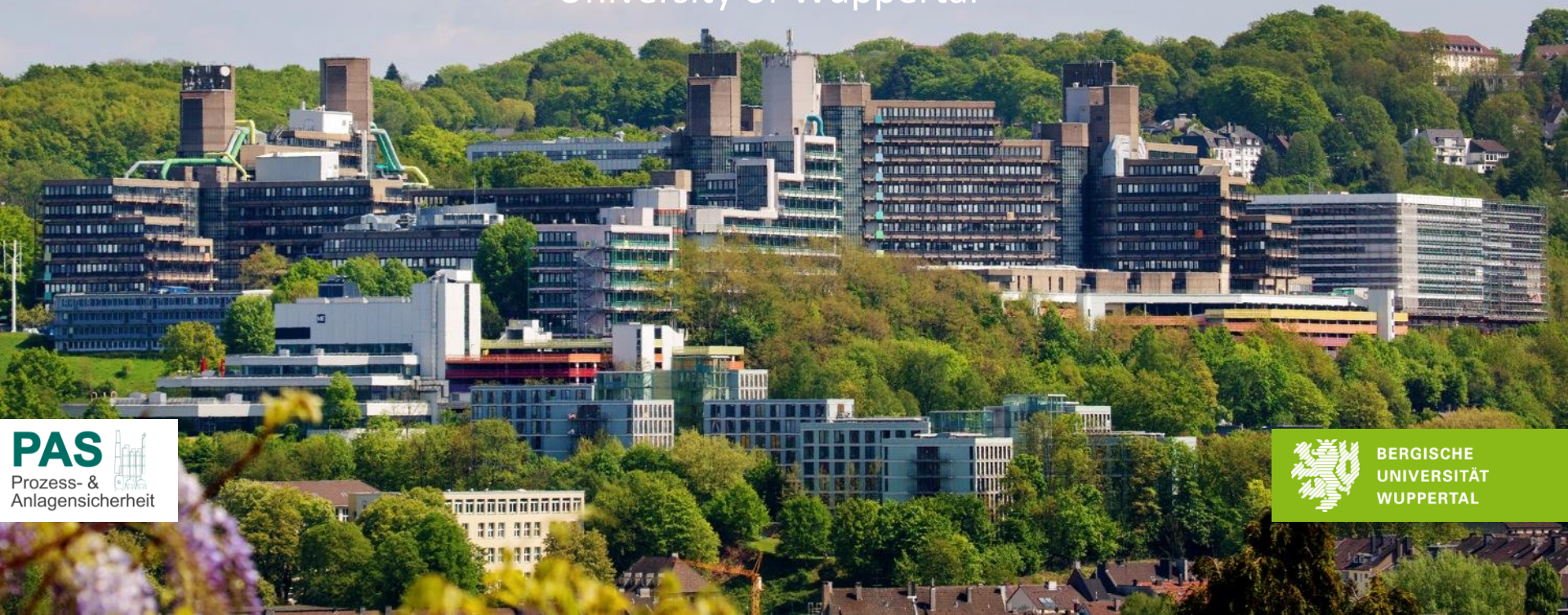


Challenges in Process and Plant Safety

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- Introduction
- New challenges in Process and Plant Safety
- Department of Plant and Process Safety - Main research topics
- Brief description of two selected projects
- Summary

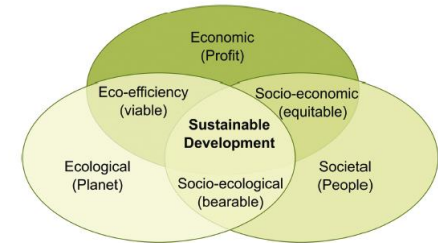
- Much has been achieved in process and plant safety in recent decades.
- There is currently a rapid technical (and politically driven) development in many areas.



- Process and plant safety face new challenges.
- There is a need for expansion and reorientation.

Current and future challenges

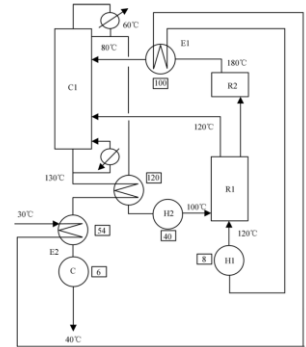
- Increase in sustainability / increase of energy efficiency



Szekely: Sustainable Process Engineering

Implementation in process plants

- Energy integration and heat recovery
→ higher degree of interconnection



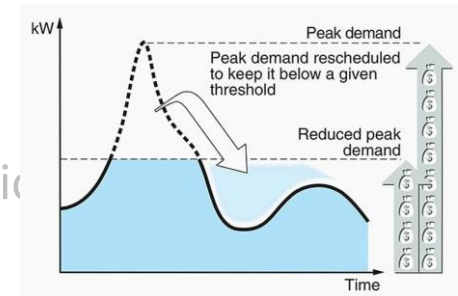
Rong: Process Synthesis and Process Intensification

Implementation in process plants

- Energy integration and heat recovery
→ higher degree of interconnection
- Process optimization
→ higher degree of automation,
→ more complex control structures,
→ consideration also of non-technical and
external parameters (e.g. spot market prices)

Implementation in process plants

- Energy integration and heat recovery
 - higher degree of interconnection
- Process optimization
 - higher degree of automation,
 - more complex control structures,
 - consideration also of non-technical and external parameters (e.g. spot market price)
- Load management
 - highly variable operation
 - high demands on process control and organization



Edvard: Smart load management strategies to save energy

Implementation in process plants

- Energy integration and heat recovery
 - higher degree of interconnection
- Process optimization
 - higher degree of automation,
 - more complex control structures,
 - consideration also of non-technical and external parameters (e.g. spot market prices)
- Load management
 - highly variable operation
 - high demands on process control and org
- Integration of renewable energies
 - high fluctuation
 - high demands on design and process control



Lausitzer Rundschau 22.05.2019

Challenges for Plant and Process Safety

- significant increase in complexity of process plants,
- increased automation and interconnection of the plants (→ security),
 - holistic, interdisciplinary approaches needed,
 - technical, organizational and behavioural approaches,
 - deeper consideration and optimization of the human-machine interface

- Increase in sustainability / increase of energy efficiency
- Interface between safety and security
 - any intervention by unauthorised individuals (internal and external)
 - cyber physical attacks
 - drone attacks

- Increase in sustainability / increase of energy efficiency
- Interface between safety and security
 - any interference by unauthorised intruders
 - cyber physical attacks
 - drone attacks

Guideline (in German)
“Measures against unauthorized interference“

www.kas-bmu.de/publikationen.html

KAS

**Kommission für
Anlagensicherheit**

beim

Bundesministerium für

Umwelt, Naturschutz und nukleare Sicherheit

Leitfaden

Maßnahmen gegen Eingriffe Unbefugter

KAS-51

Problem

- (IT)-Security not a topic of classical plant safety
- Lack of knowledge/understanding
- IT-Hazards are not constant over time



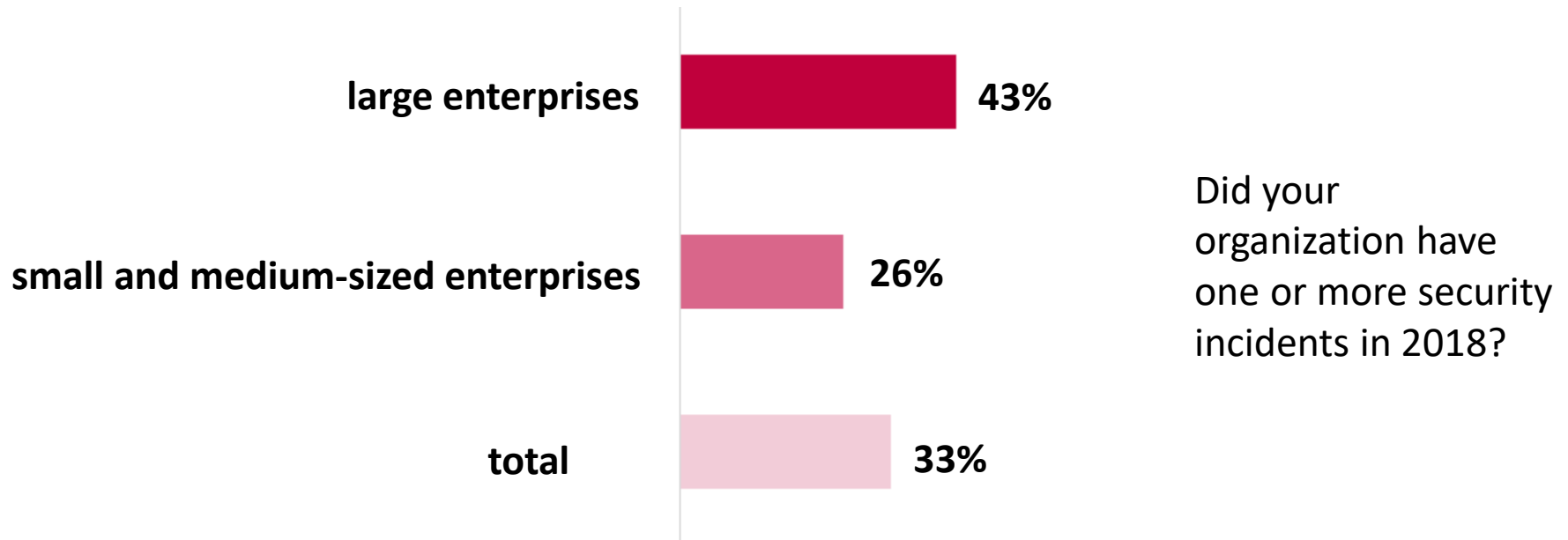
www.chemietechnik.de

Continuous identification of new hazards and their impact on existing weaknesses respectively the effect of existing IT threats on new weaknesses is necessary.



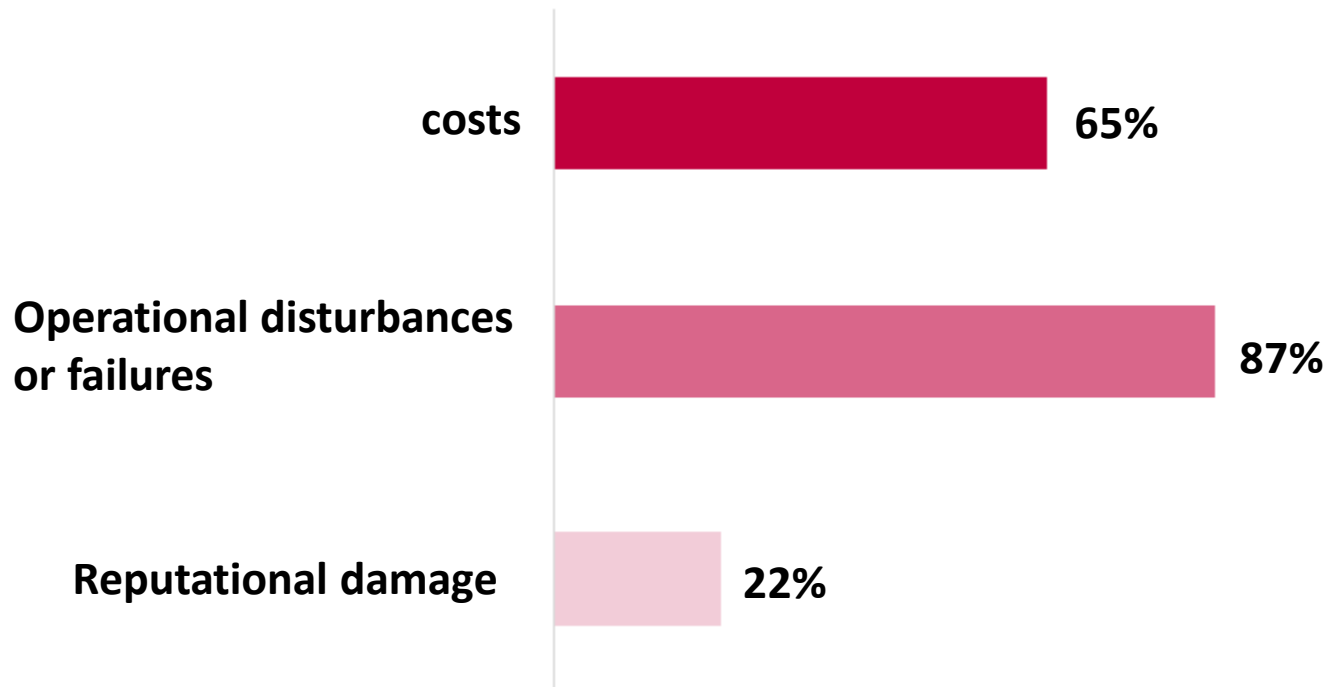
Different approach to classic process and plant safety!

Current threat situation - affected by cyber-security incidents



In half of the cases, the attackers were successful.
Usually only a part of the attacks is detected.

Type of damage caused by successful cyber attacks



Cyber attacks have significant consequences for safe operations!

Beside the safety-analysis a security-analysis is necessary (or an analysis that combines both)

- Identification and assessment of possible intervention by unauthorized persons and the hazards caused thereby.
 - Knowledge of possible motivations, (threat analysis) and possible actions of unauthorized persons (hazard analysis) necessary,
- Design of a protection concept and continuous verification.

Necessary measures

- raising awareness
 - integration into academic education and practical training
- enhancement of guidelines
- new approaches and methods to integrate security into safety analysis
 - holistic and interdisciplinary risk analysis
- interdisciplinary working groups



- The development of drones is currently extremely dynamic.
- Drones are getting increasingly powerful, especially in terms of navigation, handling, flight characteristics, payload and endurance.
- Increase of risk that drones can be used to attack operational areas and therefore a source of hazard.

Two scenarios are of interest for plant safety:

1. Spying on an area of operations with the purpose of planning an attack.
2. Direct attack by one or more drones on an industrial area.



Appropriate measures against drone attacks must be taken and regularly adapted to technical developments!

- Identification of all safety-relevant plant components that can be sensitively disturbed by drones and their documentation,
- taking measures that can effectively prevent a direct approach to safety-relevant plant components.



- Different passive and active measurements exist, but
 - currently there are no sufficient technical or organizational countermeasures.
- rapid developments (performance as well as defense of drones)
 - latest developments must be monitored!

- Increase in sustainability / increase of energy efficiency
- Interface between safety and security
- „Industry 4.0“
 - digitalization
 - higher degree of interconnection
 - higher degree of automation,
 - more complex control structures
 - „Operator 4.0“



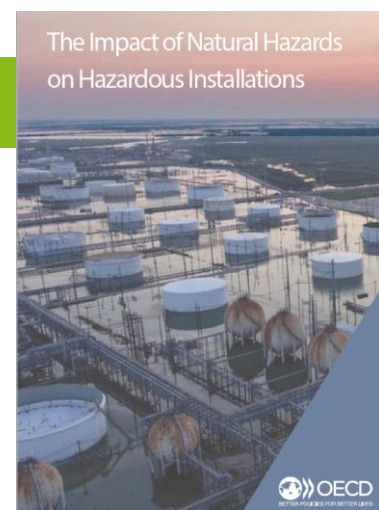
www.produktion.de

Challenges for Plant and Process Safety

- greater importance of security
 - security concepts of software and IT solutions
 - holistic and interdisciplinary risk analysis
- optimization of the human-machine interface (“Work 4.0”)
- „Safety 4.0“ – interconnected safety technology
(e.g. learning, self-testing safety technology)
- interdisciplinary working groups
- integration into academic education and practical training

Current and future challenges

- Increase in sustainability / increase of energy efficiency
- Interface between safety and security
- „Industry 4.0“
- Impact of climate change on plant safety
 - heavy rain, flooding, hail stones
 - strong winds (tornados),
 - heat and drought



www.hydrotec.de



www.vci.de



www.tagesspiegel.de

Current and future challenges

Technical Rule on Installation Safety:

Precautions and Measures against the
Hazard Sources Wind, Snow Loads and
Ice Loads

Technical Rule on Installation Safety 310:

Precautions and Measures against the Hazard Sources
Precipitation and Flooding

Short Version¹

www.kas-bmu.de/publikationen.html

TRAS 320

pursuant to the decision of the Commission on Process Safety of 3rd and 4th
November 2011, adopted following consultation with the public and the supreme
competent authorities of the Länder

¹ For official version in German and guidance see: http://www.kas-bmu.de/publikationen/tras_pub.htm



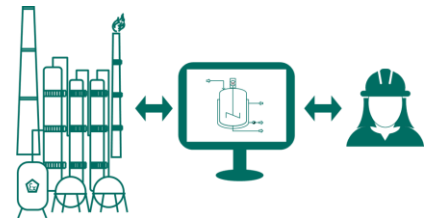
hydrotec.de



gel.de

Current and future challenges

- Increase in sustainability / increase of energy efficiency
- Interface between safety and security
- „Industry 4.0“
- Impact of climate change on plant safety
- Role of the operator in a complex system



- Due to the new technical developments and challenges, process and plant safety must be expanded.
- Expansion of topics for further training and academic studies (awareness).
- The particular challenges cannot be considered separately.
- New holistic and interdisciplinary approaches, methods and measures have to be developed.
 - Cooperation between science and practice for practice-relevant applications.
- Plant safety must be understood as an interaction between safety and security.
- More emphasis must be given to the role of the operator in a complex system.

Development of solutions for the safe and sustainable operation of process plants

- expansion of classic plant safety by future challenges
- linkage of theoretical and experimental research
- focus on interdisciplinary, holistic approaches



Holistic view in teaching also:

new master's degree program in English (start 2023)

International Master of Safe and Sustainable Systems Engineering

→ to meet the latest requirements of industry



For us it is essential that the work is of practical relevance.

→ Involvement of industry at various levels

Increasing sustainability of process plants

- There is a confusing range of different criteria lists and analysis methods, which are time-consuming and depending on various boundary conditions
→ only limited comparability



Question

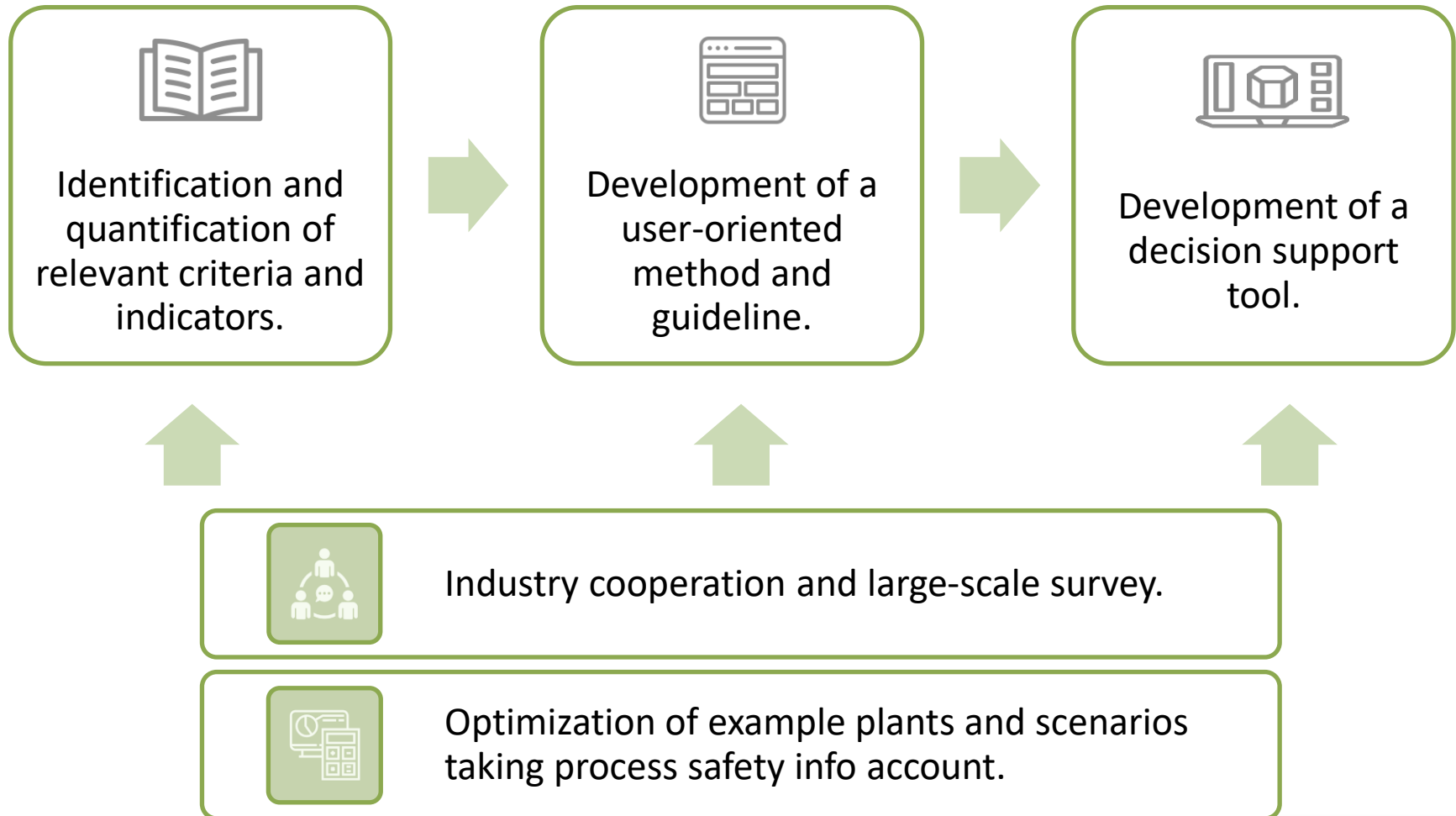
Which measures have the greatest impact on the overall sustainability of the plant?

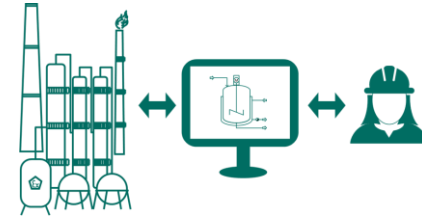


Need

- Methods and tools for comparable measurability and decision making.
- Holistic view of safety and sustainability

Increasing sustainability of process plants



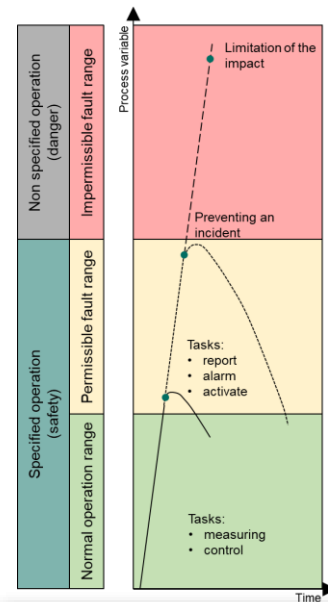


- Increasing complexity of process plants with simultaneous reduction of the required actions by plant operators
- During abnormal operation, many alarms must be processed simultaneously:
 - Operator must quickly identify the correct countermeasure
 - Causes and consequences should be recognizable
 - Alarms in the current DCS do not provide all information
- Incidents in process plants are rare
 - Low number or no historical alarm data available
 - inductive approach necessary

Objectives of the project:

- Dynamic prioritization of alarms based on plant condition
- Reduction of the number of alarms based on appropriate analysis methods
- Identification of the causal chain alarm-cause-effect-consequence and evaluation of the plant condition

→ **Operator support during abnormal operation**



- There is a variety of new challenges for process safety
- In order to generate appropriate approaches, more and more interdisciplinary knowledge is needed.
- For user-friendly solutions, an exchange (cooperation) between research and industry is necessary.

If you are interested in any of the above topics or a cooperation regarding other topics of process safety, you are welcome to contact us!

Thank you for your Attention!

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