Course document: Engineering for sustainable development 2016-2017

The course engineering for sustainable development aims to improve the capacities of engineers to contribute to sustainable development. To be able to discuss their contribution to sustainability engineers need to consider and develop innovations in the context of its – real world - wider sociotechnical system. This year we will learn from and contribute to the efforts on a Dutch city – The Hague - to transition into a circular, sustainable city. In The Hague many circular and sustainable initiatives were taken, green deals were made, but so far there is no vision and action agenda towards a circular and sustainable transition. How could that be designed to happen?

After taking this course students are able to:

- Determine complexity, tensions and dilemmas that come with sustainable practices and required interdisciplinary efforts;
- Consider their role as an engineer with regard to sustainable development and reflect on personal educational objectives, professional values, ethics and beliefs.
- Analyse (im)possibilities and design pathways of transitions to sustainable futures of sociotechnical systems.

Set up of the course: learning by doing research

We will learn by doing research about the Hague as a circular and sustainable city, “without wastage, without drop outs”. The municipality of The Hague is our client, as are the Leiden-Delft-Erasmus Centre for Sustainability and Cirkelstad which support our project.

We doing research with a research team of about 50 members, will be structured and organised by assignments and a virtual research environment. The assignments define the information we need to design. The Hague as a sustainable city; the virtual research assignment offers an integrated online environment with access to shared documents and resources needed in the course of the research project.

We will study The Hague’s circularity and sustainability on two levels of analysis:

1. the system: The Hague is a geographical unity and social community that can be studied as a sociotechnical system. A socio-technical system pertains to theory regarding the social *and* technological aspects of society. As a team we will design The Hague as a sustainable city.
2. the stream as part of a sub-system: in The Hague specific challenges for circularity and sustainability are being faced. In groups of 4 students we will study multiple interrelated material streams, from technological or biological origin (sub-systems) e.g. water, coffee, food, wood, phosphor, nitrate, heath, plastics, concrete, artificial fibre, rubber, asphalt .

The research on the sub systems will be integrated in an atlas, vision(s), pathways and an action agenda for Circular The Hague Sustainability.
The research is structured by the assignments below, to be uploaded and shared in the virtual learning environment in according to the schedule. These assignments also serve as example for the research on themes that has to be organised by groups of students.

Every student spends about 14 hrs/week on doing research.
During the course, you will work on the following products:

- 3 group coherent assignments which:

    - All groups will be interdisciplinary and international.
    - Represent and explain the future vision(s)
    - Demarcate and describe the current sub sociotechnical system and its streams.
    - Analyse the governance of change
- the (presentation of the) collaborative final integrated atlas, vision(s), pathways and action agenda for a circular The Hague.
- 7 columns, individually

ACTIVE PARTICIPATION REQUIRED: what to expect?

Required readings for each assignment can be downloaded as pdf documents. Read them *before* class and be prepared to discuss it.

Weekly, we have 4 hour meetings: preferably two hours on circular and sustainable cities, like The Hague. Professionals (guest speakers) and TPM researchers will discuss with us their ideas and perspectives. Followed by two hours that will start form a recap of the lectures to apply the lessons learned to your research assignments. Main question is: How do all the new insights relate to sustainable and circular The Hague?

BUBBLE WEEK 16-20 January 2017 – TU Delft Campus The Hague

NB: Dutch Circular Economy Week!

The course ends with a bubble week to integrate all assignments into deliverables for the client. The program is co-organised by you; it will be discussed in week 2.4. What debate and dilemmas do we expect, and who do we need for constructive feedback and decision making.

The format and programme are to be defined. It *definitely* will be exiting and focussed to deliver engaged, well informed, impressive and impactful results to our client. Focus on the interaction between students and professionals, and also promote collaborative learning. Use this week to create an even deeper and more shared understanding of sustainability and circularity. We aim to define guidelines for action to make the transition towards a sustainable circular city happen!

To do:

- Determine connections, tensions and dilemma's between sub-systems.
- Additional research on cross-overs
- Work on and integrate final products
- Present products
- Feedback, assessment and reflection

Grading

- Active involvement in making this week happen, is required. We will deliver four products: Future vision, atlas, pathways and action agendas for sustainable and circular The Hague.
- Criteria for each product: integration; critical discussion; coherence; reasoning; innovativeness; enacting sustainability and circularity; sense of reality in relation to ambition; presentation; usefulness to the client (40% of the final grade).

Week	Datum	Topic	Learning activities
2.1	17 November (morning)	The challenge: The Hague circular city	▪ Introduction to client an assignment ▪ Explore the streams ▪ Kick start group work ▪ How to share your research online ▪ Submit plan for group work ▪ Plan and preparing 2 interviews/student ▪ Write your column
2.2	21 November (afternoon)	How circular *and* sustainable is The Hague Vision as start or result	▪ Read literature ▪ Explore The Hague: field research and interviews ▪ Submit draft future vision(s) ▪ Write your column
2.3	30 November	Visit The Hague	▪ Inventory of running initiatives, attempts to change, needs and opportunities ▪ Demarcate your ST system ▪ Gather and analyse detailed data about streams, actors, (frontrunners, proponents, opponents etc), instruments ▪ Write your column
2.4	6 December	Visualisation of the ST system	▪ Give and receive feedback on vision(s) ▪ Discuss on the bubble week's program: guests, clients, visits. ▪ Design a poster describing the stream and sub STS (high level details) ▪ Write your column
2.5	12 December	Roles of innovation and engineers	▪ List 'all' possible current and future contributions to change, upscaling and mainstreaming ▪ Compare posters ▪ Prepare presentation on the dilemmas of the governance of change ▪ Write your column
2.6	22 December	Governance of change	▪ Give and receive feedback ▪ Presenting ▪ Write your column
2.7	10 January	Consultanty hrs	▪ Submit final group report ▪ Write your column
2.8	16-20 January	Project week at Delft's Campus The Hague	▪ Collaboratively developing: ▪ Integrated atlas of circular and sustainable The Hague ▪ Integrated future vision(s) ▪ Adaptive pathways ▪ Action agenda's
2.9			Write your final column

WEEKLY CHAPTERS ON SUB-SYSTEM RESEARCH (GROUP WORK)

The group work focus is on a stream of sustainable and circular The Hague as a socio-technical system. Groups of students will articulate the sustainability and circularity challenge.

Groups report about their research and design via the virtual research environment. Every assignment should be uploaded, and in the end they together form the preparatory study on the sub-system, to feed the integrated The Hague products. The preparatory assignments have to be finished before we move to in The Hague; these assignments will be graded.

Assignments can be improved after feedback until the final deadline. On the website the assignments about the sub-system have to form a coherent story line. Group assignments form a coherent book that reflect about sufficient hours of work. The assignments show informed reasoning.

To do:

- Read, discuss and apply literature.
- Write a research plan.
- Perform and report on 2 interviews/students.
- Field research: gather detailed data about the stream/sub-system.
- Write 3 draft assignments.
- Give and receive feedback on each draft assignment.
- Improve final assignments in coherence.
- Design a poster which covers all assignments. Define two questions with your poster: 1) to other research groups 2) to practitioners. The bubble week will start with discussing about these.
- Upload all information used and assignments on o*penresearch.net*

Grading

- All assignments should be handed in, and actively contributed to by assigned students.
- All assignments are submitted in time, reflect serious work and professionalism by individuals and groups.
- The three assignments together will be graded as group work, on the criteria: use of literature, scientific knowledge and insights; depth and quality of analysis and design; critical discussion on sustainability and circularity; reasoning; structure; coherence; ambition; creativity (60%)

ASSIGNMENT 1: EXPLORING FUTURE VISIONS

Behind every circularity/sustainability initiative are initiators, supporters and users. Probably they all feel they have a choice what to do with a particular material, waste, artefact. They may have started from wondering about why bricks or tires are granulated first, to become new products; about the amazing numbers of plastic bottles in the canals; or why wobbling chairs are considered waste.

It is your task to figure out why they do what they do, what or who inspired them, how do they consider their contribution to change the current unsustainable behaviour and society (in our vocabulary: the current socio technical system). Is it the same future vision that moves them all, or may be they have different motives and dreams? When is the future? You have to report on the vision(s) you analysed and discuss about the implications of the vision(s) for the demarcation of the sociotechnical sub-system.

In the bubble week, we will need these visions to merge them in an integrated vision for sustainable circular The Hague.

To do:

- Read and discuss literature about visioning.
- Start from 2 interviews/student.

- Find ‘all’ relevant related initiatives and analyse the visions behind them, implicitly or explicitly. Towards what future are they heading?
- Discuss and describe if and how that vision(s) determine the stream you propose to investigate, and what that vision(s) means for the demarcation of the socio technical system (the stream/circle is part of). Apply literature. Check the vision(s) with others/interviewees.
- Upload all information used and assignments on o*penresearch.net*
- Give and receive (online) feedback

ASSIGNMENT 2: DESCRIPTION OF THE SOCIOTECHNICAL SYSTEM

The aim of this assignment is to have a full overview of the stream your group studies, and all parties, technologies, artefacts that are related with that. We want to fully understand the system that is supposed to change.

In the bubble week, we will need these descriptions to merge them in the Atlas of The Hague as a sustainable circular socio technical system.

To do:

- Read and discuss literature about the governance of change of sociotechnical systems.
- Outline the current sociotechnical system that relates to the stream you started from. Use figures and verbs) in that system.
- Find detailed information about all elements (like technology, actors, artefacts: use numbers and nouns to describe) and mechanisms (i.e. how does, and what makes the stream move?
    - Pay attention to both households and industries
    - Use the pillars introduced in the literature to structure your analysis.
- Visualise the sociotechnical system including streams.
- Determine and conclude about loose ends, i.e. where non-circularity and/or unsustainability settles.
- Upload all information used and assignments on o*penresearch.net*
- Give and receive (online) feedback

ASSIGNMENT 3: REPORT ON THE GOVERNANCE OF CHANGE

Detailed understanding of the current system, enables us to understand in what aspects the future socio technical system as envisioned is inherently different. Moreover it shows us where initiatives to change the system recently intervened.

In the bubble week, we will need these reports to propose integrated pathways to realise the vision for sustainable circular The Hague, and to come up with guidelines for action for the short term.

To do:

- Analyse how the initiatives you came across in your research aim to change the current sociotechnical system: what mechanisms do they want to replace? How does or would that impact the rest of the system? What opportunities do initiatives use or create? Does that influence legitimacy?
    - Pay attention to both households and industries.
    - Apply the pillars and concepts from literature to answer such questions.
- Find examples of transitioning actions that may be considered applicable in The Hague as well. Consider scale, scope and feasibility.
- Discuss and conclude if and how the circularity/sustainability initiatives and examples may lead towards the envisioned future for sustainable and circular The Hague.
- Upload all information used and assignments on o*penresearch.net*
- Give and receive (online) feedback

WEEKLY COLUMN

Students write a column (about 400-500 words, individual) to reflect on lessons and experiences during 'engineering for sustainable development' students are invited to write a weekly column. So you will write 7 columns in total: 6 with each week (also when you couldn't attend, you write one) and the final concluding one at the end of the project week. Columns will be posted in individual profiles at https://tudelft.openresearch.net.

To do:

- Share inspiration, and reflect on a critical sustainability experience each week.
- Write and submit your weekly column.
- Give and receive weekly (online) feedback to another student's column.
- Upload all information used and assignments on o*penresearch.net*

Grading

Columns (individual) + or – 0,5 point: reflection; inspiration; reasoning; style.

DEADLINES

Deadline* 2016-2017	Individual	Group
21 November	Column week 1	Project plan
30 November	Column week 2	Future vision(s)
6 December	Column week 3	Interview reports
12 December	Column week 4	System description
22 December	Column week 5	Governance of change Proposal for field research
10 January	Column week 6	Improved and final assignments
16 January		Bring the poster hard copy
27 January	Final column 7	

* All assignments have to be edited and uploaded in the virtual research environment. We expect professional behaviour; be aware that information is shared. That implies that it has to be reported about is such a way (structure, language, story line) that it is understandable, and even attractive for insiders and outsiders to read and study. However,

- avoid plagiarism! Be very precise in referencing to any source of information or ideas.
- distinguish between info and data and your interpretation, discussion and opinion about them.

APPENDIX: INTERVIEWING AND REPORTING

Groups of students report about interviews on a topic your group considers relevant for sustainable and circular The Hague (1000 words/interview, group work).

To make sure our research to a sustainable and circular The Hague is grounded and well informed, each student will perform an interview with an expert. The interviewee could:

- inform you about a particular The Hague initiative,
- share his or her vision on future The Hague that is behind it,
- offer detailed information about the initiative, the stream it is part of.
- Tell stories about how the initiative developed, about the opportunity to start, subsidies, regulations, supporters, resistance.

Groups discuss and decide about interviewees. In the end there will be multiple sets of interviews with regard to issues that are relevant to sustainable and Circular the Hague.

The interview report should summarize the interviews including interview questions. It discusses its relation to the literature and topic. The interview report concludes with the group ideas about what the lessons learnt would mean for The Hague.

Tips:

1. Discuss your group's interviews in the first week of the course. Think about respondents and contact them as soon as possible.
2. Schedule your interview on time. The report of your interviews should be available in week 2.4.
3. Respondents could be professionals or scientists.
4. Professionals may tell you about The Hague initiatives, innovations, or be experienced in a comparable development, telling stories about success and failure etc.
5. Scientists may have great ideas about how to make transitions happen, analysis and diagnoses about current developments and recommendations for The Hague.

Have a look here, and be prepared for the interview:

http://www2.open.ac.uk/students/skillsforstudy/conducting-an-interview.php

http://www.youtube.com/watch?v=9t-_hYjAKww&feature=youtu.be

http://www.youtube.com/watch?v=tRT7VrbP-As

https://blackboard.tudelft.nl/bbcswebdav/pid-2031046-dt-content-rid-6992478_2/courses/tud-ed-tbm-mtepa/learning%20to%20interview_roulston.pdf

http://www.jhsph.edu/research/centers-and-institutes/center-for-refugee-and-disaster-response/publications_tools/publications/_pdf/pr_section_3.PDF