VSB TECHNICAL UNIVERSITY OF OSTRAVA | FACULTY OF SAFETY ENGINEERING

# Doctoral Thesis Assignment

Student:

Study Programme: P1032D020005 Fire Protection and Safety

Topic: A Framework for Assessing Municipal Resilience to Safety and Security Threats
Rámec pro hodnocení odolnosti obcí vůči bezpečnostním hrozbám

The thesis language: English

Supervisoring centre: 050 Department of Civil Protection

Annotation

Municipalities today face an increasingly broad spectrum of security threats, including natural disasters, technological accidents, critical infrastructure failures, cyber incidents, pandemics, and other crisis situations. The growing complexity and interconnectedness of these threats heighten the importance of the concept of resilience—understood as a municipality's ability to prevent extraordinary events, absorb their impacts, respond effectively, and subsequently restore its key functions. Although resilience has been the subject of intensive research in recent years, there is currently no unified, comprehensive methodological approach for assessing municipalities against various types of security threats. Existing approaches typically focus on specific aspects of resilience—such as technical infrastructure, crisis preparedness, or social capital—but lack an integrated assessment that encompasses institutional, social, infrastructural, and security dimensions. Consequently, the absence of a methodological framework capable of comprehensively assessing municipal resilience in the face of multiple, interconnected threats—while aligning with current European Union priorities regarding risk management and resilience building—represents a significant research gap.

Rules for elaboration:

Intended objective of the proposed dissertation:
The aim of the dissertation is to develop and verify a methodological framework for assessing municipal resilience against security threats. The research will involve identifying key determinants of municipal resilience, proposing a set of assessment indicators, and evaluating a municipality's capacity to prevent emergencies, respond to their impacts, and restore its functions following their occurrence. The proposed methodological framework will be validated through a case study of the municipality of Lipjan, enabling an assessment of its applicability within the context of local self-government and crisis management.
Expected contribution to the scientific field and to practice:
The scientific contribution of the thesis lies in the development and verification of a methodological framework for assessing municipal resilience against security threats. The work will expand knowledge regarding the factors influencing municipal resilience and contribute to the development of resilience assessment methods at the local level. The practical contribution of the thesis will be the creation and verification of a methodological framework enabling the systematic assessment of municipal resilience against security threats. The outputs will be applicable to municipal development planning, risk management, and the strengthening of crisis preparedness and local community resilience.

Supervisor: **doc. Ing. Lenka Brumarová, Ph.D.**

Consultant:

Chairman of Studies Board: prof. Ing. David Řehák, Ph.D.

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VSB TECHNICAL UNIVERSITY OF OSTRAVA | FACULTY OF SAFETY ENGINEERING

# Doctoral Thesis Assignment

Student:

Study Programme: P1032D020005 Fire Protection and Safety

Topic: Interoperability of Emergency Management Systems within the European Civil Protection Framework
Interoperabilita systémů řízení mimořádných událostí v rámci evropského rámce civilní ochrany

The thesis language: English

Supervisoring centre: 050 Department of Civil Protection

Annotation

As a result of the increasing frequency of natural disasters, technological accidents and complex crises, the importance of international cooperation in the field of civil protection and crisis management is increasing. A key European instrument in this area is the European Union Civil Protection Mechanism (UCPM), which supports prevention, preparedness, response coordination and mutual assistance between states. In summary, European approaches to risk management are influenced by the principles of the Sendai Framework for Disaster Risk Reduction 2015-2030. The research gap consists in the lack of comprehensive studies aimed at evaluating the interoperability of national crisis management systems with European civil protection mechanisms, especially in the case of non-member states and candidate countries. Current research mostly focuses on legislative analyzes or evaluation of individual disasters, but there is a lack of a comprehensive framework enabling a systematic assessment of states' readiness for involvement in European civil protection structures.

Rules for elaboration:

Guidelines for Preparation
Intended objective of the proposed dissertation:
The objective of the dissertation is to develop a methodological framework for assessing the interoperability of national emergency management systems within the European civil protection framework. The framework will identify and evaluate key institutional, legislative and operational factors affecting integration with the European Union Civil Protection Mechanism (UCPM). Its applicability and relevance will be verified through a case study of the Emergency Management Agency (EMA), Kosovo, serving as an example of a national system progressively aligning with European civil protection and disaster risk governance standards

Expected contribution to the scientific field and to practice:
The scientific contribution of the dissertation is the creation and verification of a methodological framework for evaluating the interoperability of national emergency management systems within the European civil protection environment, solving a research gap in the evaluation of integration with the European Union Civil Protection Mechanism (UCPM). The practical benefit is in the form of a methodological framework, verified on the case of the Emergency Management Agency (EMA), Kosovo, which will support Kosovo in identifying capacity gaps, aligning with European standards, strengthening international cooperation and increasing disaster preparedness and societal resilience.

Supervisor: **doc. Ing. Lenka Brumarová, Ph.D.**

Consultant:

Chairman of Studies Board: prof. Ing. David Řehák, Ph.D.

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VSB TECHNICAL UNIVERSITY OF OSTRAVA | FACULTY OF SAFETY ENGINEERING

# Doctoral Thesis Assignment

Student:

Study Programme: P1032D020005 Fire Protection and Safety

Topic: Fire Safety Parameters of Oxymethylene Ethers as Prospective Synthetic Fuels
Požárně-bezpečnostní parametry oxymethylenetherů jako perspektivních syntetických paliv

The thesis language: English

Supervisoring centre: 040 Department of Occupational and Process Safety

Annotation

Oxymethylene ethers are promising oxygenated synthetic fuels with the potential to substantially reduce soot formation and to be used as substitutes for or additives to diesel fuels. Their oxygen-rich molecular structure, however, gives rise to specific reaction pathways at low and intermediate temperatures. The effects of these pathways on autoignition, cool-flame formation, flame propagation and the formation of hazardous products are not yet sufficiently understood.
The dissertation will investigate the fire-safety-relevant reactivity of selected oxymethylene ethers, primarily OME1 and OME2, with the possibility of extending the study to higher homologues. It will combine experimental research in one-dimensional laminar flames and reactive-flow systems with detailed chemical-kinetic modelling, global sensitivity analysis and targeted reduction of available chemical kinetic mechanisms.

Rules for elaboration:

Intended objective of the proposed dissertation:
To characterize the fire-safety-relevant reactivity of selected oxymethylene ethers, focusing on autoignition, low-temperature oxidation, cool-flame formation and flame propagation. Experiments in one-dimensional laminar flames and reactive-flow systems will be used to assess the predictions of available chemical kinetic mechanisms.
Expected contribution to the scientific field and to practice:
Clarification of the key reaction pathways and parameters governing ignition and the formation of hazardous oxidation products of oxymethylene ethers. Experimental data, global sensitivity analysis and targeted reduction of kinetic mechanisms will provide a basis for more reliable modelling and fire safety assessment of these fuels.

Supervisor: **doc. Ing. Václav Nevrlý, Ph.D.**

Consultant:

Chairman of Studies Board: prof. Ing. David Řehák, Ph.D.

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VSB TECHNICAL UNIVERSITY OF OSTRAVA | FACULTY OF SAFETY ENGINEERING

# Doctoral Thesis Assignment

Student:

Study Programme: P1032D020005 Fire Protection and Safety

Topic: Integrated Assessment of Human Reliability in the Context of Natech Events
Integrované hodnocení lidské spolehlivosti v prostředí Natech událostí

The thesis language: English

Supervisoring centre: 050 Department of Civil Protection

Annotation

Climate change is increasing the frequency and intensity of extreme natural events that can lead to so-called Natech events (Natural Hazard Triggering Technological Disasters), wherein a natural hazard precipitates a technological accident with significant impacts on the population, the environment, and critical infrastructure. The European Commission's Joint Research Centre (JRC) highlights the growing importance of these events and the need for their effective management. Maritime ports constitute key critical infrastructure that is simultaneously highly vulnerable to the impacts of climate change, particularly coastal flooding, extreme precipitation, and storms. Consequently, the European Union supports enhancing their resilience against climate-related risks. This dissertation focuses on assessing human reliability during Natech events in maritime port environments, taking into account the influence of stress, uncertainty, time pressure, and the disruption of information flows on decision-making processes. Despite growing interest in Natech risks, there is currently no integrated framework linking Human Reliability Assessment, Natech scenario modeling, and maritime port resilience. A significant research gap exists, particularly regarding the insufficient understanding of the human factor's role in managing multiple climate-related risks and the absence of methodological approaches for assessing human reliability during complex Natech events.

Rules for elaboration:

Intended objective of the proposed dissertation:
The aim of the dissertation is to develop and verify an integrated methodological framework for assessing human reliability in the context of Natech events, linking the principles of Human Reliability Assessment, Natech scenario modeling, and critical infrastructure resilience. The research will involve identifying key factors influencing decision-making under conditions of climate-driven multiple risks and proposing approaches to enhance the safety and resilience of maritime ports. The proposed framework will be verified through a case study of the Autonomous Region of Madeira; its island nature, exposure to Atlantic hydrometeorological hazards, and the strategic importance of its port infrastructure create ideal conditions for this research
Expected contribution to the scientific field and to practice:
The scientific contribution of this work lies in the development and verification of an integrated framework linking Human Reliability Assessment, Natech scenario modeling, and critical infrastructure resilience assessment. The study will help overcome the current fragmentation of knowledge across the fields of risk management, crisis management, and critical infrastructure resilience, while advancing theoretical and methodological understanding of the human factor's influence on managing multiple climate-related risks. The findings will be applicable to the development of risk assessment methodologies and the strengthening of critical infrastructure resilience in European coastal and island regions.

Supervisor: **doc. Ing. Lenka Brumarová, Ph.D.**

Consultant:

Chairman of Studies Board: prof. Ing. David Řehák, Ph.D.

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