



The INACHUS System for Buildings Assessment and SAR Operations

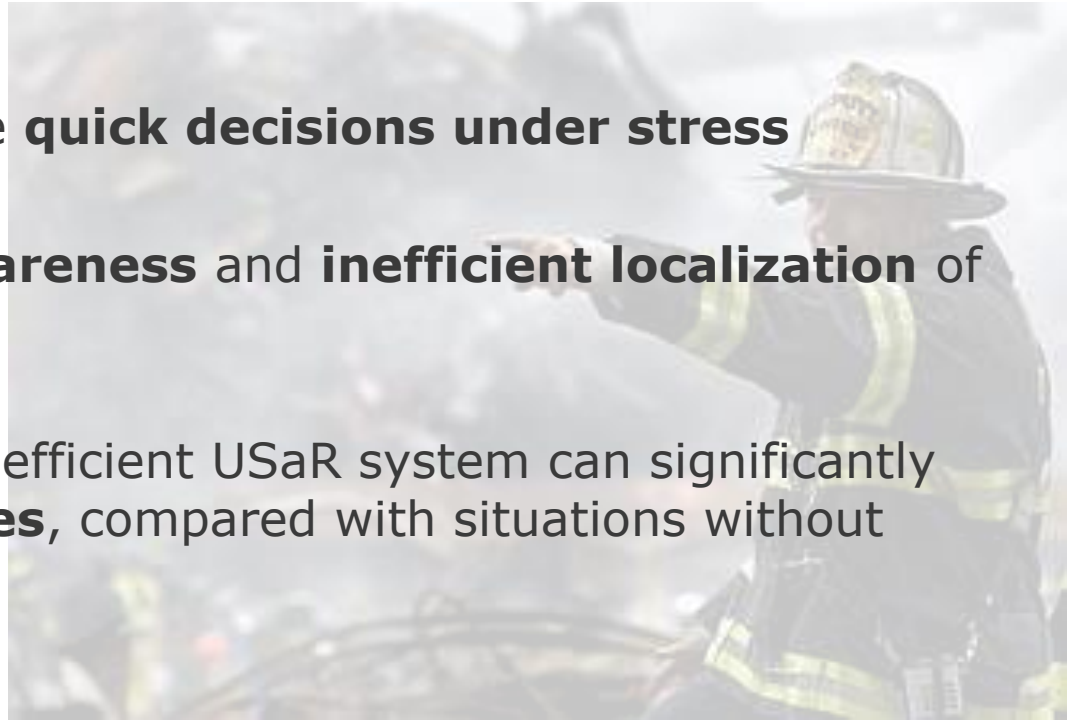
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ISCRAM Workshop, 21 May 2017,
Albi, France



Urban Search and Rescue Issues

- Natural or man-made disasters often result to **chaotic and difficult working conditions** for Urban Search and Rescue (USaR) crews
- USaR crews must make **quick decisions under stress**
- **Limited situation awareness** and **inefficient localization** of trapped victims
- Statistics show that an efficient USaR system can significantly **reduce accident losses**, compared with situations without emergency system





INACHUS - Project Info

Title: Technological and Methodological Solutions for Integrated Wide Area Situation Awareness and Survivor Localization to Support Search and Rescue Teams

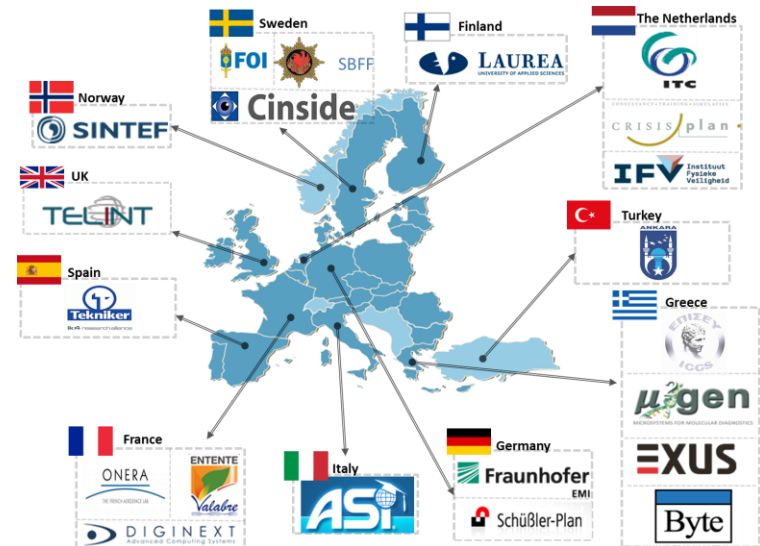
Topic: SEC-2013.4.2-1, Fast rescue of disaster surviving victims: Simulation of and situation awareness during structural collapses including detection of survivors and survival spaces

Type: Large-scale Integrating Project (IP)

Consortium: 20 partners from 10 EU countries

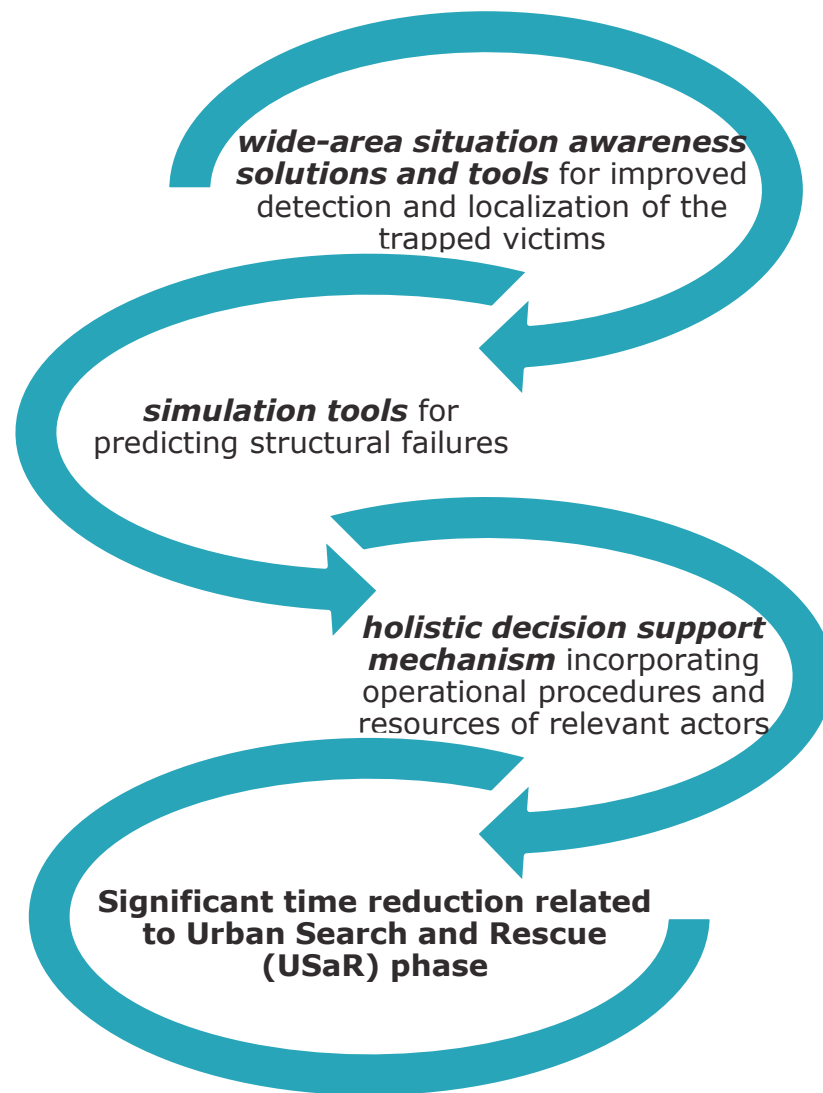
Budget: ~10M € (EU contribution)

Starting date - Duration: 1/1/2015 – 48 months



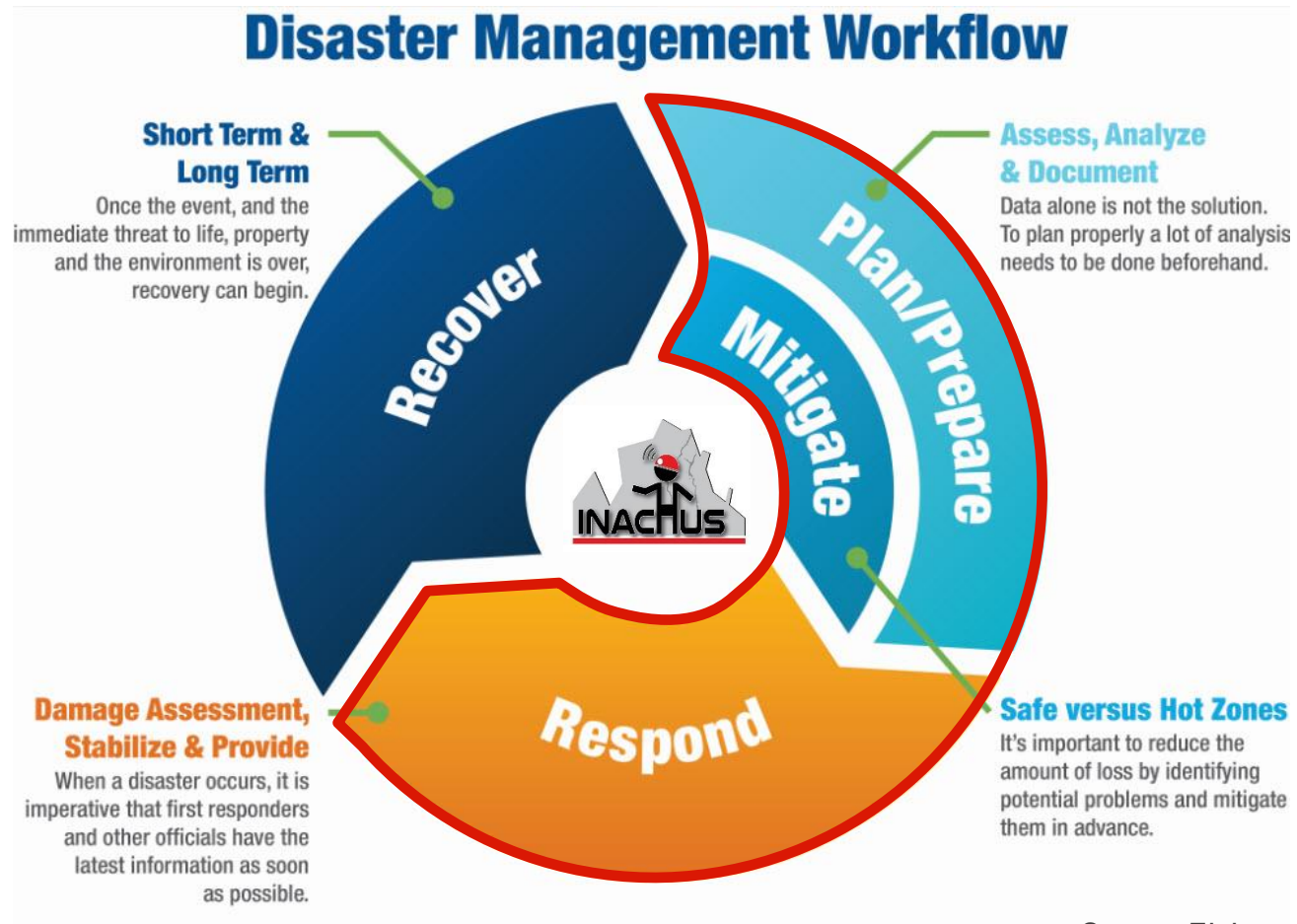


INACHUS Main Objectives





Disaster Phases



Source: EI Journal



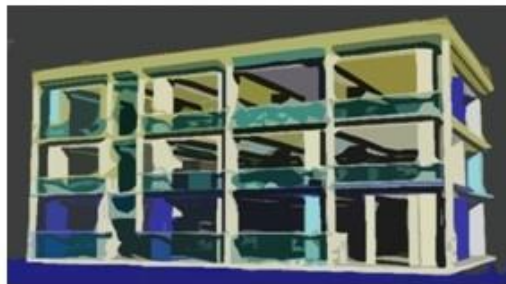
INACHUS Approach

1. Increased effectiveness with the same number of human resources
2. Effective/safe tactics and uninterrupted flow of information and decision making through different levels of commandment and logistics organization
3. End user-driven approach
 - ▶ Operational organizations from Day-Number 1
 - ▶ Heavily involved in determining the specifications
 - ▶ Provide feedback so that INACHUS system is constantly improved and complies with the established USaR procedures
 - ▶ Proactively identify potential target audiences for the project exploitation

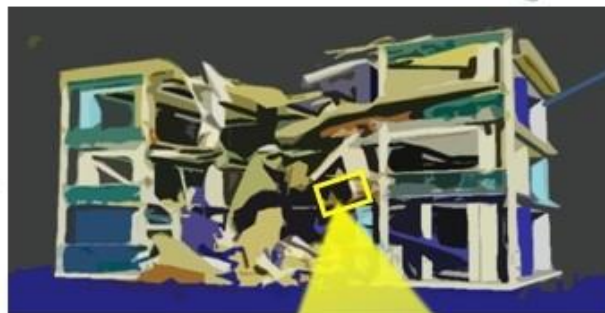


INACHUS Concept

Initial building state



after
Disaster



Airborne scanning/imagery

**Survivors
Detection &
Localization**

- Snake Robot
- UWB, Doppler
- Biochemical
- Cameras/IR

Mobile
antennas

Snake
robot

Victim

SHM sensors + cameras/IR

Disaster
Scenario

Simulator

- Damage projection

Real Event

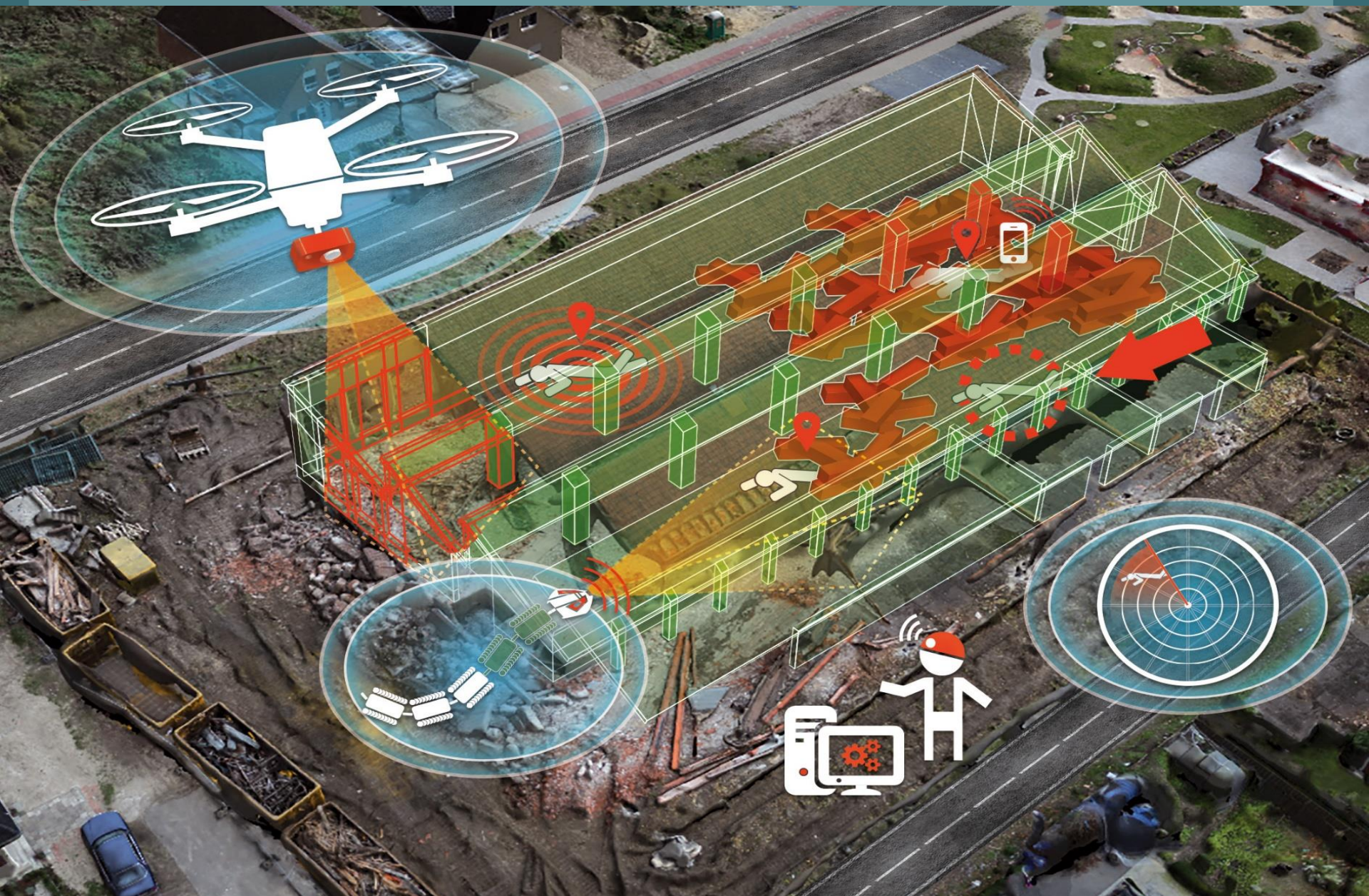
**Obtain Damage
State**

- Combine the latest
technology:
- UAV
 - Satellite Imagery
 - 3D Laser scanners

Comparison with collapse simulation

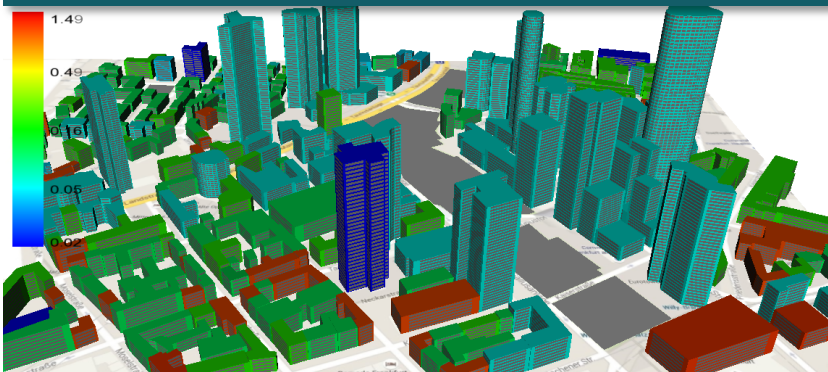


INACHUS Solution



▶ Structural Damage Analysis and Casualty Estimation

city quarter assessment

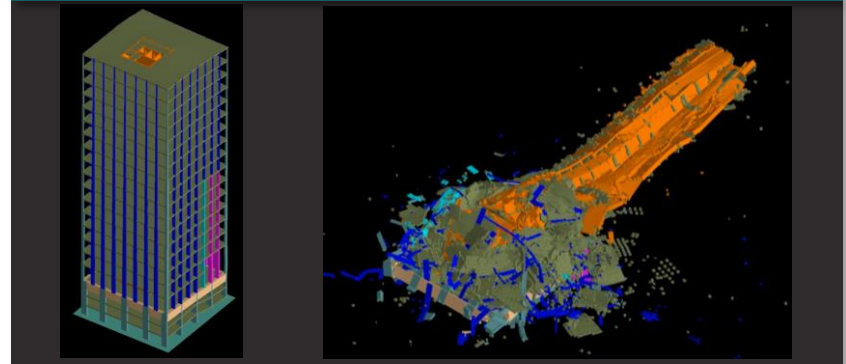


Mapping tool

assessment of damage hot spots and rescue paths in urban areas

→ *where should USaR teams start?*

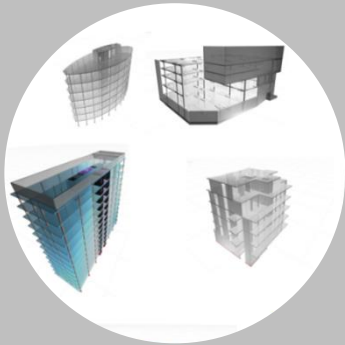
single building assessment



Detailed collapse simulation
of single buildings with
DEM/AEM/FEM

→ *where might USaR teams find people in a debris heap?*
How to get them out safely?

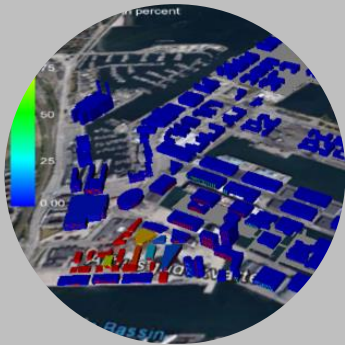
Structural Damage Analysis and Casualty Estimation



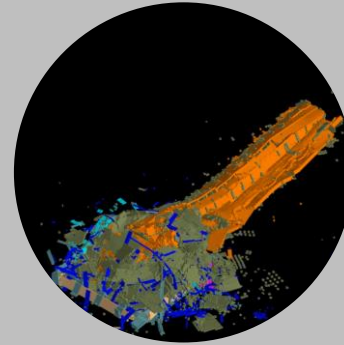
***Library of predefined
(typical European) buildings***

Templates for ...

Selected buildings



***city quarter
assessment***

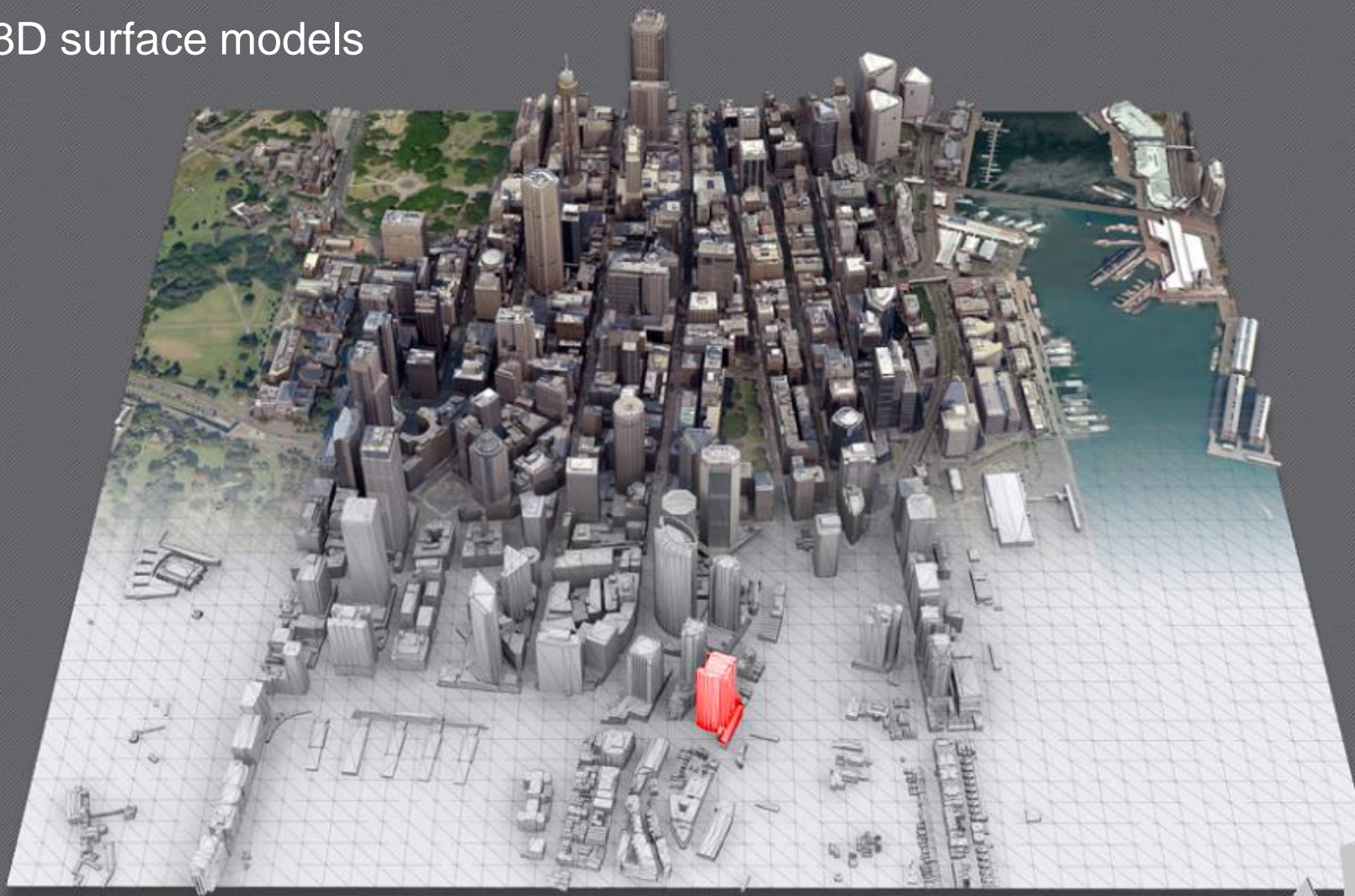


***single building
assessment***



Wide-Area Surveillance Tools

3D surface models





Wide-Area Surveillance Tools

3D surface models

Wide area

Limited resolution ~ 1 m
3D Laser acquisitions from drones

- Up to the area of a **city** in limited resolution
 - Compact drones, easy to deploy and operate (less than 1 hour)
 - Available under **bad weather conditions** (rain, fog, haze, wind)
 - Available **H24** (day and night vision)
- ✓ Classification of the typologies (building, road, tree, vegetation,,)
 - ✓ Maps of rescue paths
 - ✓ Classification maps of buildings with associated survival probabilities



10 x 10 km²



Wide-Area Surveillance Tools

3D surface models

- From Quarter to **Building** levels in high resolution
 - Autonomous outdoor flight (light-weight drones <5kg)
 - Data fusion from **Terrestrial** and **Airborne** measurements
- ✓ Precise 3D reconstruction for **visual analysis** of buildings by SaR Teams
 - ✓ Increasing **operator interpretation** by 3D / visible data fusion (damage evaluation)

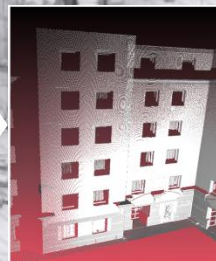
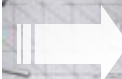
Small scale

High resolution < 10 cm

3D Laser acquisitions from ground and drones

Visible camera on drones

②

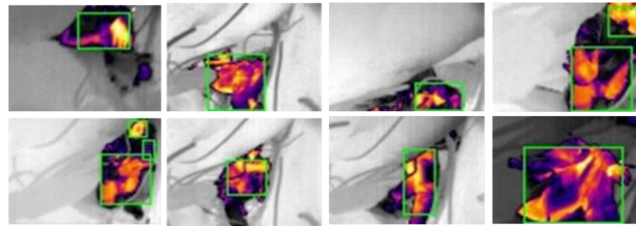
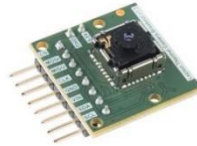


100 x 100 m²



Victim Localization

Infrared sensors



Robot radar
(CW radar)



Surface radar (UWB radar)



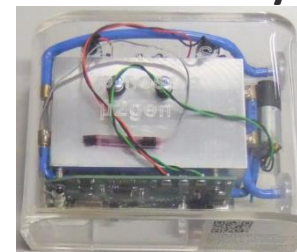
Mobile phone
detector



Distributed Seismic sensors



Electronic Nose
Sensor Array

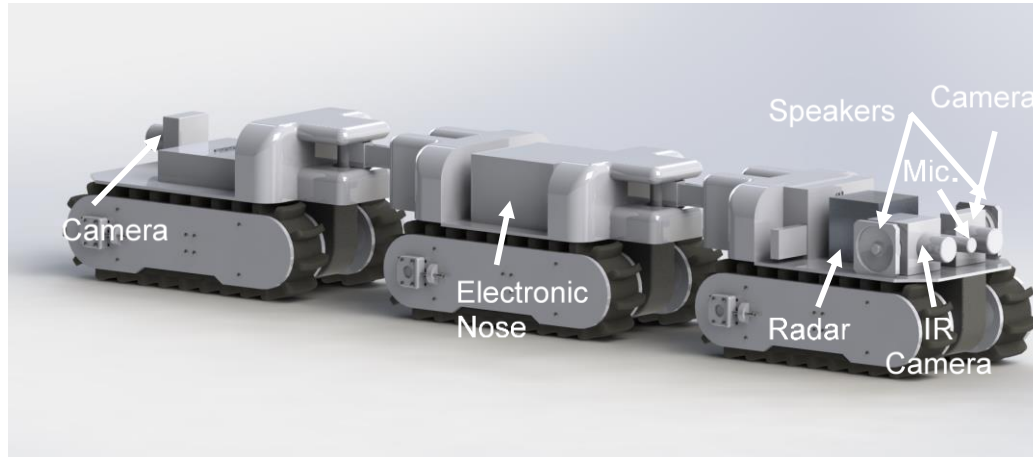




INACHUS Robot

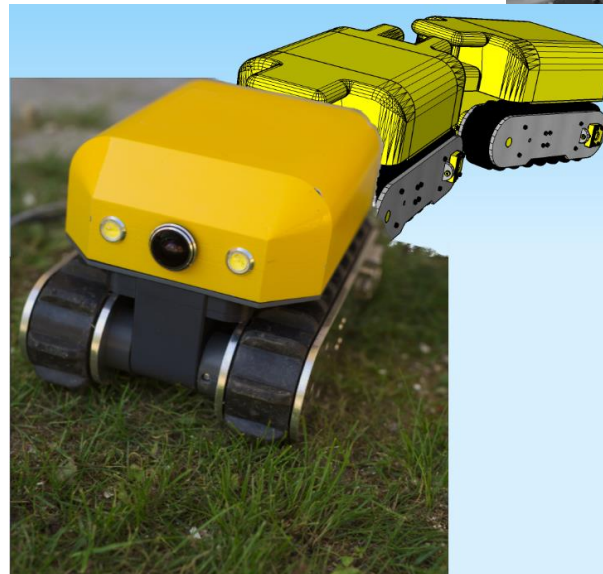
Robots go where humans can't!

*Sensors located
inside the robot*



*Obstacle-aided
locomotion*

High maneuverability



High robustness



INACHUS Robot

Vision of the final prototype – simulated environment





Work Structure

WP No.	Title
WP1	Scenarios Definition, User/System Requirements and Specifications
WP2	Framework Design and Interoperability Issues
WP3	Simulation Tool for Structural Damage Analysis and Casualty Estimation
WP4	Wide-Area Surveillance Tools for monitoring of Collapsed buildings
WP5	Victim Localization Solutions
WP6	INACHUS Emergency Support System (SaR-ESS)
WP7	Secure Communications and Positioning Issues
WP8	System Integration
WP9	Pilot Implementation and Validation of INACHUS platform
WP10	Dissemination, Exploitation and Training Activities
WP11	Evaluation and Consideration of Societal Impacts, Legal/Ethical Issues and Standardization
WP12	Project Management, Quality Assurance and Reporting



INACHUS Validation



Pilot 1: Small scale catastrophe for performance assessment of integrated sensors

Pilot 2: Small scale catastrophe for performance assessment mainly of wide-area surveillance tools for monitoring of collapsed buildings and simulation tools for structural damage analysis and casualty estimation



Pilot 3: Explosion in industrial installation due to terrorist attack scenario - First Demonstration of the integrated INACHUS system



Pilot 4: Cross-border earthquake scenario - Final Demonstration of the Integrated INACHUS system





Expected Impact



Saving more lives during disasters!

- **Improving situational awareness, reducing uncertainties and strengthening coordination**
- **Strongly reducing time for planning and intervention and increasing effectiveness**
- **Providing more advanced tools for USaR operations**
- **Reduced disaster costs**
 - *Limitation of disaster impact*
 - *Reduction in medical costs*
- **New technologies for an emerging market**



Why INACHUS?

- INACHUS offers **deeper understanding** of typical scenarios for **structural failures** and their damages following various types of incidents
- INACHUS **integrates new types of sensors** and wide are **situation awareness technologies** for **detecting and localising trapped alive humans**
- INACHUS introduces a novel **mobile platform** (Robot) able to penetrate into rubble, more efficient to the existing solutions
- INACHUS helps to **save more lives** by establishing an effective **USaR operations framework** that aims at rapidly assessing the potential of locating entrapped victims



Thank you! Any questions?

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