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Capacity Building in Science, Engineering and Technology – a European Perspective

C.L. Robertson Memorial Lecture

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Invitation by Zimbabwe Institution of Engineers

in connection with

2nd WCCE General Assembly,
ZIE 4th Congress, Victoria Falls, Zimbabwe

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Content of Paper

1. Introduction
2. Networking
3. Culture and Globalisation
4. Sustainability
5. Capacity Building for Academicians
6. New Challenges for Engineering Professionals
7. Personal Behaviour and Capacity

According to the WEC 2008 Paper of

WFEO, CONFEA and FEBRAE

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1. Introduction

Capacity Building in Science, Engineering and Technology

plays the key role

in the development of countries whether

- developed
- in transition status
- non-developed

High target as a

Millennium Development Goal

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WFEO Capacity Building, Nigeria, March 2007-05-20

- From 4 to 6 March 2007 the “Engineering Africa” initiative of WFEO Committee on Capacity Building conducted a pilot conference in Abuja, Nigeria. The conference brought together an invited group of educators, industry leaders, government officials and NGO's representatives to attract direct foreign investment, address the technical needs of Nigerian economy, and stimulate small small business development through entrepreneurship.

- Co-sponsors of the conference included the Hewlett-Packard Company, the Nigerian Society of Engineers, the African Engineering Education Association, and the UNESCO Regional Bureau for Science and Technology in Africa.

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WCCE
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ZIMBABWE INSTITUTION OF ENGINERS

2. Networking

Powerful tool for Capacity Building

The two logos above speak for themselves

Other participants in the combined conferences:
African Engineering Federation (FEA)
European Council of Civil Engineers (ECCE)

The social events like the evening music and dances have a very similar - and human - content

3. Culture and Globalisation

New global world of

- plastic language of buildings, hotels, shopping centres, homes etc.
- increasingly homogenized e.g.Mac Donald, Kentucky …, Gucci, Nike, …
- attitude of global playing architects, mayors of cities, investors, …

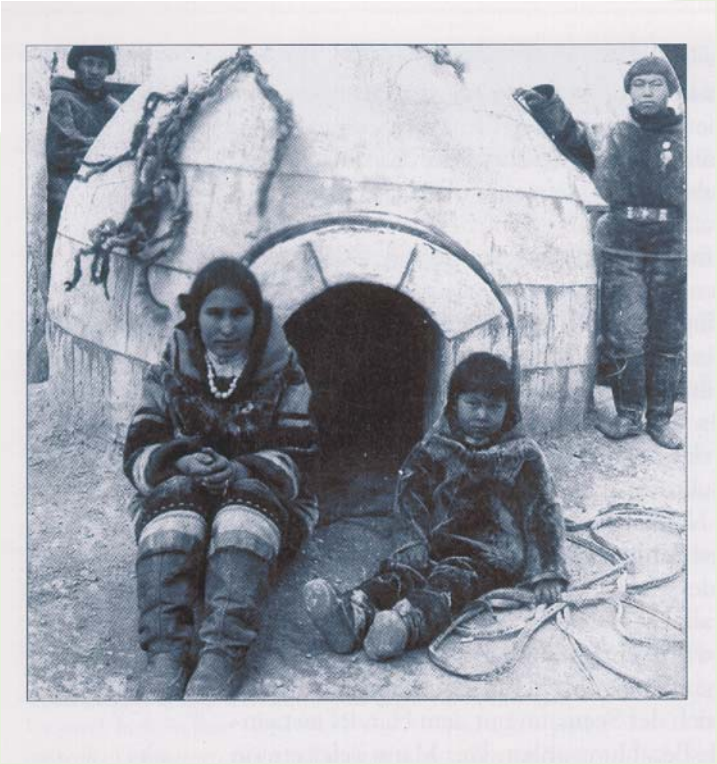
versus

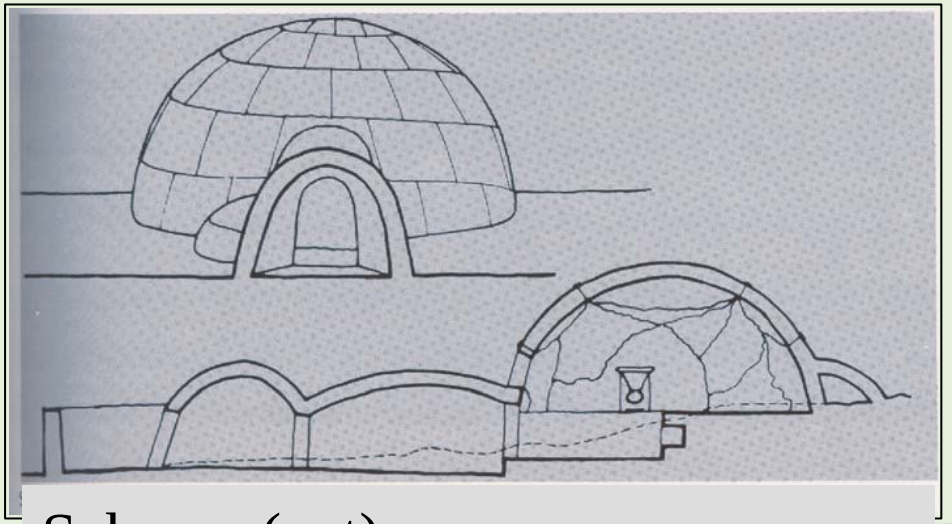
genuine national foot prints

Living in the deserts – Indian tipi

Kinder universität OLDENBURG

Living in ice - Iglu





Scheme (cut)

Kinder universität OLDENBURG

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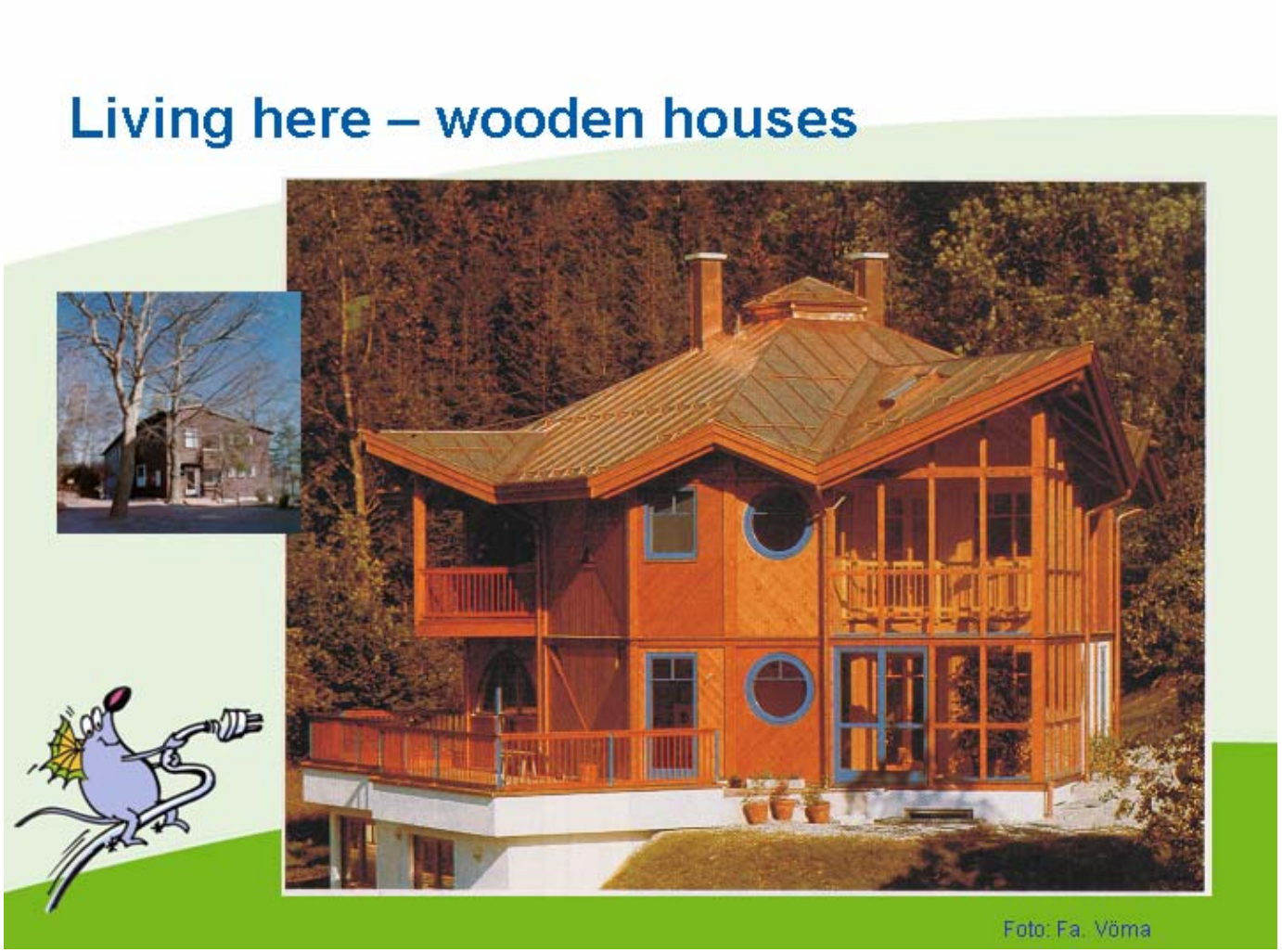
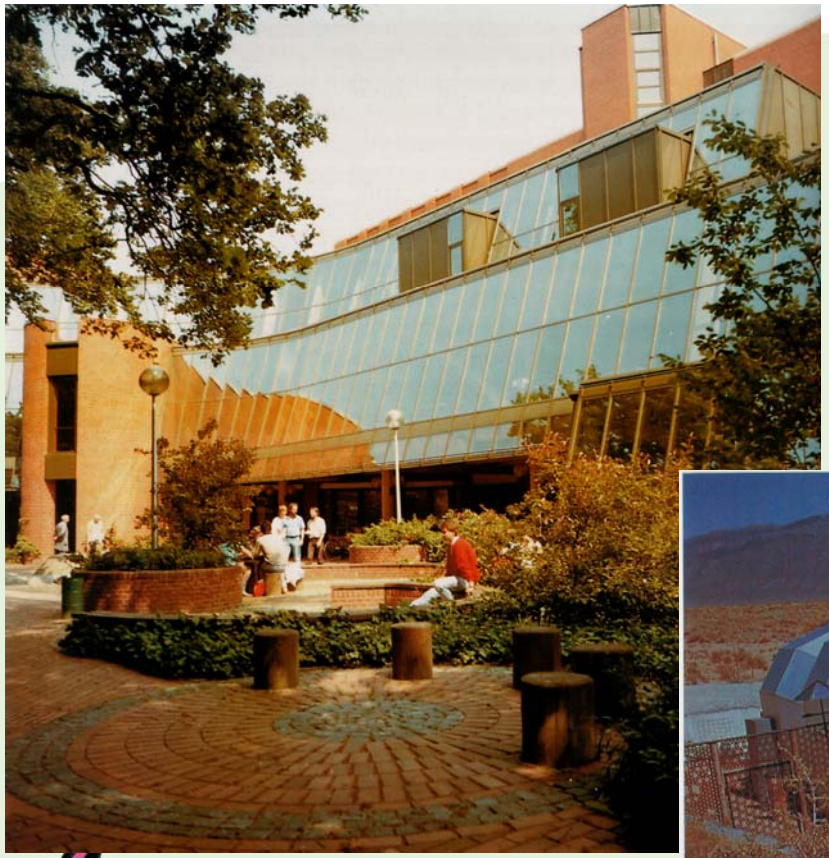
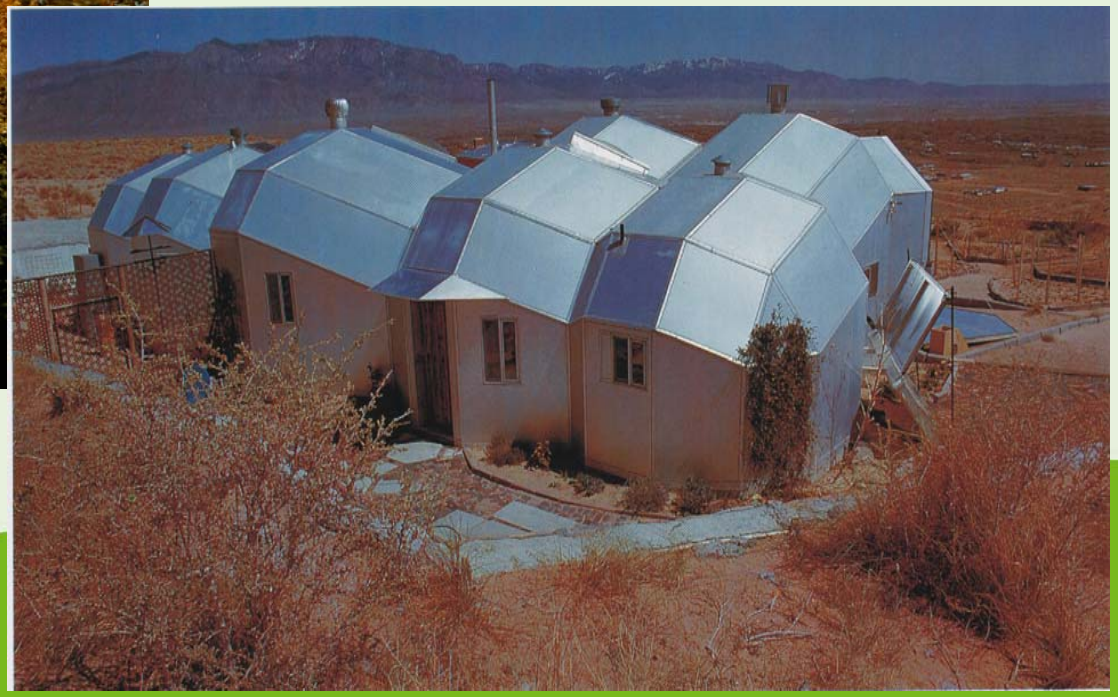
Footprints of a very high standard



Sustainable modern buildings





4. Sustainability

- is treated very often just as a word
- seems to be too expensive and thus only for rich nations
- may not really be feasible
- does not bring forthcoming, but will drive us back

But it is this thinking,

which is not sustainable at all

Topics of the agenda of 4th ZIE congress (5 out of 9)

- Education and capacity building in engineering and technology
- Renewable energy
- Research and development
- Irrigation and agricultural mechanisation
- Water and sanitation

Sustainable projects in developing countries

- should tackle (all) these topics
- must not be huge and cost intensive industrial plants
- need to foster self responsibility
- have to be of low maintenance effort
- have to be work in a self consistent way

and thus should be

insular solving or stand alone

plants and/or projects

Examples of insular solving plants

- Power – Heat – Cooling coupling systems
- (using bio-gas, bio-fuel, wood pellets, stray etc.);
- Solar process energy for cooking, baking and drying;
- Solar cooling systems for facades of business buildings;
- Photovoltaic systems;

Examples of insular solving plants (cont.)

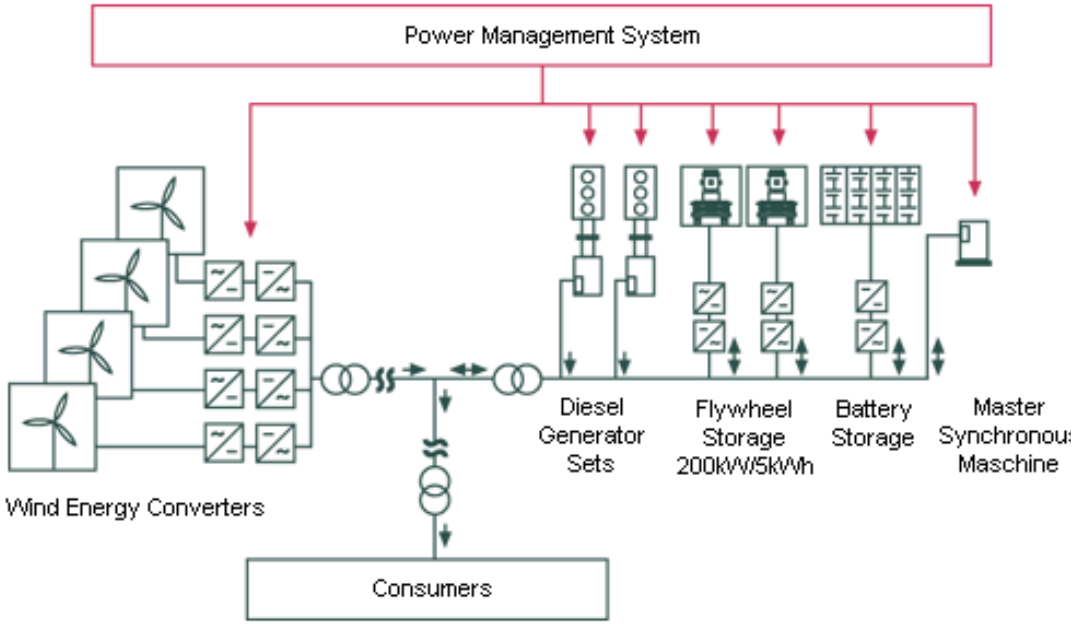
- Wind energy small grid electrical power stations;
- Wind energy powered heating and cooling systems;
- Wind energy driven salt water desalination and water purification systems;
- Wind energy driven water pumping systems;
- Energy autonomous insular supply and waste-treating systems.

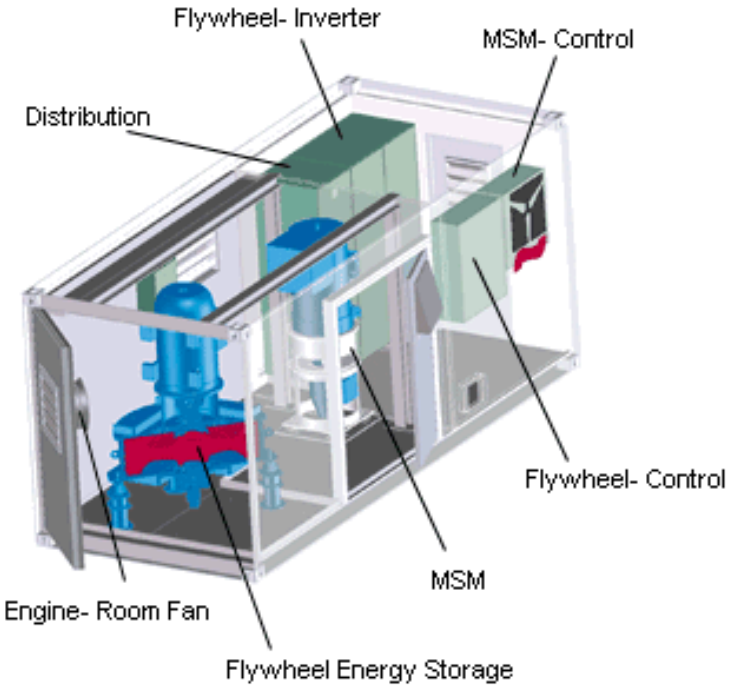
Stand alone system (windpower)

Wind energy plant

Details of (transparent) machine room

Insular system (windpower generator)





Stand-Alone power management system with
Container installment

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Realisation of stand alone systems

Technical input and installation

- mostly from developed countries
- technically no problem (trucks, waterways)

Costs and Payment

- investment plans
- duration of refinancing, payback
- leasing
- financial support from outside
- PPP (this type needs the respective trust)

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Benefits of stand alone systems

Technical input and installation

- plans
- duration of refinancing, payback
- leasing
- financial support from outside
- PPP (this type needs the respective trust)

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5. Capacity building of academicians

Bologna Declaration and its intention to:

- adopt a system of easily readable and comparable degrees
- adopt a system with two main cycles (undergraduate/graduate)
- establish a system of credits (such as ECTS)
- promote mobility by overcoming obstacles
- promote European co-operation in quality assurance
- promote European dimensions in higher education

5. Capacity building of academicians (cont.)

Later in Prague, Czech Republic, Berlin, Germany, and Bergen, Norway, three additional topics where added as

- lifelong learning
- involvement of students
- doctor's degree in a third education cycle
- enhancing the attractiveness and competitiveness of the European Higher Education Area (EHEA) to other parts of the world (including the aspect of trans-national education).

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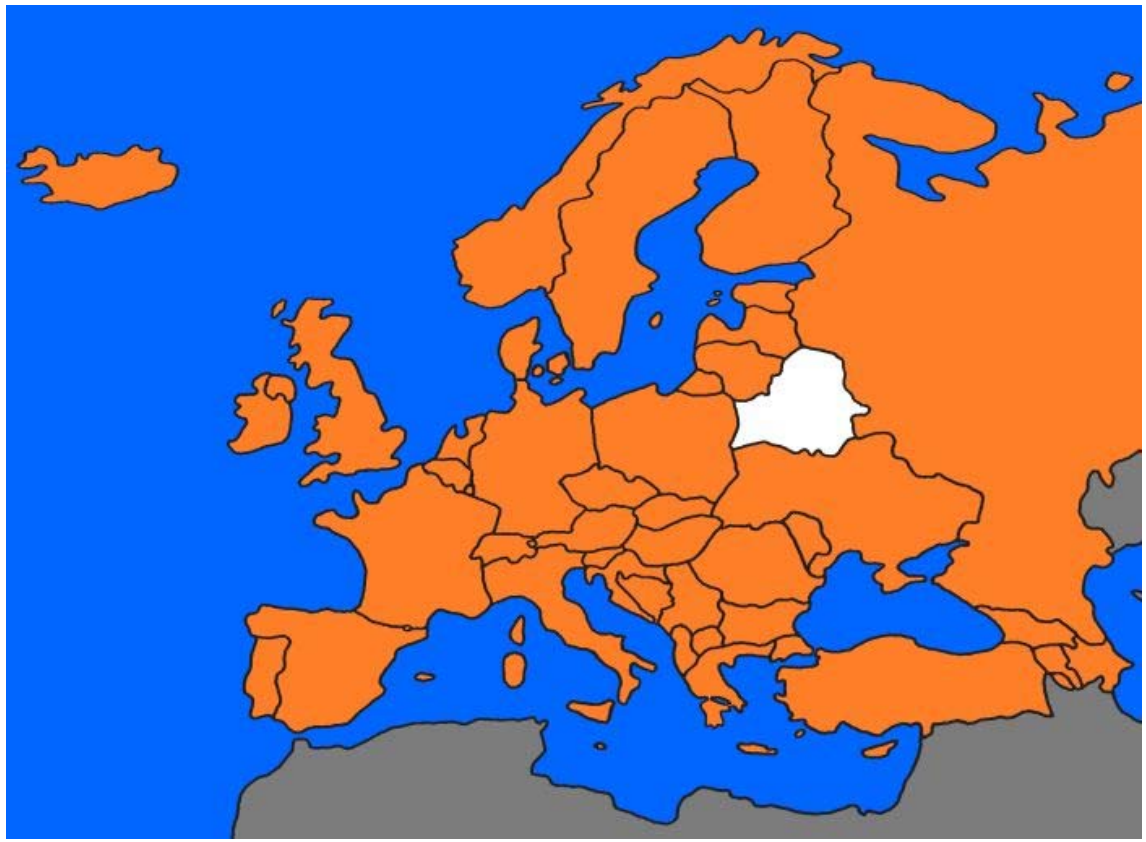

Member countries of the Bologna Region

Programme outcomes of curricula

- Knowledge and Understanding;
- Engineering Analysis;
- Engineering Design;
- Investigations;
- Engineering Practice;
- Transferable Skills.

Qualifications

First cycle qualifications are awarded to students who

can apply their knowledge and understanding in a manner that indicates a professional approach to their work or vocation, and have competences typically demonstrated through devising and sustaining arguments and solving problems within their field of study;

- **Second cycle qualifications** are awarded to students who

  can apply their knowledge and understanding, and problem solving abilities in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study;

Qualifications (cont.)

- First Cycle ….

  have the ability to integrate knowledge and handle complexity, and formulate judgments with incomplete or limited information, but that include reflecting on social and ethical responsibilities linked to the application of their knowledge and judgments;

Second Cycle ….

have the ability to gather and interpret relevant data (usually within their field of study) to inform judgments that include reflection on relevant social, scientific or ethical issues;

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Outcomes as wished by different parties (cont.)

	Ranking academics	Ranking employers
3. knowledge area	1	5
6. applying knowledge in practice	2	1
5. analysis and synthesis	3	3
4. knowledge profession	4	2
9. learn	5	7
7. generating new ideas	6	9
1. work in an interdisciplinary team	7	4
8. adapt to new situations	8	8
11. decision-making	9	6
10. critical abilities	10	13
15. second language	11	12
13. ethical commitment	12	15
16. oral and written communication	13	11
12. computing skills	14	14
14. interpersonal skills	15	10
17. research skills	16	16
2. diversity and multiculturality	17	17

Greatest ranking differencs

Spearman correlation coefficient between both rankings

r = 0,87745098

ERASMUS MUNDUS Programme

One of the biggest offers for capacity building in science, engineering and technology is the newly installed European ERASMUS-MUNDUS Programme. For African students and university staff this programme could be an objective of high appreciation and as kick-off for its own capacity building. The general ERASMUS programmes started in the beginning of the Nineties and has been one of the most powerful capacity building programmes.

- is put in force for the period 2004 - 2008
- with an investment capital of 230 Mio € (in 2008 it is accelerated to 98 Mio €)

ERASMUS MUNDUS Programme (cont.)

- communication on re-inforcing co-operation with third countries;
- preparation of citizens for the global society;
- goal to ensure world-wide recognition of European universities as centres of excellence;
- remaining at leading edge of developments;
- contribution to cultural understanding (intercultural dialogue as a new policy).

ERASMUS MUNDUS Programme (cont. 2)

- Action 1: ERASMUS MUNDUS Master Courses
- Action 2: Scholarships
- Action 3: Partnerships
- Action 4: Enhancing Attractiveness

ERASMUS MUNDUS Programme (cont. 3)

The main outputs in 2004 – 2008 are:

- 115 Erasmus Mundus Master Courses;
- 6,000 grants for incoming third-country students;
- 1,000 grants for incoming third-country scholars;
- 100 partnerships;
- 4,000 grants for outgoing EU-students;
- 800 grants for outgoing EU-scholars:
- 50 attractiveness projects.

Lack of engineers

- in nearly all European countries
- in Germany e.g. 23.000 employment offers each month
- attracting young people, starting at schools

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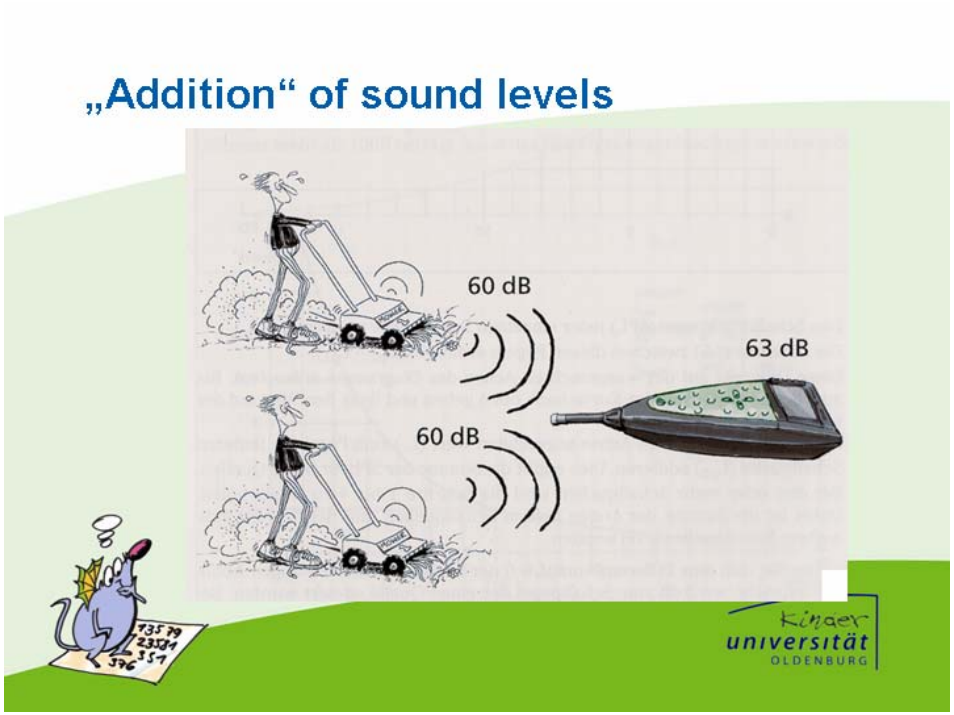
Children University



World of sound: Decibel and colour

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European Civil Engineering Management (ECEM)

launched by Prof. Dr. C. Ahrens in 1992
with four senior partners of higher education

- Hanzehogeschool van Groningen, HvG, NL
- University of Wolverhampton, UoW, UK
- Fachhochschule Oldenburg, FH OL, DE
- Polytechnic University of Stettin, UoS, PL

Now new partners from
Paris (FR), Valencia (ES), Galway (IR), Halmstad (SE),
Tampere (FI), Prague (CZ), Budapest (HU),
Moskau (RU), Hangzhou (CN)

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Time schedule of ECEM-programme at FH OL

1. sem.	2. sem.	3. sem.	4. sem.	5. sem.	6. sem.	7. sem.
WS	**SS**	**WS**	**WS**	**SS**	**WS**	**SS**
Basic studies civil and construction engineering two foreign languages			**Main studies** managerial skills law, construction management, site management, project management, economics, financing, turn key projects, rhetoric, languages etc.			**Practical Placement** and **Thesis** in/with Building Company, projecting office, …
at home institution			abroad at partner university		at home institution	

Educational Profile of ECEM basic studies

ECEM-students with

- necessary orientation and
- sound civil engineering background

to understand “pure” civil engineering colleagues

Additionally ECEM-students have to learn

- English and
- a second foreign language

of the later host country.

Future Employment of ECEM students

The future employers of ECEM-students may be found

- in engineering and architectural planning offices;
- in consulting companies;
- in public supervising and projecting offices;
- in the building industry;
- in project development and real estate companies;
- in internationally active planning and building companies;
- in big companies with international building activities;
- even banks, commercial groups, industry, insurances.

The professional skills of ECEM absolvents

An ECEM-absolvent targets to work with

- acquisition of contracts;
- planning and supervision of buildings;
- project management and steering;
- personnel management;
- cost management;
- quality management;
- project development;
- turn key construction.

Special strengths of ECEM-BSc graduates

- organizational ability;
- strong and careful treatment of costs;
- profound knowledge in contracting law and economics;
- lingual and intercultural competence;
- personal mobility;
- teamwork orientation.

Special strengths of ECEM graduates

Even in times of actual decline of the German and partly the European building industry ECEM-students still found and find an attractive employment.

Very often these are building companies or projecting offices with dependences in or having joint ventures with foreign countries in Europe or abroad.

Even companies like Siemens, not known as an active building company but as a global player, has “bought” and employed five absolvent of just one single cohort.

6. New challenges for engineering professionals

- A **common platform** is defined as a **set of criteria of professional qualifications** which are suitable for compensating for substantial differences which have been identified between the training requirements existing in the various Member States for a given profession.
- These substantial differences shall be identified by comparison between the duration and contents of the training in **at least two thirds of the Member States**, **including all Member States which regulate** this profession. The differences in the contents of the training may result from substantial differences in the scope of the professional activities.
- Common platforms may be submitted to the Commission by **Member States** or by **professional associations or organisations which are representative at national and European level.**

Professional formation framework of civil engineers

- to be definite, transparent, directly applicable and objectively reviewed;
- to contain sufficient flexibility to meet the national requirements of the different Member States;
- to take into account the two different education/training levels at institutions of higher education as described in the directive;
- to follow the descriptors and educational demands within the Bologna process in the European Higher Education Area (EHEA);

Professional formation framework of civil engineers (cont.)

- to apply criteria of professional education by outcomes and competencies
  instead of just education time;
- to be based on a combination of elements of education,
  training and professional experience;
- to define minimum conditions of professional postgraduate experience;
- to acknowledge rules of professional conduct
- and to being equivalent and/or comparable to other
  national/international (civil) engineering platforms.

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European Engineering Professional Card (ENGCARD)

- the Directive on Recognition of Professional Qualifications (DIR 2205/36);
- the Directive on Services in the Internal Market (DIR 2006/123, especially article 39 on “European Code of Conduct”);
- the EUROPASS Single Community Framework for the transparency of qualifications and competences;

European Engineering Professional Card (ENGCARD) (cont.)

- the EQF-European Qualifications Framework for Lifelong Learning (COM 2006/479);
- the EUR-ACE standards for the accreditation of engineering education programmes;
- other legislations (data privacy, electronic signature) and standards.

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European Engineering Professional Card (ENGCARD) (cont.)

FEANI

(European Federation of National Engineering Associations)

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European Engineering Professional Card (ENGCARD) (cont. 2)

ENGCARD architecture

- the “EUROPASS-CV”, which is a comprehensive standardized document containing GENERIC information;
- the “language Passport” to record language competences;
- the “Diploma Supplement” attached to a higher education diploma to understand the learning outcomes in terms of knowledge and competencies (third party certified);

ENGCARD architecture (cont.)

- the “Mobility Training Certificates”, which records the training and experience spent abroad (third party certified);
- the new ENGCARD-part, which gives the specific engineering-related information (qualifications, experiences, expertises, competences, professional titles, licences, code of conduct, penalties – and, of course, strongly third party certified);
- the optional electronic professional signature.

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ENGCARD benefits

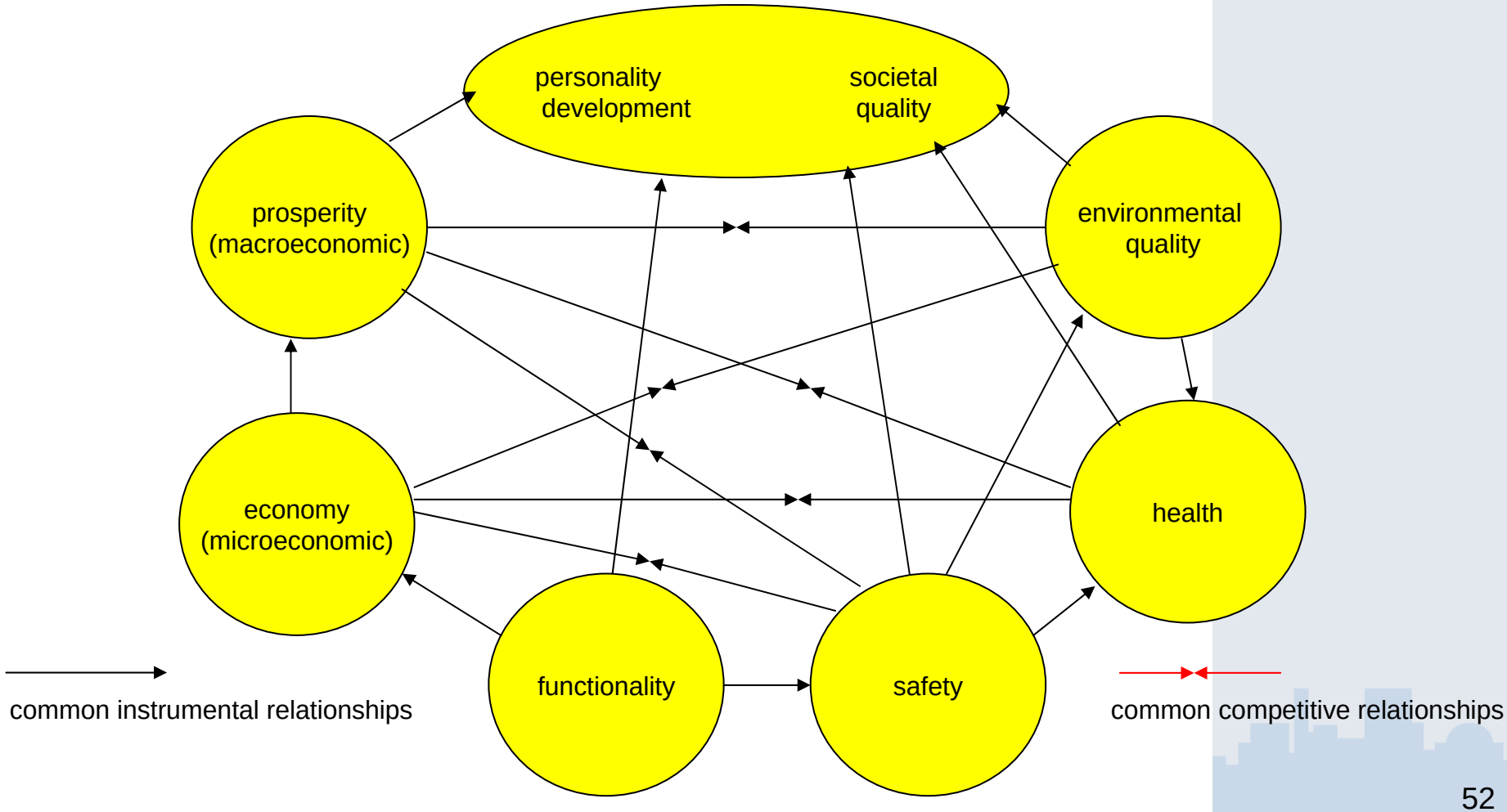
- the cardholder reached a universal quality label;
- the card will act as a qualifications transparency enhancer and recruitment facilitator tool;
- the card will act as recognition facilitator;
- The card will be the first card for international recognition of engineering professionals' qualifications.

7. Personal behaviour and capacity

In German universities

- Involvement of personal behaviour and capacity building within the curriculum,
- which is described by the Regulation VDI 3780 of the German Association of Engineers (VDI, Verein Deutscher Ingenieure).
- description of all the simple values in technical actions to be
- connected with the correct behaviour of an engineer as part of his or her education and knowledge gaining.
- Seven values are introduced and described and finally the relationship between these values is discussed.

Values in technical action



Personal behaviour and capacity building (cont.)

ERASMUS Intensive Programme

Ethics in the Built Environment (EiBE)

As a pan-European programmewith

Partner Universities of 13 different European countries

3 years programme

3 x 35 students for about 2 weeks

Ethics and economy (Valencia, ES)

AGENTS OBJECTIVES:

PROMOTER

- Reduce Costs
  - Improve production
  - Reducing periods → Less execution quality
  - Safety costs → Better paying the fine
  - Quality control → Possible risk
  - Reducing materials quality
- Increase prices
- Increase quantity
- Improving constructive methods

- Benefit obtention (short term)
- Long term: New projects, new customers

TECHNICAL DIRECTION

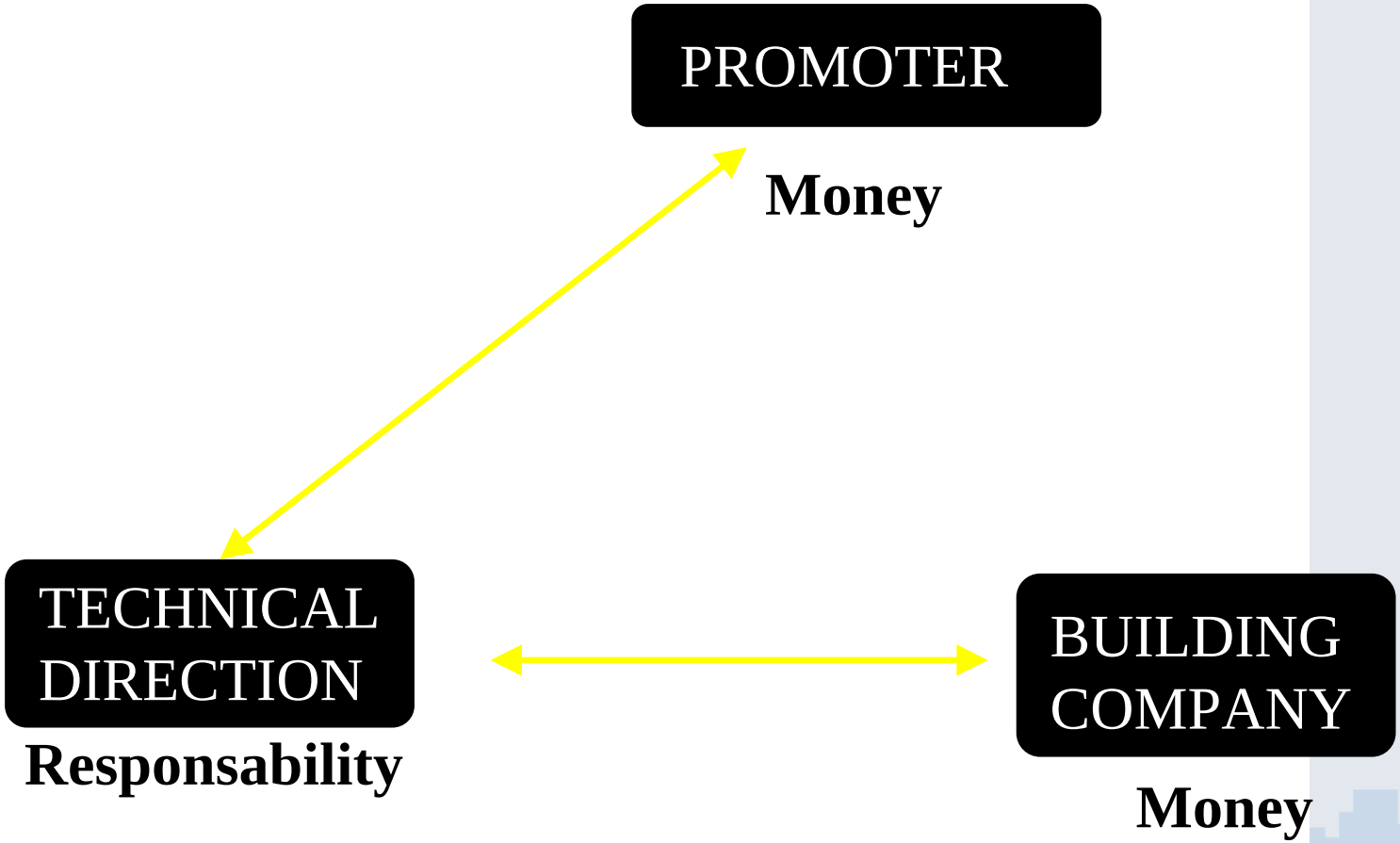
- Benefit: use less time
- Responsibilities
- Long term:quality in work, productivity, know-how

BUILDING COMPANY

- Limited resources
- Organitation, resources asignation
- Reduce costs
- Profitability, innovation

Ethics and economy (Valencia, ES) (cont.)

ETHICAL CONFLICTS:



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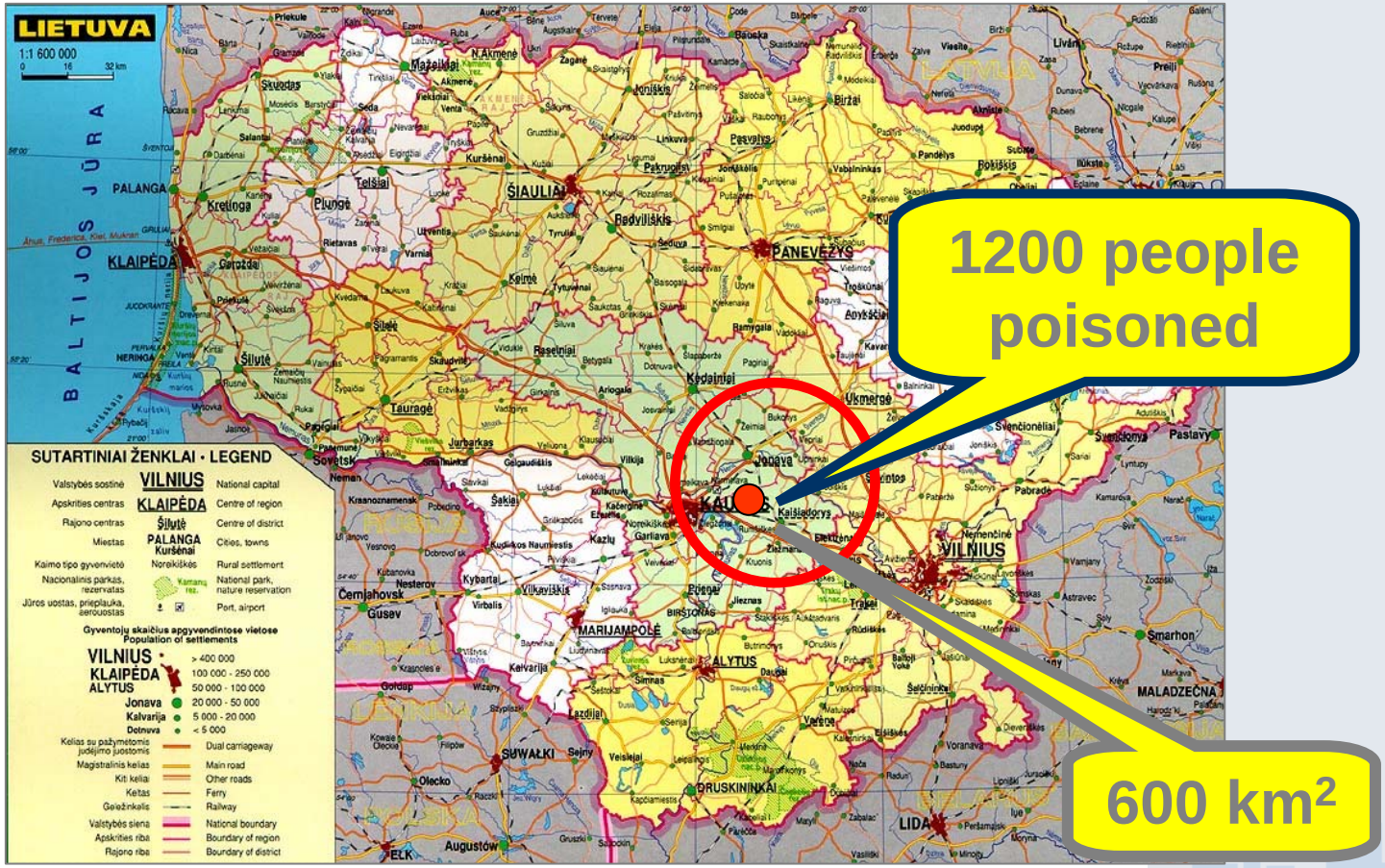
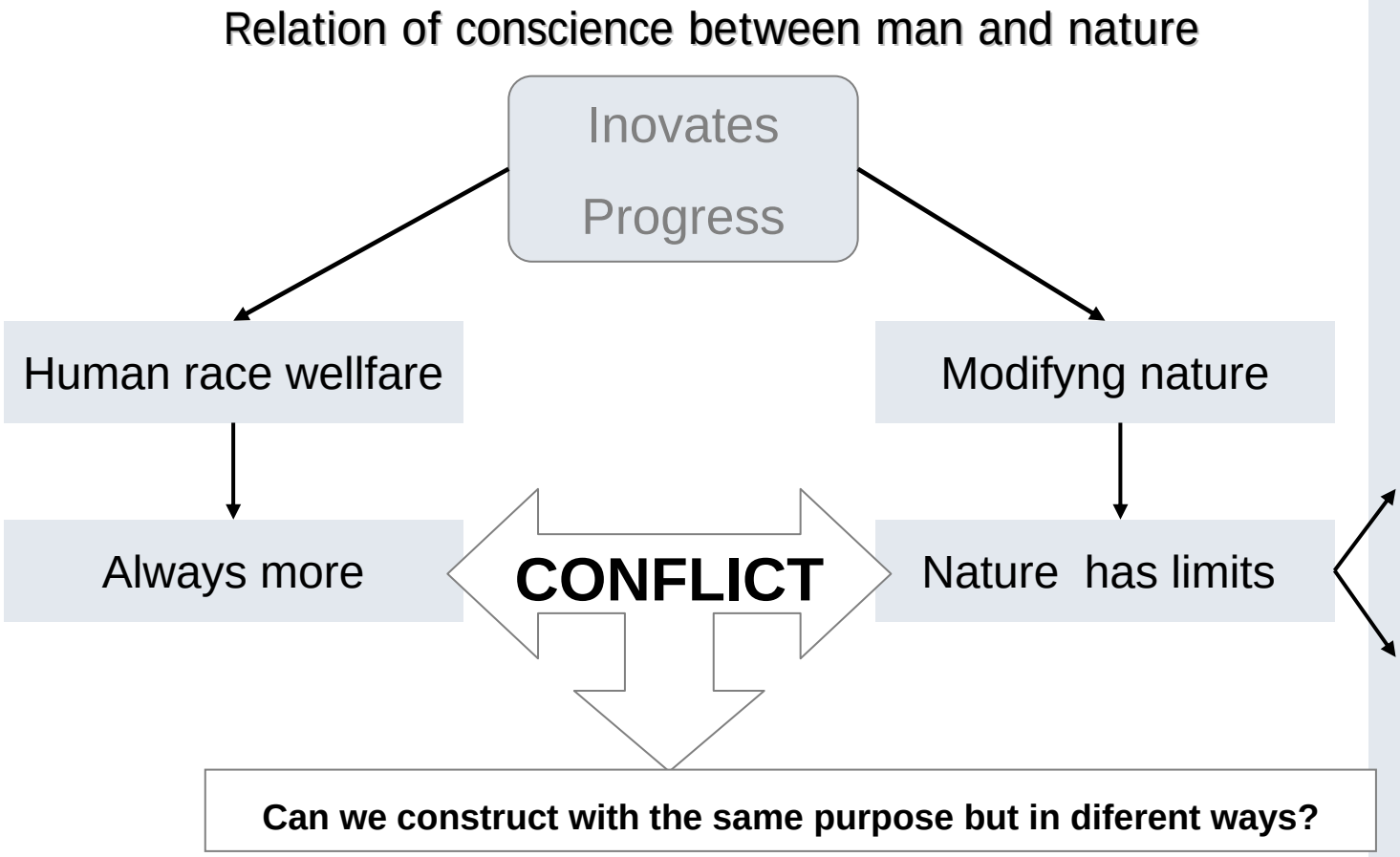
Ethics and Health (Kaunas, LIT)

Whose fault is it?



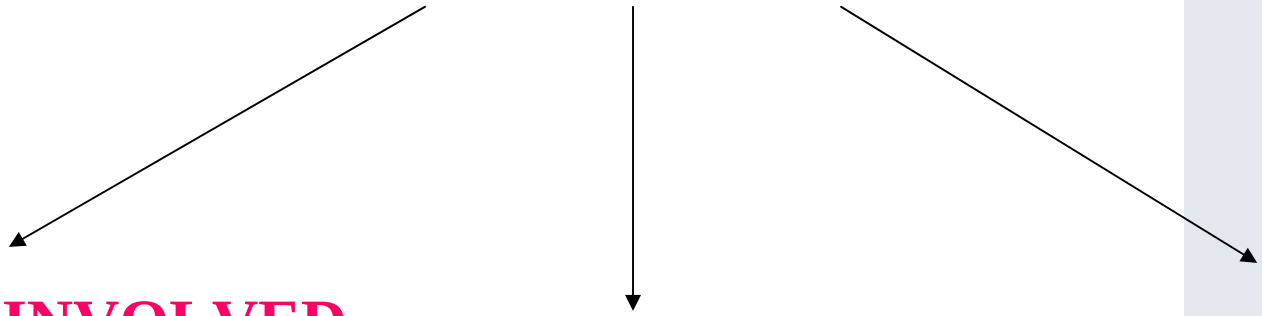
Ethics and Environmental (Porto,PT)



Ethics and Safety (Stettin, PL)

SAFETY

influences on



PEOPLE INVOLVED IN THE BUILT ENVIRONMENT

USERS (SOCIETY)

ECONOMY + ENVIRONMENTAL IMPACT

Ethics and Safety (Stettin, PL) (cont.)

INDIVIDUAL CONDITIONS FOR ALL KINDS OF WORKS

- **organizing the building site**
- **ground works**
- **concrete & reinforced concrete works**
- **steel works**
- **brick works**
- **carpentry works**

PERSONAL EQUIPMENT

- **uniforms**
- **helmets**
- **glasses**
- **gloves**
- **special shoes**

BUILDING EQUIPMENT UTILITY

- **due to individual instructions**
- **attended by qualified workers**

OCCUPATIONAL TRAINING

- **obligatory for every worker (eg. first aid)**

PROMOTER‘S RESPONSIBILITY

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Ethics in the Built Environment (all)

Socrates Intensive-Project EiBE

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Addresses of Interest

- www.fh-oow.de
- www.ecceengineers.eu (new, under construction)
- www.wcce.net
- www.feani.org
- www.vdi.de
- www.enercon.de
- www.bologna-bergen.no
- ec.europa.eu/education/programmes/mundus

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Thank You!

Questions and remarks are welcome…