technische universität
dortmund

Biochemical- / Chemical Engineering Curriculum at TU Dortmund

N. Kockmann

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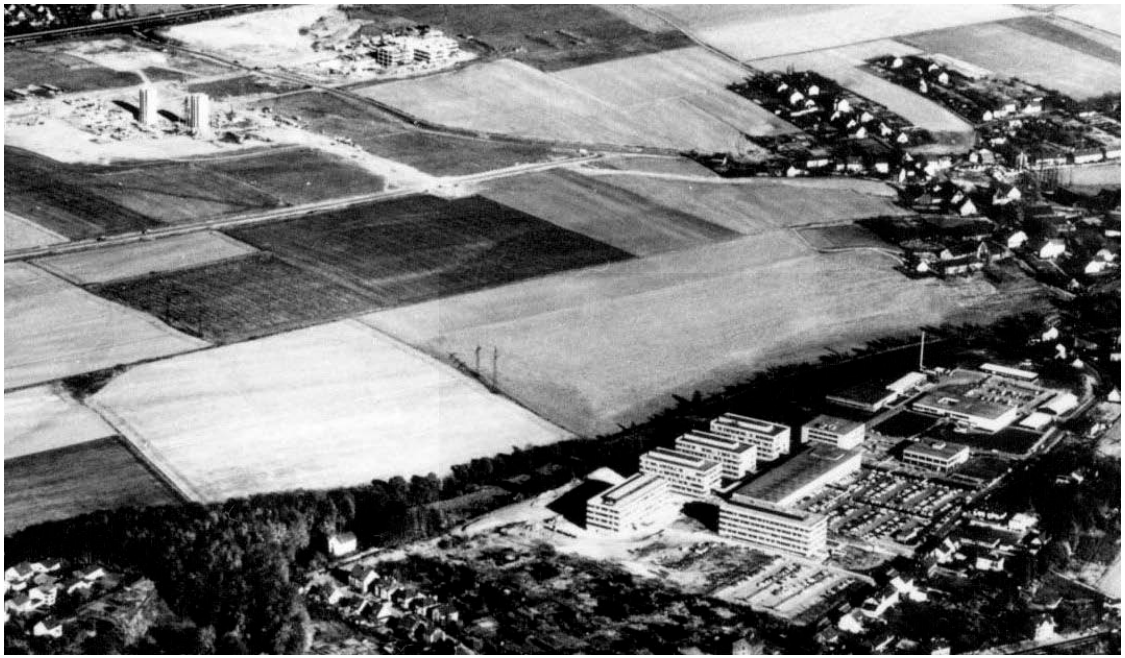
Faculty of Biochemical & Chemical Engineering

Laboratory of Equipment Design

Our department

- Founded in 1969 as Department of Chemical Technology
- 2003 renamed in Biochemical and Chemical Engineering



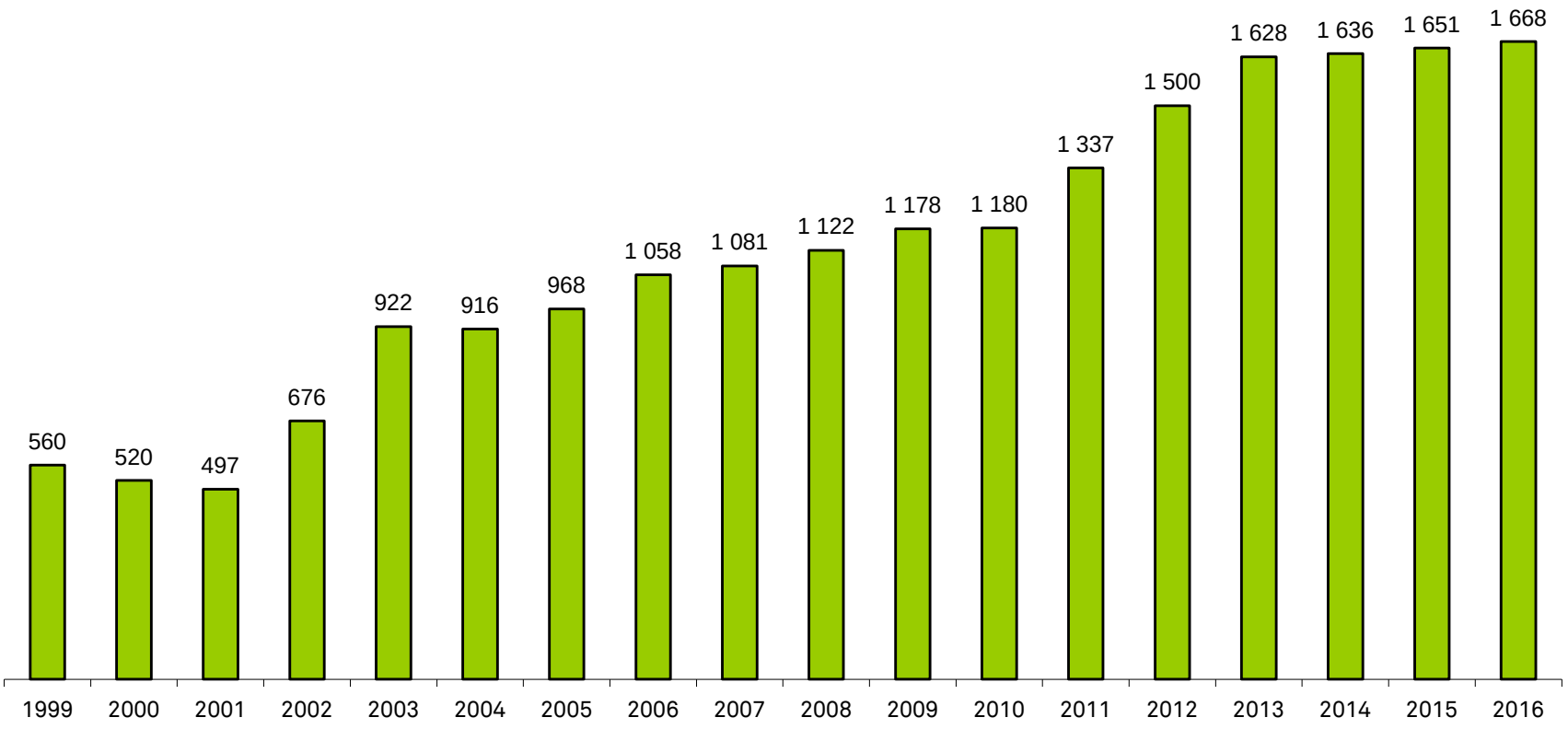
area view from 1971

- today more than 1600 students & 130 PhD students
- 14 professors from chemical, pharmaceutical, and engineering background
- no student fees

Our faculty – current structure

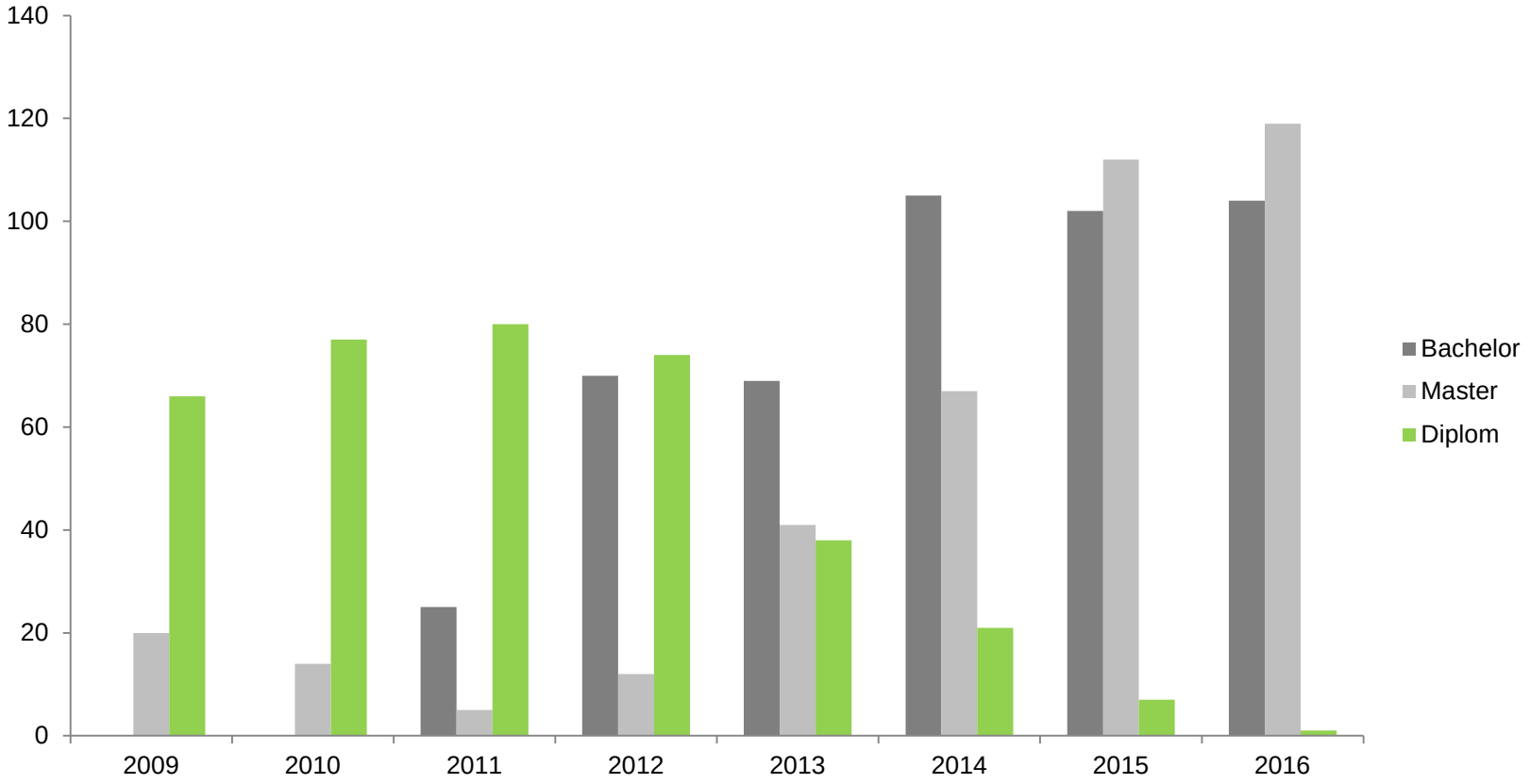
Fundamentals	Unit Operations	Process Design	Process Engineering
Thermodynamics Gabriele Sadowski	Chemical Reaction Engineering David W. Agar	Chemical Process Development Dieter Vogt	Plant and Process Design Gerhard Schembecker
Fluid Mechanics Peter Ehrhard	Fluid Separations Andrzej Górak	Bioprocess Engineering Stephan Lütz	Equipment Design Norbert Kockmann
Technical Biochemistry Oliver Kayser	Solids Process Engineering Markus Thommes		Process Dynamics and Operations Sebastian Engell
Technical Biology Markus Nett	Biochemical Engineering Rolf Wichmann		
Biomaterials and Polymer Science Jörg Tiller			

Recent trends in BCI student numbers



TU Dortmund: 34 200 students in 2016

Recent trends in graduation / BSc. and MSc.



approx. 25% enter PhD position after MSc graduation

Chem Eng recommendations from ProcessNet

EINE INITIATIVE VON DECHEMA UND VDI-GVC

- Universities: fundamentals and methods (BA) and research (MA)
- more emphasis on ethics, responsibility, non-technical skills
- Graduates are able to
  - **design** specified machines, equipment, and processes
  - understand **design methods** and apply them
  - use literature search from various sources
  - plan and perform **experiments** on their own
  - **communicate** orally and in written form with colleagues
  - work and communicate in **teams** including international members
  - organize themselve and their time schedule …

Bio-/Chem Eng study at TU Dortmund

- Well-received by industry due to broad education
  - 91% of alumni have found a full-time job with an average income more than 4.000€ p.m. (INCHER-Kassel, Alumni Survey 2015 and 2016 among batches of 2013 and 2014)
  - almost 90 % of the alumni describe their job as “near the studies”
  - almost 80 are highly satisfied with their professional situation

for example
in the last 10 years:

Bio-/Chem Eng study at TU Dortmund

- Main challenges and difficulties
  - Budget and staff issues (e.g. 110 students / professor)
  - approx. 40 – 50% drop out rate in Bachelor
  - only very few students finish in 7 semesters due to condensed lay-out (e.g. industrial internship between 6th/7th semester)
  - shorter life-cycle of contents
  - almost no possibilities for specialization during bachelor

- courses/topics eliminated in the last years
  - **energy** technology and power plants
  - **environmental** technology

Recent activities

- **Quality**: 10 Stars Service and teach'n teach as catalysts
- Solid brigdes between school and university
  (better motivation and less drop-out)

  →Self- assessment

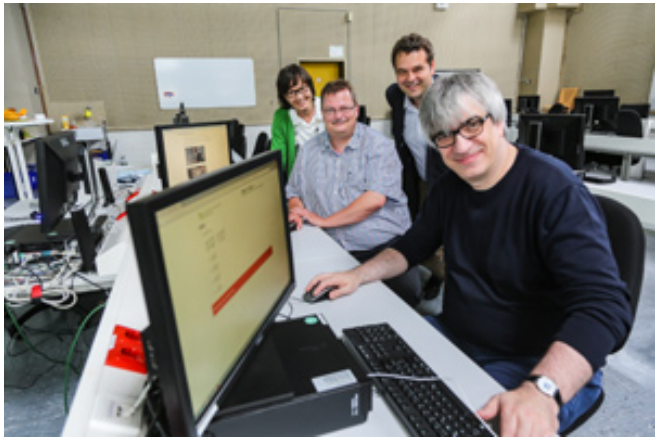
  →BCI-driving licence

  →Mathematics offensive

  →PEP project work with poster presentation

  →more feedback during the semester
- Revision of lab courses
- Complete revision of Bachelor layouts (2019, coaching by VDMA)

Self Assessment before enrolement



Current situation

- approx. 40 – 50% drop out rate
- misinterpretation of ´Bio-engineering´

Information modules with short movies

- show technical and engineering character of curriculum
- clarify false expectations, motivate interest in the subjects, and demonstrate possile job carreers
- explain necessary motivation and effort

Task modules

- mathematics
- basic technical understanding
- logic thinking
- interest in subjects
- motivation / work attitude

bci driving license

- more „how to @university“ knowlegde
- Three modules / stamps
  - University and department (structure, who is who, regulations, module handbooks…)
  - How to study
  - How to to organise yourself
- mandatory before first exams
- Merger of existing offers of the university
- Structured interview during to project work as an early intervention during the first semester

http://www.bci.tu-dortmund.de/de/studium/studieninteressierte/erstis/bci-fuehrerschein

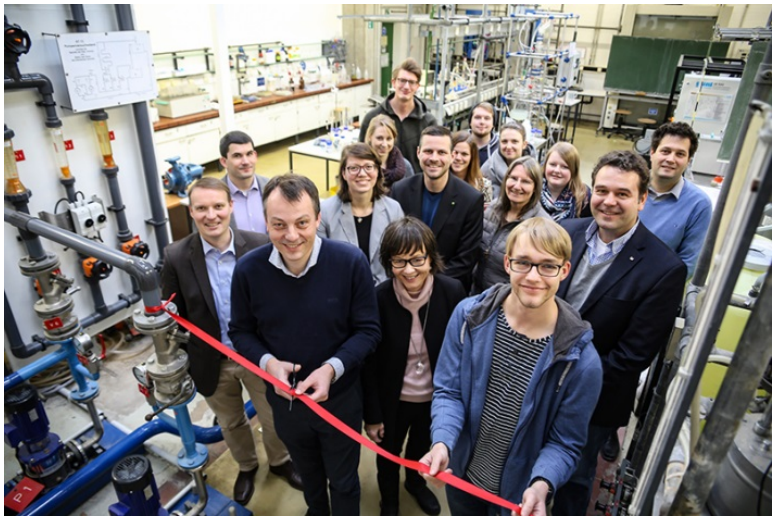
Poster presentation

- at the end of the 1st semester
- main topics on Megatrends
- team work of 5 students
- 4 page report + poster
- Topics on
  - CO_2 and climate change
  - Energy supply and storage
  - Energy efficiency
  - Health and life sciences
  - New materials
  - Food and water supply
  - …

Poster discussion with students

Praktikum 2.0 introduced in 2016

- **lab course** didactics
  - from understanding operations and phenomena to the understanding of processes
  - overview and linkage instead of "pressing buttons"
  - updated learning materials and infrastructure
  - better matching with courses given before



- clearly adressing **professional skills**
  - work in small teams
  - tandem experiments with related content, e.g. VLE measurement with LL-extraction
  - changed forms of attestations

- New format with semester structure

4. Semester (SS17)

Werkstoffkunde II (***BMP***) Strömungsmechanik II (***SM***) Transportprozesse (***TP***)	Thermodynamik II (***TH***)	2 TP 2 SM

5. Semester (WS17/18)

Mechanische Verfahrenstechnik I(***FSV***) Reaktionstechnik (***CVT***) Prozessdynamik und Regelung bzw. Prozessautomatisierung (***DYN***)	Thermische Verfahrenstechnik (***FVT***) Prozesssynthese (***TC***)	2 MV 2 RT 2 TV 2 PUR

→ Unraveling the semester structure, better preparation for exams

Design project as highlight in Bachelor Curriculum

- Team work with 8-10 students
- 6 weeks to plan a production plant from the scratch
- Including plant layout, safety analysis, cost calculation, …
- Weekly presentations and reporting
- Final presentation at Faculty with discussion
- Final presentation at company with similar process/product

2014 at INVITE, Leverkusen

2013 group after final presentation

Conclusion

- Global challenges (Megatrends) shape Chemical Engineering
- Solving complex problems, no simple answers
- Better motivation of freshmen is necessary
- Integrated view of the whole curriculum from Intro course over Lab courses to Design project and Final thesis
- Highly motivated and skilled graduates, well-appreciated by industry

Next steps

- Continuous improvement (e.g. VDMA consultation)
- Continuous evaluation of courses and curriculum
- Identify weaknesses and improve curriculum
- Intregrate research content with complexity of real world problems