4TU.

STUDY GUIDE
ACADEMIC YEAR 2020-2021

4TU Programme
Construction Management & Engineering

TU Delft Delft University of Technology

TU/e Technische Universiteit Eindhoven University of Technology

UNIVERSITEIT TWENTE.

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WHY STUDY CME AT 4TU?

By registering as a 4TU-CME student you grant yourself great opportunities.

Firstly, you have the possibility to follow ample courses in the field of Construction Management and Engineering (CME). CME is a broad topic, but together, the three involved universities cover almost every CME topic you can think of.

Secondly, in your graduation project you can have supervisors of different universities, which may have a great impact on the quality of your work.

Thirdly, by cooperating with students of other TU's your view will expand, you will get new insights and learn to solve problems in many different ways.

This study guide provides all the information you need in order to find out what are the topics are at the different locations, what are recommended courses, how to enrol for courses at each location and how to get into contact with the right persons.

We wish you a fruitful cooperation and exchange!

The 4TU-CME Management Team

FOCUS AT THE THREE CME LOCATIONS

THE CHALLENGE OF CONSTRUCTION MANAGEMENT & ENGINEERING (4TU)

Complex, innovative and multidisciplinary projects in a dynamic environment are calling for a new breed of manager able to competently combine engineering and organisation skills. Today's construction industry is changing fast. New techniques, shifting roles, complex logistics and globalization are only some of the factors affecting the character and management of projects in the building industry.

FOCUS IN DELFT

At Delft University of Technology, the master CME is an interfaculty program that is offered by the faculties of Civil Engineering & Geosciences (CEG), Architecture & the Built Environment (ABE) and Technology, Policy & Management (TPM). The master CME in Delft regards large-scale construction management, with a focus on 1) Large Projects & Networks, 2) Analytical tools & Information modelling and 3) Multidisciplinarity & Internationalisation. Through the shared expertise and collaboration of the three faculties, CME in Delft provides its students with the necessary tools to combine technical knowhow with managerial competences to be able to maximize value from technology. A CME-graduate from Delft is able to apply and develop innovative tools, systems and technologies, functions as a centre-piece in multidisciplinary projects and is at home in a dynamic multicultural environment.

Within the master CME at Delft University, relevant problems are addressed that yield huge management and project challenges for the future, such as ageing infrastructures and maintenance optimisation, urbanisation and the energy transition. To learn how to face these challenges, Delft CME-students follow courses in the following specialisations: Engineering & Systems, Projects & People and Design & Integration.

Recommended courses from other locations:

From UT:

- Construction Industry Dynamics
- Sustainability and Circularity in Civil Engineering

From TU/e:

- Technology Entrepreneurship
- Fundamentals of BIM
- Project redevelopment of problem areas
- Smart Urban Environment
- Project Big data and experiment for urban analysis

FOCUS IN EINDHOVEN

The master's degree program Construction Management and Engineering (CME) is offered by the Built Environment (BE) and Industrial Engineering & Innovation Sciences (IE&IS) departments, with their distinctive research-driven and project-oriented approach to education. At TU/e the graduation specialization of CME is focused on Smart Cities. The final graduation project has a clear scientific signature, and is grounded in actual Smart Cities

challenges. CME graduation projects are often executed in collaboration with industry partners, engineering offices or government institutes. TU/e CME borrows from two scientific domains: (i) urban/building science and systems and (ii) management and innovation sciences.

Recommended courses from other locations:

From TUD:

- Probabilistic Design
- Financial Engineering

From UT:

- Construction Industry Dynamics
- Sustainability and Circularity in Civil Engineering
- BIM and 5D Planning

Focus in Twente

At the University of Twente, the 4TU Master's programme in CME focuses on the management of the design and construction process in the construction industry (buildings and infrastructure). Students gain thorough knowledge of both the engineering and organizational aspects of this intricate process. This combination is essential to mastering current practices in complex, innovative and multidisciplinary projects in dynamic environments.
The UT approach centres on the market and organizational environment and the organization of the construction industry and the management of the various stages of the design and building process. Next to that, one of the profiles focusses on digital technologies in construction in which both industry dynamics and process management are combined with these digital technologies like BIM and 5D planning. Keywords at UT include: cooperation through the entire lifecycle, helicopter view, stakeholder approach and engaged scholarship. The emphasis is on designing, managing and organizing the design and building process. Courses that are characteristic of UT include the following: Markets, Organisation & Innovation, Procurement Strategies and Tendering, Sustainability and Circularity in Civil Engineering, Planning and Process Management and Digital Technologies in Construction.

Recommended courses from other locations:

From TUD:

- Financial Engineering
- Probabilistic Design

From TU/e:

- Technology Entrepreneurship
- Fundamentals of BIM
- Parametric design
- Research and development project

Shared Supervision (during Graduation)

So you are starting your graduation project and one of the experts of your topic is found at another TU-location? Just add the lecturer to your graduation committee! This is a great way of improving the level of your graduation. Also, it is a great way to assure the quality of the graduation project.

You will be in the lead of organising this, contacting the supervisor whether he is available and make it work.

Online courses at other locations

Below you find an overview of courses that are suitable to attend at another location since they have one or more online components. This list will grow since 4TU is eager to develop more online courses the years to come.

TUD

Course Code	Course name	Online components*	Offline components*
AR8003TU	Legal & Governance	Video Lectures, Assignments	Examination (at own location)
CME2300	Financial Engineering	Video lectures, Collegerama	Examination (at own location)
CIE4030	Methodology for Scientific Research	Video lectures, Collegerama. Assignment/report.	
CME2201	Dynamic Control of Projects	Video lectures, online material, Essay and online assignments	

TUE

Course name	Course Code	Online components*	Offline components*
L&G	7ZM6M0	Video Lectures Assignments	Examination (at own location)
Process modelling and Information management	7ZM5M0	Web lectures (from 2020-2021)	Assignments and online quizzes

UT

Course name	Course Code	Online components*	Offline components*
L&G	195800100	Video Lectures, Assignments	Examination (at own location)

Attending courses at another location

You have an automatic side registration at the two other universities that are not your 1st location of registration, so you can register for courses and exams (via electronic learning environments and online exam systems) at another location. That means that each 4TU student receives a letter containing registration information. With this registration information, you can register for courses and exams (via electronic learning environment and online exam systems) at another location.

Attending courses at the Delft University of Technology; what to do?

1. You should have received a letter/mail from the Central Student Administration (CSA) of Delft University of Technology with a NetID. With this NetID you have access to Brightspace, in order to register for courses, and Osiris, in order to register for exams.

   If you have not received this information, please mail to s.laudy@utwente.nl.
   He will organise this information through Central Student Administration for you.
   Are you a TU/e student and would you like to follow courses in Delft, but you have not received the login details? Please contact esa@tue.nl (Mr. B. Viveen). They will then create new login details for you

2. Register yourself for the course in Brightspace (https://brightspace.tudelft.nl)

3. Register yourself for the examinations of the course through Osiris via Brightspace

4. Sign up at the study advisor at the Delft University of Technology, Karel Karsen, (k.o.karsen@tudelft.nl) for more specific information about studying in Delft.

Attending courses at the Eindhoven University of Technology; what to do?

1. You should have received a letter/mail from the Education and Student Affairs (ESA) of the Eindhoven University of Technology with a student number, email address etc. With this data you have access to Osiris in order to register for courses and exams at the Eindhoven University of Technology.

   If you have not received this information, please mail to s.laudy@utwente.nl. He will organise this information through Education and Student Affairs (ESA) for you.

2. Register yourself for the course and examinations through Osiris (https://osiris.tue.nl)

Sign up at the study advisor at the TU/e, Mrs. J.A.M. Pulles (J.A.M.Pulles@tue.nl for more specific information about studying in Eindhoven.

Attending courses at the University of Twente; what to do?

1. You should have received a letter from the Central Student Administration (CSA) of the University of Twente with a student number, email address etc. With this data you have access to Osiris in order to register for courses at the University of Twente.

   If you have not received this information, please mail to s.laudy@utwente.nl. He will organise this information through Central Student Administration for you.
   Are you a TU/e student and would you like to follow courses in Twente, but you don't have received the login details? Please contact esa@tue.nl (Mr. B. Viveen). They will then create new login details for you.

Register yourself for the course through Osiris (osiris.utwente.nl) and your enrolment will automatically be linked to the corresponding Canvas page.

2. See Canvas (https://canvas.utwente.nl) and register for examinations at Canvas

3. Contact the study advisor at the UT Ir. M.J.B. Duyvestijn (m.j.b.duyvestijn@utwente.nl) for more specific information about studying in Twente.

Transferring ECTS from one location (TU) to another

To receive your ECTS at your first University of registration is a manual action!

1. Make sure the course you successfully finished is registered at the location you attended the course including final mark, i.e. in Osiris.
2. Get yourself a certified copy of your marks
   a certified copy is a photocopy with an official stamp and signature to verify that it is a true copy of the original document. You can get a certified copy at the student administration of the TU you attended the course.
3. You hand over the copy to the University of 1st registration. This can be done at the Centre for Educational Support of the respective universities. This department will administer the course and grading.

GRADUATION THEMES AT THE THREE LOCATIONS

GRADUATION THEMES IN DELFT

The overall aim throughout the different research profiles at the Master CME in Delft is to improve processes and innovate systems to optimise large-scale construction management. The graduation work in Delft focuses on profile-specific research questions that address this aim and, in addition, are relevant to practical problems. The CME graduation specialisations at TU Delft are:

- Engineering & Systems:
  The specialisation Engineering & Systems focuses on improving system performance in engineering management and real-life problem-solving using system-development and open-design methods. Examples of key graduation topics are:
  - Systems engineering, asset and operations management
  - Information modelling (BIM)
  - Risk and safety analysis and management
  - Supply chain integration, optimisation and reversal
- Projects & People:
  The specialisation Projects & People focuses on management of projects using a holistic approach by, for and with people collaborating across organizations and on learning to adapt to change. Examples of key graduation topics are:
  - Adaptive project management, governance and leadership
  - Managing complex(ity of) projects
  - Collaboration and stakeholder management
  - Procurement and contracting
  - Transition and process management
- Design & Integration
  The specialisation Design & Integration aims to design and realize plans that address societal challenges by integrating contextual needs and requirements, and by following design and action research approaches. Examples of key graduation topics are:
  - Integral and transdisciplinary design
  - Urban development and innovation
  - Sustainable and circular business models
  - Financial and entrepreneurial engineering
  - Legal and governance

GRADUATION THEMES IN EINDHOVEN

At TU/e the graduation specialization of CME is focused on Smart Cities. The final graduation project has a clear scientific signature, and is grounded in actual Smart Cities challenges. CME graduation projects are often executed in collaboration with industry partners, engineering offices or government institutes. TU/e CME borrows from two scientific domains: (i) urban/building science and systems and (ii) management and innovation sciences.

The graduation project is executed on the cross of the two aforementioned scientific domains. Within this cross section students can choose from a list of subjects that are

strongly related to on-going projects in the TU/e departments Built Environment (BE), and Industrial Engineering and Innovation Sciences (IE&IS). In the CME program, the following smart cities topics are offered:

- Energy Neutral Cities
- Urban Management
- Building Information Management

Graduation consists of two parts: (1) Research proposal and (2) Graduation project. A student can only start his/her Graduation project after the Research proposal has been approved by the chair of the graduation committee.
Each graduation project will be guided by a group of specialized (assistant and associate) professors, preferably from both TU/e departments BE and IE&IS. The students work individually, while their projects concur with research themes related to research and development activities of the involved staff and PhD's.

Graduation themes in Twente

The 4TU Master's programme in CME in Twente uses cutting-edge technology to dissect and understand processes which integrate governance issues, societal trends and management methodologies. CME at the UT has two graduation themes:

- *Markets & Organization in Construction*
  The specialisation Markets & Organisation in Construction focuses on aspects of market dynamics and organisational structures that are typical for the construction industry. Typical characteristics of the construction industry are often unique products (no mass-production), with a long planning and production phase, a long life time, constructed in public space, with many involved stakeholders.
- *Digital Technologies in Construction*
  Digital Technologies in Construction focuses on the analysis and management of the design and construction process in the building and construction industry, the coordination of the activities and roles of parties involved.

Career opportunities after CME

After the CME master you can choose out of several options, such as directly ***working in industry***, a paid combination of education and working on a practical design in industry (***PDEng***), or a scientific career (***PhD***).

Career in industry

Career opportunities for CME graduates can be found across the full spectrum of the building and construction industry, in the Netherlands and abroad. Future employers may include building and construction companies, organisations such as insurers with their own project development department, engineering and design offices and consultancy firms, government and NGOs such as Rijkswaterstaat, and institutes of research and education.

Positions may vary from company or division manager, construction supervisor or construction manager to project manager, technical consultant, project engineer or process manager. Given the wide range of knowledge and skills provided by this MSc programme and the current situation within the industry, opportunities are very promising.

PDEng - Post-Master Technological Design Programmes

Instead of directly working in the building- and construction industry, there is the opportunity to follow one of the Post-Master's designer programmes in Civil engineering at the 4TU Stan Ackermans Institute.
The ***practical focused*** PDEng (Professional Doctorate in Engineering) programmes in Civil Engineering (UT) and Smart Buildings and Cities (TU/e) are open for CME graduates.
During the program you will increase your technological knowledge, but you also learn how to apply it in practice. As well as that you work on your professional skills to increase your career opportunities. It encourages to actively look beyond the perimeters of a discipline and to recognise the challenges and restrictions imposed by product chain management, time and money.

A PDEng programme consists of an educational programme on a post-MSc level (50%) and a design project within an organization (50%). During projects students bring industrial and academic knowledge together and apply them in real industrial designs. A PDEng programme is fulltime and takes two years to complete.

By doing a PDEng programme you will become a qualified designer. When the trainee successfully completes the programme, he/she will receive a certified diploma and will be entitled to use the academic degree PDEng. During both years PDEng trainees receive a salary.

For more information you can check the websites of the PDEng Civil Engineering and the PDEng Smart Buildings and Cities:

- PDEng Civil Engineering: www.utwente.nl/go/pdeng-civil-engineering
- PDEng Smart Buildings and Cities: www.tue.nl/sbc

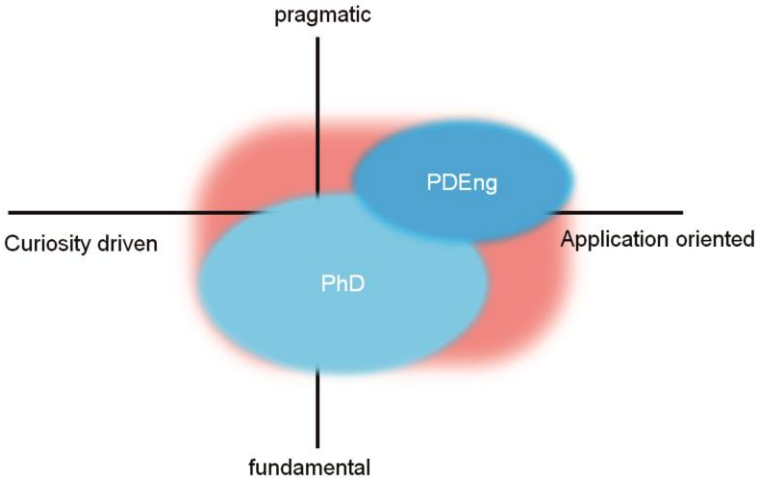
PhD - Doctoral Programmes

After completing your Master of Science degree, you also could opt for a career in ***research***. This involves spending four years studying a particular research area in depth. An integral part of this is writing your PhD thesis, and at the end of your PhD period you will present and defend your research in public. After successfully completing your PhD, you will be awarded the title of Doctor (Dr.).

Unlike in many other countries, most PhD researchers in the Netherlands are paid employees, often working directly for the university.

For more information you can check de websites of the graduate schools of each location:

- TU Delft: http://graduateschool.tudelft.nl/
- TU Eindhoven: https://www.tue.nl/en/education/graduate-school/phds-at-tue/
- University of Twente: www.utwente.nl/tgs



Organisation of the 4TU CME Master programme

Coordinators at the three locations

Coordinators in Delft

Ir. J.S. (Jeroen) Hoving, Director of Studies CME
Room: Building 23, 6.69
Phone: +31 15 27 85723
E-mail: j.s.hoving@tudelft.nl

Dr.ir. R.B. (Ruud) Binnekamp, coordinator Engineering & Systems
Room: Building 23, 6.64
Phone: +31 15 27 84771
E-mail: r.binnenkamp@tudelft.nl

Dr.ir. M.G.C. (Marian) Bosch-Rekveldt, coordinator Projects & People
Room: Building 23, 6.69
Phone: +31 15 27 84771
E-mail: m.g.c.bosch-rekveldt@tudelft.nl

Dr. D.F.J. (Daan) Schraven, coordinator Design & Integration
Room: Building 23, 6.69
Phone: +31 15 27 85967
E-mail: d.f.j.schraven@tudelft.nl

Coordinator in Eindhoven

Dr. Q. (Qi) Han
Room: VRT 9.11
Telephone: 040 247 5403
E-mail: q.han@tue.nl

Coordinator in Twente

Dr.sc.techn. A. (Andreas) Hartmann
Room: Horst HT305
Telephone: 053 489 2084
E-mail: a.hartmann@utwente.nl

Programme Developer 4TU-CME

Ir. S. (Sven) Laudy
Telephone: 06-41035617
E-mail: s.laudy@utwente.nl

Study Advisors at the three locations

Study Advisors in Delft

K.O. (Karel) Karsen
Room: Building 23, room 2.77.1
Phone: +31 15 27 83337
E-mail: k.o.karsen@tudelft.nl

Drs. P. (Pascal) de Smidt
Room: Building 23, room 2.77
Phone: +31 15 27 81068
E-mail: p.desmidt@tudelft.nl

Study Advisor in Eindhoven

Mrs. J.A.M. (Josée) Pulles
Room: VRT 2.12
Telephone: 040-247 8725 (if no answer: 040-247 3990)
E-mail: j.a.m.pulles@tue.nl

Study Advisor in Twente

Ir. M.J.B. (Monique) Duyvestijn
Room: Horst BH-111
Telephone: 053-489 3456
E-mail: m.j.b.duyvestijn@utwente.nl

Examination Committees at the three locations

Board of Examiners CME in Delft

Members of the Board of Examiners CME in Delft:

- Chair: Dr.ir. G.G. Drijkoningen
- Vice-chair: Dr. E. Mostert
- Member: Dr.ir. L.H.M.J. Lousberg (CME)
- Member: Dr.ir. G.A. van Nederveen (CME)
- Member: Dr. P.G. Ditmar
- Member: Dr.ir. D.J.M. Ngan-Tillard
- Member: Dr. V.L. Markine
- Member: Dr.ir. D.A. Koleva
- Member: Dr. R.M.P. Goverde
- Member: Dr.ir. O. Morales Napoles
- Member: Dr.ir. M. Kroesen
- External Member: Dr.ir. E. van Kampen
- Secretary: B. Zaaijer, LL.M.

Examination Committee in Eindhoven

Members of the Examination Committee in Eindhoven:

- Chair: Prof.dr. B.J.F. Colenbrander
- Vice-chair: Dr. Q. Han (CME)
- Member: Dr. T. Feng
- Member: Dr. ir. G.I. Curulli
- Member: Dr. ir. M.G.L.C. Loomans
- Ir. B.W.E.M. Hove
- External member (Dep. Industrial Design): Prof. dr. ir. J.B.O.S. Martens
- Academic advisor: Mrs. J.A.M. Pulles (CME/GS)
- Academic advisor: Mrs. J.H. Steetskamp (BC)
- Academic advisor: L. Kamphorst Msc
- Secretary: G.L.C. Bruinewoud-Klaessen

Examination Committee in Twente

Members of the Examination Committee in Twente:

- Prof.dr.ir. A.G. Doree (chairman)
- Ing. K.M. van Zuilekom (secretary)
- Prof.dr.ir. T.H. van der Meer
- Ir. J.P. Boutkan (Province of Overijssel)
- Dr. J.T. Voordijk (matters concerning the master's programme Construction Management and Engineering)
- Dr. ir. M.J. Booij
- Drs. E. Ruijgh (registry)

Education Committees at the three locations

Board of Studies CME in Delft

Members of the Board of Studies CME in Delft:

- Chairman: Dr.mr. F.A.M. Hobma
- Member: Dr. E.J. Houwing
- Member: Dr. M. Leijten
- Student member: Mr. S. de Metz
- Student member: Ms. F.G.M. Batelaan
- Student member: Mr. D.A.H. Dingelstad
- Secretary: E. van der Kruk

Education Committee in Eindhoven

Members of the Education Committee in Eindhoven:

- Chairman: Dr.ir. S.P.G. Moonen (SED)
- Member: Dr. Q. Yu (BPS)
- Member: Mrs S.S.S. Rousseau,Arch. D.P.L.G (USRE)
- Member: Dr. D. Yang (CME)
- Member: Ing. J.P.F.A. Snijders (AUDE)
- Student member: Ms J. Zhai (CME/Of CoUrsE!)
- Student member: Ms F. Heuver(Cheops)
- Student member: Ms B. van de Laar (Cheops)
- Student member: Ms D. Kerindongo (Koers)
- Student member: Mr. M. van de Mheen (AnArchi)
- Student member: Mr B. Turk (BPS/Mollier)
- Secretary: Mrs F.M. Clijsters (VRT 2.08) f.m.clijsters@tue.nl - 040-2472711

Education Committee in Twente

Members of the Education Committee in Twente:

- Chairman: Prof.dr.ir. K.T. Geurs
- Member: Dr.mr.ir. M. van Buiten
- Member: R. Wang, PhD
- Member: Dr. ir. F. Vahdatikhaki
- Member: Dr. ir. E.M. Horstman
- Student member: S.H. van Brenk
- Student member: A. Garcia Gonzales
- Student member: T.R. Bralts
- Student member: B. Pluister
- Student member: R. Roussev
- Advisor: M. Hamhuis
- Advisor: Dr. ir. D.C.M. Augustijn
- Advisor: L. Janssen
- Secretary: Drs. E. Ruijgh

Study Associations at the three locations

Study Association in Delft

CME Dispuut
Building 23, Room 6.70
Postbus 5048
2600 GA Delft

Location
Stevinweg 1, Building 23, Room 6.70
Phone: +31 15 27 85012
E-mail: info@cmedispuut.nl
Website: www.cmedispuut.nl

Study Association in Eindhoven

Study Association of CoUrsE!
Vertigo floor 8
Postbus 513
5600 MB Eindhoven

Location
Vertigo floor 2
De Zaale
Telephone: 040 247 5025
E-mail: info@ofcoursecme.nl
Website: www.ofcoursecme.nl

Study Association in Twente

Study Association ConcepT
Horst (basement) C-016 and C-018
Postbus 217
7500AE Enschede

Location
Horst (basement) C-016 and C-018
Drienerlolaan 5
Phone: 053 489 3884
E-Mail: ConcepT@ConcepT.utwente.nl
Website: www.concept.utwente.nl

Alumni Associations at the three locations

Alumni Association in Delft

CME Dispuut
Building 23, Room 6.70
Postbus 5048
2600 GA Delft

Location
Stevinweg 1, Building 23, Room 6.70
Phone: +31 15 27 85012
E-mail: info@cmedispuut.nl
Website: www.cmedispuut.nl
LinkedIn: www.linkedin.com/groups/CME-Alumni-3663314

Alumni Association in Eindhoven

Association for Construction Managers and Engineers (ACME)
Vertigo Vloer 9
Postbus 513
5600 MB Eindhoven

Email: acmeeindhoven@gmail.com
Telnr.: 040 247 2373
LinkedIn: https://www.linkedin.com/groups/126804

Alumni Association in Twente

Alumni Association ConcreeT
p/a Alumni bureau Universiteit Twente
Postbus 217
7500 AE Enschede

Email: concreet@utwente.nl
Website: https://www.concept.utwente.nl/praktijk/concreet
LinkedIn: www.linkedin.com/groups/55115

COMPULSORY COURSES AT THE THREE CME LOCATIONS

The study programme is composed as follows:

a. Core programme (compulsory courses), 30 - 56 EC
b. Specialism-related courses and electives, 28 - 50 EC
c. Graduation work, 36 – 40 EC

CORE CURRICULUM: COMPULSORY COURSES IN DELFT (42 OR 43 EC)

Course Code	Name	Period	Responsible lecturer	EC
AR8003TU	Legal and Governance	1	Dr.mr. F.A.M. Hobma	5
CME2300	Financial Engineering	1	Dr. D.F.J. Schraven	4
CME4200	Intercultural Relations	1	Dr.ir. B. Enserink	2
CME4300	Engineering Asset Management	1	Prof.dr.ir. A.R.M. Wolfert	5
CME1201	Collaborative Design and Engineering	2	Prof.dr.ir M.J.C.M. Hertogh	5
CME4000	Project Management	2	Dr. M. Leijten	6
CIE4130	Probabilistic Design	2	Dr.ir. R.C. Lanzafame	4
CIE4120	Information Systems for the Construction Industry	3	Dr.ir. G.A. van Nederveen	4
CIE4030	Methodology for Scientific Research	4	Prof.dr.ir. H.E.J.G. Schlangen	3
Ethics Course: (choose at least one out of:)				
WM0376TU	Ethics of Technological Risk	1	Prof.dr. S. Roeser	5
WM0312CIE	Philosophy, Technology, Assessment and Ethics	4	Dr. S.M. Copeland	4
TPM003A	Water Ethics	4	Prof.dr.mr.ir. N. Doorn	5
CIE4510	Climate Change: Science and Ethics	2	Dr. M. Vizcaino	4

COMPULSORY COURSES IN EINDHOVEN (30 EC)

Course Code	Name	Period	Responsible lecturer	EC
1CM900	Project Management	2	S.U.K. Rohmer	2.5
1ZM65	System Dynamics	3	Dr.ir. B. Walrave	5
7ZM8M0	Collaborative Design	3	Prof.dr.ir. B. de Vries	5
7ZM3M0	Case Study Process Modelling	1	Dr. Q. Han	2.5
7ZM5M0	Process Modelling & Information Management	4	Dr. Q. Han	5
7ZZ9M0	Design Science Methodology and Systems Engineering	1	Prof.dr.ir. B. de Vries	5
7ZZ6M0	Legal & Governance Aspects	1	Prof.dr.ir. B. de Vries	5

COMPULSORY COURSES IN TWENTE (30 EC)

Profile Markets & Organization of Construction

Course Code	Name	Period	Responsible lecturer	EC
201800040	Research Methodology and Academic Skills	2	Dr.sc.techn. A. Hartmann	5
Profile courses (minimum 30 EC including compulsory courses)				
201900107	Legal & Governance Aspects	1	Dr. P.J. Klok	5
201800072	Planning and Process management	1	Prof.dr.ing. K.T. Geurs	5
201800043	Sustainability and Circularity in Civil Engineering	1	dr. S. Bhochhibhoya	5
201800047	Construction Industry Dynamics	2	prof.dr.ir. A.G. Doree	5
201800029	Construction Process Management	2	dr.ir. W. Tijhuis	5
201800032	Systems Engineering in Construction	3	dr.ir. R.S. de Graaf	5
201800034	Infrastructure Asset Management	4	dr. A. Hartmann	5

Profile Digital Technologies in Construction

Course Code	Name	Period	Responsible lecturer	EC
201800040	Research Methodology and Academic Skills	2	Dr.sc.techn. A. Hartmann	5
Profile courses (minimum 30 EC including compulsory courses)				
201900107	Legal & Governance Aspects	1	Dr. P.J. Klok	5
201800072	Planning and Process management	1	Prof.dr.ing. K.T. Geurs	5
201800047	Construction Industry Dynamics	2	prof.dr.ir. A.G. Doree	5
201800029	Construction Process Management	2	dr.ir. W. Tijhuis	5
201800032	Systems Engineering in Construction	3	dr.ir. R.S. de Graaf	5
201800044	Digital Technologies for Civil Engineering	3	prof.dr.ir. A.M. Adriaanse	5
201800052	Technology and Innovation in Road Construction	4	dr. S.R. Miller	5

OVERVIEW OF THE COURSES IN DELFT

CORE CURRICULUM: COMPULSORY COURSES IN DELFT

Course Code	Name	Period	Responsible lecturer	EC
AR8003TU	Legal and Governance	1	Dr.mr. F.A.M. Hobma	5
CME2300	Financial Engineering	1	Dr. D.F.J. Schraven	4
CME4200	Intercultural Relations	1	Dr.ir. B. Enserink	2
CME4300	Engineering Asset Management	1	Prof.dr.ir. A.R.M. Wolfert	5
CME1201	Collaborative Design and Engineering	2	Prof.dr.ir M.J.C.M. Hertogh	5
CME4000	Project Management	2	Dr. M. Leijten	6
CIE4130	Probabilistic Design	2	Dr.ir. R.C. Lanzafame	4
CIE4120	Information Systems for the Construction Industry	3	Dr.ir. G.A. van Nederveen	4
CIE4030	Methodology for Scientific Research	4	Prof.dr.ir. H.E.J.G. Schlangen	3
Ethics Course: (choose at least one out of:)				
WM0376TU	Ethics of Technological Risk	1	Prof.dr. S. Roeser	5
WM0312CIE	Philosophy, Technology, Assessment and Ethics	4	Dr. S.M. Copeland	4
TPM003A	Water Ethics	4	Prof.dr.mr.ir. N. Doorn	5
CIE4510	Climate Change: Science and Ethics	2	Dr. M. Vizcaino	4

Specialisation: Engineering & Systems

Course Code	Name	Period	Responsible lecturer	EC
CIE4481	System Engineering Management	3	Prof.dr.ir A.R.M. Wolfert	4
CME4500	Engineering Systems Optimisation	4	Dr. M. Nogal Macho	4
SPM9448	Methods for Risk Analysis and Management	4	Prof.dr. G.L.L.M.E. Reniers	5
Choose one out of:				
CME4700	Operations Management for Construction	2	Dr.ir R. Binnekamp	4
EPA1316	Introduction to Data Science	1	Dr. T. Verma	5
SEN9235	Game Design Project	1	Dr.ir. G. Bekebrede	5

Specialisation: Projects & People

Course Code	Name	Period	Responsible lecturer	EC
CME4100	Process Management	3	Dr. M. Leijten	5
CME2201	Dynamic Control of Projects	4	Dr.ir. M.G.C. Bosch-Rekveldt	4
SPM9448	Methods for Risk Analysis and Management	4	Prof.dr. G.L.L.M.E. Reniers	5
Choose one out of:				

CME5000-19	Procurement of Complex Projects	3	Dr.ir. A. Straub	4
CIE5981	Forms of Collaboration	1	Prof.dr.ir M.J.C.M. Hertogh	4

Specialisation: Design & Integration

Course Code	Name	Period	Responsible lecturer	EC
CME4100	Process Management	3	Dr. M. Leijten	5
AR2RO25	Urban (re)Development Game	4	Dr.ir. M. Nogal	10
CME4400	Entrepreneurial Engineering	4	Dr. D.F.J. Schraven	4

General electives

Course Code	Name	Period	Responsible lecturer	EC
CME4600	Leadership & Strategic Management	4	Prof.dr. P.W.C. Chan	4
WM0201TU	Technical Writing	1,2,3,4	Drs. M. Bliekendaal	2
Choose at most one out of:				
CME2100-11	Research Internship	1,2,3,4	Dr.ir. M.G.C. Bosch-Rekveldt	10
CIE4061-09	Multidisciplinary Project	1,2,3,4	Ir. T.J. Zitman	10
TUD4040	Joint Interdisciplinary Project	1	Prof.dr.ir. J. Hellendoorn	10

Graduation Thesis

Course Code	Name	Period	Responsible lecturer	EC
CME5100	CME Master Thesis Preparation	1,2,3,4	Ir. J.S. Hoving	5
CME5200	CME Master Thesis	1,2,3,4	Ir. J.S. Hoving	30

Legal and Governance	
Responsible lecturer:	Dr.mr. F.A.M. Hobma
Course code:	AR8003TU
Period:	1
ECTS:	5

Course description:

This course is about legal & governance aspects of the construction process, especially the institutional legal & framework settings concerning the major players and the main interests concerned.

Legal aspects mainly rest in limitations and possibilities created by the legal system, as a context for interactions within and across the public and the private sector boundaries, during the complete life-cycle of the construction process. The relevant legal and institutional frameworks and their underpinnings will be explained and analysed and put into the perspective of 'real-life' problems. Insight into legal reasoning, as a specific methodology, will be practised through the use of legal literature and jurisprudence.

The main course topics will deal with both public and private law. The place and position of the future graduate in the construction process will serve as a guideline in the selection of these topics.

Financial Engineering	
Responsible lecturer:	Dr. D.F.J. Schraven
Course code:	CME2300
Period:	1

ECTS:	4

Course description:

This course deals with the finance issues related to the implementation of civil engineering projects. It introduces economic engineering concepts and finance-related topics such as project financing and financial accounting. This course requires the student to study in detail:

- Finance and the firm, covering topics such as sources of finance, cost of finance, financial structures, working capital management and financial accounting.
- Capital Budgeting Decisions and Risk, covering topics such as Capital Budgeting, Political and Social factors, Portfolio Management and Risk Considerations.
- Project finance, covering topics such as international capital markets, stakeholder/actors viewpoints and cash flow modelling of projects including characteristics of typical projects like oil wells, open mining, infrastructure and office buildings.

Intercultural Relations	
Responsible lecturer:	
Course code:	CME4200
Period:	1
ECTS:	2

Course description:

This course introduces students to some theories on diversity and dimensions of national cultures as defined by Hofstede and others. Through role-playing games and exercises the students engage with the theory and reflect on their own intercultural experience and develop their cross-cultural sensitivity.
Departing from sociological and psychological theories on in-group/out-group this course will treat theories on national cultures and intercultural cooperation and takes a dynamic and multifaceted approach to culture as its starting point. The intention is to organize two serious games/training sessions for which participation is obligatory and a test at the end of the course.

After taking this course the student:
• Is able to point out the effects of globalization, realizes and recognizes the existence of different rationales, behaviours and cultures and is aware of cultural heterogeneity.
• Can apply the TOPOI model to assess and address the impact of these differences on interpersonal and intergroup interactions.
• Can discover and discuss cultural dimensions in given social/organisational phenomena and events.
• Demonstrates cultural awareness by developing an appropriate attitude towards cross-cultural collaboration and communication in given cultural contexts.
Education Method
• Two intensive half-day small-group training sessions, consisting of role-play games.
• Blended classroom, pre-supposing self-study of the obliged and recommended materials: video clips, literature and popular articles offered in Brightspace.

Engineering Asset Management	
Responsible lecturer:	Prof.dr.ir. A.R.M. Wolfert
Course code:	CME4300
Period:	1
ECTS:	5

Course description:
Engineering Asset Management (EAM) is a holistic approach to manage portfolios of assets, overarching the worlds of project management, construction management and operations management.

The alternative view within this course is to provide a integrative viewpoint on EAM where it is viewed as a balancing act between user demands, financial enablers and asset supplies to optimally provide quality of service.

In this course the following concepts are addressed:

1. The QoS concept (strategic planning & integration: systems thinking -zooming ; its role in the service provider organisation; relation EAM with different levels of DBMO in relation with PM and CM,);
2. QoS from User demand and from Asset supply perspective (dynamic service needs, and dynamic technology enablers);
3. Financing (OPEX, CAPEX, cash flow, NPxV, financial feasibility, capital planning and budget, LCC, EAC);
4. Environmental constraints (regulator, governmental, societal, ecological);
5. Managing your in service assets (knowing your assets, service logistics, contracting and outsourcing DBMO);
6. Engineering your in-service assets (engineer for Y's: the measures of performances; e=mscsquair);
7. Safeguarding your in-service assets (integral safety and security)

This course has a constructivist character, in which the student is guided and encouraged to develop open design knowledge & solutions ('openings') using the self-chosen Service Provider of Interest (SPoI) as a connective vehicle enabling the Open Design Learning (ODL) response. The SPoI can be managing transportation, water management, communication and/or energy infrastructure.

Collaborative Design and Engineering	
Responsible lecturer:	Prof.dr.ir M.J.C.M. Hertogh
Course code:	CME1201
Period:	2
ECTS:	5

Course description:
In this course, students learn how to collaborate in large multidisciplinary teams on an ill-defined engineering assignment. Each group has to deal with an overload of information that needs to be structured in the design process, in order to identify the underlying engineering problem and present a solution to a client in an effective and efficient way. During the course, students are taught how to identify bad team performance and its effect on the design process, and how to intervene. Students are introduced to the field of Group Dynamics in a series of three workshops

(Partnering Charter; Belbin-test; giving and receiving feedback) in the first half of the course. The outcomes of the workshops help students to organize the creation of joint deliverables: Partnering Charter, Project Management Plan, Phase I-report (analysis) and Phase II-report (design-solutions). Overall, students are exposed to an experience of intensive groupwork. Grading is based both on group and individual performance.

After the course, students have gained an understanding of how to personally navigate and streamline collaborative design processes in a complex environment. Collaborative skills include: knowing how to identify shared values in a large group by making a partnering charter; how to reflect on one's personal role and behavior in a group; and how to give and receive feedback. Moreover, students learn how to acknowledge and successfully deal with different forms of disciplinary knowledge in their group. Students are thus prepared for the realities of practice where engineering assignments tend to ill-defined in the early stages of a project, and multidisciplinary collaboration is a indispensable.

Project Management	
Responsible lecturer:	Dr. M. Leijten
Course code:	CME4000
Period:	2
ECTS:	6

Course description:

his course focuses on the project management of construction projects. Projects, in all contemporary industry sectors and specifically in construction, are becoming increasingly complex and challenging with the accelerated advances in technology, new business models, forms of collaboration, availability requirements, and an augmented demand to deliver economic value and a competitive advantage. Managing projects in this environment requires strong leadership skills and proficiency in project management knowledge and practice to be able to achieve the project and organizational objectives on time, on budget and to the satisfaction of stakeholders. The course is designed to provide students with scholarly knowledge in the practice of managing construction projects in order to enhance their career options and prepare them to move into management roles by developing their professionalism, versatility and leadership in an environment of constant change.

The course presents the foundations of project management, as well as more advanced academic analyses on the matter and has been developed primarily to understand the role of project management in construction. It provides an introduction to the methods and tools of project management and how they function in the process of constructing an asset. The course provides students with the knowledge necessary to understand how projects can be managed.

The curriculum follows the competencies required to move a project through its various stages. The course provides a thorough exploration of project management processes and tasks. These include:

- Project organisation
- Planning tasks and control strategies
- Contracts and procurement methods
- Communication and relationships between project stakeholders.
- Risk analysis and management

Probabilistic Design	
Responsible lecturer:	Dr.ir. R.C. Lanzafame
Course code:	CIE4130
Period:	2
ECTS:	4

Course description:
This course focuses on the characterization and assessment of safety for civil engineering structures using probabilistic methods. As such, the course contents include:

- Probability calculus: probability theory, random variables (discrete and continuous), functions of random variables, parametric distributions, Maximum Likelihood estimation, extreme value theory, multivariate probability distributions, dependence
- Risk analysis and evaluation: decision-making under uncertainty, individual and societal risk, economic optimization, safety standards
- Reliability analysis: Level I, II and III methods for evaluating reliability, time dependence, reliability of systems
- Design applications: design codes in civil engineering, target reliability levels, characterization of loads, strengths and effects

Information Systems for the Construction Industry	
Responsible lecturer:	Dr.ir. G.A. van Nederveen
Course code:	CIE4120
Period:	3
ECTS:	4

Course description:
Information Systems for construction Management (ISM) are part of the asset and construction management processes supported by various tools, technologies involving the generation and management of digital representations of engineering assets.

The alternative view within this course is to not only represent physical, and functional characteristics of the engineering asset (3D) but also represent so-called 'design for ty' information characteristics for the entire asset service life.

In this course the following concepts are addressed:

1. Building information modelling and design for ty's;
2. Geometric 3D computer modelling;
3. Constructability within information systems;
4. Maintainability within information systems;
5. Safety within information systems;
6. Sustainability within information systems;
7. ISM future outlook.

This course has a constructivist character, in which the student is guided and encouraged to develop open design knowledge & solutions (‘openings’) using the self-chosen Project of Interest (PoI) as a connective vehicle enabling the Open Design Learning (ODL) response. The PoI is either being constructed or already been constructed (must have passed the initial phase)

Methodology for Scientific Research	
Responsible lecturer:	Prof.dr.ir. H.E.J.G. Schlangen
Course code:	CIE4030
Period:	4
ECTS:	3

Course description:
This course is intended for students that would like to 'Design a Research Project". Additionally, it is a perfect preparation for your final project in your MSc.

The topics that will be presented in this course are:

- Defining research objectives
- Setting up a research framework
- Formulating research questions
- Different research concepts and strategies
- Various research material
- Planning your research
- Analysing your research results
- Reporting and presenting your research

The course is given using Online-lectures.

Ethics of Technological Risk	
Responsible lecturer:	**Prof.dr. S. Roeser**
Course code:	WM0376TU
Period:	1
ECTS:	5

Course description:
This course investigates ethical aspects of technological risks. Debates about technological risks related to, for example, energy technologies, robotics and biotechnology frequently culminate in stalemates. This is due to the complexities and intricacies inherent to such debates as they involve scientific information and uncertainties, as well as ethical and emotional considerations. Conventional, quantitative approaches focus solely on statistical information to risk. They do not incorporate important ethical considerations such as justice, fairness and autonomy. Emotions such as compassion, care and feelings of responsibility can draw attention to such ethical aspects of risky technologies. Taking emotions seriously can lead to more fruitful deliberations between different stakeholders in which relevant concerns are taken seriously and are explicitly reflected upon. This course will study how approaches to ethical aspects of risk can lead to more morally responsible decision making and design of technological innovations.

This course will provide students with an understanding of approaches to risk ethics and students will get experience with discussing and evaluating ethical aspects of risk.

Philosophy, Technology, Assessment and Ethics	
Responsible lecturer:	**Dr. S. M. Copeland**
Course code:	WM0312CIE
Period:	4
ECTS:	4

Course description:

This module explores philosophical and ethical questions in civil engineeirng, as well as providing a basic introduction into Technology Assessment.

After having completed the course you:
• know the basic philosophical issues in engineering knowledge;
• can better recognise and analyse ethical and social aspects and problems inherent in technology and in the work of professionals and managers active in the design, development, management and control of technology.
• have insight into how these ethical and social aspects and problems are related to legal, political and organisational backgrounds.
• are able to explore and assess possibilities for solving or diminishing existing and emerging ethical and social problems that attach to technology and the work of professionals and managers.
• are better prepared to perform your future work as a professional or manager in the design, development, production and control of technology in an ethical and socially responsible way.

Water Ethics	
Responsible lecturer:	**Prof. Dr. Mr.ir. N. Doorn**
Course code:	TPM003A
Period:	4
ECTS:	5

Course description:

Water is essential for life. While we can in principle survive weeks without food, without water, we would not survive more than a couple of days.

The aim of this course is to provide an introduction to philosophical water ethics. It will present the main philosophical issues in the water domain in a practical way by situating these issues within real cases. Questions addressed will include:
• Is it fair to drink water, knowing that the production of one cup of coffee requires 140 litres of water on average?
• Should we prioritize between different water uses, like agriculture, navigation, and recreation?
• Should we continue building hard flood defences at the expense of the environment?
• Should local citizens be given a voice in water-related decision making?
These and other questions will be linked to ongoing discussions in the relevant other disciplines within philosophy, most notably in ethics of technology, philosophy and ethics of risks, environmental ethics, climate ethics, and global justice.
This course will provide students with an understanding of approaches in water engineering and water policy. Students will get experience with discussing and evaluating ethical considerations in water engineering and water policy. Topics covered include: water and justice, water and economic valuation, water and human rights, water and responsibility, and water and engineering.

Climate Change: Science and Ethics	
Responsible lecturer:	**Dr. M. Vizcaino**
Course code:	CIE4510
Period:	2
ECTS:	4

Course description:

Climate change is one of the most profound and complex issues affecting our society and economy today. Many scientists argue that there are too many variable factors to effectively see the big picture, while other scientists who believe human activity is to blame for global warming are ready to outline specific actions to prevent more damage. Skeptics believe that climate change is part of the natural global progression and that human activity will neither worsen nor improve our situation.

Those who are in favor of a global effort to reverse climate change believe that current climate models are an useful tool to estimate future warming and argue that the uncertainty surrounding this threat is no excuse for inaction. Skeptics in turn argue that scientists who want to attract attention to themselves, who want to attract great funding to themselves, have found a way to scare the public by making things bigger and more dangerous than they really are. Despite continuing uncertainties about the detailed linkages, extreme weather events are increasingly being attributed to human interference, and greater emphasis is emerging on the need to prevent and to adapt to climatic changes.

The course provides an introduction to the basic physics of the climate system, how climate has changed in the past and how climate will change in the future. The focus in on the energy balance of the climate system and how this balance is affected by greenhouse gases and aerosols; the physical processes in the atmosphere and oceans that shape the climate; the response of the oceans, ice sheets and glaciers to global warming; the evidence for past and present climate change; climate models and model uncertainties; climate predictions.

A second focal point of the course is the broader societal and ethical aspects of climate change. In particular, we will focus on past emissions and responsibilities, implications of global warming on human safety and security, the distribution of burdens and benefits, emission rights, international justice and intergenerational justice.

Course descriptions of the specialisation electives can be found at studyguide.tudelft.nl

GRADUATION IN DELFT

Master Thesis, Preparation	
Responsible lecturer:	Ir. J.S. Hoving
Course code:	CME5100
Period:	1, 2, 3, 4
ECTS:	4

Course description:
Preparation for graduation; this involves drawing up a learning plan and completing a preparatory course of study or desk research, which will be recorded in a start report by using a research methodology. Used literature should be listed in a list of references.
Study Goals
Effectively formulation of a thesis subject and a plan to carry out the necessary preparatory studies.

Master Thesis	
Responsible lecturer:	Ir. J.S. Hoving
Course code:	CME5200
Period:	1, 2, 3, 4
ECTS:	32

Course description:
The Graduation Work consists of a graduation project, a thesis report, a summary of the report and a final presentation.

The Master's Thesis Project takes place at the end of the second year and covers a period of approximately half a year (32EC). Students have to carry out an individual project to round off the CME programme. The subject for the research project may be chosen in respect to, or independent from, a specific area of technology and possible elective profile, though students are stimulated to find some connectivity in their choices.

Within this project, students must demonstrate their capacity for academic analysis, synthesis, design, reflection and written communication on a particular issue in the field of management, engineering and policy analysis.

The student can start the Master's Thesis Project after at least two members of the thesis committee have approved the (draft) project proposal and the student has filled out the application form (MSc CME). This form is available at the CME Secretary Mrs. Sandra Schuchmann, Building 23 (CiTG), room 6.49.

The student starts with an orientation phase that will lead to a detailed Master Thesis Project Proposal. After 3 and before 5 weeks orientation the student presents during a kick-off meeting this Thesis Project Proposal to execute the CME Master thesis project. The Master Thesis Project Proposal should give information on the goal of the project, the main research/design question, a set of derived sub questions/goals that give meaning to the project, data to use/collect, methods planned to be used, and a detailed project planning. After a successful kick-off meeting the student may start with the actual execution of the Thesis Project.

Overview of the courses in Eindhoven

Compulsory courses in Eindhoven

Programme overview

	EC	Quartile
Core courses (30 ECTS)		
Project Management	2.5	2
System Dynamics	5	3
Process Modelling and Information Management	5	4
Case Study Process Modelling	2.5	1
Collaborative Design	5	3
Design Science Methodology and Systems Engineering	5	1
Legal and Governance Aspects	5	1
Specialisation electives (35 ECTS out of 50 ECTS)		
Urban Research Methods	5	3
Smart Urban Environments	5	2
Fundamentals of BIM	5	2
Technology Entrepreneurship	5	2
Entrepreneurial Marketing	5	2
Built Environment and Smart Mobility	5	4
Research and Development Project	10	1,2,3,4
Big data for urban analysis	10	3,4
Urban Planning II	5	1
Free Electives course (15 ECTS)		
All 4TU-CME MSc-courses offered by TU/e, TUD, UT	15	
Graduation CME incl. Research proposal (40 ECTS)	**40**	**1,2,3,4**

Internship USRE/CME Relevant Work Experience	
Responsible lecturer:	Ir. A.W.J. Borgers
Course code:	7ZRWE0
Period:	**1, 2, 3, 4**
ECTS:	**5**
Course description: The internship Relevant Work Experience can be one of the electives in the student's personal study plan. It allows the student to acquire some experience in one of the fields related to the built environment.	

Internship USRE/CME Academic Work Experience	
Responsible lecturer:	Ir. A.W.J. Borgers
Course code:	7ZAWE0
Period:	**1, 2, 3, 4**
ECTS:	**15**

Course description:
To be specified in the Internship Plan. The learning objectives must be described on MSc-level and must lead to an academic attitude.
The learning objectives must:
be relevant for the development as a starting professional in the field of the Built Environment.
fit into the personal study plan of the student.

To establish the contents a choice must be made for:

- a type of internship and
- a connection with the unit's research program and/or
- a connection with one of the university's strategic areas and/or
- a connection with one of the themes of the department.

See the scheme below:

Possible characteristics of the Internship			
Type of internship	Design	Research	Combination
Research Program (Unit)	Design and Decision Support Systems		
Strategic Area (TU/e)	Energy	Smart Mobility	Health
Theme (Department BE)	Quality of Life	Smart Living Environments	Sustainable Transformation

Case Study Process Modelling	
Responsible lecturer:	Dr. Q. Han
Course code:	7ZM3M0
Period:	1
ECTS:	2.5

Course description:
After the project, the student is able to:

Identify the involved stakeholders' interests
Specify the process phases
Apply appropriate qualitative methods for analysis (e.g., Isikawa diagram, stakeholder power/interest grid, SWOT, creating action plan, etc.)
Identify strengths and weaknesses of the process
Provide recommendations for process improvement
Write an academic report

Content
Executing analysis for the process of a complex development project in the context of Construction Management and Engineering.

At first a real complex development project challenge is identified. The information related to the project is introduced by the involved company, students are required to use appropriate methods for analysis.
Next, students are required to search all the necessary information online with similar projects and use appropriate methods for comparison analysis and draw conclusions.
The case study focuses more on the soft side of the process in terms of understanding the nature of interaction between involved stakeholders and decision making on projects within an uncertain and dynamic social, political and physical environment

Project Management	
Responsible lecturer:	S.U.K. Rohmer
Course code:	1CM900
Period:	2
ECTS:	2.5

Course description:
The course comprises the following topics: Planning work activities, costs and budgets, activity scheduling (PERT/CPM), resource allocation, and project execution (information requirements and control).
After the course, students are able to:

- characterize a project aiming at the realization of a physical product in terms of the dynamics, the variability and the stochasticity of the project targets, the activities be performed and their precedence relationships. The available resources and the time cost budget constraints.
- analyse the possible result of a project as function of its targets, its activities and the deployment of resources over time.
- evaluate the possible contribution of advanced decision making methods to improvements in project performance

System Dynamics	
Responsible lecturer:	Dr.ir. B. Walrave
Course code:	1ZM65
Period:	3
ECTS:	5

Course description:
In the first part, the course deals with a variety of subjects related to systems thinking, like: policy resistance, positive and negative feedback, bounded rationality, misperceptions of feedback, fundamental modes of dynamic behaviour (exponential growth, oscillation) and causal loop diagramming. In the second part, the course focuses on system dynamics modelling, by dealing with stocks and flows diagramming, the mathematical relation between stocks and flows (integration and differentiation), delays, modelling human behaviour and modelling supply chains. Also, students will perform a group assignment in which a system dynamics model is developed based on a case description of business processes. With this model, students will replicate the behaviour of the business processes, understand the causes of this behaviour, and simulate scenarios to improve the performance of these processes.

Design Science Methodology and Systems Engineering	
Responsible lecturer:	Prof.dr.ir. B. de Vries
Course code:	7ZZ9M0
Period:	1
ECTS:	5

Course description:
Introduction of Design Science Methodology and Systems Engineering theory and principles in the context of the construction sector. Design Science Methodology (DSM), Systems Engineering (SE) and Building Information Modelling (BIM) tools are practiced in individual assignments and the theory is tested in an exam.

Process Modelling & Information Management	
Responsible lecturer:	Dr. Q. Han
Course code:	7ZM5M0
Period:	4
ECTS:	5

Course description:
The student will learn how to construct mathematic models to model and analyze the problems in the development projects, and optimize the process and manage the information flow in the context of urban development.

Content
The following topics will be dealt with:
Information management tools in building process
Geo-process models
Interactive Decision making, decision making under uncertainty, and optimization models

Legal & Governance	
Responsible lecturer:	Prof.dr.ir. B. de Vries
Course code:	7ZZ6M0
Period:	1
ECTS:	5

Course description:
This course is about legal & governance aspects of the construction process, especially the institutional legal & framework settings concerning the major players and the main interests concerned.

Legal aspects mainly rest in limitations and possibilities created by the legal system, as a context for interactions within and across the public and the private sector boundaries, during the complete life-cycle of the construction process. The relevant legal and institutional frameworks and their underpinnings will be explained and analysed and put into the perspective of 'real-life' problems. Insight into legal reasoning, as a specific methodology, will be practised through the use of legal literature and jurisprudence.

The main course topics will deal with both public and private law. The place and position of the future graduate in the construction process will serve as a guideline in the selection of these topics.

This course will be assessed by means of a written exam (75%) and assignments (25%).

Collaborative Design	
Responsible lecturer:	Prof.dr.ir. B. de Vries
Course code:	7ZM8M0
Period:	3
ECTS:	5

Course description:
The objective of this course is to gain insight in the problem domain of Collaborative Design with special attention to Systems Engineering (SE) and Building Information Models (BIM).

A consortium of companies will work on a design assignment for one semester. A student is member on one of the following companies: Architects, Urban designers, and Engineers. A company consists of 4 persons with one person as Chief Executive Officer (CEO), one Systems Engineering Officer (SEO) and the other two as domain experts. The consortium management consist of all CEOs and SEOs from all companies. CEO and SEO will swap roles with the two other persons halfway the project. The project starts with writing a project management plan. Following the design is created between the companies while monitoring and evaluating the progress. In this process the application of SE and BIM techniques and tools is compulsory. Consortium management is tutored by the teachers in weekly sessions. Finally the design is presented and reports are written about the design product and process.

Specialisation Electives in Eindhoven

Urban Research Methods	
Responsible lecturer:	Prof.dr. T.A. Arentze
Course code:	7ZW7M0
Period:	3
ECTS:	5

Course description:
In this course students learn core research and evaluation methods for urban planning/management. The focus is on quantitative methods and evaluation techniques. Research methods are relevant in the first stages of the decision process where the aim is to generate knowledge about a problem or possible actions. Evaluation techniques are relevant in the last stage where the aim is to determine a preference ranking of action alternatives. The techniques are explicitly positioned in a decision process model.
The course consists of a series of lectures and literature study. Each lecture is complementary to the literature studied and accompanied by a practical exercise where the students apply the theory to a case.

Technology Entrepreneurship	
Responsible lecturer:	Dr. A.S.A. Bobelyn
Course code:	1ZM20
Period:	2
ECTS:	5

Course description:
The aim of this course is to develop your awareness, understanding and application of flexible and adaptive decision-making approaches along with more familiar prediction and planning-based methods for decision making in the face of uncertainty in new business development based on new technology.
The main deliverables in the course are focused on identifying and testing the key factors that help you decide if a (technology based) idea is a real opportunity and validate and adjust the idea in the market. Therefore, identifying, defining, and understanding the market and all relevant stakeholders is a cornerstone of the course. Equally important, however, is investigating whether the idea is an opportunity for you. To answer that, you need to understand who you are and what you want, particularly in relation to the idea and the decision making process needed to further develop this idea. This course is designed to help you do that through a thoughtful and active exploration of the decisions you will make and the experiences you will encounter in pursuing an idea to its fulfillment.

Entrepreneurial Marketing	
Responsible lecturer:	Dr.ing. J.P.M. Wouters
Course code:	1ZM120
Period:	2
ECTS:	5

Course description:
This course:
- Provides knowledge of how to bridge the marketing discipline and the entrepreneurial field
- Provides guidelines and tools to deal with entrepreneurial side of marketing
- Provides guidelines and tools to deal with the marketing side of entrepreneurship

Topics in this course are the introduction to marketing-entrepreneurship interface, the technology adoption life cycle (TALC), and the entrepreneurial marketing plan.

Built Environment and Smart Mobility	
Responsible lecturer:	Prof. dr. S. Rasouli
Course code:	7ZW4M0
Period:	4
ECTS:	5

Course description:
This course deals with analysing the interdependencies between transportation and various aspects and components of urban systems. Application of models to support transport-related design and decision processes in urban design, planning, real estate and transportation, considering:
- The complex interdependencies involved
- Effects on the environment, functioning of the system and quality of life
- Uncertainties in model applications, data and scenarios.

Research and Development Project	
Responsible lecturer:	Dr. G.Z. Dane
Course code:	7ZM1M0
Period:	1,2,3,4
ECTS:	10

Course description:
Executing a Research and Development project for a specific case in the context of Construction Management and Engineering and/or Design Systems. To reach the goal, research and development methods/techniques are selected that are not yet known by the student, but are relevant for the student's education. These methods/techniques are state-of-the-art in DDSS research. Design Systems Lab facilities are available to support experiments. With support from the staff these new methods/techniques are learned by doing. The results are tested against the predefined criteria. Finally a scientific report is written that reflects upon the achieved results.

Smart Urban Environments	
Responsible lecturer:	Dr.ir. A.D.A.M. Kemperman
Course code:	7ZW5M0
Period:	2
ECTS:	5

Course description:
Cities are booming and constitute the heart of economic and cultural developments. At the same time, threats of the quality of living environments ask for smart solutions in areas such as mobility, health and energy. In this course, new perspectives offered by emerging technologies and research are addressed. The course considers current issues in urban development (smart cities, healthy cities, smart grids) and links these issues to new approaches in urban analysis and decision support (big data).

Project Big Data for Urban Analysis	
Responsible lecturer:	Dr.ir. A.D.A.M. Kemperman
Course code:	7ZW1M0
Period:	3,4
ECTS:	10

Course description:
To find good solutions one need to have a good understanding of the problem. This holds true also for the problems urban planners are facing in areas such as mobility (congestion and accessibility), health (air pollution, passive life styles), energy (smart grids and transformation to renewable sources of energy) and ageing (social exclusion, social satisfaction).
In this project students consider a planning problem of their choice and apply an approach to better understand the problem and evaluate scenarios.
- The first method (A) is the stated preference/choice approach and can be used for measuring individuals' preference and choice behaviour for new, not yet existing, alternatives.
- The second approach (B) uses information from a big database such as GPS data or one of the large national surveys, such as OVIN and WOON.

Fundamentals of BIM	
Responsible lecturer:	Dr. P. Pauwels
Course code:	7M900
Period:	2
ECTS:	5

Course description:
This course is of importance to everyone applying building information technologies in practice, developing novel ways to address current and future challenges in ICT-supported collaboration in building and construction and doing fundamental research in the field. In order to model such information, the student learns to model using tools like the visual modelling language UML (Unified Modelling Language). UML is used as the "stepping stone" to translate data models created by other diagram techniques. The student learns to read and to interpret such models created with different diagraming techniques. The student also learns to read and created models as a basis for new insights.

Urban Planning II	
Responsible lecturer:	Ir. A.W.J. Borgers
Course code:	7ZW3M0
Period:	1
ECTS:	5

Course description:

This course is about planning of retail and public facilities in urban areas. It also deals with population and housing demand forecasting and predicting the development of urban areas.

The course starts with a short introduction into spatial planning in the Netherlands and Europe. The next part deals with planning retail facilities and public facilities, both in terms of supply and demand. Retail facilities will be discussed at the level of urban areas and at the level of shopping centres. Small groups of students compare and assess facilities in different urban areas. The last part of the course is about predicting the development of urban areas. Methods to predict the size and composition of the future population and the corresponding housing demand, as well as so called land use models are introduced. Students will gain experience with such methods and models.

Graduation in Eindhoven

Graduation Project	
Responsible lecturer:	Prof.dr.ir. B. de Vries
Course code:	7CC40
Period:	1,2,3,4
ECTS:	40

Course description:

The MSc. Education program `Construction Management & Engineering (CME) at TU/e is a joint international Master-program of the three Dutch Universities of Technology. At TU/e the graduation specialization of CME is focused on Smart Cities. The final graduation project has a clear scientific signature, and is grounded in actual Smart Cities challenges. CME graduation projects are often executed in collaboration with industry partners, engineering offices or government institutes. TU/e CME borrows from two scientific domains: (i) urban/building science and systems and (ii) management and innovation sciences.

Graduation options

The graduation project is executed on the cross of the two aforementioned scientific domains. Within this cross section students can choose from a list of subjects that are strongly related to on-going projects in the TU/e departments Built Environment (BE), and Industrial Engineering and Innovation Sciences (IE&IS). In the CME program, the following smart cities topics are offered:

Energy Neutral Cities

Urban Management

Building Information Management

Graduation consists of two parts: (1) Research proposal and (2) Graduation project. A student can only start his/her Graduation project after the Research proposal has been approved by the chair of the graduation committee.

Each graduation project will be guided by a group of specialized (assistant and associate) professors, preferably from both TU/e departments BE and IE&IS. The students work individually, while their projects concur with research themes related to research and development activities of the involved staff and PhD's.

During the graduation project students will learn to make scientific analyses for complex technical and/or managerial problems. They can model these problems using state-of-the-art modelling techniques and their knowledge on technical systems, urban environment and management theories. The students are skilled in scientific publication of the problem analyses and model outcome and they can present of the results to a wide audience.

OVERVIEW OF THE COURSES IN TWENTE

PROGRAMME OVERVIEW

Profile: Markets and Organization in Construction	**Profile: Digital Technologies in Construction**
Profile courses minimum 30 EC	**Profile courses minimum 30 EC**
- Research Methodology & Academic Skills - Planning and Process Management - Legal & Governance Aspects - Sustainability and Circularity in Civil Engineering - Construction Industry Dynamics - Construction Process Management - Systems Engineering in Construction - Infrastructure Asset Management	- Research Methodology & Academic Skills - Planning and Process Management - Legal & Governance Aspects - Construction Industry Dynamics - Construction Process Management - Systems Engineering in Construction - Digital Technologies for Civil Engineering - Technology and Innovation in Road Construction
Elective profile courses	**Elective profile courses**
- Construction Supply Chains and Digitization - Experiments in Water Infrastructure - Procurement Strategies and Tendering - Infrastructure Maintenance Machines - Value Management - Culture in Construction (2019-2020) - Governing Product development (IDE) - Maintenance Engineering and Management (ME) - Product Life Cycle (IDE) - Scenario based product design (IDE) - Cost Management and Engineering (IEM) - Product Life Cycle Management (IDE) - Reliability Engineering & Maintenance Mgmt. (IEM) - Design for Maintenance Operations (IDE) - Advanced 3D Modelling (IDE) - Supply Chain Finance (IEM) - Virtual Reality (IDE)	- Sustainability and Circularity in Civil Engineering - Construction Supply Chains and Digitization - BIM and 5D Planning - Simulation and Optimization of Construction Processes - Value Management - Subsurface Infrastructure Engineering - Infrastructure Maintenance Machines - Infrastructure Asset Management - Simulation (IEM; follow-up of Module 8 CiT/TBK) 191820210 - Maintenance Engineering and Management (ME) 201200146 - Product Life Cycle (IDE) 192850740 - Scenario based product design (IDE) 192850810 - Cost Management and Engineering (IEM) 194110140 - Product Life Cycle Management (IDE) 192850750 - Reliability Engineering & Maintenance Mgmt. (IEM) 191852630 - Design for Maintenance Operations (IDE) 201500235 - Advanced 3D Modelling (IDE) 201500518 - Supply Chain Finance (IEM) - Virtual Reality (IDE) 201000201
Electives (maximum 15 EC) - Any course from UT or approved other university*	
Thesis (35 EC) - Preparation MSc-thesis (5 EC) - MSc-Thesis Project (30 EC)	

* an "approved university" is any university in The Netherlands (not HBO-schools), or any international university that is partner of the UT or of the faculty of Engineering Technology
For a list of partner universities, see: https://www.utwente.nl/ctw/student-mobility/partners/
For courses from other universities: contact your track-coordinator.
The Free Electives should be at MSc-level and should have no overlap with other courses in your programme.

COMPULSORY COURSES IN BOTH DOMAINS

Research Methodology & Academic Skills	
Responsible lecturer:	Dr. A. Hartmann
Course code:	201800040
Period:	2
ECTS:	7,5/5

Course description:
While working on assignments/projects or their master thesis many students face the challenge to define a research problem, design a research strategy, and execute the research plan. In these assignments the students often have to relate a real world problem to theory and literature from the field of construction management and engineering to come up with valid conclusions and practical recommendations.
The main aim of the course is to prepare the students for tasks/jobs where (research) reports need to be assessed or produced (in a wider sense). It is all about arguments, data, theory and proof, requires skills and competences in reasoning, research, data gathering, analysis and formulation of problems and account of results.

PROFILE COURSES

Legal & Governance Aspects	
Responsible lecturer:	dr. P.J. Klok
Course code:	201900107
Period:	1
ECTS:	5

Course description:
This course is about legal & governance aspects of the construction process, especially the institutional legal & framework settings concerning the major players and the main interests concerned. The main course topics will deal with both public and private law. The place and position of the future graduate in the construction process will serve as a guideline in the selection of these topics.

The course consist of a legal & governance part. The legal part is divided into a private and public law part. The public law part concentrates on principles of spatial regulation on national, provincial and municipal level. The private law part concentrates on procurement proceedings, contracting and responsibility and assurance matters in the field of the construction industry.
The governance part concentrates on describing and analysing markets, hierarchies and networks as governance modes in the construction sector. Special attention is given to the relations between governmental actors and the actors in the construction sector.

Planning & Process Management	
Responsible lecturer:	Prof.dr.ing. K.T. Geurs
Course code:	201800072
Period:	1
ECTS:	5

Course description:

This course focuses on (transport) infrastructure planning and process management of major infrastructure projects and area developments. Current developments in cities realities force authorities to plan, manage and monitor their transport and infrastructure systems more accurately, for example to take into account the requirements of a growing number of complex and sometimes conflicting interests like congestion relief, pollution reduction, efficient resource use, equity and accessibility.

This course has two main elements:

1. Strategic Transport Infrastructure Planning: students review and discuss the strengths, limitations and weaknesses of state of the practice strategic transport policy and transport planning frameworks.
2. Process Management: this part aims at providing students with basic concepts, skills, and insights needed to understand the nature of interaction between actors regarding the initiation and development of complex large-scale construction projects.

Sustainability and Circularity in Civil Engineering	
Responsible lecturer:	dr. S. Bhochhibhoya
Course code:	201800043
Period:	1
ECTS:	5

Course description:

This course addresses sustainability of the civil infrastructure and built environment in a broad sense with attention for economic, environmental and social aspects as well as for resilience and circularity. Sustainability is achieved when the whole society has the capacity and opportunity to maintain and improve its quality of life without degrading the quantity, quality and availability of economic, environmental and social capital.

Resilience and circularity play an important role in achieving sustainability. Resilience can be defined as the ability of a system to preserve and sustain the operation of critical functions under conditions of chronic stress or shocks. Resilience is under pressure as human-based modifications to the natural system have led to an increase of the frequency and magnitude of stressors and shocks, such as, sea level rise, extreme weather events or landslides, whereas urbanization has led to the clustering of infrastructure, population and capital.

With the increasing evidence of global warming due to greenhouse gas emissions and the reduced availability of natural resources, the pressure to create regenerative systems where waste, emission and energy leakage is minimized has become increasingly important. Circular economy models are therefore important elements to consider as well. In this context, civil engineers need to be armed with skills than enable them to develop and apply ways, means, and methods to study and analyze the construction and management processes of civil engineering infrastructure towards improving their sustainability, resilience and circularity.

Construction Industry Dynamics	
Responsible lecturer:	prof.dr.ir. A.G. Doree
Course code:	201800047
Period:	2
ECTS:	5

Course description:

The construction industry provides infrastructures crucial for our society as roads, canals, energy networks, sewage systems, flood protection). These infrastructures keep us safe, healthy and prosperous. The Industry has to respond to the challenges and need of our societies. Central in this course is the way and pace the stakeholders in the construction industry deal with competition, and develop and absorb new technologies (eg ICT, BIM, GIS) and new challenges (eg sustainability, social responsibility). This knowledge and understanding is put into the context of the strategic choices of the stakeholders, and the international initiatives undertaken to reform the construction industry. The course focuses on the issue of changes in contract types and procurement, and the effects on strategies and innovation in agencies and firms. It explains the relationships between market regulation, competition, market dynamics and innovation at the level of the industry and the organizations within. It also addresses the issue of business paradigms and strategic management for firms in the construction industry.

This Course addresses the following topics:
Outlook to the future: World Economic Forum's "Infrastructure and Urban Development Industry vision 2050")
A narrative of the changes in the construction industry over the past five decades (to provide context)
Theories and logics used to explain the relationships between industry characteristics, strategic choices and industry dynamics
Papers on markets, competition, regulation and industry dynamics (to provide insight into dynamics beyond change in the entrepreneurial environment)
Papers on obstacles for innovation due to structure and culture of the construction industry (particularly to provide insight into the systemic barriers to change and innovate due to fragmented supply chain, project wise production, procurement ad adversarial relationships)
Papers on Complex product industry and the "systems integrator" business model (to provide insight is to an integrated business model for construction industry)

Systems Engineering in Construction	
Responsible lecturer:	dr.ir. R.S. de Graaf
Course code:	201800032
Period:	3
ECTS:	5

Course description:

Most clients, designers, contractors and other relevant stakeholders in the civil engineering industry acknowledge that sustainability is important when designing and building civil engineering objects. However, in many projects, sustainability goals are often not achieved. Among others because people do not fully understand the concept of sustainability, but also because designers fail to incorporate sustainability in the design process. The main focus of this

course is therefore to teach students how to design sustainable civil engineering objects with the use of Systems Engineering, a promising and proven design method, and able to incorporate sustainability.

Systems Engineering is a universal design method, which is prescribed by the main Dutch clients in the Civil Engineering Industry (ProRail and Rijkswaterstaat). The second core concept is Sustainable development. Sustainable development is defined as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. The three main pillars of sustainable development include economic growth, environmental protection, and social equality.

Three main topics are covered in this course. First, the principles of Systems Engineering. Second, the principles of sustainability. Third, the combination of Systems Engineering principles and sustainability principles. These topics are tested by means of an individual exam (30%), an individual practical assignment (20%) and a group project (50%)

Infrastructure Asset Management	
Responsible lecturer:	dr. A. Hartmann
Course code:	201800034
Period:	4
ECTS:	5

Course description:

Infrastructure asset management (IAM) involves activities and decisions that reduce the expenditures over the life-cycle of an infrastructure asset while extending the period for which the asset provides its required performance. It focuses on three main questions: the why, when and what of activities and decisions.
The “why” concerns the objective or purpose of infrastructure. An infrastructure asset represents a resource used by an organization (e.g. public agency) to deliver services to its customers or run its production processes. By defining infrastructure objectives the importance of an asset for an organization and its role for the organization’s business can be determined.
The “when” addresses the performance of infrastructure. An infrastructure asset wears out over time and can reach a critical stage of undesired performance. By analyzing the development of functional and technical performance of infrastructure the point in time when the performance of an asset becomes critical can be identified.
The “what” deals with the kind of interventions throughout the life-cycle of an infrastructure asset. Interventions may include preventive and corrective maintenance, renovation or (re)building.
The focus of this course is on the management of infrastructure facilities and the maintenance and rehabilitation process in particular. The course provides the basic concepts and tools to procure and preserve infrastructure systems most cost-effectively. It shows how to prevent costly deterioration of infrastructure and to ensure an acceptable performance level of the infrastructural asset. The course covers the development of effective maintenance and rehabilitation strategies for portfolios of infrastructure facilities as well as the planning and procurement of single maintenance and rehabilitation projects. It particularly addresses the dynamic relationship of economical, organisational and quality issues during the life cycle of infrastructure facilities.

Digital Technologies for Civil Engineering	
Responsible lecturer:	prof.dr.ir. A.M. Adriaanse
Course code:	201800044
Period:	3
ECTS:	5

Course description:

Arguably, digital technologies are changing the world around us with a fore and pace unmatched in the modern human history. Such technologies as laser scanning, drones, robotics, artificial intelligence, embedded sensors, ubiquitous computing, Internet of Things, and 3D printing have already reshaped and pushed the boundaries of productivity, safety, and quality in many industries.

For the fragmented construction industry, it remains a significant challenge to keep abreast with these new developments. Recently, construction companies have started to appreciate the exigency of harnessing the true potentials of digital technologies to remain competitive in the fierce market. Many pilot projects with data-driven solutions are now developed to improve processes at different phases of construction projects' lifecycle. This strengthens the general notion that the development, adoption, and integration of tailor-made and customized digital technologies will be the future for construction industry.

This course reviews various types of design and data modelling applications (3D, 4D BIM, GIS), and sensors (e.g., GPS, inertial measurement unit, linescanner, laser scanner, infrared camera, accelerometers, etc.) and their applications in the construction industry. In doing so, this course will touch on topics such as wearable technologies, ubiquities computing, embedded sensors, Internet of Things, connected and smart construction site and real-time operator guidance systems.

Additionally, this course discusses how these sensor technologies support real-time and data-driven decision making throughout the lifecycle of infrastructure projects. This course will discuss various data analysis, simulation, visualization, and optimization methods that are used to address challenges in the construction industry. Finally, we discuss Building Information Modeling and as technology and process-support solutions that can integrate fragmented solutions into a harmonized system compatible with circular and lifecycle approach to infrastructure projects.

Technology and Innovation in Road Construction	
Responsible lecturer:	dr. S.R. Miller
Course code:	201800052
Period:	4
ECTS:	5

Course description:
Road construction processes are often described as being traditional where work methods are based on implicit knowledge and custom, leading to extensive variability in the final constructed road. Process control is defined as those activities involved in ensuring a process is predictable, stable, and consistently operating at the target level of performance with only normal variation. The goal therefore is to ensure that the process variability inherent in the asphalt construction process as a result of the custom-based work practices, is reduced to within acceptable limits. This

requires that the construction process is explicit, meaning that key process parameters such as temperature homogeneity and compaction are measured, visualised and improved upon in a scientific manner.

This course focuses on how new sensor technologies and innovations can be integrated into construction processes in order to reduce process variability and improve overall quality. Using the case of asphalt construction, students are taught the fundamentals of process control with the main goal of reducing process variability.

The main topics covered in this course are:

- Fundamentals of process control
- Asphalt mix design to construction and maintenance – the need for science-based approaches
- Measuring variability in construction processes – a sensor-based approach
- Integrating sensors and innovative technologies to improve process control
- Visualization and Simulation tools for construction processes
- Using sensor data to apply Statistical Process Control techniques in Quality Control
- Integrating real-time systems into method-based operational strategies

GRADUATION IN TWENTE

Preparation Master Thesis	
Responsible lecturer:	M.Hamhuis
Course code:	201800115
Period:	-
ECTS:	5

Course description:
The main objective of the course Preparation MSc-thesis project is to independently produce a research or design plan for his/her MSc-thesis project, based on state-of-the-art scientific knowledge of the sub-field and acquire additional knowledge to prepare for the MSc-thesis project. The MSc-thesis project is a large individual research or design project in one of the sub-fields of Civil Engineering and Management.
Based on a meeting with the thesis supervisor, the student will make a plan that contains the following information: outline of the thesis subject, knowledge to be gained (literature, software, and methodology), examination mode(s) and planning.
Based on this plan the student will deliver the following products:
- Research plan
- Proof of sufficient prior knowledge based on examination mode(s)

CME Master Thesis	
Responsible lecturer:	Dr.ir. R.S. de Graaf
Course code:	195899999
Period:	1,2,3,4
ECTS:	30

Course description:
The student will have to prove that he/she meets the objective of the programme which means academic knowledge, understanding and skills in the domain of civil engineering and certain sub-domains of business administration and public administration at a level which qualifies the graduate for independent professional practice and research in civil engineering.
It can either be a research project or a systematic design (of a model, object or procedure).
The assignment can be executed at one of the departments of CiT, for example a research project that contributes to a PhD dissertation. The assignment can also be executed externally at a company or an institution.