RESICITIES
Education for Resilient Cities

Course on Risk, safety, economics and planning for smart cities

A FREE course offered in the framework of the project

"Building resilience through education for Sustainable, Collaborative and Smart Cities"

(RESICITIES)

Funded by the
Erasmus+ Programme
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A course to be hosted by the University of Stavanger and delivered in collaboration with the Czech Technical University in Prague

November 15, 2021 – January 21, 2022

(consult details below about each module)

Lecturers:

University of Stavanger:

Tegg Westbrook

Harald N Røstvik

Ari K. M. Tarigan

Fabio Hernández-Palacio

Ole Andreas Engen

Kenneth Arne Pettersen Gould

Czech Technical University in Prague:

Tomas Tichy

Vaclav Jirovsky

DŮM ZAHRANIČNÍ SPOLUPRÁCE D Z S

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Course description

By 2050, up to 70% of the world's population will live in cities. Typically, as cities grow, new stresses - including crime, cybersecurity, water pollution, overcrowding, traffic congestion, climate change – will add increasing pressure on city managers and thus require proactive planning and reactive responses. City planners and technologists from various skill-sets will need to carefully consolidate complex cyber-physical processes in a cost-effective, appropriately managed, and thoughtfully implemented way. In particular, Smart Cities, as physical-digital ecosystems, will rely on complex urban and digital interventions to enable managers to predict, prepare, and respond toa number of human and natural challenges. Cities must also be prepared to function and rebound when things go wrong, and be adaptable to the known and unknowns.

Indeed, in a digital ecosystem of wireless and interoperable communication technologies, when one system fails, the whole system - including the organizational structures that accompany it -could fail. The future of cities thus cannot be fixed with ‘digital Things’ alone. Smart Cities require a robust blend of carefully considered physical and digital infrastructures, processes and organizational planning. This is why there is a growing need for multidisciplinary expertise in risk, safety, economics and planning for Smart Cities: understood beyond the “digital fixes,” but also the spatial, temporal, political, economic, and societal elements of cities too. In order to combine city planning, sensor networks, and societal security, future planners must therefore have knowledge of both technological and societal conditions that make future cities function to their optimal level.

The target group for this course are students with multidisciplinary backgrounds in planning, civil engineering, risk management, and/or architecture. The modules in this course are oriented to students who want to gain multidisciplinary perspectives into cyber-physical, case-specific manifestations of Smart Cities, with particular emphasis in risk, safety, economics, and planning. After completing the course, students will have knowledge of how to proactively forecast and design Smart Cities with consideration for the safety, security and well-being of their citizens. Such knowledge is required from municipalities, county municipalities, directorates and ministries, consultancies and small and large contractors.

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Learning Outcomes

Students who complete this course successfully will be able to:

- Assess the risks, safety, economics, and planning approaches – academic, practically, hypothetically - associated with various cyber-physical approaches to the design and organization of Smart Cities.
- Combine of technological and social science approaches to risk, safety, economics and planning for the protection and integrity of Smart Cities.
- Vocalise, orally and in writing, descriptively and analytically, the complex interrelationships between physical and digital interventions required to address present and future Smart City challenges.
- Work within interdisciplinary project groups and teams, bridging the “divides” between the digital and physical manifestations of Smart Cities, and develop real-world professional competencies in this regard.
- Utilize and apply multidisciplinary theoretical perspectives on how damage prevention, damage limitation, crisis management and spatial planning are considered through planning and organizational processes.
- To acquaint students with the issues of reliability and safety of artificial systems and human impact on systems, and reliability diagnostics of ITS technology and equipment with a focus on new methods and models for verifying equipment, technologies and subsystems in road, rail and air transport.

Required Texts, Materials, or Equipment

Gholami, H.,Røstvik, H. N., Müller-Eie, D.(2019). Holistic economic analysis of building integrated photovoltaics (BIPV) system: case studies evaluation. Energy and Buildings, ISSN 0378-7788.

Gholami, H., Røstvik, H. N., Müller-Eie, D. (2019). Analysis of solar radiation components on building skins for selected cities Advanced Building Skins.

Gould, K. A. P., Bieder, C (2020). Safety and security: The challenges of bringing them together Springer.

Hernandez-Palacio, F. A., Scherzer, S.,Frøyen, Y. K., (2018). The Value of Urban Density Tema. Journal of Land Use, Mobility and Environment, ISSN 1970-9889.

Hernandez Palacio, F., & Kesarovski, T. (2021). Developed the concept of optimal urban densities for more sustainable cities: Ideas and concepts towards a smart densification. Paper under revision.

Røstvik, H. N. (2018). Densification of Cities or Improved Technology to curb Greenhouse gas emission? Advances in Intelligent Systems and Computing, ISSN 2194-5357.

Anindito, D. B., Sagala, S., Tarigan, A. K. M.(2021). E-musrenbang: a digital framework for local participatory planning at the community level IDPR. International Development Planning Review, ISSN 1474-6743.

Sommer, M., Hanssen, M., Engen, O. A. H.,(2020). Fire regulation in Norway: an assessment of the authority's approach to functional regulations Research Publishing Services

Westbrook, T.,Schive, T.O.(2021). Urban Security and Counterterrorism: A proposed proportionality approach, Journal of Strategic Security. Accepted. Publication due Summer 2021.

Westbrook, T (2021). Home Security and Emergency Response: The Convenience vs Security Trade-off, Salus Journal, ISSN 2202-5677.

Westbrook, T (2019). Will GPS Jammers Proliferate in the Smart City? Salus Journal, ISSN 2202-5677.

Tichy T., (2015).Document for Control and Reliability, document CTU, Prague 2015.

Novák M., Votruba Z., (2018). Theory of system complexes reliability. Aracneaditrice, I. edition, Roma, 2018 ISBN 978-88.255-0801-7.

Novák M., Faber J.,Votruba Z. (2004). Problems of Reliability in Interactions between Human Subjects and Artificial Systems, monografy, NNW, 2004.

Xiao, Y. (2006). Security in Sensor Networks, Auerbach Publications.

McClellan, S., Jimenez, J., Koutitas, G. (2018). Smart Cities - Applications, Technologies, Standards, and Driving Factors, Springer 2018.

Le Coze, J. C., Pettersen, K. A., Engen, O. A., Ylonen, M., Morsut, C., Skotnes, R., & Heikkila, J. (2017). Sociotechnical systems theory and regulation of safety in high-risk industries. VTT report.

IRGC (2017). Introduction to the IRGC Risk Governance Framework, revised version. Lausanne: EPFL International Risk Governance Center.

van Asselt, M. B. A., Renn, O. (2011).*Risk Governance*. Journal of Risk Research. Vol. 14, No. 4, April 2011, 431–449

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Daily Work/Homework (expected)

Students will be required to read compulsory readings ahead of digital teaching. During classroom activities, students will be required to work in small multidisciplinary, cross-cultural groups. Some brief oral presentations will be required.

Major Assignments: Descriptions

Students will be required to elaborate a 1500-2000 report (40% weighting) accompanying a 20-minute, individual presentation (60% weighting). Students will be required to work in multidisciplinary groups on assigned tasks relating to the final major assignment – report and presentation – in the last day of the mobility week scheduled in January 2022. Student participation throughout the course is therefore an essential requirement.

Class Participation

All interactions in class are expected to be civil, respectful, and supportive of an inclusive learning environment for all students.
Students will be welcomed to participate in the live webinars and interact during the classes with the lecturer. However, in case some students will not be able to attend the live webinars on the dates and time as scheduled they can still access the webinars later within the course channel in Microsoft Teams during their most convenient time because they will be recorded.

All students will be informed through the course channel by the respective lecturer of each module about any additional (short) assignment to the final assignment that is expected to be delivered in the end of January 2022.

Course module means of assessment

Students' progress will be screened during online teaching and blended mobility activities based on attendance, engagement with topics, engagement with fellow students, and via various written and oral outputs. Students will only be graded for their final assignment, but may undergo 'mock grading' or 'mock tests' during classroom tasks.

Certificate of conclusion and ECTS credits

The postgraduate students who will accomplish the course successfully will be awarded with a certificate issued by the University of Stavanger. The course will correspond to 5 ECTS.

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Theme: Scales and Complexities of Smart Cities

Module 1: Introduction to Risk, Safety, Economics and Planning in Smart cities

Lecturers: Harald N Røstvik, Tegg Westbrook

Date: 16 November 10 - 12 o'clock

23 November 10 - 12 o'clock

(web live lectures through Microsoft Teams or Zoom)

The challenges to smart cities are always fluctuating, whether that is climate change, road congestion, crime, or recently pandemics. This module will focus on “traditional” safety and security-specific, market/consumer-driven agendas of smart places (homes, businesses and cities). From here the lecture will concentrate on how the Covid-19 pandemic has recently reconfigured our understandings of risk, safety, economics and planning for smart cities, including the human condition. We will consider new ideas and technologies for future cities and regions and, through examples, try to analyse potential for improvement of the human condition.

Compulsory introductory readings will be assigned and addressed in this module. Lecturers will invite students to debate the texts.

Theme: Smart infrastructure planning

Module 2: Measuring the built environment

Fabio Hernández-Palacio

15 November, 2021, 10AM – 2PM (web live lectures)

The rise of information technologies has witnessed enormous development in the last decades. Advances in data collection, storage and analysis open new possibilities for studying urban form and its performance. The built environment is a very complex system made up of cities and the infrastructures that connect them. The configuration of the built environment influences both the economic efficiency of an urban system and its inhabitants' health and quality of life. The urban form also affects resource usage efficiency, such as energy, space, and time, essential aspects of planning for sustainability and resilience. The lecture and short seminar will focus on and measuring the built environment, in particular, how the built environment can influence sustainability, looking at different aspects such as urban quality, urban form, urban density, densification and transportation in relation to Smart Cities.

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Theme: Cyber-physical safety and risk in Smart Cities

Module 3: Threats and risks in digital systems

Tegg Westbrook

17 November, 2021, 10AM – 2PM (web live lectures)

Smart cities are increasingly relying on surveillance and geospatial services to enable efficient functioning of basic services, adding further complexity to already vulnerable cyber-physical functions. If such services are disrupted, so too are many public and private functions. The lecture and seminar focus on the security and safety dilemmas in relation to digital systems, and the consequences this has for Smart City functions, in terms of economic, social, and political impact.

Theme: Societal and organisational approaches to risk in Smart Spaces

Module 4: Vulnerabilities and risks in cyber-physical systems – an organizational perspective across safety and security

Kenneth Arne Pettersen Gould

19 November, 2021, 10AM – 2PM (web live lectures)

Critical infrastructures in cities and their surrounding regions are to an increasing extent developed into cyber-physical systems (CPS), where computers, sensors and networks monitor and control physical processes, with feedback loops where physical processes affect computations and vice versa. The risks that arise from the development of CPS lie at the intersection between the domains of security and safety. This module introduces socio-technical developments that have contributed toward a wider and multidisciplinary foundation for understanding and managing worker- and organization-related risks. It focuses on a socio-technical understanding of causes and embraces the interrelatedness of technical, human and organizational factors for theorizing accidents and disasters. A socio-technical system approach substitutes individualized and general models of human action and error with descriptions of complex and adaptive realities involving a wide range of individual, technical, organizational and systemic factors.

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Module 5: Societal and organisational approaches to risk – an introduction to risk governance

Ole Andreas Engen

22 November,2021, 10AM – 2PM (web live lectures)

This module introduces risk governance and the IRGC Risk Governance Framework, exploring applications to Smart Cities. The lecture takes as a starting point that holistic cyber security management depends on cross-sectoral coordination, communication, cooperation, and knowledge sharing among the actors directly and indirectly responsible for security in critical infrastructures.

In the lecture we will emphasise that the dual nature of the risk concept – i.e., both as potential for physical change and as a social construct - requires a two-sided risk management strategy. Public values and social considerations act as driving forces in identifying the issues where risk analysis is considered necessary or desirable. Hence the opportunities and risks associated with modern technologies, economic development and other human activities requires a pluralistic and integrated model with both technical and social science perspectives.

The term 'risk governance' involves the translation of the substance and core principles of governance to the context of risk-related decision-making. Risk governance does not only include a multi-player risk process with many different aspects, but also considers contextual factors such as: Institutional arrangements - law and regulatory frameworks that determine the relationships, roles and responsibilities of stakeholders, and coordination mechanisms such as markets, incentives, or self-imposed norms. Political culture is also an important variable, including various risk perceptions.

Theme: Intelligent transport and sensor networks

Module 6: Safety and reliability of ITS systems

Tomas Tichy

29 November,2021, 10AM – 2PM (web live lectures)

To acquaint students with the issues of reliability and safety of artificial systems and human impact on systems, and reliability diagnostics of ITS technology and equipment with a focus on new methods and models for verifying equipment, technologies and subsystems in ITS. Basic concepts of safety and reliability in transport and its application. Basic scheme and types of diagnostic systems, including reliability diagnostics of technological equipment and ITS. Investigation of the area of optimization algorithms and fault analysis ETA, FMEA in tunnel system as ITS. Information about HMI in ITS, including operator testing and behavioural in real situations.

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Module 7: Sensors and Sensor Networks

Vaclav Jirovsky

30 November,2021, 10AM – 2PM (web live lectures)

The module is focused on the technology of sensor networks, sensors and used communication technologies with special attention on the security of data collection, data fusion and processing. It deals with the principles and use of sensors of electrical and non-electrical quantities, interfaces for sensor interconnections and communication technologies for sensor networks. Analysis of security of electronic toll collection is provided as an example of sensor network.

Blended Mobility Week– Smart campus case-study

17 – 21 January 2022, 10AM – 2PM

"Proportional, holistic, and cross-fertilised cost-effective interventions in urban places."

Oftentimes, the low-risk-high-impact probabilities of adverse human and natural events open to debate between city managers whether if, or what, interventions are proportional to the risk and threat situation. City managers sometimes must follow legislative duties of care; others have incentives to improve safety and security; whilst others may see little tangible benefit in investing in physical-digital interventions.

On the flipside, investing in interventions may demonstrate (dis)proportionate feelings of fear and concern based on specific security and safety dilemmas, as well as cultural, insurance, and legal reasons. Interventions which appear disproportionate may give the impression of panopticon-like surveillance and fortification of urban spaces, or leave places feeling too exposed and vulnerable. Proportionality therefore is about "what you don't do as much as what you do do."

Left in limbo, managers may consider "resilience thinking" into seemingly unrelated projects and initiatives. This 'cross-fertilisation' and multifunctional use of digital and urban interventions seek to maximise the return of that investment, whether that is 'peace of mind', economic returns, improved efficiency, or cleaner, climate-friendly environments.

The predominantly project-based BMW addresses a number of safety and security challenges for people in Stavanger. Using the University of Stavanger campus as a case study for situational hypothesis testing, the BMW seeks to understand how

physical and digital planning solutions can minimize safety issues, risk and threats, whilst providing returns for the proposed interventions.

Working in groups, students will be exposed to hypothetical 'worst-case scenario' issues on the university campus, which includes a hypothetical crime risk and flooding risk, and incorporate interventions within a hypothetical green initiative on campus. It must also consider the possible metaphysical impact resulting from cyber-malfunction or interference on their proposed digital measures. Their proposed interventions, overall, must reduce the vulnerability, threat, and impact to acceptable and manageable levels, and consider risks if those systems fail.

The course gives students a unique opportunity to use a variety of qualitative and quantitative measurements to find proportionate, holistic, and cross-fertilised cost-effective solutions based on classroom and fieldwork tasks. Students will also learn about the possibilities and limitations of multipurpose technologies and interventions, and individually develop a report for the protection of a selected site, accompanied by a 20-minute presentation. Their objective is to make a proposal for how 'smart' solutions can:

- Provide an economic return *higher or equal* to the security/safety return.
- Improve efficiency *higher or equal* to the security/safety return
- Reduce the vulnerability, threat, and impact to acceptable and manageable levels.
- Consider the impact if digital systems fail.

Students will also be required to prepare up to three questions for selected presentations.

Day one

The lecturers and students will introduce themselves and set out a plan for the BMW.

Students will be organised into groups.

Day two

Guest speakers involved in public and private smart initiatives in the city will give presentations. Researchers and PhD candidates from the University of Stavanger's Smart City Research Network are also invited to give brief presentations of ongoing research activities.

Day three

Field trip to Stavanger Vaagan to look at terrorism and flooding threat, and the incorporation of physical and digital interventions in the area. A field trip to downtown of Sandnes will look at security landscaping and green space.

An afternoon meeting will look at hypothetical crime and flooding threat at UiS campus, and hypothetical green initiatives on campus (wind and solar project).

Day four

Group work deciding on interventions and measuring cost-effectiveness and impact resulting from digital malfunctions.

Day five

Group work developing slides and delivering presentations.