DATACH
TECHNOLOGIES
Software solutions

SecurDomino

Esempio di sistemi di gestione software per installazioni critiche

Dino Dentone, Datach Technologies srl, 17/10/2024

The **LIFE SECURDOMINO** project
has received funding from the European Union
under Grant Agreement **n° LIFE20 ENV/IT/000436**

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Introduction

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Introduction (1)

Process facilities storing and processing hazardous substances might be targets of intentional attacks

373 security-related events in the process industry from 1954 to 2019

84 events specifically targeted Chemical&Petroleum processes

(Iaiani et. al, 2021, Rel. Eng. Syst. Saf.)

A successful intentional attack might lead to catastrophic consequences and potential domino effects

Domino effect: propagation of an accident to nearby units, ultimately causing the amplification of consequences.

<u>Integration of safety and security</u> aspects is <u>critical</u> to prevent the accident escalation

France attack: Man decapitated at factory near Lyon

26 June 2015 | Europe

«The attackers intended to blow up the facility»

Tank fire at LyondellBasell refinery, near Marseille

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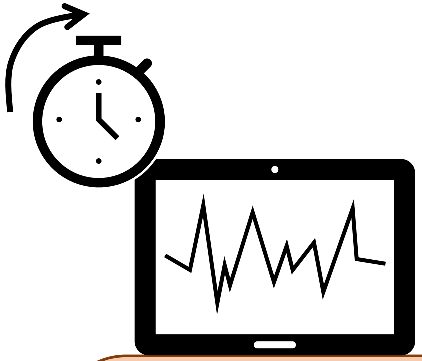
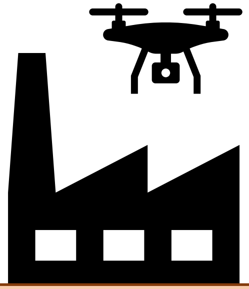
Introduction (2)



Real time (RT)

3-dimensions (3D)



RT-3D approaches beneficial for:

- ✓ management of emergency in case of a loss of containment
- ✓ support emergency squads in quickly detecting high-risk zones to secure

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Introduction (3)

Literature review:

- **DOMIFFECT** (1998) free SW for domino evaluation and risk estimation, biased by oversimplified assumptions;
- **DOMINOXL2.0** (2002) oversimplified and not supporting risk estimation;
- **ARIPAR-GIS** (2006) sold by JRC, applied in risk studies in Italy, not suitable for RT update, does not assess multiple level dominos
- **FREEDOM2** (2014), and **DomPrevPlanning©** (2007) rely on simplifying assumptions.
- Decision support systems used in the nuclear sector (**EASI, ASSESS, ATLAS**…) enable vulnerability calculation but not risk estimation.

All of them do not support: ● safety **AND** security (S/S) **quantitative indicators** (vulnerability, individual and societal risk); ● quantitative assessment of S/S barriers; ● RT evaluation of S/S status for Seveso installations; ● RT data processing; ● 3D spatial representation. Finally, DI3D SW provides 3D safety assessment of industrial plants but misses security scenarios, domino effects and S/S barriers analysis.

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Scope of the work and methodology

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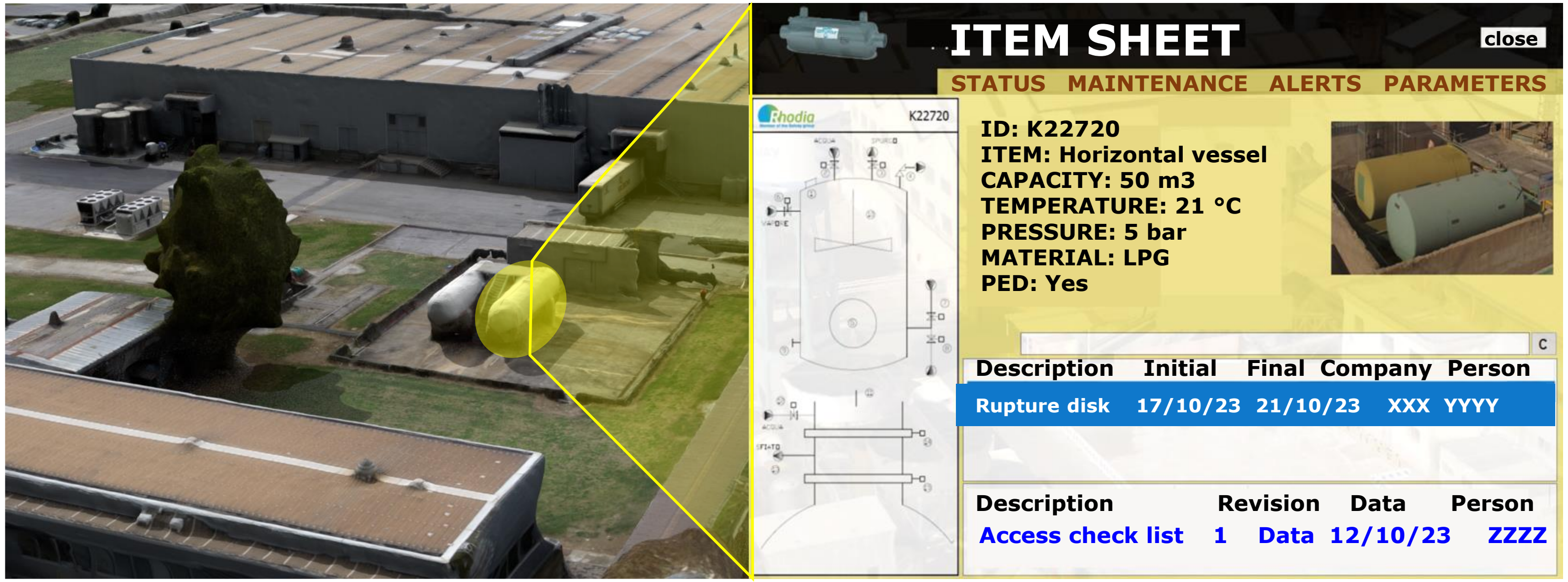
Scope of the work

In the framework of the LIFE20 ENV/IT/000436 – LIFE SECURDOMINO project (SECURDOMINO in the following), a software tool was developed for the assessment of fixed industrial facilities with the aim to manage and monitor in real time and on a single 3D platform

i) complex ISS scenarios and associated risks;

ii) ii) the documentation, administration and logistics of an industrial facility.



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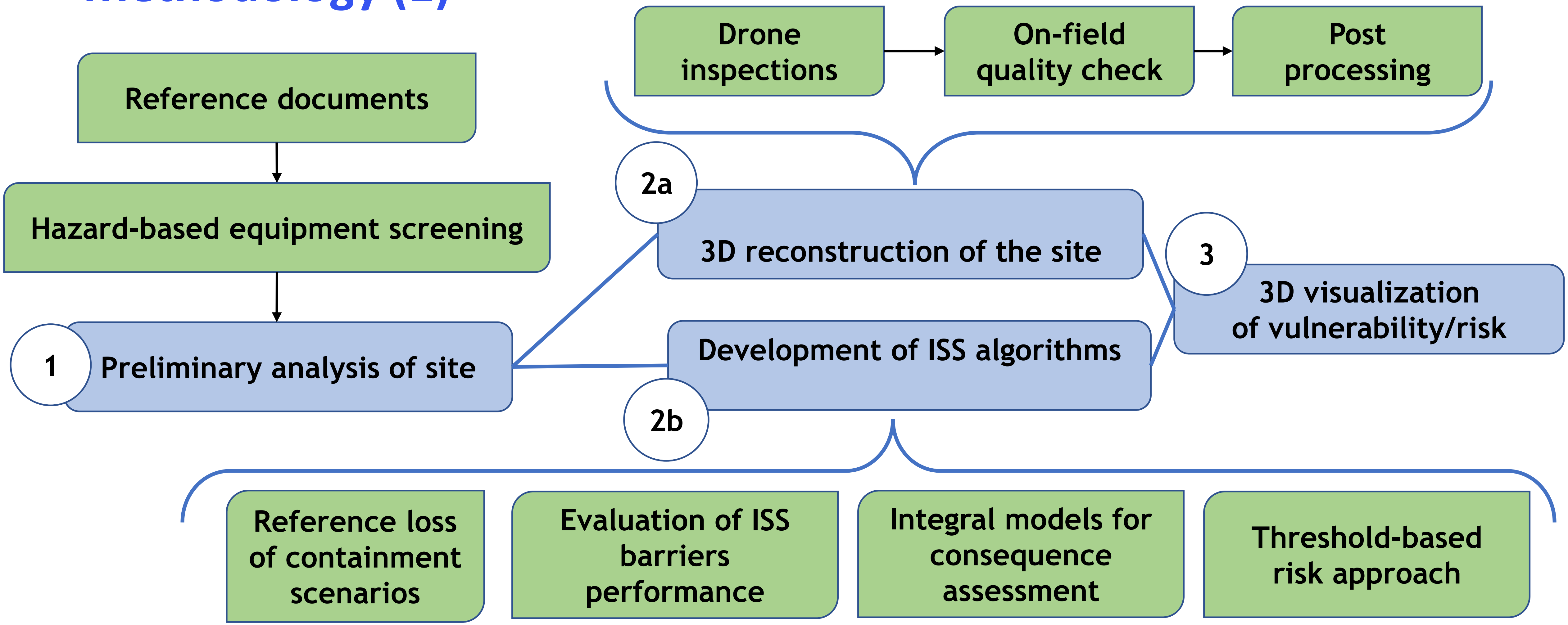
Methodology (1)



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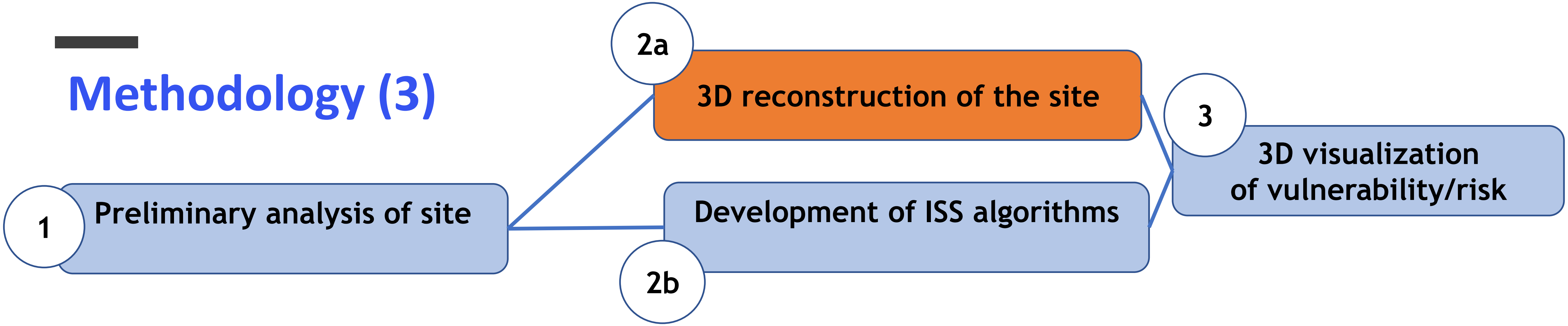
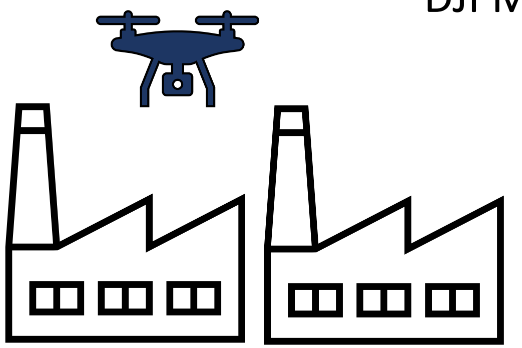
Methodology (3)



- Aerial photographs are first obtained using a **drone**, which will fly above the DEMO sites.
- The drone will fly above the DEMO sites, and it will shoot several pictures.
- Each picture taken with the drone contains all parameters necessary for the 3D reconstruction of the plant (latitude, longitude, elevation, inclination)

Our drone:
DJI Mavic Mini 2



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Methodology (4)

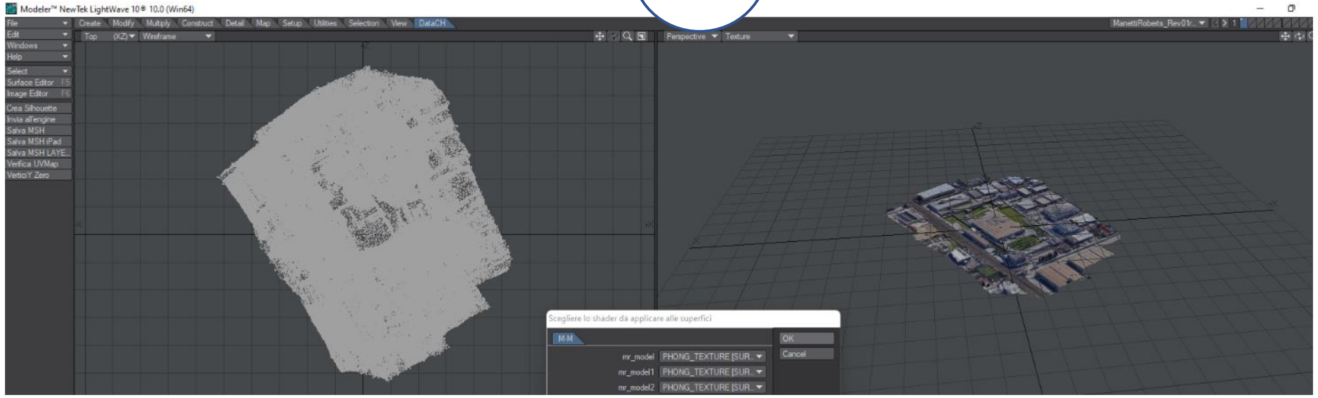
1 Preliminary analysis of site

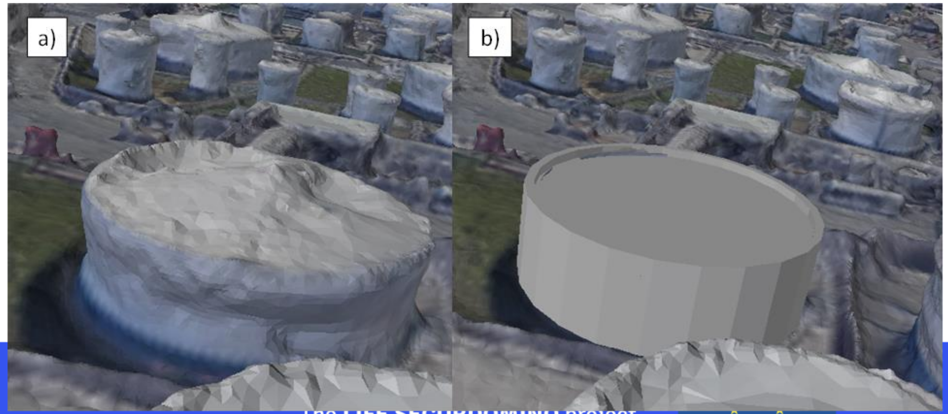
2a 3D reconstruction of the site

2b Development of ISS algorithms

3 3D visualization of vulnerability/risk

- Raw 3d model from photogrammetry using Agisoft Metashape software.
- The «Lightwave 3D» plugin allows to extract the 3D-mesh from the 3D-reconstruction software (Agisoft Metashape).
- The extracted mesh is in the .MSH2 format which is compatible with the Securdomino 3D engine.
- The mesh has been tested in the Securdomino tool after the export done with Lightwave 3D.
- **Critical elements are manually refined and are associated with RT data and ISS algorithms**





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Methodology (5)

1 Preliminary analysis of site

2a 3D reconstruction of the site

2b Development of ISS algorithms

3 3D visualization of vulnerability/risk

Identification of security release scenarios

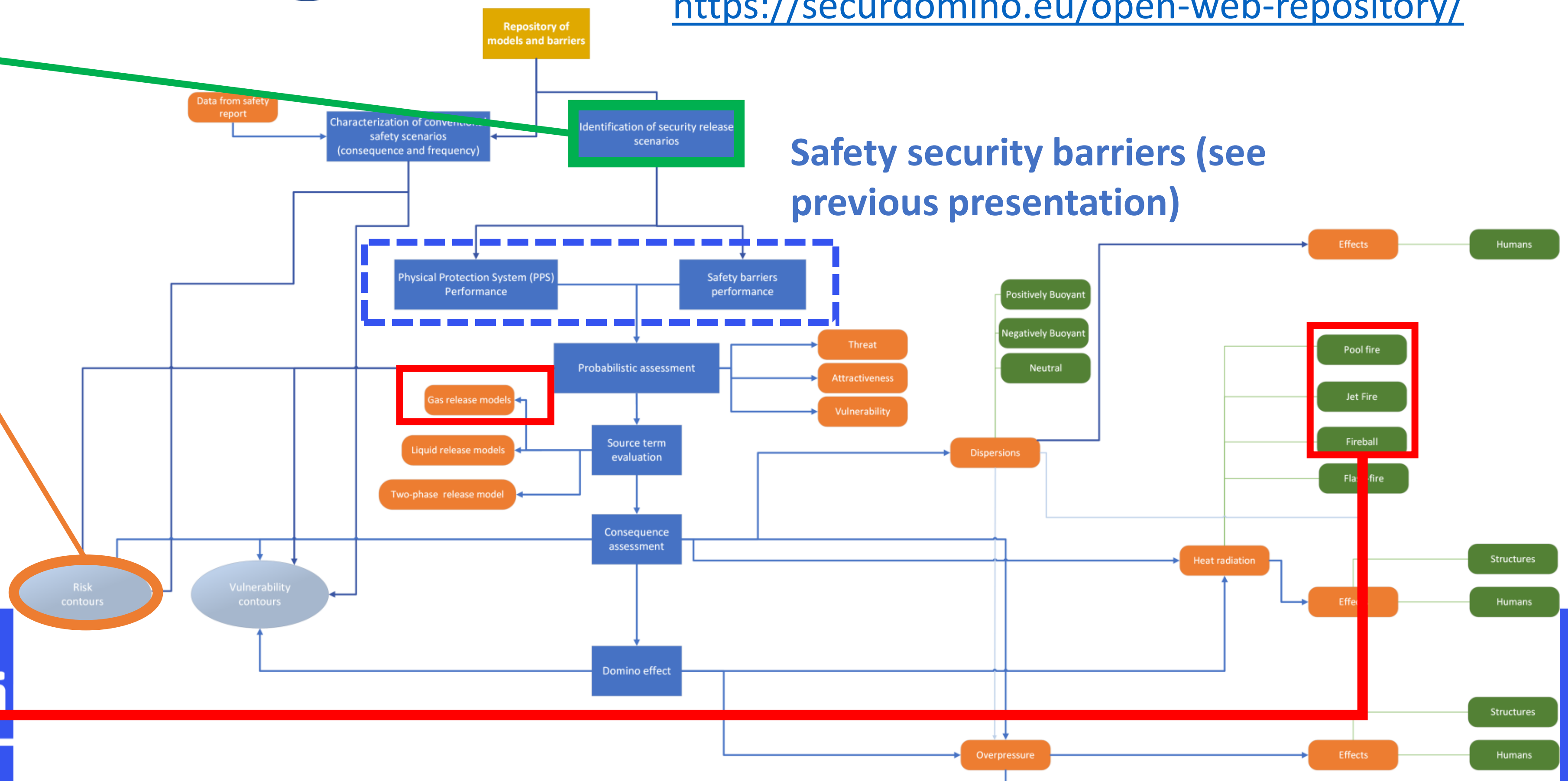
Leiden University

Risk metrics

Fire models

https://securdomino.eu/open-web-repository/

Safety security barriers (see previous presentation)



SecurDomi

Methodology (7)

1 Preliminary analysis of site

2a 3D reconstruction of the site

2b Development of ISS algorithms

3 3D visualization of vulnerability/risk

Impact zones → Pool/jet fire → Fireball → Frequency f_{FO} ↓	High lethality 12.5 kW/m² Fireball radius	Starting lethality 7.5 kW/m² 350 kJ/m²	Irreversible injuries 5 kW/m² 200 kJ/m²	Reversible injuries 3 kW/m² 125 kJ/m²
$f_{FO} < 10^{-6}$	DEF	CDEF	BCDEF	ABCDEF
$10^{-6} < f_{FO} \leq 10^{-4}$	EF	DEF	CDEF	BCDEF
$10^{-4} < f_{FO} \leq 10^{-3}$	F	EF	DEF	CDEF
$f_{FO} > 10^{-3}$	F	F	EF	DEF

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Results and discussion

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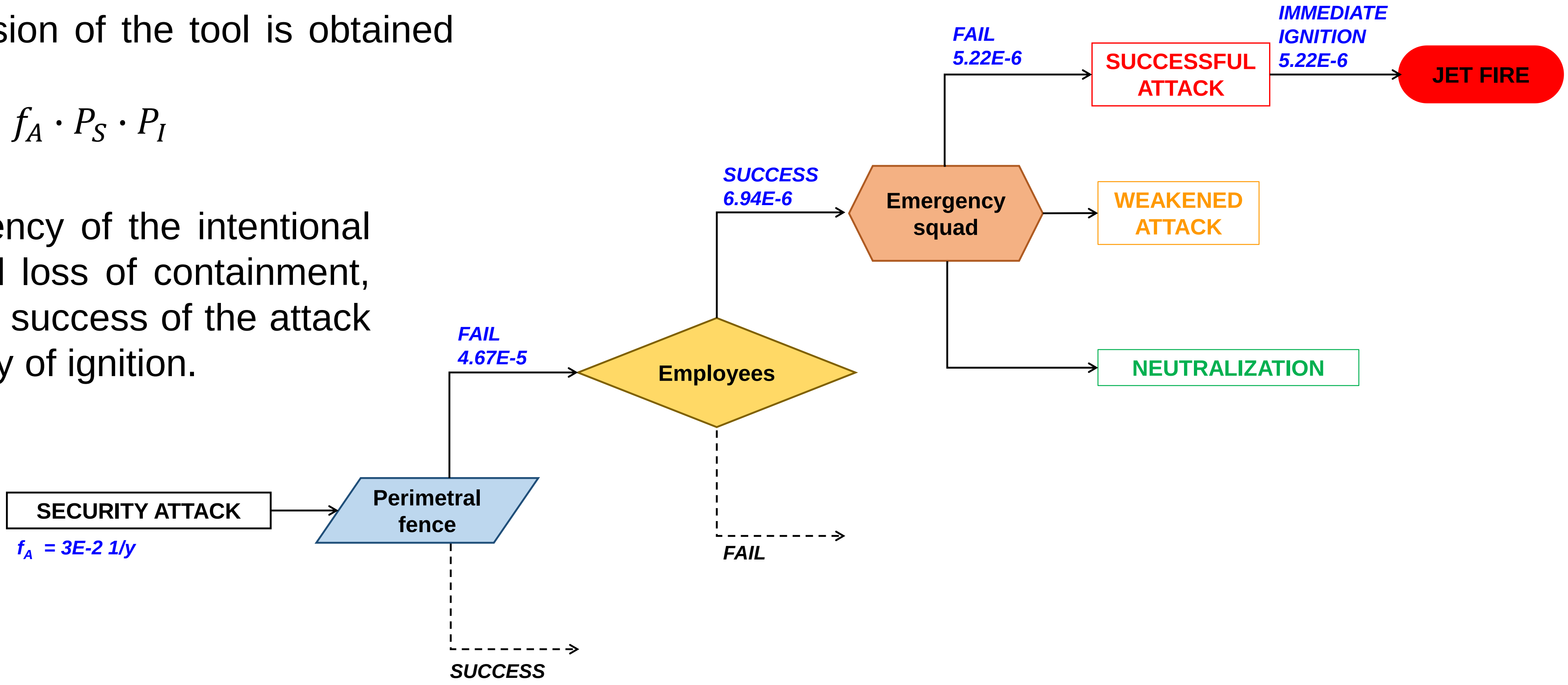
Results and discussion (1)

The frequency f_{FO} of the final outcomes included in the preliminary version of the tool is obtained as follows:

$$f_{FO} = f_A \cdot P_S \cdot P_I$$

where f_A is the frequency of the intentional attack or unintentional loss of containment, P_S is the probability of success of the attack and P_I is the probability of ignition.



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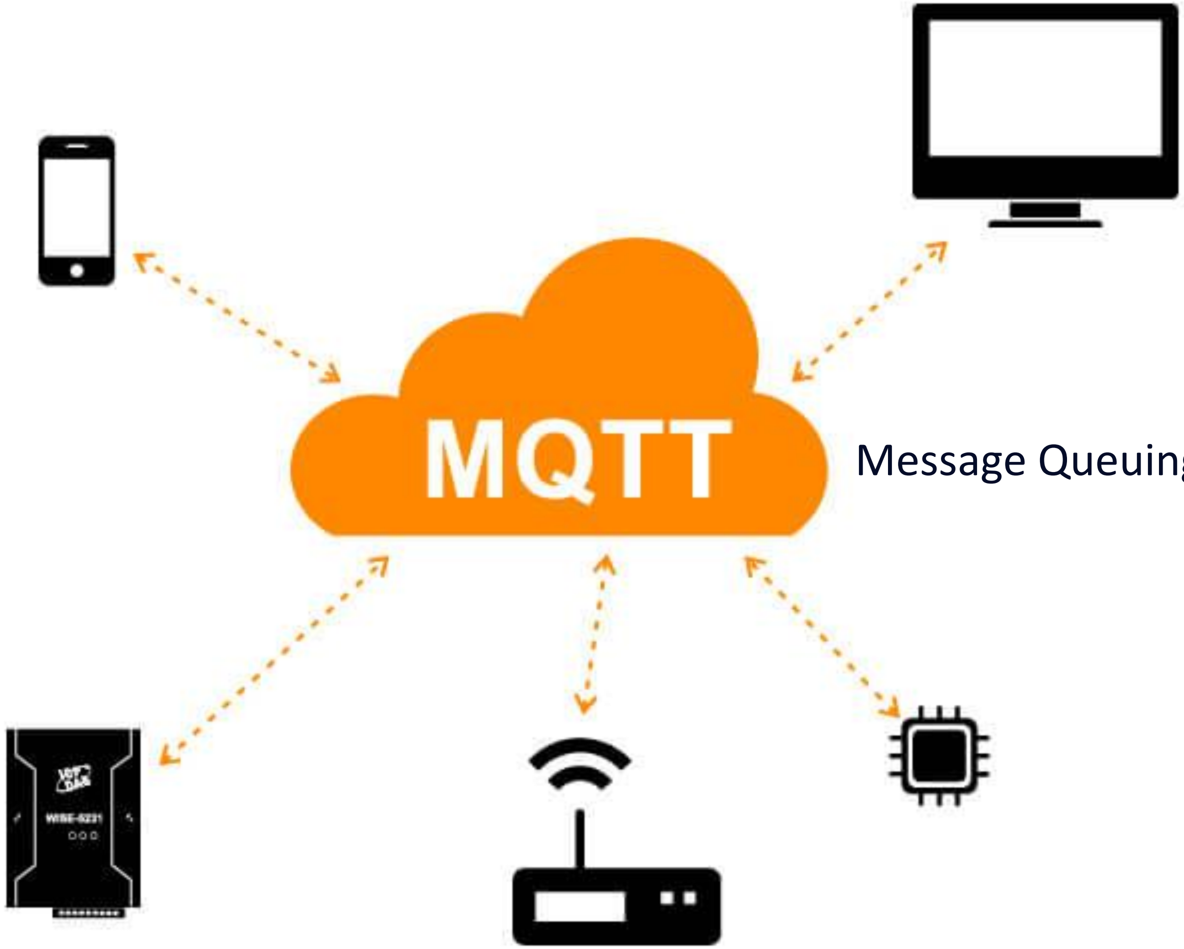
PARAMETRI IMPIANTO IN TEMPO REALE



Message Queuing Telemetry Transport

PARAMETRI METEO IN TEMPO REALE

MQTT

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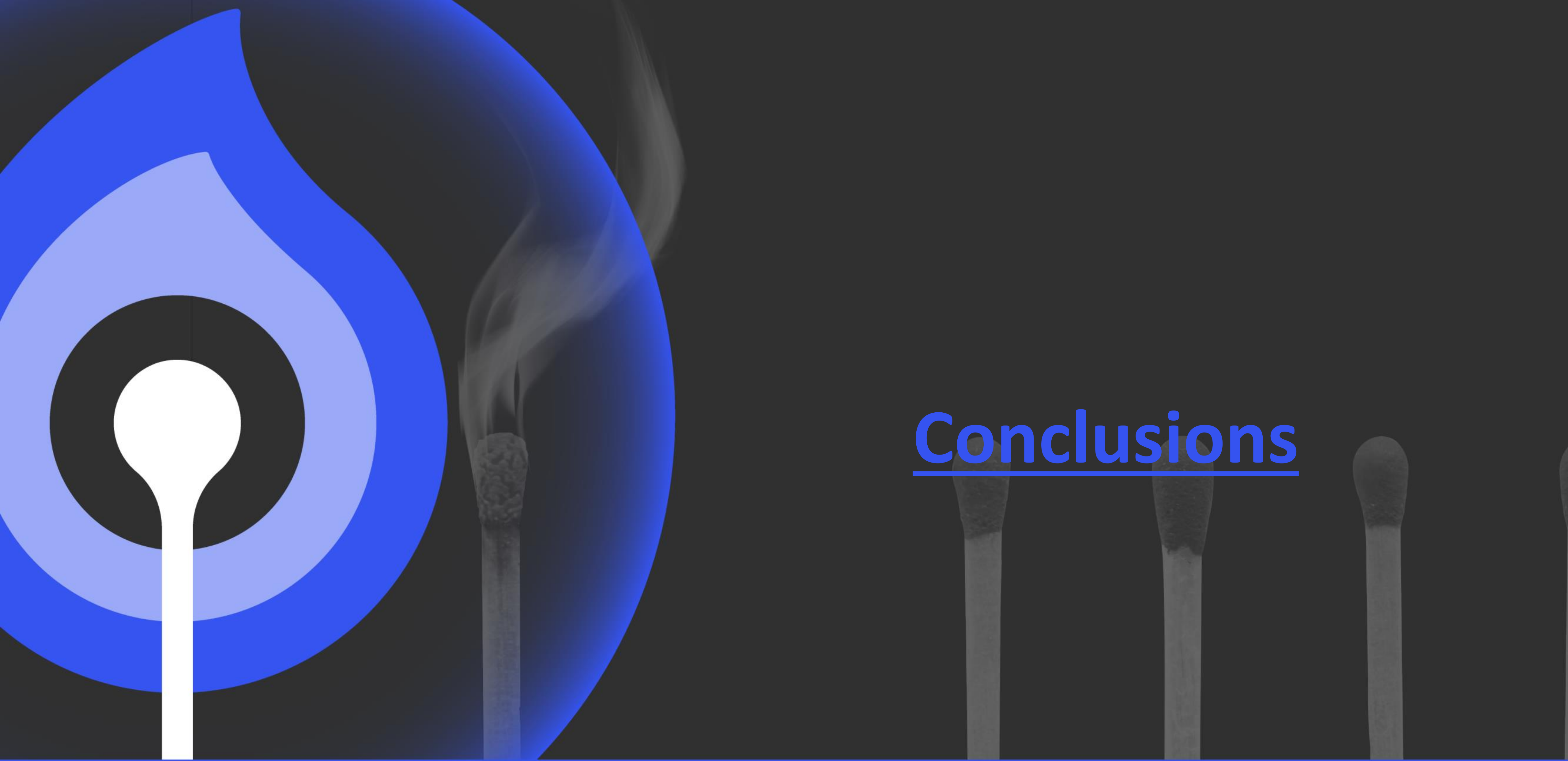

Conclusions

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Conclusions (1)

The tool developed in this work has multiple applications:

- Improve integrated management of industrial sites thanks to organizational features.

- Identify high risk zones → coordinate evacuations measures

  → support emergency squads

- Analyze risk and consequences of customized scenarios

→ support decisional processes

→ support safety training of employees

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THANK YOU!

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