"De derde veiligheidsrevolutie en haar betekenis voor de ingenieur. Quo vadis, RBT?"

Future directions of Society and Risk and the role of RBT.

Prof. dr. ir. G.L.L. Reniers

Delft University of Technology

The Netherlands

Presentation outline

1. Who am I?
2. Safety Revolutions
3. Change of society - Era of new Safety Revolution
4. Contemporary questions with respect to RBT
5. Possible pathways for RBT activities
6. How question
7. Conclusions & Recommendations

TUDelft

Presentation outline

1. Who am I?
2. Safety Revolutions
3. Change of society - Era of new Safety Revolution
4. Contemporary questions with respect to RBT
5. Possible pathways for RBT activities
6. How question
7. Conclusions & Recommendations

TUDelft

Prof. dr. ir. Genserik Reniers

- Full Professor TUDelft (+ UA + KULeuven)
- Chair on "Safety of Hazardous Materials"

- Safety and Security Scientist
- Focus on industries using chemical substances

- Engineering & Technology
- Management & Economics

- Published +/- 40 books (author + editor)
- Published +/- 300 scientific articles
  in peer-reviewed journals

Top Contribution Themes
w.r.t. Research within the fields of
Safety and Security Assessment & Management

- Domino effects in the Process Industries
- Cluster/CIP safety and security and S&S collaboration (a.o. qualitative research and also game-theory)
- Safety and security Culture
- Learning from incidents and accidents
- Barrier assessment and Management
- Systemic risks in the process industries
- Safety and security prevention and economics
- Security risk assessments in the chemical industry
- Dynamic risk assessments (BN, Petri-nets)
- Leadership and performance mgt science (Safety-I, -II, -III)
- Fundamentals of safety science
- Resilience assessment and management
- Safety and security Integration

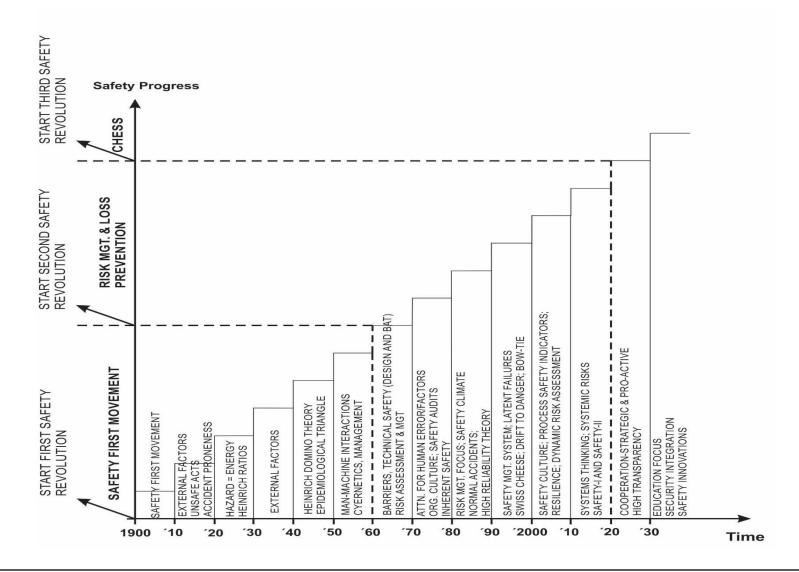# Books published on Safety and Security

Presentation outline

1. Who am I?
2. Safety Revolutions
3. Change of society - Era of new Safety Revolution
4. Contemporary questions with respect to RBT
5. Possible pathways for RBT activities
6. How question
7. Conclusions & Recommendations

Safety Revolutions

TUDelft

Presentation outline

1. Who am I?
2. Safety Revolutions
3. Change of society - Era of new Safety Revolution
4. Contemporary questions with respect to RBT
5. Possible pathways for RBT activities
6. How question
7. Conclusions & Recommendations

TU Delft

Change of society – Era of new Safety Revolution

We have definitely entered a new societal era since a couple of decades, with internet/connectivity, social media/possibility of pictures and movies, globalization, big data, IoT, security issues, both technologically and societally

Current societal expectations are more than in the past focused on
- Doing the right things (ethics)
- Doing things right (excellence)
- Doing things together
- Transparency
- Ever more risk-based and focused on safety & security
- Environment and energy transition
- Trust and Credibility

TU Delft

Presentation outline

1. Who am I?
2. Safety Revolutions
3. Change of society - Era of new Safety Revolution
4. Contemporary questions with respect to RBT
5. Possible pathways for RBT activities
6. How question
7. Conclusions & Recommendations

TUDelft

Contemporary questions with respect to RBT

- How to **integrate different types of risks** when making risk decisions?
- How to **deal with horror scenarios (e.g. terrorism) from a sustainable/design-based viewpoint**?
- How can **moral aspects and ethical principles** be taken into account in risk management and decision-making?
- How to develop **usable** and inclusive **dynamic risk assessment techniques**, using big data and real-time monitoring?
- How to **advance academic knowledge regarding operational- and cyber security**?
- How to truly advance **collaboration and transparency for risk-based solutions**?
- Changing world: new challenges (a.o. **energy transition**) and new risks
- Still too many incidents and accidents –industry can really be **more excellent, more profitable by not having accidents**
- Companies are still too much "safety-islands" instead of "**safety clusters**"

Presentation outline

1. Who am I?
2. Safety Revolutions
3. Change of society - Era of new Safety Revolution
4. Contemporary questions with respect to RBT
5. Possible pathways for RBT activities
6. How question
7. Conclusions & Recommendations

Possible pathways for RBT activities

- Energy transition and emerging risks

- Societal Resilience (f.i. towards pandemics)

- Communication about risks and safety measures and policies

- Co-creation, discussion and reflection on safety measures

- Climate issues and risks, circular economy

- Operational risks as a result of social media and fake news

- Managing the risks of information overflow, AI technology

- Dealing with Flexibility, one-size-fits-all measures

Possible pathways for RBT activities

- Collaboration within and between disciplines on risk issues (cyber, industrial, nature-related, counter terrorism, microbial, etc.)

- Security issues

- Learning from safety, AI

- Four E's (Ethics, Economics, Emotions, Education) and risk assessment & management

- Grey rhino's (such as Corona) and risk management

- Safety-I and Safety-II (Respect, performance and excellemce)

- Pro-active thinking, pro-active attitude ("voordenken") (perception, attitude)

TUDelft

Presentation outline

1. Who am I?
2. Safety Revolutions
3. Change of society - Era of new Safety Revolution
4. Contemporary questions with respect to RBT
5. Possible pathways for RBT activities
6. How question
7. Conclusions & Recommendations

Paradigm Shift: the 'Triple helix' needs to play 'CHESS'

The Triple Helix (Industry, Authorities and Research institutes) truly wanting to advance safety within the chemical and process industry, needs to play 'CHESS': Put focus on / Advance the following:

- **C**ooperation and Clustering

- **H**igh transparency and efficient inspections

- **E**ducation, learning and training

- **S**ecurity development and integration

- **S**afety innovation and dynamic risk assessment

Optimist view: Some solutions (to develop HROs)

We are not going to be able to change the trends, but we can adapt and deal with the observed threats via:

• Embrace the changes

• Managing safety and security in an integrated way

• Being prepared and resilient

• Intelligent transparency (Just culture)

• Cluster-thinking (learning communities)

• Combination of research mentality and pragmatism

Right approach

Approaches that work most for S&S if applied consistently and all the time:

- **Situational awareness**

- **Questioning attitude**

- **Safety & security are hypothetical benefit**

Approaches that are highly contraproductive for S&S:
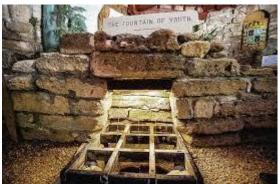
- "Getting things done" mentality, "Common sense" mentality

- Thinking that Safety & security are cost for company

- Lack of learning attitude

TUDelft

How to do this in RBT context?

- Fountain of eternal youth?

- Attract more 'young enthousiastic people'

- Timely topics (what moves people?)

- Questionnaires, surveys

- Asking for ideas (bottom-up)

- Increasing (internal and external) visibility

- Increasing knowledge (cfr. a.o. "kennisbank")

- Diversification of experts/expertise

How to do this in RBT context?

Heisessie in februari: Reflecteren en debatteren over:

- Wat/hoe/wanneer/waarmee? (Beleidsplan + haar implementatie) (missie, visie, strategie)

- Wie? (hoe verjongen)

- Kader/regels? (huishoudelijk reglement)

- Hoe inspireren/communiceren (binnen KIVI en ook naar buiten toe)

Presentation outline

1. Who am I?
2. Safety Revolutions
3. Change of society - Era of new Safety Revolution
4. Contemporary questions with respect to RBT
5. Possible pathways for RBT activities
6. How question
7. Conclusions & Recommendations

TUDelft

Conclusions and recommendations

- Attracting **young blood**

- **Timely/state-of-the-art** topics/issues

- **Paradigm shift** in dealing with safety: CHESS

- **Optimist view**: solution-oriented, inspirational

- **Right approach**: Attitude, Attitude, Attitude! (besides technology and organisation science) (BTW: attitude follows knowledge!)

Essential is educating the people...

Southwest Airlines Flight 1380 Emergency landing…

Not tricked…

Thank you very much for your attention!

G.L.L.M.E.RENIERS@TUDELFT.NL

'**C**HESS'

- **C**ooperation and Clustering:

  - Establish a **multi-plant council** or a cluster council
  - Establish pro-active strategic cooperation and improvement by setting up a '**multi-plant safety funding' budget**
  - Use '**flying risk assessment**' teams and 'flying internal audit' teams in multiple plants
  - Establish a **multi-plant safety management system** upgrade approach
  - Establish a '**multi-plant safety culture**'
  - Etc.

'<u>CH</u>ESS'

- **H**igh transparency and efficient inspections

  - Establish a **country-wide database** for incident and accident reporting in the chemical industry
  - Establish a '**just culture**' in chemical plants/clusters
  - Establish a **dissemination system** where companies and authorities/inspection teams can learn from all incidents happening within the industry
  - Establish an **understanding between multi-plant safety council members and inspection services** to make inspections much more efficient
  - Safety inspectors should have rotating chemical clusters/plants
  - Etc.

'**CH<u>E</u>SS**'

- **E**ducation, learning and training

  - **Knowledge management systems** should be present in every chemical plant
  - There should be **training sessions where plant safety managers and safety inspection** services are jointly present
  - Safety learning should be supported by adequate/validated/scientifically investigated **performance management science**
  - 'Dealing with uncertainties and risks' should be **taught to children** in primary schools
  - **'Risk management' should be taught at high schools**, either as a separate course, or within existing courses
  - 'Process safety' (and inherent safety) should be taught to all chemists, chemical engineers and industrial engineers, and be considered as essential in the educational program
  - Etc.

T̃U Delft

'**CHE**<u>S</u>**S**'

- **S**ecurity development and integration

    - Carry out TA's, SVA's or **security risk assessments** in all chemical plants/clusters (alongside safety risk assessments / integrated)
    - Use a cluster view to take **counter-terrorism measures**, besides a plant view
    - Make a priority of **transportation security** (transportation risk assessments and measures based on these assessments, secure lanes, secure emplacements, etc.)
    - Establish **cluster security teams**
    - Develop a **security incident database**
    - Establish **security inspections** for plants/clusters (alongsides safety inspections / integrated)
    - Take all security measures (incl. counter-terrorism) seriously, preferably design-based by scientific studies
    - Etc.

'**CHESS**'

- **S**afety innovation and dynamic risk assessment

  - Use **big data** to innovate safety within chemical plants/clusters
  - Use **dynamic risk assessment techniques** (invest in them) to advance real-time knowledge and decision-making
  - Invest in research for performance management science and safety/security performance indicators (should be pro-active mainly) to see which indicators work and which don't (longitudinal studies)
  - **Serious games** for safety and security major accidents/terrorist attacks should be developed and used for learning and exercising
  - Science on **mental models** and their impact on safety should be developed and implemented in chemical plants/clusters
  - Develop alternative risk assessment techniques whereby **ethical/moral principles and economic information** are considered
  - Etc.

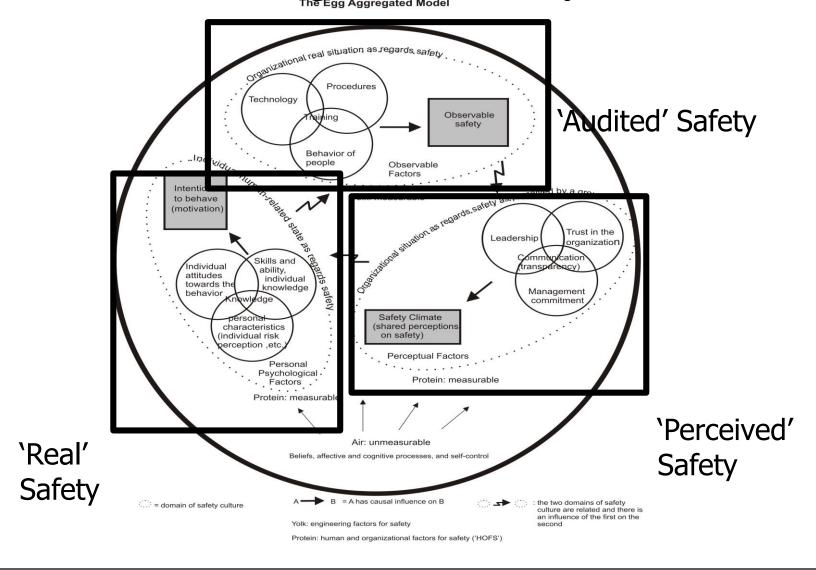# Transparency: the key to revolutionary safety success

Three types of safety:

- 'Real' safety

- 'Audited' safety

- 'Perceived' safety

All three need to be looked at and need to be excellent for **TRUE** SAFETY!!

Three types of safety and the TEAM safety culture model, leading to **TRUE safety**

The Egg Aggregated Model

'Audited' Safety

'Real' Safety

'Perceived' Safety

ᵀUDelft

Ways to deal with transparency

Three types of transparency needed for the three types of safety:

- **Company-citizen/employee transparency → 'perceived' safety improvement**
- **Company-company transparency → 'real' safety improvement**
- **Company-authorities transparency → 'audited' safety improvement**

→**Three types of transparency should be seen as one integrated problem**
(if you only focus on one type, the situation will be sub-optimal at best)

Some ways to deal with the **company-citizen/employee transparency** problem

Enhance acceptability (license to operate) of industrial activities by:

- A **Counter** for obtaining all kind of safety information for citizens (also info on other types of transparency)
- Company takes the **initiative to provide risk information** to all their neighboring communities regularly, via meetings as well as via social media
- **Citizens are informed about the safety situation within the company** (e.g. safety culture/TEAM model) and the scenarios (e.g. complex scenarios) used for risk assessments (and also about the assumptions made and their reasons), and if they have **comments, suggestions** etc. they are **taken seriously and it is investigated by an independent body (for instance an independent research institute or a credible/competent university)**
- Citizens from the surrounding communities are asked to participate in **safety think tanks** for getting information and if possible improving safety within the company
- Etc.

→ 'perceived' safety improvement

TUDelft

Some ways to deal with the **company-company transparency** problem

Enhance pro-active strategic collaboration between companies in the chemical industry (cfr. Aviation) via:

- Establish on a national level a dynamic **database for risk information** of all kind
- Establish a **database for near-misses**, incidents etc. based on industry wide-harmonized accident investigation documents, and dissemination system
- Use company-mixed '**flying risk assessment**' teams and '**flying internal audit**' teams to be deployed in chemical plants
- A program is installed based on **dialogue within a company** to assess and **influence/improve and the existing 'mental models' on safety** within the company
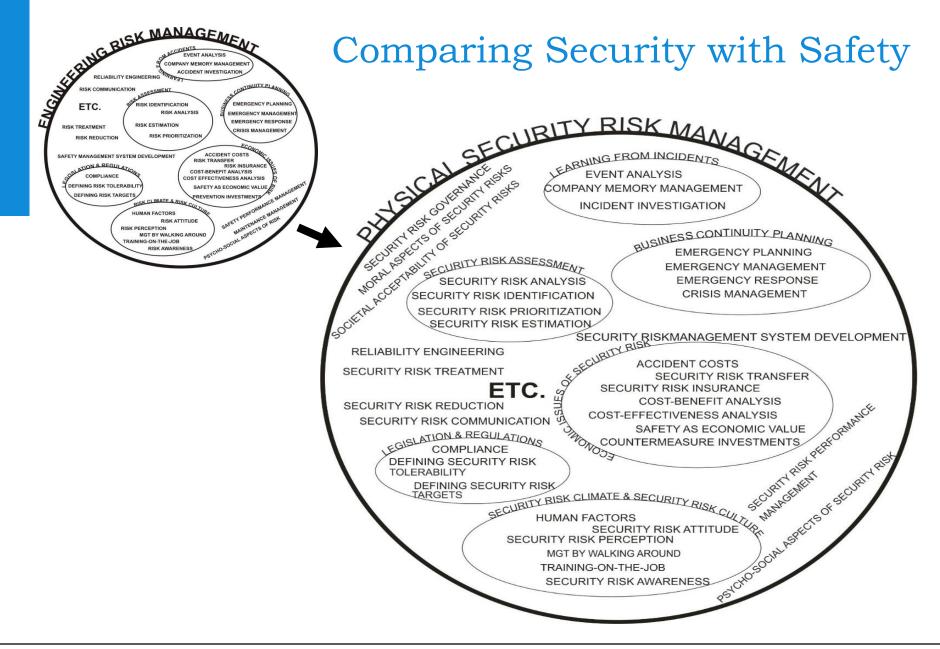- Etc.

→ 'Real' safety improvement

Some ways to deal with the **company-authorities transparency** problem

Enhance trust between companies and authorities by:

- Agreeing upon **what is 'bonafide' and what is 'malafide' behavior** and if needed, **change legislation to avoid any blame culture** in a bonafide setting, but malafide companies must be dealt with harshly (cfr. Aviation)
- Making sure that **mayors, and by extension politicians, are well informed** about the risks involved in the company's activities
- Introduce an '**Council for safety-inclusion in decision-making**'
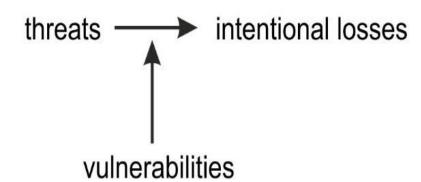- Etc.

→ 'audited' safety improvement

Comparing Security with Safety

TUDelft

Comparing Security with Safety

non-intentional risks
(safety)

safety risk trias :

hazards ──────► non-intentional losses

exposure
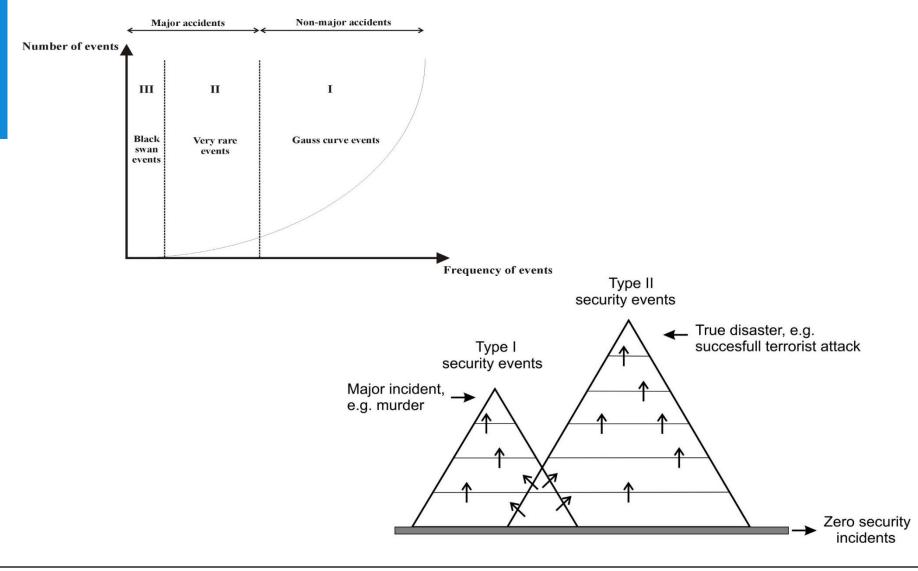
intentional risks
(security)

security risk trias :

threats ──────► intentional losses
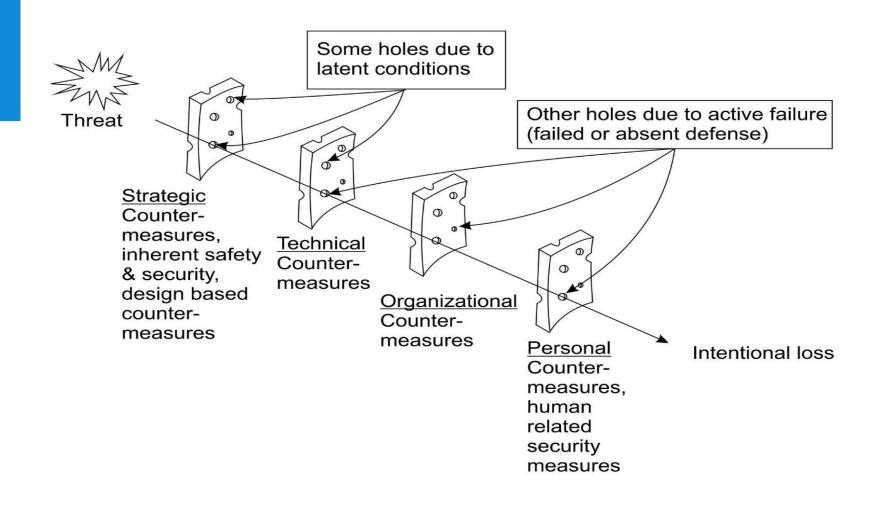
vulnerabilities

TUDelft

Comparing Security with Safety

Concept 1: Intesification

Highly dangerous → Highly dangerous but more intesified

Concept 2: Substitution

Highly dangerous → Less dangerous

Concept 3: Attenuation by moderation

Highly dangerous → Less dangerous conditions / Highly dangerous, but more intensified conditions

Concept 4: Attenuation by limitation of effects

Highly dangerous → Highly dangerous, but the consequences have been limited

Concept 5: Simplification

Highly dangerous → Less dangerous

TUDelft

Comparing Security with Safety

	At the source (Outer Ring)	At the interface (Middle Ring)	At the target (Inner Ring)
Measures **S** (strategy)	• Substitution • Change process	• Automation, telemanipulation • Land-use planning - redundancy of critical systems	• Criteria for selection of security-aware operators - enforced infrastructure
Measures **T** (technical)	• cameras / intrusion detection - fences - Bollards and trenches • intrusion sensors	• locked doors • access control system - turnstiles	• doors and cabinet locks - network firewalls and passwords - CCTV
Measures **O** (organizational)	• guards on patrol at property fence line - Passport controls at entrance	• visitor escort policies • receptionists in buildings - Badge checks	• security instructions -intelligence -emergency plans • document shredding
Measures **P** (personal)	• Education/training of the entrance guards	• Information/instruction on threats	• Instruction for the use of security equipment

Comparing Security with Safety