German Engineering

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Technology Sciences

Technology Sciences describe and document technology, make it accessible and develop it further.

- Gather, evaluate, archive (current state of technology)
- Provide knowledge and teach
- Research
Fields of Technology Sciences

- Civil engineering
- Mechanical engineering (including materials engineering and process engineering)
- Electrical engineering (including energy engineering and communications engineering)
- Information technology
- Biotechnology
- …
Institutions of Technology Sciences in Germany

- Research institutions
- Universities
- Universities of Applied Sciences
- Others
Institutions of Technology Sciences: Fraunhofer Institutes

![Chart showing changes in financial volume and staff from 2007 to 2014.](chart.png)

- **Change in %**
  - Financial Volume
  - Staff
Institutions of Technology Sciences: AiF (Industry Research Alliance)

Budget development of German Federation of Industrial Research Associations (2007: €117 MM.)
### Institutions of Technology Sciences: Universities
Median annual funding of DFG 2011 - 2013

<table>
<thead>
<tr>
<th>Field of Science</th>
<th>Funding (€MM)</th>
<th>% of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Humanities</td>
<td>346.2</td>
<td>15.4</td>
</tr>
<tr>
<td>Life Sciences</td>
<td>737.1</td>
<td>32.8</td>
</tr>
<tr>
<td>Natural Science</td>
<td>476.7</td>
<td>21.2</td>
</tr>
<tr>
<td>Technology Science</td>
<td>447.6</td>
<td>19.9</td>
</tr>
<tr>
<td>Other fields</td>
<td>241.2</td>
<td>10.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2248.8</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
## Institutions of Technology Sciences

### Compare: External Funds and Students in First-Subject-Related Semester

<table>
<thead>
<tr>
<th>Type</th>
<th>Characteristic</th>
<th>Third-party funding/professor (€)*</th>
<th>% of total students**</th>
</tr>
</thead>
<tbody>
<tr>
<td>University</td>
<td>&quot;equipped for research&quot;</td>
<td>604,100</td>
<td>43 %</td>
</tr>
<tr>
<td>University of Applied Sciences</td>
<td>&quot;mostly involved in teaching&quot;</td>
<td>27,100</td>
<td>57 %</td>
</tr>
</tbody>
</table>

* 2012
** WS 2014/15
www.destatis.de
Other Institutions of Technology Sciences

• Scientific associations
• Academies
• Museums
• Patent agencies
• Testing authorities
Research is the methodical and systematic search for the unknown, based on open questions with an uncertain outcome.

- Research and knowledge are closely linked
- The unknown most often lies on the edges of the discipline
- The great challenges in technology research today lie in the investigation of the behavior of large systems
Technology Research Methods

- Model building
- Experiments
- Hermeneutic methods to verify knowledge based in experience
- Social-scientific methods in the man-machine-interaction

To analyze and synthesize operating principles
Relevance of Technology Research

- Goal of technology research: New and improved technology (application)
- Necessity to cooperate with industry: Gather relevant questions for technology research!
The term engineering defines the profession of those who develop technology based on knowledge and implement it.

The profession historically developed from an experience-based (craftsmen) to a science-based profession.
The Profession of an Engineer

- Method competence (mathematics, sciences, technology)
- Application competence (experience in product development, production technology, use of technology)

Technology develops evolutionary, in big businesses – specialization, long-term success, ability to co-operate
## Engineering Education

<table>
<thead>
<tr>
<th>University</th>
<th>University of Applied Sciences</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technology-scientifically oriented</td>
<td>Engineering-professionally oriented</td>
<td>Dr.-Ing. (ability to research)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Master</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bachelor (qualified for a profession)</td>
</tr>
</tbody>
</table>
Facts: Engineers in Germany (VDI)

Working engineers:

- Year 2005: 1.39 M
- Year 2011: 1.66 M

Increase 2005-2011: ca. 19%

Engineering gap - 1st quarter 2015:

- Job-seeking: 29,728
- Open positions: 59,430

Engineering gap: 29,702
In the fields of technology we distinguish between

<table>
<thead>
<tr>
<th>Technology Scientist</th>
<th>Engineer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mastering the scientific work methods</td>
<td>Mastering the knowledge of the state of technology</td>
</tr>
<tr>
<td>Ability to teach and research</td>
<td>Ability to develop and operate technology</td>
</tr>
</tbody>
</table>
Thank you for your attention!