EU tools to promote lessons learned

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The Major Accident Hazards Bureau (MAHB) project

The **Major Accident Hazards Bureau (MAHB)** is an office within the **European Commission's Joint Research Centre (EC-JRC)**. We provide scientific and technical support for policy associated with **chemical safety and security**.

We work with European Union (EU) policy entities within the EC, especially the **Directorate General – Environment (DG-ENV),** to implement the **EU Seveso Directive** for the control of major chemical accident hazards.

We work with EU policy leaders in the area of disaster risk reduction and crisis management (DG-ECHO) to support impact analysis (DG-ECHO) related to accident scenarios as well as real time events and capacity building for CBRN risk management in EU neighbour countries and third countries **(DG-DEVCO and DG-NEAR)**

We collaborate with **the OECD Working Group on Chemical Accidents for over 35 years** to support improvement in chemical accident prevention and preparedness globally, as well as other international organisations, especially **UNECE** and **UN Environment**.

We manage EC obligations to collect and analyse EU Member State **data on chemical accidents to support lessons learning** and also manage reporting of information on **EU hazardous (Seveso) sites** https://minerva.jrc.ec.europa.eu

For more information, visit
https://minerva.jrc.ec.europa.eu/en/minerva

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Outline of the presentation

- The EU Technical Working Group on Seveso Inspections (TWG 2)
- TWG 2 and JRC support to Lessons Learning

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EU Support to Seveso Inspection Requirements

The Technical Working Group for Seveso Inspections (TWG 2)

- Originally formed in the 1990s to support implementation of Seveso inspection requirements and provide guidance for new requirements in Seveso II

- After 5 year pause, re-started in 2004 in its current form.
  - ~20 EU/EEA countries are active participants (one participant per country)
  - Led by a Steering Committee of country participants and EC-JRC (the secretariat)
  - Meets annually
- Products are mainly:
  - Annual “Mutual Joint Visit” (MJV) Workshops for Seveso inspectors to exchange on specific topics
  - Good Practice Reports from MJV exchanges
  - Common Inspection Criteria
  - Ad hoc exchange on implementation practices, lessons learned, enforcement, through email and during annual meetings

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Seveso Inspections Publications Page (https://minerva.jrc.ec.europa.eu)

Organisational measures	Technical Measures	Special substances and industries
The structure for organisational measures is based on annex III of the Seveso directive.	*The preventive and mitigating strategies are defined in the CIC Process Hazard Analysis.*	*The preventive and mitigating strategies applicable to specific substances and industrial processes*
Safety Management Systems • GPR on Assessment of safety management systems *Organisation and personnel* • Organisational structures • CIC - Training of personnel • CIC - Management of subcontracted personnel *Identification and evaluation of major accident hazards* • CIC - Process Hazard Analysis • CIC - Permit to work systems • CIC - Natech risk management *Operational control* • Operational instructions • Inspection and maintenance	**Preventive strategies** *Controlling process upsets* • CIC - Safety Instrumented Systems • CIC - Pressure Relief Systems • Alarm Systems *Controlling degradation of primary containment systems and critical infrastructure* • CIC - Controlling degradation of primary containment systems • GPR on Enforcement and risk management of ageing hazardous sites **Mitigating strategies** *Limiting the size of an accidental release* • CIC - Emergency isolation systems	*Explosives and pyrotechnics* • Explosive and pyrotechnic sites (Short GPR) *Industrial parks* • Industrial parks and domino effects (Short GPR) *Oil and gas facilities* • LPG and LNG sites (Short GPR) • Petroleum Oil Refineries (Long GPR) • Petroleum Storage Depots (Long GPR) *Comparison between different types of sites* • Compliance in Five Industrial Sectors (Chemical batch processors, Fertilizer Production, LPG Storage, Petroleum Refineries Pharmaceuticals) (Long GPR)

Good Practice Report on MJV Workshop in HTML

Can be translated with any browser translation extension

MJV Good Practice Report (Short Report)

Learning Lessons from Accidents

Investigation and analysis - Investigation and analysis models - Who conducts the investigation - The role of the Seveso inspector- The investigation report - Mechanisms for disseminating lessons learned - Facilitating application of lessons learned - Integrating lessons learned in Seveso inspections - A proposed learning cycle model - Suggestions for investigation reports and findings - Inspecting the site's lessons learning culture - Questionnaire for the incident learning cycle

This report aims to provide guidance for European Union (EU) Seveso inspectors on learning lessons from chemical accidents and incidents. It describes how the learning process starts with investigation and analysis and can ultimately lead to implementation of targeted improvements. The document also provides advice to inspectors and inspectorates on influencing the quality of the investigation and investigation report and on promoting the use of lessons learned in hazardous sites.

It is undisputed that learning from accidents is an essential and important part of major accident control. It is in particular an essential component in preventing future accidents, as new, hidden or underestimated potential causes are revealed, not only for those with first-hand experience. Provided that lessons learned are disseminated properly, all concerned should in theory be able to avoid similar accidents.

Learning from past incidents has thus become a crucial part of the implementation of the Seveso III Directive. The Seveso III Directive (2012/18/EU) that came into force on 1 June 2015, placed increased emphasis on this aspect by including a new requirement, where operators are more specifically obliged to review past accidents and incidents with the same substances and processes used, consider lessons learned from these, explain specific measures taken to prevent such accidents and finally compile this information in their safety report.

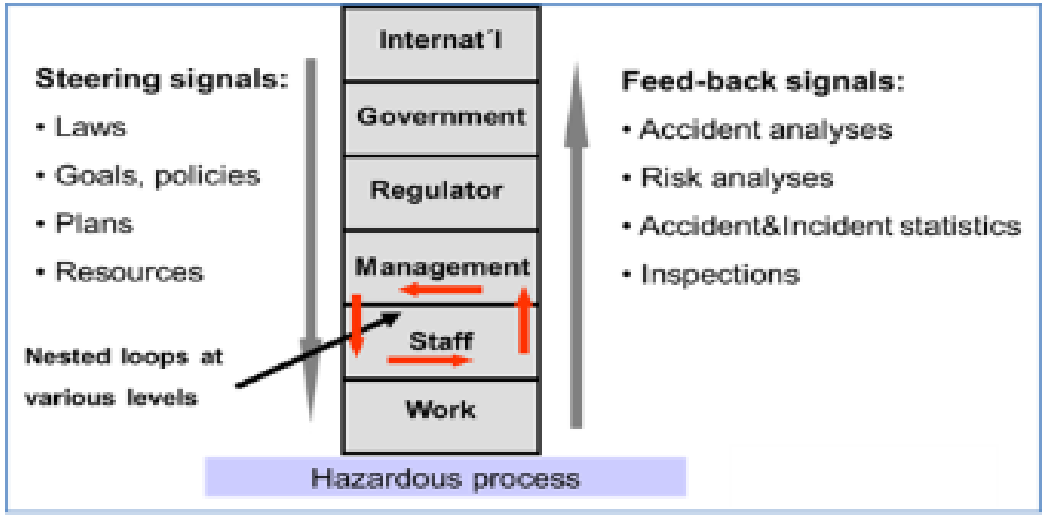
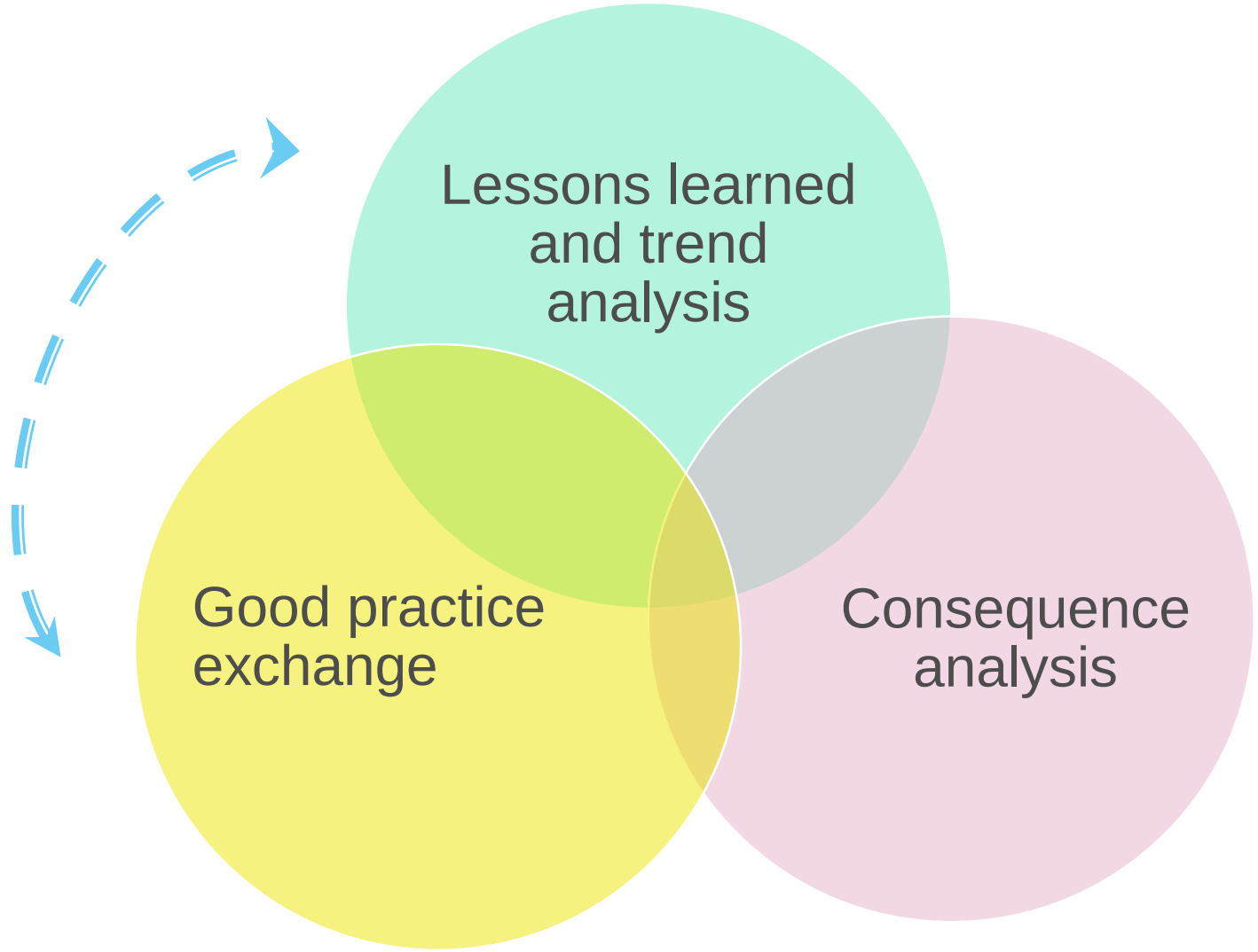


Figure 1 The Rasmussen/Svedung Hierarchical model [1]

MAHB Main activities



Inspection and other exchanges stimulate focus of MAHB accident analyses and research and tools development for lessons learning

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EU support for lessons learning from chemical accidents

- MAHB's primary tasks is to produce lessons learned from eMARS and other open source chemical accident data
- It also works towards the improvement of lessons learned analysis and dissemination in government and industry.
- The TWG 2 shares lessons learned at its annual meeting and periodically also exchanges on how to promote sharing of lessons learning on Seveso sites.
- Notably, in 2013, Sweden and MAHB organized an MJV workshop on learning our lessons.

Learning from incidents in warehouses

The aim of the bulletin is to provide insights on lessons learned from accidents reported in the European Major Accident Reporting System (eMARS) and other accident sources for both industry operators and government regulators. JRC produces at least one CAPP Lessons Learned Bulletin each year. Each issue of the Bulletin focuses on a particular theme.

This 16th issue of the Lessons Learned Bulletin (LLB) focuses on industrial accidents which took place in warehouses as a follow-up on the Beirut explosion in 2020. For this study, the JRC analysed 38 reports of chemical incidents that occurred in independent warehouses. The study focused on accidents involving warehouses, distribution, and transportation centres accommodating non-stationary storage where warehousing was the main activity. Accident investigations on warehouses are frequently incomplete since the level of destruction prevents investigators from conducting an extensive causal analyses. Therefore, the study includes only accidents that have sufficient information to identify lessons associated with prevention and mitigation management.

Please note: The accident descriptions and lessons learned are reconstructed from accident reports submitted to the EU's Major Accident Reporting System at

https://emars.jrc.ec.europa.eu

as well as other open sources. EMARS consists of over 1100 reports of chemical accidents contributed by EU Member States and OECD Countries.

The bulletin highlights those lessons learned that the authors consider of most interest for this topic, with the limitation that full details of the accident are often not available, and the lessons learned are based on what can be deduced from the description provided.

Case 1 - Explosion and fire of hazardous chemicals storage hangar

Sequence of events

An explosion followed by fire took place at a chemical storage hangar following the release of sodium chlorite from metal drums. The facility, registered as an upper-tier Seveso establishment, handles the wholesale, storage and distribution of various chemicals, including sodium chlorite, sodium persulfate, sodium nitrate, and chromic acid in various quantities. According to the preliminary investigation, the release of sodium chlorite occurred when a containment drum got punctured during an erroneous forklift operation.

The explosion, triggering a domino effect involving other drums and bags containing hazardous chemical products present in the hangar, caused its collapse due to the pressure wave. The collapse of the structure caused the death of one employee crushed by the debris. The pressure wave injured a second employee who was hospitalised and dismissed later the same day. The adjoining solids storage hangar was also affected by the explosion, causing the partial collapse of the structure and some small fires due to sparks projection. Neighbouring communities were also highly alerted and instructed to remain indoors. The cost, including material damage and loss of stored products, exceeded 4,000,000€.

Figure 1. Explosion and fire at agrochemicals warehouse, 6/8/1906 *(Source: https://www.estrepublicain.fr/)*

Tools for lessons learning available on the MAHB Minerva website

- Good Practice Report on Lessons Learned (MJV Workshop, Sweden, 2013)
  - Provides a short summary of investigation practices and the role of inspectorates in investigations in different countries
  - Offers some tips on how to disseminate and promote the use of lessons learned
  - Includes a proposed “learning model”

- JRC MAHB Accident Analysis Benchmarking Exercise (2015 to present)
  - Launched as a follow-up to the MJV in Sweden
  - 39% of workshop participants indicated that they did not “have enough knowledge” of accident investigation methodologies
  - The benchmarking project consisted of ~20 volunteers from inspectorates, industry and academia who selected and applied various analysis methods to a past accident.
  - The result included a Strengths-Weaknesses-Opportunities-Threats analysis of all the methods used.

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Method	Web Reference
Accimap	http://tiny.cc/gew45y (Page 61)
ARIA 3 (BARPI method)	http://tiny.cc/q8m55y
Barrier Analysis	http://tiny.cc/gew45y (Page 30)
Bow-Tie	http://tiny.cc/4jy45y
CAST (Causal Analysis using System Theory)	http://tiny.cc/zhx45y
Chronology Description	No web reference. This is a simple timeline.
DISC (Design for Integrated Safety Culture)	https://tinyurl.com/y23r2djn
ECFA (Events and Causal Factors Analysis) ETBA (Energy Trace and Barrier Analysis) MORT (Management and Oversight Tree)	http://tiny.cc/dex45y
ECFC (Event and Causal Factors Charting)	http://tiny.cc/gew45y (Page 27)
ESReDA Cube	http://tiny.cc/o8x45y

Excerpt from a table (18 methodologies in total listed)

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Excerpt from the SWOT Table

Method	Team	Phase	Self-supporting?	Graphical Output?	Accessibility?	Learning easiness?	Scope of investigation	Duration	Replication?
AcciMap	7	3	Yes	Yes	Yes	Yes	1□6	Weeks	Yes
	8	3	Yes	Yes	Yes	Yes	1□6	Weeks	Yes
ARIA 3 (BARPI method)	3	1, 2, 3	No	Yes	TSE	Yes	1□4	Days	Yes
Barrier Analysis	6	1, 2, 3					1□6		
Bow Tie	8	2	No	Yes	No	Yes	1□4	Days	Yes
CAST	7	3	Yes	Yes	TSE	TSE	2□4	Days	
Chronology Description	6	1	No	No	Yes		1□6	Weeks	TSE

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Lessons Learned Analysis Handbook (in development)
Phase 2 of the AABE Project

- A “how-to” for extracting lessons learned from investigations, investigation reports, and other sources
  - Includes a short summary of lessons learned theories (ways to look at lessons learning)
    - (e.g., single-double-triple loop theory, plant-processes-people, systems analyses)
  - Why lessons learning is important
  - Who can learn from incidents and types of lessons that can be learned
  - How to optimize lessons learning through investigations and how to get more lessons learning out of an accident report
  - The benefits of studying patterns in groups of accidents linked by a common theme (for those who can go the next level!)
  - How to make accident reports accessible to potential stakeholders outside your organisation

- Publication by end of 2023/early 2024 (hopefully)

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Chemical Accident Information Portal (CAPRI)

Chemical Accident Information Portal

(CAPRI)

CAPRI collects and aggregates publicly available data and information about specific worldwide chemical disasters occurring mainly in the second half of the 20th century and beyond. These events reach across a spectrum of industries, from fixed chemical installation, through transport to pipelines and offshore.

The site is intended to include the following:

- A **Worldwide disasters** section that provides a list of high impact chemical accidents from the 20th and 21st centuries that have been found in open sources online. The intention is to give interested stakeholders and scholars as complete a picture as possible of the distribution of chemical disasters distributed across time, geographic areas and industry sectors.
- The **Historical Events** collection containing extensive information and official investigation reports on chemical disasters that have influenced past developments in chemical process safety management and policy and/or public opinion and awareness of chemical accident risk.
- The **Online Resources** section is a central access point to publicly available resources on chemical accidents. This includes HIAD (the Hydrogen Incident and Accidents Database) and links to accident databases, such as eNATECH, ARIA, and ZEMA. Analyses results generated from JRC-MAHB studies on lessons learned, hazardous substances or specific thematic areas, are also accommodated in this section.
- The **Media Database** provides an interactive representation of the GMI-CHEM database, a collection of serious chemical accidents compiled and updated by JRC-MAHB. The database accommodates accidents from worldwide risk management publications and other resources since 2018. More recent years will be added as they are quality checked and analysed.

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Links to MAHB publications and related information on lessons learned

- The MJV Good Practice Report - Also includes a longer workshop report with results from the survey of inspectors on accident investigation, analysis and lessons learning
- All TWG 2 Seveso Inspection Series publications
- The Accident Analysis Benchmarking Exercise (AABE) Report
- AABE project website - Resources on accident analysis methods and the cases studied by the AABE group
- References for methodologies (part of the AABE project website)
- All MAHB Publications

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Thank you

Visit our publications site at:

https://minerva.jrc.ec.europa.eu/en/shorturl/minerva/publications

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