



**Leopoldina**  
Nationale Akademie  
der Wissenschaften

**Discussion Paper**

# The Sustainability of the German Science System

Supporting the Future Development of Research,  
Teaching and Knowledge Transfer

German National Academy of Sciences Leopoldina

[www.leopoldina.org](http://www.leopoldina.org)

# Table of contents

<b>Foreword.....</b>	<b>2</b>
<b>Introduction .....</b>	<b>4</b>
<b>Six challenges for the German science system .....</b>	<b>13</b>
<b>Summary.....</b>	<b>38</b>
<b>Annex.....</b>	<b>41</b>
Production of this statement.....	41
Sources .....	43

## Legal Information

### **Publisher:**

Deutsche Akademie der Naturforscher Leopoldina  
– Nationale Akademie der Wissenschaften –  
Jägerberg 1  
06108 Halle (Saale)

### **Editors:**

PD Dr. Stefan Artmann  
Dr. Constanze Breuer

### **Design and Setting:**

unicom Werbeagentur GmbH, Berlin

### **Printing:**

H. Heenemann GmbH & Co. KG, Berlin

**Edition (09/2013):** 800

© Deutsche Akademie der Naturforscher Leopoldina  
– Nationale Akademie der Wissenschaften –

## Foreword

Recent successes in the development of the German science system have generated significant debate on the immense challenges that must be surmounted to enhance its performance and improve its capacity to serve the public good. This debate touches on fundamental financial, legal, and organizational aspects of research, teaching and knowledge transfer. Both the international standing of the German science system and the appeal of its career pathways are at stake.

As pleasing as this heightened interest on the part of policy circles and the German public may be, all those involved in this debate must consider that far-reaching decisions need to be taken in the months and years ahead if Germany is to continue on its path towards a “Republic of Science” in which researchers are empowered to make the greatest possible contribution to the growth of knowledge and our quality of life.

As the German National Academy of Sciences, the Leopoldina has a responsibility to contribute to this debate on the future of the German science system from an independent perspective. As a scholarly society, the Leopoldina is charged with providing scientifically informed advice both to policy-makers and to the public. Within this role it has the responsibility to comment on future developments in the fields of research, teaching and knowledge transfer. Maintaining the material and non-material conditions necessary for outstanding research and advocating for their expansion are among its central tasks.

The National Academy of Sciences can only fulfil its mission to represent the interests of the German science system as a whole if its members actively engage in discussions on matters of science policy in order to arrive at a common position. This discussion paper was prepared by the Presidium of the Leopoldina with the aim of generating debate on these issues.

Focussing on the role of universities as the linchpins of the science system in Germany, the discussion paper spans six central issues: the funding of research, teaching and knowledge transfer; the operative legal environment of the German science system; cooperation between scientific institutions; its international visibility; career pathways for researchers; and the role of the academies in the science policy debate.

The discussion paper focusses on specific aspects of these issues which are crucial to the debate. Several issues – some of which are currently the subject of controversy – are not addressed here. These include matters relating to tuition fees, rankings, the structure of research funding and the division of responsibility for science policy within the executive branch. An international comparative perspective and an historical review of the development of the German science system would represent valuable additions to this discussion paper. Non-university institutions are not analysed in detail here, nor is the important role of interdisciplinarity in research, teaching and knowledge transfer considered in a systematic manner.

It is my firm hope that the paper will contribute to debate on science policy within the Leopoldina and will benefit the Academy’s discussions with other science policy stakeholders.



*Jörg Hacker*

*President of the German National Academy of Sciences Leopoldina*

# Introduction

There is a growing awareness within the political and public arenas of the immense importance of the science system in safeguarding the prosperity of our society and its various forms of participation. Against this background, the conclusion of several important funding initiatives provides an opportunity to address key issues in the funding and organization of the German science system. The time has come for us to take stock of our achievements and engage in a strategic debate on the medium- and long-term prospects for science in Germany. On the one hand, we should seek to build upon the positive developments that have resulted from the Higher Education Pact, the Pact for Research and Innovation, and the Excellence Initiative for cutting edge research at institutions of higher education and to enhance their impacts through further measures. On the other, efforts should also be made to correct negative developments.

Within this debate, the primary objective must be to ensure that the German science system continues to improve its performance across research, teaching and knowledge transfer, while significantly enhancing its international competitiveness. This is fundamental to ensuring the further development of our knowledge society over the long term. Knowledge that is validated in accordance with the standards of science and is used in the production, validation and dissemination of research findings plays an outstanding role in key areas of our society. In that sense, the modern knowledge society may well be regarded as a “science society”. Here are just four examples:

- In the *political sphere*, decision-making processes are increasingly engaging with highly complex issues of broad societal relevance with significant scientific components (e.g. the planning and implementation of the German energy transition, the development and applica-

tion of biotechnological and biomedical procedures, or the analysis and development of policy with respect to demographic change). This development has been paralleled by demands for greater transparency and scrutiny of expertise that informs policy. There is a clear trend towards a more comprehensive involvement of citizens in political processes. Within this context the expertise of scientists plays an increasingly important role in democratic decision-making processes. Corresponding to the aim of science based policy advice this is not least to highlight the relationship between social and ethical objectives and the scientific state-of-the-art.<sup>1</sup>

- New scientific and technological developments are more rapidly becoming integral elements of our *social environments* (including private and professional spheres). Recent examples of this trend include social communication media and biomedical innovations. In order that the pervasive presence of science and technology within our social environments does not have an alienating effect, it is especially important that citizens are able to create meaningful connections between scientific insights and technological innovations on the one hand, and their everyday lives and ethical-moral attitudes on the other.
- The German *economy* cannot maintain its position at an international level without highly qualified employees, their resourcefulness and the adherence to the highest standards of quality. Research-intensive sectors such as mechanical engineering and the chemicals industries – both important drivers of export performance within the German economy – exemplify this. Within the modern knowledge society, employees across all economic sectors must be prepared to build on their primary qualifications by engaging in processes of life-long learning and be granted access to appropriate learning opportunities in order to cultivate creativity and productivity within both professional and personal spheres. Individuals who

<sup>1</sup> For a discussion of good science-based policy advice, see Weingart et al. (2008).

are well-qualified and engage in further training enjoy greater success in our society: this is reflected in relative income levels as well as overall well-being and health.<sup>2</sup>

- The societal impacts of science, the growth of knowledge and its substantive and institutional differentiation present *science* with significant challenges that can only be surmounted when its relationships to other areas of society are examined using the methods of scientific enquiry, thus allowing a more substantiated approach to the management of these relationships.<sup>3</sup> Beyond this, the science system itself is called upon to maintain a constant watch on its internal mechanisms for self-governance, quality assurance, early career support and the provision of equal opportunities in employment and to reform these in light of the current state of scientific knowledge.<sup>4</sup>

These and other examples indicate that Germany must not only make efforts to establish itself as an “education republic”<sup>5</sup>, but must also seek to drive the development of a “science republic”<sup>6</sup>. On the basis of an advanced understanding of the mode of operation and the boundaries of science, its output should be used in a responsible manner to identify solutions to challenges faced by our society. The political will to maintain and develop a well-functioning and internationally competitive science system in the interest of the greater good is fundamental to this endeavour.

2 See, for example, data gathered annually by the OECD on the economic and social dividends of investment in education (OECD 2012a).

3 Efforts to establish a *science of science policy* are notable in this respect (see Husbands Fealing et al. 2011).

4 See for example the policy recommendations in Stock et al. (2012), p. 425f.

5 See Presse- und Informationsamt der Bundesregierung (2012).

6 The concept of a “Republic of Science” was put forward in the science policy debate of the early 1960s by Michael Polanyi (1962).

The goal of devoting 3% of gross domestic product to expenditure on research and development, as formulated by the European Council within the framework of the Lisbon Strategy (2002), provides an initial indicator as to whether Germany is on the right track towards providing its science system with the necessary political and financial support.<sup>7</sup> However, the 27 Member States of the European Union failed to achieve this goal by 2010, allocating on average just 2.0% of GDP to research and development.<sup>8</sup> In global terms, several countries surpassed the 3% mark in 2010; this group of countries includes Sweden (3.4%) and Finland (3.88%), Japan (3.26%) and South Korea (3.74%), and Israel (4.40%).<sup>9</sup> This has led to calls that Germany should not be constrained in its policy-making by the 3% benchmark, and that it should aspire to be among the leading global players.<sup>10</sup> According to this line of thinking, 3.5–4.0% of Germany’s gross domestic product should potentially be devoted to investment in research and development at present.

In 2010, investments in research and development in Germany amounted to €69.7 billion, accounting for 2.82% of gross domestic product, a new all-time high. Of this, €46.9 billion was invested in the business sector, €12.6 billion in higher education and €10.2 billion in non-university and governmental research institutions. However, investments totalling a further €4.7 billion would have been necessary in order to achieve the objective of 3% of gross domestic product.<sup>11</sup> Thanks to growing public and private investment in research and development, Germany is well on the way to closing this gap. In 2011, expenditure on research and development totalled €74.6 billion; raising the share of these investments to 2.9% of gross domestic product.<sup>12</sup>

7 See Europäischer Rat (2002), p. 20.

8 See Eurostat (2012).

9 These figures are quoted from: OECD (2012b).

10 See Expertenkommission Forschung und Innovation (2012), p. 20, and Expertenkommission Forschung und Innovation (2013), p. 21.

11 These figures are quoted from: Expertenkommission Forschung und Innovation (2012), p. 20 and p. 34.

12 See Bundesministerium für Bildung und Forschung (2012).

Whether Germany elects to set its sights on a cautious 3% or a more ambitious 4%, statistical benchmarks of this kind are useful only as an initial point of reference in discussions on future science policy. Greater investments in research and innovation are a necessary prerequisite for the further development of the science system. However, clarity must be achieved in the relative engagement of private sector entities, universities, non-university and federal departmental research establishments in these investments, and recommendations developed to ensure that financial resources are invested in a fruitful manner. What fundamental decisions with respect to science policy should be taken now to ensure that the science system can make a lasting contribution to the future of Germany?

In undertaking strategic planning for the future of the German science system, policy-makers must identify those institutions whose development is crucial to ensuring the capacity of the science system to respond to the challenges of tomorrow. The most important institutional components of the German science system are our universities:

- Both positive and negative trends within the German higher education sector have far-reaching consequences for the entire national science system. This is due primarily to the role of universities as institutions that bundle expertise in teaching, research and the transfer of knowledge. Our universities combine the education of future generations of scientists with the production of new knowledge and its dissemination to society. Universities facilitate the ongoing practice of science while stimulating development across society through their output. The diversity of the German university landscape – a product of the unity of research and teaching in its various implementations – is an important prerequisite for this.
- It must also be noted, however, that Germany's universities are in a critical state. The capacity of universities to fulfil their crucial roles in teaching, research and knowledge transfer is under threat; this in turn endangers their indispensable contribution to the future of

Germany. In their role as educational institutions in particular, universities face growing challenges in fulfilling their responsibility towards society: entry rates to tertiary level institutions are climbing<sup>13</sup> and students from diverse education backgrounds enter university with increasingly divergent expectations that existing programmes are unable to meet. Reducing drop-out rates, enhancing labour market matching, creating more efficient transitions between first degree and lifelong learning programmes, and improving the integration of international students are among the central challenges faced by universities today. At present, however, those concepts that have been developed in response to these challenges to reshape the organization of teaching, research and knowledge transfer at university level<sup>14</sup> must prove their worth within a financial environment that can only be characterized as one of structural underfunding.

Universities are the foundational institutions of the German science system. Therefore, strategic debate on the system's future should focus on ensuring the continued operation and further development of the universities within its wider growth. This is in no way intended to detract from the value of other forms of higher education and institutions within the science system (universities of applied sciences, for example). On the contrary, the various qualities that set these institutions apart from universities enhance the ability of the German science system to respond to the increasingly diverse demands placed on research, teaching and knowledge transfer.

The transformation of the science system in recent decades within an emerging modern knowledge society is set to continue. It requires that steps be taken now to ensure that universities are equipped with the capacity to respond to this challenge in future. The key challenges in se-

<sup>13</sup> The proportion of (German and foreign) university entrants in Germany within the relevant age bracket was 30.2% in 2000 and 46.5% in 2011 (see Statistisches Bundesamt 2012a, p. 14).

<sup>14</sup> See, for example, the joint position paper published by the Stifterverband für die Deutsche Wissenschaft and the Heinz Nixdorf Stiftung, Reichert et al. (2012).

curing the development of teaching, research and knowledge transfer capacities over the long term relate to six interlinking fields of activity:

### 1. The funding of research, teaching and knowledge transfer

The present debate is understandably shaped by discussion on the approaching conclusion of key funding programmes and the impact thereof on the structure and funding of the German science system. The funding programmes in question comprise the first and second pillars of the Higher Education Pact (the programme for the admission of additional university entrants and programme allowances for projects funded by the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG), which concludes in 2015); the Pact for Research and Innovation (concludes in 2015); and the Excellence Initiative (concludes in 2017). For the universities, this prospect raises important questions about the relationship between basic and third-party funding, and about the eventual establishment of other special funding lines following the conclusion of the Excellence Initiative.

### 2. The legal framework of the German science system

In addition to the funding of research, teaching and knowledge transfer, the legal environment within which the science system operates forms a focal point of discussion. Two issues dominate this debate. The first is the question of how science institutions – including universities – might be afforded the necessary scope for independent planning. The second is the nature of the legislative changes necessary to improve cooperation between federal and state governments so as to develop the science system.

### 3. Cooperation between science institutions

In addition to the aforementioned financial and legal aspects, differentiation within the science system itself raises important structural issues. Given the institutional and disciplinary diversity that characterizes the German science system, the challenge here lies in developing effective, efficient and sustainable strategies that facilitate

closer cooperation and the establishment of networks within and between institutions to promote synergies and healthy competition. Within this context, various questions also arise about the prerequisites, opportunities for and risks of inter- and trans-disciplinary cooperation.

### 4. The international visibility of German science institutions

The German science system faces the challenge of building a stronger strategic position within the global competition for financial and intellectual resources. This will require considerable efforts to raise the appeal of German research institutions to leading scientists and, equally, to enhance the capacity of German universities to attract foreign students in larger numbers. Addressing these issues will, among other things, call for a realistic evaluation of the progress achieved in the Bologna Process and the development of strategies to increase the visibility of German universities at an international level.

### 5. Career pathways for scientists

Another issue that is crucial to the future of the German science system relates to the design of the career pathways available. The globalized knowledge society presents highly qualified personnel with an increasing number of opportunities to exit national science systems. In response to this, science institutions must critically evaluate the career opportunities presented to young researchers from a life planning perspective.

### 6. The role of the academies in the science policy debate

Developing a coherent strategy that will deliver lasting improvements in the performance of the German science system, and its universities in particular, will require a comprehensive analysis that takes into account the complex links between funding, legislative environments, cooperation, internationalization and career pathways. The successful development of this strategy will depend not least on the particular understanding of science adopted by stakeholders

in science, politics and other areas of society. Discussions relating to this will by necessity extend to the role played by the participating institutions in democratic consultation and decision-making processes about issues pertaining to science. Within this, the German National Academy of Sciences Leopoldina and other German science academies will bear considerable responsibility.

The long-term prospects for research, teaching and knowledge transfer in Germany are currently the subject of intense debate among science institutions. The German Council of Science and Humanities (Wissenschaftsrat) discussed its recommendations on these matters in April 2013.<sup>15</sup> This statement by the German National Academy of Sciences Leopoldina emphasizes the need to reframe the development of the German science system as a collaborative undertaking that will require a strategically coordinated effort on the part of all relevant stakeholders. Focussing on universities as a key infrastructure of the German science system, this paper highlights those fields of science policy in which it is necessary for the science community and policy circles to pursue joint action.

<sup>15</sup> See Wissenschaftsrat (2013), p. 16.

## Six challenges for the German science system

**1. Universities are the linchpins of the German science system. The extent of their continued underfunding threatens to undermine the system. Addressing this issue will require sustainable changes in their funding.**

### *1.1 Urgent action must be taken to improve basic funding allocated to universities to safeguard the high quality of the science system.*

Universities continue to comprise the most important institutional components of the German science system. Their current state of underfunding is widely deplored. It is indisputable that the 'Länder' (federal states) – to whom responsibility for universities in Germany is entrusted – are unable to rectify this state of affairs without external assistance (particularly in light of their varied financial circumstances). Basic funding allocated to universities must be improved to safeguard the quality of the German science system – both at an international level and because of global competition. Between 1998 and 2009, basic funding delivered to universities rose from €12.6 billion to €15.5 billion, an overall increase of 23%. Third-party funding, however, grew by over 100% across this period, from €2.5 billion to €5.3 billion.<sup>16</sup> The aim must therefore be to restore the balance between basic and third-party funding. This will by necessity require an increase in basic funding to enable universities to deliver successful teaching programmes and maintain their ability to acquire third-party funding.

It would be wrong to view universities as mere passive recipients of state funding. Indeed, their role in the coordination and maintenance of the highest standards in teaching, research and knowledge transfer demands

<sup>16</sup> See Deutsche Forschungsgemeinschaft (2012), p. 29.



that they be recognized as crucial institutions in which the best possible conditions for producing new knowledge and qualifying of knowledge-holders in Germany should prevail. Expenditure on universities is a necessary investment in safeguarding Germany's future prosperity. Universities should therefore seek to gain greater recognition as an economic factor, and endeavour to raise awareness of their contribution to the education of highly qualified personnel and the resulting transfer of knowledge. Applied research and educational programmes with relevance to the labour market should, however, continue to represent only one aspect of scientific activity at university level. Overall, individual universities must seek to combine discussion on funding issues with the development of robust concepts for their future organization, so that they are enabled to extend and use their capacities for the benefit of society.

*1.2 Institutions recently established under the Excellence Initiative that meet with success in their activities should be maintained and developed further.*

Some universities have found significant financial relief through the Excellence Initiative, across all three funding lines. It is of great importance that Germany safeguards and builds upon the positive outcomes of this funding initiative. This is because its effects are not restricted to those institutions that are ultimately the recipients of funding: they also extend to those that conducted internal reviews of their strengths and weaknesses in efforts to secure funding through it. Through their expertise and organization, institutes and institutions distinguished by the title of "excellence" set new standards to which others may aspire. It is also worth noting that the international appeal of these first-class institutions (as seen in the USA and the UK) has a positive effect on the standing of other institutions, leading to a more favourable perception of the German science system in the long term.<sup>17</sup>

The structural funding of graduate schools and clusters of excellence has proved a success and should be maintained on a permanent ba-

<sup>17</sup> For international perspectives on excellence initiatives, see Wespel et al. (2012).

sis. For instance, this could be as part of the portfolio of programmes administered by the DFG, which has delivered funding to similar institutions through its Research Training Group and DFG Research Centre funding lines. The so-called "overhead allowance" – currently allocated to cover indirect additional costs – should also be raised substantially (to a level of at least 40%) to ensure that the successful operation of these institutions does not impact negatively on university budgets and to afford universities greater scope in financial matters. As the delivery of funding through the Excellence Initiative will cease in 2017, those projects that first received funding in the second round should be given the opportunity to apply for a second period of funding. The financial resources necessary to allow this should be allocated to the DFG as additional funding.

The promotion of excellence in larger organizations – whether in the areas of teaching or research – should be flanked by efforts to promote excellence on a smaller scale. This implies that in some areas of research smaller units are better placed to deliver findings. A failure to develop funding formats of this type (e.g. DFG Research Units) further will increase the likelihood that universities – irrespective of their size – will soon be unwilling and unable to afford excellence in research on a small scale.

In addition to this, it is important to maintain proven forms of funding for the promotion of excellence such as Collaborative Research Centres and coordinated Priority Programmes, which are suitable for implementation at small and medium-sized universities. These measures should be implemented with the aim of averting the potential evolution of small and medium-sized universities into purely teaching universities over the short or long term. Conversely, these universities must seek to show that excellence in research and the development of innovative methods is not the exclusive remit of larger universities; they could do this, for example, by specializing on particular research topics that are also suited to interdisciplinary research. Different research environments provide incentives for different people and topics. The failure of

small and medium-sized universities to achieve this would endanger the diversity of the German university landscape – one of the strengths of the science system – by concentrating excellence funding at a few locations.

Complaints by researchers that the diverse requirements of application and evaluation processes have a negative impact on their ability to conduct actual research should be taken into account in developing new forms of funding. Efforts should therefore be made to encourage further the practice of dispensing funding for more extensive periods to projects directed by leading researchers.<sup>18</sup>

### *1.3 Universities should intensify their efforts to access funding from international and non-state sources.*

It is not unreasonable to assume that the federal government will be unable to address the underfunding of German universities as a whole, and will instead direct its investments in basic and applied research towards universities and non-university institutions with the potential to perform at an international level. Universities will therefore need to investigate ways of attracting alternative funding sources in future.

Although the high level of participation and success enjoyed by German universities in the European Framework Programmes is pleasing, a comparison with other states reveals scope for further development. Accordingly, universities should, as a matter of course, seek to acquire funding both through national and European funding instruments in future.<sup>19</sup> Previous efforts to support applications by German researchers for grants from the European Research Council (ERC) are commend-

<sup>18</sup> The Reinhart Koselleck Projects, for example, are an important point of reference in this context; the financial resources assigned to the respective funding lines would need to be increased, however.

<sup>19</sup> The existing hierarchy of national, European and other international sources of funding is as yet too pronounced. In 2010, for example, universities derived 36.3% of their third-party funding from the DFG and 21.5% from the federal government, but just 9.3% from the European Union and 1.0% from international organizations (see Statistisches Bundesamt 2012b, p. 127).

able. These efforts should be complemented by steps to increase significantly the proportion of foreign researchers undertaking research at German universities on the basis of ERC grants.<sup>20</sup> The increased use of transnational funding resources is made all the more plausible by the growing coordination of national science policies, which are increasingly dependent on the coordination of research at an international level to address cross-border challenges.

In recent years, partnerships uniting universities, enterprises and foundations have attracted greater attention.<sup>21</sup> The funding of research through cooperation models of this form requires that parties observe the rules of good practice and maintain transparency. Likewise, incentives must be provided to researchers to engage in entrepreneurial activity that will also benefit their respective universities. In this respect, universities should continue to professionalize their activities, identify creative potential and support the transfer of knowledge.

Universities must seek to hone their institutional and/or subject-specific profiles, and would benefit from providing greater detail on the profiles of their graduates. Doing so could both highlight the relevance of their programmes to labour markets and allow universities access to new funding sources by way of particular groups of graduates. In implementing supplementary funding measures of this type, care must be taken to ensure that a convergence of interests between universities and the business sector does not impact on the focus and content of research and teaching to the extent that these are primarily directed towards business interests.

In light of the regard with which German universities are held on the international stage owing to their high standards in teaching, research and knowledge transfer, universities should seek to support the opportunities for distance and lifelong learning processes created by the

<sup>20</sup> See Deutsche Forschungsgemeinschaft (2012), p. 58f.

<sup>21</sup> See Mora et al. (2012).

emergence of new communication technologies by strengthening their engagement in the further education sector. In academic further education, for example, university and non-university partner institutions in Germany and abroad could collaborate in developing new teaching concepts and contents tailored to labour market requirements for delivery on e-learning platforms as Massive Open Online Courses (MOOCs). These considerations should look to expand the range of academic education services and ensure their links with currently available undergraduate programmes in order to meet the highly differentiated demand for educational services at an international level and to support the development of science, the economy, and society by ensuring the availability of highly qualified graduates of all ages.

**2. Unnecessary legal obstacles hinder the development of the German science system at present. Key legal frameworks should be amended to increase its scope of action.**

*2.1 Article 91b of the Basic Law of the Federal Republic of Germany must be reformed to enable the federal government to provide direct funding to institutions for research and teaching at universities.*

The successful transformation of old institutional structures and the establishment of new ones within the science system require legal frameworks that are both reliable and appropriate to the task. This is true both of special legislation (e.g. the Genetic Engineering Act – *Gentechnikgesetz*) and the general legal environment within which the science system operates.

The federal and state governments are engaged in intense discussions on the amendment of Article 91b of the Basic Law, but have been unable to reach an agreement so far. However, the impact on the successful development of the German science system of enabling federal and state governments to jointly fund “projects” as well as “institutions” at universities can hardly be overestimated. Science needs legislation that facilitates and does not impede cooperation. The implementation of legislation conducive to achieving this should not be conditional on the resolution of other issues relating to Article 91b of the Basic Law.

In the wake basic law amendments, new formats of institutional funding could be developed by the federal and state governments in collaboration. The amendment to the Basic Law should place universities and non-university institutions on an equal footing in their efforts to access indirect institutional funding lines administered by the federal government. However, it is important to note that the amendment to Article 91b of the Basic Law is just one of the prerequisites for the further development of the German science system, as federal financial resources must still be directed to structures that are deserving of funding in the respective facilities.

Another aspect of Article 91b relates to the construction of universities. With the reform of the German federal system on 1 January 2007, responsibility for the construction of universities, previously shared by federal and state governments, passed to state governments. In the transition period leading up to 2019, €700 million in compensation will be made available to state governments annually through federal sources in accordance with Article 143c of the Basic Law. Although use of these funds will be restricted to particular purposes until 2013, their allocation within the respective *Länder* is difficult to track. Under Article 91b Section 1 No. 3 of the Basic Law, the federal government is allowed to contribute to the funding of large-scale research facilities – including major instrumentation – at universities. The federal government should, however, be afforded the opportunity to contribute to the funding of construction projects at universities – subject to a ceiling of 100% – in keeping with previous practice. This would provide greater security and flexibility in funding issues given the financial uncertainties faced by state governments and, by default, universities.

### *2.2 Universities should give greater precedence to the further development of their governance structures.*

The university of the future will be characterized by an increasing degree of autonomy within the context of traditionally strong self-administration structures. To address the diverse challenges that will result from this, an intelligent governance model must be developed with the aim of increasing efficiency and enabling greater agility in academic self-administration while reducing the diffusion of responsibility.

Changes to the legal framework within which universities operate should therefore not be restricted to improving federal financial support. Universities should increase their efforts to evaluate previously trialled governance structures that could be implemented under various legal forms (e.g. foundations). Additionally, a legal framework is required that would enable universities to make optimal use of any private assets made available to them, thereby facilitating the diversification of funding sources (see 1.3).<sup>22</sup>

<sup>22</sup> See Expertenkommission Forschung und Innovation (2012), p. 44f.

**3. The diversity of the German science system, in terms of its institutional structures and areas of research, holds immense potential for development. Scientific institutions could enhance their use of available material and intellectual resources through greater cooperation to exploit this potential better.**

#### *3.1 Models of closer cooperation in the areas of research and teaching between university and non-university institutions at jointly operated major infrastructure centres to which both parties enjoy equal access should be developed, trialled and embedded within appropriate legal frameworks.*

The institutional diversity and broad spectrum of research undertaken within the German science system represents an immense potential for the growth of knowledge. Steps must be taken to ensure that this diversity does not result in disciplinary or organizational fragmentation, thereby safeguarding the generation of new knowledge and innovation, which remains the purpose of all research. Here too, the objective must be to facilitate rather than impede cooperation in science (see 2.1).

Discussion on the third funding line of the Excellence Initiative – directed towards funding relating to future concepts of universities – has frequently focussed on cooperation between university and non-university research institutions. With the support of federal funding, new models of cooperation and integration with the capacity to adapt to existing local structures, rather than the reverse, must be implemented. Universities should be enabled to access and use the resources of non-university research institutions within their respective regions as necessary. The aim must be to enable universities to tap into the benefits of non-university research (which are undisputed at an international level) and to strengthen universities, rather than allowing them to bleed out.

Irrespective of the amendment to Article 91b of the Basic Law, several other legal obstacles to successful cooperation between non-university

and university facilities exist, which must be overcome to the mutual advantage of both.<sup>23</sup>

This could involve, for instance, the establishment of new funding measures that would target well-equipped infrastructure centres with strong international profiles and which are jointly operated by universities and non-university institutions. Demand for centres of this kind is no longer limited to the fields of physics, engineering and chemistry. Within the life sciences, there is a clear need for centres of this kind in the wake of the biotechnology revolution, whether for the production and evaluation of gene sequences and protein patterns or to facilitate the rapid establishment of new research areas, such as systems biology and synthetic biology. To manage costs and keep pace with international research developments, the possibility of addressing these needs through European or transnational infrastructure projects should be considered.

Certain research areas in the social and behavioural sciences also require costly infrastructure: for example, for the collection, maintenance and analysis of panel data. Similarly, in the humanities and social sciences one could think of well renowned, university-based centres for digital humanities and editing of texts.

The funding of new infrastructure centres should not be restricted to instrumentation and buildings. Rather, its scope should extend to include other measures, such as research and management, as these ultimately ensure the smooth operation of infrastructure centres, while also driving their development, preserving technical expertise and providing a professional framework for the transfer of knowledge into practice. In addressing these funding issues, recourse should be made to the EU infrastructure funding programme, which will be continued in *Horizon 2020*, the 8<sup>th</sup> European Union Framework Programme for Research and Innovation.

<sup>23</sup> For a detailed proposal, see Hoffmann (2012), p. 32ff.

### *3.2 Incentives should be created to preserve diversity in research as a key structural feature of the German university landscape.*

Not only are the current changes in the German science system compelling individual institutions to hone their profiles, but they also require that the profiles of individual disciplines be more clearly articulated, within national and international contexts.

The example set by the so-called “fringe subjects” offers a good role model within this process. These subjects have been forced to grapple with profound changes in higher education systems. In the course of the Bologna Process, in particular, they have developed strategies to ensure their preservation, focussing consistently on internationalization and inter-disciplinarity. Although historically evolved academic cultures are easily destroyed, their reconstruction is a laborious task. As a whole, the “fringe subjects” illustrate in an exemplary manner how scientific disciplines can benefit from an institutional shift towards greater inter- and trans-disciplinarity by bundling specialized expertise to address current developments and structural issues.<sup>24</sup>

<sup>24</sup> See Hochschulrektorenkonferenz (2012). For example, the German Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung, BMBF) has made the strengthening and development of centres for regional studies a funding priority, with the explicit aim of strengthening existing expertise and excellence within the “fringe subjects” in Germany, raising their international visibility and improving their use.

**4. The German science system should adopt a proactive approach in its engagement with the new opportunities for research, teaching and knowledge transfer presented by rapid globalization and therefore improve the strategic coordination of its international activities.**

*4.1 German science institutions could develop joint strategies for international cooperation and align their respective activities with these strategies.*

Previous efforts to enhance the visibility of German science abroad are to be commended. These initiatives include various cooperation projects by non-university research institutions (e.g. the Max Planck Centers) and the offices of research funding organizations (e.g. DFG offices abroad), the activities of German universities abroad (e.g. TUM Asia), the establishment of Houses of Research and Innovation within the framework of the Research and Academic Relations Initiative of the Federal Foreign Office, and the federal government's internationalization strategy.

To coordinate these activities in future, joint strategies must be developed and implemented in cooperation with the respective ministries. The strategies must ensure that the entire German science system is represented at an international level and enable existing institutions abroad to emerge as hubs for the exchange of researchers. Potential conflicts of competence and instances of unilateralism within science policy will need to be overcome in the interest of facilitating effective joint action.

More generally, the debate in recent years on research and academic relations policy and foreign science policy must continue and therewith contribute to the development of coordination strategies for the entire German science system.<sup>25</sup> Positive outcomes in this area could enhance

<sup>25</sup> See Stiftung Wissenschaft und Politik/ Alexander von Humboldt Stiftung (2007) and Schütte (2008).

the effectiveness and efficiency of international coordination to define common goals and fields of activity in science policy.

As a matter of course, the responsibility for representing the German science system on the global stage also involves that its institutions, major science organizations in particular, must be willing to submit to the coordinated systemic evaluations conducted by relevant international boards and commissions on a regular basis.<sup>26</sup>

*4.2 Germany should seek to emphasize its reputation as a science society on the international stage.*

International studies predict far-reaching changes in the global science system in the coming decades.<sup>27</sup> Outstanding researchers in particular will be drawn more strongly than before towards those countries and facilities that offer the most attractive conditions. These conditions are not limited to financial resources, but include other factors such as the overall quality of life and a social environment that is liberal, science-friendly and culturally diverse.<sup>28</sup>

In future, a greater emphasis should be placed on internationalization in filling vacancies, especially professorships. This is especially true for universities that have the potential to occupy leading positions in major education and research rankings. It is also notable that greater mobility between higher education, the private sector and other sectors of society exists abroad than is the case in Germany. Efforts should therefore be made, for example, to facilitate the mobility between the academic and industrial sectors, in particular of foreign researchers.

Similarly, it must be Germany's aim to encourage greater numbers of talented foreign students to study in Germany, preferably with the start of

<sup>26</sup> For example, evaluations of the kind conducted under the International Review Panel for Systems Evaluation of the German Research Foundation and the Max Planck Society (1999).

<sup>27</sup> See Royal Society (2011).

<sup>28</sup> See van Noorden (2012).

their Master's degree. In addition, appropriate linguistic and legal environments must be established to retain the best researchers in Germany after the completion of their qualification phase. This concerns in particular various issues relating to the right of residence, for example the lowering of income thresholds applied in connection with residency permits.<sup>29</sup>

#### *4.3 The internationalization of German universities within the framework of the Bologna Process must be continued through the implementation of structural adjustments.*

The widespread trend towards the internationalization of university education has also resulted in significant changes in education structures in Germany with the introduction of Bachelor's and Master's degrees, while improving the comparability of higher education qualifications within the global context. The implementation of this structural measure and the resulting growth in student numbers have led to changes in the courses of study available at German universities, particularly Bachelor's programmes. The difficulties associated with the Bologna Process should be resolved in a timely manner through the implementation of appropriate corrective measures. This would ensure that internationalization is not achieved at the price of sacrificing quality in education, an outcome that would in turn diminish the appeal of German universities compared with those abroad.

The central challenges are: degree programmes with insufficient scope that hinder a change of universities; inordinately brief orientation and talent identification phases; and the excessive number of short-term examinations entailing a disproportionate administrative burden. Corrective measures that might be implemented – provided the “fast-track Abitur” (after 8 years of secondary schooling) were to be introduced nationwide – include extending Bachelor's programmes from three to four years while retaining the two-year Master's model and enabling especially talented students to start doctoral studies directly after the completion of a Bachelor's degree.

<sup>29</sup> See Expertenkommission Forschung und Innovation (2012), pp. 70–72.

#### *4.4 The international appeal of German universities should be raised through the delivery of tailored support measures to selected facilities.*

As a leading industrial nation, Germany cannot afford to perform below its potential in international rankings of leading universities over the long term, not least because institutions of this calibre add to the wider appeal of Germany as a centre of scientific endeavour (see 1.2). Every effort should therefore be made to ensure that several of our universities match the performance of leading universities in the United Kingdom, Switzerland, the United States of America and some Asian countries. Achieving this goal will require structural changes in several areas, including regulations governing university capacity, admission/funding ratios, staffing ratios and selection procedures for students, education and qualification opportunities, the prerequisites for cutting-edge research, university hierarchies and administrative structures, and financial resourcing.

Within ongoing efforts to enhance the international visibility of the German science system, current discussions on the establishment of graduate universities and “federal universities” should continue to ascertain whether these models are likely to mobilize the financial resources necessary to promote the development of top-ranking universities. The right to award doctoral titles must remain the privilege of universities, however. Successful examples such as the International Max Planck Research Schools and similar institutions operated by non-university research organizations demonstrate that both universities and non-university institutions can benefit from this form of cooperation, especially in raising international visibility.



**5. The German science system has substantial ground to cover in the provision of transparent and reliable career pathways. This situation must be addressed through the implementation of appropriate measures at all qualification levels.**

*5.1 Recent developments in the training and support of doctoral researchers should be consolidated and implemented at all universities.*

Significant improvements have been achieved in the training of graduate students in recent years, not least by the increasing growth of structured training through graduate schools and postgraduate programmes. Efforts should be made to support this trend, particularly on the funding of institutions with an international perspective. Emphasis should be placed on ensuring that independent research conducted by graduate students dovetails with tailored educational opportunities that fall within the remit of teaching assignments, in a manner that reflects the cultures of the respective disciplines. Graduate institutions should also be empowered to establish specific entry requirements in line with their current needs and according to their research focus and international reach. Researchers undertaking doctoral studies outside structured doctoral programmes should become the exception in Germany within the foreseeable future.

This development presupposes that universities have a strong and documented research focus and are able to guarantee the quality of their doctoral programmes. One solution to this would be the establishment of a monitoring system to ensure that universities fulfil their obligations. This, however, is likely to result in universities offering a selection of doctoral programmes rather than delivering programmes in every discipline. Regular discussion between doctoral researchers and supervisors on the state and future development of research are vital to the success of doctoral research. This exchange of information should be institutionalized and made transparent to doctoral commissions. It is equally important that doctoral researchers be afforded the

support of at least two supervisors from the outset and that an external reviewer be engaged in the review process on a mandatory basis. The availability of broad-based, tailored and personal supervision – including a career development component – is crucial to the success of doctoral research. This would bolster the appeal of doctoral programmes in Germany against a backdrop of intense global competition for the best early career researchers, heading off a development that would parallel the shortage of skilled professionals.

*5.2 There is a clear need to establish within the German science system a “postdoctoral culture” that reflects the contributions of young researchers at this qualification level both in teaching and in research.*

Max Weber was well aware of the vagaries of undertaking postdoctoral research. “The life of the academic is a wild gamble,” he stated in his lecture *Science as a Vocation* in 1917.<sup>30</sup> Weber’s claim that fresh graduates hoping to make a living in research are taking a gamble, in which the chances of losing – i.e. failing to earn sufficient income – are significantly higher than in other professions, is an assessment that most postdoctoral fellows would share today. Overall the situation for postdoctoral fellows has improved to a far lesser degree than that of doctoral researchers. This is despite the former fulfilling an indispensable role at universities and other research institutions, combining as they do a broad spectrum of knowledge with specialized expertise in a research area and the highest standards of scientific practice.

Postdoctoral fellows make a significant contribution to research, not only in the Anglo-Saxon countries, but also particularly in Germany. In light of this, more steps should be taken to prepare early career researchers for the period immediately after their graduation. This would facilitate both the development of a “postdoctoral culture” at German universities and other research institutions, and the transition from postdoctoral to independent research.

<sup>30</sup> Weber (1917/1919), p. 3.



One approach that could be expanded upon is the DFG's programme of allowing early career researchers to apply for the necessary funding to finance a research post. This could be supplemented by career strategies developed in cooperation between the respective institutions and postdoctoral researchers, streamlining the postdoctoral phase and placing the development of specialized expertise within the framework of a comprehensive career development pathway<sup>31</sup>. This would include, for instance, expertise in management, personnel management and organization, as well as training in didactics to allow for the effective integration of postdoctoral researchers and their scientific expertise in teaching practice.

*5.3 The opportunities available to postdoctoral researchers to pursue career pathways within the German science system should be clearly defined and their scope extended.*

The development of a postdoctoral culture in Germany would also impact positively on academically qualified employees, in particular those doctoral degree-holders who do not wish to pursue a professorial career. In the first instance, this development would serve the best interests of institutions with large research infrastructures, which must maintain and diligently cultivate a 'collective memory', as it were, if they are to keep pace with rapid changes in technology. It would also benefit those postdoctoral researchers whose activities are primarily focussed on teaching (e.g. holders of lecturer posts) by obliging them to track the state-of-the-art in research through participation in continuing education. The encouraging and widespread recognition of the importance of these posts that has resulted from the Bologna reforms should lead to the development of comprehensive measures to improve their appeal and increase their overall numbers.

In addition, in future it will be more important than ever for universities to identify personnel suitable for university management roles among

<sup>31</sup> Cf. the *Individual Development Plan* (IDP) now widespread in the USA (see Austin und Alberts 2012).

their postdoctoral researchers and to develop their expertise through individual coaching (so-called "Third Space professionals").<sup>32</sup>

*5.4 Steps should be taken to facilitate the integration of independent junior research groups at universities.*

Independent junior research groups, led by highly motivated young researchers who are thus enabled to engage in independent research at an early stage in their careers, should be seamlessly integrated within academic life as a key form of organization. Young group leaders, including those at non-university institutes, are keen to contribute to teaching programmes at universities; the universities in turn can benefit from this, provided that it is not perceived as an opportunity to diminish the responsibility of university personnel for the quality of teaching programmes.

*5.5 Greater support should be given to efforts to trial performance-based employment models for research and academic posts at German universities.*

Universities should be enabled to implement tenure track and other performance-based employment models on a broader scale than hitherto and to develop the requisite mentoring and evaluation cultures. The widespread deployment of research-focussed junior professorships with tenure tracks would comprise a central component of this development. Care must be taken to ensure that evaluation capacities are responsive to performance and that the mobility of post holders is not restricted. It is also important that the scope of these models is not restricted to the funding of positions and encompasses the equipment necessary for research and teaching.

Options open for consideration include replacing the permanent contract model with individualized contracts having a reliable prospect of continued employment based on performance and attractive remuneration packages. Higher education systems abroad (in Switzerland, for

<sup>32</sup> See Whitchurch (2008) and Kehm et al. (2010).

example) offer valuable insights for this discussion. In addition, the current salary structure for university professors could be improved by dispensing with caps on remuneration frameworks, thereby allowing more flexible solutions in the distribution of financial resources between individual employees. This is particularly relevant to efforts to increase mobility between science and the private sectors (in the engineering sciences, for example).

Differences in the positions of individual faculties and academic cultures in the introduction of performance-based models for the assignment of permanent posts at German universities cannot be considered here. The issues raised here about the tenure track model only apply to a degree in the case of the engineering sciences, for example, where the convergence of theory and practice in engineering qualifications facilitates mobility between the science and private sectors, and teaching personnel frequently have backgrounds in private sector research and development. Accordingly, these comments are intended as a contribution to the current discussion; their relevance to specific institutional and academic contexts must be considered in each case.

#### *5.6 German universities should be enabled to make greater use of the expertise of retired professors.*

Efforts should be made to improve the integration of retired professors in research, teaching and knowledge transfer activities at universities, particularly in light of comparisons between Germany and the USA. Retired professors should be given more opportunity to apply for individually tailored positions combining teaching duties and research. In doing so, care must be taken to ensure that this is not implemented to the detriment of younger generations of researchers. A senior professorship model could be established to this end, as a position that is independent of the individual's final university posting, equipped with a reasonable salary and an extension of the authority to conduct examinations.

#### *5.7 German science institutions should seek to extend their diversity management, which is poorly developed at present.*

Overall, efforts must be made in the area of diversity management to align career opportunities in academia and research more closely with the personal circumstances of researchers. Particular precedence should be given to improving career opportunities for female researchers, not only, but especially, in the STEM disciplines. A more rigorous implementation of the cascade model with quotas to facilitate the career advancement of female researchers within the German science system should be considered.

Greater support should be provided to couples in which one or both partners intend to or are currently pursuing careers in research through the introduction of "dual career" options pitched to facilitate mobility. In this context, consideration must be given to developing solutions that reconcile the fundamental demands of dual careers – for both partners – with family life and excellence in research, and practical consequences for everyday life (for instance in the area of childcare facilities at universities).

Efforts in the area of diversity management must also take into account the different cultural backgrounds of students and researchers in an adequate manner. These activities will heighten the international appeal of our universities, which with a few exceptions display significant deficits in this area. Better and stronger incentives should be created to encourage universities to invest financial resources and develop greater expertise in diversity management.

#### *5.8 Universities should treat the delivery of strategic career counselling to students and employees as a core responsibility.*

Career counselling services should be provided to students, aspiring researchers and science managers as early as possible at universities, irrespective of whether individuals might wish to pursue a career in science and the humanities, the business sector or other sectors of society. To this end, the scope of programmes designed to improve the quality of

services delivered to students, for example, should be extended beyond the entry phase and qualification period to encompass systematic and continuing career counselling. In addition, the development of graduate profiles would emphasize the links between universities and labour markets (see 1.3). Creating profiles of this kind could enhance the appeal of individual degree programmes by enabling school leavers in particular to assess better the available career opportunities on the labour market. Beyond this, the creation – before the postdoctoral phase – of individual plans to identify and develop skills and specialist expertise could actively benefit the generation of career perspectives, for example, by enhancing the alignment of individual profiles with the requirements of the non-university sector.

**6. The German science academies should seek to make a greater contribution to the deliberative and decision-making processes of our democracy by engaging their considerable expertise and capacity to provide science-based policy advice, especially in discussions about the development of the science system.**

One of the key lessons that can be drawn from current developments is that in seeking to ensure a sustainable development of the German science system, stakeholders must arrive at a broader understanding of science policy: one in which science policy figures as an continuing process of critical reflection and consultation on the role of science both within and for society. The discourse necessary to facilitate the emergence of this understanding must be conducted on an equal footing by stakeholders in science, politics, the business sector, civil society and the media. This is to secure sustainability in research, teaching and knowledge transfer in the interest of the common good.

The German academies of sciences should play a more active role within this debate than previously. The academies are firmly anchored in the science system thanks to their capacity to unite excellent researchers from university and non-university institutions from Germany and abroad within their ranks. They are therefore ideally positioned to gain an overview of the current state of research, teaching and knowledge transfer and to provide informed guidance on the further development of the science system. Moreover, the academies are especially interested in identifying the particular systemic conditions required to facilitate the generation of scientific excellence.

The German academies of sciences wish to use this opportunity to work in a spirit of trust and cooperation both for the public good and to drive the development of their activities. The German National Academy of Sciences Leopoldina, with the Union of the German Academies of Sciences and Humanities and the German Academy of Science and

Engineering (acatech), have a proven track record in the provision of science-based policy and social advice at a national level. Their statements and policy recommendations meet with considerable interest in the political arena and society at large. By supplying reliable information and independent advice, the academies have had a demonstrable impact on democratic decision-making processes.

Institutions frequently find that they must grapple with a divide between their historical legacy and their current role in society. This is not true of the science academies, however, which are well placed to meet the consultation requirements of our modern society of science as a result of their specific cultural histories. Germany's academies of science and the humanities have rigorously pursued scientific and academic excellence, while striving to achieve the greatest possible degree of independence from political, economic and external influences and embracing both genuine inter-disciplinarity and international cooperation on a global scale. Some look back on a history spanning several centuries. Not only are the academies well placed to bring these qualities to bear with increasing effect within the public sphere, but it is also their desire to do so.

The fact that the academies of science and the humanities undertake research – if at all – to a far lesser extent than other scientific and academic institutions (for instance, the Academies' Programme for long-term research projects in the humanities and natural sciences) and do not compete with these institutions, enables them to seek recognition as the neutral guardians of the science system in its entirety. Therefore, the academies of science and the humanities are particularly well-suited to the task of engaging in debate on sustainable science policy and the analysis of individual issues from the perspective of the wider structure of the science system.

In light of the high degree of international cooperation in science and the humanities, the activities of the national science academies at an international level are also relevant within the broad context of science

policy. One of the central objectives of the German National Academy of Sciences Leopoldina is to promote the interests of the German science system abroad by strengthening its growing international ties through cooperation with other national academies and the active involvement in international academic and research bodies.

The German National Academy of Sciences Leopoldina has a clear commitment to providing independent analyses of issues of broad social relevance in research, teaching and the transfer of knowledge. It does so from a perspective that transcends special interests, and formulates its recommendations for action in the fields of policy and science on this basis. The Leopoldina hopes to ensure that, beyond forthcoming policy decisions, the high level of attention currently afforded to science policy issues will result in continuing and critical debate within the public sphere on the science system and its potential contribution to the future of Germany.

## Summary

1. Universities are the linchpins of the German science system. The extent of their continued underfunding threatens to undermine the system. Addressing this issue will require far-reaching and fundamental changes in their funding.
  - 1.1 Urgent action must be taken to improve basic funding allocated to universities to safeguard the high quality of the science system.
  - 1.2 Institutions established under the Excellence Initiative that meet with success in their activities should be maintained and developed further.
  - 1.3 Universities should intensify their efforts to access funding from international and non-state sources.
  
2. Unnecessary legal obstacles are hindering the development of the German science system. Key legal frameworks should be amended to increase its scope of action.
  - 2.1 Article 91b of the Basic Law of the Federal Republic of Germany must be reformed to enable the federal government to provide direct funding to institutions for research and teaching at universities.
  - 2.2 Universities should give greater precedence to the further development of their governance structures.
  
3. The diversity of the German science system in terms of its institutional structures and areas of research holds immense potential for development. Scientific institutions could enhance their use of available material and intellectual resources through greater cooperation to exploit this potential better.
  - 3.1 Models of closer cooperation in the areas of research and teaching between university and non-university institutions at jointly operated major infrastructure centres to which both parties enjoy equal access should be developed, trialled and embedded within appropriate legal frameworks.
  - 3.2 Incentives should be created to preserve diversity in research subjects as a key structural feature of the German university landscape.
  
4. The German science system should adopt a proactive approach in its engagement with the new opportunities for research, teaching and knowledge transfer presented by rapid globalization and therefore improve the strategic coordination of its international activities.
  - 4.1 German science institutions could develop joint strategies for international cooperation and align their respective activities with these strategies.
  - 4.2 Germany should seek to emphasize its reputation as a science society on the international stage.
  - 4.3 The internationalization of German universities within the framework of the Bologna Process must be continued through the implementation of structural adjustments.
  - 4.4 The international appeal of German universities should be raised through the delivery of tailored support measures to selected facilities.

5. The German science system has substantial ground to cover in the provision of transparent and reliable career pathways. This situation must be addressed through the implementation of appropriate measures at all qualification levels.
  - 5.1 Recent positive developments in the training and support of doctoral researchers should be consolidated and implemented at all German universities.
  - 5.2 There is a clear need to establish a “postdoctoral culture” within the German science system that reflects the contributions of young researchers at this qualification level both in teaching and research.
  - 5.3 The opportunities available to postdoctoral researchers to pursue career pathways within the German science system should be clearly defined and their scope extended.
  - 5.4 Steps should be taken to facilitate the integration of independent junior research groups at universities.
  - 5.5 Greater support should be given to efforts to trial performance-based employment models for research and academic posts at German universities.
  - 5.6 German universities should be enabled to make greater use of the expertise of retired university teaching personnel.
  - 5.7 German science institutions should seek to extend their diversity management, which is poorly developed at present.
  - 5.8 Universities should treat the delivery of strategic career counselling to students and employees as a core responsibility.
  
6. The German science academies should seek to make a greater contribution to the deliberative and decision-making processes of our democracy by engaging their considerable expertise and capacity to provide science-based policy advice, especially in discussions about the development of the science system.

## Annex

### Production of this statement

This discussion paper draws on several manuscripts prepared in recent years by the German National Academy of Sciences Leopoldina in connection with a variety of occasions. These include, in particular, the lecture *Perspektiven für die Entwicklung der deutschen Forschungslandschaft*, delivered by the President of the Leopoldina, Jörg Hacker, to the Committee of the Joint Science Conference on 24 January 2011 in Bonn, and the statement *Perspektiven des deutschen Wissenschaftssystems*, delivered by the Vice President of the Leopoldina, Ursula M. Staudinger, at the hearing of the working group of the same name at the German Council of Science and Humanities on 13 September 2012 in Cologne.

The latter statement, drafted in consultation with Dorothea Dzwonnek, Wolfgang Frühwald and Ernst-Ludwig Winnacker, was adopted by the Presidium of the German National Academy of Sciences Leopoldina at its retreat on 11–12 September 2012. It was published under the title *Perspektiven des deutschen Wissenschaftssystems unter besonderer Berücksichtigung der Universitäten* in a volume of materials compiled by the Stifterverband für die Deutsche Wissenschaft on the occasion of the 2012 Villa-Hügel-Gespräch *Wie viel Bund braucht die Uni? Hochschulen 2020 zwischen Bildungsauftrag und Exzellenzanspruch* held on 8 November 2012 in Essen.

At its session in Berlin on 21 September 2012, the Presidium of the German National Academy of Sciences Leopoldina adopted a motion to prepare a comprehensive discussion paper on the future of the German science system on the basis of the aforementioned paper. The present document was adopted in a circular resolution by the Presidium of

the Leopoldina on 18 March 2013 after a previous draft was debated in Halle (Saale) on 27 February.

*The production of this discussion paper was supervised at the office of the German National Academy of Sciences Leopoldina by PD Dr. Stefan Artmann (Presidential Office) and Dr. Constanze Breuer (Department Science – Policy – Society).*

## Sources

Austin, Jim; Alberts, Bruce (2012): Planning Career Paths for Ph.D.s. In: Science 337, 1149.

Bundesministerium für Bildung und Forschung (2012): Press release (German) 151/2012, published 6.12.2012. Available at: <http://www.bmbf.de/press/3382.php> (last accessed on 29.01.2013).

Deutsche Forschungsgemeinschaft (2012): Förderatlas 2012: Kennzahlen zur öffentlich finanzierten Forschung in Deutschland. Weinheim: Wiley-VCH. Available at: [http://www.dfg.de/download/pdf/dfg\\_im\\_profil/evaluation\\_statistik/foerderatlas/dfg-foerderatlas\\_2012.pdf](http://www.dfg.de/download/pdf/dfg_im_profil/evaluation_statistik/foerderatlas/dfg-foerderatlas_2012.pdf) (last accessed on 30.01.2013).

Europäischer Rat (2002): Schlussfolgerungen des Vorsitzes des Europäischen Rates (Barcelona), 15. und 16. März 2002 (SN 100/1/02 REV 1, German version). Available at: [http://www.consilium.europa.eu/ueDocs/cms\\_Data/docs/pressData/de/ec/71067.pdf](http://www.consilium.europa.eu/ueDocs/cms_Data/docs/pressData/de/ec/71067.pdf) (last accessed on 29.01.2013).

Eurostat (2012): Available at: [http://epp.eurostat.ec.europa.eu/statistics\\_explained/index.php/R\\_%26\\_D\\_expenditure](http://epp.eurostat.ec.europa.eu/statistics_explained/index.php/R_%26_D_expenditure) (last accessed on 01.02.2013).

Expertenkommission Forschung und Innovation (Eds.) (2012): Gutachten zu Forschung, Innovation und technologischer Leistungsfähigkeit Deutschlands 2012, Berlin: Expertenkommission Forschung und Innovation. Available at: [http://www.e-fi.de/fileadmin/Gutachten/EFI\\_Gutachten\\_2012\\_deutsch.pdf](http://www.e-fi.de/fileadmin/Gutachten/EFI_Gutachten_2012_deutsch.pdf) (last accessed on 30.01.2013).

Expertenkommission Forschung und Innovation (Eds.) (2013): Gutachten zu Forschung, Innovation und technologischer Leistungsfähigkeit Deutschlands 2013, Berlin: Expertenkommission Forschung und Innovation. Available at: [http://www.e-fi.de/fileadmin/Gutachten/EFI\\_Gutachten\\_2013\\_deutsch.pdf](http://www.e-fi.de/fileadmin/Gutachten/EFI_Gutachten_2013_deutsch.pdf) (last accessed on 15.03.2013).

Hochschulrektorenkonferenz (2012): Kleine Fächer an den deutschen Universitäten: Interdisziplinär und international. Available at: [http://www.hrk.de/fileadmin/redaktion/hrk/02-Dokumente/02-10-Publikationsdatenbank/EVA-2012\\_Kleine\\_Faecher.pdf](http://www.hrk.de/fileadmin/redaktion/hrk/02-Dokumente/02-10-Publikationsdatenbank/EVA-2012_Kleine_Faecher.pdf) (last accessed on 30.01.2013).

Hoffmann, Reinhard (2012): Das monistische Modell: Die Mitfinanzierung des Bundes von Universitätseinrichtungen im integrativen Kooperationsverbund Universität/außeruniversitäre Forschungseinrichtung. Berlin: Berlin-Brandenburgische Akademie der Wissenschaften (Wissenschaftspolitik im Dialog 5/2012). Available at: [http://www.bbaw.de/publikationen/wissenschaftspolitik\\_im\\_dialog/BBAW\\_Wissenschaft-im-Dialog-5.pdf](http://www.bbaw.de/publikationen/wissenschaftspolitik_im_dialog/BBAW_Wissenschaft-im-Dialog-5.pdf) (last accessed on 30.01.2013).

Husbands Fealing, Kaye; Lane, Julia I.; Marburger, John H. III; Shipp, Stephanie S. (Eds.) (2011): *The Science of Science Policy: A Handbook*. Stanford/CA: Stanford University Press.

Internationale Kommission zur Systemevaluation der Deutschen Forschungsgemeinschaft und der Max-Planck-Gesellschaft (Eds.) (1999): *Forschungsförderung in Deutschland: Bericht der internationalen Kommission zur Systemevaluation der Deutschen Forschungsgemeinschaft und der Max-Planck-Gesellschaft*. Hannover: Volkswagen Foundation.

Kehm, Barbara; Merkator, Nadine; Schneijderberg, Christian (2010): Hochschulprofessionelle?! Die unbekannteren Wesen. In: *Zeitschrift für Hochschulentwicklung* 5(4), 23-39. Available at: <http://zfhe.at/index.php/zfhe/article/view/11> (last accessed on 30.01.2013).

Mora, José-Ginés; Vieira, María-José; Detmer, Andrea (2012): *Managing University-Enterprise Relationships*. In: Temple, Paul (Ed.): *Universities in the Knowledge Economy: Higher Education Organisation and Global Change*, New York: Routledge, p. 63-81.

van Noorden, Richard (2012): Science on the Move: The Big Picture of Global Migration Shows That Scientists Usually Follow the Research Money – But Culture Can Skew This Pattern. In: *Nature*, Vol. 490 (18.10.2012). Available at: <http://www.nature.com/news/global-mobility-science-on-the-move-1.11602> (last accessed on 30.01.2013).

OECD (2012a): *Education at a Glance 2012: Highlights*. Paris: OECD Publishing. Available at: [http://www.oecd.org/edu/EAG%202012\\_e-book\\_EN\\_200912.pdf](http://www.oecd.org/edu/EAG%202012_e-book_EN_200912.pdf) (last accessed on 30.01.2013).

OECD (2012b): *OECD Science, Technology and Innovation Outlook 2012*. Paris: OECD Publishing. Accessible at: [http://www.keepeek.com/oecd/media/science-and-technology/oecd-science-technology-and-industry-outlook-2012\\_sti\\_outlook-2012-en](http://www.keepeek.com/oecd/media/science-and-technology/oecd-science-technology-and-industry-outlook-2012_sti_outlook-2012-en) (last accessed on 25.02.2013).

Polanyi, Michael (1962): *The Republic of Science: Its Political and Economic Theory*. In: *Minerva* 1(1), 54-73.

Presse- und Informationsamt der Bundesregierung (Eds.) (2012): *Mehr Chancen durch Bildung*. Available at: [http://www.bundesregierung.de/Content/DE/Publikation/Bestellservice/2012-10-16-ratgeber-bildung.pdf?\\_\\_blob=publicationFile&v=5](http://www.bundesregierung.de/Content/DE/Publikation/Bestellservice/2012-10-16-ratgeber-bildung.pdf?__blob=publicationFile&v=5) (last accessed on 29.01.2013).

Reichert, Sybille; Winde, Mathias; Meyer-Guckel, Volker (2012): *Jenseits der Fakultäten: Hochschuldifferenzierung durch neue Organisationseinheiten für Forschung und Lehre*. Essen: Edition Stifterverband. Available at: [http://www.stifterverband.info/publikationen\\_und\\_podcasts/positionen\\_dokumentationen/jenseits\\_der\\_fakultaeten/jenseits\\_der\\_fakultaeten.pdf](http://www.stifterverband.info/publikationen_und_podcasts/positionen_dokumentationen/jenseits_der_fakultaeten/jenseits_der_fakultaeten.pdf) (last accessed on 29.01.2013).

Royal Society (2011): *Knowledge, Networks and Nations. Global Scientific Collaboration in the 21<sup>st</sup> Century*. Available at: [http://royalsociety.org/uploaded-Files/Royal\\_Society\\_Content/policy/publications/2011/4294976134.pdf](http://royalsociety.org/uploaded-Files/Royal_Society_Content/policy/publications/2011/4294976134.pdf) (last accessed on 29.01.2013).



Schütte, Georg (Ed.) (2008): *Wettlauf ums Wissen: Außenwissenschaftspolitik im Zeitalter der Wissensrevolution*. Berlin: Berlin University Press.

Statistisches Bundesamt (2012a): *Bildung und Kultur: Nichtmonetäre hochschulstatistische Kennzahlen. 1980-2011 (Fachserie 11 Reihe 4.3.1)*. Wiesbaden: Statistisches Bundesamt. Available at: [https://www.destatis.de/DE/Publikationen/Thematisch/BildungForschungKultur/Hochschulen/KennzahlenNichtmonetaer2110431117004.pdf?\\_\\_blob=publicationFile](https://www.destatis.de/DE/Publikationen/Thematisch/BildungForschungKultur/Hochschulen/KennzahlenNichtmonetaer2110431117004.pdf?__blob=publicationFile) (last accessed on 29.01.2013).

Statistisches Bundesamt (2012b): *Bildung und Kultur: Monetäre hochschulstatistische Kennzahlen. 2010 (Fachserie 11 Reihe 4.3.2)*. Wiesbaden: Statistisches Bundesamt. Available at: <https://www.destatis.de/DE/Publikationen/Thematisch/BildungForschungKultur/BildungKulturFinanzen/KennzahlenMonetaer.html> (last accessed on 30.01.2013).

Stiftung Wissenschaft und Politik; Alexander von Humboldt Stiftung (2007): *Außenwissenschaftspolitik – Wissenschaftsaußenpolitik (Arbeits- und Diskussionspapier 7/2007)*. Available at: <http://www.humboldt-foundation.de/pls/web/docs/F921/aussenwissenschaftspolitik.pdf> (last accessed on 29.01.2013).

Stock, Günter; Bertram, Hans; Fürnkranz-Prskawetz, Alexia; Holzgreve, Wolfgang; Kohli, Martin; Staudinger, Ursula M. (Eds.) (2012): *Zukunft mit Kindern: Fertilität und gesellschaftliche Entwicklung in Deutschland, Österreich und der Schweiz*. Frankfurt a.M. and New York: Campus.

Weber, Max (1917/1919): *Wissenschaft als Beruf*. In: Mommsen, Wolfgang J.; Schluchter, Wolfgang (Eds.): *Studienausgabe der Max Weber-Gesamtausgabe. I/17*. Tübingen: J.C.B. Mohr (Paul Siebeck) 1994.

Weingart, Peter; Kielmansegg, Peter Graf; Ash, Mitchell G.; Hüttl, Reinhard F.; Kurth, Reinhard; Mayntz, Renate; Münkler, Herfried; Neidhardt, Friedhelm; Pinkau, Klaus; Renn, Ortwin; Schmidt-Aßmann, Eberhard (2008): *Leitlinien Politikberatung*. Berlin: Berlin-Brandenburgische Akademie der Wissenschaften. Available at: [http://www.bbaw.de/service/publikationen-bestellen/manifeste-und-leitlinien/BBAW\\_PolitischeLeitlinien.pdf](http://www.bbaw.de/service/publikationen-bestellen/manifeste-und-leitlinien/BBAW_PolitischeLeitlinien.pdf) (last accessed on 29.01.2013).

Wespe, Johannes; Orr, Dominic; Jaeger, Michael (2012): *Exzellenzinitiativen in der Forschung aus internationaler Perspektive*. HIS-HF: Schwerpunktthema Nr. 1. Available at: [http://www.his.de/pdf/pub\\_st/st-201201.pdf](http://www.his.de/pdf/pub_st/st-201201.pdf) (last accessed on 30.01.2013).

Whitchurch, Celia (2008): *Shifting Identities and Blurring Boundaries: The Emergence of Third Space Professionals in UK Higher Education*. In: *Higher Education Quarterly* 62(4), 377-396. Available at: <http://eprints.ioe.ac.uk/2035/1/Whitchurch2008ShiftingIdentities377.pdf> (last accessed on 30.01.2013).

Wissenschaftsrat (2013): *Arbeitsprogramm Januar – Juli 2013*. Available at: <http://www.wissenschaftsrat.de/download/archiv/Arbeitsprogramm.pdf> (last accessed on 29.01.2013).



Deutsche Akademie der Naturforscher Leopoldina

– Nationale Akademie der Wissenschaften –

Jägerberg 1

06108 Halle (Saale)

Phone: (0345) 47 239 - 600

Fax: (0345) 47 239 - 839

E-Mail: [leopoldina@leopoldina.org](mailto:leopoldina@leopoldina.org)

**Berlin Office:**

Reinhardtstraße 14

10117 Berlin