Karlsruher Institut für Technologie

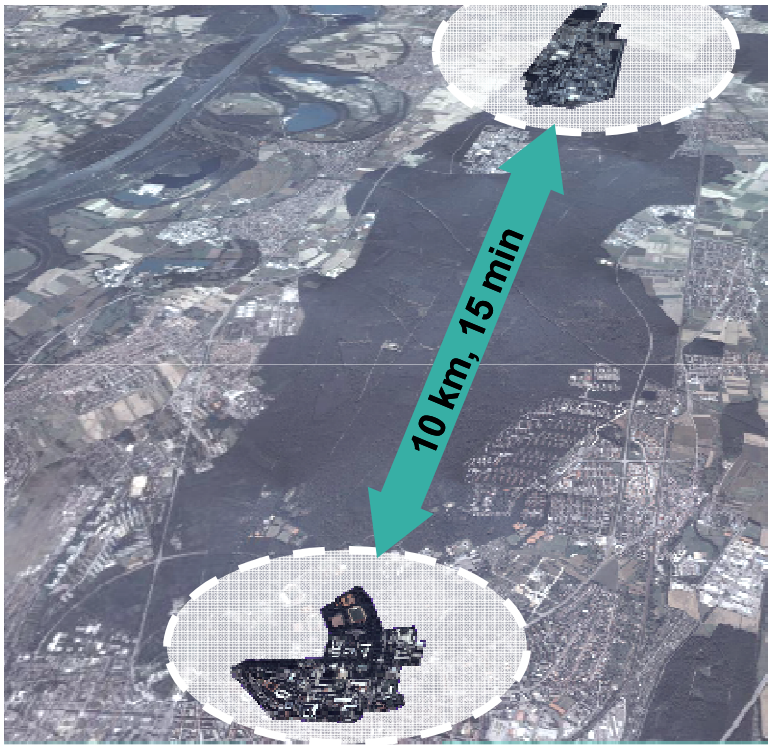
Engineering Education in Europe driven by Research and Innovation @ KIT

Jürgen Becker

Karlsruhe Institute of Technology - KIT

The two former Institutions – now KIT

Campus North



Campus South

KIT Campus North
formerly Research Center Karlsruhe GmbH

12 Programmes
27 Institutes
4359 employees

KIT Campus South
formerly University Karlsruhe (TH)

11 Faculties
130 Institutes
4922 employees

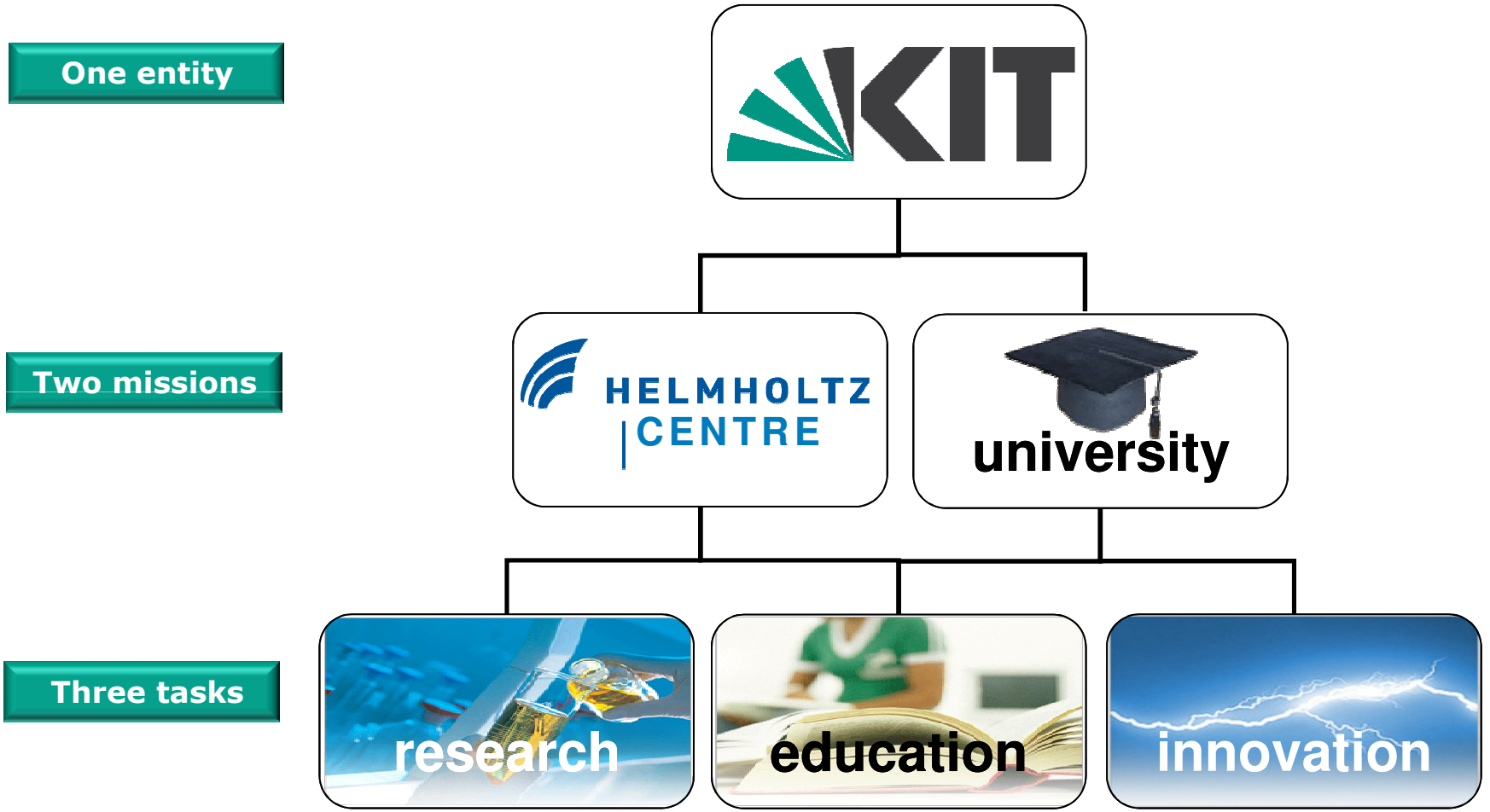
22500 students, about 3100PhD students

primarily Nature- & Engineering Sciences

Excellent overlap and complement synergies for…

- **... teaching**
- **... research**
- **... technology transfer**
- **... cooperations with industry**

KIT – One legal entity, two missions, three tasks



KIT South Campus

formerly: Universitaet Karlsruhe (TH)

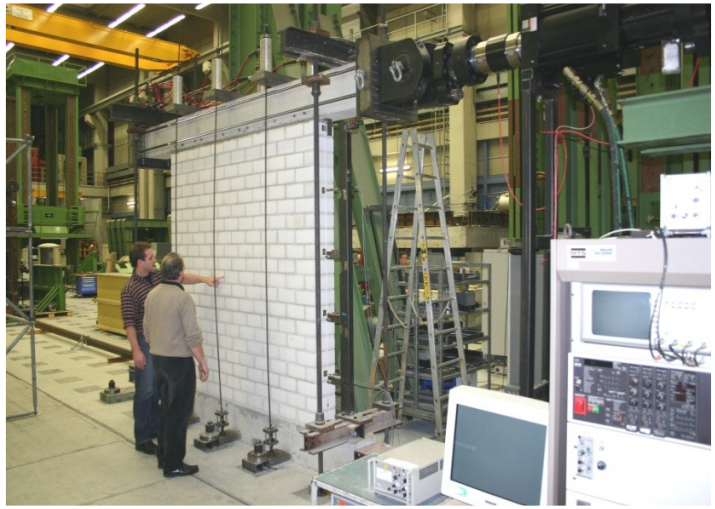
1825 Founded as Polytechnical School
similar to the Ecole Polytechnique in Paris

1885 Technical College

1902 Additional name „Fridericiana“ in honor of the Grandduke Friedrich von Baden

1967 Universitaet Karlsruhe (TH)

2005 Supplemental name:
„Research University· founded 1825“



- Mathematics
- Physics
- Chemistry and Biology
- Humanities and Social Sciences
- Architecture
- Civil Engineering, Geo- & Environmental Sciences
- Mechanical Engineering
- Chemical and Process Engineering
- Electrotechnical Engineering & Information Techn.
- Computer Sciences
- Economics and Business Engineering

KIT North Campus

formerly: Research Center Karlsruhe (FZK)

1956 Founded as Society for Construction and Operation of Nuclear Reactors

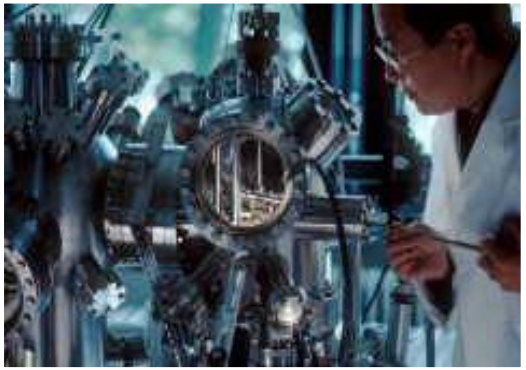
1963 Society for Nuclear Research Karlsruhe

1978 Nuclear Research Center Karlsruhe GmbH (KfK)

1995 Research Center Karlsruhe – Technology and Environment

2002 Research Center Karlsruhe – Member of the Helmholtz Association

Programmes:



- **Atmosphere und Climate**
- **Renewable Energies**
- **Conversion of Energy**
- **Fusion**
- **Nuclear Safety**
- **Technology, Innovation & Society**
- **Nano- and Microsystems**
- **BioInterfaces**
- **Scientific Computing**
- **Grid Computing**
- **Synchrotron Source ANKA**
- **Astroparticle physics**

KIT-Structures

KIT -Centers

- **Energy** 01.01.2008
- **NanoMicro** 01.01.2008
- **Elementary Particle and Astroparticle Physics** 01.01.2008
- **Climate and Environment** 01.01.2009
- **Mobility systems** 01.01.2011

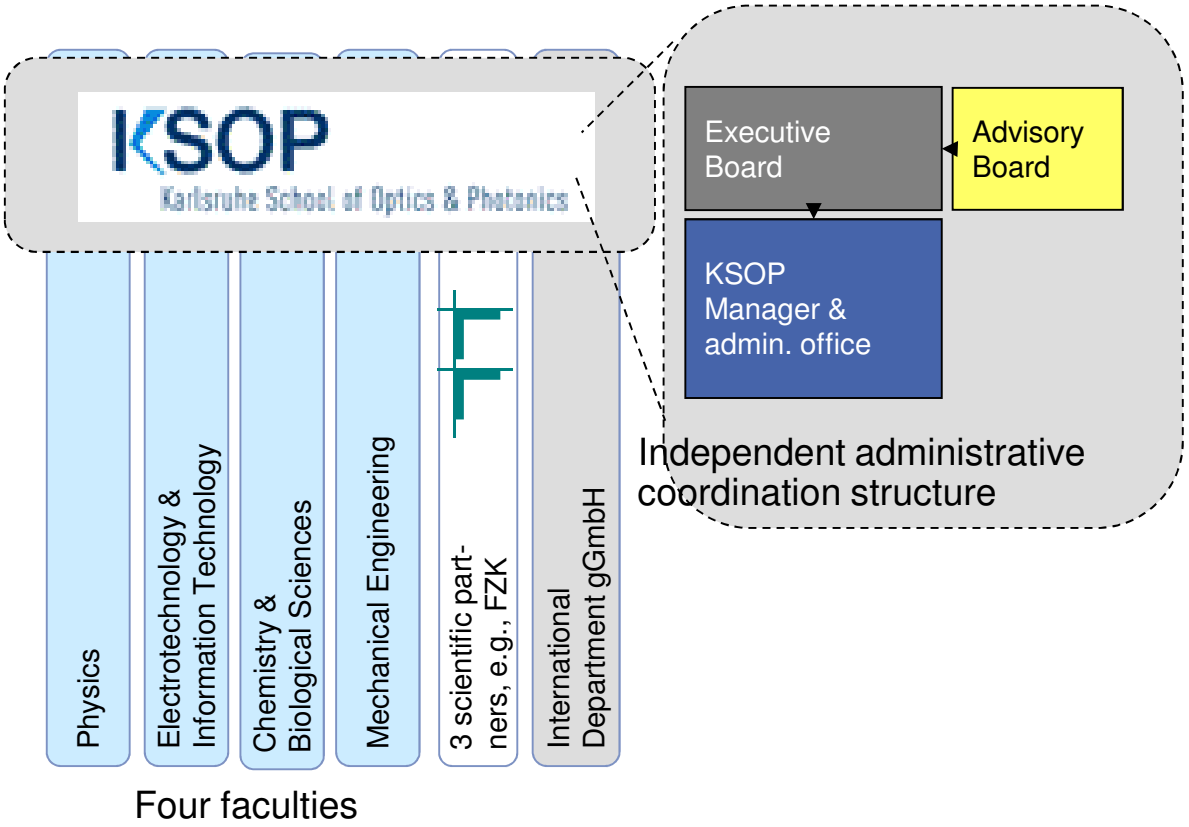
KIT -Focuses

- **COMMputation** 01.05.2008
- **Humans and Technology** 15.07.2009
- **Optics and Photonics** 01.01.2010
- **Anthropomatics and Robotics** 01.07.2010

KIT -Schools

- **School of Optics and Photonics** 13.10.2006
- **School of Energy** *Starting 2011/2012*
- **Schools Excellence Initiative II**
- ...

Example: Karlsruhe School of Optics & Photonics KSOP

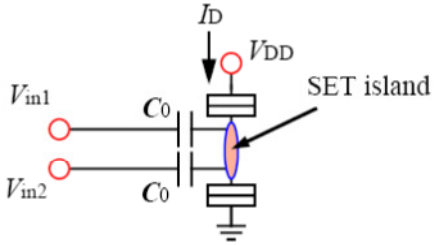


- Research-oriented teaching

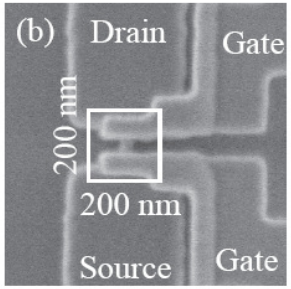
  ➔ Basis for future KIT Focus for Optics and Photonics

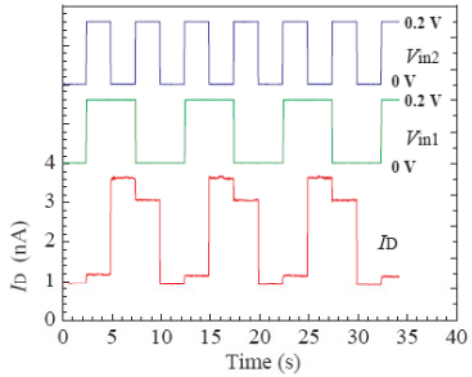
- Master's Program "Optics & Photonics"
- Doctoral Program
- Topic-specific industry contacts and securing of outside Funding

Nanoscaled Systems at KIT

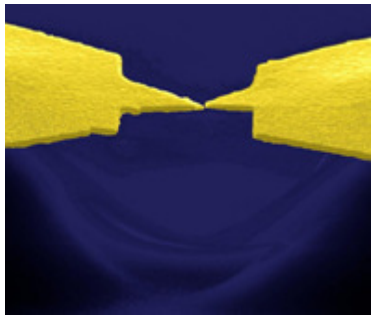


Single Electron Transistor (SET)

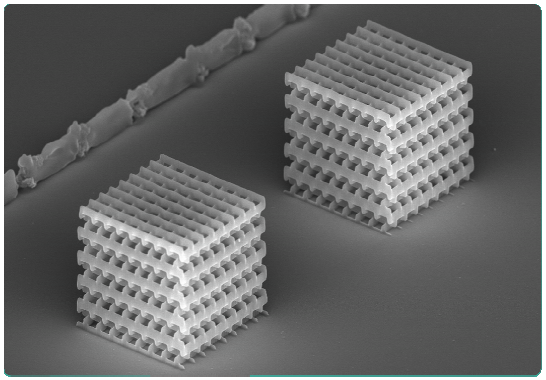




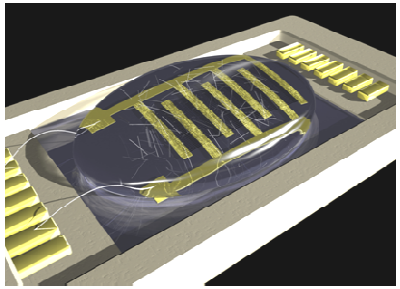
Single Molecule Diode

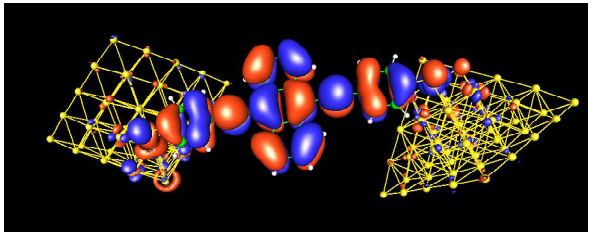


Photonic Crystals

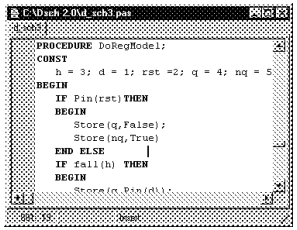


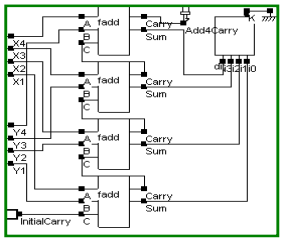
Carbon Nano Tube

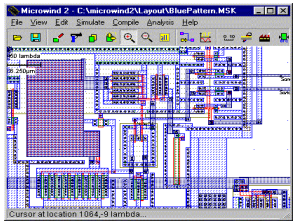


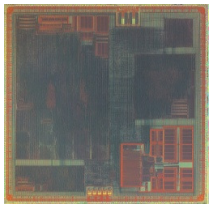


New Field Groups : Nanocomputing









New Technologies and Design Methodologies

New Adaptive Mechanisms

New Computing Paradigms

Nano Education:

needs especially also to bridge

terminology &

cultural gaps

between different disciplines!

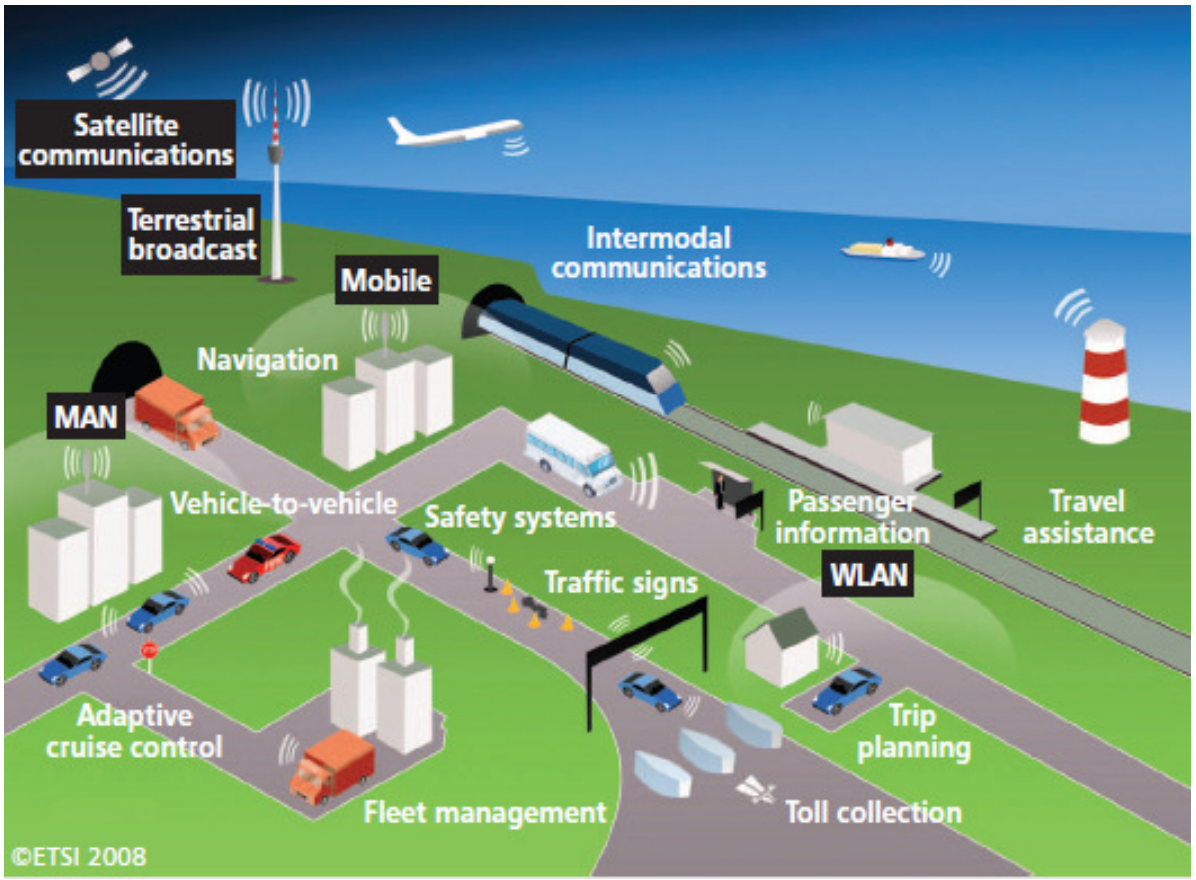
Cyper-physical System: Vision Smart Mobility

Relevant information of current situations will be used in real-time by all traffic participants for a safe, efficient, environmentally friendly and comfortable mobility

Examples:

- Green Mobility[1]
- Accident-free driving[1]
- Support for elderly people [1]
- Adaptive route planning to the point of 4D harmonization [2]

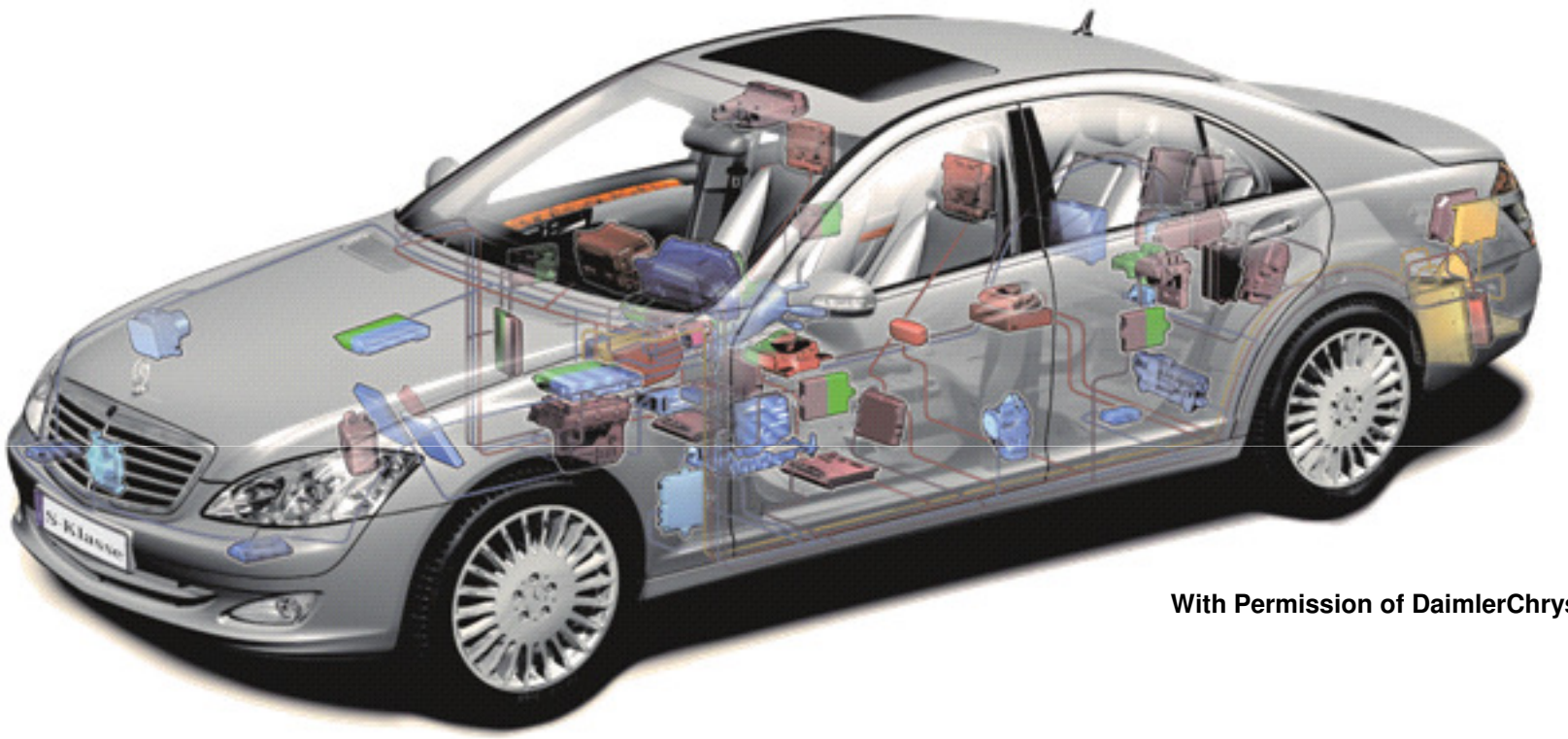
The requirements of **realtime information processing** capability and control of individual traffic participants increase considerably



This vision is directly and technological inevitably linked to the realizable processing power of the individual mobile subsystems.

[1] ZVEI - Nationale Roadmap Embedded Systems, 4.2 Mobilität, Mobilitätsszenarien 1-3
[2] SESAR – Single European Sky ATM Research

CPS: Connected ECUs in Automotive



With Permission of DaimlerChrysler AG

More than 80 ECUs
in Upper Class Cars

90 % of all Innovations
are based on Electronics

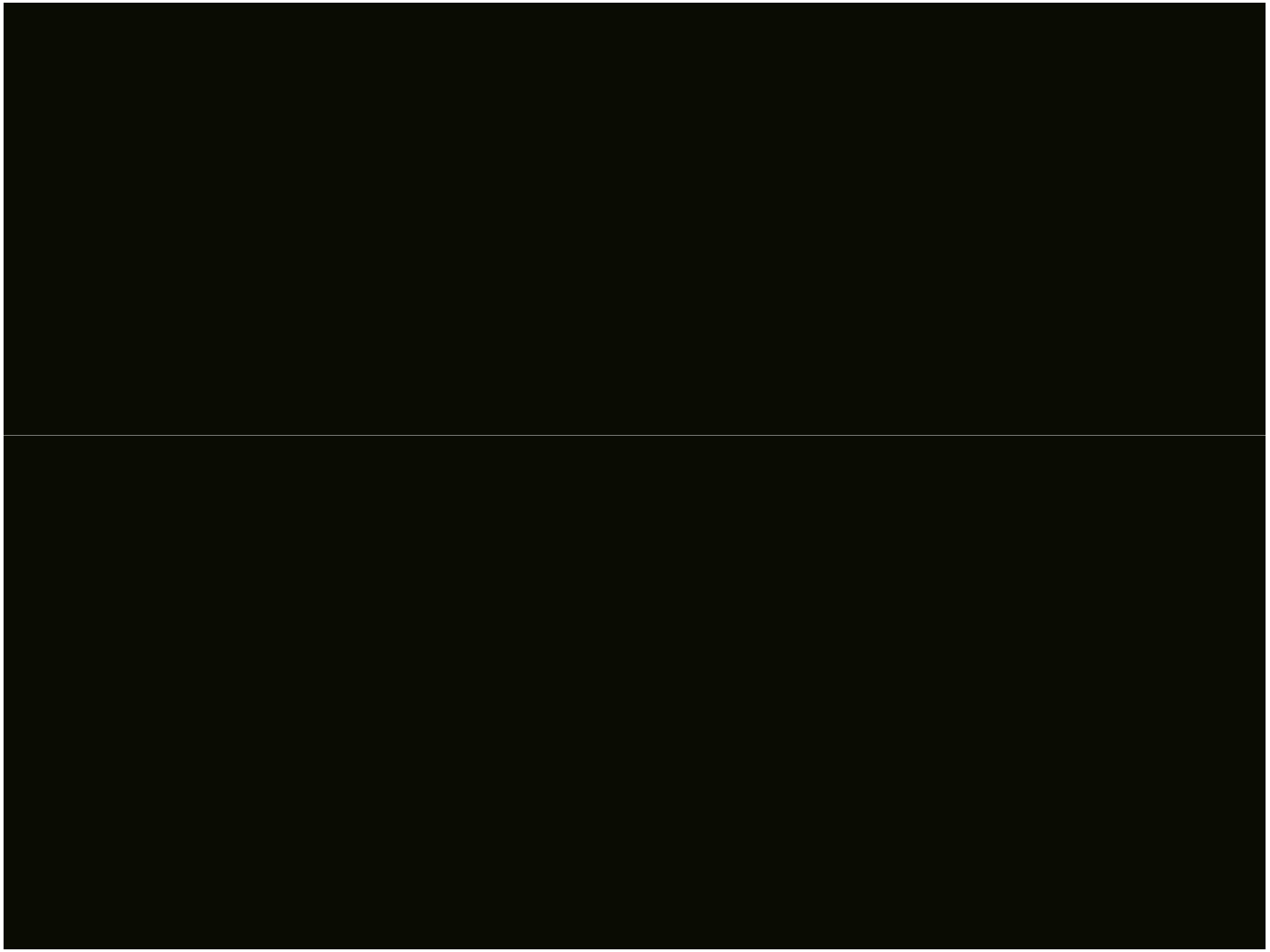
More than 35% of Added Value
of Passenger Car for
Electrical/Electronic Systems

Software Part
is quickly increasing

Opening of the Carl Benz School

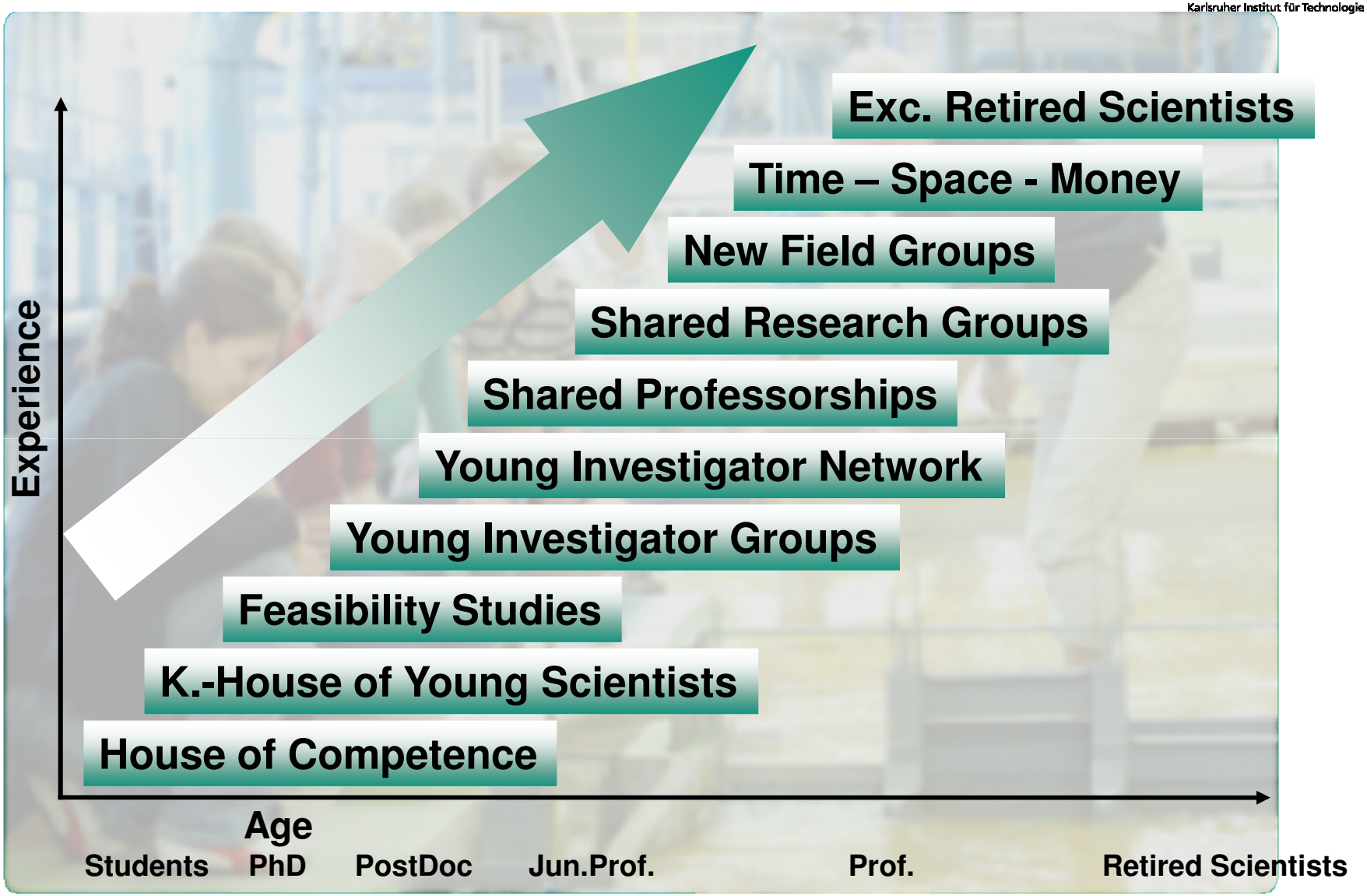
Dr. Dieter Zetsche, CEO Daimler AG & Ms. Jutta Benz, Granddaughter of Carl Benz

Automotive Security Systems ….



are
more & more
important!

Institutional Strategy: Promotion of Scientists



HoC – House of Competence

House of Competence

- As a central academic institution for **competence development** and **competence research** at KIT, **HoC promotes**:
  - ✓ cross-disciplinary research and the
  - ✓ acquirement of important key competencies.
- HoC provides new approaches to promote and maintain high levels of performance (innovative teaching and learning scenarios).

HoC will accompany the inclusion of the KIT Helmholtz domain into study courses with the project "**Study cultures under large scale research conditions**", thereby developing project-based learning and teaching formats compatible with large scale research.

Management Modules in Engineering Programs

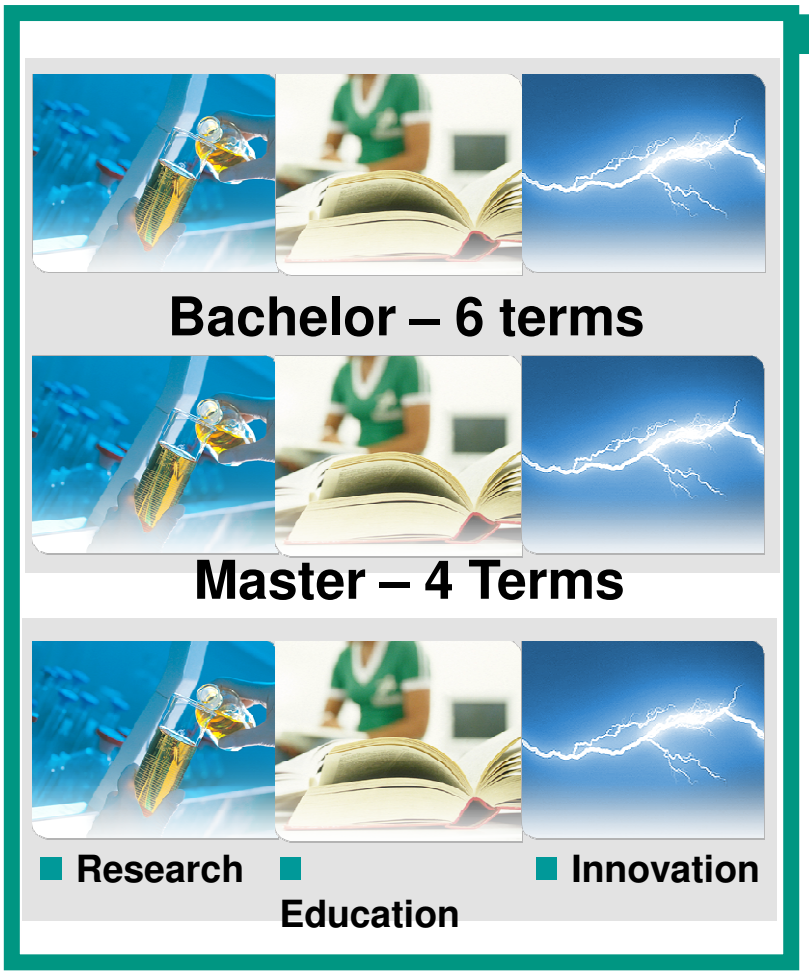
International Project Management	Human Resources Management
Project Management and Scheduling	Innovation Management & Entrepreneurship
Information and Process Engineering	Teamwork and Creativity Generation
Multiproject Management in a Global Environment	Leadership and Conflict Management
Development Management	Management Training

Two-week modules to be taught within the executive MSc programs

at the

Hector School of Engineering and Management

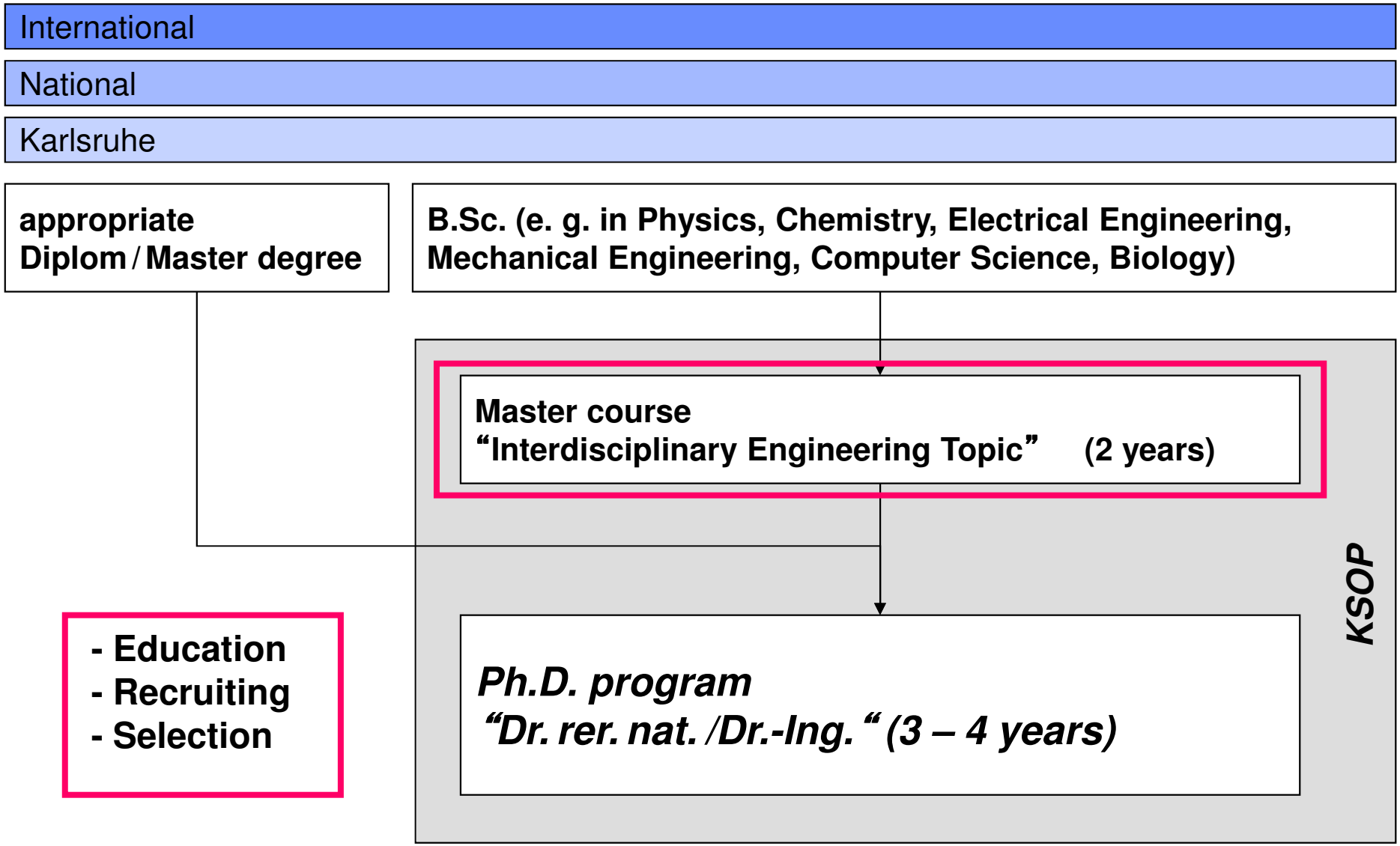
New BA/MA-Courses @ KIT



KIT-Concept:

- 6 + 4 BA/MA Model
- MA is the general Goal!
  - Consecutive Course Structure
  - „Diploma“-quality will be sustained
- Strong Research Orientation
- Strong Innovation Orientation

Polyvalent Engineering Education @ KIT



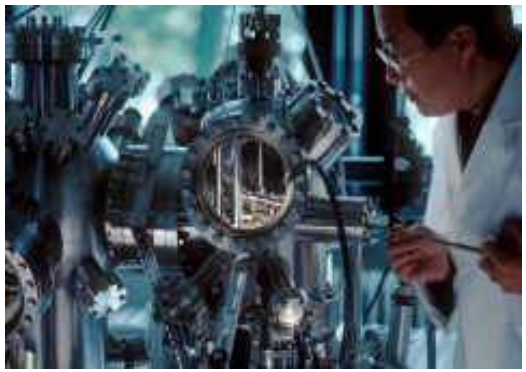
Three Dimensions of Innovation

First Dimension:

Innovation is Transfer of Ideas.

Second Dimension:

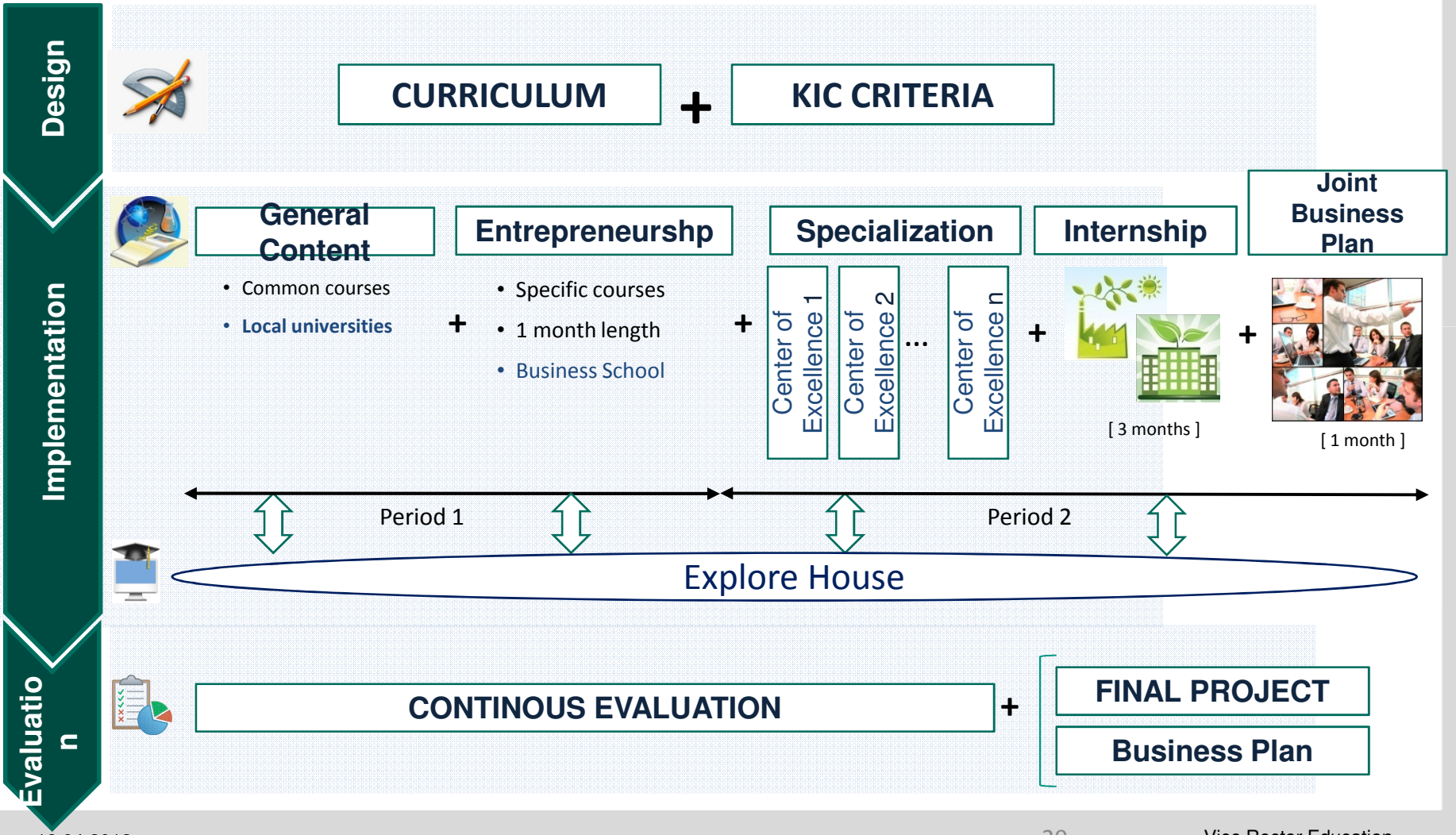
Innovation is Business Development.



Third Dimension:

Innovation is Exchange of Personnel.

Educational Program Example
European MSc in Sustainable Energy



Requirements for Future Engineers

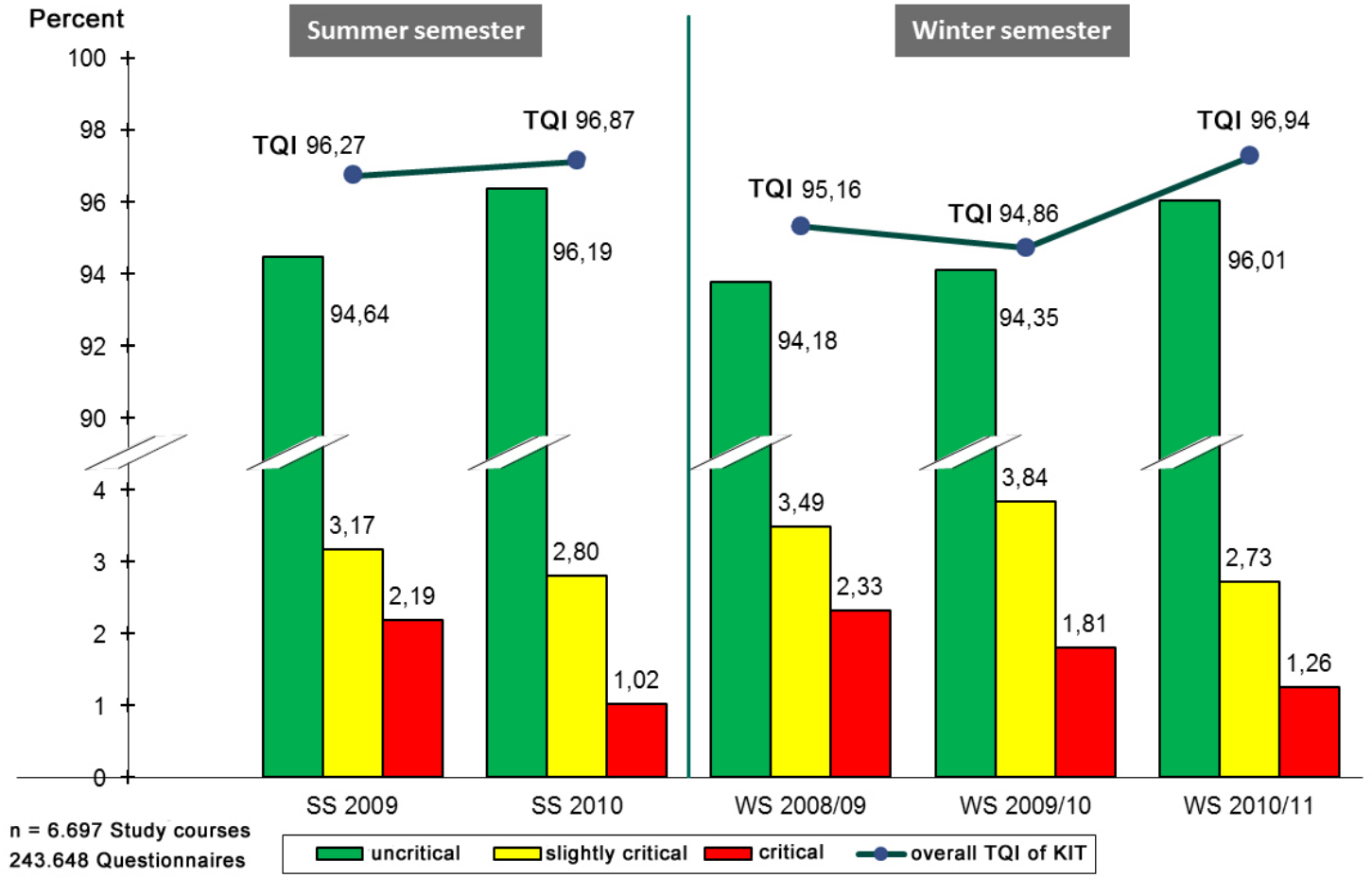
Important Skills for future engineers ...

- Technically & interdisciplnary skilled
- Able to communicate multilingually
- Able to work in a multicultural team

... adjusted for a global market

KIT Teaching Quality Index

Changes in the quality of study courses in the overall analysis for KIT in a time series of five semesters (WS 2008/09 until WS 2010/11)



Summary: The Bundling of Competences will add significant Value to existing Structures

Future Engineering Education: Needed and Added Values

Research	• **Profile Development (Reputation)** and **Strategic Orientation** for **Education follows Research** • **Development and Realization of new ideas** with an dynamic and **transparent Competence Portfolio** • **Internationally visible and competitive Models for Engineering Education** in **Europe**, e.g. **similar EIT-Models**
Teaching	• **Improved Student/Instructor Ratios** with experienced Scientists **from European Research Centers** as instructors, including selected **Lab Access** (also remotely via Internet and e-learning Platforms) • **New Prospects for Education: systematic early Inclusion** of Students in **major Research Projects**
Innovation	• **Higher Level of Innovation** with the **systematic Bundling** of Innovation Management Activities and stronger Integration with **Entrepreneurship and EIT-based Education Models**
Quality management	• **Encouragement of top Performance** with consistent **internationally** accepted **Quality Management** (w. g. ABET) and **useful System Accreditation Models**
Bodies	• **Shared Strategies** with **common EIT** Board and **Co-Location Strategies** • **Coordinated** and **extended Promotion** of especially **Young Scientists -> e. g. "Shared Models"**
Infrastructure and Services	• **Higher Capacity Utilization**, joint Human-Resources development in **Research, Education** and **Innovation**, e.g. in strong **Cooperation** with the related **Industry** • **Urgently necessary: European Scholarschip System for Students at all Levels -> Mobility!**

Kroemer ‘s Lemma of new Technology

“The principal applications of any sufficiently new and innovative technology always have been – and will continue to be – applications created by that technology.“

Examples: Transistor, semiconductor laser, NMR, ...

Nobel lecture: H. Kroemer, Rev. Mod. Phys. 73, 783 (2001)

Future Engineering Students …

Engineering Students are very creative …

especially in Exams!