



Complex Systems Engineering and Management

At the intersection of technology and governance.

Diploma	MSc Complex Systems Engineering and Management
Tracks	- Built Environment & Spatial Development - Energy - Information & Communication - Transport & Logistics
Credits	120 ECTS, 24 months
Starts in	September
Language of instruction	English
% International students	15%

Our society strongly depends on complex systems: think of the infrastructures for telecom, transport and energy. These systems are not only technologically complex, but almost always involve many parties if we are to innovate. Maintaining cyber security, safely introducing automated vehicles and increasing the amount of sustainable energy without compromising our electricity supply are just some of the challenges we face.

To achieve this, you have to know not only how these technical systems function, but also how their governance and management are organised. Who is responsible for the network? Which companies supply services on that network? Do we need to regulate the market, and how? What are the drivers and incentives of all parties involved, and what power do they have? These questions – and many more – need to be answered before you can start designing to bring about change.

Are you looking for an MSc programme that teaches you the technological skills as well as the non-technical ones (policy, law, economy) needed to tackle the challenges in an integrated way? Then join our unique

Master's programme Complex Systems Engineering and Management (CoSEM).

Programme

The CoSEM programme teaches you how to design in socio-technical systems: engineering and managing the complex systems we depend on. You learn to work in a broader field than technology alone. After all, when designing technological innovations, you have to deal with matters such as existing regulations, subsidies, distribution channels and infrastructures, as well as interests, cultures and human behaviour. In order to achieve successful innovations, these aspects must be considered and used in your socio-technical design. The programme spends a great deal on ethical issues and has an international character.

Global citizens

The CoSEM Master's degree programme educates global citizens. We look at the challenges at an international level, and do not confine ourselves to the Netherlands. We encourage our students to study abroad in the first semester of the second year. Studying in a different culture boosts your creativity and flexibility.

Programme chart Complex Systems Engineering and Management

First year				
1 st Semester			2 nd Semester	
1 st period		2 nd period	3 rd period	4 th period 4
Introduction to Designing in Complex Systems (2EC)	Complex Systems Engineering (5 EC)	Managing multi-actor decision making (5 EC)	Law and Institutions (5 EC)	Design Project (5 EC)
	Institutional Economics for designing in Sociotechnical Systems (3 EC)	Methods: Agent-based modelling (5EC) or: Statistics Analysis of Choice Behaviour (5 EC)	Methods: Mixed Research Methods for Multiactor Systems (5 EC) or: Design in Networked Systems (5 EC)	CoSEM Research Challenges (5 EC)
Track (5 EC)		Track (5 EC)	Track (5 EC)	Track (5 EC)

Second year			
3 rd Semester		4 th Semester	
1 st period	2 nd period	3 rd period	4 th period 4
Electives (15 EC)		CoSEM Master Thesis Project (30 EC)	
Track electives (10 EC)			
Foundations	Elective	1 EC = 28 hours of study, according to the European Credit Transfer System (ECTS). Total number of credits in the MSc Complex Systems Engineering and Management = 120 EC For more information on all courses: studyguide.tudelft.nl	
Methods	Thesis		
Track	CoSEM Research Challenges		

Create Your Own Programme

The CoSEM programme takes two years and offers a lot of freedom to make your own choices.

The programme starts with a Boot Camp week in which you design a socio-technical system.

After Boot Camp, you choose one of four different tracks that are based on major current issues. In the track courses you will gain the in-depth technical knowledge you need to make socio-technical designs. This means you will focus on your area of interest from the start.

You can choose from the following tracks:

Built Environment & Spatial Development (B&S)

The long lifespan of buildings and the shortage of available land in Western countries necessitate sustainable and flexible solutions for our spatial planning and built environment. People and businesses demand good, safe and affordable housing facilities. The plans and designs we create for this purpose should also meet future needs, which will likely be very different

from the present. Will the population grow or shrink? How much can we afford to pay for our housing? Which limitations and opportunities does climate change offer us? In the current arena with established interests, we face the challenge to arrive at socio-technical designs for spatial development that will meet the requirements for decades to come.

Energy

The transition towards a sustainable energy supply raises questions for both engineering and governance. How can interventions in the energy system best be designed? Can we ensure the demanding energy supply while more and more electricity is produced from solar and wind energy? How should national policy deal with cross-border effects? What role can national policy for energy efficiency and renewable energy play in a free European market? Developments in the energy system such as smart grids, electric vehicles, energy storage and shale gas are just a few examples of the topics explored in the Energy track.

Information and Communication (I&C)

Today's society cannot function without a large-scale digital information infrastructure.

This infrastructure is complex because it is made up of components that are publicly or privately owned. This requires a systems design and governance based on public-private partnerships to make optimal use of the information. As a CoSEM engineer you manage and design on the basis of applicable legislation, values and standards. You require a broad interest in designing applications for smart logistics, for example, or platforms for local energy generation or for big and open data to create green energy services within a smart city.

Transport and Logistics (T&L)

The transport and logistics sector is constantly developing and requires innovative engineers. In this track you analyse and design urban mobility, freight and logistics systems, taking into account travel behaviour, conflicting interests and competing political, social and economic demands. The right socio-technical designs should deal with these conflicting interests. You develop alternatives for designing new or improved transport and infrastructure systems and gain insight into the problems related to the design and control of transport processes from a multi-actor perspective.



Timo Gerres (Germany)

In general, I was always quite interested in the field of renewable energy technology and the future transition of energy systems, one of the great challenges of our society. In my Bachelor studies – a combination of mechanical engineering and business

administration – I learned a lot about different technologies, but the question of how to utilise them on a greater scale was never fully addressed. How do you ensure investments in new energy technologies? How can you increase acceptance? What needs to be done to integrate them into the electricity system? What regulative hurdles have to be taken?

After two years at TPM, I can say that CoSEM was exactly the programme I was looking for. Trying to understand complex systems by studying the different actors involved was new to me, but it provides exactly the perspective on sociotechnological interactions I was missing in my previous studies. Further on, domain courses helped a lot in providing the link between energy sector specific characteristics and system understanding.

For my graduation project I developed an algorithm to adjust electric vehicle charging to cope with the production uncertainty of photovoltaic production. Working on something that can actually help us to make the energy transition possible fulfils me with great joy. Not just presenting an engineering solution, but also focusing on the implications and consequences of your doing on the technical system and its stakeholders was one of the reasons I chose CoSEM.

Looking back at CoSEM, I will always remember the great time I had working together in projects with fellow students or researchers. Whether a design project, modelling assignment or sector analysis, working together with Dutch and international fellow students was always a pleasure.

Second year

In the second year you choose from a range of TU Delft electives packages. You can also propose your own package, which gives you the opportunity to study outside TU Delft and even abroad.

The programme is concluded with the Master Thesis Project.

ICT education

In our programme we use the latest teaching methods, including blended learning. We offer you a combination of learning on campus and e-learning. The more you progress in the programme, the more you can follow your own route with extra modules or research. If you prefer to follow a predefined route, simply follow the standard Master's programme.

Electives

In the second year, you can select one of the following predefined electives packages:

- Emerging Technology-Based Innovation & Entrepreneurship (*)
- ICT Management and Design
- Infrastructure and Environmental Governance (*)
- Economics and Finance
- Modelling, Simulation and Gaming
- Cyber Security
- Supply Chain Management

Alternatively, you can propose your own elective package.

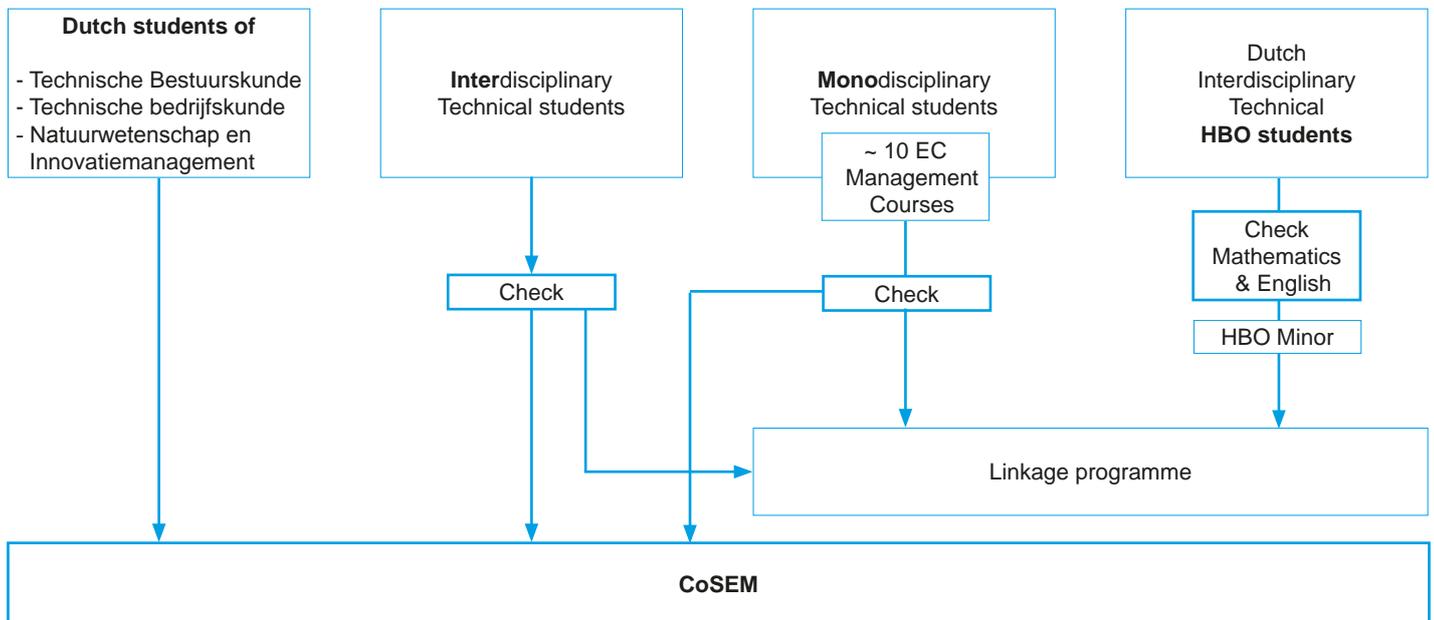
Two of the electives packages (*) offer an annotation, which means that you will receive an additional certificate with your diploma. Please note that electives are subject to change, and may be offered only if there is sufficient interest. Visit our website for current information about the electives.

Career prospects

CoSEM graduates typically take up positions as project managers, policy makers and strategic consultants. Graduates are just as comfortable speaking to technical experts as they are when speaking with managers, and they often work in an interdisciplinary environment. They are greatly appreciated for their systematic approach to solving problems and their analytical thinking.

Many CoSEM graduates work in large organisations (such as Shell, Unilever and Heineken), consultancy companies (Accenture, McKinsey), energy companies (Eneco, TenneT, Alliander), engineering companies (Arcadis, Heijmans), insurance companies and financial institutions, as well as in ministries and governmental agencies. In addition, a substantial number have launched their own ventures or became a PhD candidate within the faculty.





1. All candidates for the CoSEM Programme are required to submit a motivation letter (essay).
2. Dutch candidates with a **BSc degree in 'Technische Bestuurskunde', 'Technische Bedrijfskunde' or Industrial Engineering & Management** are admitted without additional requirements.
3. Candidates with an **interdisciplinary technical BSc degree** may be required to complete parts of the online Linkage Programme, depending on their educational background*.
4. Candidates with a **monodisciplinary BSc degree** in engineering or natural sciences with a proven interest in management (~10 EC of courses relevant for solving complex multi-actor problems) may be required to complete the online

Linkage Programme, depending on their educational background*. Students of this group with a grade point average of their entire BSc curriculum less than 7.5 must finish the Linkage Programme with an exam in the form of an essay.

5. **Dutch HBO bachelors** with an interdisciplinary technical background can be admitted on the basis of their grade point average (>7), final assignment (>7), study duration (≤ 4 yrs) and level of mathematics and English. They are to complete the HBO Minor and the Linkage Programme. See hbodoorstroom.tudelft.nl for detailed information.

All applications through Studielink: tudelft.studielink.nl

All others should contact the academic counsellors (see contacts below).

Linkage Programme

A Linkage Programme of about 80 hours is available for those with insufficient prior knowledge. When applicable, it must be completed before the deadline of application (1 July for Dutch students).

International applicants

For international students, the application period starts on 1 October and closes on 1 April. To be considered for admission to an MSc programme, you will also need to meet TU Delft's general admission requirements. For more information about the application procedure and studying at TU Delft in general, go to admissions.tudelft.nl.

* This will be decided on the basis of the quality of their educational institute, their curriculum, their individual performance and their motivation.

Further Information and Contacts

For all details, official requirements, deadlines and contact information please visit the website: tudelft.nl/msc/cosem

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