

***Analysis of the vulnerabilities
of a metro station under
terrorist attacks***

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Stam presentation

Stam at a glance



Stam is an **engineering company** that support its clients in addressing new businesses and technology challenges leveraging on a **multidisciplinary expertise** and hands-on experience across four main industrial domains.



Security & Transport



Energy, circular and sustainable economy



Space & Defence



Robotics & Industry 4.0



ID CARD

- 4 M€ turnover
- 24 years in business
- 600+ projects delivered



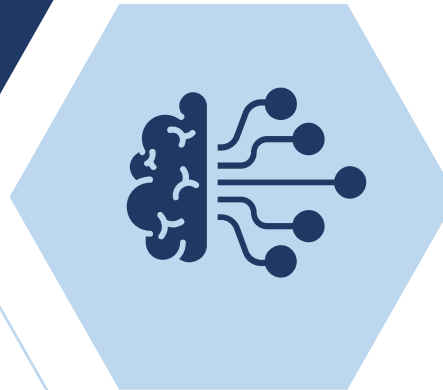
STAFF

- 40+ graduates and PhD
- 35 average age



R&D

- 13+ M€ grants
 - 250+ M€ projects value
 - 4 patents
 - 2 spin-off companies
-



Business challenge

Context and needs



Between 2000 and 2018 more than **3,000** terrorist attacks in the EU

A constant increase in the number of attacks against **soft targets** (especially metro stations and pedestrian areas / markets)

Before 9/11 → terrorist events were **logistically complex** and often intended for hostage-taking or mass casualties

After 9/11 → strong orientation towards targets that are **simple to hit**, with **low logistical complexity**

Due to the new amount of open-source information, experts worry that the weaponisation of **CBRN materials** might be more within the reach of potential perpetrators than ever before



ISFP-AG ISF-Police Action Grant

*“[...] The **objective** is to support projects aiming at:*

- Improving the **protection of public spaces** and other **soft targets** in line with the EU Action Plan to improve the protection of public spaces;*
- Improving protection against **CBRN attacks** in line with the Action Plan to enhance preparedness against chemical, biological, radiological and nuclear security risks;*
- Enhancing the capacity of Member States' authorities and other stakeholders to implement the Regulation 98/2013, incl,*
- Addressing CBRN-E as well as emerging threats to critical infrastructure and public spaces.*

*Expected results: **Improved protection of citizens and infrastructures** (both critical and public spaces) against terrorist threats, including from CBRN-E and emerging threats. [...]*”

<https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/isfp-2018-ag-ct-protect>

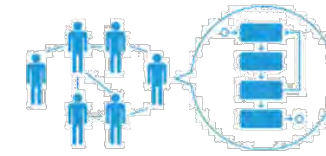
Stam and AnyLogic

Multi-method modelling environment

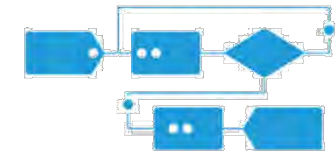
- Agent Based
- Discrete Event
- System Dynamics

Pedestrian library

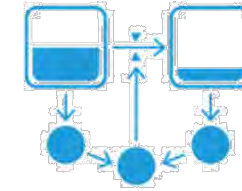
- Different categories of agents and characteristics



agent based



discrete event



system dynamics





FUTURE SECURE AND ACCESSIBLE RAIL STATIONS

Analysis of the flows of **heterogeneous crowds**, also composed of **PRM** (People with Reduced Mobility), to assess the level of **accessibility** of infrastructural solutions and services in large railway stations both in **ordinary** and **emergency conditions**.

Info: <http://www.fairstations.eu/>

Video: <https://www.youtube.com/watch?v=-FrX0hbYCFk&t=5s>



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 777636.



DEVELOPMENT OF NEW SOLUTIONS FOR THE PROTECTION OF CITIZENS AND INFRASTRUCTURES AGAINST TERRORIST THREATS

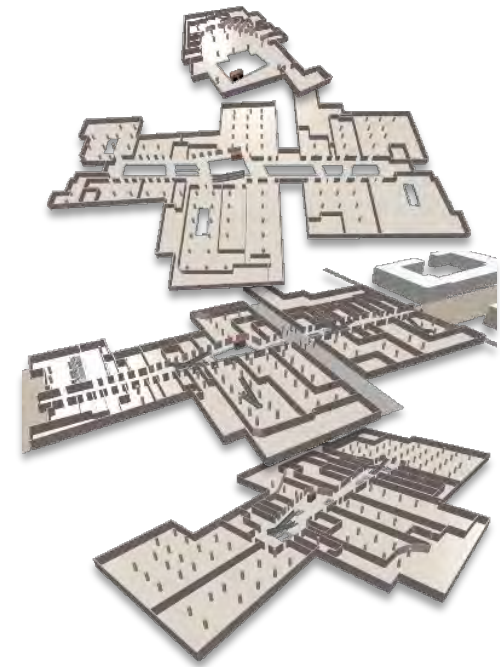
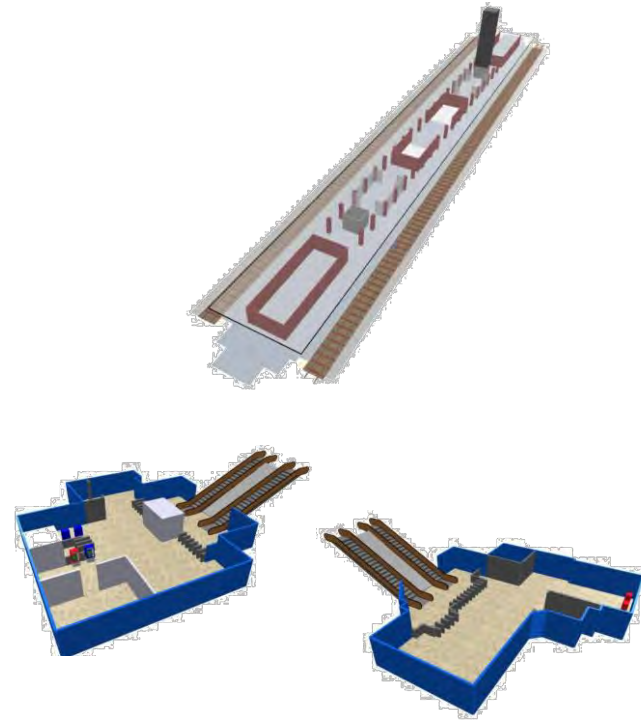
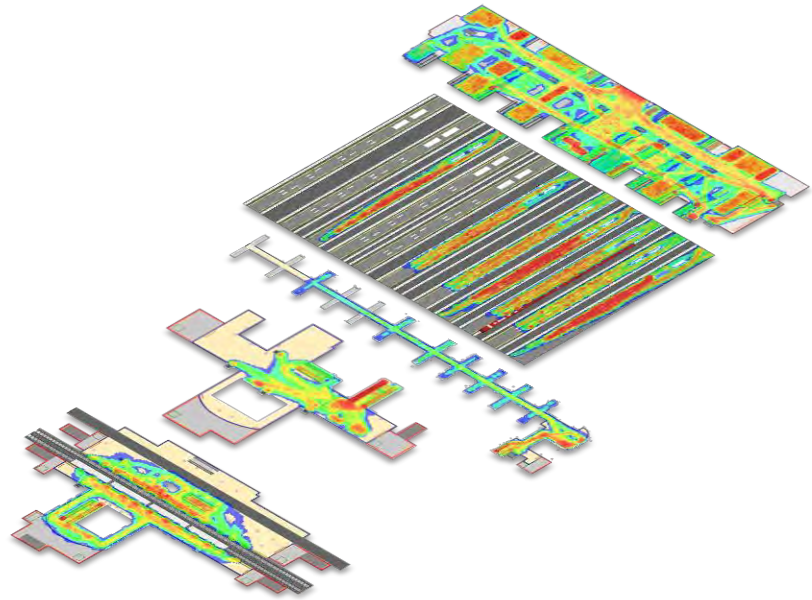
Development of models aimed at simulating the **behaviour** of the **crowd** in **ordinary scenarios** and in **attack scenarios** (with CBRN agents, explosive devices and weapons) inside a shopping centre and a metro station.

Info: <https://www.euprotect-project.eu/>

Video: <https://www.youtube.com/watch?v=ZxFrbTnZlnk>



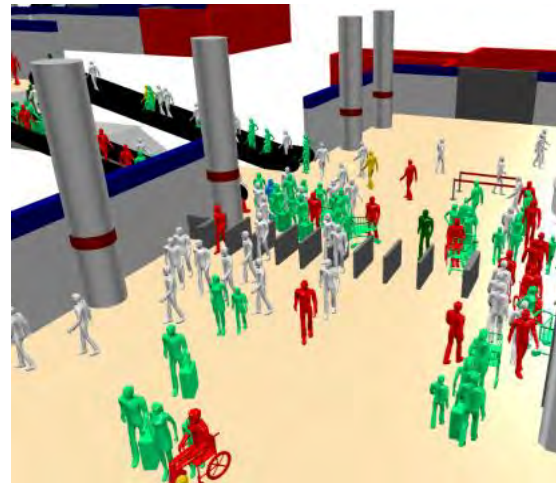
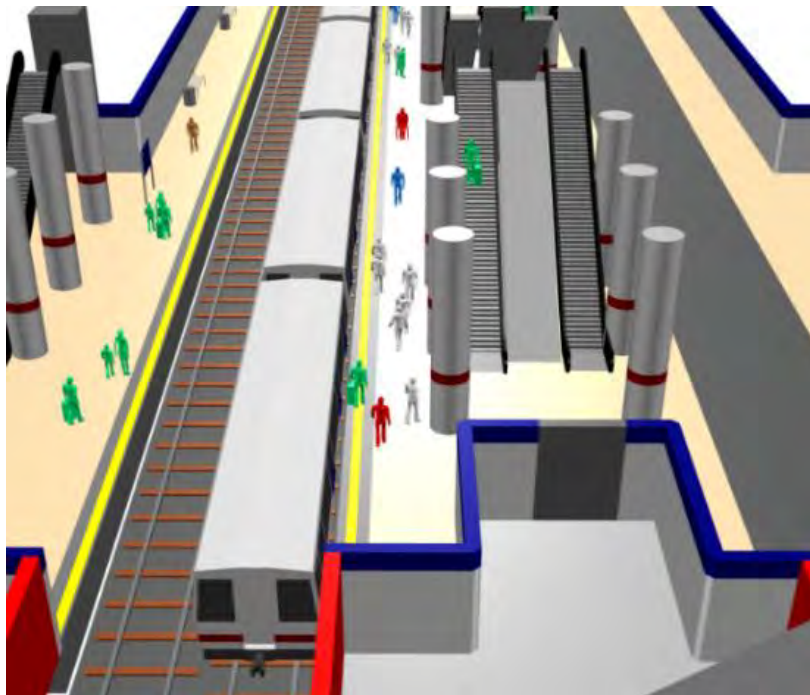
This project was funded by the European Union's Internal Security Fund – Police, under Grant Agreement No 861727.





The model was **validated** by comparing the data collected from the analysis of the images of the station's cameras and the results obtained from the model.

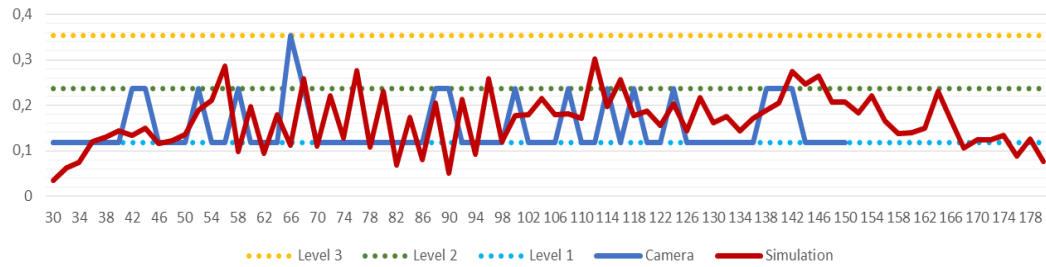
The validation process was carried out both in a **qualitative way**....



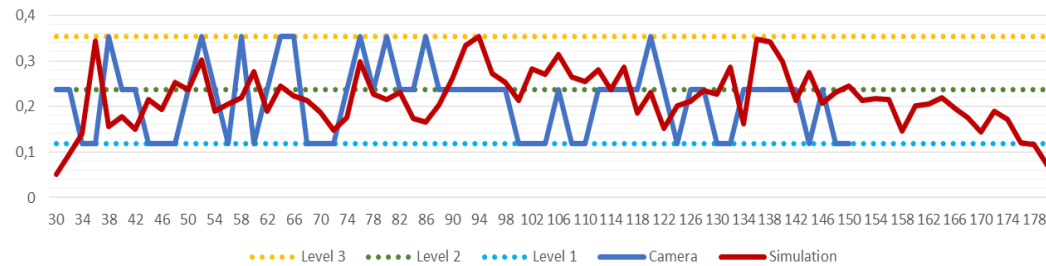


... and in a **quantitative way** by comparing the data obtained.

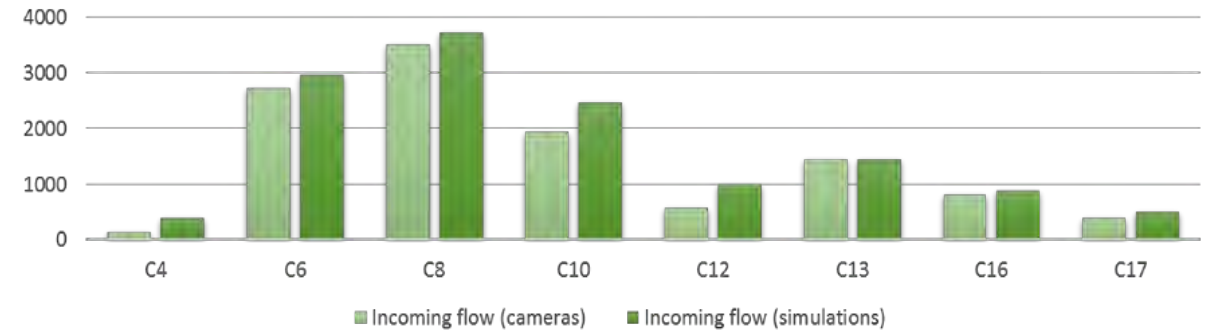
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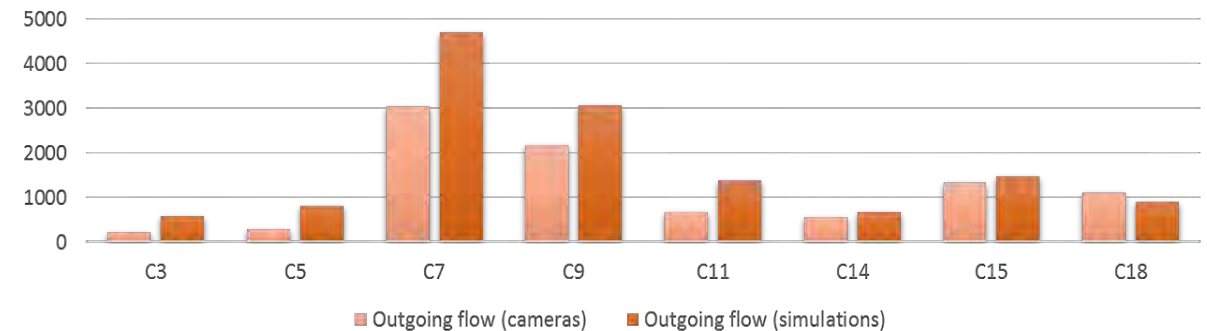
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Incoming flows



Outgoing flows



Analysis of the vulnerabilities of a metro station under terrorist attacks



Objective 1

Development of models of the metro station

Objective 2

Modelling citizens' behaviour in standard and emergency conditions

Objective 3

Modelling and simulations of reference attack scenarios

Objective 4

Identification and analysis of criticalities in critical infrastructures and public spaces



Scenario 1

Terrorist attack with **explosives inside a metro station**. This attack is carried out with a Remote-Controlled Improvised Explosive Device (RCIED).



Scenario 2

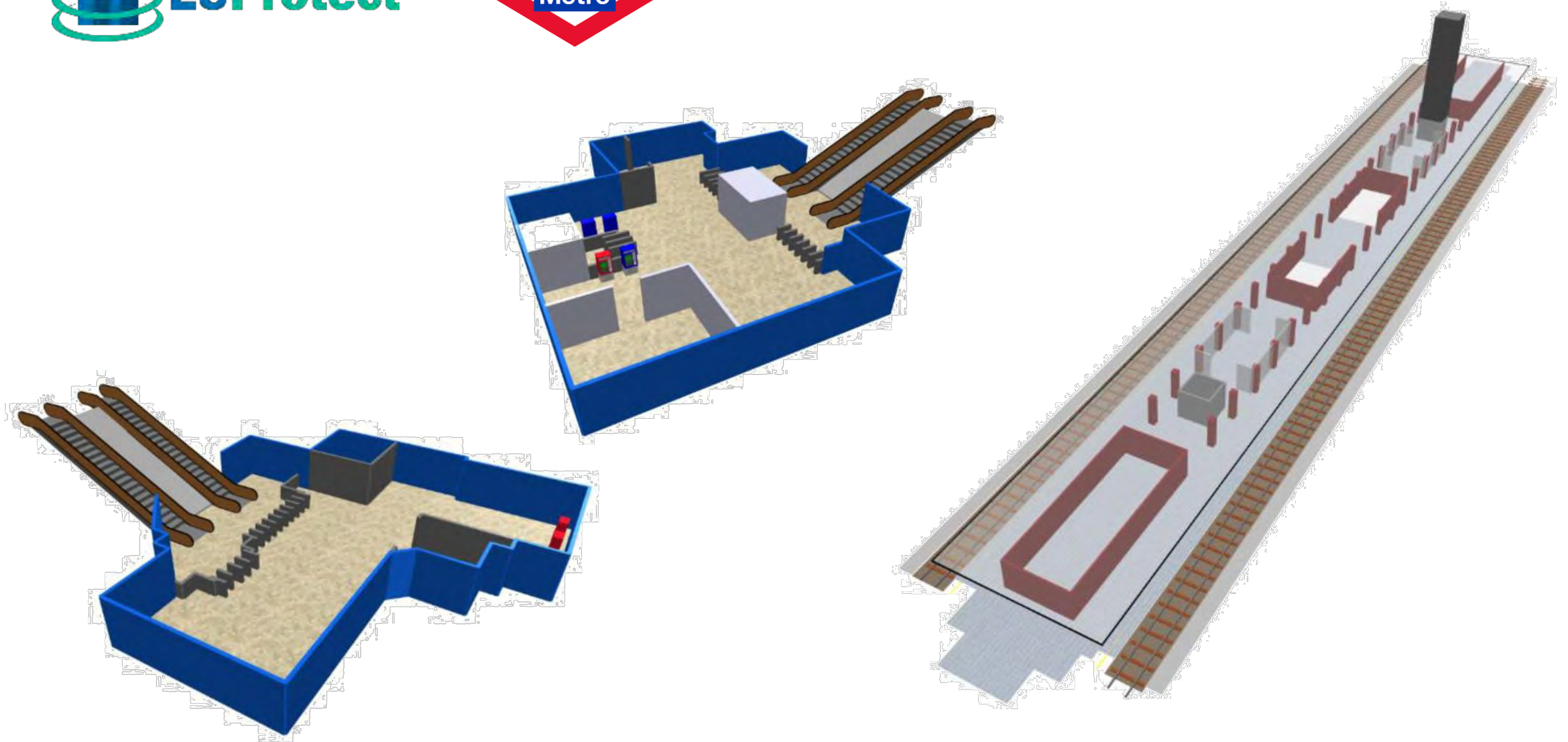
Terrorist attack with a **melee weapon inside a metro station**. This is a stabbing conducted with a kitchen knife.

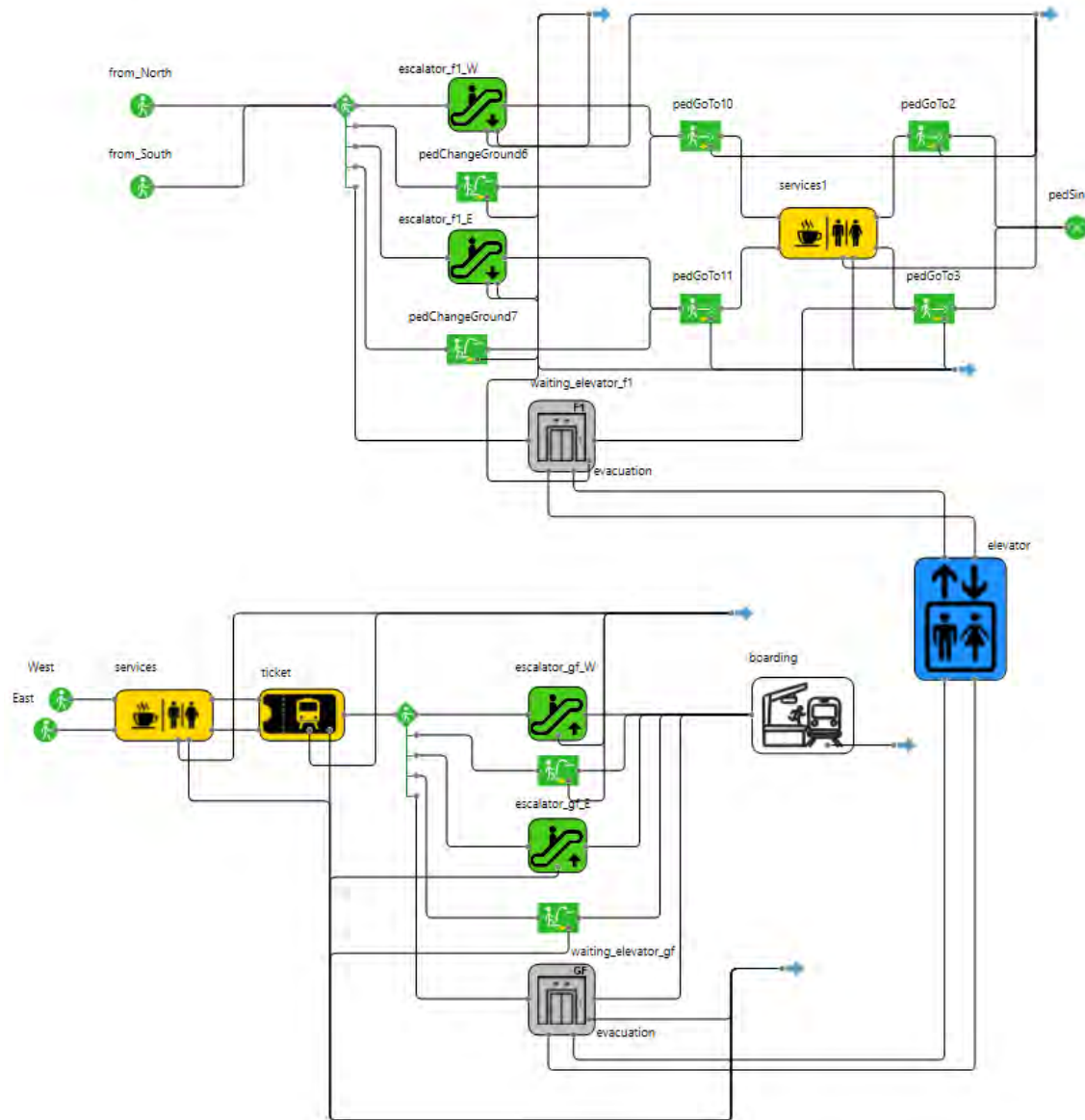


Scenario 3

Terrorist attack with a **drone charged with explosive inside a metro station**: the explosive is dropped on an uncovered metro platform.

Modelling of the metro station

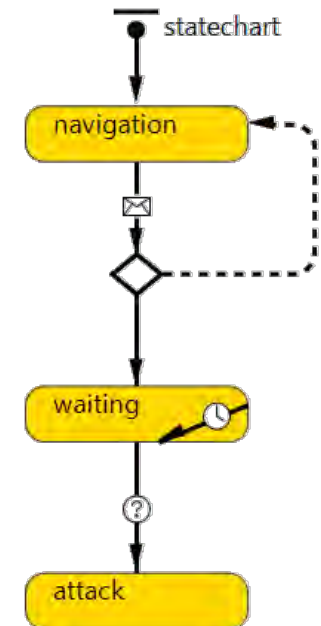
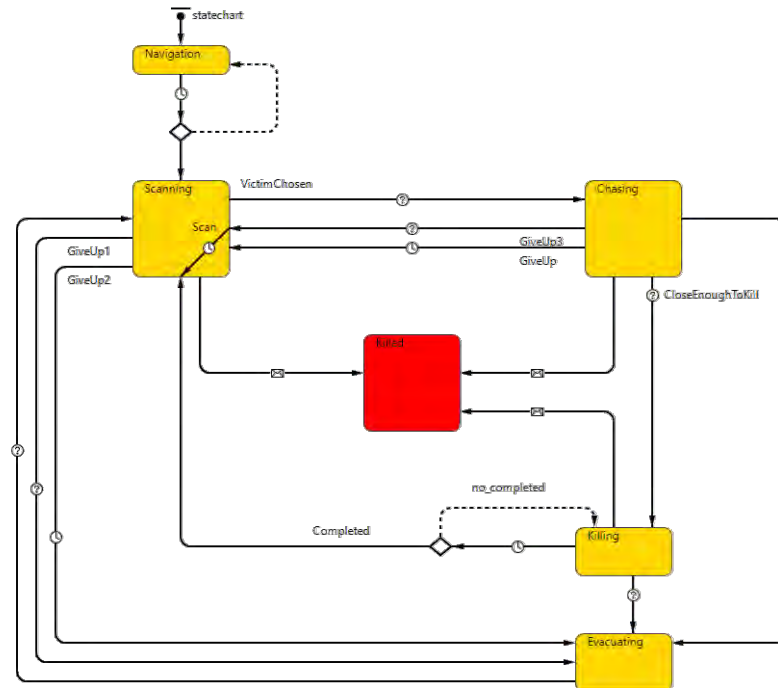
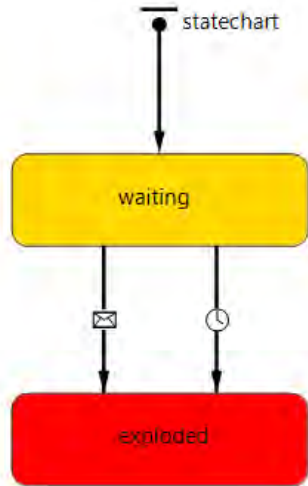
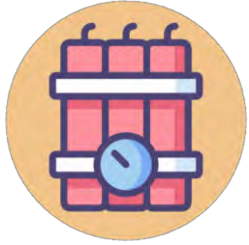




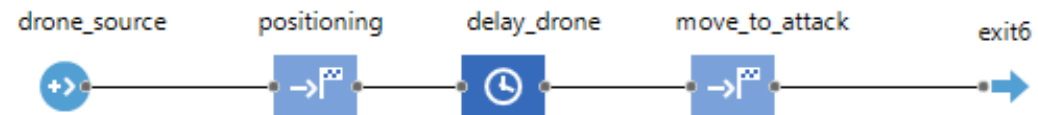
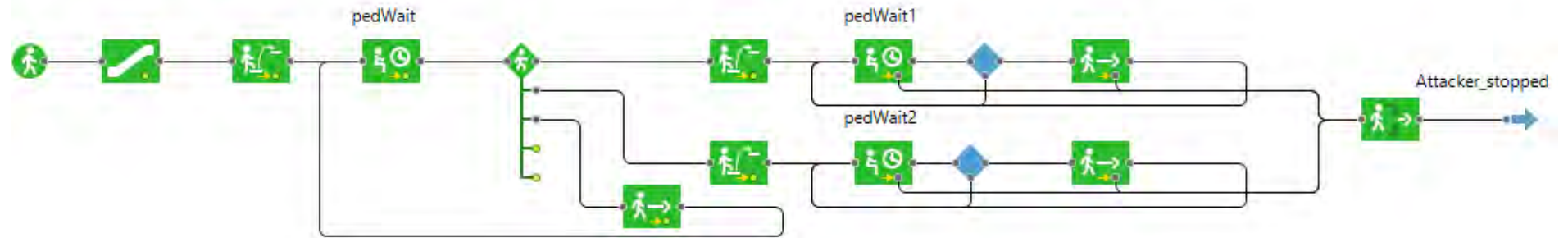
Users arriving from trains and leaving the station

Users arriving at the station to get on the train

Modelling of the Attackers – Statecharts

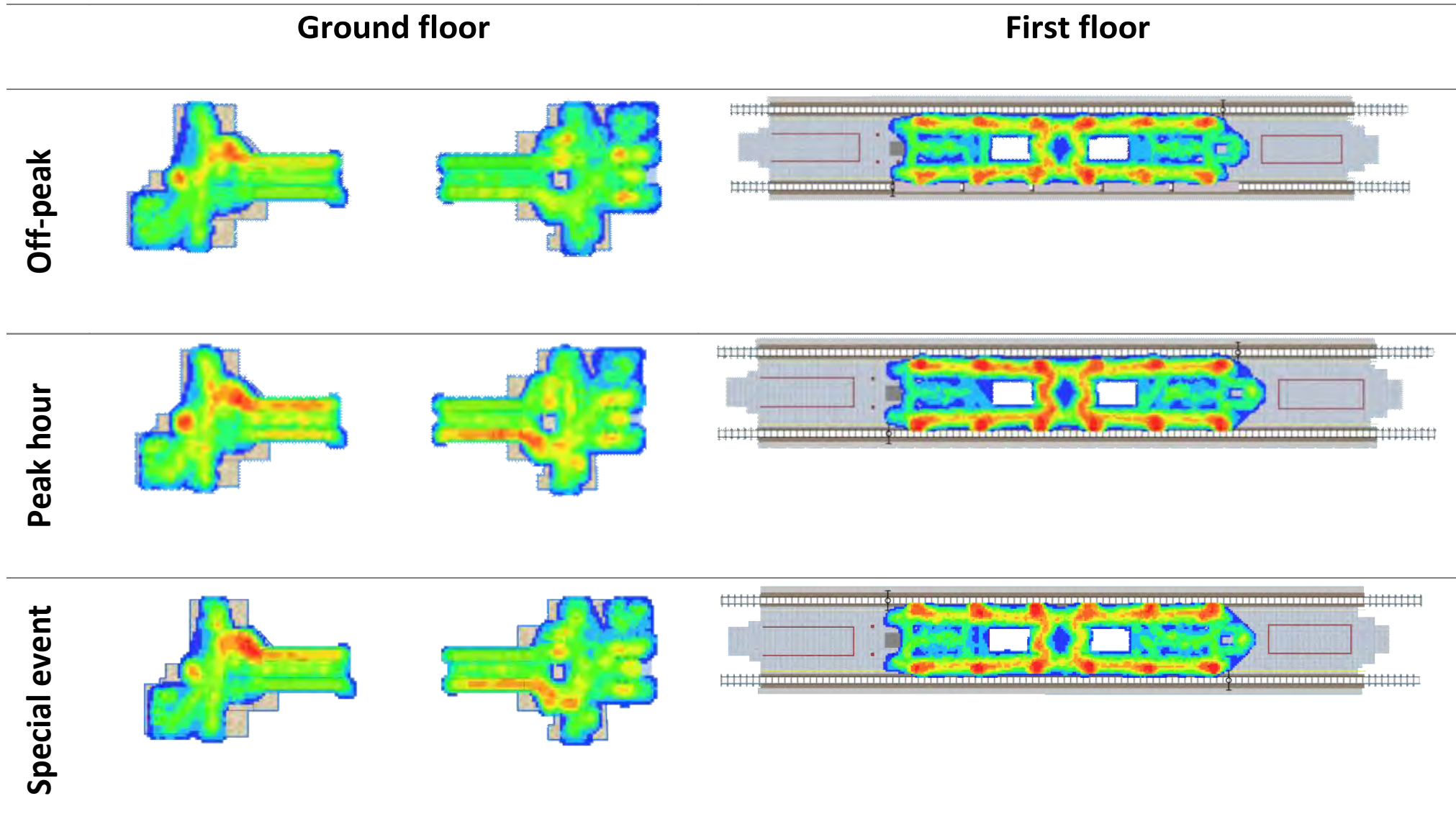





Modelling of the Attackers – Flowcharts





Main results and conclusions



EMERGENCY SCENARIOS		Criticalities	Average casualties/ injuries/exposed [people]	Average evacuation time
<i>ALUCHE</i>				
	<i>Scenario 1 Explosive</i>	Exit turnstiles, spaces in front of stairs and escalators on the first floor, platforms	8	2'21"
	<i>Scenario 2 Melee weapon</i>	Exit turnstiles, spaces in front of stairs and escalators on the first floor, platforms	6	2'29"
	<i>Scenario 3 Drone</i>	Exit turnstiles, spaces in front of stairs and escalators on the first floor, platforms	13	2'44"

The metro station has **few evacuation routes**, there are no emergency exits and the only path available is the one that connects the 1st floor with the ground floor used in ordinary conditions.

Metro, train stations and open-air infrastructures are highly vulnerable to **drone attacks**.

The implementation of **smart signalling** may improve the flow of people during evacuation.

The presence of well-indicated shelters or isolated areas would increase security levels against armed attacks.

The use of **artificial intelligence** (AI) is a potentially applicable option to increase the ability to detect possible threats and the responsiveness of facility managers. For instance, AI for image recognition can support in the preventive detection and identification of terrorists, weapons or suspicious objects.

Future implications



- EUProtect has entered the design and development phase of new solutions to improve the security of critical infrastructures.
- The model will integrate the new solutions and a simulation campaign will be carried out to demonstrate the efficiency of security measures in a virtual environment .
- EUProtect will end at the end of March 2022, meanwhile new projects have started, which are focused on simulating attack scenarios in port terminals and underground stations.
- Stam can provide support to owners and operators of infrastructures and public spaces to simulate crisis scenarios and identify vulnerabilities, test security measures and procedures.



MASTERING EXCELLENCE



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Any questions?