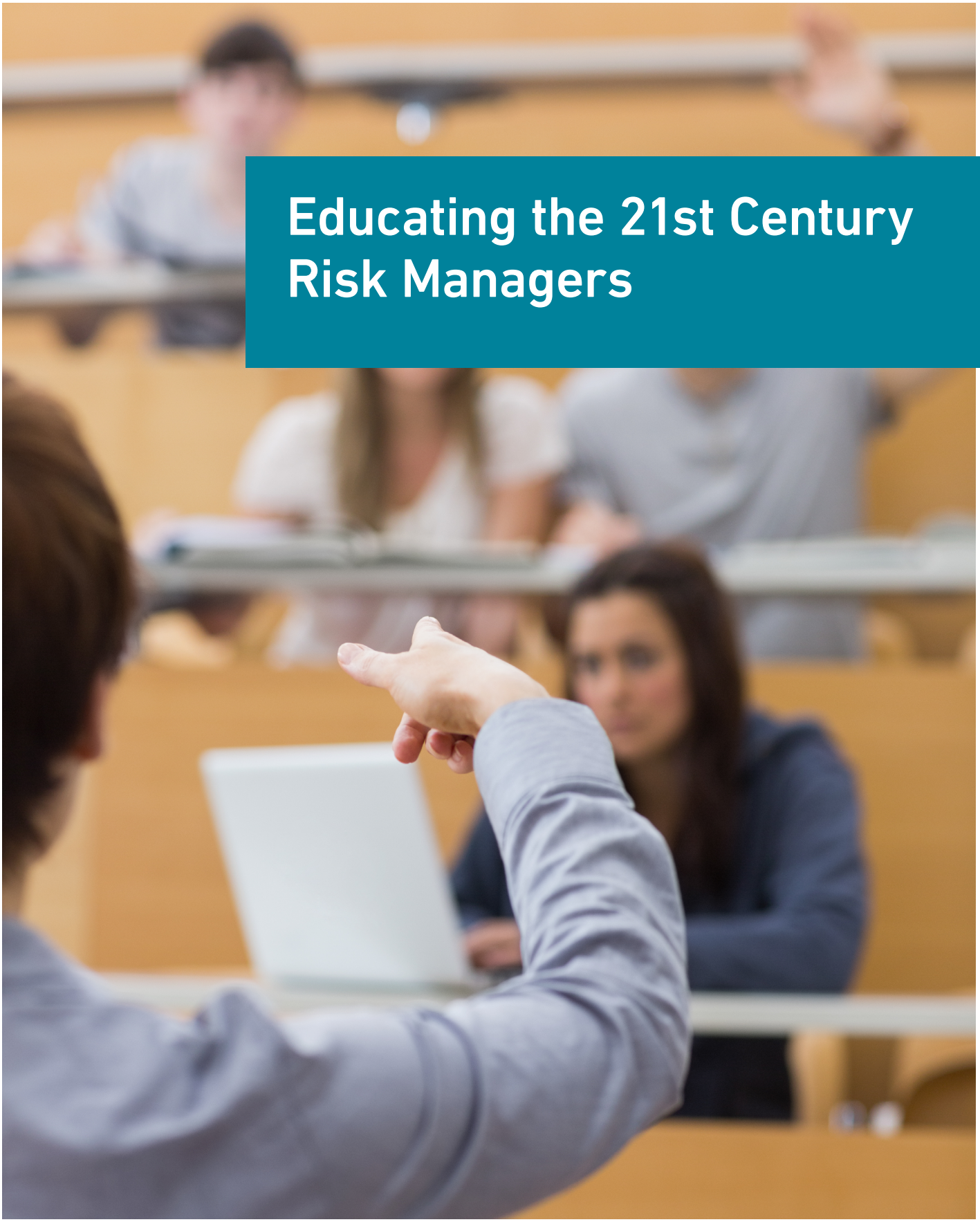
ETH zürich

ETH RISK CENTER



Educating the 21st Century Risk Managers

Training Tomorrow's Risk Managers

Education is the most effective channel to disseminate knowledge and create impact in academia, industry, government agencies and society. The Risk Center offers a portfolio of education opportunities ranging from master-level courses to continuing education.

An integrative approach to risk management

Risk Center courses allow participants to explore the many dimensions of risk. Multi-disciplinary approaches equip students with a sound understanding of the interdependencies and complexities of social and engineered systems. In our teaching, we encourage our students to overcome the traditional silo-thinking of risks and risk-management.

Combining theory and practice

Risk managers cannot be pure theoreticians. Building on the solid theoretical knowledge students acquire at ETH Zurich, Risk Center courses provide insights into the actual practice of risk management.

This is achieved through cooperation with the Risk Center's partner companies and our community. Course speakers often come from the industry or civil society and share their experience and real-life challenges with students. Consequently, our students are better prepared to tembark on their career in risk management.

Fostering critical thinking

While models are at the core of many risk management practices, we encourage students to take a step back and reflect on the actual meaning of mathematical models.

Several courses, such as the Risk Case Study Challenge (pages 5-6) are designed to get students to think outside the box and come up with their own risk management initiatives!

Empowering today's and tomorrow's risk managers

At the Risk Center, we provide education formats for students as well as professionals.

Because the tools and techniques of risk management evolve incredibly fast, it is crucial that everyone is up to date with the latest theories, tools and technologies. See page 4 for more details on our Continuing Education opportunities.

Coordinators and Lecturers:

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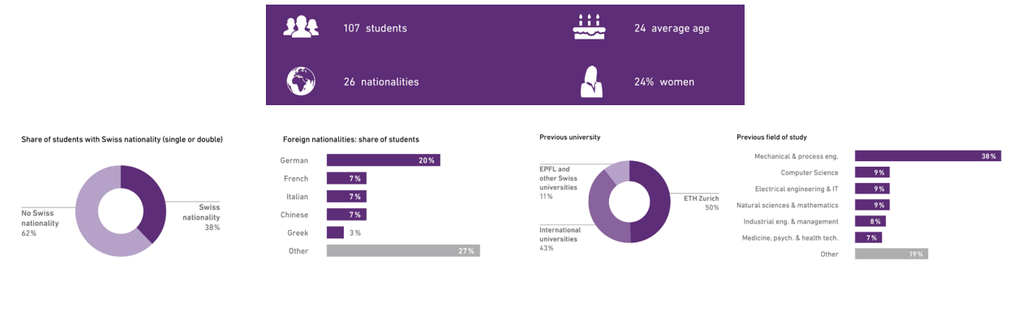
Working with fresh minds

The Risk Center works closely with the Department of Management, Technology and Economics (D-MTEC) at the MSc and MAS level. Here is an overview of these students' profiles.

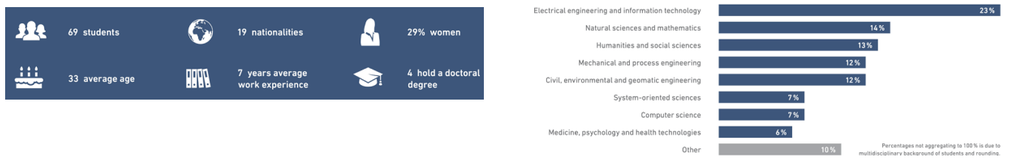
The MSc ETH MTEC (Class of 2021)

The MSc ETH MTEC is a four-semester full-time programme attracting ambitious students with a Bachelor's degree in engineering or natural sciences. By building on students' already extensive knowledge of engineering and natural sciences, the MSc provides a solid foundation for developing systemic solutions to complex professional challenges.



The MAS ETH MTEC (Class of 2021)

The MAS ETH MTEC programme is one of the longest-standing and most successful management education programmes in Switzerland. It builds on students' existing technical and scientific knowledge. The goal of the programme is to equip paticipants with the knowledge and skills required to develop and present systematic solutions to complex entrepreneurial challenges. It targets working professionals with at least 2 years of experience.



Student from other departments at ETH

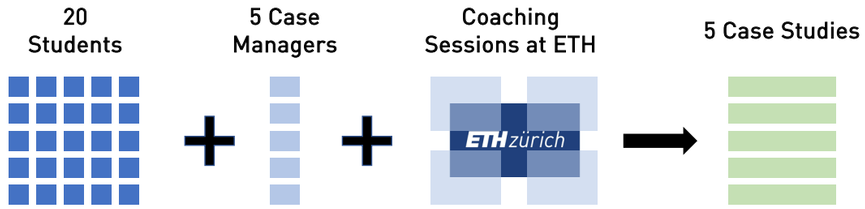
Our courses also attracts MSc and doctoral students from various deisciplines at ETH Zurich: Mathematics, Physics, Computer Science, Engineering... They are eager to connect with the science of risk and risk management to braoden their expertise and expand their career choices.

Professionals

Participants in Continuing Education courses are risk professionals from banking, finance, insurance as well as managers of critical infrastructure providers. They typically have a quantitative background.

«Risk Case Study Challenge» (MSc/MAS)

In collaboration with a partner company and supported by Risk Center and ETH faculty, teams of students from diverse backgrounds develop innovative solutions to challenging risk-management problems.



Design

Each Challenge involves a Risk Center partner company. The cases are explored with support from Risk Center and ETH lecturers. The cases offer students a concrete environment to apply their knowledge, logic, creativity, and problem-solving skills. Typical cases are complex, contain ambiguities, and may be addressed in more than one way.

The course is an elective in the ETH D-MTEC curriculum as well as in other ETH MSc Programs. It is open to MSc, MAS and doctoral students from D-MTEC and from other ETH departments.

Students work in groups of 3 ot 5 under the supervision of a case manager from the partner company. In addition, Risk Center lecturers offer coaching sessions on presentation skills.

Objectives

The Risk Case Study Challenges helps students learn to think like a scientist, with an emphasis on evidence, in order to solve real-life problems. Students learn to aggregate information from various sources under a time constraint. They also engage in active inquiry and in-depth discussions, coordinating within and across groups, and with their case managers.

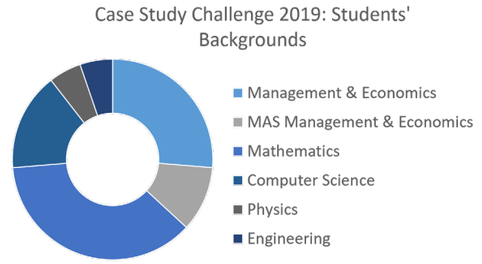
A beneficial experience for students

Students acquire a better understanding of risk-management and modelling. They discover new tools and applications for the theoretical knowledge gained at ETH.

Finally, they learn first-hand to process their findings and communicate their results in a professional environment.

A beneficial experience for the partner company

Case Managers from the partner company help students explore the case. They typically enjoy interacting with fresh minds and being challenged with creative ideas. Students will present their results in the final session at the partner's headquaters.



Feedback from Partners:

"A fast track to revealing solutions"

"We met 4 groups of bright, fresh minds with excellent academic training."

"We all now look at things from a new angle - the students brought us towards revealing solutions – Thank you!!"

Student's impressions

"I liked the topic because it is a real problem that people in the industry are working on and we had the chance to taste this practical approach" *(Nikolas, PhD Student, BAUG)*

"I will recommend the course to other students. Getting first-hand insights into risk-management from a practical point of view was an enriching experience" *(Claudia, MSc GESS)*

"The group size is ideal for such a task and for communication within the group as well.
Having members from diverse disciplines allows us to learn from each other" *(Diya, MSc ERDW)*

"Great opportunity to develop soft skills that are often overlooked when studying technical subjects (presentation skills, communication skills, ability to discuss with the management, receive feedback and implement it, teamwork)" *(Franscesco, MSc MATH Statistics)*

"I enjoyed being part of the risk case study challenge of this year. It was a great opportunity for me to study the topic of supply chain from the perspective of an insurance company" *(Ambra, PhD Student, MTEC)*

Past Risk Case Study Challenges

Spring 2018 on **Conceptualizing and Assessing Reputation Risk** with Swiss Re
Spring 2019 on **Supply Chain Risks and Extreme Events** with Zurich Insurance
Fall 2019 on **Machine Learning Applications in Banking and Finance** with Credit Suisse
Spring 2022 on **User Experience in Online Banking** with Credit Suisse

Course: Introduction to Risk Modelling and Management *(MSc/MAS)*

This course describes the building blocks of risk modelling and management: uncertainty, vulnerability, resilience, decision-making under uncertainty, to name but a few. It fosters a practical, real-world understanding of how models are used in the decision-making process in business.

Topics range from enterprise risk management to natural catastrophes, from climate risk to energy market risk, from risk engineering to financial risks, operational risk, cyber risk and more. Note that our panel of speakers varies every year. Therefore, not all risks are covered on any given year.

The course is organised in three blocks:

- Elements of Risk Modelling and Analysis: Probability, Uncertainty, Vulnerability…
- Elements of Risk Management: Enterprise Risk Management, Project Risk Management, decision-making under uncertainty…
- Applications to various areas.

Each session is taught by a different speaker. Our guests are ETH faculty or risk professionals from various domains.

After taking this course, you are able to

- Reflect on risk models, their uses and limits.
- Identify the characteristics of risk modelling and management for various risks and contexts.
- Understand what is expected of 21st century risk managers in the different industries explored during the course.
- Describe the qualities that an efficient risk manager must possess to excel in their role.

Course coordinator: Dr. Hélène Schernberg

Past speakers

- Dr. Sandra Andraszewicz, Senior Researcher, Chair of Cognitive Science, ETH Risk Center
- Dr. Bastian Bergmann, MAS Coordinater, D-MTEC
- Dr. Diethelm Boese, Vice President, Head of New Product Delivery, ABB
- Dr. Jeffrey Bohn, Chief Strategy Officer (CSO), One Concern
- Dr. Stefan Brem, Head Risk and Research Coordination, Swiss Federal Office for Civil Protection (BABS)
- Prof. David Bresch, Chair of Climate Risk, Risk Center (D-USYS)
- Prof. Roger Cooke, Ressources for the Future Institute, Washington DC
- Dr. Michel Dacorogna, Prime Re Solutions
- Prof. Paul Embrechts, RiskLab and Risk Center (D-MATH)
- Dr. Jennifer Firmenich, elsener+partner AG
- Dr. Stefan Frei, Senior Information Security Officer, SIX Digital Exchange (SDX)
- Dr. Roland Goetschmann, Advisor Financial Stability, Swiss National Bank
- Dr. Lukas Gubler, Chief Risk Officer, Axpo Trading
- Dr. Anastasia Kartasheva, Senior Economic Advisor, Bank for International Settlement
- Prof. Marie Kratz, ESSEC Paris
- Dr. Laurent Marescot, Senior Director, RMS
- Dr. Robert Perich, Vice President for Finance and Controlling, ETH
- Dr. Katja Pluto, Chief Risk Officer EMEA, Zurich Insurance
- Dr. Hélène Schernberg, Executive Director, ETH Risk Center
- Dr. John Scott, Head of Sustainability Risk, Zurich Insurance Group
- Iwan Stalder, Head of Accumulation Management, Group Underwriting Excellence, Zurich Insurance
- Patricio Verdieri, Head of Enterprise Risk Management, Group Risk Management, Zurich Insurance
- Prof. Uelrich Weidmann, Vice-President for Infrastructure, ETH

Course: New Technologies in Banking and Finance *(MSc/MAS)*

This course unpacks the technologies underlying the digital transformation in banking and reflects on their impact on finance.

Technological advances, digitization and the ability to store and process vast amounts of data has changed the landscape of banking and finance. The course also covers changes in management practices.

The financial manager of the future commands a wide set of skills. Those range from a great familiarity with technological advances to a sensible understanding of the impact on workflows and business models. Students with an interest in finance and banking are invited to take the course, although they may not have any explicit theoretical knowledge of financial economics.

The course is organised around three main themes:

- Machine Learning: Covers fundamentals of ML and insights in real application,
- Distributed Ledger Technology Crypto currencies: Covers fundamentals of DLT and applications from finance and trading (Central Bank Digital currencies, Bitcoin, Tokenization, NFTs),
- Quantum Computing: General introduction and envisioned applications with an additional focus on cyber security aspects.

After taking this course, students will be able to

- Understand recent technological developments and how they drive transformation in banking and finance,
- Understand the skill set needed in these technological domains.
- Reflect on the impacts this transformation has on workflows, agile working, project and change management.

Course coordinator: Dr. Bastian Bergmann

Past speakers

- Dr. Bastian Bergmann, MAS coordinator, ETH Zurich
- Prof. Patrick Cheridito, Chair of Mathematics, RiskLab, ETH Zurich
- Jan Cuonz, Advisor at BIS Innovation Hub
- Dr. Daniel Egger, IBM Zürich
- Dr. Stephan Eckstein, Chair of Mathematics, RiskLab, ETH Zurich
- Prof. Hans Gersbach, Chair of Macroecomics: Innovation and Policy, ETH Zurich
- Dr. Andreas Gottschling, Member of the Board of Directors, Deutsche Börse AG.
- Dr. Sergio Herrero Lopez, Head of Data Science, Credit Suisse
- Edouard Hurstel, Director, FSO, Consulting, Digital transformation, EY
- Christoph Jans, Head Digital Transformation and Products Lab, Credit Suisse
- Dr. Philipp Kamerlander, ETH Quantum Center
- Dr. Jakob Maciag, Vice President, Global Credit Portfolio Management, Credit Suisse
- Dr. Philippe Mangold, Credit Suisse
- Prof. Kenny Paterson, Applied Cryptography Group, ETH Zurich
- Kris Pawluk, Head of Strategy and Operations, Google Switzerland
- Oliver Sigrist, Advisor at BIS Innovation Hub
- Prof. Josef Teichmann, Institute of Stochastic Finance, ETH Zurich
- Prof. Roger Wattenhofer, Distributed Computing Group, ETH Zurich
- Dr. Dan Wunderli, Data Scientist, FINMA

Course: Resilience in the New Age of Risk *(MSc/MAS)*

This course explores the concept of resilience and its application to socio-technical systems: The resilience of infrastructure systems and how individuals and social groups interact in and with them.

Our increasingly complex and connected systems face continuously emerging disruptions. Resilience constitutes a fundamental departure from the philosophy of risk-management. With resilience, stakeholders adopt risk mitigation strategies aligned to the theories of complex systems.

Resilience applies to an extremely large array of systems and contexts. Moreover, the topic of resilience is surprisingly absent from most university curricula. This course fills a gap and walks you through a mode of thinking that is bound to shape the way risks and disasters are dealt with in our increasingly connected society. Hence, tomorrow's risk managers will and shall also be "resilience managers".

This course, co-organised with the leaders of the Singapore-ETH Center's Future Resilient Systems II programme, breaks down the concept of complex systems and their resilience. It introduces some of the different flavors of resilience and provides tools for building it in various socially relevant areas (social resilience, engineered systems resilience, organizational resilience...).

The course is divided in 4 parts.

Part 1: Foundations of Resilience
Part 2: Resilience Analysis: Infrastructure Systems
Part 3: Organizational resilience and sensemaking
Part 4: Resilience in Practice

Part 1 introduces the concept of resilience, and the framework in which it is applied. The distinction between resilience and risk management is highlighted, as well as how these approaches complement each other. The founding concepts of resilience are explained and illustrated: vulnerability, disruption, absorption, recovery, adaptation, etc.

Part 2 walks you through the analysis of the resilience of infrastructure systems. It introduces the useful metrics of resilience. It provides examples of building resilience into complex systems, by increasing the robustness and recoverability of systems, and reducing vulnerabilities. Finally, students will explore the optimization of infrastructure systems.

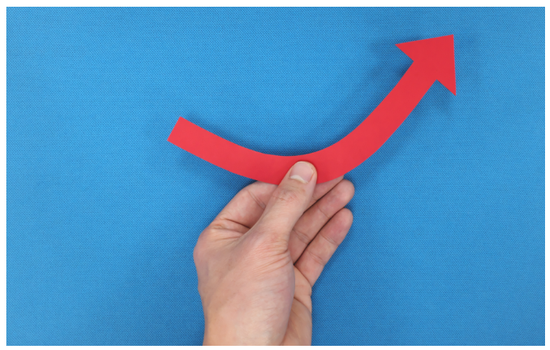
Part 3. Every system subject to potential disruptions is managed by a human organization. Sensemaking describes how humans frame the problem. It is a process whereby organizational actors attach meaning to external events to resolve the uncertainty surrounding them. Investing in mindfulness improves personal and organizational resilience and success. Finally, the management of organizational resilience is discussed.

Part 4 will provide examples of the use of resilience by practitioners, with guest speakers from the public and private sector.

After taking this course, you will be able to:

- Discuss the concept of resilience and related frameworks and concepts, and explain their relevance in different contexts (organizations, infrastructure, social groups...).
- Use and discuss key resilience metrics and use them to analyze infrastructure systems.
- Discuss the role of organizational resilience and describe methods to improve it.
- Describe how resilience is applied in practice.

Course coordinator: Dr. Hélène Schernberg



Course: Risk and Insurance Economics *(MSc/MAS/SAV)*

The course introduces students to basic microeconomic models of risk attitudes and highlight the role insurance can – or cannot – play for individuals facing risks.

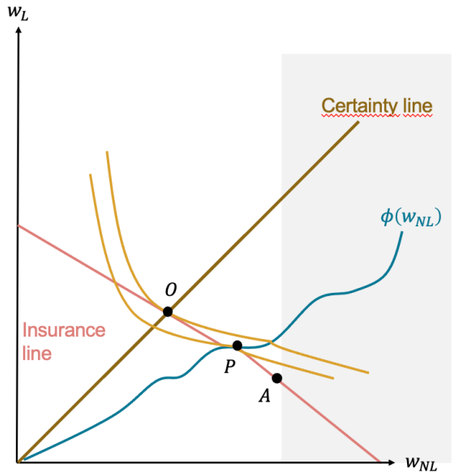
Everyday, we take decisions involving risks. These decisions are driven by our perception of and our appetite for risk. Insurance plays a significant role in people's risk-management strategies.

In the first part of this lecture, we discuss a normative decision concept, Expected Utility theory, and compare it with empirically observed behaviour.

Students then learn about the rationale for individuals to purchase insurance, and for companies to offer it. We derive the optimal level of insurance demand and discuss how it depends on our model's underlying assumptions.

We then discuss the consequences of information asymmetries in insurance markets and the consequences for insurance supply.

Finally, we discuss refinements in decision theory that help account for observed behaviours that don't fit with the basic models of microeconomic theory. For example, we'll explore how behavioural economics can be leveraged by the insurance industry.



Lecturer: Dr. Hélène Schernberg

MSc "Risk Focus"

The confirmation of "Risk Focus" is delivered by the Department of Management, Technology and Economics (D-MTEC) and the ETH Risk Center. It distinguishes ETH students following a risk-management-focused MSc curriculum.

Most -if not all- challenging risks society faces, such as climate risk, technological risks, energy risks, health risks, economic risks and many more, can only be managed through an interdisciplinary approach. Because these risks are increasingly connected, tackling them becomes more and more complex. At the corporate level, the complexity and interdependence of risks keeps rising: Business interruption risk, cyber attacks, natural hazards, macroeconomic shocks...

21st Century Risk Managers must have a holistic and interdisciplinary mindset. Only then can they understand and overcome the increasing complexity of interdependent social, natural, and engineered systems. The confirmation of "Risk Focus" acknowledges that students have followed an integrative curriculum that puts them on track to becoming an all-round risk expert.

Workshops

Workshops are an ideal format to spend an afternoon -or a day- learning about a specific topic. Our Workshops integrate expertise from researchers, professionals and students. Typically, a workshop targets a specfic group of students -such as the MAS MTEC students with a professional background.

Workshops are held jointly with an Industry Partner. They take place either on the Partner's premices or at ETH. In this setting, professionals and researchers share their insights about a specific topic and stimulate a joint discussion with the students.

In this interactive format, students get an understanding of the professional tasks and scope of projects and topics within the company. Workshops are interactive, combining talks and presentations with breakout sessions and small case studies with joint discussion sessions.

Past Workshops

- Managing Supply Chain Agility & Resilience in a Global Enterprise
- How to Run Business with China: Case for Swiss SME
- Cyber Risk from an Insurance Perspective
- Deciphering Blockchain: Applications, Impact and Risks
- A Systems Approach to Safety and Security
- Climate Risk and the Built Environment: Can Data make a difference?
- Managing Risk in Agriculture:A Symposium focused on Innovations in Agricultural Insurance and Digitization
- Autonomous Decision-Making: Assessing the Technology and its Impact on Industry and Society
- Preferences over Random Variables: Let's talk about Continuity
- Extreme Value Theory and its Application to Insurance and Finance
- Foundations of Behavioral Insurance

Continuing Education

The Risk Center is involved in Continuing Education. Our courses adress two key topics: Cyber risk and the digital transformation, and Machine Learning in finance and insurance.

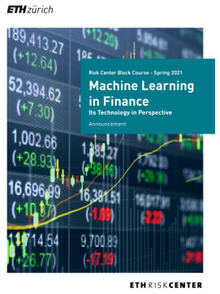
Machine Learning in Finance

The fascinating success of Machine Learning (ML) in language processing, image recognition or multi-player games has triggered many fantasies. One of them is to apply these technologies in other fields, such as banking and finance. In the last few years, the adoption of ML tools in the financial industry grew tremendously. According to executives, however, the use of ML tools has yielded mixed results. Why is this the case and what are the perspectives of ML in banking and finance?

This course goes through the basic concepts of ML and the most common tools and programming techniques used in state-of-the-art research. We elaborate on the conceptual frameworks of ML and describe the historical context of current approaches. By opening up the conceptual foundations of AI, we find out which problems translate well into ML problems and which ones don't. Finally, we integrate ML applications from other areas: text mining, modelling extreme events and intelligent maintenance.

Contents

- **Introduction to programming and basic applications**
- **Fundamentals of Machine Learning with recent applications in Finance**
- **Further applications in Finance**
- **Machine Learning applications to other areas**
- **Perspectives from the insurance industry and the regulator**



Cyber Risk

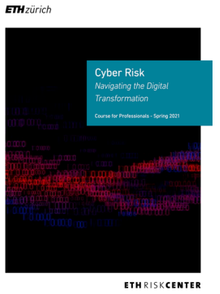
Navigating the Digital Transformation

The technology landscape is evolving at an increasing pace, forcing businesses, individuals and society to adapt in order to remain competitive. At the same time, the risk to businesses from cyber-attacks is growing just as fast, if not faster. To keep on top of such risks, one must understand the key drivers of cyber risk and get updates on the latest trends, research, solutions and best practices.

This course offers an integrative perspective on cyber risks. It helps understand the important developments, the principles, the challenges and limitations and the state of practice surrounding cyber risk from the technological, economic, legal, and insurance perspectives. The course provides tangible takeaways that cyber risk stakeholders in all organizations can use to strengthen their resilience.

Contents

- **Managing Cyber Risk, Threats, and Actors**
- **Theoretical Foundations of Cyber Security**
- **Cyber Resilience and System Architectures**
- **How to Model and Mitigate Cyber Risk?**
- **Critical Infrastructure Protection**
- **Cyber Risk Governance**



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