

Skill shortages and gaps in nanotechnologies

What can be learned from other technologies?

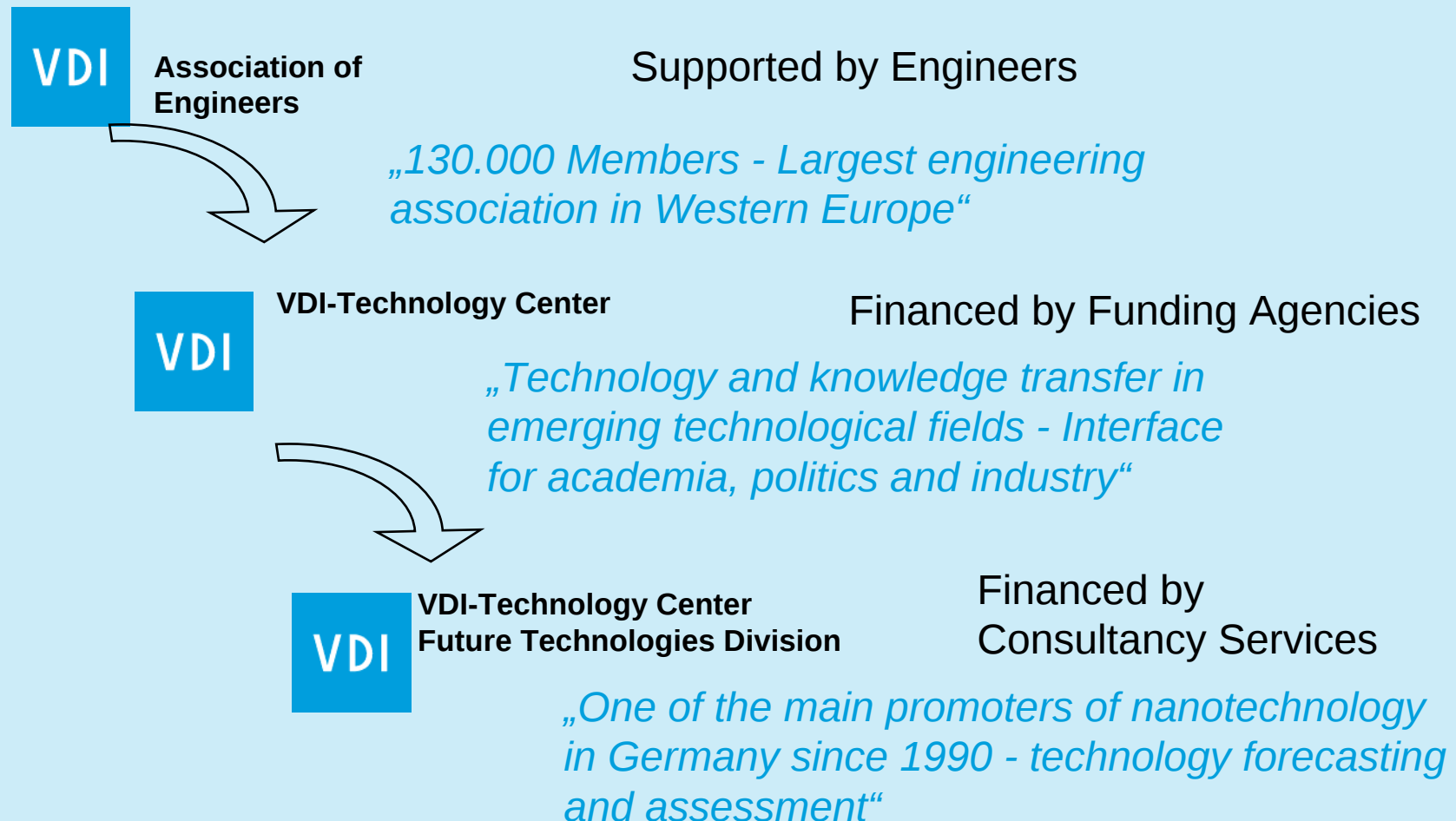
Dr. Wolfgang Luther



Content

- Introduction of VDI TZ
- Skill shortages in emerging technologies in Germany – general trends
- Qualification aspects in emerging technologies
 - Identifying skill shortages/ gaps in optical technologies
 - Qualification aspects in micro-/microsystem technologies
- Identifying skill shortages in nanotechnologies
 - Status Quo of nanotechnologies in Germany
 - Activities to identify skill shortages
 - How can future skill shortages / skill gaps be tackled and possibly prevented?

Future Technologies Division - one part of VDI



Nanotechnology Activities of VDI TZ

- Administration of Project Funding for the BMBF
- National Contact and Information Point for EU Funding
- Participation in European Projects (nanoforum, nanosafe, IPTS, ...)
- International Cooperations (Ukr, Br, F, USA)
- Technology Forecasting and Assessment
- Innovation Supporting Measures
 - Education and Qualification
 - Market Studies
 - Public Relations (websites, brochures, DVD, fairs)

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Skill shortages in emerging technologies in Germany - General trends

- ➡ Shortage of about 15.000 engineers one of the most severe innovation barrier in Germany (VDI)
- ➡ Every fourth enterprise in chemistry, pharmacy, electrical engineering, automotive and equipment engineering are affected by shortage of skilled workers
- ➡ Due to demografic development up to 3,5 Mio skilled workers will be lacking in 2015 (BMBF)
- ➡ Societal status and reputation of engineering relatively low

projection of the potential of labour force in Germany 1995 - 2040

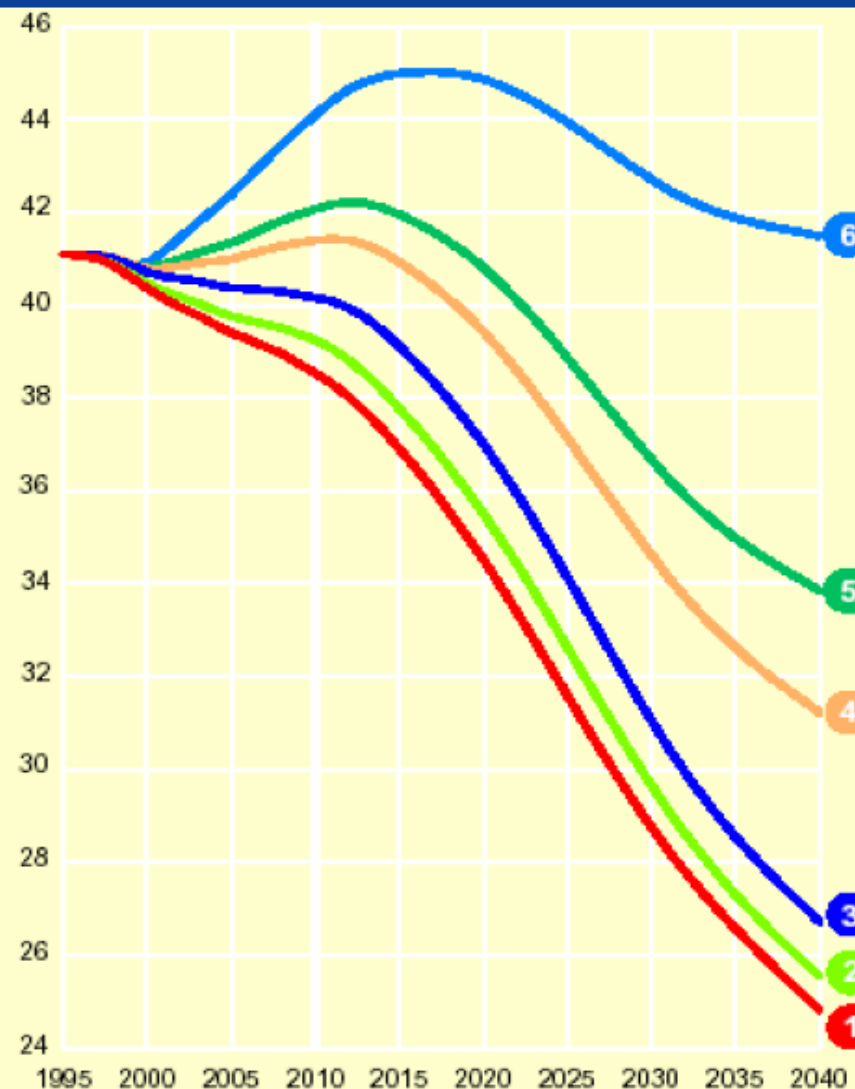
- dramatic decline of population leads to slowdown of labour supply
- Even high labour-force participation rate of women will not contain this development
- in parallel the average age of labour force population increases

Varianten ohne Zuwanderung

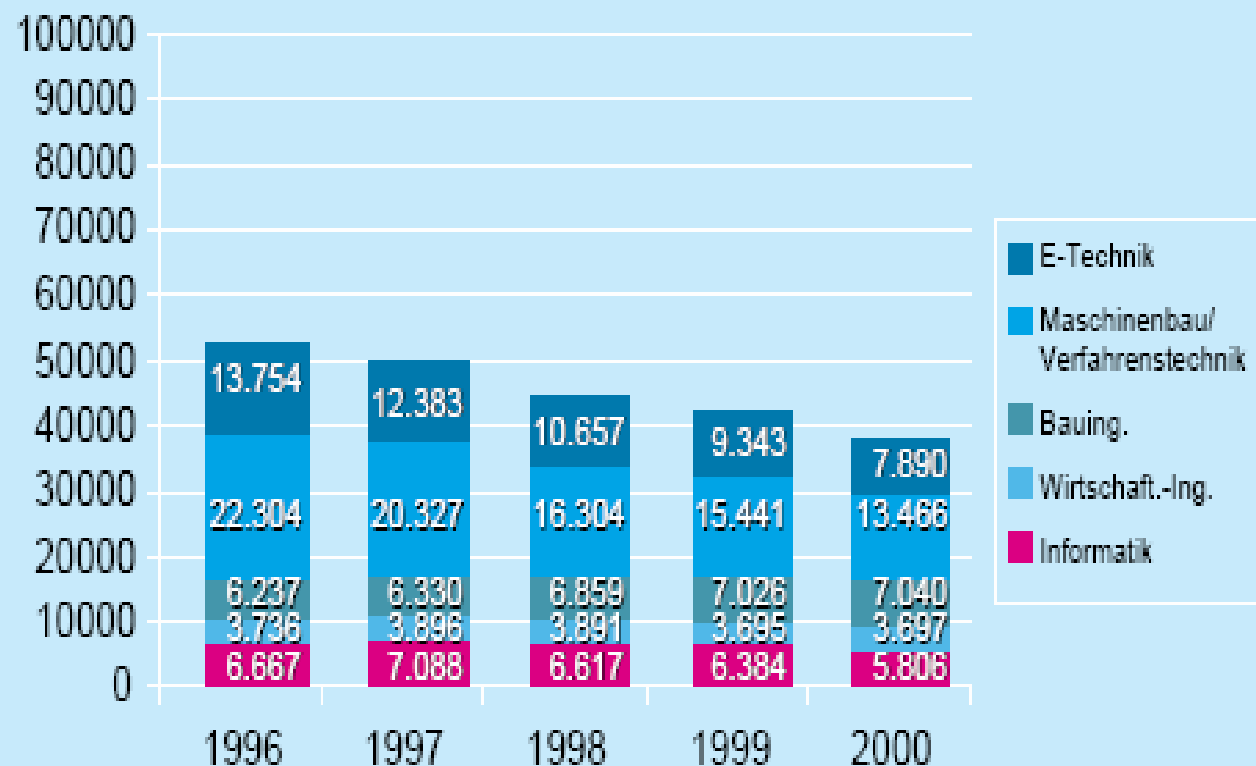
- 1** konstante Erwerbsquoten aus 1995 (Ostdeutschland) bzw. 1996 (Westdeutschland)
- 2** untere Erwerbsquotenvariante
- 3** obere Erwerbsquotenvariante

Varianten mit Zuwanderung (jeweils mit oberer Erwerbsquoten-Variante)

- 4** Wanderungssaldo der ausländischen Bevölkerung 100.000 jährl. ab 2000,
- 5** Wanderungssaldo der ausländischen Bevölkerung 200.000 jährl. ab 2000,
- 6** Wanderungssaldo der ausländischen Bevölkerung 500.000 jährl. ab 2000,

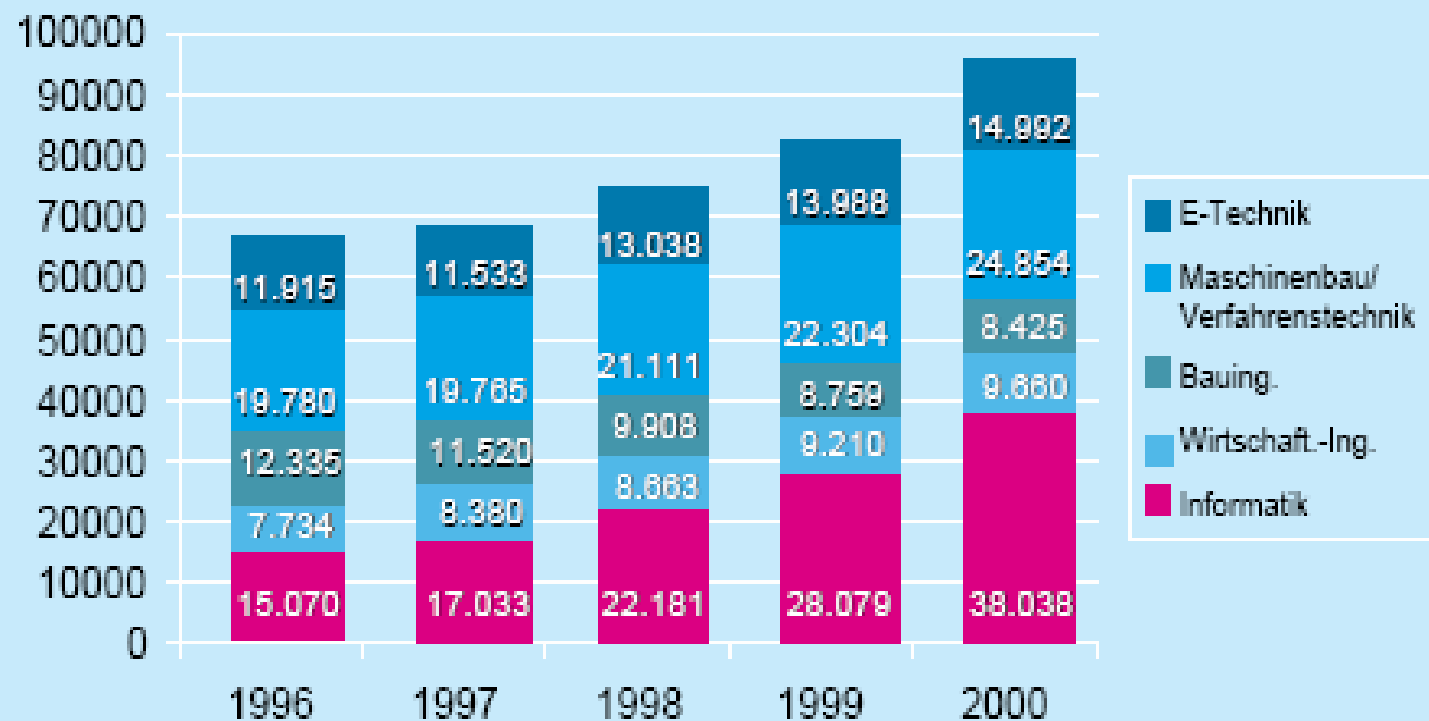


Decrease of engineering graduates since mid of 1990ies



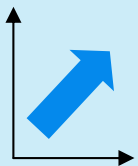
Quelle: Statistisches Bundesamt

Increase of engineering freshers since mid of 1990ies



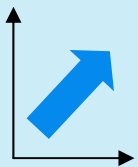
Quelle: Statistisches Bundesamt

Development of emerging technologies in Germany



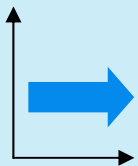
• Microsystem Technologies

- World Market 2005 ~ 68 bn \$, Annual growth rate: ~ 19% (Source: Nexus)
- Development in Germany: More than 600.000 jobs in Germany affected (Source: VDI-VDE)



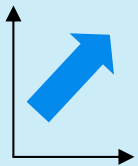
• Optical Technologies

- World Market 2005 ~ 80 bn \$, Annual growth rate ~ 20% (VDI)
- Development in Germany: 15.000 new jobs in SME until 2010 (Source: VDI)



• Biotechnology

- World Market 46,1 bn \$,
- Development in Germany: 10.000 jobs (decreasing), slightly increasing turnover (Ernst&Young)



• Nanotechnology

- World Market 100 bn \$,
- Development in Germany: 10.000 – 15.000 more jobs between 2003 and 2006 (Source: VDI)

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Identifying skill shortages in emerging technologies

Things to be investigated:

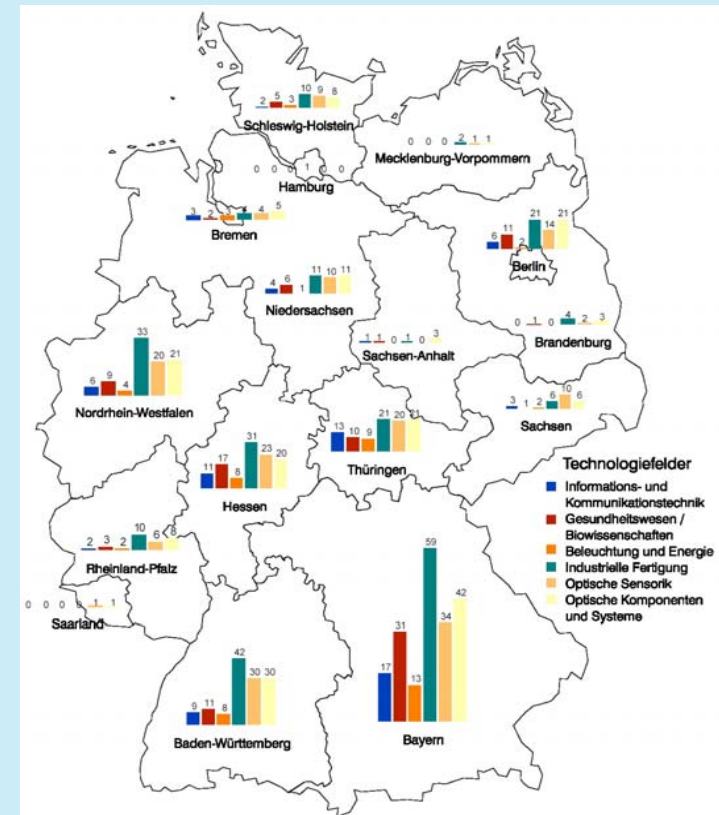
- Structure of industrial landscape (number and size of enterprises, branches, technology fields)
- Number and qualification level of employees
- Economical prospectus of technology field (jobs, market volume)
- Qualification demand/gaps in enterprises
- Educational offerings (initial and continuing, different levels)
- Potential gaps of existing curricula ...

Identifying Skill Gaps/Demands in Optical Technologies

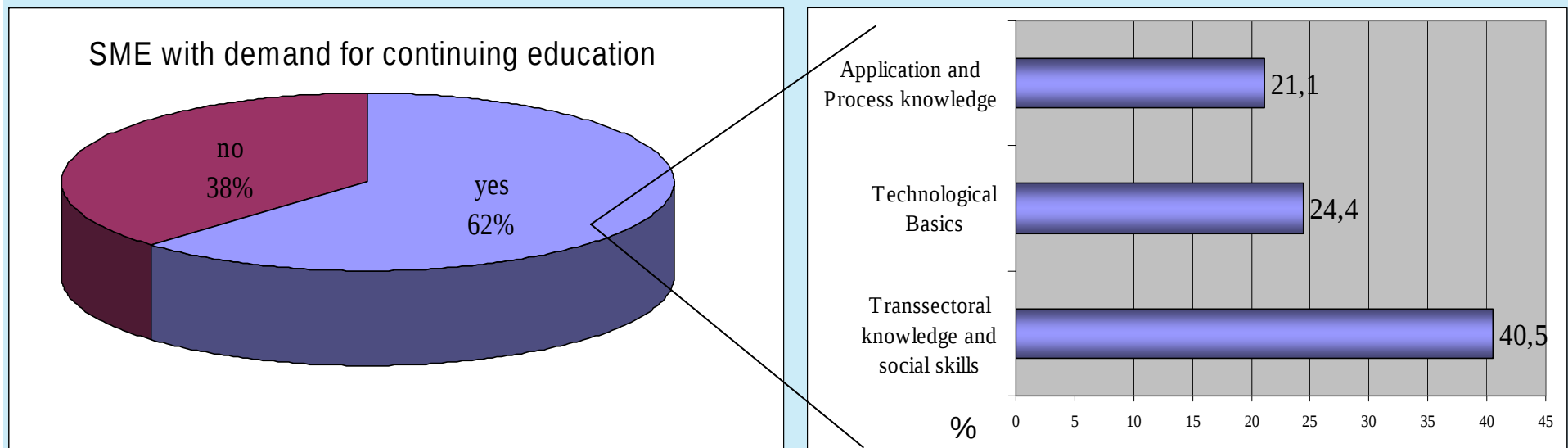
Investigation performed by ISW/VDI-TZ

- SME (representative Interviews)
- Handcraft (Expert Interviews)
- Big Enterprises (Case studies)

⇒ General view through mix of methods



Optical Technologies/ Gaps/Demand in Continuing Education



- ⇒ SME in emerging technologies are often innovation leaders
- ⇒ Demand for cross sectional skills training is more important than technical training

Optical technologies - Analysis of educational offerings

University education:

- More than 800 lectures on optical technologies at universities and colleges in Germany
- Some degrees in optical engineering have been established (bachelor, masters, diploma)

Vocational Training:

- About 10 trainee careers relevant for optical technologies
- No own trainee career necessary, but adaption and updating of existing training courses and additional specialisation modules



Optical technologies - measures to improve education and qualification

⇒ Vocational Education:

- Modernisation of existing curricula
- Development of additional qualification modules
- Establishment of training centers (including handcraft)

⇒ University Education:

- Initiation of new degrees, curricula, distant learning courses
- Fostering of interdisciplinary research groups and courses

⇒ Improve the transparency of educational offerings

⇒ Enhance Networking and build strategic alliances with relevant players (enterprises, competence centers, educational institutions)



Microsystem technology – Qualification aspects



academic courses at about 2/3
of German universities for applied
science

Diploma: Dipl.-Ing. MST

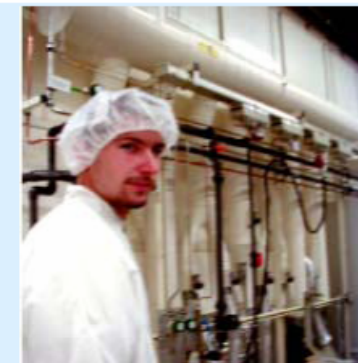
Graduates: $\sim 350 \text{ a}^{-1}$ trend: 



vocational training (3 years)
„Microtechnologist“
specialization microsystems technology

mostly co-operative education
in company networks

Trainees: ~ 350 a⁻¹ trend: 



Source VDI-VDE-IT

Microsystem technology – Training Networks

AWNET



MANO
Mikrosystemtechnik-Ausbildung in Nord-Ostdeutschland
Ansprechpartner:
Nicolas Hubner
nicolas.hubner@mano-berlin.de
www.mano-net

MST-Ausbildung
Ausbildungsnetzwerk zur Förderung der Mikrosystemtechnik in Niedersachsen
Ansprechpartner:
Casper Morsbach
morsbach@imt.uni-hannover.de

Learn-mst
Lernen am Arbeitsplatz - Mikrosystemtechnik
Ansprechpartnerin:
Dr. Monika Hiegemann
hiegemann@bfz-essen.de

FastMIT
Aus- und Weiterbildungsnetzwerk zur Fachkräftebeschaffung in der Mikrosystemtechnik in Thüringen
Ansprechpartner:
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www.fastmit.de

pro-MST
Aus- und Weiterbildungspartnerschaft für Prozesstechnologien in der Mikrosystemtechnik
Ansprechpartner:
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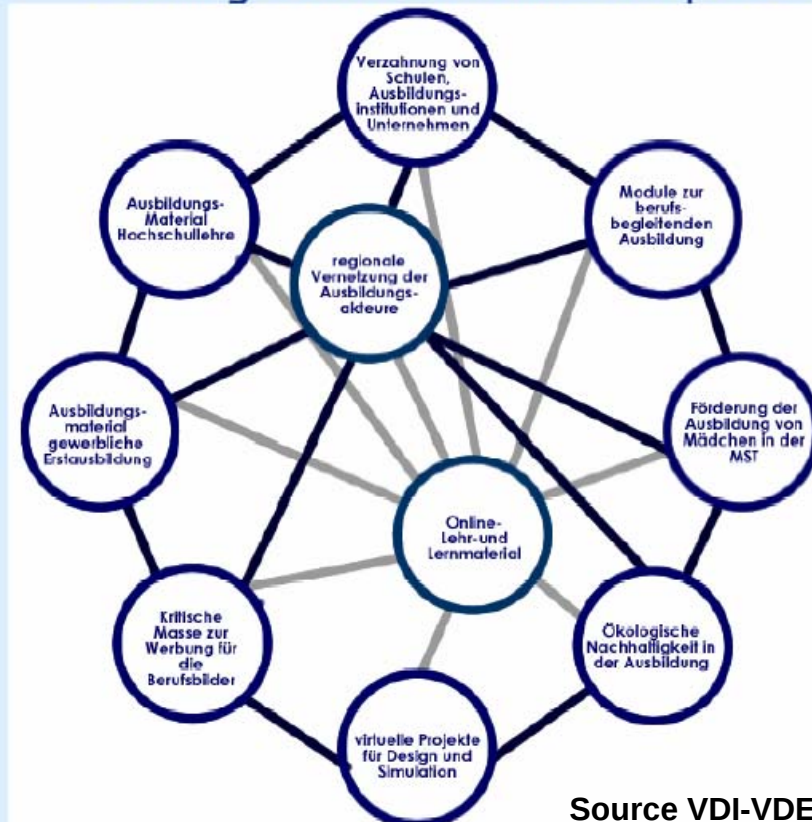
MunichMicronet
Mikrosysteme für mobile und fluide Anwendungen als Lerngegenstand
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Tel.: 03328/435-195, -109

www.vdi-vde-it.de/portale/ausbildung

regional edu and training networks

to stimulate and accelerate the dialogue between institutions for training/education and companies



Source VDI-VDE-IT

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Status Quo of nanotechnologies in Germany



- „Nanotechnology world market“ ca. 100 bn. € (rough estimation dependent of definition, time horizons, position in value chain etc.)
- Germany has a good position with regard to nanoscience and patents but commercialisation is weaker than in US and Japan
- ca. 450 enterprises in Germany in the nanotechnology sector
- ca. 20.000 bis 32.000 jobs affected in Germany
- So far little diffusion in traditional especially in medium enterprises
- In the year 2015 almost every industrial branch will be influenced by nanotechnology applications

Qualification demand in nanotechnologies

- Investigations by ISW for non academic professions
- Study by Nanobionet for non academic professions
 - ⇒ Industrial demand for updated curricula rather than for specific nanotechnology professional careers
- Systematic analysis planned by VDI-TZ for academic professions
 - ⇒ Voices from industry: Estimated industrial demand for a sound scientific and technical background and specialisation in nanotechnology relevant topics
 - ⇒ Interdisciplinary skills should be enhanced

Qualification offerings in nanotechnologies

- More than 50 courses and lectures dealing with nanotechnology at universities and technical colleges
- Some nanotechnology degrees established e.g. Dipl.Ing. with specialisation in bionanotechnologies, nanostructure technology, etc. (Uni Würzburg, Kassel, Iserlohn, München ...)
- Distant and online learning courses e.g. by CC Nanobiotech and University Kaiserslautern
- More than 100 continuing education offerings (conferences, seminars etc.) in Germany
- Ca. 10 vocational training courses leading to a non-academic career in the nanotechnology sector

How can skill gaps be prevented? Make educational offerings more transparent

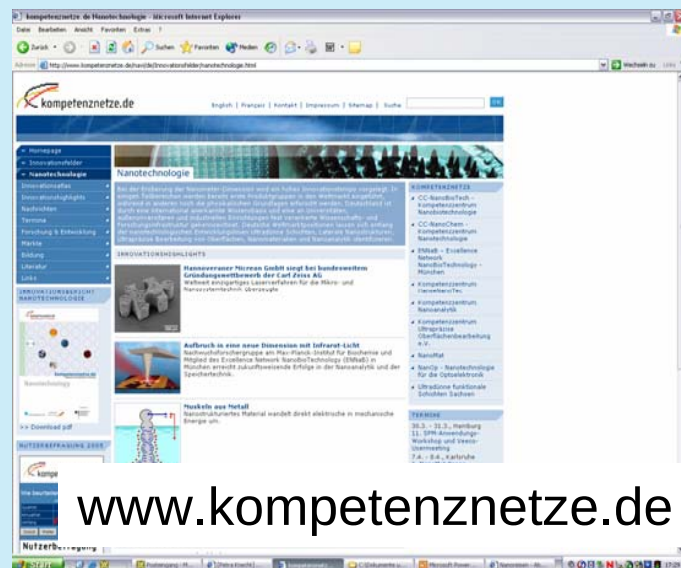
Activities by VDI-TZ

- Establish training databases for nanotechnology courses (Cooperation with job agency)
- Presentation of continuing education institutions and professional careers in nanotechnology (www.techportal.de)
- Overview on educational offerings at universities and technical colleges



How can skill gaps be prevented? Building of Networks and Competence Centers

- 9 nano CCN on federal level
- Several networks and competence centers on regional and state level
- Networking with educational institutions could be improved

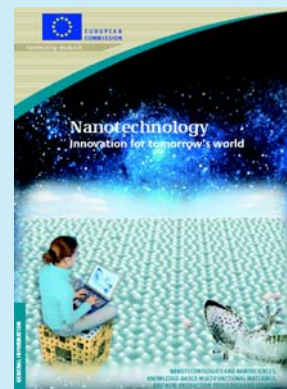
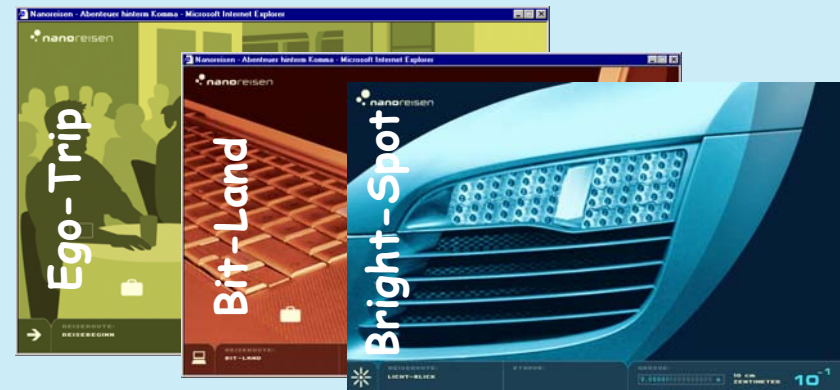


www.kompetenznetze.de



How can skill gaps be prevented? Fascinate young people

- Nanotruck: In 2004 more than 100.000 visitors at 200 locations
- BMBF Nanotechnology brochure adopted by European Commission and translated in all EU languages
- „Nanoreisen“ Interactive journey into the nanocosmos



Conclusion

- Nanotechnology sector is less mature than microsystem technologies or optical technologies but progresses fast
- At present skill shortage is a general problem in Germany not a nanotechnology specific
- Interdisciplinarity and cross sectional qualifications have to improved (by additional training courses and modules rather than nanotechnology degrees and curricula)
- Networking, transparency of qualification demand and offerings as well as engagement of young people should be improved