図2．3．1　SAChE 資料の 9 テーマ別の分類

Material/Energy Balances (Fundamentals)
- Solutions to Student Problem Set Volume 1
- A Process Safety Management (PSM) Overview
- Student AIChE 2002 Design Problem Solution

View all Products for this course.

Fluid Flow
- Solutions to Student Problem Set Volume 2
- Consequence Modeling Source Models I: Liquids & Gases
- Compressible and Two-Phase Flow with Applications Including Pressure Relief System Sizing

View all Products for this course.

Heat Transfer
- Seveso Accidental Release Case History
- Case History: A Batch Polystyrene Reactor Runaway
- Mini-Case Histories

View all Products for this course.

Mass Transfer
- Solutions to Student Problem Set Volume 2
- Mini-Case Histories
- Metal Structured Packing Fires

View all Products for this course.

Thermodynamics
- Chemical Reactivity Hazards
- Solutions to Student Problem Set Volume 2
- Rupture of a Nitroaniline Reactor

View all Products for this course.

Chemical Reactions/Kinetics
- T2 Runaway Reaction and Explosion
- Dow Fire and Explosion Index (F&EI) and Chemical Exposure Index (CEI) Software
- Runaway Reactions -- Experimental Characterization and Vent Sizing

View all Products for this course.

Process Control
- Solutions to Student Problem Set Volume 2
- Rupture of a Nitroaniline Reactor
- Solutions to Student Problem Set Volume 1

View all Products for this course.

Lab
- Project Risk Analysis (PRA): Unit Operations Lab Applications
- Improving Communication Skills
- Introduction to Biosafety

View all Products for this course.

Design
- An Inherently Safer Process Checklist
- Inherently Safer Design
- Improving Communication Skills

View all Products for this course.

表2. 3. 2　SAChE の資料例(2003 年～2012 年, 2013 年 9 月初旬)

SACHE (The Safety and Chemical Engineering Education) Products

SACHE Products	年度	スポンサー	利用数
Hydroxylamine Explosion Case Study	2003	C.J. Kelly (Syracuse University), J.V. Birtwistle (Risk	312
Mini-Case Histories	2003	Joe Louvar and Durai Dakshinamoorthy (Wayne State University)	131
Safety Valves: Practical Design Practices for Relief Valve Sizing	2003	Eric N. Parvin and Arthur M. Sterling (Louisiana State	249
Safety, Health, and Environmental Text for Textbooks	2003	S. Horsch (Wayne State University), M. Horsch (University	236
Consequence Modeling Source Models I: Liquids & Gases	2004	Jan Wagner (Oklahoma State University)	118
Green Engineering Tutorial	2004	Hui Chen (Arizona State University), David Shonnard	55
Improving Communication Skills	2004	Robert M. Bethea and Sarah A. Brown (Texas Tech	206
Metal Structured Packing Fires	2004	Mark T. Roberts (Texas A&M University)	133
Chemical Reactivity Hazards	2005	Robert Johnson (Unwin Co.)	130
Emergency Relief System Design for Single and Two-Phase Flow	2005	Ron Darby (Texas A&M University)	371
Introduction to Biosafety	2005	Art Schwartz (Bayer Corp., retired)	179
Runaway Reactions — Experimental Characterization and Vent Sizing	2005	Ron Darby (Texas A&M University)	518
Simplified Relief System Design Package	2005	Ed Kitchen (Digital Solutions Technology, Inc.)	51
Solutions to Student Problem Set Volume 1	2005	J. R. Welker and C. Springer (University of Arkansas)	173
Solutions to Student Problem Set Volume 2	2005	R. Willey (Northeastern University), D. Crowl (Michigan Tech University), R. Welker (University of Arkansas), R. Darby (Texas A&M University)	500
University Access to SuperChems and ioXpress	2005	Georges A. Melhem (ioMosaic, Inc.)	53
Design for Overpressure and Underpressure Protection	2006	S. S. Grossel (Process Safety and Design, Inc.), J. F. Louvar (Wayne State University)	253
Dust Explosion Prevention and Control	2006	J. Louvar and R. Schoeff (Wayne State University)	594
Inherently Safer Design	2006	Dennis C. Hendershot (Rohm and Haas Co., retired)	254
Safety in the Chemical Process Industries	2006	D.A. Crowl (Michigan Tech University)	2082
Student AIChE Design Problem Solution (2002 Problem)	2006	S. Horsch and J. Louvar (Wayne State University), J. Wehman (BASF Corporation, retired)	88
CCPS Process Safety Beacon Archive	2007	Tom Spicer (University of Arkansas)	0
Piper Alpha Lessons Learned	2007	Joe Louvar (CCPS Staff Consultant)	64
Properties of Materials	2007	Ronald J. Willey (Northeastern University)	138
Rupture of a Nitroaniline Reactor	2007	Ronald J. Willey (Northeastern University)	364
Static Electricity I — Everything You Wanted to Know about Static Electricity	2007	Marc Rothschild (Rohm and Haas)	254
Venting of Low Strength Enclosures	2007	W. B. Howard (Monsanto, retired), J. F. Louvar (Wayne State University)	175
Inherently Safer Design Conflicts and Decisions	2008	Dennis C. Hendershot (Rohm and Haas Company, retired) John Murphy (United States Chemical Safety and Hazard Investigation Board, retired)	164
Risk Assessment	2008	Ralph W. Pike (Louisiana State University)	646
Seminar on Tank Failures	2008	Ronald J. Willey (Northeastern University)	160
Seveso Accidental Release Case History	2008	Ronald J. Willey (Northeastern University)	145
Static Electricity as an Ignition Source	2008	Konanur Manjunath (DOW Chemical)	76
Explosions	2009	Reed Welker (University of Arkansas)	109
Process Hazard Analysis: An Introduction	2009	David Mody (Queen' s University at Kingston)	407
Process Hazard Analysis: Process and Examples	2009	David Mody (Queen' s University at Kingston)	125
Project Risk Analysis (PRA): Unit Operations Lab Applications	2009	Bruce Vaughen (Cabot Corporation)	419
Reactive and Explosive Materials	2009	R. J. Willey (Northeastern University), J. F. Louvar (Wayne State University)	1
Seminar on Fire	2009	Reed Welker and Charles Springer (University of Arkansas)	136
Fire Protection Concepts	2010	Reed Welker (University of Arkansas)	129
Process Safety Course Presentations	2010	D. Crowl (Michigan Technological University), S. Mannan (Mary Kay O' Connor Process Safety Center, Texas A&M University)	1512
Safe Handling Practices: Methacrylic Acid	2010	R. Willey (Northeastern University)	327
The Bhopal disaster: A Case History	2010	R. Willey (Northeastern University)	230
Understanding Atmospheric Dispersion of Accidental Releases	2010	R. Schneider (CCPS Staff)	131
Case History: A Batch Polystyrene Reactor Runaway	2011	Ron Willey (Northeastern University)	169
Compressible and Two-Phase Flow with Applications Including Pressure Relief System Sizing	2011	J. Wagner and R. Whiteley (Oklahoma State University)	335
Dow Fire and Explosion Index (F&EI) and Chemical Exposure Index (CEI) Software	2011	S. Mannan (Mary Kay O' Connor Process Safety Center), W. Smades (Dow Chemical Company)	648
Jeopardy Contests for Process Safety	2011	Jon Bernardi (Lubrizol Corp.)	333
Layer of Protection Analysis – Introduction	2011	Art M. Dowell (Chemical Process Safety Consultant and Rohm and Haas, retired)	211
Safety Guidance for Design Projects	2011	Bruce K. Vaughen (Cabot Corporation)	279
A Process Safety Management (PSM) Overview	2012	Bruce K. Vaughen (Cabot Corporation)	1125
Conservation of Life: Application of Process Safety Management	2012	Klein (DuPont)	339
Fundamentals of Chemical Transportation with Case Histories	2012	Ronald J. Willey (Northeastern University)	154
T2 Runaway Reaction and Explosion	2012	Ronald J. Willey (Northeastern University)	153

Download 0～99: 8 products
Download 100～200: 19 products
Download 200～499: 18 products
Download 500～1500: 5 products
Download 1000～2100: 3 products
(Total: 53 SAChE products)

注) 2013 年の SAChE 資料:"An Inherently Safer Process Checklist", CCPS 作成　合計 54 件

2.4 平成 26 年度(2014 年度)報告
オストラバ工科大学における工学教育研究プログラム調査

世界最大規模で学部において安全工学教育を実施しているチェコ共和国のオストラバ工科大学においてカリキュラム調査を行った。

以下に調査の概要を示す。

2.4.1 訪問日 及び 訪問場所

日時:2014 年 9 月 9 日 10 時～12 時

場所:Safety Enginerring Building

2.4.2 出席者

オストラバ工科大学

Ales Dudacek (Vice dean)

Prof. Pavel Danihelka

横浜国立大学

熊崎美枝子

澁谷忠弘

笠井尚哉

2.4.3 オストラバ工科大学について

オストラバ工科大学は、学生数およそ 24,000 人で、経済学部、土木工学部、機械工学部、電子工学及びコンピューター工学部、鉱山及び地学部、安全工学部、金属工学及び材料工学部の 7 学部で構成されている。

2.4.4 オストラバ工科大学 安全工学教育の概要

(1) 沿 革

1968 年 7 月

教育省により「防火工学と産業安全」の研究の大学の分校の設立が鉱業と地質学部に認められた。

1973 年

防火工学と産業安全学科が設立された。

1994 年

安全工学研究所が設立された。

2002 年

安全工学部が設立された。

(2)教育システム

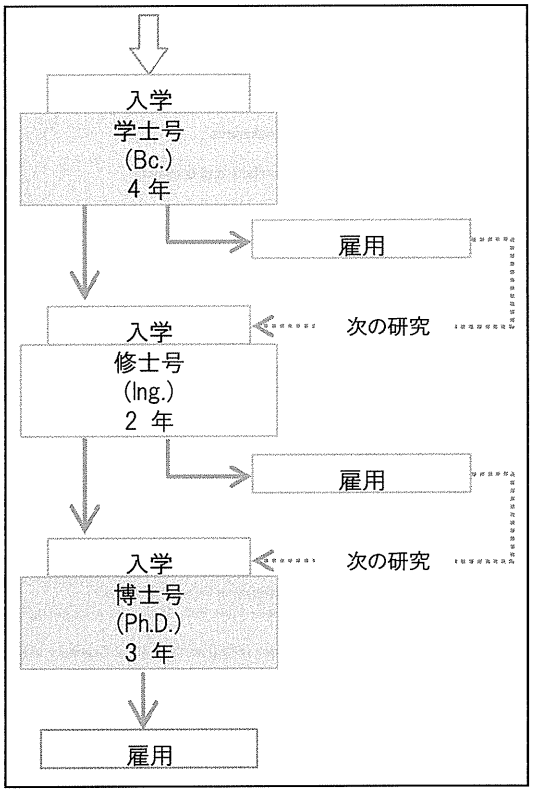
研究の形式:

·フルタイム形式

·遠隔授業との複合形式

研究プログラムの種類

·学士号、·修士号 、博士号



(3)研究分野

1 年生では、教養科目と基礎科目を行い、2 年生から、緊急計画と危機管理、人と資産の安全工学、防火安全と産業安全、職業上およびプロセス安全の 4 つのコースに分かれて教育が行われている。

以下に、“防火と産業安全”のカリキュラム内容について示す。授業の単位認定は、14 週間の授業と試験で構成され、おおよそ日本と同じである。**試験の種類は、**筆記試験、口頭試問、筆記と口頭試問の両方を用いるものがある。**科目の種類は、必修科目、**選択必修科目、選択科目実習科目、インターンシップ科目がある。

科目の種類:

- 理論的、基本的な科目
- 理論ベースの応用科目
- 専門分野の科目
- その他の科目
- 実習、インターンシップ

..

理論及び基礎科目の科目の例

● 基礎科目
- 化学
- 数学
- 物理　　など

● 専門基礎科目
- 流体力学
- 熱伝達
- 応用物理
- 燃焼、爆発のプロセスの物理化学基礎

など

● 専門科目
- 火災科学
- 材料科学
- 建築構造
- 防火と安全システム
- 建築物のブラスト効果
- ビルの火災安全
- 建築構造の抵抗力
- 建築物内火災安全の計算法
- 防火における通信システム
- 消防設備
- 消防戦術　など

● その他の科目:
- 法律
- 哲学
- 心理学
- 社会学
- 生理学　　など

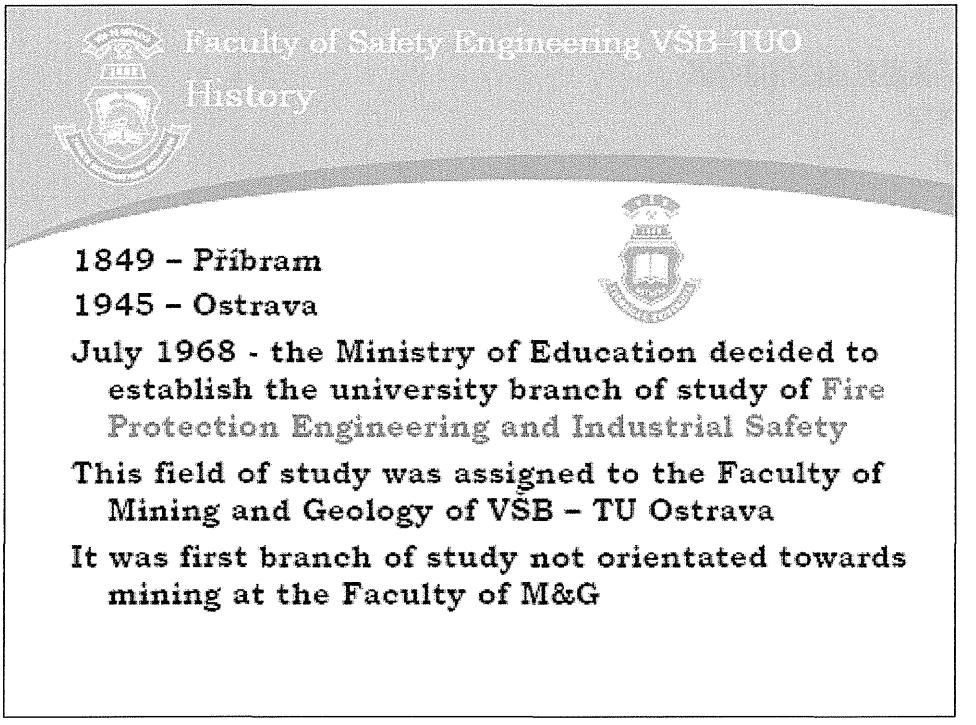
● 実習、インターシップ
- 消防隊の実習(火災と救出活動)

配布資料（1）

1


Faculty of Safety Engineering VŠB-TUO
VŠB – Technical University of Ostrava
Faculty of Safety Engineering

2


Faculty of Safety Engineering VŠB-TUO
History
1849 – Příbram
1945 – Ostrava
July 1968 - the Ministry of Education decided to establish the university branch of study of Fire Protection Engineering and Industrial Safety
This field of study was assigned to the Faculty of Mining and Geology of VŠB – TU Ostrava
It was first branch of study not orientated towards mining at the Faculty of M&G

3

Faculty of Safety Engineering VŠB–TUO
History

1973 - Department of Fire Protection Engineering and Industrial Safety

1994 - Institute of Safety Engineering

- Section of Fire Protection and Industrial Safety
  - **Fire Protection Engineering and Industrial Safety**
  - **Safety Engineering (1996/1997)**
  - **Engineering Safety of Persons and Property (1998/1999)**
- Section of Ventilation and Safety Techniques

2002 – Faculty of Safety Engineering (FSE)

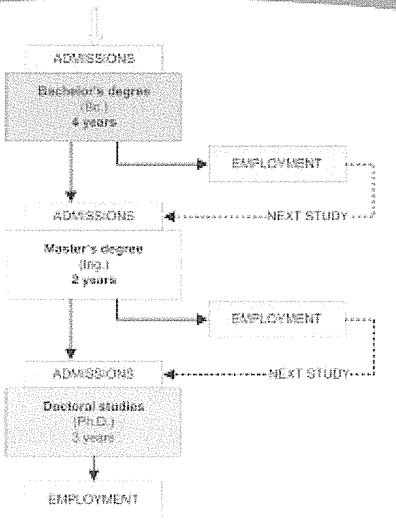
4

Faculty of Safety Engineering VŠB–TUO
Education System

Form of Study:
- Full Time Study
- Combined Study

Study Programme
- Study Branche 1
- Study Branche 2
- …

Type of Study Programme:
- Bachelor
- Master (Further)
- Doctoral



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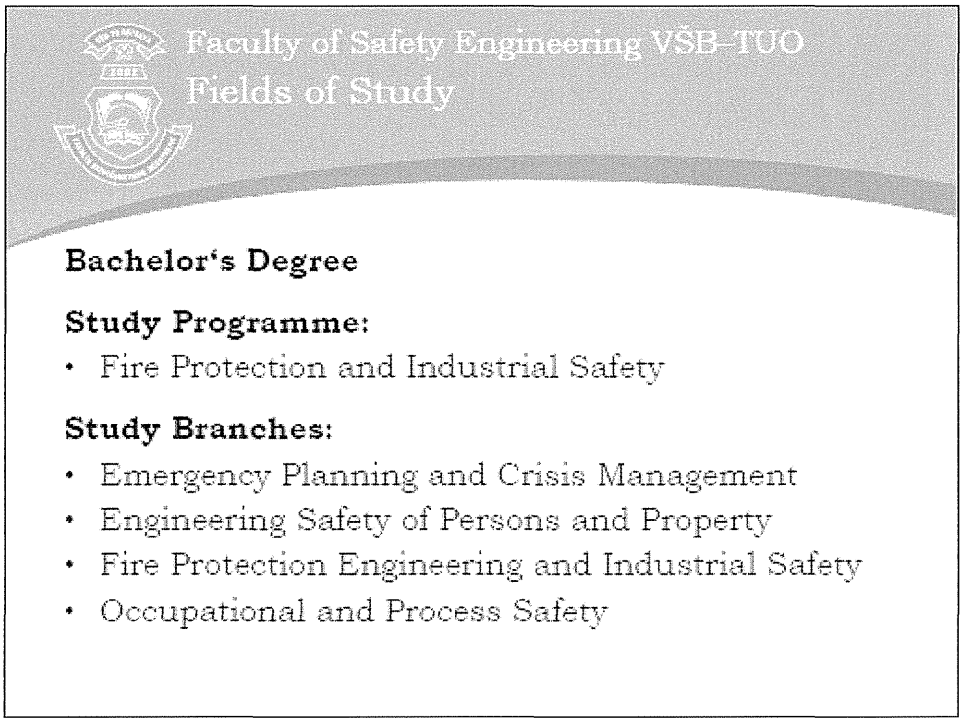
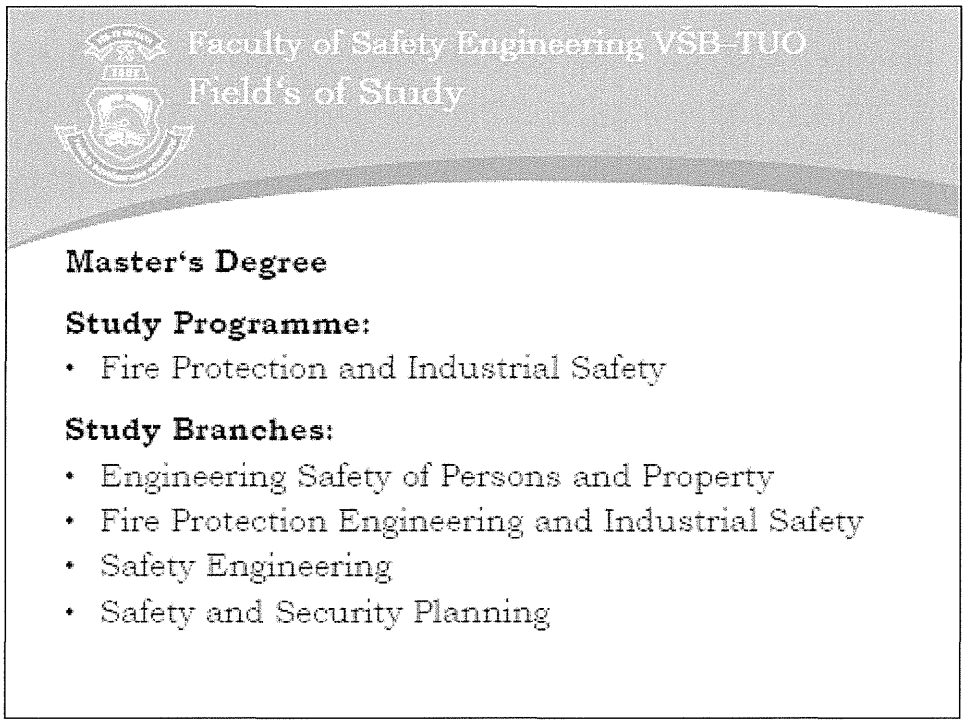
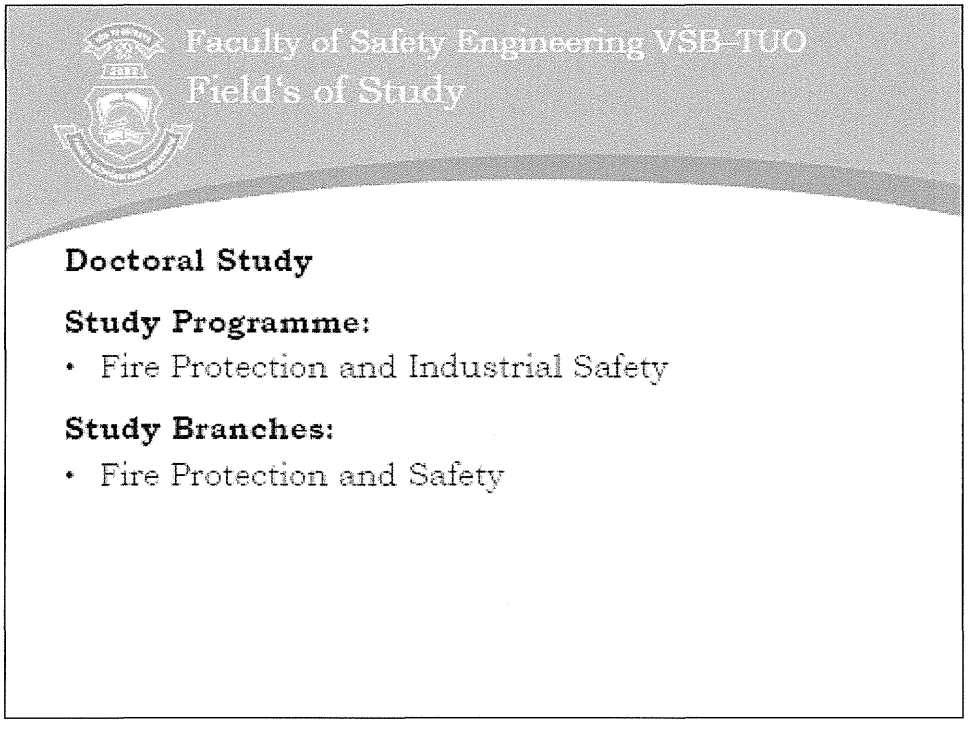

Faculty of Safety Engineering VŠB-TUO
Fields of Study
Bachelor's Degree
Study Programme:
• Fire Protection and Industrial Safety
Study Branches:
• Emergency Planning and Crisis Management
• Engineering Safety of Persons and Property
• Fire Protection Engineering and Industrial Safety
• Occupational and Process Safety

6


Faculty of Safety Engineering VŠB-TUO
Field's of Study
Master's Degree
Study Programme:
• Fire Protection and Industrial Safety
Study Branches:
• Engineering Safety of Persons and Property
• Fire Protection Engineering and Industrial Safety
• Safety Engineering
• Safety and Security Planning

7



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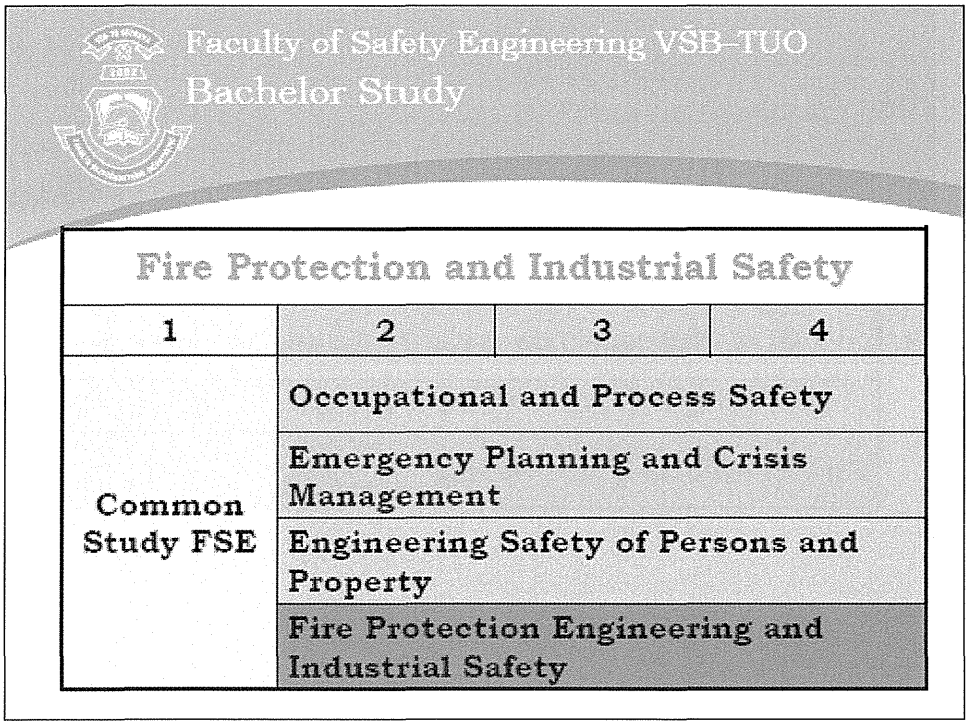
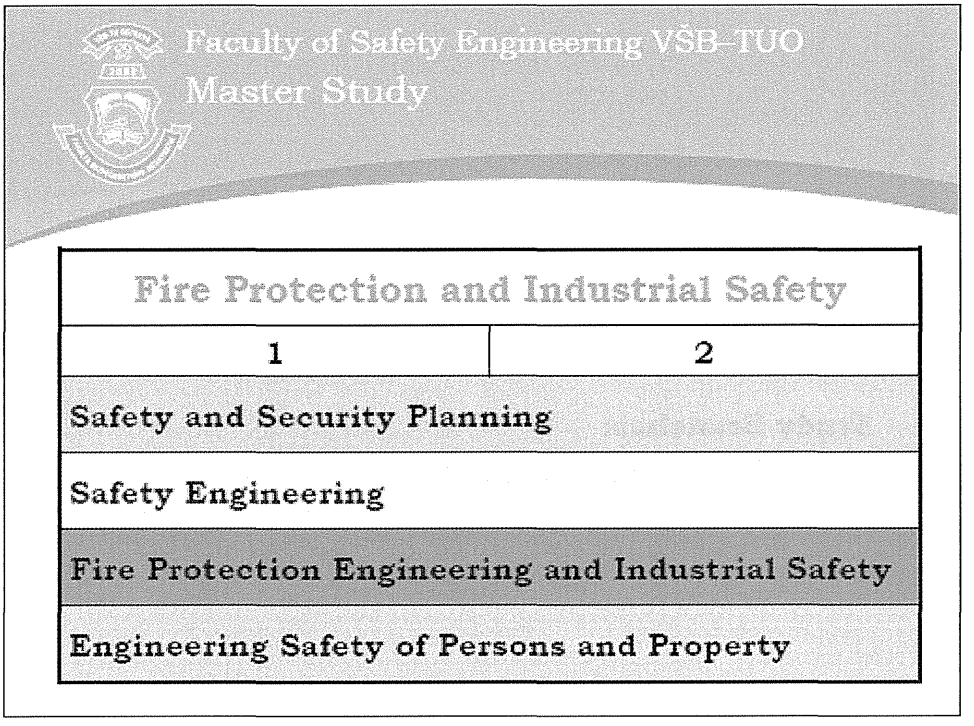
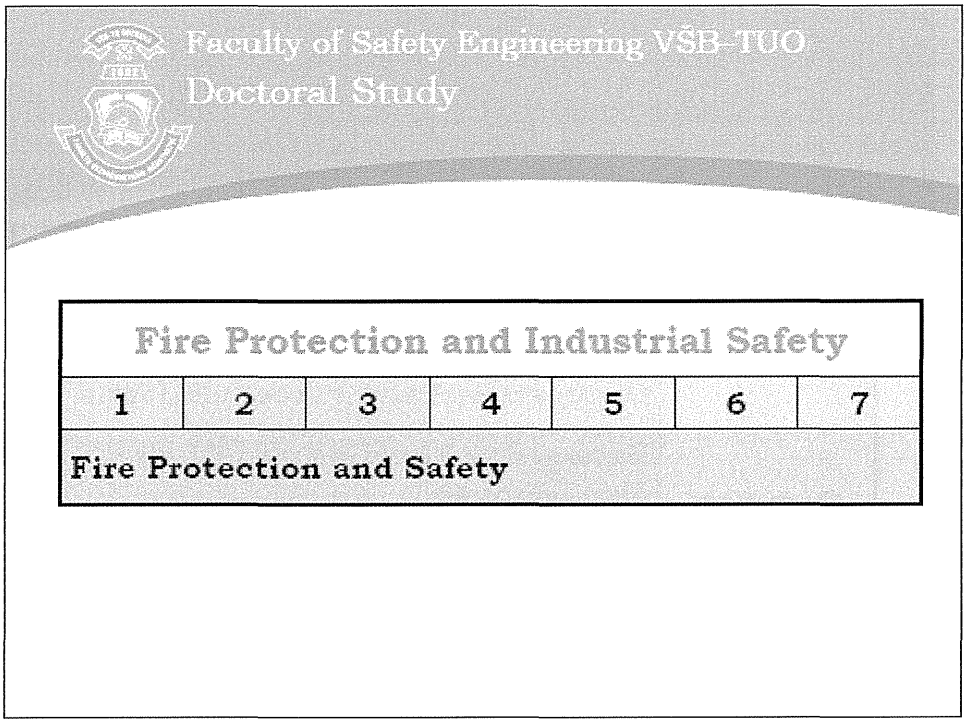


Fire Protection and Industrial Safety			
1	2	3	4
Common Study FSE	Occupational and Process Safety		
	Emergency Planning and Crisis Management		
	Engineering Safety of Persons and Property		
	Fire Protection Engineering and Industrial Safety		

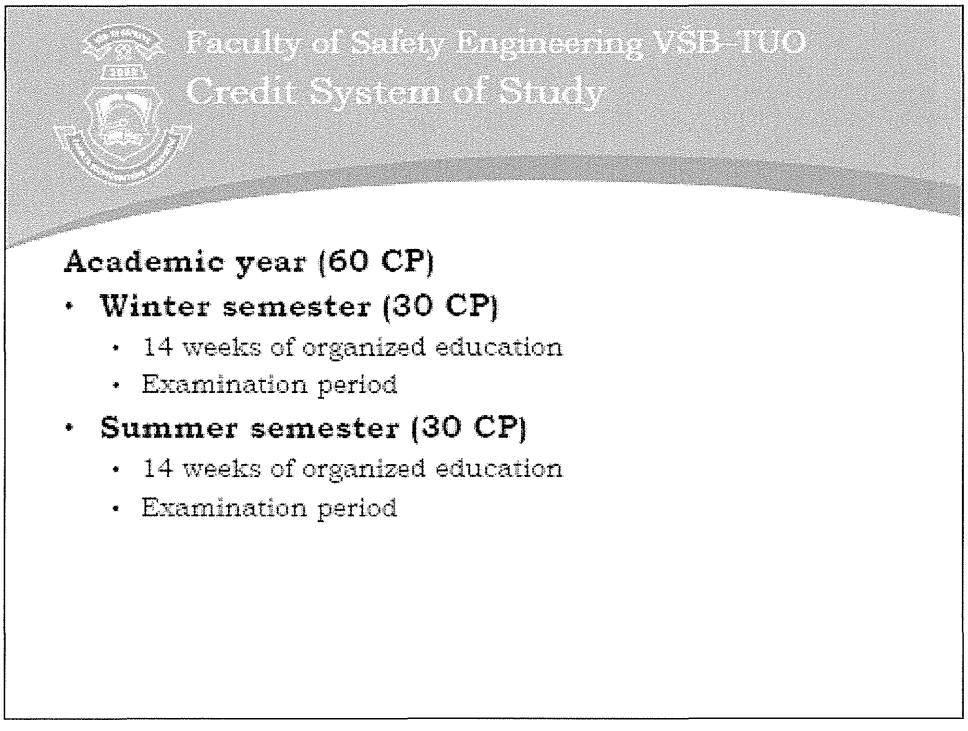
9


Faculty of Safety Engineering VŠB-TUO
Master Study
Fire Protection and Industrial Safety
1
2
Safety and Security Planning
Safety Engineering
Fire Protection Engineering and Industrial Safety
Engineering Safety of Persons and Property

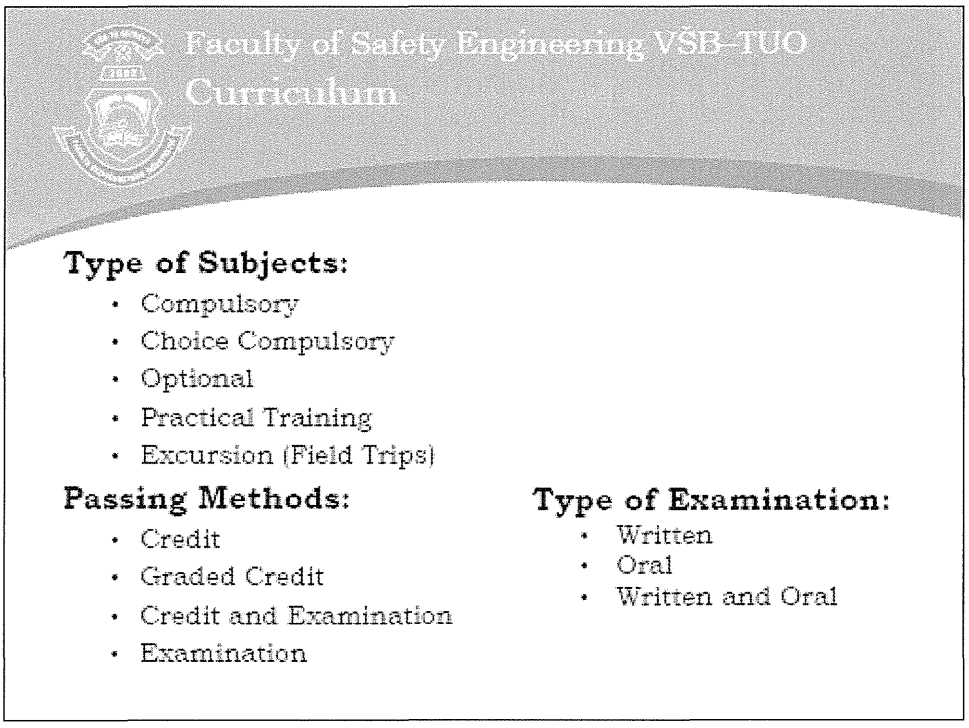
10


Faculty of Safety Engineering VŠB-TUO
Doctoral Study
Fire Protection and Industrial Safety
1
2
3
4
5
6
7
Fire Protection and Safety

11


Faculty of Safety Engineering VŠB-TUO
Credit System of Study
Academic year (60 CP)
• Winter semester (30 CP)
• 14 weeks of organized education
• Examination period
• Summer semester (30 CP)
• 14 weeks of organized education
• Examination period

12


Faculty of Safety Engineering VŠB-TUO
Curriculum
Type of Subjects:
• Compulsory
• Choice Compulsory
• Optional
• Practical Training
• Excursion (Field Trips)
Passing Methods:
• Credit
• Graded Credit
• Credit and Examination
• Examination
Type of Examination:
• Written
• Oral
• Written and Oral

13

Faculty of Safety Engineering VŠB-TUO

Curriculum Control

Degree Programme Board

Guarantors of Degree Programmes

Guarantors of Fields of Study (Study Branches)

Guarantors of Subjects

Academic Senate of the Faculty

- expresses its view on proposals for degree programmes to be offered

Scientific Board

- approves the degree program

14

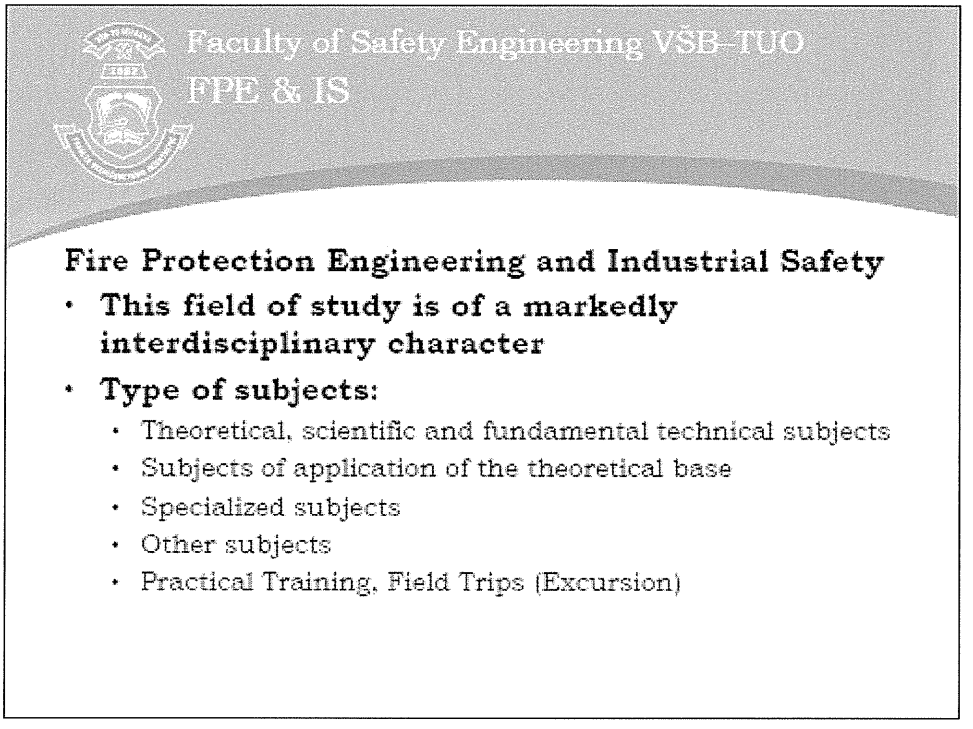
Faculty of Safety Engineering VŠB-TUO

Accreditation of Degree Programme

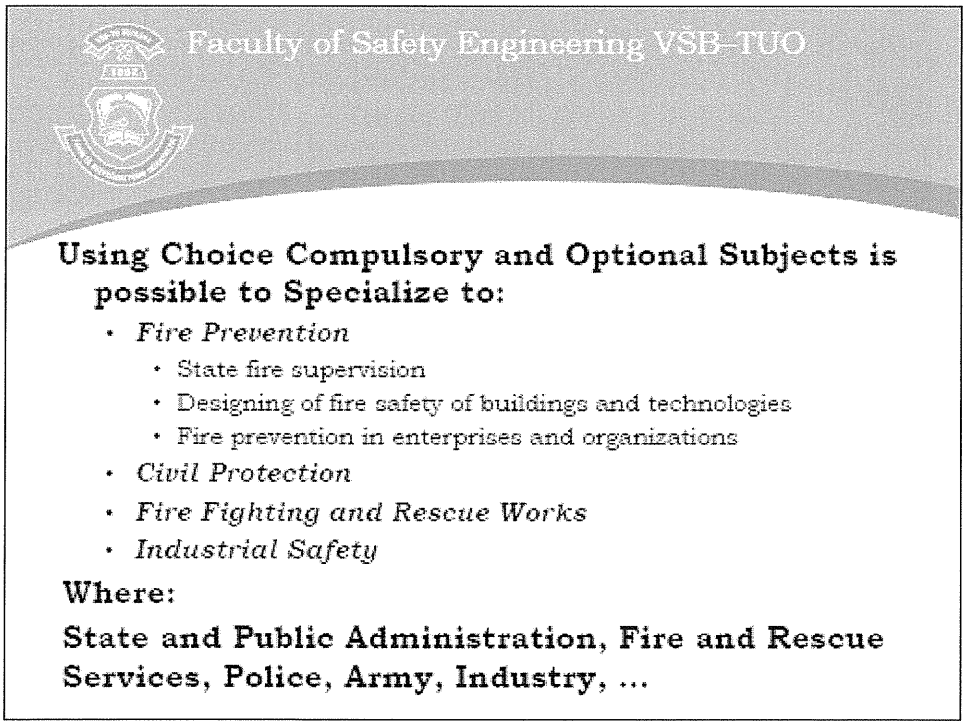
Accreditation of Degree Programme (+ Fields of Study)

- Internal Accreditation Commission of VŠB-TUO
  - deals with quality of education at VŠB-TUO
- Accreditation Commission (Czech Republic)
  - deals with quality of higher education
  - performs comprehensive evaluation of educational, scholarly, research, artistic or other creative activity of higher education institutions
  - quality assessment and accreditation process of degree programmes
    - WG for Military and Security Studies

15


Faculty of Safety Engineering VŠB–TUO
FPE & IS
Fire Protection Engineering and Industrial Safety
• This field of study is of a markedly interdisciplinary character
• Type of subjects:
• Theoretical, scientific and fundamental technical subjects
• Subjects of application of the theoretical base
• Specialized subjects
• Other subjects
• Practical Training, Field Trips (Excursion)

16


Faculty of Safety Engineering VŠB–TUO
Using Choice Compulsory and Optional Subjects is possible to Specialize to:
• Fire Prevention
• State fire supervision
• Designing of fire safety of buildings and technologies
• Fire prevention in enterprises and organizations
• Civil Protection
• Fire Fighting and Rescue Works
• Industrial Safety
Where:
State and Public Administration, Fire and Rescue Services, Police, Army, Industry, ...

17

Faculty of Safety Engineering VSB-TUO

Theoretical subjects, ...

- **Theoretical, scientific and fundamental technical subjects**
  - Chemistry
  - Mathematics
  - Physics
  - ...
- **Subjects of application of the theoretical base**
  - Hydromechanics
  - Heat Transfer
  - Applied Physics
  - Physical Chemistry Fundamentals of Combustion and Explosion Processes
  - ...

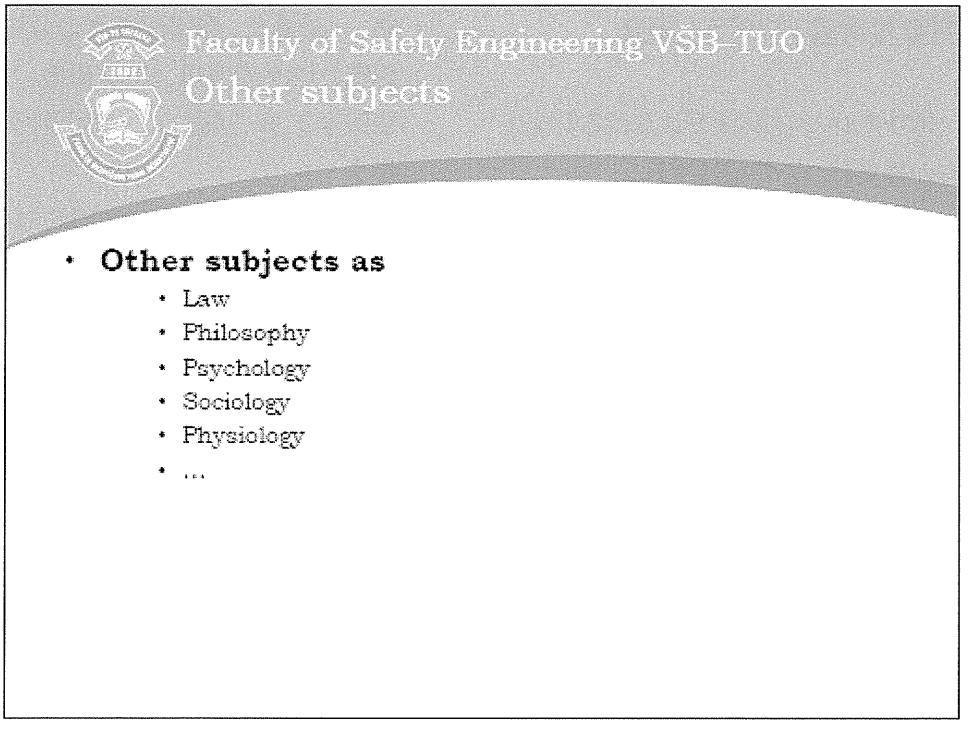
18

Faculty of Safety Engineering VSB-TUO

Specialized subjects

- **Specialized subjects as:**
  - Fire Dynamics
  - Material Science
  - Building Constructions
  - Fire Protection and Safety Systems
  - Blast Effects on Buildings
  - Fire Safety in Buildings
  - Resistance of Building Constructions
  - Computing Methods in Fire Safety in Buildings
  - Communication Systems in Fire Protection
  - Firefighting Equipment
  - Firefighting Tactics
  - ...

19


Faculty of Safety Engineering VŠB–TUO
Other subjects
• Other subjects as
• Law
• Philosophy
• Psychology
• Sociology
• Physiology
• ...

20


Faculty of Safety Engineering VŠB–TUO
Practical Training, Field Trips
• Practical Training, Field Trips
• Initial Professional Training (as professional firefighter)
• Practical Training at Fire Brigade (Fire and Rescue Service)

2.5 平成 26 年度(2014 年度) 報告
オランダ デルフト工科大学における
安全工学教育研究プログラム調査

オランダのデルフト工科大学における安全工学の調査の概要について記述する。

2.5.1 訪問日 及び 訪問場所

日時：2014 年 9 月 12 日　12 時～15 時

場所：Building 31

2.5.2 出席者

デルフト工科大学

Pieter van Gelder

(安全グループリーダー)

Genserik Reniers

(化学安全工学担当)

横浜国立大学

熊崎美枝子

澁谷忠弘

笠井尚哉

2.5.3 オランダ デルフト工科大学について

デルフト工科大学は、 航空宇宙学、応用科学、化学工学、建築学、土木工学、電子数理情報工学、生産工学、海洋学・機械工学、技術管理学で構成される。

2.5.4 オランダ デルフト工科大学での安全工学教育について

デルフト工科大学では、安全工学教育研究活動として、以下の視点を重視しているということであった

1. リスク分析 (確率分析法、品質・信頼性保証、不確定性解析、感度解析、リスク評価、安全チェーン (プロアクション,予防, 抑圧), フォルトツリー-、イベントツリー-解析、検査戦略、－最適化、利害関係者の分析、リスクの規範、リスク最適化、リスク補償、事故調査、法医学工学、回復力、－脆弱性分析を含む)
2. ヒューマンファクター (合理的対不合理の人間行動、行動的心理学と組織的心理学、認知バイアス、文化的偏見、表記法バイアス、不安、外生対内在性人的ミス、省略エラー、実行エラー、回復エラーを含む)
3. リスク –危機コミュニケーション(リスク知覚、危機調整、危機の視覚化、リスクマップ、警報システム、ソーシャルメディア、コミュニケーション計画、事故調整プロセスを含む)
4. 安全な文化 (組織の安全、安全マチュリティラダー、安全文化調査、リスペクト、/パフォーマンスマネジメントを含む)
5. リスクと倫理 (リスクの制限、規範的なリスク評価の性質、リスク評価：容認されているリスク、道徳的ジレンマ、予防原則、リスクに対する哲学の視点、リスク値、持続可能性、運と責任、リスクの共有、リスク正当化を含む)
6. リスクガバナンス (自然—そして技術的リスクの政策決定、協力、参加、緩和と持続可能性、リスクアクション、危機プロセス、伝統や制度、相互関係、(国際)国家インフラ、法的枠組みに基づいたものを含む)

開講されている科目のうち、重要なものを以下に示す。

コース名
輸送機関の安全性
交通安全性
輸送の安全性
火災安全計画
自動車事故安全性；実行中&受動的な安全装置システム
安全科学入門
リスク分析と安全性管理
プロジェクト安全科学
安全とセキュリティシステムの設計
品質管理：バイオ医薬品の品質と安全性
オフショアエンジニアリングにおける安全性
自動車安全&ヒューマンファクター
エージェントベースの安全リスク分析
自動運転、自動車のヒューマンファクターと安全性
安全コース
車両力学入門、自動運転&安全性
リスクと安全性の確実な管理
法務、健康と安全
サイト上のオペレーションメンテナンスと安全性
運輸安全
安全、衛生環境の修士
安全、健康、環境の短縮修士

配布資料（1）

1

Outline

- An overview of safety and security research at TU Delft
- A perspective view on safety and security
- Methodological analyses of safety and security
- Safety and security dealing with a changing world

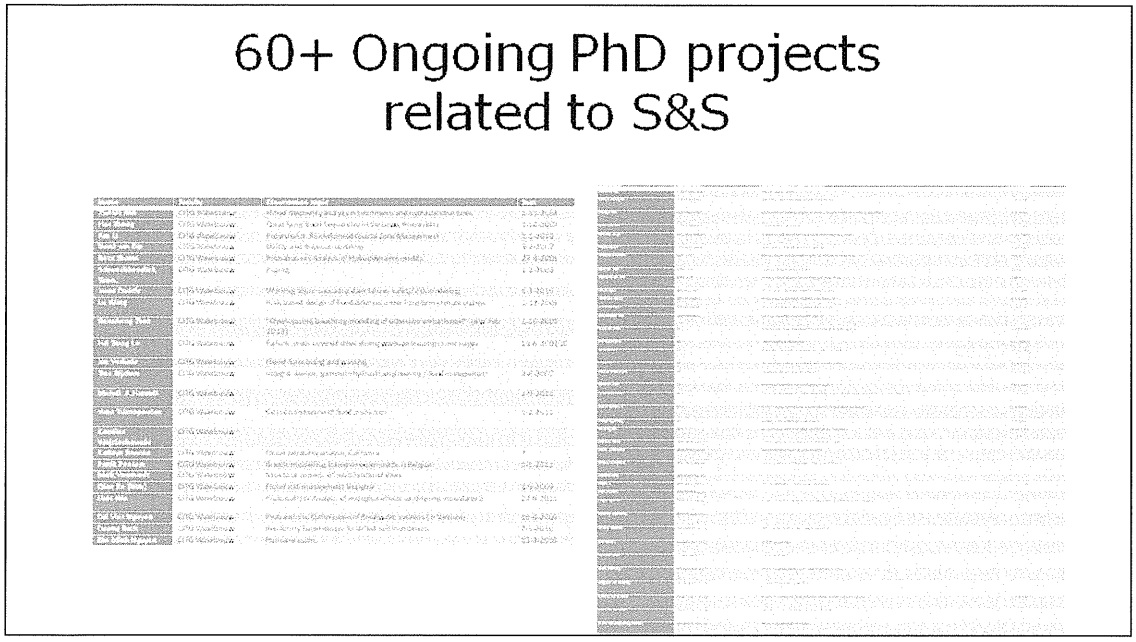
SAFETY & SECURITY

TUDelft

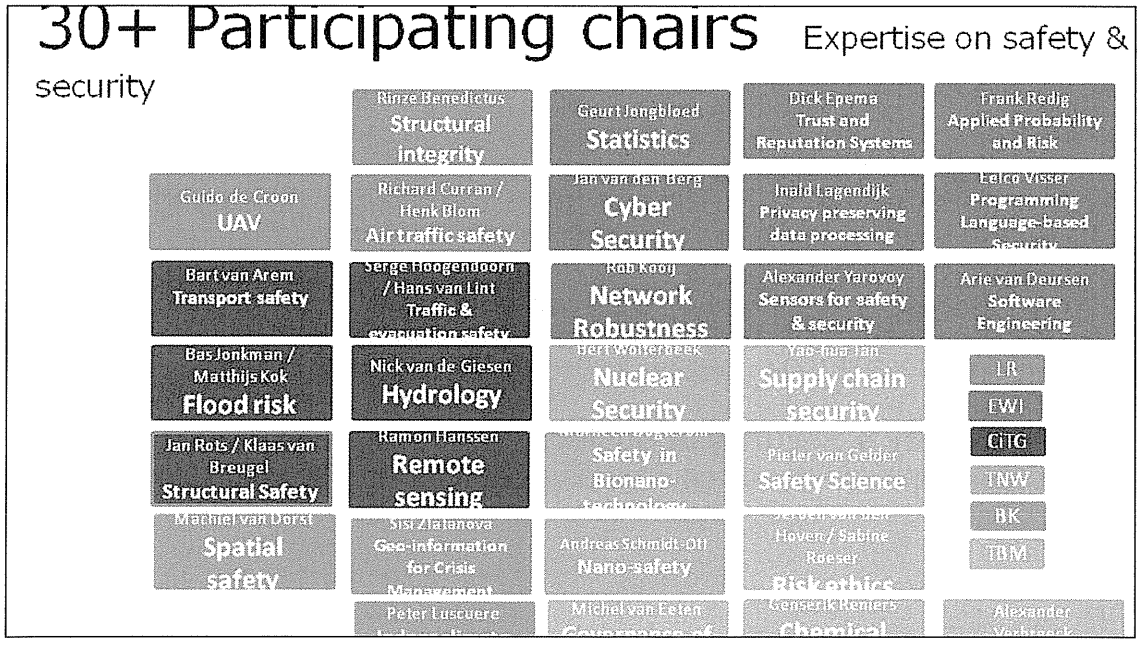
2

Bringing order in the chaos of safety and security at TU Delft

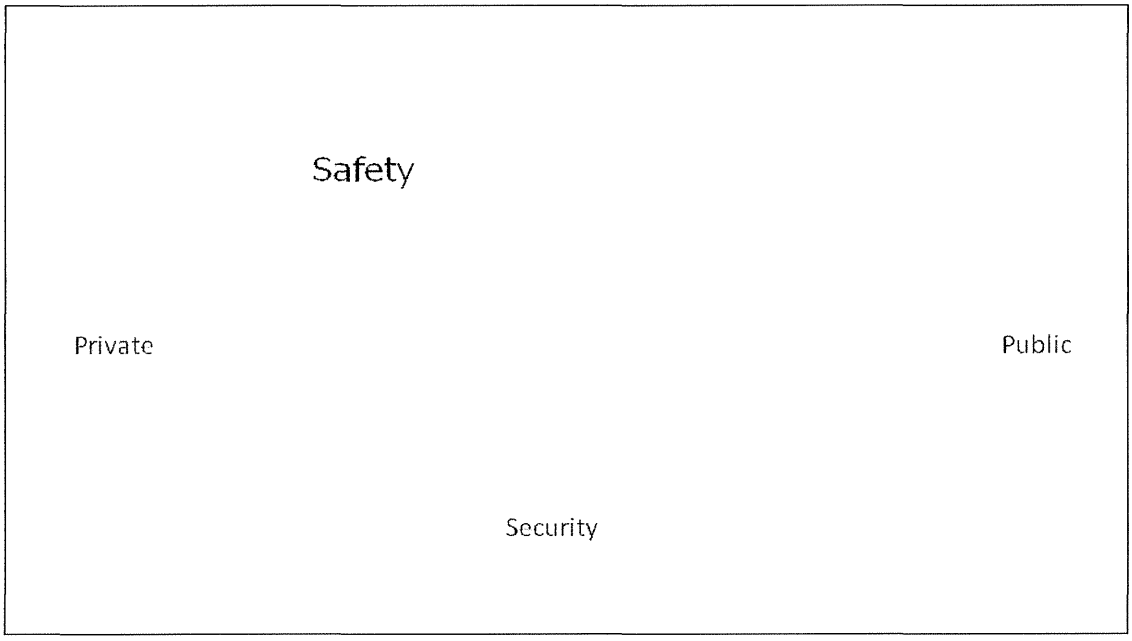
3


60+ Ongoing PhD projects
related to S&S

4


30+ Participating chairs
Expertise on safety &
security
Rinze Benedictus
Structural integrity
Geurt Jongbloed
Statistics
Dick Epema
Trust and Reputation Systems
Frank Redig
Applied Probability and Risk
Guido de Croon
UAV
Richard Curran / Henk Blom
Air traffic safety
Jan van den Berg
Cyber Security
Inald Lagendijk
Privacy preserving data processing
Eelco Visser
Programming Language-based Security
Bart van Arem
Transport safety
Serge Hoogendoorn / Hans van Lint
Traffic & evacuation safety
Rob Kooij
Network Robustness
Alexander Yarovoy
Sensors for safety & security
Arie van Deursen
Software Engineering
Bas Jonkman / Matthijs Kok
Flood risk
Nick van de Giesen
Hydrology
Bert Wolterbeek
Nuclear Security
Yao-hua Tan
Supply chain security
LR
EWI
CiTG
TNW
BK
TBM
Jan Rots / Klaas van Breugel
Structural Safety
Ramon Hanssen
Remote sensing
Safety in Bionano-technology
Pieter van Gelder
Safety Science
Machiel van Dorst
Spatial safety
Sisi Zlatanova
Geo-information for Crisis Management
Andreas Schmidt-Ott
Nano-safety
Hoven / Sabine Roeser
Peter Luscuere
Michiel van Eeten
Genserik Reniers
Alexander

5



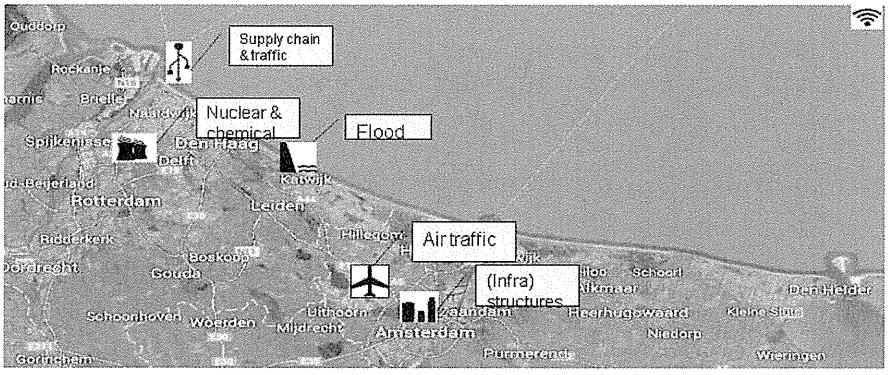
6

Themes

- **Safety & Security at home / at work**
  (concentrating on eldery people and infants, mitigating risks of theft at home, DNA sprays, mini drones)
- **Safety & Security at transport**
  (in (public) transport exploiting big data collection via wireless signals, aerial drones, supply chains)
- **Safety & Security at society**
  (external safety, large crowds at events, forest fires, drought)

7

Safety & Security in the Randstad area



8

Connecting methodologies