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TM6

Smart metering

Social risk perception and risk governance

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Introduction

The goal of this teaching module is to broaden the understanding of technology-related risks and to present the concepts of social risk perception and risk governance in the context of smart metering technology.

In current phase of technological development – known as the fourth industrial revolution – rapid and profound changes are setting up new and particularly destabilizing risks. In more and more complex technological systems that constitute modern life, the risks become difficult to identify and even more difficult to measure and manage. Many of the technologies, such as artificial intelligence (AI) or genetically modified organisms (GMO) are considered from this point of view. A demonstrative example from the energy sector is smart metering (SM) technology.

» *Smart metering means, inter alia employing communication technologies to exchange information between electric companies and their customers, and sensing technologies to constantly measure the quantity and quality of electricity being transferred over the grid, which is thus called the smart grid (SG).*

» *Smart grid is a complex system comprising numerous interconnected components – controls, computers, measuring devices, and other digital equipment, as well as advanced software and applications – working together and exchanging information.*

In electrical smart grids, becoming enormously complex systems, it's difficult not only to mitigate but also to recognize and estimate even relatively isolated technological risks, such as for example the risk of a cyberattack interrupting supply of electricity.

» *In an increasingly interconnected world new technology-related risks – such as for example the "big brother" effect, or security of energy consumers' private data – are emerging and raising additional technical, social and political concerns.*

The dilemmas call for proper governance of SG and SM development. It should be comprised of both: application of suitable technical tools (i.e. secure transfer of sensitive data), and also implementation of appropriate political and social instruments. Exemplary of the latter may include inter alia decision-making on who and how should govern the energy consumers' data or to what extent the technical innovations should be integrated into the community. Rapid development of smart grids and smart meters (as well as other modern technologies) requires farsighted policy and social awareness to avoid harming the society.

Using the example of SM, a ***'risk governance' framework*** is introduced in the course. It consists of three main parts: risk perception, risk communication and risk management. All of them are subsequently presented and discussed in the respective sessions.

The teaching module is composed of 4 successive sessions:

1

Session 1: Smart grids and smart meters
introduces the technical and economic aspects of Smart Grids and smart metering technology.

135 minutes

2

Session 2: Risk perception
deals with risk perception concept and its historical development.

120 minutes

3

Session 3: Risk communication
is devoted to presenting the existing risk communication approaches in the context of different "controversial technologies", such as nuclear energy, radioactive waste management or genetically modified food.

135 minutes

4

Session 3: Risk management
discusses different risk management and governance strategies – stretching out from uniquely expert risk estimation and decision-making to broad public debates with the involvement of different stakeholders.

135 minutes

Session 1:
Smart grids and smart meters

a) Session objectives

This session is intended to give students an inside general knowledge of what smart meters are, how they operate, how they cooperate in a grid, what are the benefits of smart meter use, etc.

b) Session scope

Introduction

A smart meter is an advanced electricity meter (less often gas or heat meter), which measures energy consumption of the consumer, and additionally collects other information regarding this consumption (e.g. voltage, phase angle and frequency) that may be useful for the energy supplier and / or consumer.

Smart meters can read information about energy consumption and its parameters and send them via communication networks to remote data centers in real-time.

» *Smart meters employ sensors to identify various physical parameters, and communication devices to transfer the data. Smart meters usually employ two-way communication between the meter and the energy company.*

It enables not only gathering information from the meter (regarding the energy supplied, times of peak usage, etc.), but also sending information and / or commands to the meter (regarding e.g. current electricity prices, operation schedules, etc.)

An integrated system of numerous smart meters, communication networks, and data management system, that facilitates two-way communication between energy company and its customers is defined as advanced metering infrastructure (AMI). AMI and smart meters constitute an important part of **smart grid** infrastructure – infrastructure of a power grid designed for enhanced efficiency and reliability of energy supply (using automated controls, IT and communications technologies, sensing and metering devices, energy management techniques, and the like) (Patel, Modi 2015).

Applications

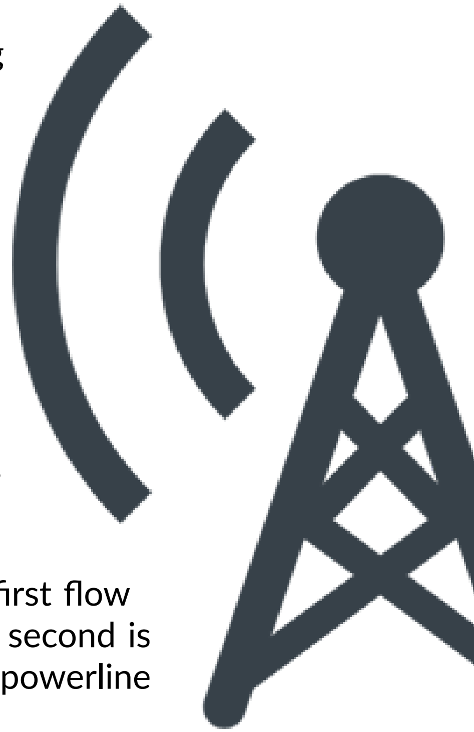
The range of possible applications of smart meters is just beginning to reveal itself and the technology starts to reach a wide audience. These meters can not only measure electricity consumption (or even bill customers), but they can also collect massive statistical and diagnostic information about distribution grids, electricity equipment in households, or decentralized units of energy generation and / or storage.

Thanks to the communication capabilities, smart meters can be used to monitor, as well as to control household appliances and devices connected to the grid at customers' sites. Other possible applications include controlling the maximum consumption of electricity and disconnecting / reconnecting the electrical supply to any customer. To perform those tasks, smart meters can also communicate with one another.

Real-time data on energy consumption from a large number of smart meters (i.e. energy consumers) allow energy companies to effectively employ **demand side management** techniques. Combined with in-home displays, smart meters can reveal information to end-users about periods when higher energy prices are in effect, which should encourage consumers to save money. Smart meters can bring new time-based rate programs or even directly control the work schedules of home appliances and other energy devices. In addition, smart meters also help to detect unauthorized consumption and theft of electricity.

All of these new services and applications impose the need of collecting large amounts of data on energy consumption on energy utilities, also in real time. That's where smart meters come in action and give the functionality required.

Communication



The most important aspects of smart meters technology include security and safety requirements regarding communication networks and communication devices. The use of smart meters involves transfer of a huge amount of data between energy companies, the meters and household appliances powered thru the meters. These data are confidential and access to them should be authenticated. Guidelines and standards for security of transmission, collection, storage and maintenance of energy data in smart grids have been formulated and are under implementation.

Data transmission in smart grids allows to employ various communication technologies, both wired and wireless. Wireless communication has certain advantages over wired technologies – the most important are cheaper infrastructure and the possibility of connecting to energy users in less accessible areas. On the other hand, wireless transmission is vulnerable to interference and signal weakening, which applies to wired solutions to a lesser extent.

Generally, two types of information infrastructure are used for information flow in a smart grid system. The first flow is from sensors and electrical appliances to smart meters (which can be a part of the Internet of Things), the second is between smart meters and the energy utility's data centers. The first data flow can be accomplished through powerline communication (PLC) or wireless communications, such as ZigBee, Z-wave, and others. For the second information flow, cellular technologies or the Internet can be used. It is expected that part of this infrastructure will make use of the power distribution lines themselves as communications carriers using broadband PLC technology (Patel, Modi 2015).

Nevertheless, there are several factors that should be taken into account in the smart metering deployment process, such as time of deployment, operational costs, the availability of the technology and rural/urban or indoor/outdoor environment, etc. The technology choice that fits one environment may not be suitable for the other. An overview of some smart grid communication technologies is indicated in the table below.

Technology	Spectrum	Data Rate	Coverge Range	Applications	Limitations
GSM	900-1800 MHz	Up to 14.4 Kbps	1-10 km	AMI, Demand Response, HAN	Low data rates
GPRS	900-1800 MHz	Up to 170 Kpbs	1-10 km	AMI, Demand Response, HAN	Low data rates
3G	1.92-1.98 GHz 2.11-2.17 GHz (licensed)	384 Kpps-2Mbps	1-10 km	AMI, Demand Response, HAN	Costly spectrum fees
WiMAX	2.5 GHz, 3.5 GHz, 5.8 GHz	Up to 75 Mbps	10-50 km (LOS) 1-5 km (NLOS)	AMI, Demand Response	Not widespread
PLC	1-30 MHz	2-3 Mbps	1-3 km	AMI, Fraud Detection	Harsh, noisy channel environment
ZigBee	2.4 GHz-868-915 MHz	250 Kbps	30-50 m	AMI, HAN	Low data rate, short range

Source: Umang M, Patel & Modi, Mitul. (2015). A Review on Smart Meter System. IJIREEICE. Vol. 3, no. 12, pp. 70-73.

The communication infrastructure in smart grid requires two-way communications, interoperability between advanced applications and end-to-end reliable and secure communications with low-latencies and sufficient bandwidth. Moreover, the system security should be robust enough to prevent cyber-attacks and provide system stability and reliability with advanced controls. Secure information gathering, transmission, and storage are critical issues for energy companies and their customers, especially due to grid control and billing purposes. To avoid cyberattacks, efficient security mechanisms regarding communication in smart grid should be developed and applied.

Another critical issue is providing the reliability of the smart grid infrastructure. Combining different communication and information technologies and protocols, numerous advanced intelligent and electronic devices, controls, etc. with power grid infrastructure from substation to customer meters, requires significant reliability and robustness of the whole system.

Controversies

Although smart meters for electricity have received widespread acclaim as a means to achieve more resilient and sustainable electricity consumption, public opposition has emerged in several countries. In North America concern with the health effects of wireless smart meters has been an important reason given by opponents of this technology, but frequently the reasons for opposition are bundled into a group that also includes security, privacy, and excessive costs. In some cases, people who would otherwise support smart meters due to their environmental beliefs have rejected them due to this bundle of concerns. These opponents appear to represent only a minority of households and businesses, but they have been persistent and vocal enough that they have achieved some policy responses (SE GB 2019).

c) Pre-reading

No.	Author and title	Description
1.	Umang, M. Patel, Mitul Modi. A Review on Smart Meter System. "IJ IREEICE" 2015, Vol. 3, Issue 12, pp. 70-73. DOI: 10.17148/IJIREEICE.2015.31215	The paper presenting a brief literature review of the work carried out by the various researchers in this field by using smart meters and the various communication system used in smart metering technology.
2.	The campaign for a smarter Britain https://www.smartenergygb.org/en	Webpage of Smart Energy GB – non-governmental British organization acting in favor of the smart meter roll-out –helping to understand smart meters by the broad public.
3.	Discover Smart Meters & Smart Grids http://my-smart-energy.eu	Webpage of EDSO for Smart Grids – European Distribution System Operators' Association for Smart Grids, acting in favor of smart metering and smart grids roll-out across of Europe – helping to understand smart meters and smart grids by the broad public.

d) Session activities

Activity 1: Introductory lecture

Methods	Interactive lecture
Keynotes	This presentation is a general introduction to technical aspects and comments on SSH issues should be avoided.
Materials	**TM6-ST1-RM1-Smart metering – introductory lecture**
Required accessories	Computer + projector
Time allocation	30 min
Learning outcomes	Understanding of smart grids on the basis of smart meters.

The lecture presents and explains what Smart Meters are, how they operate, how they cooperate in a grid, what are the benefits of Smart Meter use. An evolutionary explanation of the development of meter technology is given. The lecture presents and explains what are different advancements in Smart Meters and what are their capabilities in each respect. A broad application benefits comparison is given which illustrates the capabilities available thanks to Smart Meters' Smart Grid advancements. Basic operations of a Smart Meter system are covered and discussed with the focus on communication. Initial information on security issues is presented in context of privacy and legislation.

Activity 2:
Presentation of end-user energy consumption data management

Methods	Participatory lecture
Keynotes	The calculations provided in the presentation are simple and should be treated as examples elaborating on the procedure. They are the introduction to activity 3.
Materials	**TM6-ST1-RM2-End-user energy consumption**
Required accessories	Computer + projector
Time allocation	20 min
Learning outcomes	Understanding of energy consumption.

The goal of activity 2 is to provide understanding of the general concept of end-user energy consumption and its everyday application. The awareness of the omnipotence of energy consumption in all energy consumer systems is raised and the lack of basic knowledge by users evidenced. The idea of energy savings translated to savings is presented based on optimization of energy consumption based on the information feedback. The simplicity of calculating end-user energy consumption cost is presented with focus on basic required information. The general step procedure of calculations is presented on a given example with step by step instructions and clarification. Basic energy consumption tables are given. Time variance pricing concept is introduced with the explanation of the need for its existence. Innovative variable tariffs are covered with the automation technology explanation which can automatize the process of consumption control. As a proof for the concept, an example calculation is conduced and the results discussed. Finally, advantages of being aware of energy tariffs in conjunction with the use of Smart Meters are perpetuated.

Activity 3:
End-user energy consumption data calculation

Methods	Webquest, computer workshop
Keynotes	A good explanation of the task is very important. Comment on differences in tariffs in EU.
Materials	**TM6-ST1-RM3-Cost calculation exercise (blank)** **TM6-ST1-RM4-Cost calculation exercise (CES – dishwasher)** **TM6-ST1-RM5-Cost calculation exercise (Endesa – air conditioner)** **TM6-ST1-RM6-Energy tariffs** **TM6-ST1-RM7-Cost calculation example – instructions for students** **TM6-ST1-RM8-Cost calculation example – instructions for teacher** **TM6-ST1-RM9-Energy-label-air-conditioner-example** **TM6-ST1-RM10-Energy-label-dishwasher-example**
Required accessories	Computer laboratory
Time allocation	50 min
Learning outcomes	The skill to calculate and evaluate energy consumption.

The main goal of this activity is for the students to practice energy consumption calculations and to realize, that by adjusting the energy tariff the cost of energy may vary significantly. In addition, time shifting the use of some appliances may bring additional savings. This time shift may be done by Smart Meters semi or fully automatically. Students are asked to calculate energy consumption cost for specific household appliances based on the provided handouts with the use of a pre-prepared spreadsheet. The teacher should divide the class into 2-3 groups. Common assumptions should be made. Each group should be asked to perform the calculations for the same appliance but for different tariffs from different EU countries. This will provide comparison material for the activity summary.

Activity 4:
Discussion on energy consumption data management

Methods	Panel discussion
Keynotes	The discussion should be guided to reach a conclusion that Smart Meters pose also social risks.
Materials	**None**
Required accessories	None
Time allocation	35 min
Learning outcomes	Understanding the energy consumption information flow.

The main idea of this discussion is for the students to come to a conclusion that Smart Meters have not only advantages but also disadvantages which are not all technically based. After a brief summary of activity 3 in the form of voluntary exclamations, the students are asked to think and present the ideas on how is information transferred from the Smart Meters to the stakeholder. The guided discussion should elaborate on the "route" (IoT – Internet of Things) of information and possible danger that may arise in the course of this transfer. The discussion should be guided to come to a conclusion, that besides technical dangers, there are also social ones – to be discussed in later sessions.

Activity 5:
Assignment with further work

Methods	Discussion
Keynotes	Ask the students to make notes from their discoveries.
Materials	**TM6-ST1-RM11-Toronto**
Required accessories	None
Time allocation	Home assignment
Learning outcomes	Ability to analyze public discourse on smart metering.

Students are asked two things: first, to look in the Internet for cases of public debates on smart metering and identify all the risks appearing in the discussion. Second, to study at home materials on a case of Toronto city, which will be the subject of the next session.

e) Additional resources

No.	Author and title	Description
1.	U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability. 2016. Advanced Metering Infrastructure and Customer Systems: Results from the Smart Grid Investment Grant Program. https://www.smartgrid.gov/document/SGIG_Results_for_AMI_and_Customer_Systems_2016.html	This report shares key results and benefits from the 70 Smart Grid Investment Grant (co-financed by U.S. DOE) projects implementing AMI and customer system technologies, and also documents lessons learned on technology installation and implementation strategies.
2.	Gungor, C. Vehbi et al. Smart Grid Technologies: Communication Technologies and Standards. "IEEE Transactions on Industrial Informatics" 2011, Vol. 7, Issue 4, pp. 529-539. DOI: 10.1109/TII.2011.2166794	The paper provides a better understanding of the technologies, potential advantages and research challenges of the smart grid and provoke interest among the research community to further explore this promising research area.
3.	Hess, J. David. Smart Meters and Public Acceptance: Comparative Analysis and Design Implications. "Health, Risk & Society" 2014, Vol. 16, Issue 3, pp. 243-258. DOI: 10.1080/13698575.2014.911821	The study examines patterns in public opposition, suggests hypotheses for future research, and compares two policy strategies, one of which views public opposition as a lack of good communication from utilities and the other of which views it as an opportunity for innovation in overall systems design.

Session 2:
Risk perception

a) Session objectives

This session has as its aim to get the students introduced with specificity of technological risk perception and teach them to identify possible risks which might be important for various groups of people (sometimes called stakeholders). Students should be also able to understand the causes in differences in risk perception between experts and lay-people and to categorize risks according to their character, actors who perceive them and sphere they apply to.

b) Session scope

Introduction

Risk perception belongs to classical motifs of social history of technology. Stretching back to the beginnings of modern scientific and technological era, when first innovations like cars and trains arouse social fears and faced the problem of acceptability, risk perception became crucial in the 70's of 20th century. Development of new technologies, especially the atomic energy, resulted in intensive public protests and unease with the fast pace of technological innovations. Psychometric studies, initiated in the 70's at the University of Oregon, tried to answer the question why (from the expert point of view) lay-people incorrectly perceive risks related to new technologies. Why they fear things which (again, from the expert point of view) are irrelevant, negligible or even do not exist. Why do people fear nuclear energy, pesticides, spray cans or large constructions much more than they are 'really' (it means due to the experts evaluations) risky? Why do people refuse building a nuclear power point in their neighborhood, while at the same time they smoke cigarettes risking lung cancer, drive cars risking road accidents, etc.? Answering these question and understanding the social perception of risk became even more pressing, as new controversial technologies came to use: such as genetically modified organisms in the 80's and nanotechnologies in the 90's. Reflection of the social perception of risk allowed to identify a number of factors influencing how people perceive risks related to new technologies. However, it also led to a significant change in the approach to social risk perception and rejecting the basic assumption, that the expert evaluation of technological risk is always right, while everything

diverging from it is a mistake resulting from irrational fears and lack of professional knowledge. Instead, social risk perception began to be treated 'seriously', as a justified expression of another perspective, based in socio-cultural rationality. Such rationality reflects rather values, needs, interests, general approach to life and future of the people, then scientific methods of technology assessment. Therefore social perception of risk should not be rejected as such, but taken into account and answered properly.
In case of smart metering we also face the problem of diverging opinions of the level of safety and character of risks related to 'smart' technologies. Starting from health risks from wireless smart meters, through security of the data collected in the system to privacy issues related to possibility of collecting, processing and combining data about behavior patterns of virtually every citizen in the system. Thus, in order to govern the risks related to smart metering, one need first to confront the issue of risks perceived by lay-people (even if they sometimes seem to be unjustified).
The sessions deals with specificity of risk perception by the public, which is mainly presented as opposed to the experts evaluations of risks. In order to prepare students for understanding why smart metering arouses social fears of different kinds, at the beginning of the session a presentation of historical cases of risk perception takes place. The characteristics of risk perception is shown in details on the example of radioactive waste management in Sweden, where a comprehensive social study has been conducted from 1980s, as a part of site selection process for final repository of radioactive waste. After that, students get acquainted with a case of Toronto city, where a company Sidewalks Labs (related to Google) plans to develop a high-tech district at the southeast of Downtown Toronto, called Quayside, using the smart metering technologies. At the end of the sessions, students are asked to identify both technical and social risks which may be perceived by the community in Toronto.

Origins and foundations of the risk perception approach

The topic of social risk perception emerged as a research subject in the 60's and 70's of the 20th century, when discrepancies between risk evaluations delivered by scientific experts and lay-people perception of risk related to new technologies became vivid, endangering the decision-making processes. The most striking example was the nuclear energy, commonly perceived by extremely dangerous, while according to expert assessments, bearing only low level of risk.

The discovery of "risk perception gap" led to developing a new field of research: psychometric risk studies. They were based on psychological risk perception studies, conducted since the 60's. A leading research center became the University of Oregon, where a.o. Paul Slovic has been working. The psychometric paradigm aimed at establishing an acceptable level of risk, i.e. to answer the question "how safe is safe enough?", to quote the famous statement from an article published in 1969 by Chauncey Starr in Science (Starr 1969). The psychometric approach was based on comparing different levels of risk people are willing to accept. E.g. if we accept a relatively high risk of accident related to driving a car, we should be willing to accept the much lower risk for health caused by using pesticides and chemical food conservatives. If the death rate in case of coal mining is higher that the death rate caused by nuclear accidents and we as society accept coal industry, we should accept nuclear energy as well.

The comparisons of risk acceptance levels were however based on the technological risk assessment procedure (R=PxH). And it quickly turned out, that in case of social risk perception it doesn't work these way. Such statements as "the annual risk from living near a nuclear power plant is equivalent to the risk of riding an extra 3 miles in an automobile" (Slovic 2000: 231) do not convince the people and do not make them accept the siting of a nuclear power plant in their neighborhood. The popular explanation of the phenomena was the differentiation between expert and social risk perception. The explanation of differences between expert and social risk perception was rooted in depreciating social rationality. The cause for lack of acceptance of new technologies, like nuclear energy or biotechnology was seen in the irrational fear of everything new, lack of scientific knowledge, lack of trust and backwardness of lay-people. Like in an enlightenment paradigm, the uneducated lay-people were set as opposed to well-educated scientists who "know the truth", while the former are simply wrong in their amateur and mistaken risk perceptions.

However, the social and psychological research on risk perception, which followed (and replaced) the psychometric approach in the 80's, has shown that such an opposition between the false social risk perception and correct expert assessments is misleading. The researchers pointed out to psychological and social factors which determine social risk perception and which are not reducible to simple irrationality and lack of knowledge. On the contrary, the social and expert risk perception are rather based in specific forms of rationality, which form the framework for risk assessments. As Terje Avon and Ortwin Renn point out, "A vast majority of studies on risk perception and concerns tend to show, however, that most of the worries are not related to blatant errors or poor judgement, but to divergent views about the tolerability of remaining uncertainty, short-term versus long-term impacts, the trustworthiness of risk regulating or managing agencies, and the experience of inequity or injustice with regard to the distribution of benefits and risks. All of these concerns are legitimate in their own right and valid for the respective policy arena. They cannot be downplayed by labelling concerns as irrational fears." (Aven, Renn 2010: 60).

An useful framework for understanding the social risk perception offers Peter Sandman, who coined the phrase that risk is the hazard + outrage factor. By 'outrage factor' he understands the character of public response to a given hazard, which is determined by various psychological and social factors and not objective, technical characteristics of a given technology or phenomena (Covello, Sandman 2001).

Dr. Peter M. Sandman

"Creator of the "Risk = Hazard + Outrage" formula for risk communication, Peter M. Sandman is one of the preeminent risk communication speakers and consultants in the United States today, and has also worked extensively in Europe, Australia, and elsewhere. His unique and effective approach to managing risk controversies has made him much in demand for other sorts of reputation management as well."
http://www.psandman.com

Research on risk perception has come to the conclusion, that in order to understand the differences between social and expert risk perception we should accept that there is no one sort of risk which is seen differently, but rather we have to deal with two various 'risk constructions': one is based on social, while the other on scientific rationality. In this sense, the social risk perception is not simply an 'immature' version of expert risk perception. These two cannot be compared, like the psychometric paradigm attempted to, since there are referring to various criteria.

Controversy over smart meters

Smart metering technology arouses much controversy in the world. From the point of view of risk perception, interesting is that different countries and communities perceives and highlights different risks. The most common issues are: security and safety (cyberattacks and power outages, possible fires), privacy (collecting data and selling them to third parties, surveillance, legal issues), health (impact of wireless data transmission on the body), opt-out (coercion), finance (cost of device and its infrastructure, increasing cost of electricity). Among the many different initiatives against smart metering, there is established in 2010 website stopsmartmeters.org, which grew out of a grassroots initiative and which focuses on supporting various local movements. This initiative has contributed to several legal precedents, which resulted in the mass removal of smart metering devices in some states (US). In 2013 was released a documentary film Take Back Your Power, which sharply criticized the legitimacy of setting up smart meters. It focused mainly on issues related to the security of collecting data and its use by the state and third parties. Many of doubts about smart metering are not justified by scientific research, but from the point of view of risk perception, it is not important whether any threat is real or not, and on the basis of which criteria to decide on it. If people perceive something as a threat, the consequences of their behavior are real and unquestionable.

CASE STUDY: Toronto

At the beginning of 2017 Toronto decided to develop a post-industrial waterfront area. In addition to the municipal authorities, this area was taken care of by a grassroots initiative called „Waterfront Toronto". Google's daughter company, Sidewalk Labs, decided to build a city of the future here. Although the final decision was taken at national and city level, it was immediately stipulated that Waterfront Toronto would be heavily involved in the decision-making process. The plans immediately aroused many different controversies among different social groups. The most frequently raised problem turned out to be the collection of data by intelligent metering devices. The company conducts meetings with residents, has created an editable online document in which everyone can express their concerns and ask questions, to which the company is obliged to answer.

An example of building a city of the future on the Toronto's waterfront was chosen because it is an ideal example, including of local residents (grassroots initiatives, professors, ordinary citizens, etc.) to co-decide on the technologies used, technical solutions and the applicable legal principles.

CASE STUDY: Siting of a deep nuclear waste repository in Sweden

The storage of radioactive waste is one of the most important challenges facing humanity in the 21st century. Different countries apply not only different technological solutions, but also different ways of selecting a storage site and, consequently, different ways of dealing with the local community. The example of Sweden was chosen because it is often presented as a model to follow.

The first commercial nuclear power plant in Sweden started work in 1975. In 1977 Sweden introduced a law that required accurate documentation of the absolutely safe storage of nuclear waste. In 1984 this law was updated, adding the requirement that plant owners must submit a “comprehensive research and development programme” for the storage of nuclear waste. SKB (Svensk Kärnbränslehantering AB) became the company that was set up to manage nuclear waste. The Swedish company initially focused only on the scientific dimension of the problem. In the 1980s, the SKB started to drill test boreholes all over the country, which I met with great resistance from local residents. The protests of local residents led to the cessation of drilling. The company came to the conclusion that without the consent of local residents, the implementation of any solution will be impossible. The company changed its strategy in the 1990s and began to conduct extensive public consultations.

Strategy of in-depth public consultations, in which local residents have the opportunity not only to learn many things, but also to express their concerns, their voice is respected and has real decision-making significance, has its drawbacks. It is a long-term process that requires competence from outside hard science. The choice of a radioactive waste disposal site required a skillful combination of social sciences, humanities and a range of natural sciences. The consultation and selection of the final place ended in 2007. Although the strategy was time-consuming, the result brought many benefits. Local residents have raised their awareness of radioactive waste, have a sense of co-determination on important national projects, and the company has succeeded in addressing technical issues related to the storage of radioactive waste.

Svensk Kärnbränslehantering AB

c) Pre-reading

No.	Author and title	Description
1.	Ropeik, David. Understanding Factors of Risk Perception. "Nieman Reports" 2002, Vol. 56, Issue 4, pp. 52. Code: TM-ST2-AM5-FactorsOfRiskPerception	Basic list of risk perception factors.
2.	Risk Perception https://www.youtube.com/watch?v=dNgrKQo0gMg	Course Risk in Modern Society conducted at Ledien University. Module: Risk Perception
3.	Berggren, Marie, Rolf Persson. Public Involvement and Participation in Site Selection for Spent Nuclear Waste in Sweden. 2014, WM2014 Conference (post conference paper). Code: TM-ST2-AM8	Post-conference paper: Berggen, Marie, Persson, Rolf. 2014. "Public Involvement and Participation in Site Selection for Spent Nuclear Waste in Sweden".
4.	Final repository for spent nuclear fuel https://www.youtube.com/watch?v=WCHqxqlZUNA	Video about technological aspects of storage of nuclear waste.
5.	Is your smart meter spying on you? Code: TM-ST2-AM9	Newspaper article on dangers of smart meters.
6.	Covello, Vincent, Peter M. Sandman. 2001. Risk communication: Evolution and Revolution. In: Anthony Wolbarst (ed.), Solutions to an Environment in Peril. Baltimore: John Hopkins University Press, pp. 164–178. Code: TM-ST2-AM7-RiskCommunication	Article on the history of risk communication, discussing the basic issues and difficulties related to it.
7.	Public Draft Code: TM-ST2-AM4-TorontoCasePublicDraft	A bottom-up public opinion project in which anyone interested could ask a question. The file contains over 100 questions divided into several thematic groups. It is to be used as a teaching aid for the teacher.

d) Session activities

Activity 1:
Risk identification exercise

Methods	Presentation
Keynotes	Students should only focus on presenting their findings without prolonged comments.
Materials	**None**
Required accessories	whiteboard, markers
Time allocation	20 min
Learning outcomes	Students can identify risks appearing in public discourse on smart metering.

Students briefly list the identified risks. Teacher writes them down on the board. After the list is completed, students are asked to indicate which risks they think to be real and which are not.

It is important that the teacher abstains from commenting and does not enable discussion on it. It will come later with and after the introductory presentation. Thus, the list of the risks should stay visible for the next part of the session.

Activity 2: Introductory presentation

Methods	Direct presentation
Keynotes	Alert the students to a great variety of potential risks.
Materials	**SM-ST2-RM1 Risk Perception**
Required accessories	None
Time allocation	20 min
Learning outcomes	Students are aware of the broad context of technological risk perception, understand its backgrounds and conditions.

This activity has an introductory character and consists of a concise presentation. It delivers basic concepts in risk perception and presents history of psychometrical and sociological research on the topic. As illustration for the presented concepts the example of Swedish radioactive waste management debate is used.

Activity 3:
Technical and social risks identification

Methods	Project based analysis, work in groups, discussion, assessment
Keynotes	Students should focus not only on finding but also on classifying and grouping risk.
Materials	**SM-ST2-RM2-TorontoCase Presentation** **SM-ST2-RM3-TorontoCase** **SM-ST2-RM4-TorontoCase** **SM-ST2-RM5-TorontoCase** **SM-ST2-RM6-TorontoCase** **SM-ST2-RM7-TorontoCase** **SM-ST2-RM8-TorontoCase** **SM-ST2-RM9-TorontoCase** **SM-ST2-RM10-TorontoCase** **SM-ST2-RM11-TorontoCase** **SM-ST2-RM12-TorontoCase** **SM-ST2-RM13-TorontoCase** **SM-ST2-RM14-TorontoCase** **SM-ST2-RM15-TorontoCase** **SM-ST2-RM16-TorontoCase** **SM-ST2-RM17-TorontoCase**
Required accessories	flip charts, markers
Time allocation	55 min
Learning outcomes	Students can identify technical risks related to smart meters.

Students are divided into two groups and given various materials (press articles, webpages' printouts etc.) about the case, they should discuss and try to identify technical and social risks. Students should try to group together the different risks and find links between their different types. Then, groups present shortly (approximately 5-10 minutes per group) the identified risks (it can be done using flip charts). At the end, the results of the activity are evaluated together with the teacher.

Social risks example outcome:

- Who will own/control/have access to the data that is captured by the sensors deployed in this project?
- Under what terms will that data be shared? For whom and for what purposes?
- Who will be trained to operate, control, maintain proprietary systems used throughout this project?
- Who will be responsible to respond should project infrastructure be hacked?
- How will sustainability design elements be prioritized – low carbon, cost savings, comfort of residents?
- How will public feedback and feedforward be incorporated into design and implementation?
- Do residents have a right to opt-out of the systems? Do they have, or can they claim, a right to be forgotten if data is collected about them?

Activity 4:
Risk map

Methods	Mind map, discussion
Keynotes	This task is best done on a whiteboard.
Materials	**None**
Required accessories	white board, white board pens (in different colors), colored cards needed to build a risk map
Time allocation	20 min
Learning outcomes	Students can see connection between various kinds of perceived risks and ascribe them to different social actors (stakeholders).

Both technical and social risks identified in activities 2 and 3 are now ordered and structured in a 'risk map'. Teacher together with the students looks for connections and relations between different kind of risks in order to group them together as they appear in public discourse. Teacher and students aim at describing which risks are connected with each other, which ones usually appear together, which ones are mutually exclusive. The results of the discussion are directly written on the white board. Afterwards, students are asked to identify social actors (individuals, institutions, social groups, private and public bodies) which share the perceived branches of risk.

Activity 5:
Summary discussion

Methods	Discussion
Keynotes	The discussion should be guided to discover the necessity of proper risk communication.
Materials	**None**
Required accessories	**None**
Time allocation	20 min
Learning outcomes	Students can take the perspective of various stakeholders and perceive risks related to smart metering from their point of view.

Final discussion serves summing up the session. During the discussion natural differences between perspectives of various stakeholders should be stressed. The session should be concluding by asking the practical question how to deal with the differences and how to take decisions on controversial technologies when they are so diverging opinions of them. This question is a platform to the next session.

e) Additional resources

No.	Author and title	Description
1.	Smart attack! https://youtu.be/N29AtA3VodU	Short video: Smart attack!
2.	Take back your power! https://takebackyourpower.net/watch-take-back-your-power-2017/	Documentary movie: Take back your power!
3.	Stop Smart Meters! https://stopsmartmeters.org/	The most popular website gathering opponents of smart metering.
4.	Smart electricity meters can be dangerously insecure, warns expert https://www.theguardian.com/technology/2016/dec/29/smart-electricity-meters-dangerously-insecure-hackers	Article on the threats of hacking smart meters.
5.	FBI: Smart Meter Hacks Likely to Spread Code: TM-ST2-AM10	Article in cyber intelligence bulletin in which FBI warns against the spread of smart meters hacking.
6.	Smart meter hacking can disclose which TV shows and movies you watch Code: TM-ST2-AM11	Article about how smart metering can put our privacy at risk.
7.	Smart Hacking for Privacy https://www.youtube.com/watch?v=YYe4SwQn2GE&feature=youtu.be	Speech at the conference on smart meters hacking.
8.	Google Partners with Eight Utilities in Smarteter Projects to Track Energy Use Online Code: TM-ST2-AM12	Article on Google's plans for online tracking of consumption of energy.

Session 3:
Risk communication

a) Session objectives

The goal of the session is to introduce the next step of the risk governance framework, namely the risk communication approach. In this session students should learn to identify advantages and disadvantages of each model of communication and choose the most appropriate one in case of smart metering.

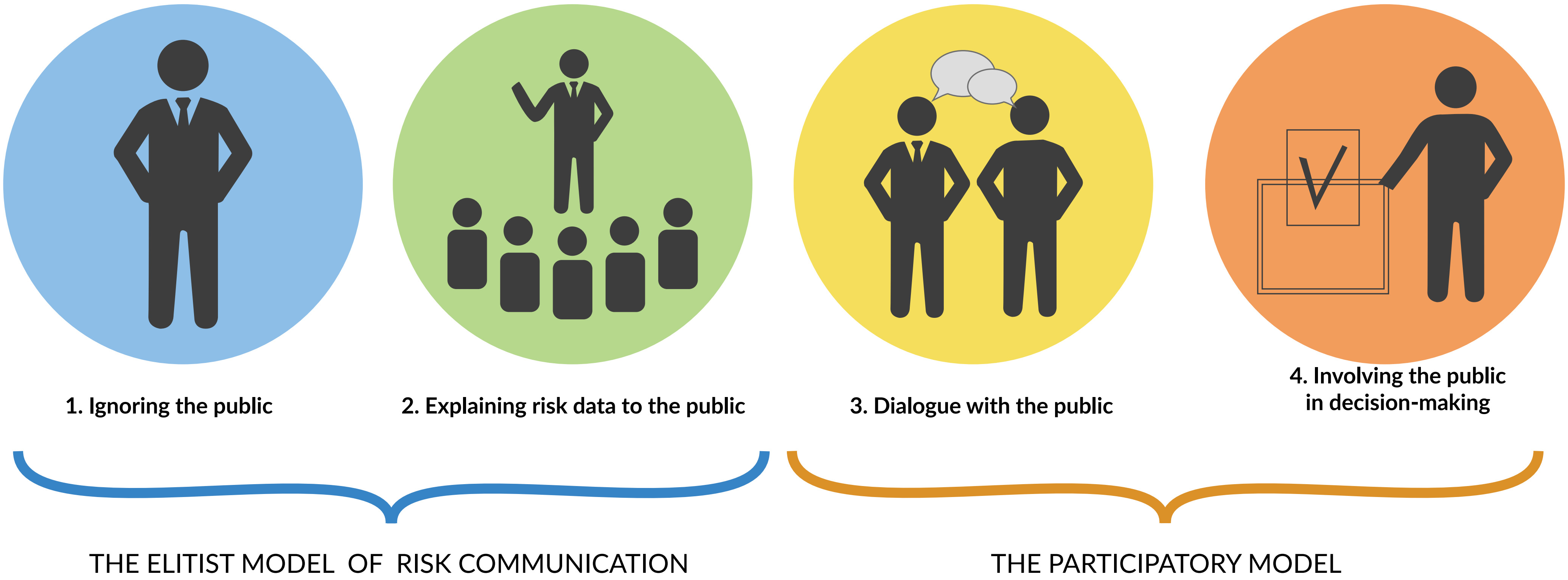
b) Session scope

Risk communication deals primarily with the question how to talk with the interested parties about the controversial technology. Approaches in risk communication reflect to a high degree the position taken previously on risk perception. If we assume that lay-people are simply wrong because of their irrational fears and lack of knowledge, the most probable risk communication strategy is aimed at convincing them that they are wrong and deliver them 'correct' knowledge by the experts. This approach has become famous as the so-called 'deficit model', what refers to the deficit of knowledge as an assumed source of flawed risk perception. If, again, we accept the diverging opinions on risk in the society, 'dialogue model' of risk communications comes into play. It is based on the recognition of different actors taking part in the debate, each of them having different needs and interest, representing various cultural values, traditions, norm, having diversified visions of future. Therefore, the spectrum of risk communication stretches from approach based on convincing and educating people to including them into dialogue and cooperation.

Using the deficit and dialogue model of risk communication, within this sessions students are confronted with different approaches to communication with the public on the matter of smart metering. As first comes a general introduction, where the conceptual framework is presented, illustrated by two cases of deficit and dialogue approach respectively. Afterwards, the framework has to be adapted to the previously introduced Toronto case and students have to choose the most effective risk communication approach. At the end, a 'Court roleplaying game' is conducted, and the students divided into two groups have to defend one of the approaches.

Models of risk communication

The history of risk communication, closely related to the developments in research on social risk perception, can be described in four stages (Covello, Sandman 2001):



The elitist model of risk communication

This model, also called technocratic, top-down, hierarchic, expert-based, managerial is based on a well described "deficit model of public understanding of science". Its basic assumptions say that most people lack the knowledge needed for proper evaluation of complex technological phenomena and risks related to them. Therefore, the lack ("deficit") of knowledge is perceived as the main problem.

What's next, delivering scientific knowledge by experts is seen as the most efficient strategy of risk communication. Expert knowledge and rationality is perceived as superior to the social perception of risk, which has to be corrected.

The participatory model

The participatory model, in turn, results from acknowledging the specificity of social risk perception and doesn't place it in opposition to expert risk assessment. It is based on values of dialogue, inclusiveness, engagement of the public and open deliberation. Stages three and four of risk communication (dialogue with the public and including of the public) are the best known expressions of this model.

Based on these two models, two opposite risk communication strategies can be named:

DAD strategy

(Decide-Anounce-Defend) based on the elitist model and used in stages one and two. Starting from taking a decision by the experts and limiting the risk communication to one-way flow of information to the public, focusing on defending the decision taken, it often ends up in the necessity to abandon the decision (hence DADA). It is not only based on false assumptions about the risk perception, but also on ineffective methods of communication. This strategy works well only in case of emergency situation and/or where there are no controversies about the decision to be taken. In case of diverging opinions and risk assessments, when many social, cultural and political values are at stakes, the strategy usually fails.

ADD strategy

(Announce, Discuss, Decide), based on participatory model of risk communication. The decision is preceded with dialogue with the public (social partners, stakeholders). This strategy is commonly perceived as more effective in case of controversial energy investments.

Żurawlów case study - example of unfavorable practices of risk communication

In 2012 the Polish government, in agreement with the American company Chevron and with the positive opinion from scientists, decided to extract shale gas in Poland in a small village called Żurawlów. It was a top-down initiative, without consulting local residents. Some consultations took place after the introduction of heavy equipment on the drilling site. However, they were purely informative and the opinion of the inhabitants was not taken into account.
The local community turned out to be very well organized and concerned with the common fate of the village. It blocked the area and organized 24/7 patrols to ensure that heavy equipment does not enter the drilling site. It had the support of communities from other countries who were in a similar situation. Ultimately, after 400 days of occupation, Chevron abandoned shale gas production in Żurawlów. Lack of public consultations and failure to take the voice of the residents seriously caused the project to fail. The Żurawlów case became a handbook example of a failed DAD strategy.

source: www.facebook.com/OccupyChevronPL

c) Pre-reading

No.	Author and title	Description
1.	Fischhoff, Baruch, John Kadvany. 2011. Risk Communication. In: Risk: A Very Short Introduction. New York: Oxford University Press.	Chapter introducing the issue of risk communication.
2.	Fischhoff, Baruch. Risk Perception and Communication Unplugged: Twenty Years of Process. „Risk Analysis" 1995, Vol. 15, Issue 2, pp. 137-145. DOI: 10.1111/j.1539-6924.1995.tb00308.x	Historical outline of risk perception and communication.
3.	Poland's shale gas revolution evaporates in face of environmental protests Code: SM-ST3-R1-Zurawlow	Article on protests in Żurawlów.
4.	Palasz, Pawel. Cleantech Poland. Code: SM-ST3-AM2-Zurawlow	Article on protests in Żurawlów.
5.	Site investigation Forsmark 2002-2007, pp. 5-12. Code: SM-ST3-AM1-Forsmark	Information on the difficulty of finding a storage site for radioactive waste by SKB.
6.	Decide Announce & Defend Code: SM-ST3-AM3	Article on disadvantages of DAD approach to risk management.
7.	The evolution of public understanding of science – discourse and comparative evidence Code: SM-ST3-AM4	The article, the first part of which deals with the historical development of public understanding of science.

d) Session activities

Activity 1:
Introduction to risk communication

Methods	Lecture
Keynotes	None of the communication methods should be pointed out as better than the other.
Materials	**SM-ST3-RM1- Risk Communication**
Required accessories	None
Time allocation	25 min
Learning outcomes	Basic understanding of risk communication.

The activity consists of an introductory presentation on two opposite approaches in risk communication: deficit model and dialogue approach, known also as DAD strategy (decide-announce-defend) and ADD strategy (announce-discuss-decide). Both styles of communicating with the public are then illustrated using examples of a 'good practice' and a 'bad practice' in risk communication. The first approach will be presented on the example of radioactive waste disposal in Sweden by SKB. The second approach will be presented on the example of shale gas extraction in the Polish town of Żurawlów. Social consequences of adopting both models are shown, using the context of investment siting literature.

Activity 2:
Risk simulation analysis

Methods	Project based analysis, discussion, assessment
Keynotes	Students should focus mainly on identifying communication methods.
Materials	**SM-ST2-RM2-TorontoCase** **SM-ST2-RM3-TorontoCase** **SM-ST2-RM4-TorontoCase** **SM-ST2-RM5-TorontoCase** **SM-ST2-RM6-TorontoCase** **SM-ST2-RM7-TorontoCase** **SM-ST2-RM8-TorontoCase** **SM-ST2-RM9-TorontoCase** **SM-ST2-RM10-TorontoCase** **SM-ST2-RM11-TorontoCase** **SM-ST2-RM12-TorontoCase** **SM-ST2-RM13-TorontoCase**
Required accessories	flip charts, markers, writing paper in various colors
Time allocation	35 min
Learning outcomes	Understanding of communication approaches.

The goal of this activity is to use the knowledge from Activity 1 on different approaches to risk communication to the Toronto case. Students are reminded shortly by the teacher about the case and given selected materials regarding the case. Then, working in groups, they have two tasks: first, to describe and identify characteristics of the communication strategy actually used in the Toronto case, and then to evaluate it and – if needed – propose a better one.

Activity 3:
Court roleplaying game

Methods	Court roleplaying game
Keynotes	It is important to select an active student as the judge.
Materials	**TM6-ST3-RM14 – Court roleplaying materials**
Required accessories	Sheets of paper
Time allocation	75 min
Learning outcomes	Understanding of communication methods application.

The aim of this activity is for the students to practice the understanding of DAD and ADD risk communication methods. The students are asked to play out a court roleplaying game. The immediate purpose of the game is to select the method which is better from the point of view of the students. The rules of the roleplay are described in TM6-ST3-RM14.

It is suggested that the number of arguments presented in favor of each method (DAD vs. ADD) should not exceed 5 (students should decide to choose 5 arguments out of the pool of arguments discussed in groups). It is proposed that the arguments are distributed among students so that each reason is presented by another group member.

e) Additional resources

No.	Author and title	Description
1.	Consultation for final disposal of spent nuclear fuel http://www.skb.com/future-projects/the-spent-fuel-repository/our applications/consultation-for-final-disposal-of-spent-nuclear-fuel/	Annual reports on consultations conducted by the SKB.
2.	Sidewalk Labs Advisory Council - Meeting 1 Summary https://sidewalktoronto.ca/wp-content/uploads/2019/01/Sidewalk-Labs-Advisory-Council-Meeting-1-Summary.pdf	Labs advisory council' meeting with the citizens of Toronto and various organizations.
3.	Covello, Vincent, Peter M. Sandman. 2001. Risk communication: Evalution and Revolution. In: Anthony Wolbarst (ed.). Solutions to an Environment in Peril. Baltimore: John Hopkins University Press.	A chapter in the book about the history of risk communication, its most important aspects, as well as seven cardinal tips on how to communicate about risk.

Session 4:
Risk management

a) Session objectives

Students get knowledge about possible strategies in risk management, based on the criteria of various kinds of risk. They learn to assess which strategy is required and how to plan its realization.

b) Session scope

Risk management comes as the last and final part of each risk governance process. It encompasses the ultimate moment of decision-making on the risk issue, thus is crucial for the whole approach. The question ‘how to deal with risk’ is answered within this approach depending of the kind of risk. One of the most widespread and popular classification of different kinds or risk and respective ‘risk discourses’ is the model adapted by International Risk Governance Council.

It distinguishes four kinds of risks (Renn 2008: 178-180; Aven, Renn 2010: 183-185):

Simple (routine) risk and instrumental risk discourse

Simple risks are those with low complexity, uncertainty and ambiguity. In other words, these are known, calculable and relatively easy to manage risks with established regulatory procedures. Examples include car accidents, smoking, regular natural disasters, building constructions risks. The assessment of simple risks is not controversial and does not differ significantly between various social groups.

Complex risk and epistemic discourse

Complex risks are those where identifying and quantifying causal links is not so easy as in case of simple risks. Long delay periods between cause and effects, a multitude of intervening variables but also the lack of sufficient knowledge and scientific methods belong to the main obstacles. “The global decrease in biodiversity is an example of a risk situation that is characterized by high complexity. The destruction of natural habits of endangered species, the intrusion of invasive species caused by globalized transport and travels, and environmental pollution are only some influencing factors, of which the interdependencies are unknown to a large extent.” [Aven, Renn 2010: 12].

Unknown risk and reflexive discourse

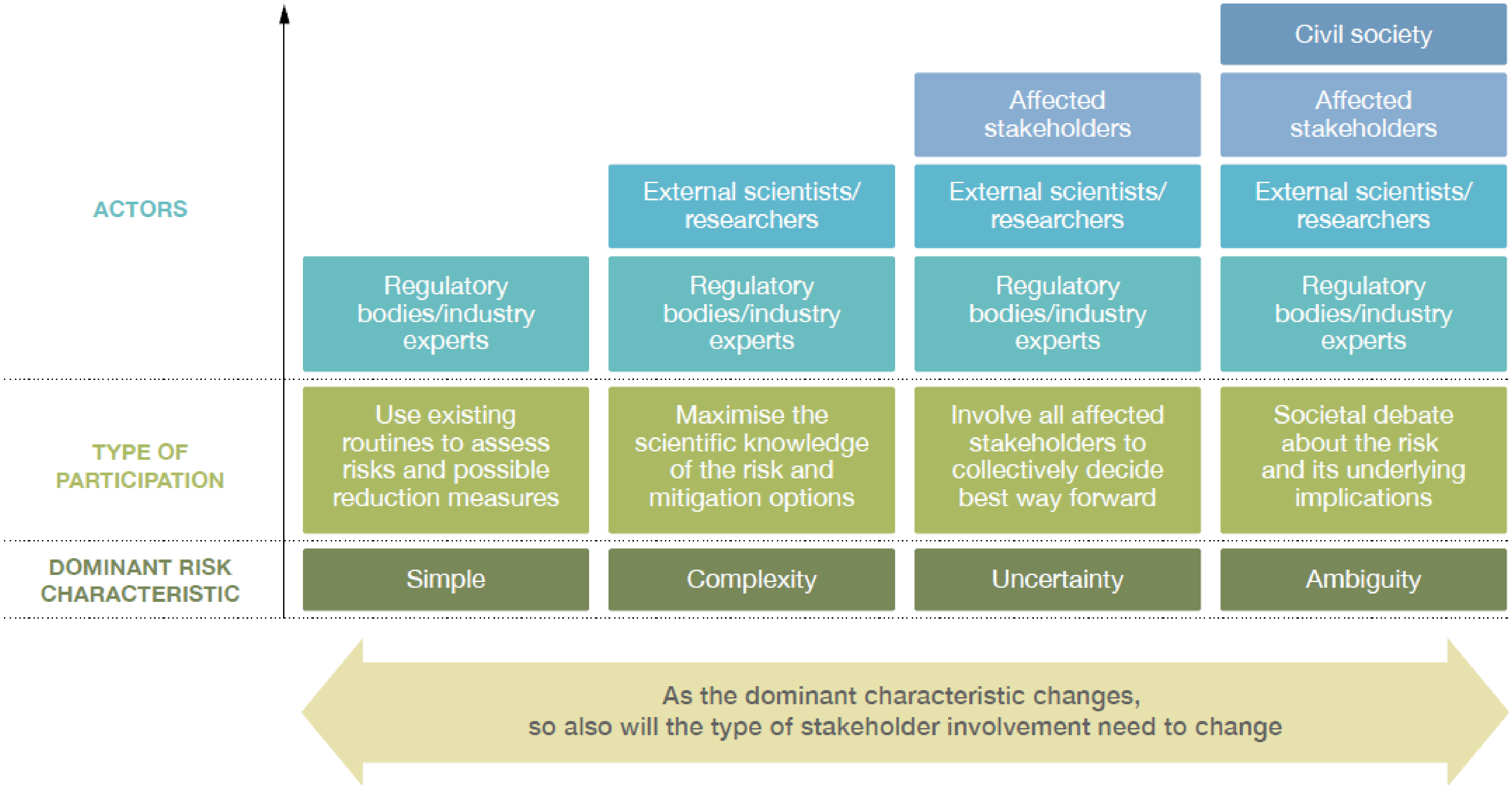
Uncertain risks are caused by a difficulty of predicting the occurrence of an event and/or its consequences. It refers to the classical risk definition as probability of occurrence of a harmful effect. Examples are natural disasters (such as earthquakes), possible health effects of mass pollutants or consequences of introducing genetically modified species into environment.

Ambivalent risk and participatory discourse

Ambiguity refers to different ways of interpreting the level and character of risk, both in technical and in normative terms. Ambiguity in risk disputes is a public phenomenon, appearing as a result of concerns what an advancement of a given technology means for human health, environment, social life etc. Such ambivalent technologies are e.g. low dose radiation, food supplements, nuclear power, pre-natal genetic screening.

This categorization comes from the Risk Governance Framework promoted by International Risk Governance Framework (see IRGC 2017). This approach is based on the idea, that the more uncertainty and disagreement about possible consequences of a technology exist, the bigger the required engagement of the public should be (see IRGC 2017: 17-19) . Therefore, each of the four types of risk requires a different risk management strategy, which differ from each other by the scale of public engagement (IRGC 2017: 23-25, 29-31).

In case of simple risk, an instrumental routine-based procedures of regulatory bodies and agencies are usually enough. Complex risk require risk-informed and robustness-focused strategy, stemming from scientific discourse led by experts from various disciplines. Uncertain risks should be managed using precaution-based strategies (like the precautionary principle in EU law) and include relevant stakeholders (local communities, NGOs, business actors, consumers groups). The broadest inclusion of the public takes place in case of ambivalent risks, where a public debate with civil society is required.



The choice of an appropriate risk management strategy depends thus on the kind of risk (and its complexness) that is being dealt with. They stretch out from purely expert decision-making procedures to broad public debates based on involvement of different stakeholders. As we can see, risk management discourses reflect therefore the previously presented variety of risk perception and communication approaches. Depending of the level of uncertainty and importance of values at stake, various levels of public participation are required.

‘GM Nation?’ debate – case study

Within this session the concepts of risk management with its four risk discourses are adapted to smart meters. After presenting main approaches within the risk management field, a case study of British “GM Nation?” public debate on genetically modified food is discussed. Afterwards, attention is put to smart meters, in order to assign the appropriate kind of risk to the issue and then the respective risk discourse.

The issue of genetically modified food is an important global problem. Genetically modified food is a controversial issue, mainly with regard to its impact on health. Different countries are trying to deal with it in different ways. The example of GM Nation was chosen because it is one of the largest risk management projects based on the inclusion of citizens in the debate. In July 2002, the UK government launched a nationwide debate on GM crops and foods – GM Nation. NGOs, scientists, grass-roots initiatives, companies and ordinary citizens were to take part in the debate. The aim was to produce an opinion, including a public opinion, in order to be able to develop national policies on GMs. Although the debate did not produce the expected results, in the form of unanimous attitudes and decisions, it was an important lesson, showing that involving the general public in the risk management process not only makes sense, but is necessary.

c) Pre-reading

No.	Author and title	Description
1.	GM: the GM Nation Review https://www.youtube.com/watch?v=Jd2uD0V3h7I https://www.youtube.com/watch?v=NMDOWP1fOXs	Two (of four) films commenting on GM controversies in the UK from The Open University.
2.	Introduction to the IRGC risk governance framework Code: SM-ST4-AM6	Comprehensive risk governance framework developed by International Risk Governance Council.
3.	GM Nation? Debate GM Debate: Dispelling myths Code: SM-ST4-AM1-GMNATION	Two short comments from Nature journal on the GM Nation debate.
4.	GM Debate: No trust, no go! Code: SM-ST4-AM2-GMNATION	Short article from Heredity journal on the GM Nation debate.
5.	GM nation? Public debate: a valuable experiment Code: SM-ST4-AM3-GMNATION	News about the value of the public debate around GM Nation.
6.	British public Code: SM-ST4-AM4-GMNATION	Short newspaper article summarising a report by a non-governmental organisation expressing concerns about some of the gaps in the ongoing debate.
7.	The GM public debate: context and communication strategies Code: SM-ST4-AM5-GMNATION	Article analysing the way of communicating risk on the example of GM Nation.

d) Session activities

Activity 1:
Introduction to risk communication

Methods	Lecture, discussion
Keynotes	The key of this activity is the description of the risk governance framework.
Materials	**SM-ST4-RM1-Risk management**
Required accessories	None
Time allocation	25 min
Learning outcomes	Knowledge on the IRGC scheme and four types of risk discourses.

Based on the results of the court roleplaying game from session 3, the concept of IRGC risk management is presented. As a starting point, a case of UK 'GM Nation?' debate is introduced.

Four types of risk discourses are introduced and then within a discussion with the students applied to risks related to smart metering. Students try to answer the question, which strategy would be the most appropriate to effectively manage the SM? Which kind of risk does SM represent? Where do other known examples of controversial technologies fit?

Activity 2:
Risk simulation analysis

Methods	Group work, workshop
Keynotes	It is the final assignment of the module.
Materials	**TM6-ST4-RM2-risk simulation analysis materials**
Required accessories	None
Time allocation	80 min
Learning outcomes	Knowledge of risk governance framework.

This activity sums up the whole course, putting all the three parts – risk perception, communication and management – into one. Students are asked to analyze the given cases based on the knowledge and skills gained in the previous session. Once complete, Students present their risk simulation analysis results.

Activity 3:
Module summary discussion

Methods	Discussion
Keynotes	It is a good idea to repeat the most important points of all four sessions.
Materials	**None**
Required accessories	None
Time allocation	30 min
Learning outcomes	Knowledge of risk governance framework.

This summary discussions aim is to facilitate the students understanding of risk perception, risk communication and risk governance. The students should be again lead to the idea that a given subject matter can be perceived in terms of risks differently by groups and individuals with taking into account the correctness of each perceived risk.

e) Additional resources

No.	Author and title	Description
1.	GM: The UK Debate – Politics https://www.youtube.com/watch?v=d8gDVDbsETA https://www.youtube.com/watch?v=d8NyuILCVKc	The other two films (the first and the second can be found in pre-readings) on GM Nation's national debate in the United Kingdom.
2.	GeneWatch UK Code: SM-ST4-AM7	GeneWatch UK report on the conduct of the UK's public debate on GM crops and food.
3.	Fra Paleo, Urbano (ed). 2015. Risk Governance. The Articulation of Hazard, Politics and Ecology. Springer: The Netherlands.	Collection of texts on different perspectives and applications of risk governance.
4.	Renn, Ortwin, Andreas Klinke, Marjolein van Asselt. Coping with Complexity, Uncertainty and Ambiguity in Risk Governance: A Synthesis. "Ambio" 2011, Vol. 40, Issue 2, pp. 231-246.	In-depth analysis of the concept of the idea of risk governance.
5.	Van Zoonen, Liesbet. Privacy concerns in smart cities. "Government Information Quarterly" 2016, V ol. 33, Issue 3, pp. 472-480.	Article dealing with the issue of privacy in the context of data collection in smart cities.
6.	Mengolini, Anna, Julija Vasiljevska. 2013. The social dimension of Smart Grids. Consumer, community, society. JRC Scientific and Policy Reports. https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/social-dimension-smart-grids-consumer-community-society	Report of the European Union Committee of Energy and Transport.

Assessment methods and final assignment

Session 4 includes the final assignment in which the students are asked to apply all gained skills and knowledge in a risk simulation analysis and present the results. Criteria to be taken into account:

– proper identification and classification of risks;
– adequate understanding and application of risk communication methods;
– correlation of risks and risk communication methods in the risk governance framework.

The proper evaluation and marks awarded for the assignment and module are subject to applicable rules of the institution hosting the course.

- identification of possibilities to go further: related courses, topics, disciplines.

Glossary

AMI	stands for "Advanced Metering Infrastructure".
Technology assessment	a scientific, interactive, and communicative process that aims to contribute to the formation of public and political opinion on societal aspects of science and technology.
TOU	stands for "time of use" (related to the time of being used).
Grid	refers to the electric grid: a network of power generators, transmission lines, substations, transformers and other devices delivering electricity from power plants to our homes or businesses.
EVCS	stands for "Electrical Vehicle Charging Station".
IoT	stands for "Internet of Things". It is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

MDMS	stands for “Meter Data Management System” which utility centers use to function. One of their uses is billing of end-users energy use.
RF	stands for “Radio Frequency”. It is a term used to describe wireless radio data transmission.
PLC	stands for “Power Line Carrier”. It is a term used to describe transmission of data thru power lines.
FCC	is stands for Federal Communications Commission (U.S. federal agency responsible for implementing and enforcing communications law and regulations).
CEN	stands for European Committee for Standardization.
CENELEC	stands for European Committee for Electrotechnical Standardization.
ETSI	stands for European Telecommunications Standards Institute.
NIST	stands for National Institute of Standards and Technology (U.S. Department of Commerce physical science laboratories and standardization organization).
Risk perception	applies to different perceptions of risk. There are two main approaches to risk assessment: – Technological risk: risk = probability x harm – Social risk perception: based in socio-cultural rationality. Such rationality reflects rather values, needs, interests, general approach to life and future of the people, then scientific methods of technology assessment
Risk communication	refers to the communication strategy between the parties when applying technology to the society. The communication strategy depends to a large extent on the concept of risk perception. There are two basic models of risk communication: – DAD(A): Decide – Announce – Defend (– Abandon) The model is based on a simple technological risk perspective, in which experts, on the basis of their knowledge, try to implement a technology, and contacting with society only if they meet resistance from them. – ADD: Announce – Discuss – Decide It is the strategy based on social perception of risk, in which the decision to implement a technology is made together by experts and the public.
Risk management	Risk management is a way of identifying, assessing, prioritizing and choosing ways of coping with risks at different levels (economic, technological, security, social, etc.). The risk management strategy varies according to the type of risk, which could be divided on: simple, complex, uncertain and ambivalent.