

FOM-Edition  
International Series

Fehim Bakırcı  
Thomas Heupel  
Orhan Kocagöz  
Üstün Özen *Editors*

# German-Turkish Perspectives on IT and Innovation Management

## Challenges and Approaches



 Springer Gabler

The Springer Gabler logo consists of a white chess knight icon to the left of the text 'Springer Gabler' in a white, serif font.

---

# **FOM-Edition**

## International Series

### **Series editors**

FOM Hochschule für Oekonomie & Management, Essen, Germany

This work appears in the FOM-Edition, published by the FOM Hochschule für Oekonomie & Management.

More information about this series at  
<http://www.springer.com/series/12753>

---

Fehim Bakırcı · Thomas Heupel ·  
Orhan Kocagöz · Üstün Özen  
Editors

# German-Turkish Perspectives on IT and Innovation Management

Challenges and Approaches

 Springer Gabler



*Editors*

Fehim Bakırcı  
Atatürk Üniversitesi İktisadi ve İdari Bilimler  
Fakültesi  
Erzurum, Turkey

Orhan Kocagöz  
FOM Hochschule für Oekonomie &  
Management  
Nürnberg, Germany

Thomas Heupel  
FOM Hochschule für Oekonomie &  
Management  
Essen, Germany

Üstün Özen  
Atatürk Üniversitesi İktisadi ve İdari Bilimler  
Fakültesi  
Erzurum, Turkey

FOM-Edition  
International Series

ISBN 978-3-658-16961-9

ISBN 978-3-658-16962-6 (eBook)

<https://doi.org/10.1007/978-3-658-16962-6>

Library of Congress Control Number: 2017957563

Springer Gabler

© Springer Fachmedien Wiesbaden GmbH 2018

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Printed on acid-free paper

This Springer Gabler imprint is published by Springer Nature

The registered company is Springer Fachmedien Wiesbaden GmbH

The registered company address is: Abraham-Lincoln-Str. 46, 65189 Wiesbaden, Germany

---

## Message of Greeting



Foto: Bundesregierung/  
Steffen Kugler

### **“2nd Economic Forum: German-Turkish Perspectives on IT and Innovation Management”**

Information and communication technologies (ICT) are drivers of innovation. They are also an inherent component of an excellent education system and ensure the quality of scientific work. At the same time, they make our everyday life easier and are becoming an increasingly important key to social participation. This is why ICT has also been chosen as a field of scientific cooperation between Germany and Turkey.

By launching the German-Turkish Year of Research, Education and Innovation 2014, the German Federal Ministry of Education and Research and the Turkish Ministry of Science, Industry and Technology forged closer ties between Germany and Turkey. Furthermore, we also agreed to continue to develop the potential of our close cooperation in education, research and innovation beyond the Science Year.

I am delighted that the “2nd Economic Forum: German-Turkish perspectives on IT and Innovation Management” is also a step in this direction. The Forum offers the opportunity to reflect upon the success factors for German-Turkish cooperation in ICT and is at the same time a platform that can inspire forward-looking collaborative projects.

I would like to thank all those players who have committed to continuing German-Turkish cooperation beyond the joint Science Year both within the framework of this 2nd Economic Forum and other collaborative projects. I wish the participants at this conference a lively exchange of new ideas and inspiration for future cooperation.

Prof. Dr. Johanna Wanka  
Federal Minister of Education and Research

---

## Preface by the Editors

In 2014 the German-Turkish year of science, education and innovation, entitled as “Science Bridging Nations”, was initiated by the German Federal Ministry of Education and Research and the Turkish Ministry of Science, Industry and Research. In the course of the scientific year, around 100 projects were submitted for an idea contest. The FOM University of Applied Sciences was able to assert successfully in this contest with the project “E2E – Building a Bridge on Sciences”, an initiative to strengthen the innovative potential of the cooperation between the FOM University of Applied Sciences and the Ataturk University Erzurum.

The starting point of the project was the already existing teaching cooperation between the FOM and the Ataturk University. The aim of “E2E” was to extend the cooperation to the research sector of both universities and to establish a fundament for common researching projects. In addition to a delegation trip of German scientists to Erzurum in April 2015, the common conference of the Ataturk University Erzurum and the FOM “2. Economic forum: German-Turkish perspectives on IT and Innovation Management” took place from 4th to 6th November 2015 at the FOM Munich. For this purpose, the following topics were scientifically discussed:

- IT in the education system and as a macroeconomic factor
- IT in the health care sector
- IT in Human Resource Management
- Management of technical innovations
- Innovation management in SME
- Success factors (measurement) of innovations

The results of the conference contributions are now available in this essay collection. In addition to the exchange of research results, German and Turkish perspectives for the economic discourse were discussed in order to develop theoretical insights and practical success potentials. Although the E2E project is officially completed with this essay collection, the cooperation between the FOM and the Ataturk University is not finished but will be continued at various levels. Both this book and the cooperation make a valuable contribution to the maintenance of the cooperation between Germany and Turkey, which

is not limited to politics, economics and culture but has to be further deepened, especially in education and research.

First of all we would like to thank the Federal Ministry of Education and Research for the financial support of the entire project what makes the success of this project possible. Also the FOM and the Ataturk University have provided additional financial resources to complete this project. We would also like to take this opportunity to express our gratitude to all the people who have supported the project. We would like to start by thanking the Rector of the FOM, Prof. Dr. Burghard Hermeier, and the previous Rector of the Ataturk University, Prof. Dr. Hikmet Koçak, for the cooperation between the two universities. We would also like to thank Christoph Hohoff and Gerrit Landherr from the FOM's support research department who have planned the project. Additionally we would like to take the chance to thank the directors of the FOM Munich, Prof. Dr. Gerald Mann and Oliver Dorn, who have contributed to the organization of the aforementioned conference in Munich. For the publishing of this book, Kai Stumpp from the FOM's publishing department has rendered valuable services that we would like to acknowledge. Furthermore, we would like to thank the Springer Publishing house for the excellent cooperation.

May this book not only be interesting and profitable for students and scientists, but also be noticed by the public by keeping in mind the German-Turkish cooperation.

The editors

Prof. Dr. Fehim Bakırcı

Prof. Dr. Thomas Heupel

Prof. Dr. Orhan Kocagöz

Prof. Dr. Üstün Özen



---

## About the Editors



**Fehim Bakirci** is a professor of economic theory and labor economy at the Faculty of Economics and Administrative Sciences and head of the Department of International Trade and Logistic at Atatürk University in Erzurum, Turkey. His research fields are micro economy, labor economy, industrial economy and efficiency and economic productivity.



**Thomas Heupel** studied economics at the University of Siegen and subsequently worked as a research assistant at the IöB (Institut für ökologische Betriebswirtschaft) and managing director of the SMI (Siegener Mittelstandsinstitut) at the University of Siegen, Germany. He is a professor of business administration, with a focus on cost accounting

and controlling. Since 2009 he has been vice rector of research at the FOM University of Applied Sciences in Essen, Germany. His research focuses on the fields of behavioral economics, automotive industry management, demographic change, blue ocean strategy, management of SMEs and cost control. He is a member of several scientific institutions' advisory boards and editor of numerous academic books.



**Orhan Kocagöz** studied business administration at the Friedrich Alexander University in Erlangen and received a doctorate on the topic “Business groups in developing countries. The rise, organization and business policy of Turkish holdings”. Since 2011 he has been professor of general business administration in particular international management at the FOM University of Applied Sciences in Nuremberg, Germany.



**Üstün Özen** is professor at the Faculty of Economics and Administrative Sciences and head of the Department of Management Information Systems at the Atatürk University in Erzurum, Turkey. He has published a wide spectrum of articles in various national and international journals in the fields of information systems management, project management, system analysis & design, distance learning, and e-commerce, as well as numerous books. He has also presented a number of scientific papers at national and international symposiums.

---

# Content

## Part I Introduction

- 1 **R&D in Germany and Turkey – a Comparison** . . . . . 3  
Andreas Kladroba
- 2 **Knowledge and Innovation Economy: an Evaluation of Turkey** . . . . . 21  
Fehim Bakırcı
- 3 **Research and Development and High Technology Exports in Selected Countries at Different Development Stages: a Panel Co-integration and Causality Analysis** . . . . . 43  
Yusuf Bayraktutan, Hanife Bıdırdı, and Aziz Kutlar

## Part II Innovation

- 4 **Business and Innovation** . . . . . 75  
Kürşat Timuroğlu, Ersin Karaman, and Mustafa Keskinılıç
- 5 **Strategic Reorientation Due to Competitors' Disruptive Innovation** . . . . . 89  
Alexander Schmidt
- 6 **Public Innovation Management Support in Rural Areas: the ARTIE Case in Germany** . . . . . 109  
Hartmut-Heinrich Meyer and Bastian Paulsen
- 7 **The Innovative Role of Social Media in Healthcare** . . . . . 123  
İmran Aslan
- 8 **The Analysis of Factors that Affect Innovation Performance of Logistics Enterprises in Turkey** . . . . . 143  
Osman Demirdöğen, Hamit Erdal, and Ahmet İlker Akbaba

<b>9</b>	<b>Corporate Evaluation as an Instrument of Innovation Management in Turkey</b> . . . . .	<b>165</b>
	Sven Lauterjung and Alessandra Bugla	
<b>10</b>	<b>An Assessment on Innovative Activity and Performance of Turkish Logistics Sector</b> . . . . .	<b>181</b>
	Osman Demirdöğen and Hamit Erdal	
<b>11</b>	<b>Determining Performances of Innovation and Exports in Turkey and Selected Countries via Malmquist Index for the Period of 1996–2012</b> . . . . .	<b>199</b>
	Aziz Kutlar, Yusuf Bayraktutan, and Hanife Bıdırıdı	
<b>12</b>	<b>Structure Genesis as a Factor of Success of Interorganisational Innovation Networks</b> . . . . .	<b>215</b>
	Axel Müller and Silvia Pick Vidal	
<b>13</b>	<b>Knowledge Transfer as Driver for Innovation Culture in Heterogeneous Economic Zones</b> . . . . .	<b>229</b>
	Winand Dittrich and Matthias Biniok	
 <b>Part III IT</b>		
<b>14</b>	<b>Driver’s Choice and System Outcomes in Congested Traffic Networks</b> . . . . .	<b>249</b>
	Siegfried Weinmann, Kay W. Axhausen, and Christoph Dobler	
<b>15</b>	<b>Development of an Efficient Europe-wide e-Recruiting System (European Recruiting 2020)</b> . . . . .	<b>267</b>
	Ricardo Büttner	
<b>16</b>	<b>Cloud-computing in the Insurance Industry</b> . . . . .	<b>275</b>
	Thomas Christiaans and Stefan Steden	
<b>17</b>	<b>Dynamic Store Procedures in Database</b> . . . . .	<b>291</b>
	Muhammet Dursun Kaya and Hasan Asil	
<b>18</b>	<b>The Impact of High-Tech Expenditures on Exports in Turkey: 1996–2012</b>	<b>303</b>
	Aziz Kutlar and Ali Kabasakal	
<b>19</b>	<b>A Fresh Look at an Old Classification Algorithm</b> . . . . .	<b>323</b>
	Bernd-Jürgen Falkowski	

## Part IV Finance

- 20 Islamic Banking 101: Turkish Banks in Germany** . . . . . 333  
Andree Elsner, Tobias Kleinert, and Helena Strebels-Nelson
- 21 Social Impact Bonds as a Financial Innovation – an Evolutionary Economic Approach** . . . . . 351  
Thomas Holtfort
- 22 Success Factors of Crowdfunding Projects on the Kickstarter Platform** . . 361  
Jörg Gutsche and Sabrina Sylla

## Part V Education

- 23 Measuring the Effectiveness and Innovative Capability of Bingöl University and Atatürk University** . . . . . 377  
İmran Aslan and Orhan Çınar
- 24 An E-conversion Project in Turkey's Education System: the FATİH Project** 403  
Daha Orhan, Embiya Çelik, and Arif Daş
- 25 Turkish Academics and Students in the Context of Skill Shortages in Germany** . . . . . 411  
Winand Dittrich and Natalina Reuffurth

## Part VI SME

- 26 Risk Controlling in SMEs – a German-Turkish Perspective** . . . . . 429  
Stephan Schöning and Çağla Ersen Cömert
- 27 Study of the Obstacles and Motivational Factors of Innovation in SMEs** . 447  
Osman Demirdöğen and Farid Haddadzadeh Hendou

## Part VII Miscellaneous

- 28 Emotional Ethnic Marketing** . . . . . 463  
Julia Hermann
- 29 Use of Information Communication Technologies in Political Communication and Participation – with Special Reference to Turkey** . . . . . 485  
Hasan Emir Aktaş

**30 Trust Management as an Innovative Factor of Customer Retention: the Negotiation Behavior in Comparison to German and Turkish Business Partners . . . . . 497**  
Volker Eickenberg

---

## List of Contributors

**Ahmet İlker Akbaba** Faculty of Economics and Administrative Sciences, Erzurum Technical University, Erzurum, Turkey

**Hasan Emir Aktaş** Faculty of Economics and Administrative Sciences, Ataturk University, Erzurum, Turkey

**Hasan Asil** Computer Department, Azarshahr Branch, Islamic Azad University, Azarshahr, Iran

**İmran Aslan** Occupational Health and Safety Department & Business Administration Department, Bingöl University, Bingöl, Turkey

**Kay W. Axhausen** Institute for Transport Planning and Systems, ETH Zurich, Zurich, Switzerland

**Fehim Bakırcı** Faculty of Economics and Administrative Sciences, Ataturk University, Erzurum, Turkey

**Yusuf Bayraktutan** Faculty of Economics and Administrative Sciences, Department of Economics, Kocaeli University, Kocaeli, Turkey

**Hanife Bıdırdı** Faculty of Economics and Administrative Sciences, Department of Economics, Kocaeli University, Kocaeli, Turkey

**Matthias Biniok** Frankfurt, Germany

**Alessandra Bugla** Essen, Germany

**Ricardo Büttner** Institute of Management & Information Systems (mis), FOM University of Applied Sciences, München, Germany

**Embiya Çelik** Open Education Faculty, Ataturk University, Erzurum, Turkey

**Thomas Christiaans** FOM University of Applied Sciences, Siegen, Germany

**Orhan Çınar** Labor Economics and Industrial Relations Department, Ataturk University, Erzurum, Turkey

- Arif Daş** Open Education Faculty, Ataturk University, Erzurum, Turkey
- Osman Demirdöğen** Faculty of Economics and Administrative Sciences, Ataturk University, Erzurum, Turkey
- Winand Dittrich** KCI KompetenzCentrum für Interdisziplinäre Wirtschaftsforschung & Verhaltensoekonomie, FOM University of Applied Sciences, Frankfurt, Germany
- Christoph Dobler** Senozon AG, Zurich, Switzerland
- Volker Eickenberg** FOM University of Applied Sciences, Essen, Germany
- Andree Elsner** HRW University of Applied Sciences, Mülheim, Germany
- Hamit Erdal** Institute of Social Sciences, Ataturk University, Erzurum, Turkey
- Cağla Ersen Cömert** Faculty of Business Administration, Marmara University, Istanbul, Turkey
- Bernd-Jürgen Falkowski** FOM University of Applied Sciences, Augsburg, Germany
- Jörg Gutsche** Trier University of Applied Sciences, Trier, Germany
- Farid Haddadzadeh Hendou** Faculty of Economics and Business Administration, Ataturk University, Erzurum, Turkey
- Julia Hermann** Nürnberg, Germany
- Thomas Holtfort** FOM University of Applied Sciences, Essen, Germany
- Ali Kabasakal** Department of Economics, Sakarya University, Sakarya, Turkey
- Ersin Karaman** Faculty of Economics and Administrative Sciences, Ataturk University, Erzurum, Turkey
- Muhammet Dursun Kaya** Science Research Center, Ataturk University, Erzurum, Turkey
- Mustafa Keskinılıç** Faculty of Economics and Administrative Sciences, Ataturk University, Erzurum, Turkey
- Andreas Kladroba** FOM University of Applied Sciences, Düsseldorf, Germany
- Tobias Kleinert** HRW University of Applied Sciences, Mülheim, Germany
- Aziz Kutlar** Department of Economics, Sakarya University, Sakarya, Turkey
- Sven Lauterjung** University of Duisburg-Essen, Essen, Germany
- Hartmut-Heinrich Meyer** Stade, Germany
- Axel Müller** FOM University of Applied Sciences, Essen, Germany



---

**Daha Orhan** Pasinler Vocational High School, Ataturk University, Erzurum, Turkey

**Bastian Paulsen** Osterholz-Scharmbeck, Germany

**Silvia Pick Vidal** FOM University of Applied Sciences, Essen, Germany

**Natalina Reuffurth** Frankfurt a.M., Germany

**Alexander Schmidt** Hersbruck, Germany

**Stephan Schöning** SRH University Heidelberg, Calw, Germany

**Stefan Steden** ConCreTech Gesellschaft für Technologie- und Organisationsberatung mbH, Viersen, Germany

**Helena Strebel-Nelson** HRW University of Applied Sciences, Mülheim, Germany

**Sabrina Sylla** Berlin, Germany

**Kürşat Timuroğlu** Faculty of Economics and Administrative Sciences, Ataturk University, Erzurum, Turkey

**Siegfried Weinmann** FOM University of Applied Sciences, Stuttgart, Germany

---

**Part I**  
**Introduction**

Andreas Kladroba

## Contents

1.1	Introduction . . . . .	3
1.2	The International R&D Survey . . . . .	4
1.3	Germany and Turkey – a Brief Economic Overview . . . . .	5
1.4	R&D Systems in Germany and Turkey . . . . .	6
1.4.1	Intramural R&D Expenditures – Absolute and in Relation to the GDP . . . . .	6
1.4.2	The Sectoral Breakdown . . . . .	10
1.4.3	Funding . . . . .	11
1.4.4	Personnel . . . . .	12
1.4.5	R&D in the Business Enterprise Sector . . . . .	14
1.4.6	R&D in the Higher Education Sector . . . . .	16
	References . . . . .	18

---

## 1.1 Introduction

Innovative solutions are the factors that drive our prosperity and support our quality of life. They strengthen Germany’s position as a leading industrial and exporting nation. And they make it possible to find creative answers to the urgent challenges of our time (Bundesministerium für Bildung und Forschung 2014a, p. 3).

These are the words the federal government used in 2014 to substantiate its continued commitment to research and development in accordance with the “High-tech Strategy”. This insight, however, is far from new. In 2000, at the European Council meeting in Lisbon the Heads of State and Government had set the objective to make the European Union “the most competitive and dynamic knowledge-based economy in the world”, the main in-

---

A. Kladroba (✉)  
FOM University of Applied Sciences  
Düsseldorf, Germany  
e-mail: andreas.kladroba@fom.de

strument for this endeavor being a Europe-wide increase of intramural R&D expenditures to 3% of the gross domestic product by 2010. Like Germany, R&D activities are here considered “a driving force for a competitive and dynamic knowledge-based economy” (Commission of the European Communities 2002, p. 3).

Consequently, the promotion of R&D is not only an integral part of various government programs, but also of importance for supranational organizations like the United Nations or the OECD.

In consequence, given the economical and societal magnitude of the topic, it would be appropriate to dedicate attention to comparative observations of R&D activities in the focus countries Germany and Turkey within the framework of the *Second Wirtschaftswissenschaftliches Forum*. This could involve assessing the current state and carrying out an international comparison. Recommendations for political and economic actions should be discussed only as an afterthought.

The international R&D survey (briefly described in the following chapter) serves as empirical basis of the analysis.

The rest of the paper is structured as follows:

- Sect. 1.2: The R&D survey on the basis of international agreements set forth in the Frascati manual
- Sect. 1.3: General economic reflections on Germany and Turkey
- Sect. 1.4: R&D systems in Germany and Turkey
- Conclusion

---

## 1.2 The International R&D Survey

The member states of the European Union (pursuant to Regulation (EU) 995/2012), OECD countries, and other countries gather data on research and development (R&D). The common framework of the Frascati manual, prepared and published by the OECD (2015), allows for an international comparison of the R&D structures in the individual countries.

The R&D survey distinguishes between four R&D sectors: business enterprises, higher education, government and PNP.<sup>1</sup> Data on the different sectors is gathered and published separately. There are, however, cross-sectorial analyses providing an overall societal or economical view on R&D structures (cf. also Bundesministerium für Bildung und Forschung 2014b; European Commission 2013; Wissenschaftsstatistik 2015a, 2015b).

The core indicators of the R&D survey are intramural R&D expenditures and R&D personnel. Intramural R&D expenditures are defined as expenditures for research and developmental activity performed in-house. Research contracts awarded to external institutions are consequently considered extramural R&D. In addition to scientific staff, R&D

---

<sup>1</sup> Private Non Profit.

personnel also comprises technicians and so-called “other supporting R&D staff” (these being mostly administration employees, however, attributable to R&D activities).

Key structural aspects to be examined in the R&D survey include

- R&D-performance (Where is R&D carried out?) versus R&D-funding (Who is financing R&D?). Industrial R&D (R&D in the business enterprise sector), for instance, can be state-funded.
- Regional R&D distribution at the Federate State level (NUTS<sup>2</sup> 1) is of particular interest in a federal country like Germany. However, also underlying regional structures (NUTS 2 or NUTS 3) as well as special aggregations (chamber’s districts, metropolitan regions etc.) can be covered.
- When assessing R&D personnel, gender issues are crucial.  
The findings are published by Eurostat (including Turkey), OECD, BMBF and Stifterverband/Wissenschaftsstatistik.

---

### 1.3 Germany and Turkey – a Brief Economic Overview

Some particular economic and societal issues, such as research and development, must be examined in a broader context in order to allow practical interpretations. For that reason, this chapter offers a brief comparison of important facts on Germany and Turkey.

#### 1. National territory

Turkey is twice the size of Germany (783,562 km<sup>2</sup> compared to 357,340 km<sup>2</sup>).<sup>3</sup>

#### 2. Population

In 2014 the number of inhabitants were roughly the same for Turkey and Germany (Turkey: 78.6 million, Germany: 80.8 million).<sup>4</sup> This means that Germany’s population density is on average twice as high as Turkey’s (226 and 98 inhabitants per square kilometer, respectively). This number is somewhat misleading, however, as the regional distribution in Turkey is considerably more heterogeneous than in Germany. For example, more than 15 million people (almost one fifth of the population) live in the greater Istanbul area (as defined in NUTS 2). Germany’s largest agglomeration, the Ruhr district (as defined by the Regionalverband Ruhr<sup>5</sup>) has a population of only 5 million – slightly over 6%.

With reference to the urban/rural distribution, however, the two countries are fairly similar. 57% of the German population and 52.5% of the Turkish population live in an urban environment.

---

<sup>2</sup> NUTS = Nomenclature des unités territoriales statistiques is the official regional classification of the EU. For Germany NUTS 1 corresponds to the federal states, NUTS 2 to the administrative districts and comparable aggregations, and NUTS 3 to the counties and county boroughs.

<sup>3</sup> Source: [www.wikipedia.de](http://www.wikipedia.de) (08.01.2016).

<sup>4</sup> Source: Eurostat.

<sup>5</sup> The Ruhr district is no administrative unit. Therefore there is no official delimitation.

### 3. Gross domestic product (GDP)

With 3757.1 billion US dollars, the German GDP was two and a half times the amount of the Turkish GDP (1502.5 billion US dollars) in 2014<sup>6</sup>, a per capita GDP of 45,619 USD and 19,610 USD for Germany and Turkey, respectively. A breakdown by industries of the economic output reveals that in Germany a quarter of all value is created in the industry (approximately 22% in Turkey). Agriculture contributes 8% to the total value created in Turkey, but only 0.8% in Germany. This results in a number of similarities in the economic performances of both countries which are, as we are going to see, only partially reflected in the R&D sector structure.

### 4. Intramural R&D expenditures

German intramural R&D expenditures amounted to €79,729.51 million for all sectors in 2013, €53,566.2 million of which was accounted for by the business enterprise sector. In Turkey these numbers are €5844.61 million for overall R&D expenditures and €2775.4 million for R&D in the business enterprise sector.

---

## 1.4 R&D Systems in Germany and Turkey

### 1.4.1 Intramural R&D Expenditures – Absolute and in Relation to the GDP

As already mentioned, with almost €80 billion, intramural R&D expenditures across all sectors in Germany (GERD = Gross Domestic Expenditures on R&D) are more than thirteen times as high as in Turkey. Fig. 1.1<sup>7</sup> shows both countries in an international ranking. In order to better assess this relation one needs to consider the following comparative figures:

1. The most research-oriented federal state in Germany is Baden-Württemberg with €20.2 billion worth of intramural R&D expenditures. In a ranking of German federal states, Turkey would rank 6th Turkish R&D expenditures are comparable to the ones of the administrative district of Darmstadt (with Frankfurt/Main as the largest city).
2. Volkswagen is the most research-oriented enterprise in the world. In 2014 VW spent approximately €13.1 billion on research and development (European Commission 2015). If Turkey was an enterprise, it would rank around 13th in an international business ranking (equivalent to the Daimler AG).

A comparison of absolute R&D data in this form is certainly impractical. Therefore, both in the field of innovation research and in the political debate the relation between intramural R&D expenditures and the gross domestic product has established itself as a comparative figure.

---

<sup>6</sup> Source: OECD.

<sup>7</sup> All R&D data refers to 2013, with the exception of the US and Switzerland, where only data on 2012 was available.

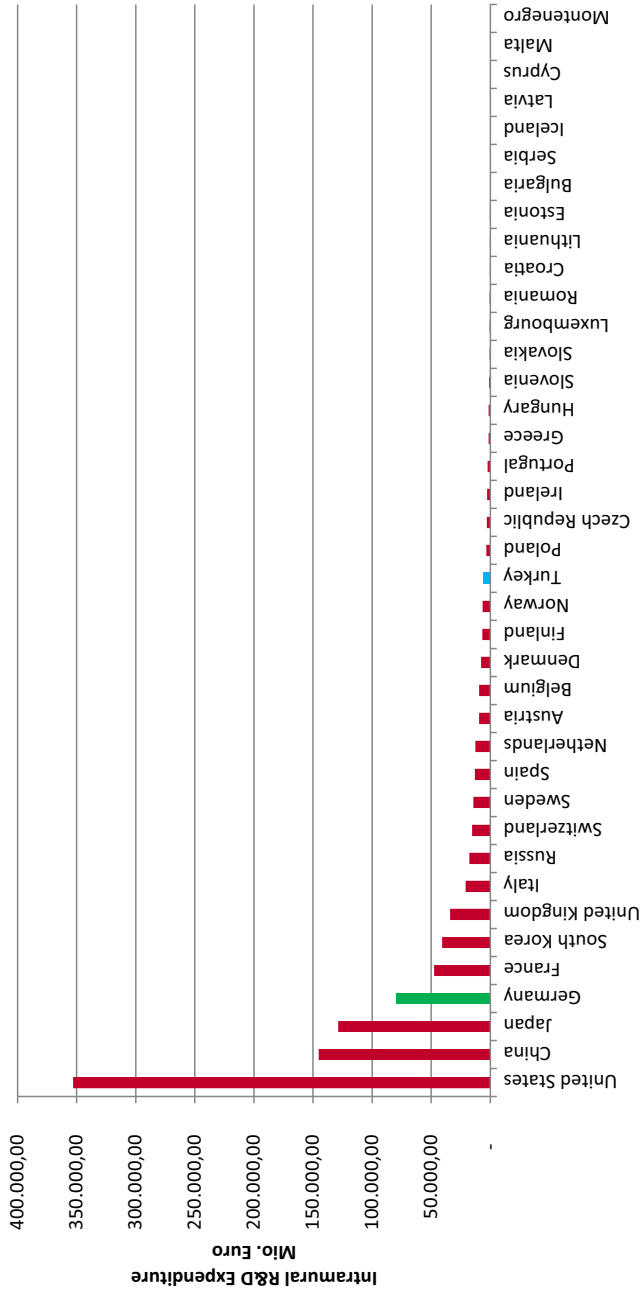


Fig.1.1 Intramural R&D expenditures 2013

Fig. 1.2 shows the corresponding international ranking.

Measured by this indicator, the most research-oriented countries are South Korea (4.15%) and Japan (3.47%), followed by the Scandinavian countries Finland (3.3%), Sweden (3.3%) and Denmark (3.08%). With 2.83% Germany ranks eighth, just above the US (2.81%). Turkey (0.95%) ends up in the bottom third, however, still higher than several other EU countries. With 2.03% the EU itself (EU 28) falls considerably short of its own 3% aim. Even the EU 15 states achieve only 2.12%.

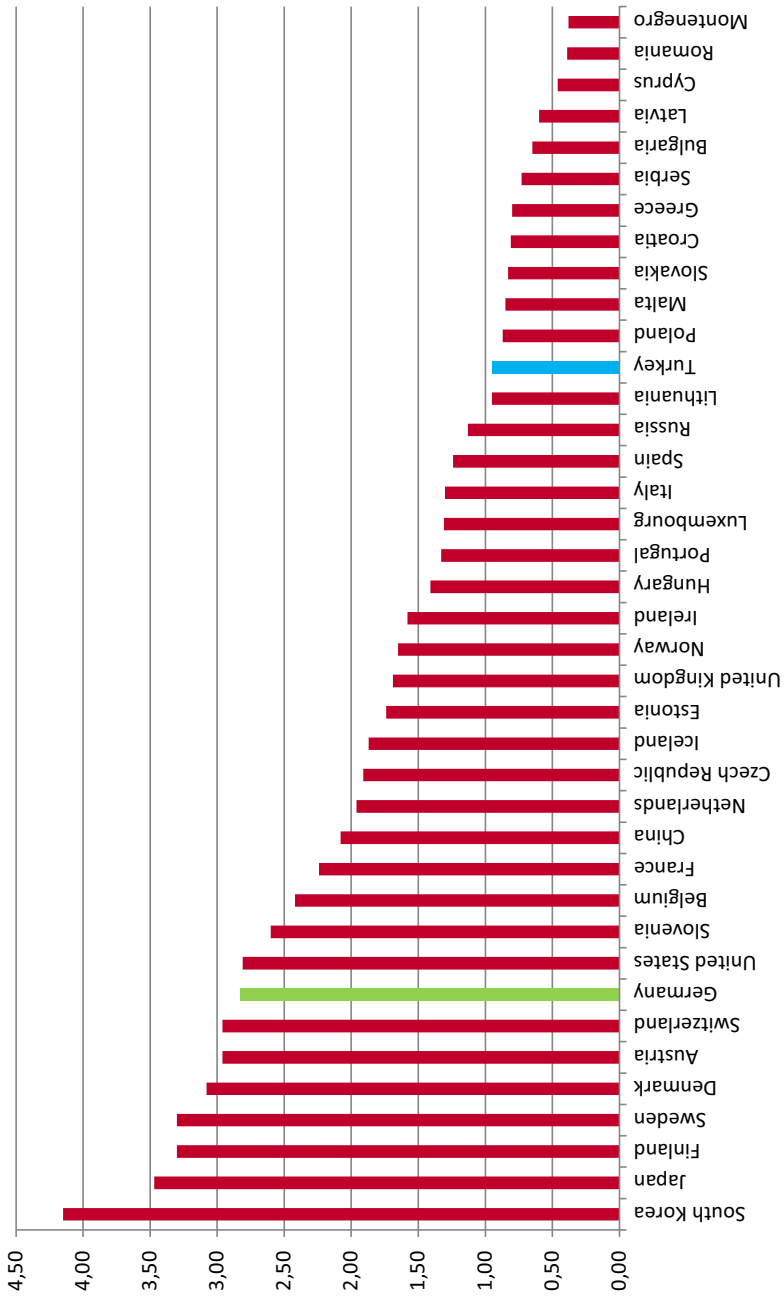
A look at the development of R&D expenditures in Germany and Turkey over the last 20 years provides further interesting insight. Fig. 1.3 shows the annual rate of change between 1993 and 2013.

Two points appear to be particularly striking:

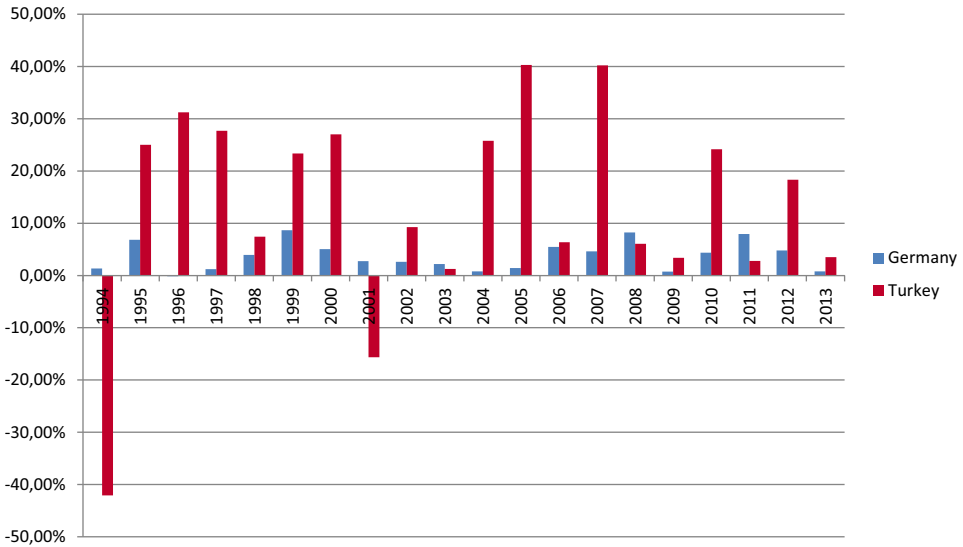
1. The total increase during the period considered was considerably higher in Turkey than it was in Germany. Whereas the amount of German intramural R&D expenditures merely doubled, the Turkish growth rate was at over 750%, however, with different increases in different sectors. The business enterprise sector saw the most drastic increase, with an almost unbelievable increase of research activities by the factor 16 within 20 years. Well below that are the higher education sector (+800%) and the government sector (+400%). In addition to that, R&D activities appear to vary with the years. In the first decade (1993–2003) R&D expenditures were not even doubled (+90%). The following decade (2003–2013) saw a 350% increase, evidently due to an increased political support of R&D (cf. also European Commission 2013, p. 329).
2. Whereas the changes in Germany remain relatively constant (annual rate of change below 10%) and consistently positive, Turkish R&D expenditures are far more volatile, with a more-than-40% decrease between 1993 and 1994 on the one hand, and a 40% increase between 2005 and 2007 on the other hand. This kind of high volatility is displayed throughout all sectors. The sectors are, however, not positively correlated as one might assume. In 2004, for instance, the government sector experienced a slight decrease, whereas the other sectors saw an increase of about 30% each. In 2008 R&D expenditures in the higher education sector declined significantly, while expenditures in the other two sectors rose substantially.

All in all it can be said that, as also noticed by the EU, with the turn of the millennium R&D increasingly became the focus of Turkish policy. So far, however, R&D could not be put onto a stable, sustainable growth path.





**Fig. 1.2** Intramural R&D expenditures in relation to the GDP 2013

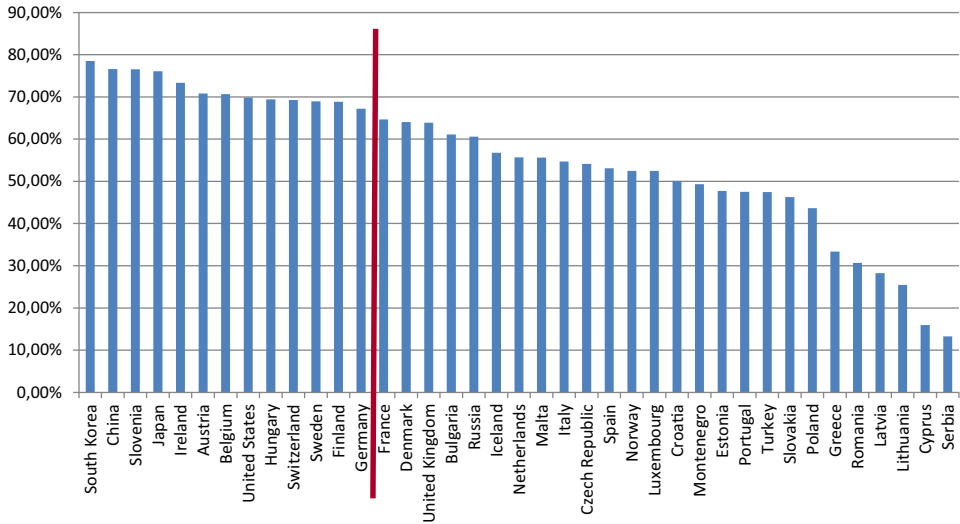


**Fig. 1.3** Rates of change of intramural R&D expenditures

## 1.4.2 The Sectoral Breakdown

When the EU set its 3% target, it did so with the stipulation that two thirds of national R&D expenditures should be spend within the business enterprise sector. This, however, was more of a means to an end than an economic objective. It had been supposed that the business enterprise sector did not invest enough in R&D compared to, for example, the US, which allegedly accounted for the 80% gap between US and European R&D expenditures. Fig. 1.4 shows that in addition to Germany other countries, too, meet the requirements. Turkey was at 47% in 2013, with an apparent investment gap in private R&D efforts. It should be specified, however, that

1. since 1993 the rate of R&D in the business enterprise sector in Turkey has increased from 23 to 47%, meaning that this sector is making a considerably bigger effort today than it was 20 years ago.
2. a simple calculation shows that increased efforts of the private sector alone do not suffice to bring the Turkish R&D expenditures to a level comparable to that of leading research nations. If one was to take the expenditures in the higher education sector and the government sector in the year 2013 as given, private expenditures would have to rise to €9.2 billion (currently €6.136 billion) to meet the 2 : 1 requirements. Based on the assumption of a constant GDP, however, this would account for merely 1.5% of the GDP (currently 0.95%) – only half of the intended 3%. Increased effort is required, therefore, not only in the business enterprise sector.



**Fig. 1.4** Share of the business enterprise sector in intramural R&D expenditures 2013

### 1.4.3 Funding

The other question besides R&D performance (“Who is doing it?”) is the one of funding (“Who is paying for it?”). It is easy to see that the institution paying for R&D is not necessarily the one conducting it. The State, for instance, may fund R&D projects in enterprises and at universities, and universities may acquire external funding for projects from enterprises.

Unfortunately international R&D surveys do not always cover R&D funding with the appropriate amount of detail. Eurostat, for instance, reports R&D funding just “by the business enterprise sector”. Whether this means that an enterprise is funding its own R&D or that it is carrying out research for another enterprise remains unclear. Such information can often only – if anywhere – be found in national publications.<sup>8</sup>

All the same, even the Eurostat publications allow for interesting insight into R&D financing structures. In the following, the focus will be on three issues:

1. To what degree are enterprises involved in the funding?
2. How far is the State involved?
3. What role do other countries play?

In Germany approximately 65% of all domestic R&D expenditures are funded by the business enterprise sector, earning Germany a place among the leading countries Japan, South Korea, and, interestingly, China. Hence, the German business enterprise sector is

<sup>8</sup> For Germany cf. Wissenschaftsstatistik (2015).

more strongly involved in R&D than for example the American one (with share of financing of slightly under 60%). The share of business-based R&D funding in Turkey amounts to approximately 49%, making Turkey rank more or less in the middle, ahead of Norway (43%) and the UK (46%), tied with Austria (49%), and slightly behind the Netherlands (52%).

The degrees of State involvement in Germany and Turkey are, relative to the total sum, more or less similar (27–29% of intramural R&D expenditures), situating both countries in the lower part of the middle range. This category is headed by Russia (67%), followed by several lesser developed countries such as Cyprus, Serbia, Greece, and Romania. But even in countries such as Norway, Spain, and Italy does the state share in funding amount to more than 40%.

Foreign R&D funding in the business enterprise sector is not very common.<sup>9</sup> With slightly above 5% in Germany and a mere 0.8% in Turkey, the overall share of foreign funding is rather low in both countries. However, a look at other countries reveals that this is quite common: Foreign shares in Japan and Korea amount to significantly less than 1%, and 3.8% in the US, which raises the question as to why.

Countries with a low degree of foreign funding can be roughly divided into two groups.

1. Countries focusing more on the export of R&D: Globally operating enterprises tend to conduct their own research globally as well. If these enterprises are, for example, relatively centrally organized, R&D is more likely to be exported from these countries than imported.<sup>10</sup> The US and Germany are typical representatives of this category.
2. Countries with enterprises lacking foreign partners. This appears to be the problem Turkey is facing. Czernich (2014) found that German enterprises tend not to name Turkey as an attractive target country for their R&D activities.

#### 1.4.4 Personnel

588,615 people were involved in R&D in Germany in 2013<sup>11</sup> – approximately 1.5% of the overall workforce. In Turkey 112,969 FTEs were involved in R&D, 0.5% of the overall workforce. Broken down by sectors, 61% of the German R&D personnel were employed in the business enterprise sector and 22% in the higher education sector. In Turkey the numbers were at 52 and 38%, respectively.

<sup>9</sup> On the international interdependence of R&D cf. also Czernich and Kladroba (2013) and Belitz (2015).

<sup>10</sup> On the different forms of organization of foreign R&D cf. Czernich (2014).

<sup>11</sup> R&D personnel is generally measured in form of Full Time Equivalents (FTEs). The data on the proportion of women, however, is presented as headcount, as this value was available for a higher number of countries.

The R&D survey distinguishes three personnel groups: researchers, technicians, and other supporting R&D staff. The proportion of researchers among R&D personnel was around 60% in Germany, with a relatively large range of 55% in the business enterprise sector and 76% in the higher education sector. The Turkish R&D survey presents a detailed listing of personnel groups only for the business enterprise sector. Here, the proportion of researchers amounted to 69% – significantly higher than in Germany.

An evaluation of the data according to gender revealed a proportion of women among the entire R&D personnel of 27% in Germany and 36.2% in Turkey. Considering only scientific personnel, i.e. highly qualified staff with a university degree, the proportion of women would be 28% in Germany, ranking Germany 29th in a ranking of 34 countries for which Eurostat provides R&D personnel data. Turkey ranks 17th and therefore in the middle. Just for comparison – at the top of the ranking are Latvia and Lithuania with a proportion of women of more than 50%. At least 10 of the 34 countries ranked have a percentage of women of over 40%.

It should be noted, however, that neither Germany nor Turkey are homogeneous in themselves. First of all there are considerable differences between individual sectors. In Germany the female share in scientific personnel in the higher education sector is 38%. In the business enterprise sector, it is a mere 14%. In Turkey a similar trend is noticeable, albeit at a higher level, with a 42% proportion of women in the higher education sector and 24% in the business enterprise sector. The phenomenon of a higher percentage of women in the higher education sector than in the business enterprise sector can be observed throughout all industrial nations without exception, however, with varying differences between individual sectors.

Still, both in Germany and Turkey there are also differences within individual sectors, however, with similar results. Within the business enterprise sector, for instance, the proportion of women is comparatively high in the food sector, the textile industry, agriculture and the manufacture of pharmaceuticals. The percentage of women in the manufacture of pharmaceuticals, for instance, is over 40% in Germany and even over 65% in Turkey. Traditional industries such as the manufacture of electrical and optical equipment, the manufacture of machinery, and the manufacture of motor vehicles on the other hand have a low female share in the overall workforce, with less than 10% in Germany and approximately 15% in Turkey.<sup>12</sup>

There is, however, a noticeable difference between Germany and Turkey in regard to the proportion of women in the higher education sector broken down by fields of science. In Germany medicine, agricultural sciences, the humanities and the social sciences have a high percentage of women (over 40%, partly also over 50%). At the bottom end of the ranking are the STEM subjects, with a proportion of women of only 20–30%. A more homogeneous emerges in Turkey. With a good third, the lowest proportion of women can

---

<sup>12</sup> For a comprehensive representation of R&D personnel within the German business enterprise sector cf. Schneider and Stenke (2016).

be found in agricultural sciences and engineering sciences. The other fields of science feature a percentage of women of more than 40%, again with medicine at the top (48%).<sup>13</sup>

It is also interesting to compare the development over time of the proportion of women among scientific personnel in Germany and Turkey. During the last ten years since 2003 the percentage of women in Turkey has remained largely unchanged. Germany, on the other hand, has seen an increase from below 20 to 27% which, however, is attributable only to the public sector. The public employers' attempt to integrate more women into academic life has been successful to a certain extent. With an 8% increase Germany has played one of the leading roles in an international comparison. In the private sector, however, there has only been a mere 3% increase to 14%.

### 1.4.5 R&D in the Business Enterprise Sector

In 2013 €53,566.2 million were spent on intramural R&D in the German business enterprise sector – approximately two thirds of all R&D expenditures. After many years of continuous growth, expenditures stagnated for the first time and were at roughly the same level as the previous year, with a slight 0.4% minus.<sup>14</sup> German R&D is dominated by the manufacturing industries, accounting for more than 85% of the entire intramural R&D expenditures in the German business enterprise sector. This makes Germany the undisputed leader among the industrial nations, followed within the EU by Italy, Finland, and Sweden with 70–72%. The end section consists of, inter alia, Norway, with less than a third. Bulgaria brought up the rear with 14%. The other side of the coin is, of course, a correspondingly small proportion of the service sector to the overall German R&D activities.

A breakdown by industries reveals that German R&D is largely dominated by the automotive industry (Fig. 1.5). Nearly a third of all intramural R&D expenditures in 2013 can be attributed to car manufacturers and their suppliers. This value has remained largely unchanged for many years.

As expected, a comparison between Germany and Turkey yields various differences, but also some unanticipated parallels. Similarities include the facts that

- the Turkish business enterprise sector, too, has been steadily growing for many years, albeit in total at a considerably higher rate than the German one.
- with slightly under 9% the growth between 2012 and 2013 was, compared over many years, below-average (as mentioned before, this period saw a stagnation for Germany).

---

<sup>13</sup> For a detailed structural analysis of women at higher education institutions (including an international comparison) cf. Ihnen (2014).

<sup>14</sup> The Wissenschaftsstatistik (2015a) provides a comprehensive set of figures on R&D within the German business enterprise sector. Analyses into that matter can be found in Wissenschaftsstatistik (2015b).