UNIVERSITY OF APPLIED SCIENCES MÜNCHEN

"The Change of academic education of engineers from Dipl.-Ing. to Bachelor / Master Degree - Experiences and results in Germany"

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1 The new European Academic Education System

1.1 Motivation

- Integrated European High Education Network
  - Continual study at any European University
- Flexibility of studies in Natural, Engineering, Medical, … Sciences
- Straight forward oriented study with 3 different levels and degrees:

  Bachelor -> Master -> PhD / Dr.

  within about 3, 5, 8 Years
- Simplify the exchange of students (e.g. Erasmus-program)
  - Acceptance of courses taken at a foreigner university by the home university
- Worldwide acceptance of the high education degree in industries, labourites, government

- **It's a good chance to redesign "crusted" study programs for the new century**

1 The new European Academic Education System

1.2 General Conditions of Bologna Process

- Until 2012 all universities should educate along the Bachelor/Master concept

- Period and Degree of studies
  - First: Undergraduate study 3 .. 4 years => first Degree is a **Bachelor**
  - Second: Graduate study 1 .. 2 years => second Degree is a **Master**
  - Third: Postgraduate study 2 .. 4 years => third Degree is a **PhD / Dr.**

- Special degrees are
  - Bachelor of Engineering (**B.Eng.**) for undergraduate study with more practical basics
  - Bachelor of Sciences (**B.Sc.**) for undergraduate study with more theoretical basics
  - Master of Engineering (**M.Eng.**) for graduate study with more practical basics
  - Master of Sciences (**M.Sc.**) for graduate study with more theoretical basics
- The Master degree should have a time period of total minimum 5 years

1 The new European Academic Education System

1.3 European Credit Transfer System (**ECTS**)

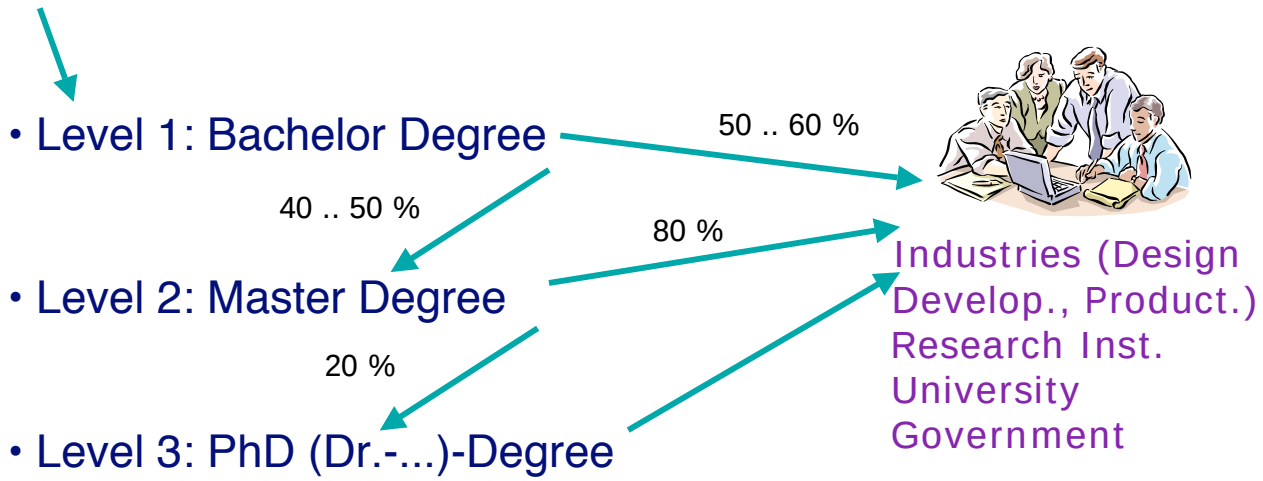
- All universities should count the study's work load by **Credit Points (CP)** measured by the European Credit Transfer System (ECTS)
- ECTS-Specifications are
  - **one Semester = about 30 CP**
  - one Year of study (2 semesters) = 60 CP
  - **1 CP = 25 .. 30 h work load** (of a student for lecture, hw, exam preparation, etc.)
  - one year of study (2 semesters) = 1500 .. 1800 h WL
  - A Bachelor degree has about 180 .. 240 CP
  - A Master degree should have total 300 CP = 210 + 90 or = 180 + 120

    (**it must have 300 CP to start a PhD-project**)
- A typical value of CP: A four-hour-lecture (2x90 min/week for one semester)

  => 4 .. 5 .. 6 CP, dependent to the add. proposed home work
- A semester of Eng. Study has about 6 different lectures each 5 points = 30 CP

1 The new European Academic Education System

1.4 Common Relationship of Educations and Graduates



2 The Historical German University Structure

1) Classical high **Universities** (188)
for Subjects in Physics, Mathematics, Medine, Engineering, Philosophy, Law, Teaching, ...
Example: Technical Univ. München (TUM)
Leopold-Maximilian-Univ. München (LMU)

old Degrees: Dipl.Ing.(TU), Dipl.Math. , Dipl.Geo, Dr.-Ing., Dr.nat., Dr.med. etc.
new Degrees: B.Sc., M.Sc., Dr-Ing. etc.
• most of the students want to finish with the M.Sc.

2) Polytechnic Institutes ->Fachhochschule ->
Hochschule = **University of Applied Sciences** (327)
for any kind of subjects: Engineering, Sociality, Tourist
=> with the skills to get a more practical engineering education
to work in industries and labourites
=> Mostly, **one semester of practical trainee is compulsory subject**
Example: Munich University of Applied Sciences (MUAS)

old Degrees: Dipl.Ing.(FH), ...
new Degrees: B.Eng., B.Sc., but also M.Eng., M.Sc.
• 65 % of the students want to finish with the B.Eng, B.Sc., 35 % want to cont. Master

3) Berufsakademien = **University of Cooperated Education** (63)
mostly engineering subjects
=> with an integrated study at university and engineering work in industries
=> Mostly, **1/2 time at Univ. + 1/2 time at industries**
Example: Berufsakademie Esslingen

old Degrees: Dipl.Ing.(??)
new Degrees: B.Eng.

3 Common Curriculum of Engineering Studies

3.1 German Accreditation Agencies

ACQUIN, a German Accreditation Agency for Accreditation of German Bachelor and Master study programmes, see www.acquin.de

ACQUIN
Your intention. Our focus.

International Issues and Projects

ACQUIN operates internationally in selected key regions:

- Region D-A-CH (Germany, Austria, Switzerland)
- Middle and Eastern Europe
- North Africa - Near and Middle East

ASIIN, a German Accreditation Agency for studies in Mechanical Engineering, Process Engineering, Civil Engineering, Surveying/Architecture, Informatics, Mathematics, Natural Sciences, and more, see www.asiin.de

ASIIN®
Akkreditierungsagentur für Studiengänge der Ingenieurwissenschaften, der Informatik, der Naturwissenschaften und der Mathematik e. V.

from the ASIIN- home page:

ASIIN Requirements and Procedural Principles for Accreditation

The ASIIN Requirements and Procedural Principles describe the requirements as well as the procedures for the award of the ASIIN Quality Label. They are revised in regular intervals and adapted to recent developments and results from accreditation practice.

ASIIN Requirements and Procedural Principles (PDF 257 KB)

Subject-specific Criteria

The ASIIN Requirements and Procedural Principles are complemented by Subject-specific Criteria (SSC) for the various disciplines represented within ASIIN. These are developed by the 13 Technical Committees for their respective area of competence and set into force by the Accreditation Commission.

TC 1 - Mechanical Engineering and Process Engineering (PDF 70 KB)
TC 2 - Electrical Engineering and Information Technology (PDF 78 KB)
TC 3 - Civil Engineering and Surveying (PDF 138 KB)
TC 4 - Informatics / Computer Science (PDF 62 KB)
TC 5 - Physical Technologies, Materials and Process Engineering (PDF 74 KB)
TC 6 - Industrial Engineering (PDF 76 KB)
TC 7 - Business Informatics / Information Systems (PDF 62 KB)
TC 8 - Agronomy, Nutritional Science and Landscape Architecture (PDF 81 KB)
TC 9 - Chemistry / (PDF 81 KB)
TC 10 - Biosciences (PDF 59 KB)
TC 11 - Geosciences / Geography (PDF 100 KB)
TC 12 - Mathematics (PDF 138 KB)
TC 13 - Physics (PDF 65 KB)

3 Common Curriculum of Engineering Studies

3.2 Skill Profiles of a Bachelor Graduate

see e.g. ASIIN

Bachelor, mechanical engineering, more practice-oriented (on the example of the 6th semester)	ECTS %	ECTS CP	> B.Eng. ECTS %	> B.Eng. ECTS CP	> B.Sc. ECTS %	> B.Sc. ECTS CP
Mathematic-scientific fundamentals Mathematics, physics, informatics	min. 14	min. 25	min. 18	min. 32		
Engineering fundamentals Technical mechanics/mechanical dynamics/theory of vibrations, fluid mechanics, technical thermodynamics, electrical engineering and electronics, materials engineering and chemistry, measurement and control engineering	min. 26	min. 47	min. 28	min. 50		
Engineering applications Machine engineering, construction/product development, manufacturing/production technology	min. 16	min. 28	min. 12	min. 22		
Advanced subjects, focal subject Practice-oriented according to choice	min. 4	min. 8	min. 6	min. 10		
Cross-subject contents Subjects in the fields of economics, non-technical electives, languages (as far as not taught in the afore-mentioned subjects) soft skills	min. 10	min. 18	min. 10	min. 18		
Bachelor's Thesis		12		12		
Practical training (technical laboratory)		min. 12		min. 6		
Total		180		180		

3 Common Curriculum of Engineering Studies

3.3 Skill Profiles of a Master Graduate

Master, mechanical engineering, more practice-oriented, (on the example of the 4th semester)	ECTS %	ECTS CP	> M.Eng. ECTS %	> M.Eng. ECTS CP	> M.Sc. ECTS %	> M.Sc. ECTS CP
Advanced fundamentals of mathematics, natural sciences and engineering Mathematic methods, advanced mechanics, technical informatics, construction theory	min. 13	min. 16	min. 19	min. 22		
Advanced engineering applications Motors and machines, laboratories, practice-oriented elective subject (energy management, conveying engineering, logistics, etc.)	min. 25	min. 30	min. 19	min. 22		
Advanced subjects, focal subject Practice-oriented according to choice	min. 22	min. 26	min. 22	min. 26		
Cross-subject contents Subjects in the field of economics, non-technical electives, languages (as far as not taught in the afore-mentioned subjects) soft skills	min. 10	min. 12	min. 10	min. 12		
Master's Thesis		min. 15		min. 15		
Practical engineering activity (technical laboratory, as far as not contained in the previous studies)		min. 5		min. 5		
Total		120		120		

Currently German universities try to establish
Bachelor and Master study programs
and to set up the curriculum
proposed by ASIIN or ACQUIN
for a successful accreditations

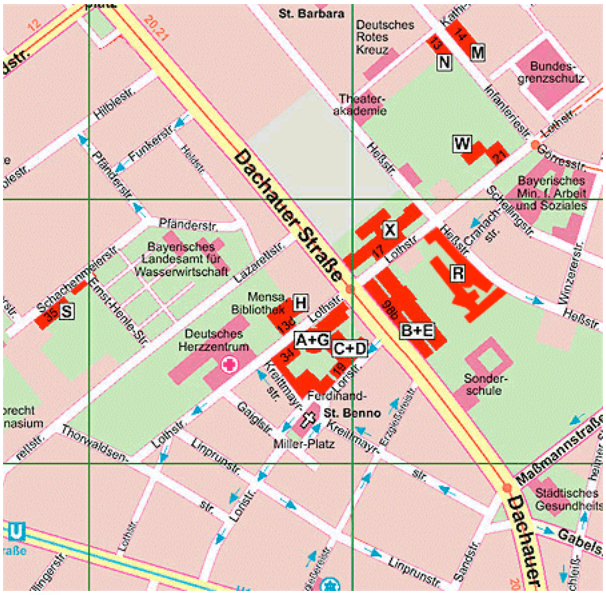
The certification is valid for 5 years

In the German engineering field about 70 % is done

4 Examples of Bachelor / Master Programs at MUAS

Lothstraße 34
D-80335 Munich
Germany
www.hm.edu

15 000 studs
700 professors
14 faculties

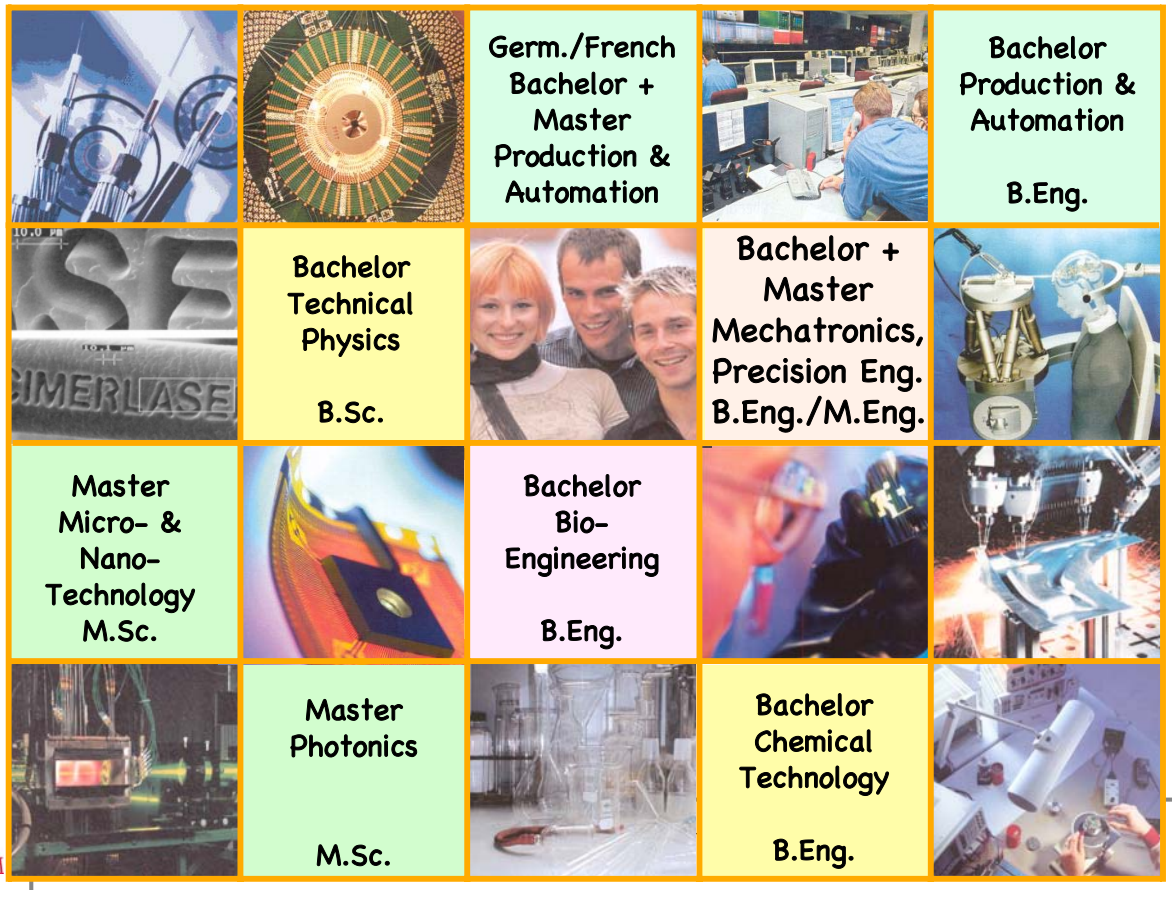


Main Entrance

Library

Faculty 06: Precision- and Micro-Engineering, Engineering Physics

see http://www.fb06.fh-muenchen.de/fb/



4.1 Standard Bachelor / Master Concept at MUAS

Period	Scope	ECTS CP
1 Years (2 Semesters)	Basic Eng. Theory and Labourites Work (about 28 * 45 Min/Week, 13 weeks/Sem.)	2 * 30 = 60
	min 45 CP to continue	
1 Year (2 Sem)	Theory and Labourites Work	2 * 30 = 60
	min 105 CP to continue	
½Year (1 Sem)	Practical Trainee at Industry or Institution (18 .. 19 weeks) + block lect. in Soft Skills	30
1 Year (2 Sem)	Theoretical Specialisation incl. Bachelor-Thesis	2 * 30 = 60
Bachelor 7 Sem	Skills to work as an Engineer in Industry/Inst. Degree: B.Eng, B.Sc.	**210**
	min 210 CP and a mark<2.5 to continue	
1 Year (2 Sem)	Advanced Theory and Specialisation	2 * 30 = 60
½Year (1 Sem)	Master Thesis	30
Master 3 Sem	Skills to work as an Engineer in Industry/Inst. Degree: M.Eng, M.Sc.	**90**

4.2 Lectures of B.Eng. Mechatronics and Precision Eng.

Sem.	MFB No	Lecture	SWS	CP	Speci
1	110	Mathematics 1	6	7	
1	120	Physics 1	5	5	
1	130	Electrical Engineering1	4	4	
1	140	Technical Mechanics 1	4	4	
1	150	Materials Technology / Chemistry 1	5	5	
1, 2	160	CAD	4	5	
2	210	Mathematics 2 mit Computer algebra	5	6	
2	220	Physics 2	4	4	
2	230	Electrical Engineering 2 with actutors	3	4	
2	240	Technical Mechanics 2	4	4	
2	250	Technical Optics 1	3	4	
2	250	Precision Mechanical Design	4	4	
1,2		General Elective	4	4	
		Sum 1. and 2. Semester	*55*	*60*	
3	310	Informatics	4	4	
3	320	Signal and Systems	6	6	
3	330	Electronics	4	4	
3	340	Technical Optics	3	4	
3	350	Materials Technology 2	3	4	
3	360	Manufacturing Engineering 1	4	4	
3	370	Ergonomics	4	4	
4	410	Design Engineering 1	4	5	
4	420	Modeling & Simulation -Introduction	3	4	
4	430	Control Engineering	4	5	
4	440	Signal Engineering	4	4	
4	450	Micro-processors	4	4	
4	460	Sensorics in Mechatronik	4	4	for route G
4	470	Mechanism Design and Analysis	4	4	for route G
4	480	Sensoric in Medical Eng.	4	4	for route M
4	490	Human biology	4	4	for route M
		Sum 3. and 4.. Semester	*55*	*60*	

Route G: Precision Mechanics, Route M: Medical Engineering

Sem	MFB No	Lecture	SWS	CP	Specifications
5	510	Internship		24	
5	520	Internship Seminar	2	2	
5	530	Industrial Science	4	4	
		Sum 5. Semester	*6*	*30*	
6	660	Med. Product development	4	4	for route M
6	670	Hospital Techniques/Communication	3	4	for route M
6	680	Medical Systems	4	4	for route M
6	690	Medical Optics	6	6	for route M
6	600	Medical Techniques / **Project**	2	4	for route M
6	800	Technical Elective 1 G/M, Table 3	4	4	for route M
6	900	General Technical Elective	4	4	
		Sum 6. Semester	*27*	*30*	
7	710	Finite Element Method	4	4	for route G
7	720	Quality Management in Mechatronics	3	4	for route G
7	730	Medical Imaging	4	4	for route M
7	740	Quality Management in Med.Eng.	3	4	for route M
7	800	Technical Elective 2 G/M, Table 3	4	4	for route M or G
7	900	General Technical Elective	4	6	
7	700	Bachelor-Thesis		12	
		Sum7. Semester	*15*	*30*	
		Sum of Bachelor Study	158	210	

4.3 Lectures of M.Sc. Micro and Nano Technology

Sem.	Code	Teil	Modul	CP	SWS ges	SWS einzeln	WS/SS	Sprache
	MNM010		Grundlagen der Mikro- und Nanotechnik	8	6	4V 2U	X	DE,EN
	MNM020		Projektstudie in einer branchenspezifischen Anwendung	8	4	4	X	DE,EN
	MNM510		Praktikum Mikrotechnik	4	2	2P	X	DE,EN
	MNM520		Praktikum Nanotechnik	4	2	2P	X	DE,EN
	MNM600		Masterarbeit	30	8	8	X	DE,EN,FR
#EN	MNM400		Technisches und wissenschaftliches Englisch	4	4	4V	X	EN
#WPF	MNM100		Fachspez. Module der Mikro- und Nanotechnik (MN1)	18	12	12	X	DE
#WPF	MNM200		Fachübergreifende Qualifikationen (UWP)	6	4	4	X	DE
#WPF	MNM300		Branchenspezifische Vertiefung (MN3)	12	8	8	X	DE
MN1	MNM110		Eigenschaften niedrigdimensionaler Strukturen	6	4	4V	X	DE,EN
MN1	MNM120		Mikro- und Nanoanalytik	6	4	4V	SS	DE,EN
MN1	MNM130		Dünne Schichten und Oberflächenanalytik	6	4	4V	SS	DE
MN1	MNM140		Grenzflächen, Kolloide und Nanopartikel	6	4	4V	X	DE
MN1	MNM150		Mikro- und Nanostrukturen	6	4	4V	X	DE
MN1	MNM160		Biomikro- und -nanotechnik	6	4	4V	X	DE,EN
MN1	MNM170		Werkstoffe der Mikro- und Nanotechnik	6	4	4V	X	DE
MN1	MNM180		Niederdruckplasmen/Mikrostrukturtechnik	6	4	4V	WS,SS,X	DE
MN1	MNM190		Advanced Topics in Quantum Mechanics	6	4	4V	WS,SS	DE
MN1	MNM310		Mikro- und Nanotechnik in Optik/Photonik	6	4	4V	SS	DE
MN3	MNM320		MNT in Medizin-, Chemie-, Biotechnik	6	4	4V	SS	DE
MN3	MNM330		MNT in Elektronik und Informationstechnik	6	4	4V		DE
MN3	MNM340		MNT in Fahrzeugbau und Mechatronik	6	4	4V	X	DE
UWP	MNM210		Systemtechniken	6	4	4V	SS	DE
UWP	MNM220		Wissensmanagement	6	4	4V	X	DE
UWP	MNM230		Unternehmensführung und -gründung	6	4	4V	X	DE
UWP	MNM240		Qualitätsmanagement	6	4	4V	X	DE

soft skills

Annual Alumni - Celebration July 2008

150 out-going students (about 65 % of started students)

5 Student Exchange Programs

a) MUAS is open for any worldwide students
b) MUAS offers English spoken lectures

see http://www.hm.edu/allgemein/hm_international/wege_in_die_welt_2/sprachen/coursesinenglish/coursesinenglish.de.html

c) MUAS has many co-operations with universities worldwide,

also hard installed coop. (e.g. integrated studies)

d) MUAS has lists of free places at industry and institutions
for a practical trainee semester

DEPARTMENT	COURSE	LECTURER	HOURS/ WEEK	ECTS CREDITS
1 Architecture	three-dimensional Design	Berktold	2	2
5 Building Services, Energy, Environment	Fluid Mechanics II (Advanced Fluid Mechanics)	Liepsch	4	4
5 Building Services, Energy, Environment	Finite Element Method	Mair	2	3
6 Precision and Micro Engineering	Mechanism Design and Analysis	Wallrapp	4	4
6 Precision and Micro Engineering	Multibody Dynamics	Wallrapp	4	5
7 Computer Science / Mathematics	TECHNICAL WRITING	Balazs	4	5

6 Summary

The new B/M/PhD study concept

1) is a chance to re-design and update engineering education for the next generations in a fast running global worldwide market

2) leads to an unified, worldwide accepted education

2) allows a global worldwide study - at any university

3) the German universities (General Univ / Univ. Applied Sciences) have a good concept for engineering education

   a) with more **theoretical** + research oriented subjects

   b) with more **practical** oriented subjects

4) German industries and institutions currently learn to employ the new B/M graduates of both type of educations
Both type of students are necessary.

My personal proposals for the re-design:

1) Don't cut your previous old 5 year study program into B and M, rather setup skill profiles for required graduates in industries, research institutes, government, etc., and than describe the new curriculum

2) Distinguish between an education

   a) with more **theoretical + research oriented subjects**

   b) with more **practical oriented subjects**

3) Establish associations to guide and control the B/M-Edu. process by clear regulations => "don't invent the wheel again"
=> maybe use German Accreditation Agencies

Further Questions:

4) How much soft skills should an Eng. program have?

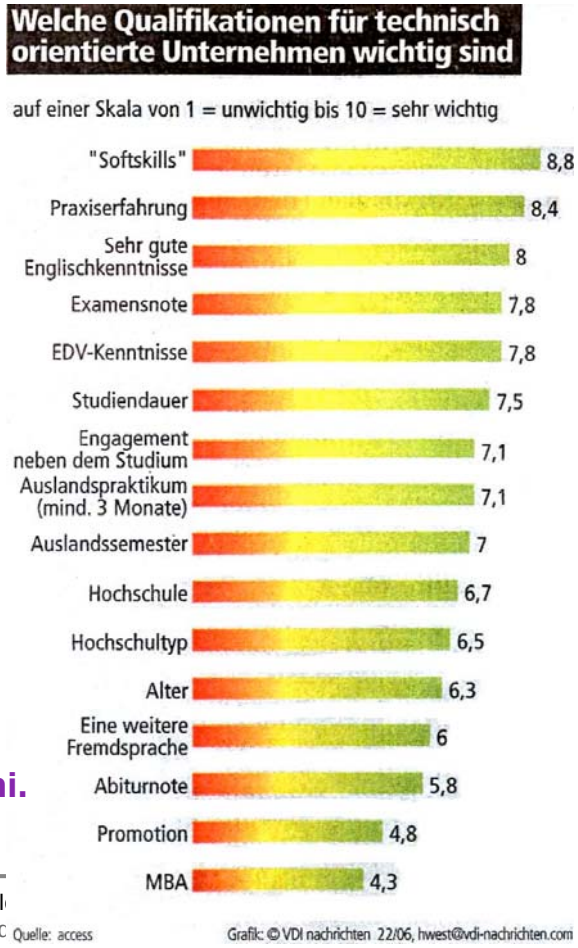
=> 10 .. 12 % is the minimum

5) How much Eng.-praxis should an Eng. program have?

=> For engineers in industries one semester is fine.

6) Should you cooperate with a foreign Uni?

=> First setup own good programs of a view of subjects (e.g. B, M), then extent subject (M) with foreign uni.



Further Questions:

7) Which engineering study directions are necessary / we should install ?

Research – Design+Develop. – Production – Marketing

Each subject is important,
it is going in balance with requirements of industry,
institutes, government

MUAS: ~10 % ~40 % ~25 % ~25 %

8) What are the biggest problems during the change?

1-To setup an all accepted program for the new century
2-To inform industries, institutions about your new edu.
3-A 5 year parallel running edu. (old one + new one)

Thank you for Your Attention