.188	0.267	**0.410**	*0.263*	0.352	0.342
Lithuania	0.532	0.443	0.090	0.918	0.534	0.204	0.456	0.078	0.208	0.466	0.354	0.717	0.496	*0.318*	**0.436**	0.417
Netherlands	0.364	0.766	0.761	0.140	0.638	0.542	0.175	0.372	0.455	0.617	0.375	0.392	**0.508**	0.432	*0.460*	0.466
Norway	0.415	0.534	0.591	0.275	0.141	0.397	0.274	0.307	0.557	0.568	0.376	0.723	0.454	*0.280*	**0.556**	0.430
Poland	0.336	0.219	0.203	0.379	0.324	0.131	0.268	0.300	0.505	0.491	0.033	0.621	0.284	*0.256*	**0.413**	0.318
Portugal	0.321	0.612	0.066	0.537	0.426	0.394	0.460	0.226	0.529	0.448	0.321	0.306	0.384	*0.376*	**0.401**	0.387
Romania	0.410	0.392	0.271	0.629	0.119	0.049	0.387	0.219	0.018	0.627	0.214	0.391	**0.425**	*0.193*	0.312	0.310
Slovakia	0.364	0.562	0.487	0.556	0.419	0.342	0.226	0.243	0.345	0.564	0.242	0.126	**0.492**	*0.307*	0.319	0.373
Slovenia	0.254	0.567	0.591	0.364	0.305	0.358	0.452	0.430	0.602	0.400	0.429	0.418	0.444	*0.386*	**0.462**	0.431
Spain	0.437	0.505	0.258	0.534	0.498	0.312	0.507	0.550	0.452	0.445	0.300	0.592	*0.433*	**0.467**	0.447	0.449
Sweden	0.608	0.617	0.739	0.494	0.642	0.775	0.469	0.345	0.706	0.653	0.509	0.310	**0.614**	0.558	*0.544*	0.572
UK	0.392	0.633	0.688	0.701	0.593	0.333	0.610	0.629	0.657	0.559	0.332	0.462	**0.604**	0.541	*0.502*	0.549
Ave - 23	0.419	0.495	0.429	0.417	0.480	0.386	0.413	0.345	0.496	0.516	0.372	0.425	0.440	*0.406*	0.452	0.433

Indicator contributory values to a countries composite capability index

* 10^-3	We1	We2	We3	We4	Wa1	Wa2	Wa3	Wa4	Wa5	Ww1	Ww2	Ww3	Ww4	Ww5	Wc1	Wc2	Wc3	Rl1	Rl2	Rl3	Rl4	Rr1	Rr2	Rr3	Rr4
Ind.	3	4	5	6	10	11	12	13	14	16	17	18	19	20	21	22	23	26	27	28	29	30	31	32	33
Austria	4.2	10.0	14.2	**20.8**	14.7	2.5	3.8	6.3	7.4	14.1	3.3	8.4	13.5	6.3	*0.0*	*2.3*	6.3	9.7	**16.2**	**17.0**	6.1	**27.6**	15.6	8.7	n
Belgium	6.8	11.3	5.7	9.2	13.8	*1.7*	8.1	4.2	11.5	**16.7**	3.6	**16.7**	8.5	10.7	16.0	6.6	**19.1**	6.3	**17.6**	13.9	7.4	12.7	9.8	9.9	10.5
Czech Republic	*1.9*	3.5	14.2	10.2	10.2	11.6	n	**14.6**	n	n	3.5	n	**19.6**	**17.8**	n	4.5	10.3	6.3	11.6	13.9	6.0	6.7	7.5	4.0	*1.4*
Denmark	8.9	**20.8**	13.3	4.6	4.1	13.6	12.2	10.6	16.7	*1.6*	8.9	8.0	16.7	12.3	4.9	11.4	4.5	**20.8**	15.7	15.4	11.4	3.7	14.5	10.6	*0.0*
Estonia	2.2	8.8	11.4	5.7	4.2	10.6	*0.0*	12.4	1.9	6.4	2.5	3.5	8.1	1.9	4.9	7.1	**23.7**	9.7	11.6	11.6	0.2	0.5	9.4	0.6	3.8
Finland	15.1	11.8	19.9	10.6	*4.3*	9.6	12.2	9.5	*3.3*	5.4	8.3	7.6	12.4	12.6	10.8	18.4	6.3	11.1	**20.8**	**20.8**	*2.5*	**20.8**	**20.8**	14.6	7.9
France	**20.8**	9.8	16.1	4.3	10.2	4.9	5.5	5.0	10.4	11.3	3.1	12.5	13.7	11.0	**20.4**	**27.8**	*1.0*	12.1	16.2	20.1	*1.7*	12.5	15.9	8.0	5.9
Germany	4.3	5.1	11.4	6.6	8.2	5.9	3.5	10.1	10.4	*0.0*	*2.4*	2.7	12.0	6.9	8.5	3.5	*0.0*	11.1	16.2	**20.1**	9.4	11.8	14.5	10.4	10.8
Greece	n	5.0	**26.5**	n	4.1	6.9	3.0	6.6	8.9	**15.3**	1.2	10.4	*0.2*	*0.9*	10.5	n	11.2	8.7	10.6	3.9	7.5	14.6	6.6	*0.5*	3.4
Hungary	*0.0*	7.5	**18.0**	4.6	11.2	2.0	2.7	6.1	6.0	9.8	2.4	13.8	2.6	*0.9*	11.4	*0.0*	9.9	**19.4**	14.8	12.3	11.9	**17.9**	11.9	1.5	4.3
Italy	3.1	6.8	10.4	10.5	10.7	2.5	7.8	7.9	**14.9**	9.8	*1.7*	3.9	3.0	3.8	7.0	7.1	7.0	7.3	12.0	11.6	*1.6*	**18.3**	9.4	2.7	5.3
Latvia	4.5	9.0	2.8	1.1	13.2	12.7	n	**24.3**	n	n	5.7	n	5.7	*1.0*	n	15.2	**41.6**	3.9	9.7	8.5	*0.0*	2.7	2.3	*0.3*	7.2
Lithuania	13.8	10.5	13.3	6.7	15.0	13.1	n	8.8	n	n	2.7	n	4.3	*0.5*	n	**34.8**	**41.7**	7.3	7.9	8.5	**20.8**	n	12.2	*0.1*	4.7
Netherlands	3.0	6.8	12.3	8.2	12.0	7.9	**16.7**	14.0	13.3	16.0	7.7	13.9	15.8	10.1	5.5	*0.3*	5.9	**17.0**	**16.7**	**17.0**	*2.6*	**18.7**	15.0	5.9	5.7
Norway	7.2	**19.8**	n	7.6	6.2	n	9.0	**18.5**	10.9	8.2	10.1	5.9	15.0	10.1	7.8	6.3	8.9	*2.9*	n	n	8.8	11.6	13.1	5.4	2.9
Poland	5.0	9.1	9.5	4.4	13.0	1.3	4.1	*0.0*	*0.0*	9.3	1.9	*0.0*	3.0	2.8	11.6	8.8	11.1	*0.0*	10.2	12.3	4.5	*0.0*	7.3	*0.0*	3.6
Portugal	4.1	10.5	*0.0*	12.3	7.5	17.0	n	**26.5**	n	n	2.0	n	*0.4*	3.1	n	16.3	**28.5**	12.1	10.2	7.7	5.5	15.7	10.8	*1.2*	5.1
Romania	4.8	*0.0*	**20.8**	8.5	6.6	5.4	12.2	7.7	0.8	13.5	*0.0*	9.1	*0.0*	*0.0*	**33.8**	**18.6**	n	4.8	*0.0*	*0.0*	5.0	1.7	*0.0*	0.7	1.8
Slovakia	4.2	3.0	**19.9**	3.3	16.7	*0.4*	12.4	1.6	15.8	**22.5**	3.0	15.1	n	n	**27.8**	8.1	10.5	2.4	13.9	12.3	6.2	3.9	2.6	*1.2*	**20.8**
Slovenia	6.2	n	11.4	3.6	14.6	*0.0*	10.2	12.2	10.2	12.7	7.0	13.9	6.6	9.1	**16.2**	5.1	9.1	*2.4*	10.2	6.9	5.8	11.7	11.0	5.1	*2.1*
Spain	8.9	4.5	12.3	10.7	13.3	6.4	6.4	12.2	3.8	6.7	*2.3*	*2.3*	4.5	5.7	**16.0**	12.9	15.6	12.1	12.0	14.7	2.7	13.3	7.5	2.8	2.4
Sweden	10.9	16.1	16.1	7.6	*0.0*	16.7	11.7	16.7	6.4	6.4	16.7	6.4	15.4	16.7	12.2	17.9	11.0	12.1	**19.0**	17.7	4.7	11.8	**25.0**	**27.8**	n
United Kingdom	17.6	5.6	9.5	*0.0*	7.3	11.8	9.2	14.3	10.2	11.1	10.1	12.3	13.5	10.4	19.8	**26.8**	11.8	12.1	15.3	**20.1**	2.0	5.3	10.8	7.4	4.3

For each country: **Top-5 indicator** *Bottom-5 indicator* n = not available For each country:

Appendix F

Rh1	Rh2	Rh3	Rh4	Ri1	Ri2	Ri3	Oi1	Oi2	Oi3	Oi4	Oe1	Oe2	Oe3	Oe4	Oe5	Oe6	Os1	Os2	Os3	Os4	Os5	On1	On2	On3	
34	35	36	37	38	39	40	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	67	68	69	
7.7	5.5	8.3	7.4	10.2	13.9	4.9	**19.0**	15.6	13.1	4.9	*1.3*	*2.1*	11.5	12.6	6.7	8.4	*0.0*	4.1	10.3	4.3	7.7	16.0	15.9	6.3	Austria
8.9	9.1	7.6	10.7	9.6	*3.5*	8.1	**19.8**	5.6	15.0	11.5	*2.5*	*3.1*	13.9	11.6	9.7	7.6	9.2	7.9	13.8	*3.1*	**16.7**	14.2	10.3	6.7	Belgium
0.0	2.1	5.8	8.1	11.7	6.9	2.2	**18.0**	3.2	6.1	4.9	n	12.6	n	**17.3**	10.0	4.3	n	5.7	11.8	11.3	n	3.7	*0.0*	*1.4*	Czech Republic
16.7	8.9	**20.8**	9.9	3.6	17.4	5.3	**27.8**	n	**22.6**	18.3	*2.0*	*1.6*	4.2	13.9	10.0	13.9	*2.9*	14.0	4.1	7.2	5.5	**24.5**	**27.8**	11.2	Denmark
4.8	3.7	12.7	6.2	*0.0*	*0.0*	0.3	**27.3**	n	12.6	5.1	*0.0*	3.5	n	**13.1**	5.3	8.4	n	9.9	**14.3**	4.2	4.1	**16.3**	7.9	*0.2*	Estonia
6.0	**20.8**	17.6	11.0	*4.6*	**24.3**	5.3	16.9	8.4	**20.8**	9.9	5.5	*3.1*	7.9	13.3	13.1	11.5	16.7	16.7	12.0	16.7	9.9	**26.9**	17.5	11.7	Finland
16.7	8.4	14.3	16.2	**27.8**	10.4	**22.8**	18.3	*2.0*	15.9	9.9	2.9	*2.0*	*0.0*	13.3	13.0	5.7	n	10.5	12.0	5.1	15.5	11.6	15.9	4.0	France
6.0	8.4	8.9	6.5	**21.4**	**20.8**	**27.8**	14.7	*2.0*	16.3	9.9	*1.8*	2.9	4.8	12.7	6.9	7.1	6.5	5.9	16.7	4.3	6.9	8.1	**18.3**	4.5	Germany
10.3	3.7	6.7	n	7.6	13.9	8.2	12.6	**16.4**	6.3	1.1	3.1	12.2	9.7	*0.0*	13.0	2.2	n	2.6	5.2	*0.0*	**17.1**	3.7	**17.5**	7.9	Greece
14.3	4.4	n	11.0	2.0	10.4	1.9	**20.1**	6.8	6.0	2.2	3.5	6.1	n	1.3	*0.0*	9.9	n	16.9	n	*1.1*	8.9	11.3	3.2	**21.6**	Hungary
8.9	1.9	6.1	**18.7**	11.9	6.9	**18.1**	12.2	10.0	7.7	*0.0*	8.9	13.9	5.4	9.1	10.6	8.9	*0.4*	*0.2*	10.1	8.0	8.5	3.0	**18.3**	3.1	Italy
11.9	2.5	11.7	**18.0**	2.2	6.9	*0.0*	**21.1**	n	7.4	5.8	n	2.8	n	16.4	9.2	**16.9**	n	3.4	12.3	n	n	10.4	11.9	*0.0*	Latvia
10.7	4.9	6.9	15.5	2.6	3.5	*0.5*	7.5	2.0	6.7	*1.1*	n	*1.7*	n	18.9	5.2	12.9	n	12.9	11.9	4.7	n	6.5	**25.4**	**27.8**	Lithuania
0.0	8.1	n	6.5	16.0	3.5	11.5	n	5.9	**19.7**	12.4	9.8	*0.7*	6.0	11.2	12.6	11.2	*0.7*	7.3	12.5	4.6	6.1	15.4	12.7	4.6	Netherlands
3.0	11.5	8.4	*0.0*	6.9	13.9	4.8	**18.0**	4.8	16.6	7.1	*2.0*	*0.0*	6.0	13.1	13.9	12.3	9.4	8.6	9.2	*1.0*	3.1	**27.8**	**20.6**	11.9	Norway
0.0	2.7	6.9	12.8	7.6	**13.9**	3.5	**23.5**	n	5.5	**13.2**	6.5	5.5	n	11.8	9.8	7.4	n	1.4	*0.0*	1.4	*0.0*	8.3	**23.8**	**19.6**	Poland
6.0	3.1	8.4	**20.8**	3.9	10.4	4.5	12.9	**20.8**	7.6	2.7	n	12.9	1.4	13.7	7.4	2.0	*1.0*	3.8	12.8	9.1	n	*0.0*	**19.8**	5.6	Portugal
27.8	*0.0*	4.4	n	3.7	13.9	0.6	*0.0*	n	*0.0*	1.5	17.7	1.3	n	17.3	n	15.9	n	*0.0*	n	11.5	6.4	n	**25.0**	7.5	Romania
0.0	3.4	*0.0*	15.5	2.3	**17.4**	*0.6*	8.8	n	10.4	9.5	16.7	6.0	n	14.2	7.6	2.5	n	2.0	4.1	8.0	6.1	5.0	2.4	3.1	Slovakia
8.9	5.1	9.3	14.3	7.1	**27.8**	*1.0*	**25.4**	n	13.8	11.0	8.0	5.3	n	13.0	3.9	*3.2*	n	7.9	7.3	5.6	**15.0**	6.7	**19.0**	9.1	Slovenia
8.9	4.9	10.6	**17.8**	**20.9**	10.4	14.6	15.8	10.4	10.9	*0.5*	3.1	7.1	4.8	10.2	11.9	*0.0*	4.3	*0.6*	8.2	4.9	7.0	**16.1**	**23.0**	10.3	Spain
11.9	14.5	*2.7*	10.0	11.2	10.4	7.1	**20.1**	6.4	**19.7**	12.6	*3.5*	*2.3*	10.3	13.7	11.1	13.6	5.8	12.4	12.8	n	11.4	12.9	10.3	*2.6*	Sweden
11.9	6.5	19.2	13.2	15.0	13.9	**23.5**	19.0	*0.0*	14.9	**20.8**	*0.3*	2.0	6.6	13.7	12.6	11.4	n	6.0	8.5	*0.3*	12.8	**27.3**	9.5	*1.7*	United Kingdom

Top-5 indicator *Bottom-5 indicator* n = not available

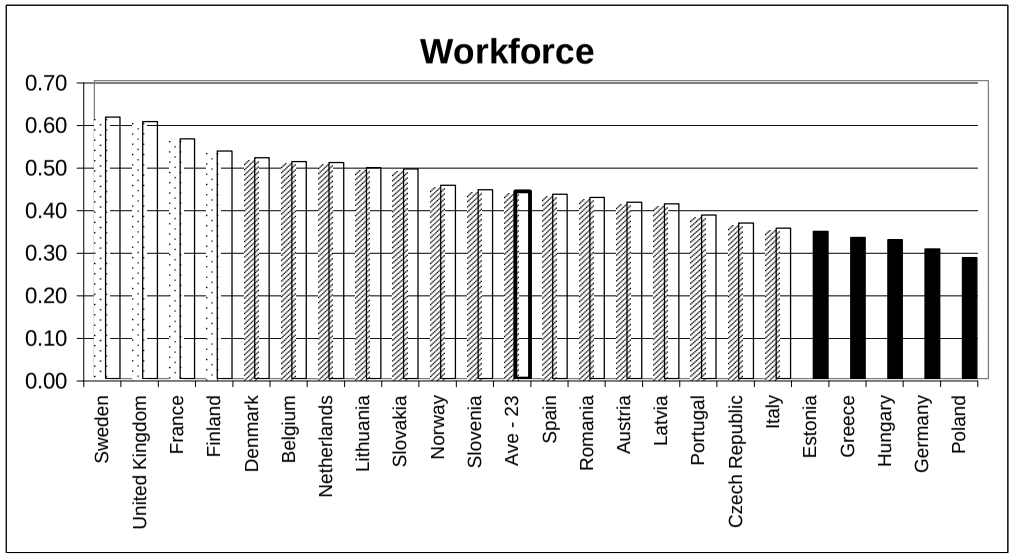
Countries' foci results compared to Ave-23

	WE	WA	WW	WC	RL	RR	RH	RI	OI	OE	OS	ON
Austria	**41%**	-16%	**27%**	*-75%*	**22%**	**61%**	-16%	1%	**27%**	-1%	-15%	8%
Belgium	-5%	-5%	**57%**	20%	13%	**33%**	5%	*-26%*	**25%**	13%	**64%**	-12%
Czech Republic	-15%	-12%	14%	*-57%*	-6%	*-39%*	*-53%*	*-28%*	*-22%*	3%	-7%	*-86%*
Denmark	**36%**	**38%**	**33%**	*-40%*	**58%**	-10%	**63%**	-9%	**66%**	6%	9%	**79%**
Estonia	-20%	*-29%*	*-37%*	3%	-17%	*-56%*	*-21%*	*-99%*	9%	*-30%*	5%	*-31%*
Finland	**65%**	-6%	**29%**	2%	**38%**	**99%**	**61%**	19%	**35%**	**27%**	**132%**	**58%**
France	**46%**	-13%	**44%**	**41%**	**25%**	**32%**	**61%**	**112%**	11%	-14%	**39%**	-11%
Germany	*-22%*	-8%	*-33%*	*-65%*	**42%**	**48%**	-14%	**144%**	4%	-16%	**30%**	-13%
Greece	-10%	*-29%*	*-21%*	*-38%*	*-23%*	*-22%*	*-40%*	3%	-12%	-6%	-20%	-18%
Hungary	-14%	*-32%*	-18%	*-39%*	**46%**	11%	-14%	*-50%*	-15%	*-52%*	-13%	2%
Italy	-12%	6%	*-38%*	*-39%*	-19%	11%	4%	**29%**	*-28%*	**32%**	-12%	*-31%*
Latvia	*-50%*	**21%**	*-65%*	**63%**	*-45%*	*-61%*	**28%**	*-68%*	-17%	5%	*-49%*	*-37%*
Lithuania	**27%**	-10%	*-79%*	**120%**	11%	*-47%*	10%	*-77%*	*-58%*	-10%	-5%	**69%**
Netherlands	-13%	**55%**	**77%**	*-66%*	**33%**	**40%**	*-58%*	8%	-8%	20%	1%	-8%
Norway	-1%	8%	**38%**	*-34%*	*-71%*	3%	*-34%*	-11%	12%	10%	1%	**70%**
Poland	-20%	*-56%*	*-53%*	-9%	*-33%*	*-66%*	*-35%*	-13%	2%	-5%	*-91%*	**46%**
Portugal	*-23%*	**24%**	*-85%*	**29%**	-11%	2%	11%	*-34%*	7%	-13%	-14%	*-28%*
Romania	-2%	*-21%*	*-37%*	**51%**	*-75%*	*-87%*	-7%	*-37%*	*-96%*	**22%**	*-42%*	-8%
Slovakia	-13%	14%	14%	**33%**	-13%	-11%	*-45%*	*-29%*	*-30%*	9%	*-35%*	*-70%*
Slovenia	*-39%*	15%	**38%**	-13%	*-37%*	-7%	9%	**25%**	**21%**	*-22%*	15%	-2%
Spain	4%	2%	*-40%*	**28%**	4%	-19%	**23%**	**60%**	-9%	-14%	-19%	**39%**
Sweden	**45%**	**25%**	**72%**	19%	**34%**	**101%**	13%	0%	**42%**	**27%**	**37%**	*-27%*
United Kingdom	-6%	**28%**	**60%**	**68%**	**23%**	-14%	**48%**	**82%**	**33%**	8%	-11%	9%

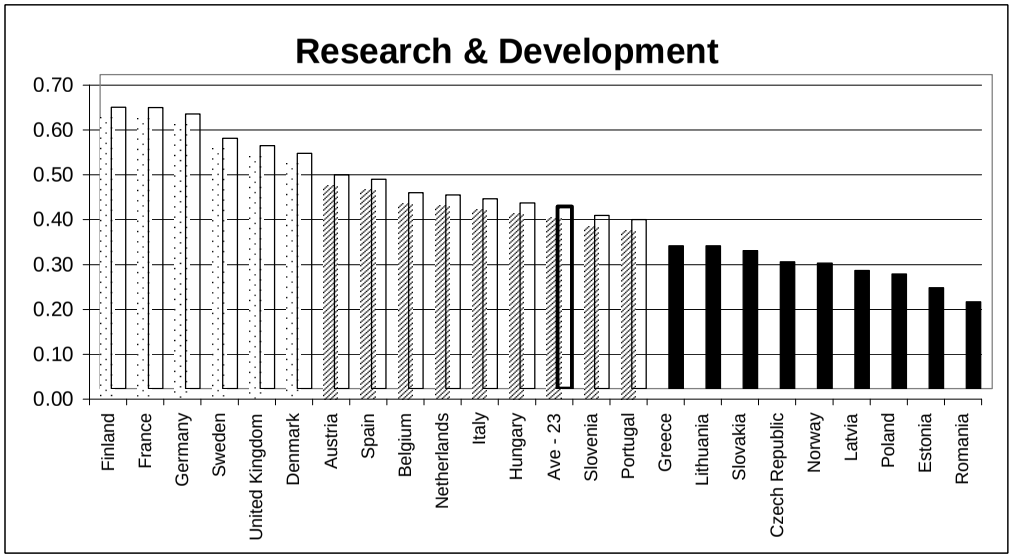
MAX:	65%	55%	77%	120%	58%	101%	63%	144%	66%	32%	132%	79%
MIN:	-50%	-56%	-85%	-66%	-75%	-87%	-58%	-99%	-96%	-52%	-91%	-86%
DIFFERENCE:	115%	110%	162%	187%	134%	188%	121%	243%	163%	84%	223%	165%

20.0%	>= +20 %
10.0%	20>, >0
-10.0%	0=>, >-20
-20.0%	< -20%

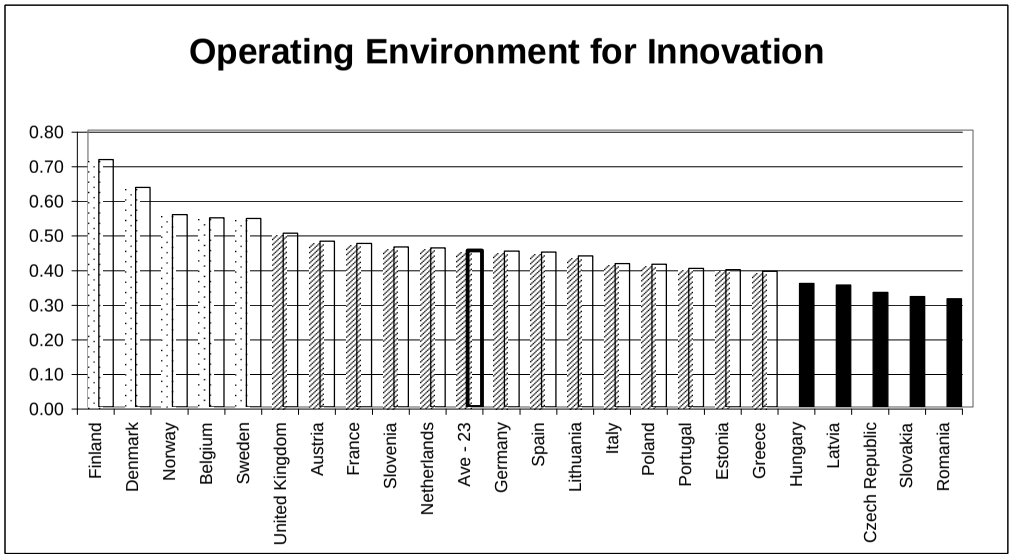
Country	Workforce
Sweden	0.6145
United Kingdom	0.6037
France	0.5632
Finland	0.5343
Denmark	0.5187
Belgium	0.5101
Netherlands	0.5077
Lithuania	0.4957
Slovakia	0.4924
Norway	0.4538
Slovenia	0.4439
Ave - 23	**0.4399**
Spain	0.4334
Romania	0.4255
Austria	0.4144
Latvia	0.4102
Portugal	0.3842
Czech Republic	0.3657
Italy	0.3534
Estonia	0.3455
Greece	0.3319
Hungary	0.3263
Germany	0.3044
Poland	0.2844
Ave - 23	*0.440*



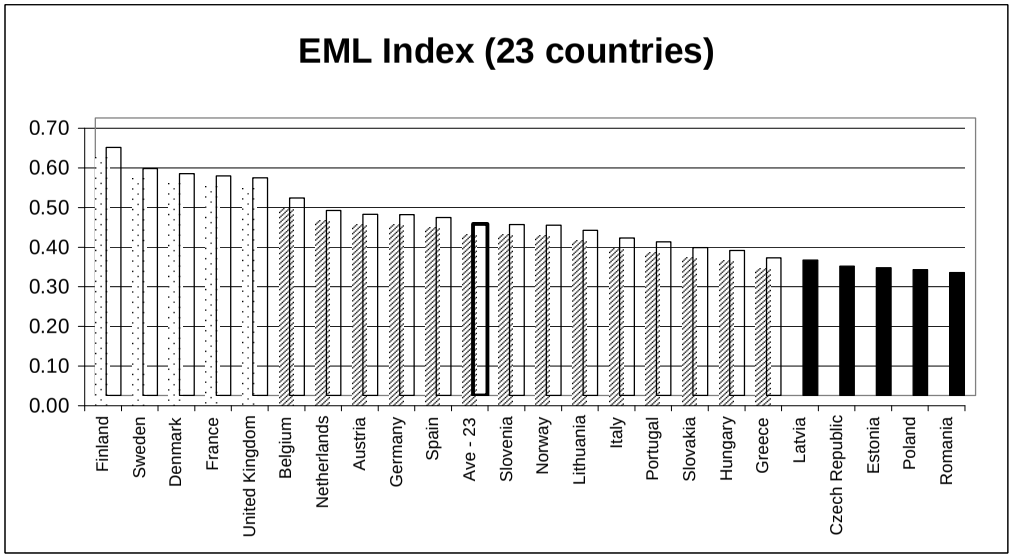
Country	Research & Development
Finland	0.6271
France	0.6267
Germany	0.6124
Sweden	0.5579
United Kingdom	0.5412
Denmark	0.5244
Austria	0.4766
Spain	0.4670
Belgium	0.4368
Netherlands	0.4318
Italy	0.4230
Hungary	0.4140
Ave - 23	**0.4063**
Slovenia	0.3861
Portugal	0.3765
Greece	0.3183
Lithuania	0.3180
Slovakia	0.3075
Czech Republic	0.2827
Norway	0.2797
Latvia	0.2632
Poland	0.2558
Estonia	0.2248
Romania	0.1933
Ave - 23	*0.406*



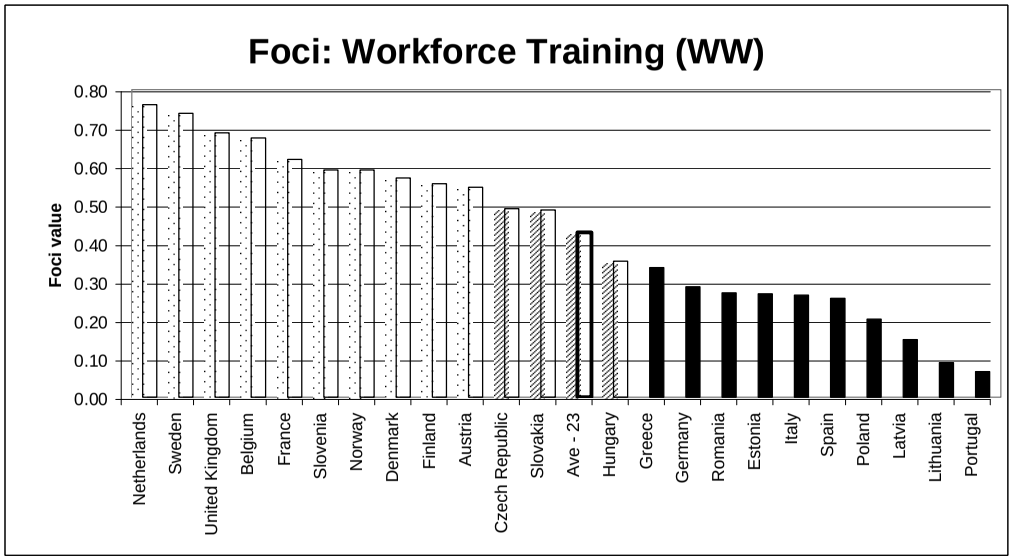
Country	Operating Env. for Innovation
Finland	0.7151
Denmark	0.6347
Norway	0.5562
Belgium	0.5466
Sweden	0.5443
United Kingdom	0.5025
Austria	0.4793
France	0.4725
Slovenia	0.4623
Netherlands	0.4597
Ave - 23	**0.4520**
Germany	0.4506
Spain	0.4472
Lithuania	0.4361
Italy	0.4144
Poland	0.4127
Portugal	0.4009
Estonia	0.3965
Greece	0.3918
Hungary	0.3566
Latvia	0.3524
Czech Republic	0.3309
Slovakia	0.3193
Romania	0.3122
Ave - 23	*0.452*



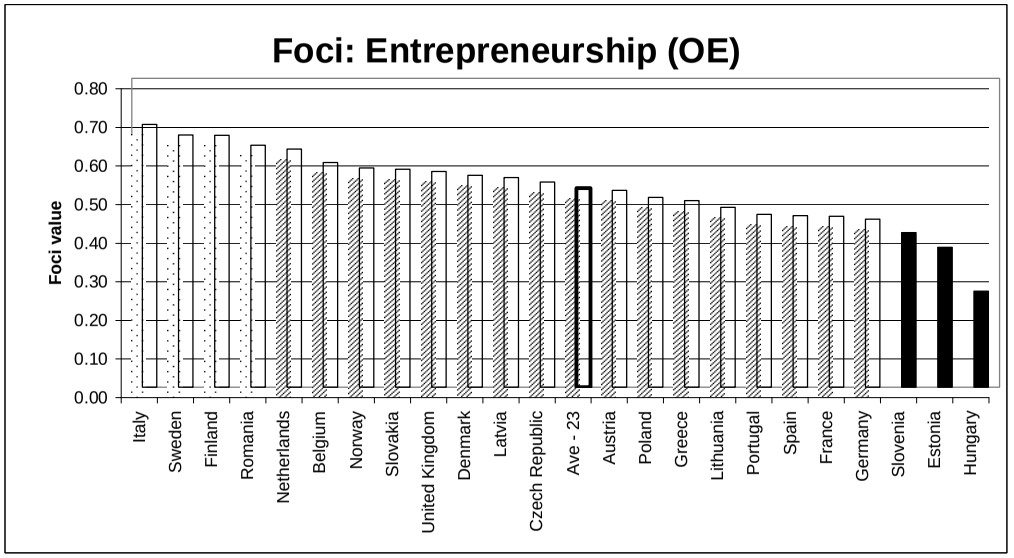
Country	Value - tot
Finland	0.6255
Sweden	0.5722
Denmark	0.5593
France	0.5541
United Kingdom	0.5491
Belgium	0.4978
Netherlands	0.4664
Austria	0.4568
Germany	0.4558
Spain	0.4492
Ave - 23	**0.4327**
Slovenia	0.4308
Norway	0.4299
Lithuania	0.4166
Italy	0.3969
Portugal	0.3872
Slovakia	0.3730
Hungary	0.3656
Greece	0.3473
Latvia	0.3419
Czech Republic	0.3264
Estonia	0.3223
Poland	0.3176
Romania	0.3103
Ave - 23	*0.433*



Country	Foci: WW
Netherlands	0.7609
Sweden	0.7387
United Kingdom	0.6879
Belgium	0.6746
France	0.6188
Slovenia	0.5914
Norway	0.5907
Denmark	0.5702
Finland	0.5552
Austria	0.5461
Czech Republic	0.4904
Slovakia	0.4871
Ave - 23	**0.4288**
Hungary	0.3537
Greece	0.3368
Germany	0.2874
Romania	0.2715
Estonia	0.2689
Italy	0.2651
Spain	0.2575
Poland	0.2034
Latvia	0.1499
Lithuania	0.0900
Portugal	0.0663
Ave - 23	*0.429*



Country	Foci: OE
Italy	0.6805
Sweden	0.6529
Finland	0.6522
Romania	0.6268
Netherlands	0.6169
Belgium	0.5816
Norway	0.5677
Slovakia	0.5643
United Kingdom	0.5591
Denmark	0.5485
Latvia	0.5432
Czech Republic	0.5312
Ave - 23	**0.5156**
Austria	0.5100
Poland	0.4913
Greece	0.4830
Lithuania	0.4659
Portugal	0.4480
Spain	0.4448
France	0.4428
Germany	0.4356
Slovenia	0.4005
Estonia	0.3625
Hungary	0.2491
Ave - 23	*0.516*

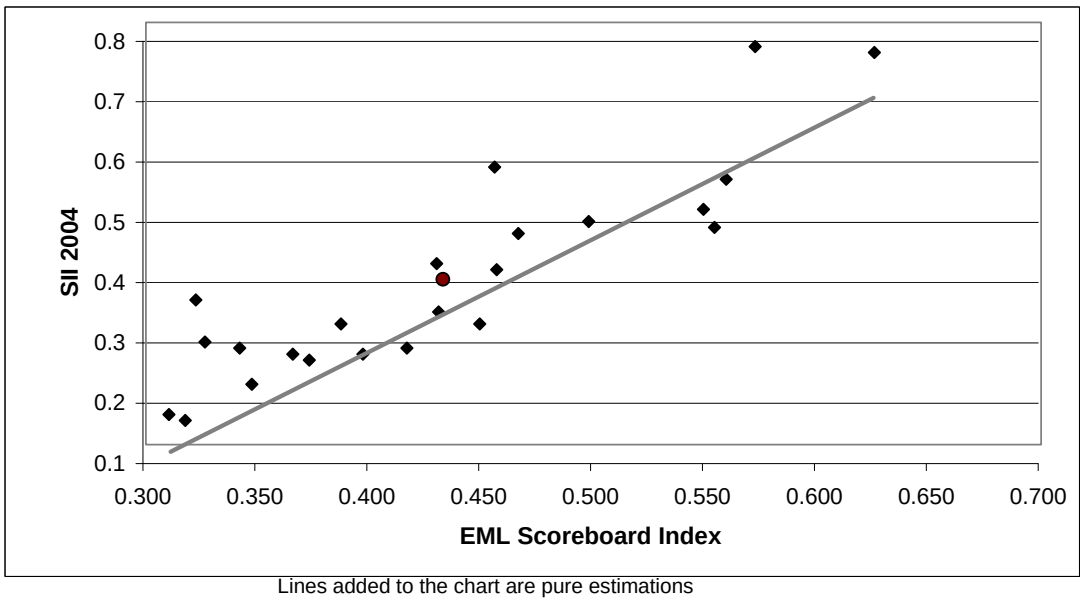


Comparison of the EML-23 (composite capabilities index) with other indecies

Countries		EML Index 23	1) Summary Innovation Index 2004 (SII2)	2) Growth Competitiveness Index 2004	3) The Lisbon Review Rankings 2004
Ave - 23	**Ave - 23**	0.433	*0.374*	*4.91*	*4.60*
Norway	NO	0.430	0.4	5.56	n/a
Austria	AT	0.457	0.39	5.2	4.94
Belgium	BE	0.498	0.47	4.95	4.88
Czech Republi	CZ	0.326	0.27	4.55	4.16
Denmark	DK	0.559	0.54	5.66	5.63
Estonia	EE	0.322	0.34	5.08	4.64
Finland	FI	0.626	0.75	5.95	5.8
France	FR	0.554	0.46	4.92	5.03
Germany	DE	0.456	0.56	5.28	5.18
Greece	EL	0.347	0.2	4.56	4
Hungary	HU	0.366	0.25	4.56	4.12
Italy	IT	0.397	0.31	4.27	4.38
Latvia	LV	0.342	0.26	4.43	4.34
Lithuania	LT	0.417	0.26	4.57	4.05
Netherlands	NL	0.466	0.45	5.3	5.21
Poland	PL	0.318	0.14	3.98	3.68
Portugal	PT	0.387	0.3	4.96	4.25
Romania	RO	0.310	0.15	3.86	3.35
Slovakia	SK	0.373	0.24	4.43	3.89
Slovenia	SL	0.431	0.32	4.75	4.36
Spain	ES	0.449	0.3	5	4.47
Sweden	SE	0.572	0.76	5.72	5.62
United Kingdo	UK	0.549	0.49	5.3	5.3
Correlation with EML-23:			**0.892**	**0.802**	**0.889**

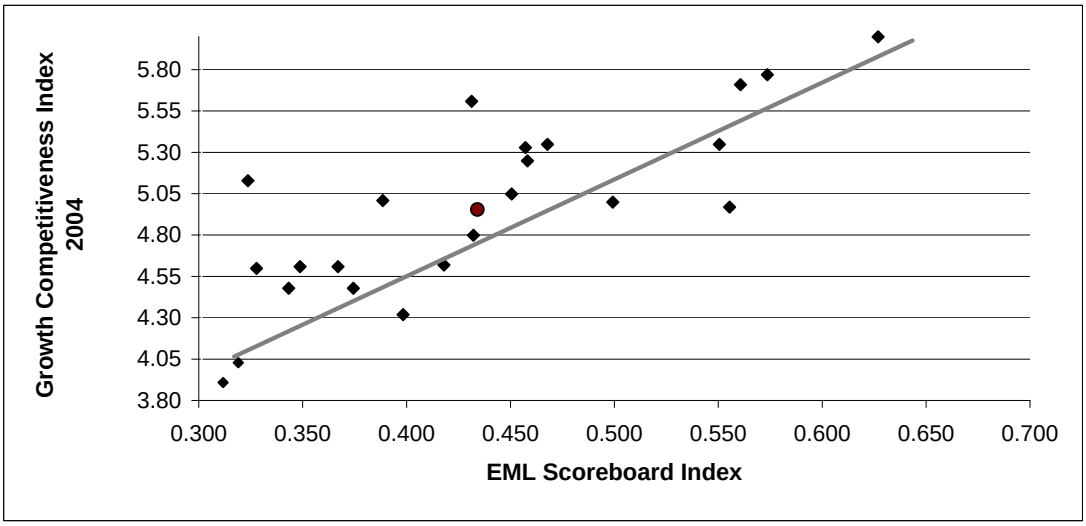
2002

1) http://trendchart.cordis.lu/scoreboards/scoreboard2004/inno_index.cfm
2) & 3) http://www.weforum.org/pdf/Gcr/Growth_Competitiveness_Index_2003_Comparisons
All last accessed: 2005-01-27

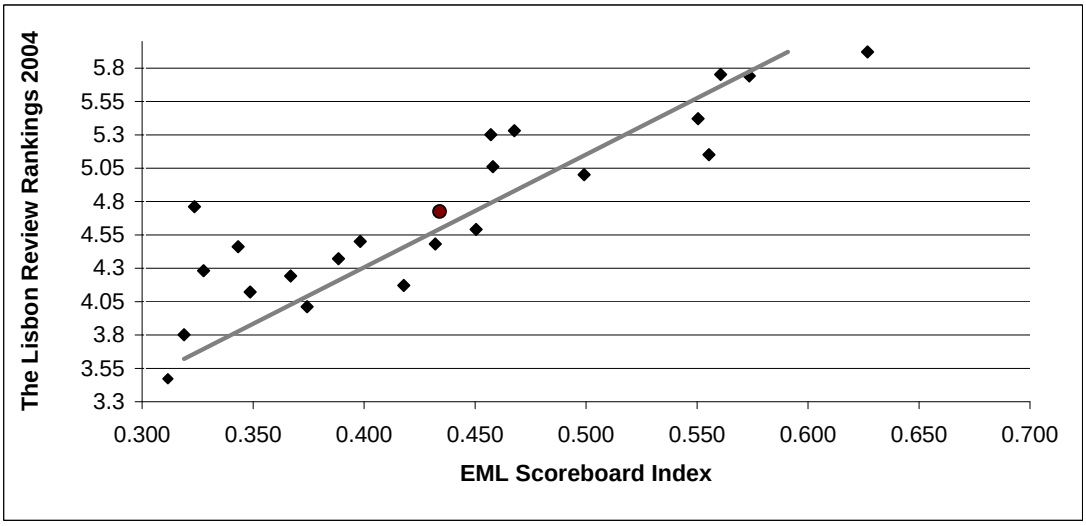


Lines added to the chart are pure estimations

Comparison of the EML-23 (composite capabilities index) with other indecies



Lines added to the chart are pure estimations



Lines added to the chart are pure estimations

	European Manufacturing Landscape (EML - 11)															
	Workforce				Research & Development				Operating environment							
	Careers for Women	Age of workforce	Educating the Future Workforce	Workforce Training	R&D Spending	International Cooperation	Human Resources	Links between industry & academia	National Policies & Government	Entrepreneurship	SME	ICT				
	21, 22, 23	10, 11,12,13,14	3, 4, 5, 6	16, 17, 18, 19, 20	30, 31, 32, 33	38, 39, 40	34, 35, 36, 37	26, 27, 28, 29	67, 68, 69	55, 56, 57, 58, 59, 60	61, 62, 63, 64, 65	51, 52, 53, 54	**Work**	**Research**	**Operating**	**Total Index**
Austria	*0.134*	*0.313*	**0.501**	0.467	0.506	*0.258*	*0.286*	0.437	0.449	*0.395*	*0.234*	**0.610**	*0.35*	*0.37*	0.42	*0.382*
Belgium	**0.671**	*0.379*	*0.268*	**0.614**	0.517	*0.130*	*0.400*	*0.367*	*0.336*	0.495	**0.592**	**0.586**	0.48	*0.35*	**0.50**	0.446
Denmark	*0.293*	**0.649**	**0.521**	**0.528**	*0.240*	*0.229*	**0.682**	**0.709**	**0.945**	0.513	*0.288*	**0.788**	0.50	0.47	**0.63**	**0.532**
Finland	0.506	*0.382*	**0.659**	0.501	**0.846**	*0.353*	**0.654**	**0.605**	**0.806**	**0.666**	**0.806**	**0.638**	**0.51**	**0.61**	**0.73**	**0.619**
France	**0.684**	*0.332*	**0.565**	**0.564**	0.496	**0.705**	**0.699**	0.448	*0.312*	*0.441*	**0.446**	**0.484**	**0.54**	**0.59**	0.42	**0.515**
Germany	*0.179*	*0.368*	*0.207*	*0.194*	**0.605**	**0.857**	*0.289*	**0.629**	*0.322*	*0.330*	**0.421**	0.387	*0.24*	**0.60**	*0.37*	*0.399*
Italy	*0.319*	0.455	*0.246*	*0.139*	*0.372*	*0.363*	0.431	*0.017*	*0.208*	**0.590**	*0.247*	*0.160*	*0.29*	*0.30*	*0.30*	*0.296*
Netherlands	*0.193*	**0.752**	*0.250*	**0.718**	**0.533**	*0.267*	*0.073*	0.485	*0.324*	**0.598**	*0.293*	**0.422**	0.48	*0.34*	0.41	*0.409*
Spain	**0.688**	*0.424*	*0.328*	*0.140*	*0.197*	**0.490**	**0.516**	*0.211*	**0.711**	*0.360*	*0.205*	*0.338*	*0.39*	*0.35*	*0.40*	*0.384*
Sweden	**0.607**	**0.572**	**0.562**	**0.716**	**0.714**	*0.249*	0.437	**0.542**	*0.181*	**0.637**	**0.421**	**0.711**	**0.61**	0.49	0.49	**0.529**
UK	**0.853**	**0.586**	*0.288*	**0.640**	*0.248*	**0.595**	**0.617**	0.430	*0.333*	0.545	*0.230*	**0.585**	**0.59**	0.47	0.42	0.496
Ave - 11	0.466	0.474	0.400	0.475	0.479	0.409	0.462	0.444	0.448	0.506	0.380	0.519	0.45	0.45	0.46	0.455
Min	0.134	0.313	0.207	0.139	0.197	0.130	0.073	0.017	0.181	0.330	0.205	0.160	0.24	0.30	0.30	0.296
Max	0.853	0.752	0.659	0.718	0.846	0.857	0.699	0.709	0.945	0.666	0.806	0.788	0.61	0.61	0.73	0.619

This shows the composite capability index for the 11 countries fulfilling the stricter constraints. Bold indicates outperforming (>1,2 * "Ave-11") and italics indicates underperforming (<0,8 * "Ave-11"). Note that all EML values are relative. EML-11 values can't be compared to EML-23.