2021 SAF€RA joint call

Industrial safety in the context of pandemics and exponential change

RESMOD- RESilience enhancement MODel

Workshop 7th June 2022 – Praha Czech Republic
Vienna House Diplomat Hotel- room Budapest

SAF€RA is a partnership between 19 research funding organizations from 10 European countries who collaborate on research programming and launch joint calls in the field of industrial safety.

Scope of the call: The scope of the call includes research on the management of industrial risk, avoiding major impacts on the environment or society, as well as research on products and systems required to improve safety in industrial settings. Industries involved include, among others, the process industries, energy, dangerous goods transport, construction and operation of major infrastructure and the services sector.

In 2021, the SAF€RA "fast-track" joint call concerns Industrial Safety in the context of pandemics and exponential change.

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Topic : Lessons learned from Covid-19 and capacity building for resilient response

The emergency triggered by Covid-19 revealed that both the industrial processes and the manufacturing sector must include, among the unforeseen threats and external environmental stressors, the pandemic impact.

As a direct consequence, the levels of management, technology and internal policy must develop resilience and the impact of adaptation. For this reason, the present proposal dealt with **lessons learned from Covid-19 and capacity building for resilient response**.

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Research groups

Università di Genova	University of Genoa, Polytechnic School, (DICCA) Department of Civil Chemical and Environmental Engineering
VSB TECHNICAL UNIVERSITY OF OSTRAVA	Consortium of VSB-Technical University of Ostrava, Faculty of Safety Engineering and Czech Occupational Safety Research Institute - VUBP (VSB) — VÚBP
University of Belgrade	University of Belgrade -Faculty of Mechanical Engineering
Università degli Studi di Messina	University of Messina - Department of Engineering

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Project aims

The applied inter-disciplinary research aims at developing an innovative approach for managing emerging pandemic risks, suitable to create new momentum and choices that make adaptation easier. In this regard, as an overall safety umbrella, the organizational resilience assessment and setting-up resilience indicators can support business continuity and help dealing with unexpected events, absorbing the disruptive potential.

The aim of the project is the **development of a predictive framework integrating the operational and the organizational resilience model,** based on the results obtained by statistical elaboration of field data and questionnaire surveys in the tested industrial settings.

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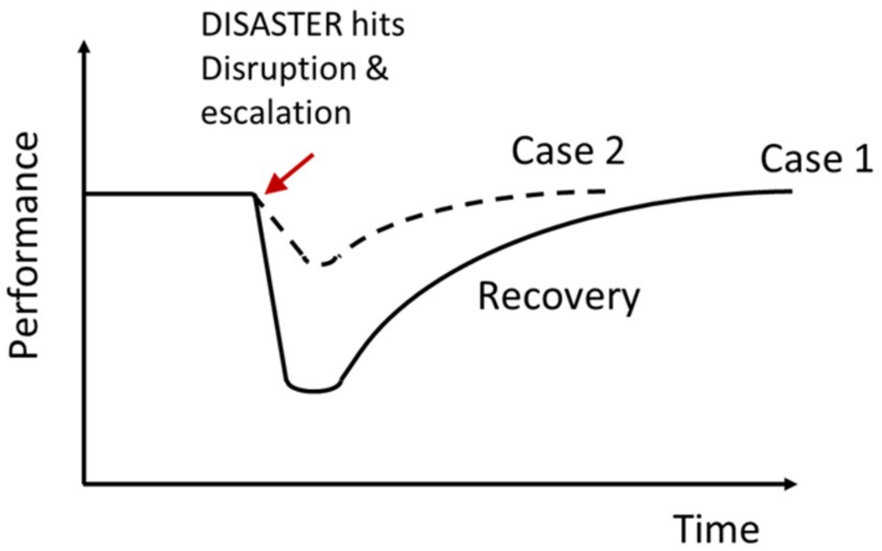
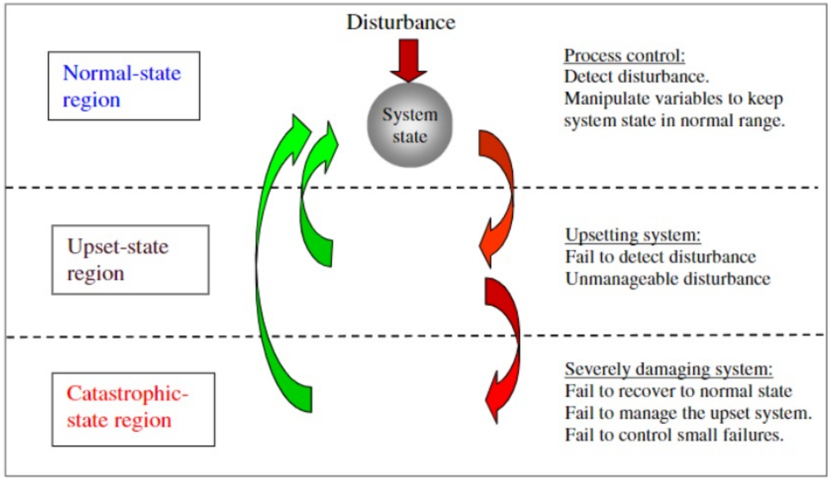
Basics

- The Organizational Resilience is the ability of an organization to anticipate, prepare for, respond, and adapt to incremental changes and sudden disruptions to survive and endure continuity.
- Organizational Resilience can be obtained by proper balancing **preventative control, mindful action, performance optimisation and adaptive innovation**, as well as managing the tensions inherent to these distinct perspectives. A critical issue is learning from this global pandemic to improve complex risk management and develop tools helping to build greater firm resilience to prevent and prepare for future shocks.
- The project focuses on developing a conceptual model for the organizational resilience evaluation for different industrial sectors covering both the manufacturing and the process sides and relying on the actual experience gained during the first and following waves of the pandemic emergency.

Resilience

Resilience is the ability to restore performance after sustaining serious damage by a usually unexpected threat.





A **resilient system** should be able to prevent highly undesirable transitions by means of appropriate design, technology, human and management activities, and emergency procedures, which can reverse an incipient mishap and eliminate potential hazardous side effects.

Pasman et al. 2012, 2020, 10.3390/su12156152; 10.1016/j.jlp.2011.09.003

Three phases of resilience

During external disturbances, resilient industrial systems go through three phases:

ABSORPTION

Ability of the system to absorb external disturbances without any significant deviation in the output.

ADAPTATION

When the output of the system deviates significantly from its normal value, during the adaptation phase, the dynamics of the system are adjusted in such a way that it adapts to the external disturbances and there is no further deviation.

RESTORATION

After the system has adapted to external disturbances, the restoration phase comes into effect to restore the system to its normal state.

Strategies and principles of resilience

The **Minimization of Failure** principle is to prevent something bad from happening by preventive measures: **Inherently safer design.**

Early detection: early response can be achieved by early detection resulting in a more effective response since operators have more time to consider and respond to the urgent situation.

The **Flexibility** principle for resilience is to design a more flexible process that can operate under various disturbances.

Controllability is an ability of the system to achieve a specific target state. It is determined by how effective the system can be controlled.

Limitation of effects principle is to use safeguard or mitigation measures to limit the consequence of an upset event.

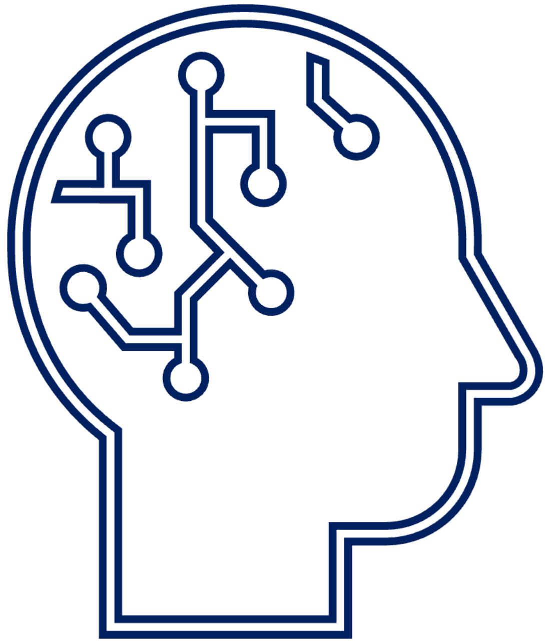
Administrative controls and procedures are another safeguard to prevent and recover from process deviation and accidental release.

Resilience to pandemic can be intended as a forward and pro-active defense approach.

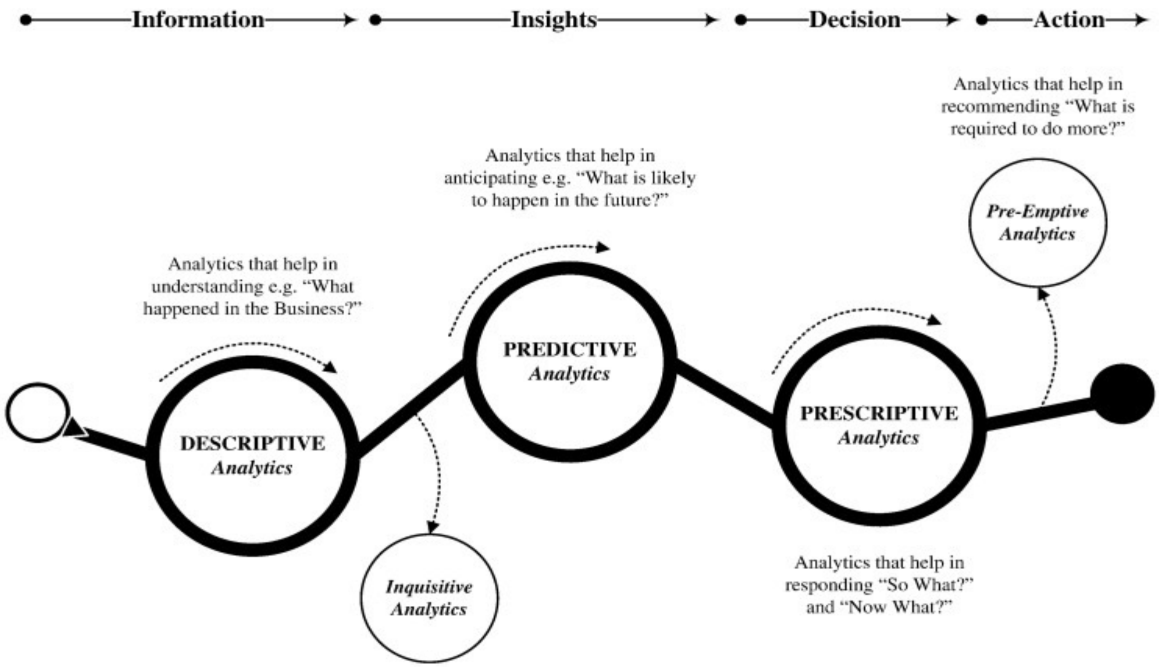
Early Warning

A timely warning for impending threat and risk is of the utmost importance. Weak signals or “small things” from a variety of sources should be permanently scanned. In the first place, this will be the regular process control signals.

As a result of the development of signal processing techniques by coupling advanced sophisticated statistical methods, ML and AI, scientific literature is now sparse on fault detection and diagnosis of measured process variables.



Dynamic Risk Assessment



Although conventional RA has played an important role in identifying major risks and maintaining safety in process industries, it has the disadvantage of being static; it fails to capture the variation of risks as deviations or changes in the process and plant take place.

The crucial ability of a **resilient industrial organisation** is the anticipation of the system weak signals. Rooting the resilience assessment process on a Data Driven model, can ensurein perspective the compliance with all the resilience pillars.

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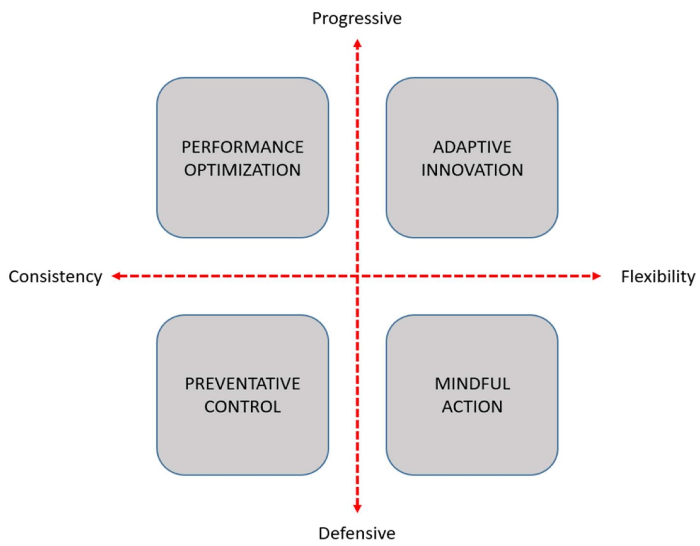
Methodology

1. **Preventative control** (defensive consistency). It is achieved by means of risk management.
2. **Mindful action** (defensive flexibility). It is the ability to 'bounce forward', to grow and prosper in the future.
3. **Performance optimisation** (progressive consistency). It relies on continuously improving, refining and extending existing competencies, enhancing ways of working and exploiting current technologies.
4. **Adaptive innovation** (progressive flexibility). Creating, inventing and exploring unknown solutions are the pillars of this property.



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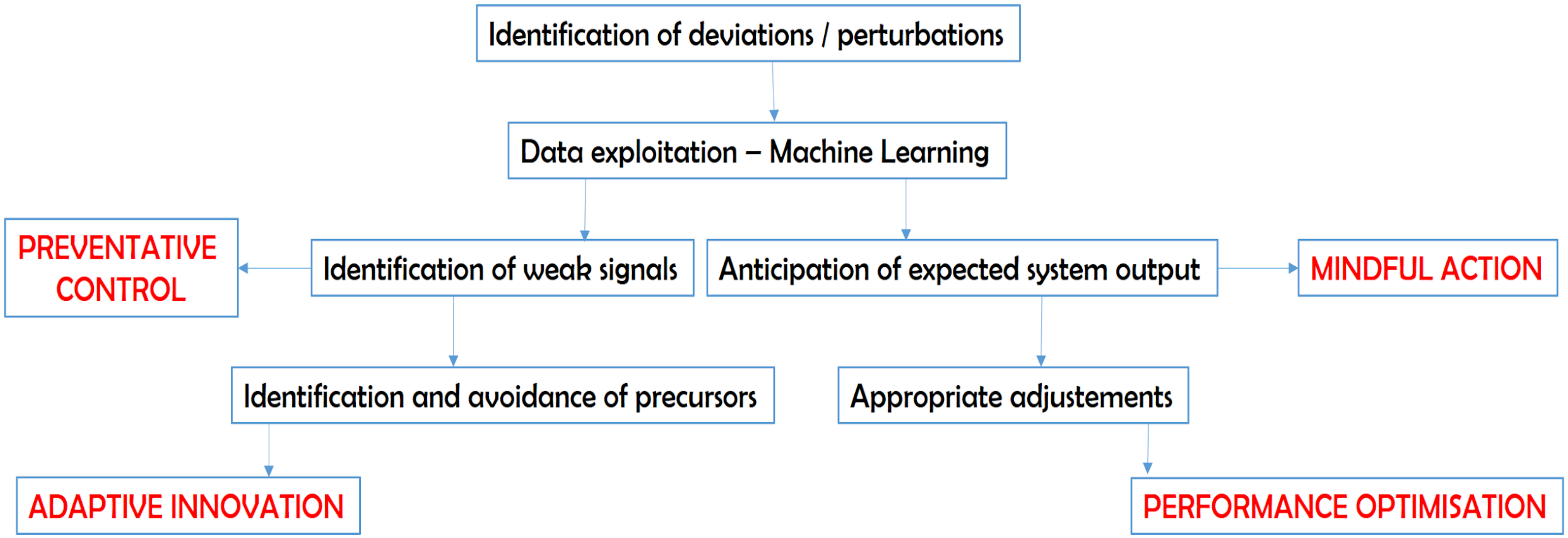
Methodology



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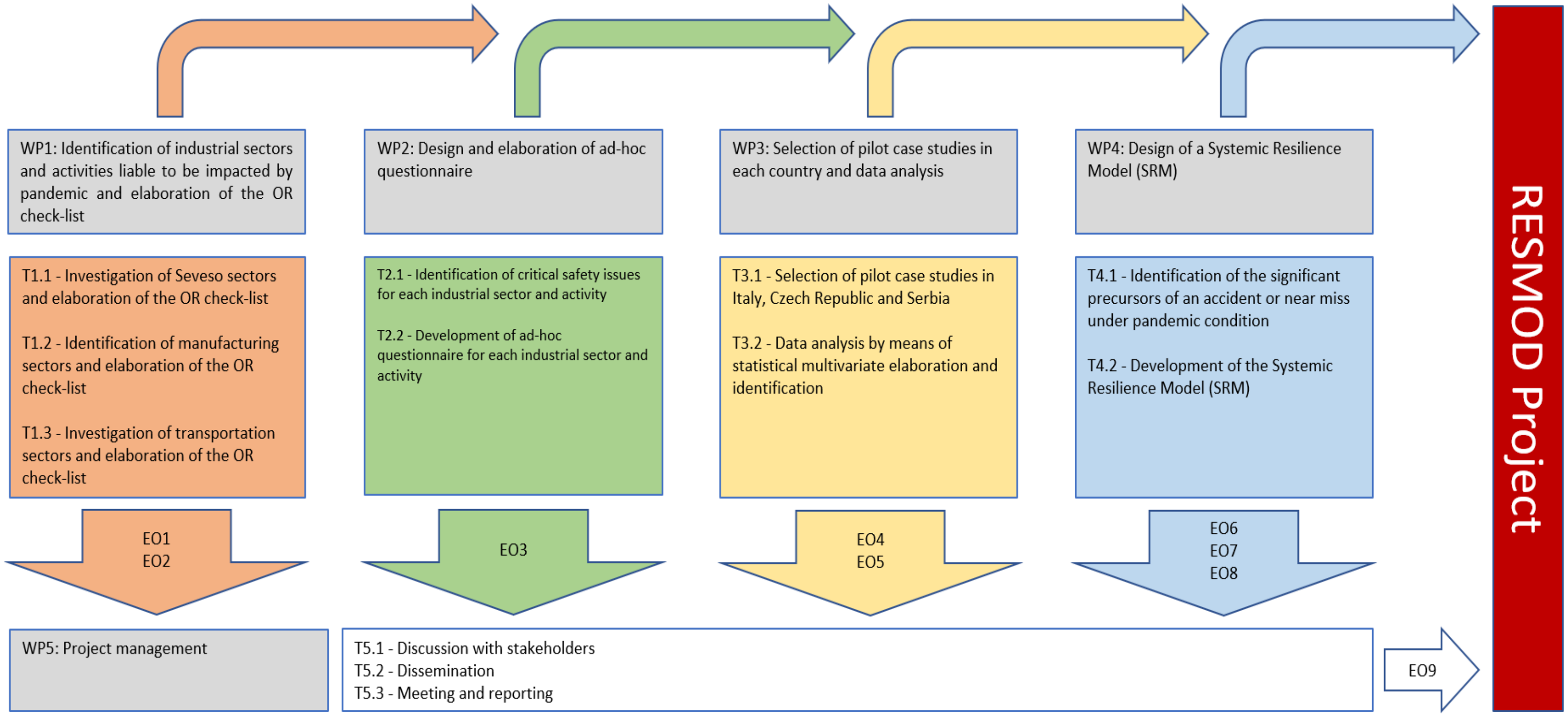
Project flow



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STEP 1: Identification of industrial sectors and activities liable to be impacted by pandemic

Identification of industrial sectors and activities (e.g. multi modal transport, urban port areas etc.) liable to be impacted by pandemic in terms of business continuity, personnel absence in strategic plant/equipment, activity/plant section shut-down, massive smart-working, massive reduction of on-site personnel for emergency preparedness, etc. and elaboration of a preliminary Organizational Resilience check-list.

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STEP 2: Design and elaboration of *ad-hoc* questionnaire

Ad-hoc questionnaire design and elaboration differentiated between frontline operator and management including demographic variables, work background information and covering several critical issues including, e.g., near-misses; minor accidents; shut-down and start-up safety issues related to pandemic; personnel and management hazard awareness; involvement in risk perception and behaviour, satisfaction/dissatisfaction with pandemic and contingency measures, non-resilience indicators related to re-configurability, modularity, flexibility, restorability, robustness, resourcefulness, etc.

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Resilience Management Component 1

LEADERSHIP AND SAFETY CULTURE

- ✓ Higher level strategies, including health plan - ANTICIPATE
- ✓ Business continuity plan (activities essential for safety, recovery times, etc.) in the event of emergencies outside the plant - REACT
- ✓ Financial studies on organizational impacts of health emergency – ANTICIPATE

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Resilience Management Component 2

RISK AWARENESS

- ✓ Identification of key sources of information on the epidemic, including trade associations, research institutes, experts - ANTICIPATE
- ✓ Identification of critical activities that cannot be suspended - MONITOR
- ✓ Identification of circumstances in which it may be necessary to suspend operations - MONITOR
- ✓ Possibility of remote process control (e.g., SCADA) – MONITOR
- ✓ Assessment of the effects on safety of the procedural changes introduced to meet the needs of the health plan - MONITOR
- ✓ Assessment of the safety impact of organizational changes, including selected staff and supply outage - MONITOR
- ✓ Assessment of collective and personal protective equipment – MONITOR
- ✓ Specific attention to work permits, with extension of measures also to third parties - MONITOR

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Resilience Management Component 3

COMUNICATION AND INFORMATION FLOW

- ✓ Timely documentation of the activities carried out for health emergencies - LEARN
- ✓ Staff behavior observation system - LEARN
- ✓ Review of the response of the safety management system to the health emergency - REACT

SKILL AND COMPETENCIES

- ✓ Identification of the necessary resources to support critical activities (people, processes, equipment) - MONITOR
- ✓ Define face-to-face and remote meetings - REACT
- ✓ Policies for employees infected or suspected of being infected - REACT
- ✓ Agile/flexible work policies and flexibility of working time, including permits, temporary leaves and travel restrictions - REACT

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Resilience Management Component 4

ACTION – DECISION MAKING PROCESS

- ✓ Specific measures for a safe shutdown for a longer or indeterminate period of time, taking into account the degradation of hazardous materials - LEARN
- ✓ Measures for a safe restart after prolonged shutdown, including warehouses – LEARN
- ✓ Communications to personnel and other interested parties on the progress of the emergency and the repercussions on the management system - REACT
- ✓ Availability of individual and collective protection equipment - REACT
- ✓ Sanitation of work environment - REACT

EXTERNAL AND INTERNAL CIRCUMSTANCES

- ✓ Analysis of the system's reactions to the pressures of the external context (evaluation of strengths and weaknesses) and sharing with all staff – LEARN
- ✓ Assigning responsibility for planning in the event of an epidemic - ANTICIPATE

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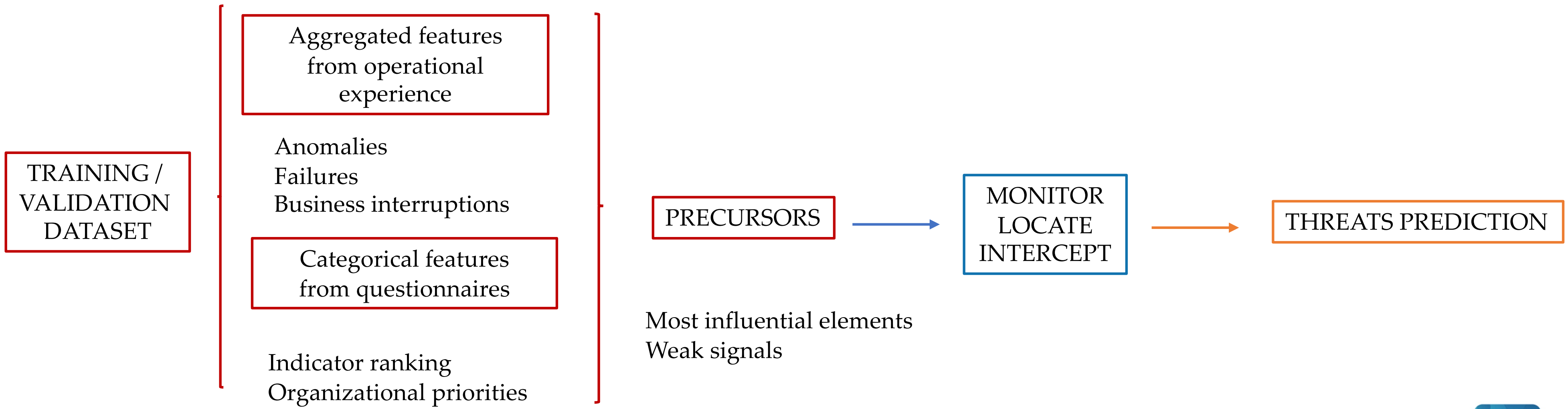
Resilience Data Driven Model

For each relevant indicator, questions are defined, with Linkert type scle from 5 (Excellent) to 1 (Poor).

The questionnaire results and the factors prioritization constitutes the dataset for training the Data Driven Model, thus defining the appropriate precursors for incremental changes related risks.



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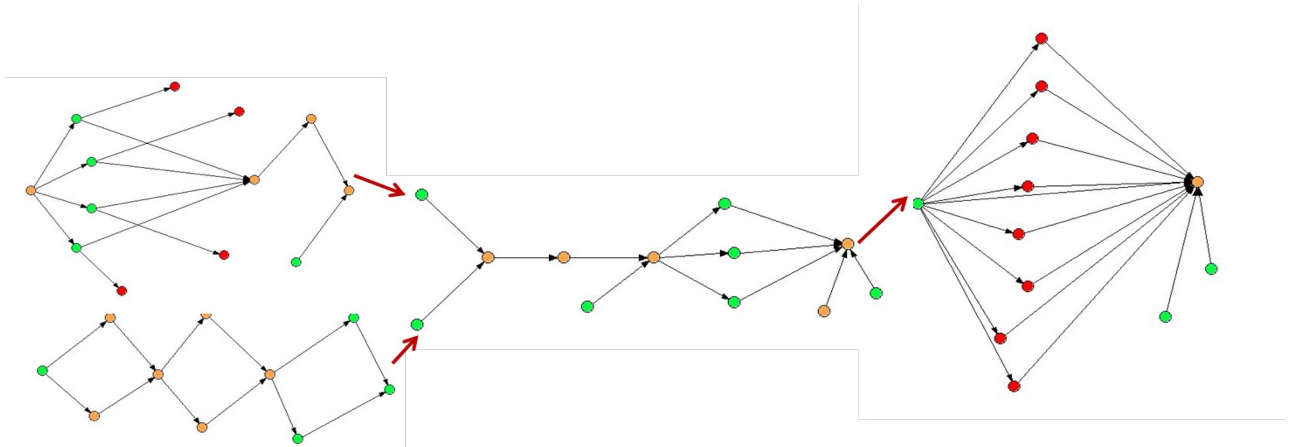
STEP 3: Selection of pilot case studies in each Country and data analysis

Selection of pilot case studies for questionnaire survey, covering both Seveso upper tier/lower tier establishments and non-Seveso establishment/activity in each participating Country.

STEP 4: Design of a Systemic Resilience Model (SRM)

Design of a Systemic Resilience Model (SRM) for identifying the significant precursors of an accident under pandemic condition combining questionnaire experience and a data driven approach.

Resilience final checklist for assessing the organizational resilience (OR) will be developed based on lessons learned in the fields of **operational** and **organizational management**.



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Advisory Board

Expert advisory panel among professional top experts and distinguished researchers in the area of safety and health worldwide.

Delegates of the Loss Prevention Working Party of the European Federation of Chemical Engineering (EFCE) accepted appointment as committee members.

Prof. ir. Hans J. Pasman, The Netherlands, Research Professor at Mary Kay O'Connor Process Safety Center, Texas A&M University, TX, USA.

Prof. Agnieszka Gajek, Head of Chemical Safety Laboratory, Central Institute for Labour Protection - National Research Institute, Warsaw, Poland

Dr. Zsuzsanna Gyenes, JRC , ISPRA , VA, Italy.