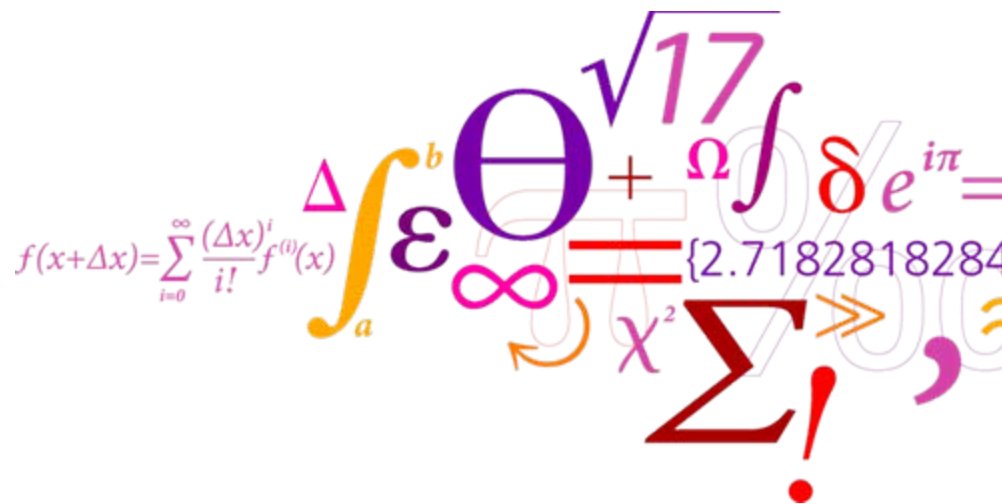


# A strategy for teaching sustainability assessment

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# DTU Management Engineering

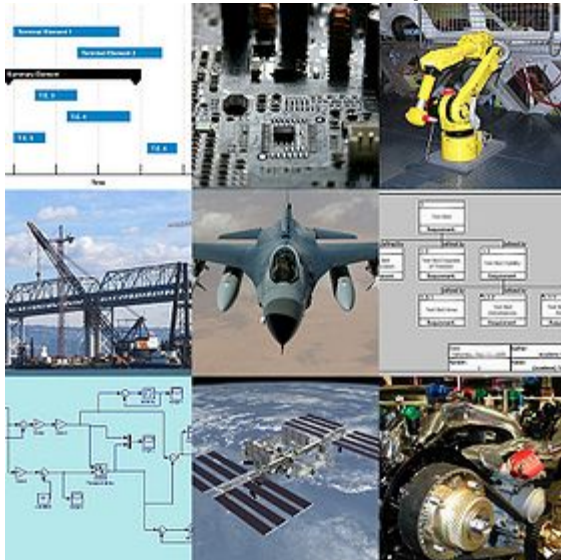
- One of three generic departments at DTU
- 125 faculty, 60 PhD students and 27 administrative + post docs etc.
- **Research in planning, innovation and management** of relevance to the engineering profession
  - **Decision-making support systems**
    - E.g. operations research, operations management, logistics, financial engineering, risk and reliability and quantitative sustainability assessment
  - **Product development, design and innovation**
    - E.g. product innovation management, engineering design, entrepreneurship, innovation studies, technology foresight, strategy, urban development, sustainability and science and technology studies
  - **Production and organisation development**
    - E.g. production management, advanced planning systems, product configuration, mass customization, strategy, change management, knowledge management, project management, strategic management, construction management, facilities management, risk management and human factors
  - several **multi-disciplinary areas** such as health, food and sustainability.

# Section for quantitative sustainability assessment (QSA)

- 4 faculty, 1 administrative, 6 PhD students and 7 post docs (but still some vacancies)
- Life cycle based decision support tools for sustainability assessment (primarily environmental and social)

# Engineering education and sustainability

- Engineer knowledge and aim
  - Apply (technical) science to deliver practical solutions
  - Technology development
- Engineers and sustainability
  - Part of the problem – and – part of the solution
- Barcelona declaration 2004 from the "Engineering Education in Sustainable Development" conference



# Teaching sustainability at DTU

- Sustainability is embedded implicitly in the teaching strategy, but there is no direct reference to or adoption of a sustainability agenda
- GRØN DYST is a new, DTU-based educational opportunity bringing into focus sustainability, climate technology, and the environment at all DTU's study programmes.
  - The purpose is to incorporate the green aspect in existing courses at DTU.
  - More than 90 projects participated with 1-5 students pr. project

# DTU Management Engineering

- **Courses** in material technology to process engineering, planning, production, finance, management and innovation and sustainability. A common ground for most of the courses is the engineering approach where focus is on solving technological problems.
- Within sustainability e.g.
  - Ecological economics and industrial ecology
  - Urban planning and sustainable urban development
  - Management of change
  - Life Cycle Assessment of products and systems
  - Nanotechnology, design, society, and environment

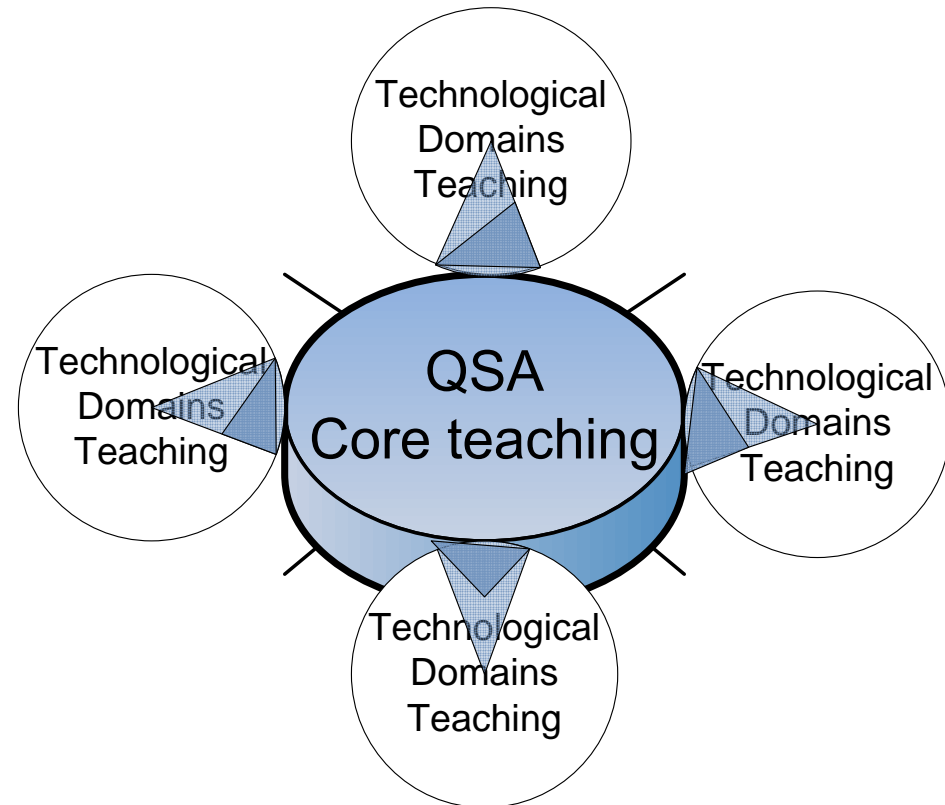
# QSA teaching vision for quantitative sustainability assessment

- **All engineers** graduating from DTU should be able to administer the sustainability dimension in business and society. They must know what sustainability is and how their decisions as engineers can affect sustainability. Further they should be aware that there are methods and tools to assess the sustainability of their decisions
- All engineers graduating from DTU with a **specialization in innovation and development of technology, systems or products** should understand the principles of sustainability assessment and be able to apply tools for sustainability assessment
- Engineers graduating from DTU should be able to **specialize in tools for quantitative sustainability assessment** of products, systems, and technologies

# The strategy for teaching

Three legs targeting different groups of students:

- Teaching in methods and tools for sustainability assessment targeted at the different technological domains at DTU, providing a **background knowledge** to students pursuing a career in other technical fields
- More **in depth education** for students aiming to work with the development of technical solutions and therefore wishing a more in depth knowledge of the tools available to assess sustainability of technologies
- **Specialized teaching and education** in principles and methods for sustainability assessment targeted at the student pursuing a professional career within the field



# Implementation of the strategy

- An introductory course offered to all bachelor student as an elective
- Introductory modules within technical courses at each bachelor study addressing specific sustainability issues
  
- Each master study line should offer courses including elements of sustainability assessment either in the electives or in the compulsory courses.
- A range of courses specializing in sustainability assessment and management will be offered as electives for master students

# Teaching activities

- A number of courses offered as electives
- Involvement in courses at other technological domains (e.g at manufacturing engineering and at civil engineering)
- Problem oriented project based learning is the general teaching approach

# Teaching

**Plan of courses and teaching offered by DTU MAN QSA**

	<b>Plan of courses and teaching offered by DTU MAN QSA</b>			
	<i>Bachelor Level</i>	<i>Master Level</i>	<i>PhD Level</i>	
Teaching in core competence of QSA	<p>42342 – Sustainable production</p> <p>42344 – Sustainable production in industrialising countries</p> <p>42644 – Global product chains</p>	<p>42372 – LCA "I"</p> <p>423XX – Life Cycle Management</p> <p>42343 – Nanotech, design, env. and society</p>	<p>42375 – LCA "II"</p> <p>423XX – Toolbox for SAT</p> <p>423XX – Social dimension, CSR</p> <p>423XX – Economy, e.g. CBA, LCC etc. - cooperative course</p>	<p>423XX – Damage modelling</p> <p>423XX- Impact Assessment modeling</p>
Teaching QSA expertise in other technological domains	<p>5 ECTS elective: Sustainable engineering</p> <p>App. 1-2 ECTS on each bachelor study line</p>	<p>App. 2-3 ECTS as electives on each master study line</p>		



Courses existing or under development by existing faculty positions



Courses to be developed by the three missing faculty positions

# Introductory course

## “Sustainable engineering”

- Overall it is the aim that:
  - Students will acquire an understanding of the concept sustainability and the three dimensions of sustainability
  - Students get an overview of selected methods and tools for analysis and synthesis of solutions that are sustainable in their whole life cycle and acquire the skills to operate them.
  - Students get an understanding of the engineer’s role and responsibility in a sustainable society.
- Teaching principle - POPBL
  - Tools first - e.g. ecological footprint, simplified life cycle assessment, DfE, CSR-kompass, and CBA
  - Then context

# Development of an introductory course

Theories and concepts covered	Learning outcomes (the student will be able to)
<ul style="list-style-type: none"> <li>• Absolute sustainability vs. relative sustainability</li> <li>• Life cycle perspectives and Cradle-to-Cradle concept</li> <li>• DPSIR (Driving forces – Pressures – Stressors – Impacts – Responses)</li> <li>• Consumer behaviour</li> <li>• Environmental regulation</li> <li>• Actor network analysis</li> <li>• Governance (e.g. actors in sustainability, Marrakesh process etc. WBCSD)</li> <li>• Change management</li> </ul>	<ul style="list-style-type: none"> <li>• Describe the three pillars of sustainability (BT – 1)</li> <li>• Explain that every dimension is multifactorial and that trade-offs exists within and between them (BT-2)</li> <li>• Illustrate how companies can work towards development of sustainable solutions (BT-2)</li> <li>• Describe the product chain perspective (BT-2)</li> <li>• Know and apply different simple tools for sustainability assessment (BT-3)</li> <li>• Explain that assessments involve integrated sensitivity analysis and iterations (BT-2)</li> <li>• Relate critically to the results of the different assessment tools (BT-6)</li> <li>• Master analysis of solution by means of simplified LCA (BT-4)</li> <li>• Master synthesis of solution by ecodesign principles (BT-5)</li> </ul>

## Future aspects

- Our strategy is in line with the general trends in engineering education in sustainability
- Plans for sustainability in education are officially being adopted by top management of many universities but nevertheless meets **barriers in terms of organizational, academic and engineering culture**
- These are hurdles that have to be met proactively in the further development and implementation of the teaching strategy