ISM UNIVERSITY OF MANAGEMENT AND ECONOMICS

SUSTAINABLE DEVELOPMENT OF EMERGING TECHNOLOGIES

Course code	*GRAI018*
Compulsory in the programme	*Innovations and Technology Management*
Level of studies	*Graduate*
Number of credits	*6 ECTS (32 contact hours, 128 individual work hours)*
Course coordinator (title and name)	
Prerequisites	*Undergraduate diploma*
Language of instruction	*English*

THE AIM OF THE COURSE:

Developing a new technology requires much more than an economical cost-benefit analysis of production and performance. Many aspects will influence the success of an emerging technology at its final use stage. In this course we study how we can assess the potentials and pitfalls of emerging technologies to optimize their development process. We define this "Sustainable Innovation process" as a directed process of balanced consideration of the influencing aspects to optimally guide the development of an emerging technology. The process involves a.o.:

- Actor network analysis of the many entities that can influence the technological field

- Analysis of governance and development of regulations and legislation in the field

- Life cycle check of the technology, and paths for optimizing the lifecycle to reduced footprint.

- Resource supply security and forecasts of involved materials.

- Toxicological aspects and ecotoxicological aspects

- The historical development in the field and the fundamental limitations on performance

- Competing technologies and future market analysis

This course aims at giving students experience in performing an analysis involving a combination of aspects in order to optimize the success of a product innovation process. Taking technologies relevant for the participants (in business or as private persons), as a case of a rapidly evolving technological field, we study example cases of sustainable innovation, combined with state-of-art literature to give an overview of different methods being applied to guide the development.

Students will formulate their own project and work in groups on a selected case of emerging technology, and during the course present their analysis in a presentation and report. The aim is to account for the choice of method and then to formulate a substantiated recommendation for optimal development of the technology the students have been investigating.

The project cases will be developed by the students and may be based on an industrial collaborator, a research project, or a technology you find interesting in surveying to locate new potentials for innovation and development, maybe even in your further work after the course.

The course hence gives a functional introduction and hands-on experience for performing basic actor network analysis, life cycle screening, and technology assessments, but given the time constraints it will not give a full in-depth explanation on these methods.

MAPPING OF COURSE LEVEL LEARNING OUTCOMES (OBJECTIVES) WITH DEGREE LEVEL LEARNING OBJECTIVES (See Annex), ASSESMENT AND TEACHING METHODS

Course level learning outcomes (objectives)	Degree level learning objectives (Number of LO)	Assessment methods	Teaching methods
CLO1. The student develops an appropriate method to perform a simplified technology assessment of a chosen (emerging) product/technology and assess its potential advantages and drawbacks based on the limited available information.	LO1.1, LO1.2	Individual report, class presentations, peer review of the reports.	Lecture, discussions, case analysis, debates, simulations, independent studies.
CLO2. The student is able to assess the potential advantages and drawbacks of a developing technology based on the limited available information.	LO1.3	Individual report, class presentations, peer review of the reports.	Lecture, discussions, case analysis, debates, simulations, independent studies
CLO3. The student performs an actor-network analysis concerning the involved parties and how they can influence the technological area.	LO1.2	Individual report, class presentations, peer review of the reports.	Lecture, discussions, case analysis, debates, simulations, independent studies
CLO4. The student performs a life cycle check of the technology and analyzes paths for environmental optimization including supply horizon and – security of necessary mineral resources.	LO1.2	Individual report, class presentations, peer review of the reports.	Lecture, discussions, case analysis, debates, simulations, independent studies
CLO5. The student performs an analysis of "governance" and development of regulation and legislation within the field, and discusses social and environmental advantages and risks of the new technology, and relate to examples of these aspects.	LO2.1	Individual report, class presentations, peer review of the reports.	Lecture, discussions, case analysis, debates, simulations, independent studies.
CLO6. The student explains the historical development of the chosen technology and the underlying limitations	LO1.2	Individual report, class presentations, peer review of the reports.	Discussions, case analysis, debates, simulations, independent studies
CLO7. The student improves independent learning skills necessary to continue studies on a higher level.	LO3.1, LO3.2	Individual report, class presentations, peer review of the reports.	Discussions, case analysis, presentations, debates, simulations, independent studies

ACADEMIC HONESTY AND INTEGRITY

The lecturer assures a variety of teaching methods and timely feedback to students. The feedback from students will always be highly valued and appreciated. The course is designed to maximize active engagement by students in their own learning process and the successful achievement of the learning outcomes is dependent upon the quality of such engagement. Depending on the particular situation in class, this syllabus may be adjusted, in that case the students will be informed during lectures and via the e-learning notification system.

COURSE OUTLINE

Topic	In-class hours	Readings
Introduction to the course.	2	Watch the two introductory videos and consider the accompanying questions
Test of background reading	1	Background literature numbers 01-07
Module 1. Introductory lecture on assessment of emerging technologies	1	Literature # 01 & 02
Discussion of methodology	2	Literature # 01 & 02
Module 2. Technology characterisation. The historical development in the field and the fundamental limitations on performance.	1	
Technology characterisation of a case study	1	
Module 3. Life cycle check – introduction to life cycle thinking	0.5	Literature #03 & 04
Module 3. Life cycle check – the MECO matrix	1.5	
Module 4: Evaluation of resource use	2	Literature 05
Formation of groups – choice of project case studies	2	
Creating an overview of your project case study and developing your method. Start creating a life cycle overview	2	
Working with the life cycle overview of the cases	2	
Module 5. Analysing actor network	2	Literature 04
Module 6 Analysis of governance and development of regulations and legislation in the field	2	Literature 06
Potential risks and potential legislative barriers in your project cases	2	
Module 7. Discussion of how different businesses approach SAT	1	Watch the video by Dieter Wegener, Siemens AG

Module 8. The business case; Market analysis, SWOT, Strategy canvas, CSR and global compact, SDG assessment	1	Literature 07
Analysing the business case and social responsibility of your project case	2	
Presentation of the case study and the methods you expect to be relevant for your project case	2	
Wrap up of methodology. Preparation for self study projects	2	
	Total: 32 hours	

FINAL GRADE COMPOSITION

Type of assignment	**%**
Group Components 65%	
Project case study report	45
Presentation	20
Individual Components 35%	
Test on background reading	15
Peer review	20
Total:	**100**

DESCRIPTION AND GRADING CRITERIA OF EACH ASSIGNMENT
(Provide short descriptions and grading criteria of each assignment)

- **Test on background reading.** The test will run on-line as a quiz at ISM Learning/moodle. Test will cover the conceptual material from the background readings (positions from 01 to 07, provided on e-learning) relating to lecture/discussion material from class. Test questions will be multiple choice, short answer/essay, and/or fill in the blank format types. It is imperative for students to prepare for the Test before the class on **March 17th at the beginning of class**. Test will count 15% of the final grade.
- **Presentation.** The PP presentation should be prepared between course weekends and delivered on the assigned day. The groups should prepare a 10-15 min. Power Point presentation focusing on explaining their project case and particularly how they are going to analyze it, i.e. which methods are relevant. Another group will be appointed as opponents. After the groups presentation the whole class discussion is welcome. Presentation counts 20% of the final grade.
- **Peer review.** Each participant has to read at least one of the other groups reports and deliver a 2 or maximum 3 pages feedback to the report **no later than April 7th**. Review counts 20% of the final grade.
- **Project case study.** In the project case study you assess a technology of your own choice using appropriate theory to develop your own method, and supplement it with your common sense and scientific articles. The project case study analysis counts 45% of the final grade. Students work in groups to prepare an assigned project case study. The project case study must be 15-20 pages. The written work should be submitted to the teacher by email and **uploaded on e-learning platform** no **later than April 1st.** The paper must be designed in accordance with **APA** (American Psychological Association, www.apastyle.org) and ISM University of Management and Economics requirements for the written works**. Papers presented later than the appointed time are worth automatically 50% less.**
- **Extra Credit.** The instructor reserves the right to give extra credit for student participation in events that increases student awareness of social responsibility and/or sustainability.

- **Exam re-take.** The retake exam will consist of a written exam counting 35% of the overall grade, with the completed assignments (project case study and presentation) counting as 65%.

The project case report should be written in English and be no longer than a maximum of 5000 words (excl List of content, references and appendices). Although appendices are not included in the limit, be sure to include only what is relevant for understanding your conclusions, not to document everything you have done. Additional information can be added to an appendix, but this is not a part of the report being assessed.

At the beginning of the report write a short clarification on what each group member contributed with to the report (also not in the word count):

- Who wrote what? Who did what? How did you organise the work?

Please provide argumentation for each step of your method

- why you do make this type of analysis?
- what kind of information does it provide to the decision maker?
- Refer to scientific literature on the methods

The reader is not an expert in the field – so be sure to explain terminology and methods.

- Proper references to information resources - make sure you have a nice well formatted reference list.
- If you use wikipedia, generally you should quote the original reference they quote and *not* wikipedia itself. If you feel grateful for wikipedias services, then its better to acknowledge them by giving a small donation to wikipedia or by improving some of the entries in it.
- Use clearly marked quotations if copying any text from other sources and provide a clear reference to the source.
- We must emphasize that you must not copy and paste others text or images without credit and a reference. We have a zero tolerance for copying others work, and will make automated copy-paste checks for electronic hand-ins, so it will be detected if you do it.

More criteria for the evaluation can be deducted from the guide to peer evaluation.

<u>The report will be evaluated by:</u>

- Structure and language
- Topics covered
- Analyses and tools described
- Presentation of results
- Link to theory
- Value of recommendations, improvements and conclusion

Peer evaluation

Each of you have to peer review one other groups report and make an individual written peer review statement. The peer evaluation must result in a very short summary – app. two and maximum three pages - with the most important questions and comments to the report being reviewed. You should follow the simple guiding questions below to provide constructive comments for improvements and appraisal of the valuable parts of the report. One individual statement is written pr person.

Guiding questions for the peer review statement

- As an overall guidance for the feedback relate to the learning objectives - how do the presenting group achieve the learning objectives?
- Do you think there was a clear problem formulation and focus of scope?
- Did they explain the technical background convincingly so it is understandable for you ?

- Do you feel you received a fair explanation of state-of-art and was provided a comprehensive overview of the subject?
- Is it clear what the difference is between the different products being compared? are there easy to understand overviews of them and their differences (if we dont know what we talk about, the talk is not of much value :-)
- Did they argue for their choice of methodology and focus in their work? Is the chosen method clearly explained and justified? and does it make sense? is something missing?
- Did they use a convincing functional unit in the Meco?
- We compare products in the LCC/MECO, but how is the comparison in the other aspects of the assessment (actor network differences btw the products? Scenario differences?)
- How do they tackle impact assessment?
- What was most interesting for you in the report?
- What did you learn most of from the report?
- Are there any points in the report you do not understand?
- Was the report/ presentation scientific?
- Specifically:

  - Is credit or a reference provided for every image, quote etc. from an external source?
  - Do you trust the references they cite?
  - Do you think they have critically considered their information sources? (do they just quote some company selling some product, or do they thoroughly and critically assess even peer reviewed information not just plainly accepting what people write?)

- Were the conclusions well founded on presented data and discussions?
- Any further comments and feedback you may have on the report/presentation.
- What grade would you give the report on a scale from 1 (low) – 5 (high grade)?

Then list your most important questions to the report, as these are valuable feedback to the authors telling them which parts of the work was clearly understood and which were less clear.

<u>The peer review will mainly be evaluated by:</u>

- Link to theory
- Value of recommendations, improvements and conclusion

Presentation of project should present an overview of the project case and the methods that are relevant to apply for that specific case. It will be evaluated by:

- Presentation well structured (all parts included)
- Clear knowledge of the subject (theoretical background)
- Analysis of the life cycle
- Relevant methods and material
- Response to the questions and discussion

REQUIRED READINGS

01. Mulder, KF, 2007: Innovation for sustainable development: from environmental design to transition management. Sustain Sci (2007) 2:253–263 DOI 10.1007/s11625-007-0036-7
02. Mulder, K F., 2013: Impact of New Technologies: How to Assess the Intended and Unintended Effects of New Technologies? Chapter 45 in J. Kauffman, K.-M. Lee (eds.), Handbook of Sustainable Engineering, DOI 10.1007/978-1-4020-8939-8 35, © Springer Science+Business Media Dordrecht 2013
03. Helling, R. (2015). Driving innovation through life-cycle thinking. Clean Technologies and Environmental Policy, 1769–1779. http://doi.org/10.1007/s10098-015-0928-7
04. McAloone T and Bey N, Environmental improvement through product development - a guide
05. Allwood, J. M., Ashby, M. F., Gutowski, T. G., & Worrell, E. (2011). Material efficiency: A white paper. Resources, Conservation and Recycling, 55(3), 362–381. http://doi.org/10.1016/j.resconrec.2010.11.002
06. EEA Report No 1/2013: Late lessons from early warnings: science, precaution, innovation. Implications for science and governance | In conclusion. ISSN 1725-9177

07. vanDrimmelen R, 2013: New Business Models for Sustainable Development . Chapter 47 in J. Kauffman, K.-M. Lee (eds.), Handbook of Sustainable Engineering, DOI 10.1007/978-1-4020-8939-8 53,

ADDITIONAL READINGS

A Brief Introductory Note to Actor-Network Theory (ANT), its approach and premise. DTU Lecture notes by Yutaka Yoshinaka, Technical University of Denmark.

Wenzel and Caspersen, 2000: Product Life Cycle Check. A Guide

Armin Grunwald: TECHNOLOGY ASSESSMENT: CONCEPTS AND METHODS. Handbook of the Philosophy of Science. Volume 9: Philosophy of Technology and Engineering Sciences. Volume editor: Anthonie Meijers. General editors: Dov M. Gabbay, Paul Thagard and John Woods. 2009 Elsevier BV.

Kunnari, E., Valkama, J., Keskinen, M., & Mansikkamäki, P. (2009). Environmental evaluation of new technology: printed electronics case study. Journal of Cleaner Production, 17(9), 791–799. http://doi.org/10.1016/j.jclepro.2008.11.020

Barraneche, A et al, 2016: An Oecd Horizon Scan Of Megatrends And Technology Trends In The Context Of Future Research Policy. Available at ufm.dk/en/publications

Bocken et al, 2014: A literature and practice review to develop sustainable business model archetypes. J Clean Prod. 65 (2014) 42-56. https://doi.org/10.1016/j.jclepro.2013.11.039

Project reports from previous course participants

ANNEX

DEGREE LEVEL LEARNING OBJECTIVES

Learning objectives for the <u>Master of Business Management</u>
Programme:
International Marketing and Management
Innovations and Technology Management

Learning Goals	Learning Objectives
Students will be innovative decision makers	LO1.1. Students will be able to define the business problem and develop **innovative solutions**.
	LO1.2. Students will become **independent learners** and develop their own comprehension of scientific theories, models, and concepts.
	LO1.3. Students will be able to demonstrate critical thinking in problem solving.
Students will be socially responsible leaders	LO2.1. Students will be able to evaluate past and current practices in their discipline from an **ethical perspective**.
Students will be effective communicators	LO3.1. Students will develop and deliver a **coherent oral presentation**.
	LO3.2. Students will develop and deliver a **coherent written research paper**.