Safety Concepts in reverse – A novel inversive Design Perspective

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Process optimization drivers call for innovative approaches that go beyond conventional process design. Presentation Rationale: Awareness Raising, Experience Reflections, Peer Interaction

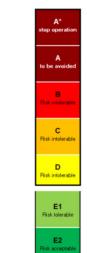
- 1. Plants in operation are often still not designed to deliver best energy efficiency, performance and safety i.e. no holistic approach.
- 2. Legislation and market dynamics, however, require optimization of the above KPI's.
- 3. Design changes in the existing plants are therefore mandatory and effective with key focus on
 - re-evaluation of costly safety concepts and devices inherently - optimized in process and plant design:

Safety Concept in Reverse

Streamlining Safety by Design

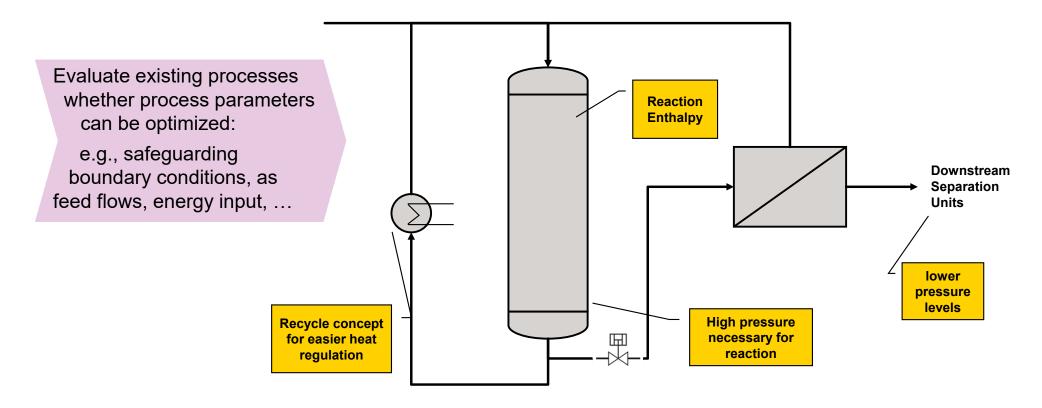
Efficient Path to Inherent Safety





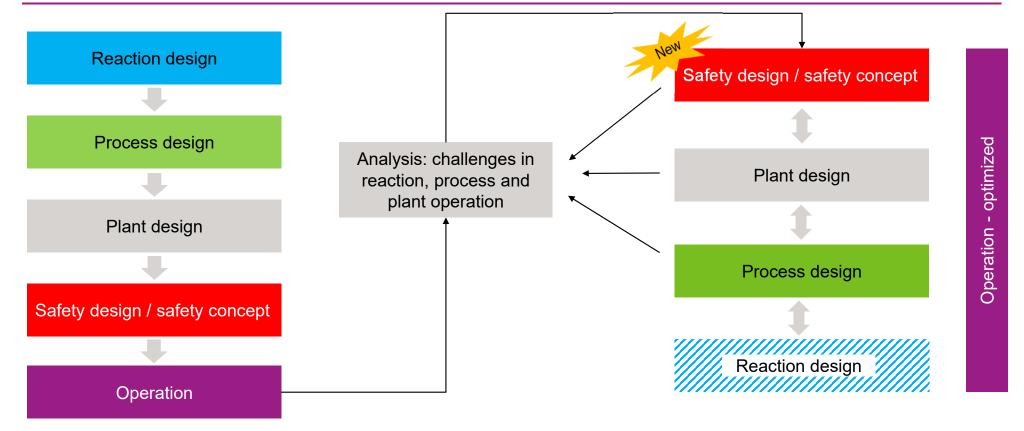


Example of an optimization approach: Challenging process parameters and complex safety devices





Process development – Standard and In-Reverse





Requirements for process optimization and "Safety Concept in-reverse"

Reaction Dynamics

Reaction dynamics in the parameter space to be optimized

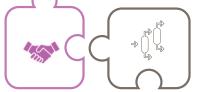


Kinetic Data

Reliable reaction kinetics

Cooperation

Support from production and engineering disciplines



Thermophysical Data

Relevant physico-chemical property data

Holistic Teamwork

Systemic cooperation in a holistic perspective team



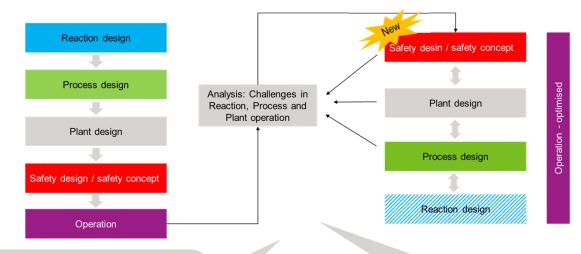
Safety Data

Safety-relevant characteristics, properties and kinetics



Implementation - First start is already possible and sensible with little preparation asking questions, providing stimuli → low 'threshold for hesitation'

- Joint holistic development
- > Calculation and evaluation of reaction, design and safety concept alternatives
- **Iteration loops**

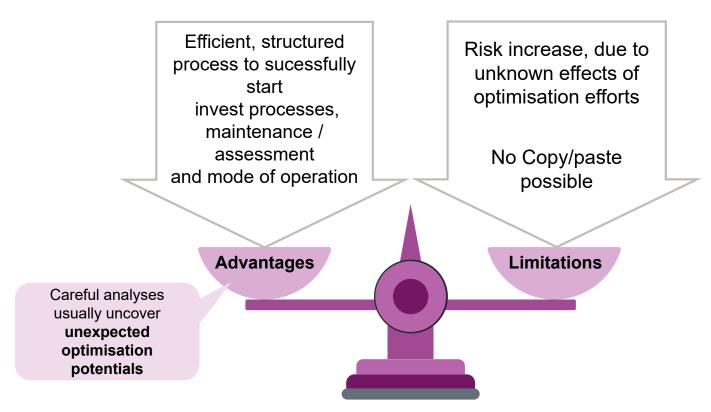


- How can implicit knowledge be made available,
- is it digitally accessible
- > is clarification already possible with this (e.g., with the support of large language models) consider efficiency versus knowledge protection in this regard!

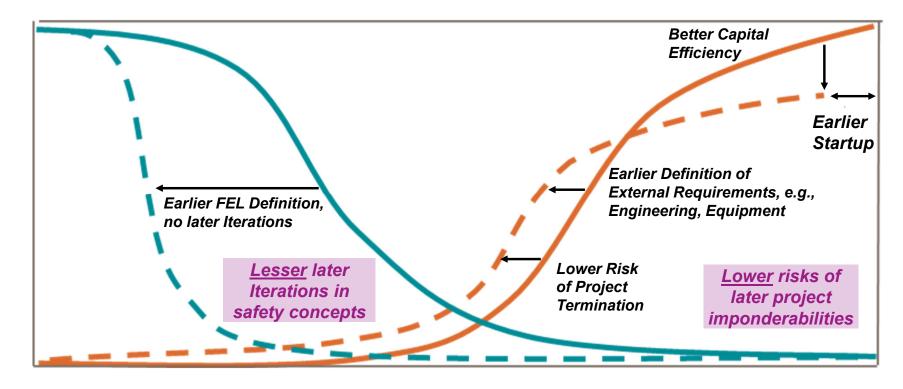
- Questioning balance limits for considerations -
 - only reaction system or
 - together with downstream units



Safety-integrated process development can lead to robust, efficient, and sustainable solutions. For these advantages, limitations are to be considered





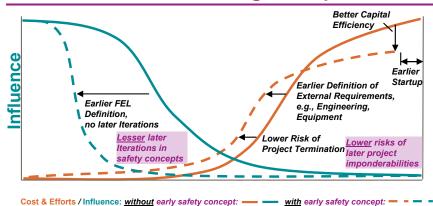


Influence: without early safety concept: — with early safety concept:



Influence

Outlook For a novel inversive Design Perspective



Start safety consideration early

- initially more effort/costs
- > BUT ALSO less effort with changes

Joint holistic efficient
Process & Plant & Safety Design

Discussion and Experience exchange



Was there an **example** where it could have been used but could not be applied/implemented?

Was there an **example** where it was applied and did work?

What are the challenges in practice?



