COURSE-PM

ME2067 INDUSTRIAL TRANSFORMATION AND TECHNICAL CHANGE (ITTEC)

6 credits, Advanced Level,
Period 3, Spring Semester 2026

Contents

1 General Information

Eligibility

- Admitted to the master program TINEM
- Passed and finished the course ME2501 Perspectives on Industrial Management

Language

The course will be given and examined in English.

Course Staff

Associate Prof. Johan Nordensvärd (johan.nordensvard@indek.kth.se), examiner and course responsible
Emily Christley (emilych@kth.se), lecture and seminars

Course evaluation board

For the continuous development of the course, students are invited to participate in a course evaluation board along with the course's teachers. The meetings are intended to help us identify strength and weaknesses in how the course works towards the intended learning outcomes, as well as potential improvements thereof. Student board members will serve as representatives for the other students and thus also provide an additional channel for feed-back to the course administration.

2 Course Introduction and Overview

The theoretical basis of the course is derived from innovation theory with strong connections to evolutionary and institutional economics. The area of Industrial dynamics has a strong interdisciplinary character related to fields such as technology history, technology, sociology, economic history, economic geography and economics. Industrial Dynamics has a strong technology and industry-focus and provides students with tools to manage industrial change processes. The course covers management issues on a

"meso level" - that is those concerning strategic leadership to meet industrial change. The majority of today's most challenging industrial management problems originate from rapid technological and industrial transformation caused by pressure for change, such as globalization, climate change, sustainable development policies, digitalization and radical shifts in technology.

Intended Learning Outcomes

After completing the course, students are intended to be able to:

- Critically discuss the mechanisms that underlie industrial transformations and technical changes and their implications
- Evaluate theoretical concepts and current research from the field of industrial dynamics for managing technological and industrial change processes
- Write an analysis related to industrial and technological change and independently discuss problem formulations and their solutions to tackle complex change
- Present results and conclusions based on a scientific investigation for different types of audiences

Learning activities

The course is based on a consecutive series of lectures. In addition, the students are to conduct a study with the aim of analyzing an authentic company's handling of a current transformation process using theoretical concepts from industrial dynamics and "management of innovation". The examination is done through a series of seminars that focus on problem definition, purpose, research questions and sources. The students are trained in how to combine different knowledge areas to make a complex reality researchable. The final examination will consist of an academic individual report aiming to evaluate the theoretical concepts in relation to the chosen problem statement, as well as an academic group report and a fictive presentation of the main results to the investigated company's board of directors.

The course includes activities aimed at deepening the knowledge in scientific method, academic writing, and presentation. The course supports the whole program´s learning objectives through a deepening of the problem-based approach introduced in ME2501 (which continues in the courses ME2502 and ME2069):

- **Assignments** motivate students to read the course literature in a timely manner and prepare them for lectures, seminars and presentations.
- **Lectures** facilitate students' understanding and learning of the key concepts and methods. Students are encouraged to read the assigned course literature and reflect upon them before the relevant lectures start, thus getting a chance to ask informed questions.
- **Seminars** let students present their understanding and application of concepts and methods, and to receive feedback from peers and instructors.

3 Course Structure and Readings

The course starts with a review of the theories that form the foundation of Industrial Dynamics, helping the students understand and explain technological and industrial change, and innovation theories. The course then focuses on management issues on a "meso level", i.e. strategic leadership to meet industrial change. Historical and current context is important in the course and students are expected to undertake their own analysis of an industry based on the theories presented. Examples of areas covered are innovation theory, historical analysis of industrial dynamics, knowledge processes and phenomena such as technological paradigms, regimes and trajectories. In ME2067 an introduction to innovation management will be given. This will serve as the basis for understanding more applied innovation management in ME2069, where the students will discuss company cases.

Part 1 Foundations of Industrial Dynamics

Lecture 1:1 – Introduction/Industrial Transformations and Technical Change (Johan Nordensvärd) -
Read Arthur (1989), Christensen & Rosenbloom (1995), Dosi (1982) and Unruh (2000)

Lecture 1:2 - The industrial development in Sweden and the World (Johan Nordenvärd)
Read Giertz (2016) and Porter (1990).

Lecture 1:3 - Systems in Transition (Frauke Urban)
Read Laestadius (2016), Geels (2014a; 2014b) and Hughes based on Blomkvist & Johansson (2016)

Lecture 1:4 - Innovation Processes (Johan Nordensvärd)
Read Abernathy and Utterback (1978) and Rogers based on Karakaya & Sriwannawit (2016).
Review again Christensen & Rosenbloom (1995) and Dosi (1982).

Lecture 1.5 The social, political and economic challenges of transformations (Johan Nordensvärd)

Read Avelino et al. (2016), Nordensvärd (2017) and Rockström et al. (2017)

Lecture 1.6 Case study methodology and literature review (Johan Nordensvärd)

You are strongly encouraged to acquaint yourself with Yin (2009) or with another equivalent overview of case study methodology. Read chapter 3, Critically reviewing the literature, of Saunders et al. (2009).

Lecture 1.7 Assessment lecture (Johan Nordensvärd)

You are strongly encouraged to read through the essay examples for both the individual and group assignments until the lecture. There will be more instructions on Canvas when the course starts.

Part 2 Management of Technological Innovation

Lecture 2:1 – Innovation Management part 1 (Niklas Arvidsson)
Read chapter 1-2 in Tidd & Bessant (2013)
Review again Dosi (see above)

Lecture 2:2 – Innovation Management part 2 (Niklas Arvidsson)
Read chapter 3-4 in Tidd & Bessant (2013) and Stabell. & Fjeldstad (1998).

4 Schedule

Date	Time		Lecture	Activity	Venue
2025-01-13	10:00	12:00	L1:1 (JN) Introduction	Lecture	Q2
2025-01-15	13:00	15:00	L1:2 (JN Industrial development	Lecture	B1
2025-01-20	10:00	12:00	L1:3 (FU) Systems in transition	Lecture	D3
2025-01-22	13:00	15:00	L1:4 (JN) Innovation Processes	Lecture	Q2
2025-01-27	10:00	12:00	L1:5 (JN) Challenges	Lecture	E3
2025-01-29	13:00	15:00	L1:6 (JN) Case study method	Lecture	E3
2025-02-03	10:00	13:00	L1:7 (JN) Assessment	Lecture	Q2
2025-02-10	10:00	12:00	L2:1 (NA) Innovation management part 1	Lecture	Q2
2025-02-12	13:00	15:00	L2.2 (NA) Innovation management part 2	Lecture	E3
2025-02-16	10:00	15:00	Seminar group 1 and 2	Seminar	M38
2025-02-17	10:00	15:00	Seminar group 3 and 4	Seminar	M38
2025-02-18	13:00	15:00	Seminar group 5	Seminar	M38
2025-02-19	10:00	12:00	Closing lecture/workshop	Lecture	E3

Seminarinfo:

To help you structure your work, the following table lists tasks and events directly linked to the assignments. Please note that missed mandatory elements require additional tasks, see section 7.

date	Tasks
By 2025-01-16	Group formation for group work
2025-02-16,17,18	Seminars
2025-03-13	Submit final group report
2025-03-13	Submit final individual assignment

5 Assignments, Learning Activities and Examination

Our general position is that a text should always be adapted to its context and purpose. Your LR has one purpose and your case study a different one. They also have different layout and word counts. For each step in your process you are also likely to have reached new insights. This means that it is likely that you need rephrasing. However, since your topic may still be the same (but perhaps with a different focus), some overlap and similar formulations will be acceptable. Always provide references where the information has been taken from previous work (by yourself or others).

- INL1 - Assignment, 2.0 credits, grading scale: A, B, C, D, E, FX, F
- SEM2 - Seminars, 4.0 credits, grading scale: A, B, C, D, E, FX, F

There are two examined assignments:

- One group work task of writing a 5.000 word report based on secondary and primary data, with mandatory seminar presentation. Deadline for the final group report of 2024-03-13 and the seminars are on 2025-02-16,17 and 18. - 4 credits.
- One individual assignment, writing a 2.500 word essay based on secondary data, with a deadline of 2025-03-13. - 2 credits.

Both assignments should be submitted on Canvas.

The group work should cover the following:

- Groups of 5-6 students (group formation to be communicated to the course responsible by 2025-01-24, please self-assign to a group).
- The task is to **choose an industry** of your choice that is currently undergoing transitions, such as the energy industry, the transportation industry, the process industry (e.g. mining, steel etc), the IT industry, the banking industry, the fashion industry, the telecoms industry etc.
- **Select a case study company** within that industry.
- **Write a report of up to 5.000 words** (plus references) **to discuss how the case study company and the industry is changing and why, what the drivers are and how this can be explained by the use of theories from industrial economic and management that were outlined in the ITTEC course.**
- Use secondary data such as academic literature from journal articles and books, data, company reports etc. Use course literature, as well as other sources, including latest research findings from 2023-2024.
- In addition try to use primary data by contacting the company and conducting interviews or surveys with their staff.
- Use proper referencing and add a full bibliography. Use the Harvard style referencing system: https://libguides.scu.edu.au/harvard/books
- See here for proper academic conduct for writing: https://www.kth.se/en/biblioteket/skriva-referera/skriv-referenser-1.856564
- In case you are considering the use of AI: The approach to the use of AI such as ChatGPT needs to be explained in detail. It should NOT be used to write the paper, only as a background literature review, after which you are supposed to check and critically review the information, as well as adding your own thoughts and your own analysis**. Every must have a method section that includes how ChatGBT or any other AI tool was used as a tool for literature review or as a proof reading tool. Not having this will lead to f(X).**
- Note that the report should include primary data as well, such as from interviews with experts and company representatives. **It is therefore very important that every statement in the**

report is supported by academic references. If you are referencing incorrectly you will fail or you will have to resubmit a new version with references.

- Follow the outlines of a journal paper for writing your report:
- Introduction
- Material and methods (including data sources)
- Theory
- Findings
- Discussion
- Conclusion

- Present the findings of the draft report at the seminars on 2025-02-16,17 and 18. Prepare a short presentation with max 5 ppt slides. Submit the final version of the group report on Canvas by 2024-03-13.
- Write a short statement of who did which tasks for the group work to explain the division of labour. All group members are supposed to participate in the research, the report writing, attend the seminar and be able to present / answer questions at the seminar.
- Group work and seminar attendance are mandatory.

The individual assignment should cover the following:

- **Choose one country or city or region** of your choice (be creative, not everyone to choose Sweden or Stockholm).
- **Choose one industry** of your choice that is undergoing industrial transformations and technical changes (e.g. the energy industry (wind, solar, hydro, bioenergy, hydrogen, nuclear, carbon capture and storage CCS, bioenergy carbon capture and storage BECCS, energy storage etc), the transportation industry (road, air, sea, rail, could also be autonomous vehicles), the process industry (e.g. mining, steel, batteries etc), the IT industry (e.g. digitalization), the banking industry (e.g. blockchain, cryptocurrencies), the fashion industry, the telecoms industry etc. Do NOT use the same industry as the one you used for the group work. We will check that everyone will choose another industry than their group work.
- **Choose one theory** of your choice from the ITTEC course, apply this theory to your case and explain how industrial transformations and technical change are happening in the country/city/region and the industry you selected based on this theory.
- **Write a report of up to 2.500 words** plus references.
- Use secondary data such as academic literature from journal articles and books, data, company reports etc. Use course literature, as well as other sources, including latest research findings from 2023-2024.
- Use data sources from reports and databases that are specific for your chosen industry and your chosen geographic location. Include information about the data sources you are using, where they come from, data quality etc. Include figures and graphs to support your arguments.
- Use proper referencing and add a full bibliography. Use the Harvard style referencing system: https://libguides.scu.edu.au/harvard/books
- See here for proper academic conduct for writing: https://www.kth.se/en/biblioteket/skriva-referera/skriv-referenser-1.856564
- In case you are considering the use of AI: The approach to the use of AI such as ChatGPT needs to be explained in detail. It should NOT be used to write the paper, only as a background literature review, after which you are supposed to check and critically review the information, as well as adding your own thoughts and your own analysis. **Every must have a method section that includes how ChatGBT or any other AI tool was used as a tool for literature review or as a proof reading tool. Not having this will lead to f(X).**
- **Everything needs to be referenced in the text – every section of the text will need a reference to the literature, interview or document. Lack of references will lead to f or f(x).**

- Follow the outlines of a journal paper for writing your report:
- Introduction
- Material and methods (including data sources)
- Theory
- Findings
- Discussion
- Conclusion
- **Deadline for submission of the individual assignment on Canvas: 2024-03-13.**

6 Information for Distance-Learning Students

Students taking the course by distance are to follow the instructions in this PM, along with further instructions from the course administration. This will largely entail the same activities, dates and deliverables, with some modifications. Use Zoom / Teams to connect to your group for the group work and for attendance of lectures and seminars. We will check attendance online for mandatory teaching events such as guest lectures and seminars. If you are unable to find a group to work with remotely, you may be excused to do the case study work individually.

- Follow the instructions for complementing missed mandatory elements in section 7.

7 Complementing Missed Mandatory Elements

The intended learning outcomes of this course necessitates some elements which we consider to be of critical importance for taking part in the course and have hence been made mandatory. However, as some of you are taking the course by distance and as unexpected hindrances may occur, we have made it possible to complement any missed elements as follows. Note that we strongly encourage your participation unless you have valid reasons for missing them.

Lectures

We are glad to be able to present a number of very knowledgeable guest lectures in this course (Niklas Arvidsson, Emily Christley and Frauke Urban. All guest lectures are mandatory and we will check attendance in class and online. If you miss any of these guest lectures, you are asked to write a 500 word essay on its topic, referencing lecture slides and all the literature listed in the reading list (see section 3). The reflection should primarily be a summary of the readings and (as far as possible) the lecture's contents. Your reflections can be made in relation to the case that you are working with. The work can then be potentially be reutilized for your individual assignment if the theme fits your case. Complementary assignments are graded pass or fail since they correspond to seminar/lecture participation.

Seminars – *Book the date to avoid clashes with other events*

It is mandatory to attend the seminar and to present your group work. If you are not able to attend physically, for example because you are based abroad for exchange studies, you should attend digitally on Zoom and support your group in presenting your joint work. If you cannot attend because of other reasons, you should send an individual recording of your group work presentation to the course responsible Johan Nordensvärd (and the rest of your group will jointly present at the seminar as planned).

8 Grading Procedures

The examination is formally composed of two elements as shown in the table below.

Element	Type	Credits	Grading Scale	Content

INL1	Assignment	2	A, B, C, D, E, Fx, F	Individual assignment
SEM2	Seminar participation and assignments	4	A, B, C, D, E, Fx, F	Group assignment and seminar attendance with active oral participation [1]

Formula used for combining the grades:

SEM2 \ INL1	A	B	C	D	E	F
A	A	A	B	B	C	F
B	B	B	B	C	C	F
C	B	C	C	C	D	F
D	C	C	D	D	D	F
E	C	D	D	E	E	F
F	F	F	F	F	F	F

Examination adapted to students with special needs

The following applies for students with functional variations who have a statement from KTH's FUNKA unit on recommended support measures during examination:

- Support measures under code R (i.e. adjustments relating to space, time, and physical circumstances) are granted by the examiner.
- Support measures under code P (i.e. pedagogical measures) are granted or rejected by the examiner after the examiner has been contacted by the student in accordance with KTH's rules. Normally, support measures under code P will be granted.

More information is available on KTH's website.

[1] Seminar attendance and preparatory assignments, including peer-review, are required to receive a passing grade on the group work

9 Literature

Methodological Literature

Collis, J., and Hussey, R., 2013. *Business research: A practical guide for undergraduate and postgraduate students.* Macmillan International Higher Education.

Farquhar, J. (2012). *Case study research for business*. Los Angeles, California; London: SAGE (available online)

Saunders, M, Lewis, P, and Thornhill, A. (2009). *Research methods for business students.* Pearson education.

USC (2018) Writing a research proposal. Available at http://libguides.usc.edu/writingguide/researchproposal (Länkar till en externa sida.)Länkar till en externa sida.

Yin, R. K. (2009). *Case study research: Design and methods (applied social research methods).* London and Singapore: Sage.

Papers and Books

Abernathy, William J. and James M. Utterback. 1978. *Patterns of Industrial Innovation*. Technology Review. 80:7, pp. 41–47.

Avelino, F., Grin, J., Pel, B., Jhagroe, S., 2016. *The politics of sustainability transitions.* Journal of Environmental Policy & Planning 18, 557–567. https://doi.org/10.1080/1523908X.2016.1216782

Arthur, B, 1989. *Competing Technologies, Increasing Returns, and Lock-In in Historical Events.* The Economic Journal, Vol. 99, No 394, March, pp. 116 – 131.

Christensen, C.M.; Rosenbloom, R.S., 1995, *Explaining the attacker's advantage: Technological paradigms, organizational dynamics, and the value network.* Research Policy, 24(2), 233-257.

Dahmén, E. – Laestadius, S., 2016 *Erik Dahmén and industrial dynamics*, in Blomkvist, P. & Johansson, P., eds., 2016 A dynamic mind: perspectives on industrial dynamics. SID/INDEK/KTH.

Dosi, G., 1982. *Technological paradigms and technological trajectories. A suggested interpretation of the determinants and directions of technical change*. Research Policy, Vol. 11(3):147-162.

Geels, F.W., 2014a. *A socio-technical analysis of low-carbon transitions: introducing the multi-level perspective into transport studies*. Journal of Transport Geography, Vol. 24 (2012) 471–482

Geels, F.W., 2014b. *Regime Resistance against Low-Carbon Transitions: Introducing Politics and Power into the Multi-Level Perspective.* Theory Culture Society 31, 21–40. https://doi.org/10.1177/0263276414531627

Giertz, E., 2016. *Dynamics in Swedish Industrial and Political History.* In Blomkvist, P. & Johansson, P., eds., 2016. A dynamic mind: perspectives on industrial dynamics. SID/INDEK/KTH.

Laestadius, S., 2015, *"Transition Paths: Assesing Conditions and Alternatives*", in Fagerberg, J., Laestadius, S. & Martin, B., 2015, *The Triple Challenge for Europe*, Oxford: Oxford University Press. DOI:10.1093/acprof:oso/9780198747413.003.0006 (Available online via KTHB)

Porter, M.E., 1990. *The Competitive Advantage of Nations*. Harvard Business Review, March–April 1990.

Rockström, J., Gaffney, O., Meinshausen, M., Nakicenovic, N., Schellnhuber, H.J., 2017. A roadmap for rapid decarbonization. Science, Vol. 355, Issue 6331, pp. 1269-1271. Available from: https://science.sciencemag.org/content/355/6331/1269

Rogers, E. – Based on Karakaya, E., & Sriwannawit, P., 2016, "*Diffusion of Innovations*" in Blomkvist, P. & Johansson, P., eds., 2016 A dynamic mind: perspectives on industrial dynamics. SID/INDEK/KTH.

Stabell, B.C. & Fjeldstad, Ø. (1998). *Configuring Value for Competitive Advantage: On Chains, Shops, and Networks*. Strategic Management Journal. 19. 413-437.

Thomas P. Hughes – Based on: Blomkvist, P. & Johansson, P., 2016, *"Systems Thinking in Industrial Dynamics*" in Blomkvist, P. & Johansson, P., eds., 2016 A dynamic mind: perspectives on industrial dynamics. SID/INDEK/KTH.

Tidd, J. and Bessant, J. (2013) *Managing Innovation. Integrating Technological, Market and Organizational Change*, 5th/6th ed.

Unruh, G.C., 2000 "*Understanding carbon lock-in*". Energy Policy 28 (12):817-830.

Annex A. Grading Criteria

A - High distinction of publishable quality:

- Potentially publishable after minor amendment and/or improvement to presentation
- Ability to plan, organize and execute independently a research project to the highest standards
- Clearly demonstrates creativity, originality, and independence of thought in research design
- Ability to assemble information from different sources to produce highly organized and original arguments
- Ability to evaluate critically existing methodologies and suggest new approaches to current research or professional practice
- Ability to analyze data critically to the highest professional and academic standard
- Ability to evaluate published or publicly-presented work critically to the highest professional standards
- Highest standards of competence, written expression, and presentation

B - Distinction (potentially publishable):

- Includes content that is original and potentially publishable after significant amendment and/or improved presentation
- Ability to plan, organize and execute independently a research project to a high standard
- Considerable evidence of creativity, originality and independence of thought in research design
- Ability to assemble information from different sources to produce well organized and original arguments
- Ability to analyze data critically and to a high standard
- Ability to evaluate published or publicly-presented work critically and to a high standard
- High standards of competence, written expression and presentation

C - Merit:

- Evidence of capability to undertake original research given appropriate guidance and support
- Flexibility of thought, and the ability to solve complex, though not entirely original research problems
- Evidence of some creativity, originality and independence of thought in research design
- Ability to evaluate published or publicly-presented work and to analyze critically sources of literature and information
- Ability to analyse data critically
- Professional standard of competence, expression and written presentation

D - Pass:

- Adequate knowledge and understanding of the relevant literature and other key sources of information
- Ability to construct coherent and relevant responses to research questions, though with few signs of originality
- Some ability to analyze critically sources of literature and information
- Ability to engage in research when provided with supervision and support
- A competent level of organization and written expression
- Satisfactory degree of technical accuracy

E - Pass, with some reservations:

- Some knowledge and understanding of the essential literature and other key sources of information, but arguments are either incomplete or not entirely coherent
- Limited grasp, or inadequate specification, of the research problem or topic
- Lacks clarity in written presentation
- Little or no evidence of originality
- Weak grasp of the relevant basic concepts and facts
- Poor formatting, style, presentation and referencing
- Work which is just enough

Fx - Fail on some or most indicators:

- Fragmentary knowledge and understanding of the essential literature and other key sources of information
- Shows little or no grasp of a clear research problem or topic
- No evidence of independent or original thought
- No attempt to analyze data or present results in scientific manner
- Confused written presentation
- Inadequate formatting, style, presentation and referencing
- Work that is below an acceptable professional standard

F - Fail on most or all indicators:

- A short submission with no knowledge and understanding of the literature or topic
- No independent thought or analysis
- Incoherent written presentation
- Wholly improper formatting, style, presentation and referencing

Annex B. Intended learning outcomes and alignment with examination

ILO	Examination Element
Critically discuss the mechanisms that underlie industrial transformations and technical changes and their implications	INL1 SEM1
Evaluate theoretical concepts and current research from the field of industrial dynamics for managing technological and industrial change processes	INL1 SEM1
Write an analysis related to industrial and technological change and independently discuss problem formulations and their solutions to tackle complex change	INL1 SEM1
Present results and conclusions based on a scientific investigation for different types of audiences	SEM1