Safety and security in the chemical industry: A new paradigm and the vision for the future in the Netherlands.

Keynote SRA-Nordic chapter; 8 November 2018

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The Netherlands
Presentation outline

1. Who am I?
2. Why? Safety and Security concerns in Europe
3. Brief history of safety progress
4. What are current evolutionary trends to improve safety within the chemical industry?
5. A paradigm shift is needed: CHESS
6. The Program ‘Sustainable Safety 2030’ (DV2030) in the Netherlands – 5 Roadmaps
7. A vision of 2040 thanks to the DV2030 Program
8. Conclusions & Recommendations
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Who am I?

- Full Professor Delft University of Technology
- Chemical engineer, Safety and Security Scientist
- Focus on industries using chemical substances
- Engineering & Technology
- Management & Economics
- Published 35+ books (author + editor)
- Published 150+ articles
Prof. dr. ir. Genserik Reniers

- MSc. in Chemical engineering
- Ph.D. in Applied Econ. Sciences
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Prof. dr. ir. Genserik Reniers

- MSc. in Chemical engineering
- Ph.D. in Applied Econ. Sciences

- Expert in
  - Domino effects in the Process Industries
  - Cluster safety and security (culture)
  - Safety and security collaboration
  - Uncertainty analyses and game-theory
  - 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
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WHY - Safety and Security Concerns

- **Prudence due to industrial activities** should be present in every industry, and certainly also in the hazardous materials using industries.
- **Characteristics of chemicals using industries**: use of hazardous materials, existence of chemical industrial parks, license to operate/acceptability linked with reputation, high uncertainties linked with debatable opinions.
- **The Netherlands & Belgium**: densely populated areas combined with highly concentrated chemical industrial activities.
- The Rotterdam & Antwerp Port Areas are part of the “ARRRA” and are extremely important for the Dutch (/Belgian/German/European) economies.
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Brief history of safety progress
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Safety in organisations (a.o. in the chemical industry)
What are current evolutionary trends to improve safety within the chemical industry – Using the bow-tie:

- **PRO-ACTIVE PHASE**: collaboration (scale + O³), dynamic risk assessments, big data, economic analyses, security TAs, harsh environments, performance mgt, trans-disciplinary solutions, systemic solutions / barriers, educate people pro-active communication (safety apps), ‘culture’ (single + cross-c), how safe is safe enough / ethics, mental models

- **INCIDENT PHASE**: use real-time data to make assessments, big data, communication, collaboration, simulation exercises: more ‘real’ and more involvement from public; serious games

- **RE-ACTIVE PHASE**: collaboration (scale + O³), communication, psychological aspects

However: too many of the old recipes are being used and re-used in safety, leading to evolutionary safety innovation, but no Safety Revolution!
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A paradigm-shift is needed

"Business as usual" in the chemical industry regarding dealing with safety and safety improvements in the chemical and process industry since 1960’s (second safety revolution)

However: 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, 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 safety and security
- Environment and energy transition
Certain issues and questions need to be addressed and answered

- How to **integrate different types of risks** when making risk decisions?
- How to **deal with horror scenarios** (e.g. terrorism in a chemical cluster) from a sustainable/design-based viewpoint?
- How can **moral aspects and ethical principles** be taken into account in 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 in the CPI**?
- How to tackle new societal challenges (a.o. Process security)?
- How to be more excellent and more long-term profitable by understanding that **not having accidents delivers huge profits**?
- How to turn chem. ind. areas from “safety-islands” into “safety clusters”?
- How to **not let process safety education** depend on ‘champions’?
- How to make chemical industrial activities **more resilient**?
Certain issues and questions need to be addressed and answered:

- How to **integrate different types of risks** when making risk decisions?
- How to **deal with horror scenarios** (e.g., terrorism in a chemical cluster) from a sustainable/design-based viewpoint?
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- 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 **advance collaboration and transparency in the CPI**?
- How to **improve safety DO NOT SUFFICE** to answer these questions and **to revolutionize safety** and make it much safer in a realistic way?
- How to truly advance **collaboration and transparency in the CPI**?
- How to **be more excellent and more long-term profitable** by understanding that not having accidents delivers huge profits?
- How to **not let process safety education depend on ‘champions’**?
- How to **make chemical industrial activities more resilient**?
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:

- **Cooperation and Clustering**
- **High transparency and efficient inspections**
- **Education, learning and training**
- **Security development and integration**
- **Safety innovation and dynamic risk assessment**
‘CHESS’

- Cooperation and Clustering:
  - Establish a **multi-plant council** or a cluster council
  - Establish a **Counter** for obtaining all kind of safety information for citizens in every chemical cluster
  - 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 (learning and implementing the best practices from each other)
  - Establish a ‘**multi-plant safety culture’**
  - ...
‘CHESS’

- High 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 (bonafide/malafide)
  - 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
  - **Providing the cluster council with inspection information** of all companies, so that it may act upon this information (transparency of inspections)
  - Making sure that **mayors, and by extension politicians, are well informed** about the risks involved in the cluster’s activities
  - ...
‘CHESS’

- **Education, 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** (it’s all about making safety second nature!)
  - ‘**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
  - ...

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‘CHESS’

- **Security 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 chemical plants/clusters** (alongsides safety inspections / integrated)
  - Take all security measures (incl. counter-terrorism) seriously, preferably design-based by scientific studies
  - ...

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‘CHESS’

- **Safety 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
  - Use advanced tools/techniques for making chemical industrial areas **more resilient (preferably design-based)** against Type II/HILP accidents
  - **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**
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Moto: “The world’s safest chemical industry in 2030”

**PROGRAMMA DUURZAME VEILIGHEID 2030**

Samen werken aan duurzame veiligheid

Some focus areas and projects in progress, in start-up or in preparation

1. How to obtain a **Just culture** in the chemical industry: learning from aviation (finished)
2. Studying parameters influencing **safety of clusters versus stand-alone companies** (e.g. impact of governance structure, cooperation levels on safety, for instance domino effects) (will be finished in Jan 2019)
3. Trial project for learning from near-misses and incidents like in aviation (**bonafide/malafide approach** for inspection and regulator) (project in progress)
4. Like in aviation, development of a shared database for near-misses, incidents and accidents for the chemical and process industry, to disseminate ALL lessons learned to ALL other companies, also from near-misses (in conceptual phase)
Some focus areas and projects in progress, in start-up or in preparation

5. **Transparency projects** for
   - Company-citizen transparency (→ ‘perceived safety’ improvement) (project in progress)
   - Company-company transparency (→ ‘real safety’ improvement) (project in conceptual phase)
   - Company-authority transparency (→ ‘audited/procedural safety’ improvement) (cfr. Project bonafide/malafide)

Remark that the three types of transparency should be seen as one integrated problem (if you only focus on one type, nothing will change)
Brainstorming results

- **Triple helix** is essential
- Learn from **existing initiatives**
- **Valley approach** (cfr. Energy Valley, Food Valley)? – **However Safety** should not be ‘part of’, but **should be the focal point**, it should be organised on its own overarching level!
- Safety as field of science in universities – Dutch universities should **develop curricula and chairs with focus on process safety**; accreditation should be part of this approach and European harmonization with respect to the vision on safety, is strived for; chemical industry can play a role by creating career opportunities and sponsoring
- Safety as field of science in higher education (non-universities): create curricula and teaching modules with respect to safety
- **Nation-wide knowledge agenda should be developed** – existing initiative in the Netherlands should be bundled where interesting, learning from each other, upscaling initiatives, etc. Someone should be assigned to do this, and to make the safety knowledge agenda a part of the National Dutch science agenda

→ **Action plan will further be elaborated based on this brainstorm by Ministry**
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A vision of 2040 thanks to the DV2030 Program – some observations

• Companies within clusters trust and help each other, proactively and reactively, strategically and operational;
• Chemical companies within the Netherlands learn from every near-miss that happens in the country;
• Companies and authorities trust each other with the same goal: healthy, safe and long-term profitable economic activities in industrial chemistry;
• The Netherlands serves as an example for the rest of the world with respect to learning from near-misses and incidents in the chemical industry;
• The last major accident that happened in the Dutch chemical industry was in 2024; nonetheless, the industry has grown a lot since 2020;
• The Dutch society embraces the chemical industry, is proud of it, and accepts the risks that go together with the activities; people have the maturity to understand that the industry is crucial for people’s welfare and that it does its very best wrt safety;
• Chemical industrial areas are as resilient as possible (both real and perceived);
• Inspections are seen purely as learning-opportunities by both inspectors and companies;
• The ‘whistleblower house’ doesn’t exist anymore for the chemical ind.
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Conclusions & Recommendations

• Ageing assets should be well managed and **innovative technology should be developed and used** to this end (R1)

• The **DV2030 Roadmaps should be accommodated** by the accompanying **right/useful legislation, aimed at a just culture** (R2)

• Trust is not given, **trust is earned**, and that is via **adequate transparency** as a mediator (this holds for companies, authorities and citizens) (R3)

• **Cluster Safety Parameters** need to ensure that **clusters can further expand and at the same time be made safer (and more secure) than stand-alone companies** (R4)

• **High-level knowledge** doesn’t work ‘one-way’; it **requires collaboration from all sides** (companies, inspection, authorities, citizens) – Triple Helix! (R5)

• **Security** should be treated as a **separate Roadmap**…(R missing)
Loss Prevention Symposium 2019 at the TUDelft in the Netherlands

- At the Delft University of Technology (jubilee edition, 45 years after first LP Symposium in Delft)
- **16-19 June 2019**
- Since 1974 (3-yearly)
- **Very international** (mainly European, but also USA, China, and rest of world)
- 350-600 participants
- **Good mix between academics, practitioners/industrialists, consultants, authorities/inspections**
- High quality research presented
- Keynote speakers: Terje Aven (UIS, Norway), Faisal Khan (MUN, Canada), Pol Hoorelbeke (Total, France), Jos van Winsen (Shell, the Netherlands), Hans Pasman (Texas A&M University, USA), Paul Amyotte (Dalhousie University, Canada), Roald Laperre (Ministry of I&W, the Netherlands)
- Paper submissions are finished, but **Poster communications are still welcome** – send abstract to: A.C.Pinzger@tudelft.nl
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Wrap-up:

Never forget:
Unsafety is patient!

Strategic thinkers fear transparency and collaboration.

Strategic intellectuals however use it to their advantage.
Thank you very much for your attention!

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