1981 – 1986

PhD

Software Engineering

1987 – 1991

PostDoc

Information Systems

?

| Model |

| Software |

| DB schema |

| Database |

Multidisciplinarity
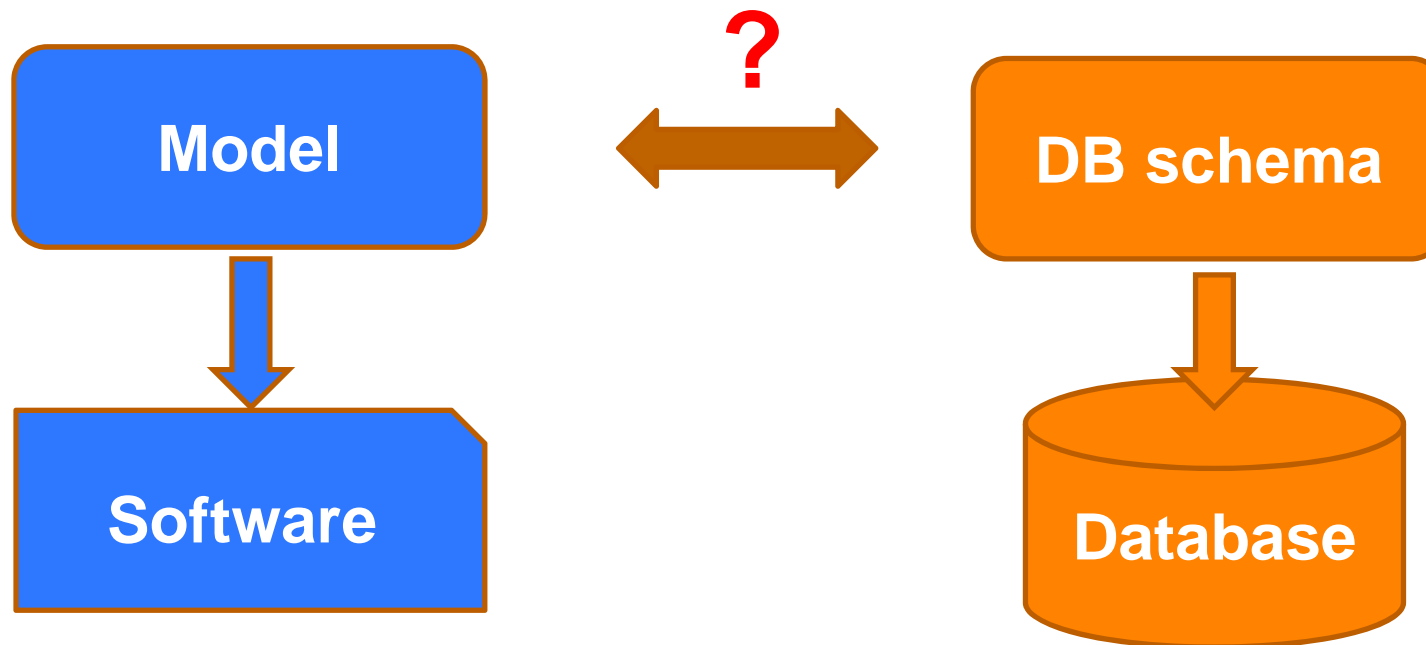
Software Engineering

Information Systems

Meta Model

Data Model

!!!

Model

DB model

2 subdisciplines of Computer Science
2 different ontologies / methods

Software

Database

Application Software

Database
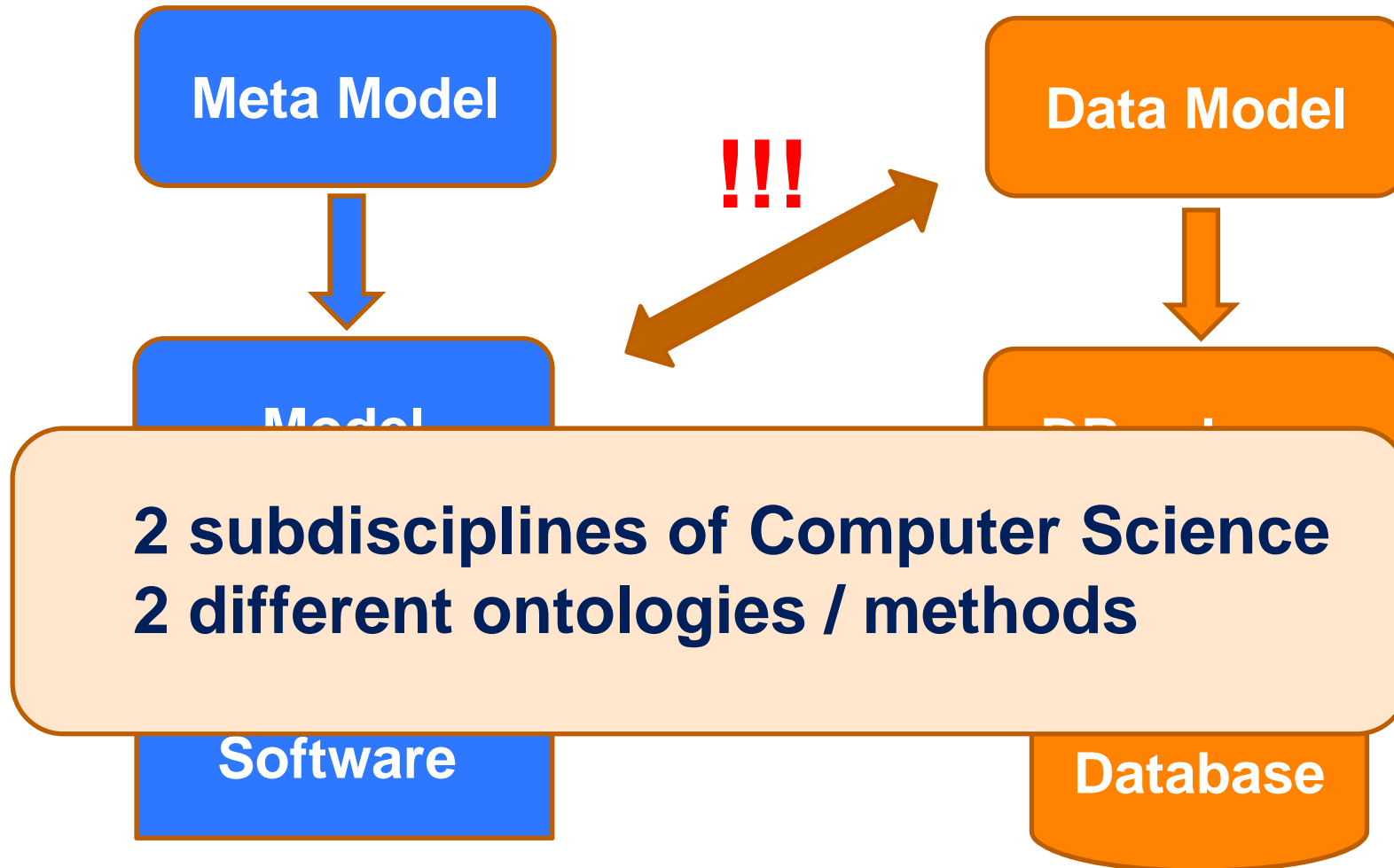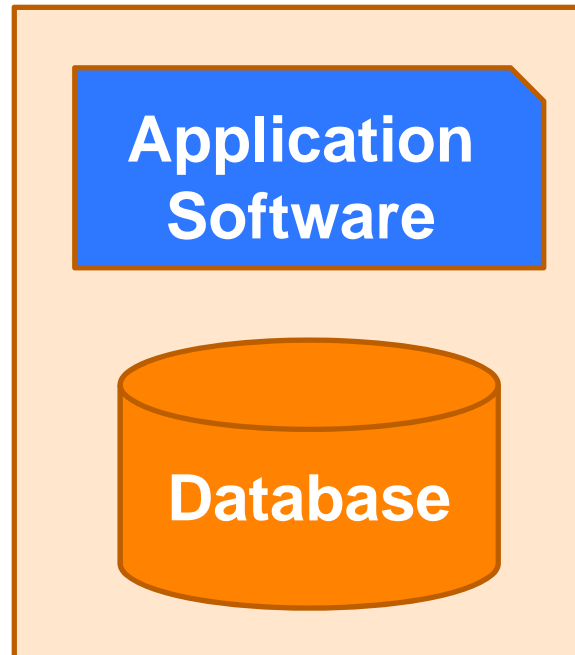
Multidisciplinarity

Several different disciplines with different (disjoint) ontologies / methods

1991 – 1997

Chair

Software Engineering and Information Systems

since 1997

Chair

Information Systems

Research Area: Software Engineering
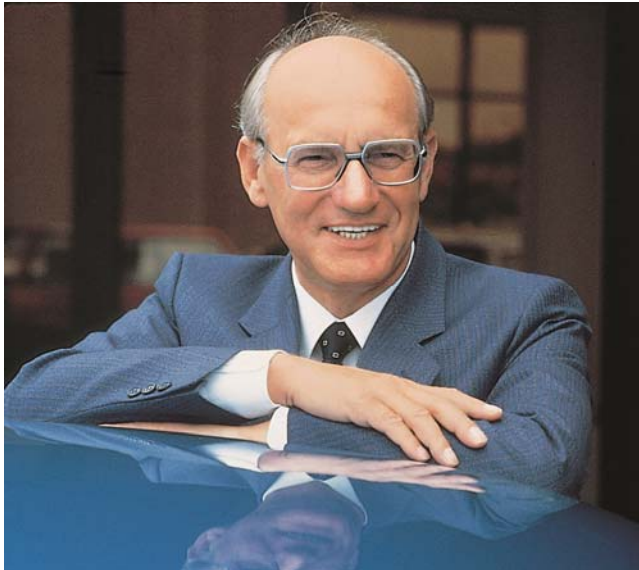
**Heinz Nixdorf (1925 – 1986)
German Computer Pioneer**

Industry ⟷ University

HEINZ NIXDORF INSTITUT
UNIVERSITÄT PADERBORN

- **seven endowed chairs**
  - **interdisciplinary approach**
    - **computer science**
    - **mechanical engineering**
    - **electrical engineering**
    - **economics**
    - **(philosophy)**

HEINZ NIXDORF INSTITUT
UNIVERSITÄT PADERBORN

- **seven endowed chairs**
- **corporate identity (board, marketing)**
- **high appreciation / reputation / success**

Interdisciplinarity

Several different disciplines with aligned ontologies / methods

faculty structure

Computer Science, Electrical Engineering & Mathematics
Mechanical Engineering
Business Administration & Economics
Natural Sciences
Arts & Humanities

Heinz Nixdorf Institute
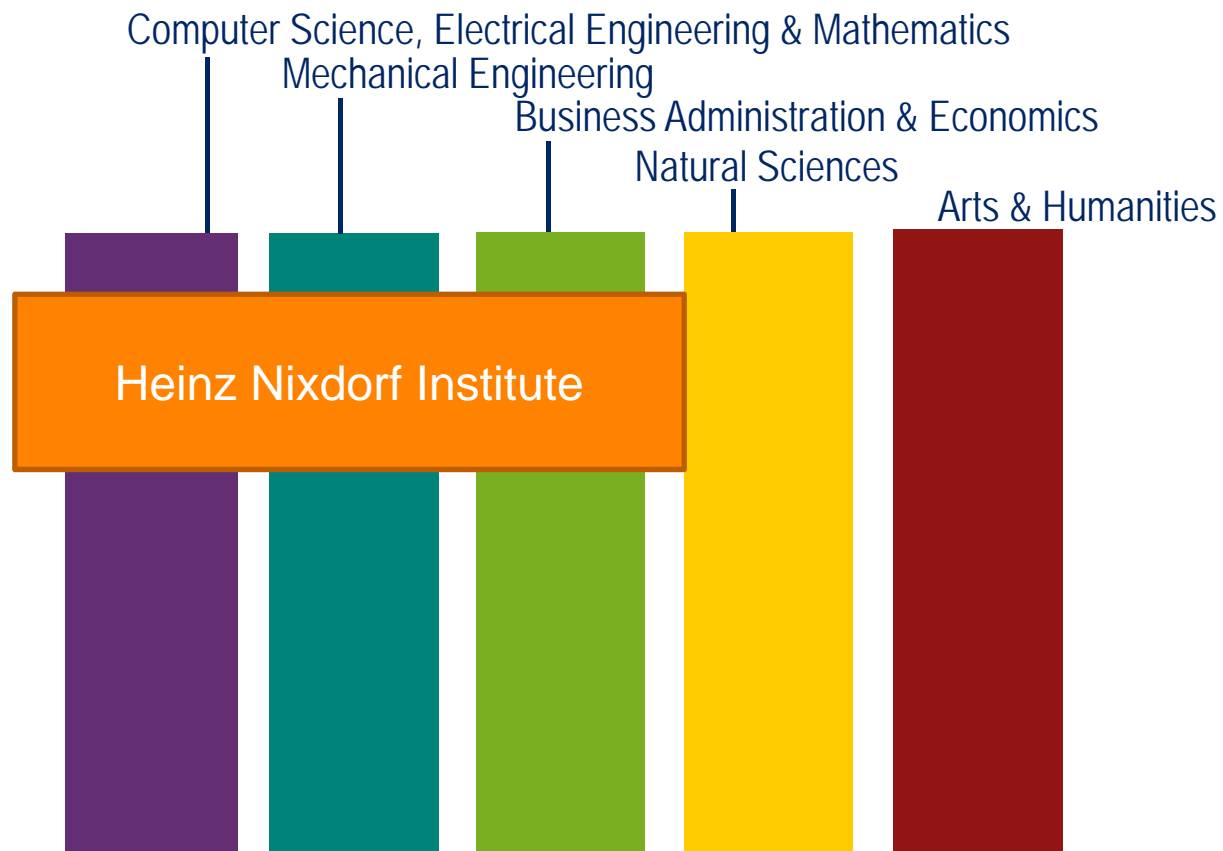
Any organization that designs a system (defined broadly) will produce a design whose structure is a copy of the organization's communication structure.

-- Melvyn Conway, 1967

faculty structure

Computer Science, Electrical Engineering & Mathematics

Mechanical Engineering

Business Administration & Economics

Natural Sciences

Arts & Humanities

Heinz Nixdorf Institute

Silo faculty structure

- **low coupling**
- **individual goals**
- **discipline-oriented quality assessment**

Institute structure

- **high coupling**
- **common goals**
- **goal-oriented quality assessment**

4th industrial revolution: **Industry 4.0**

Source. Fraunhofer IPA)

Source: dpa

Cyber-Physical Social Systems (CPSS)

Work 4.0
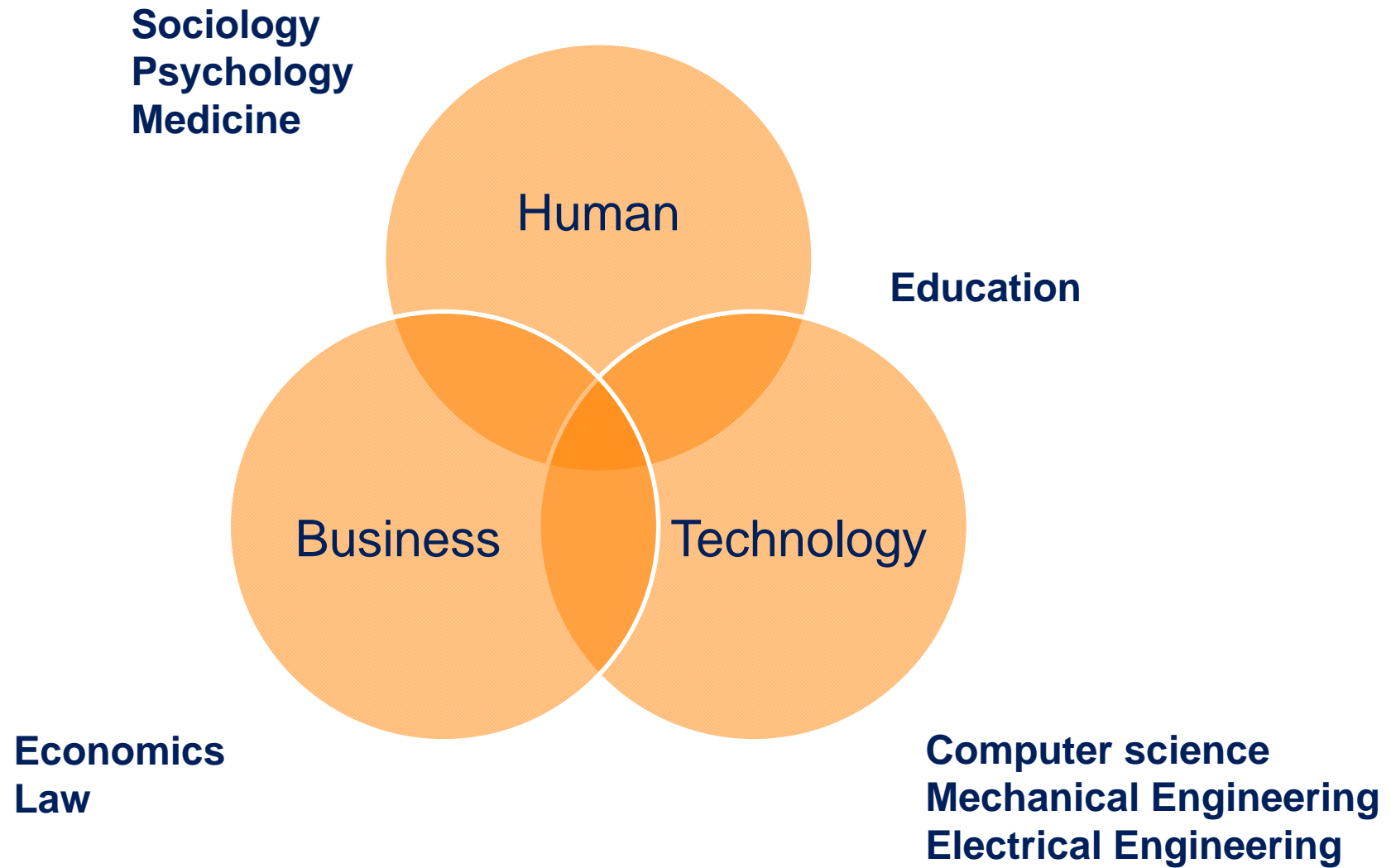
Sociology
Psychology
Medicine

Education

Human

Business

Technology

Economics
Law

Computer science
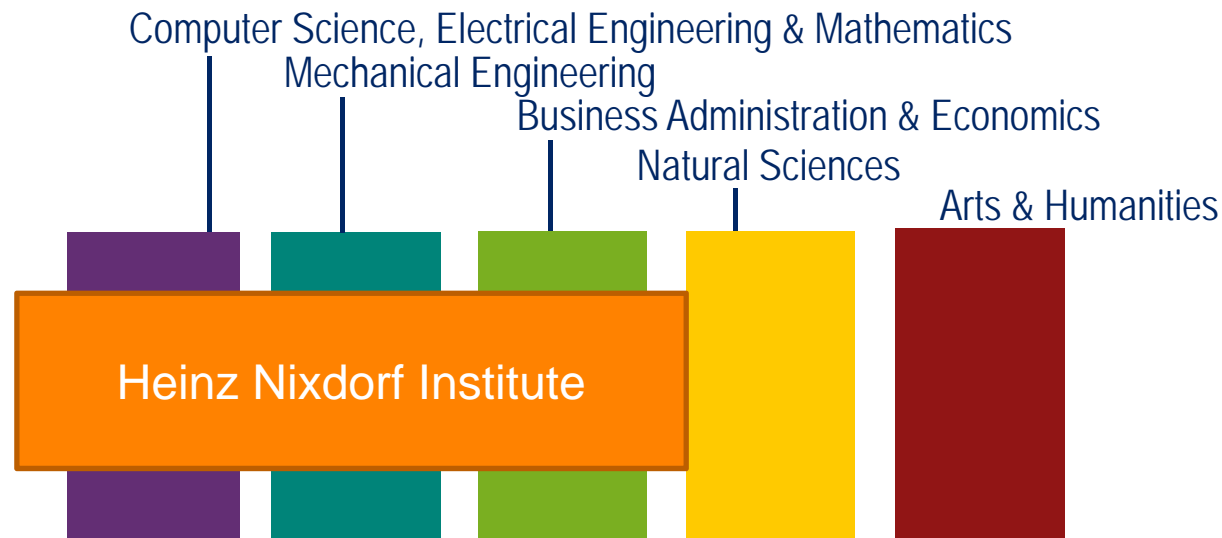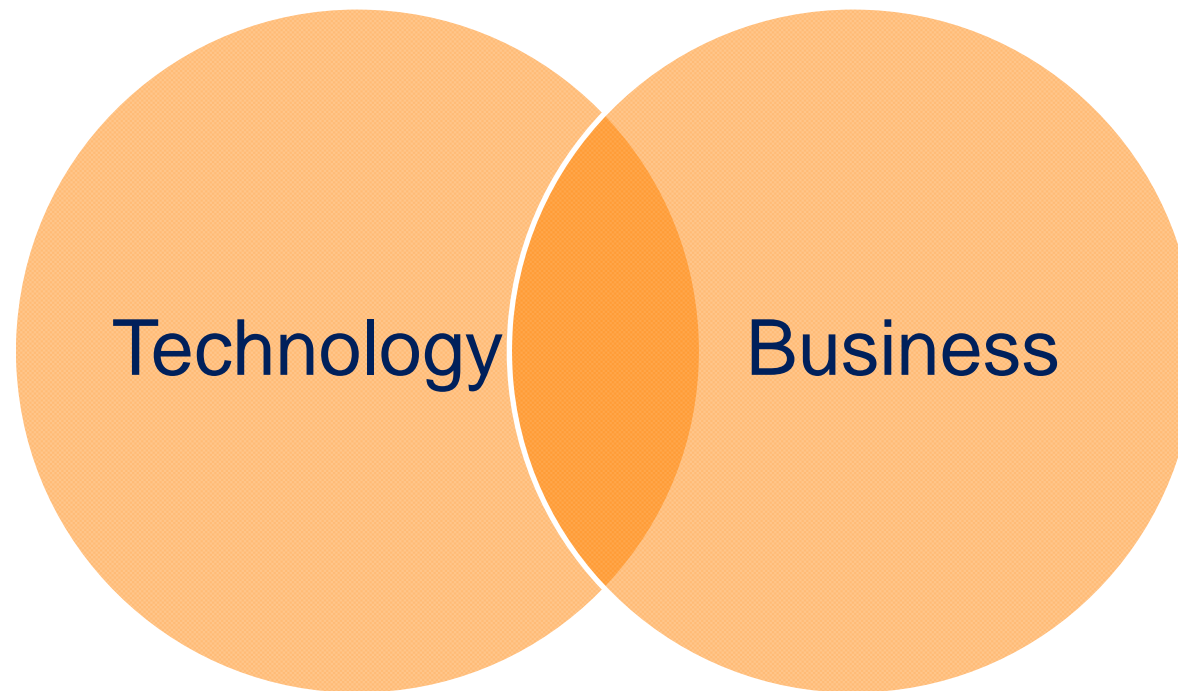**Mechanical Engineering**
Electrical Engineering

4th industrial revolution: **Industry 4.0**

Source. Fraunhofer IPA)

Source: dpa

Work 4.0

- **new role of employee**
- **impact on relationship between employer, unions, works council**

4th industrial revolution: **Industry 4.0**

Transdisciplinarity

Ontologies / methods from one or several disciplines are transferred / applied in another discipline / domain
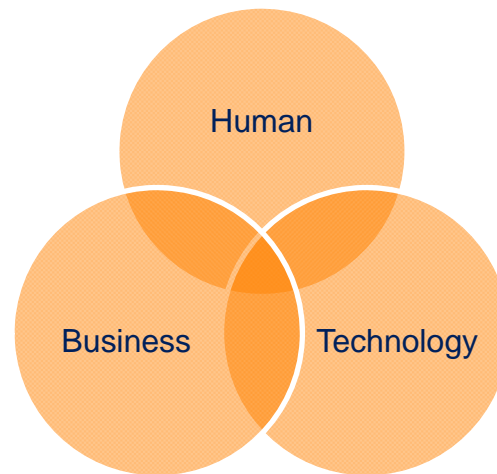
Source. Fraunhofer IPA)   Source: dpa

Work 4.0
- new role of employee
- impact on relationship between employer, unions, works council

Human

Business

Technology

PADERBORN UNIVERSITY

Mechanical Engineering
   Product Development
Education
Computer Science
   Software Engineering
   Process Engineering

Joint PhD School Work 4.0
- **10 professors**
- **10 PhD students**
- **1 coordinator**
- **4 years**
- **external partners (unions, IT networks)**

Universität Bielefeld

Sociology
Industrial Psychology
Computer Science
   Sensorics
   Robotics
   Neuro informatics

- **Board** (4 professors, 2 PhD students, 2 external partners)
- **PhD supervision**
  - direct supervisor
  - PhD students in his/her research group
  - regular meetings of PhD students (coordinator or self-organized)
  - regular meetings of whole consortium
  - advisory board (3 professors)
  - interdisciplinary research question
  - feedback from external partners
  - access to works councils / employees

"In theory, theory and practice are the same. In practice, they are not."

Anonymous

Pitfalls – Professor

- „takes" the money
- integrates PhD student as „regular" PhD student in his/her team
- leaves university
- not open to interdisciplinary work (time, fear, no reputation)

Pitfalls –

PhD student

- „takes" the money
  - wants only a PhD
- is isolated in the research team of his/her supervisor
- leaves university
- not open to interdisciplinary work (time, fear, hard to publish, additional time for discussion with other PhD students)

Pitfalls –

Interdisciplinary work

- discipline-specific research methods
  - analytical
  - constructive
  - empirical
- discipline-specific culture / publication methods
  - in-between, at-the-end
  - co-authors
  - journal, conference

Remedies

- careful selection of team
  - professors
  - PhD students
- strong leadership
  - discussions / meetings (individual, group)
  - distribute/assign responsibilities
- incentives for interdisciplinary work
  - new quality criteria
  - appropriate publication means
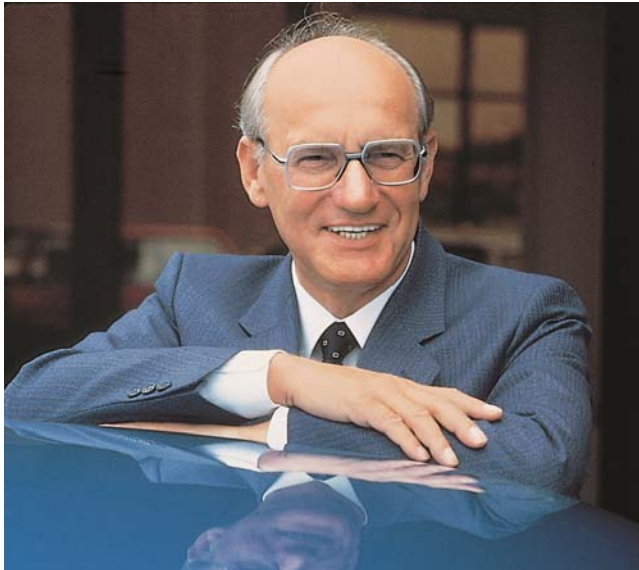
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UNIVERSITÄT PADERBORN

Technology Transfer   **PhD School Work 4.0**

Topics of modern ICT systems

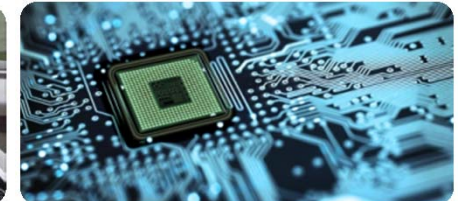| Software Engineering	Digital Transformation	Big Data Analytics	Security

Cloud Computing	Mobile Applications	Cyber-Physical Systems	Embedded Systems Design

Software Innovation Campus Paderborn

SICP Partner

- Atos
- dSPACE
- FUJITSU
- HJP CONSULTING.
- resolto
- S&n
- UNITY CONSULTING & INNOVATION
- WINCOR NIXDORF
- REDKNEE Looking Beyond
- SIEMENS

SICP
Software Innovation Campus Paderborn

cooperation

on campus
or
in the company

Paderborn University

SI-Lab

SI-Lab Competence Centers

Faculties
- EIM
- WIWI
- MB
- ...

Institutes
- HNI
- PC^2
- ...

Fraunhofer
IEM

Competence Centers

- *no technology silos, but strong cooperation*
- *no static structure, but agile and competent teams*

| Cloud & Mobile Systems | Director | Prof. Dr. Holger Karl |
| | Manager | Dr. Simon Oberthür |

| Cyber Physical Systems | Director | Prof. Dr. Falko Dressler |
| | Manager | Dr. Bernd Kleinjohann |

| Digital Business Innovation | Director | Prof. Dr. Dennis Kundisch |
| | Manager | Dr. Stefan Sauer |

| Smart Systems | Director | Prof. Dr. Eyke Hüllermeier |
| | Manager | Dr. Gunnar Schomaker |

| Software Engineering | Director | Prof. Dr. Gregor Engels |
| | Manager | Dr. Stefan Sauer |

Benefits of SICP

- single entry point for industry
    - in particular for SMEs
- adequate interdisciplinary team of researchers for each project
- centralized experience (proposals, contracts, IPR, budgets, employments)
- higher visibility of university
- knowledge exchange

Pitfalls

- **Professor**
  - doesn't understand the benefits
  - „can do everything"
  - afraid of loosing visibility / reputation / money

- **PhD student**
  - likes project work, forgets PhD

- **Research**
  - soft border between research and development

Remedies

- **Win-Win is the key!**
  - university, professor, Phd student
  - industry

- **long-standing relationships**
  - trust, appreciation
  - competence

Conclusions

- multi-, inter- and transdisciplinary work is needed to solve nowadays problems
- it needs additional effort and time
  - to cooperate in teams
  - to manage the people
- it is more risky
  - diverse backgrounds, expectations
  - unclear rewards
- it is more fun
  - broadens the horizon
  - greater impact

No risk, no fun!

Thanks

(engels@upb.de)