

INGENIOUS: THE FIRST RESPONDER OF THE FUTURE – A NEXT GENERATION INTEGRATED TOOLKIT FOR COLLABORATIVE RESPONSE, INCREASING PROTECTION AND AUGMENTING OPERATIONAL CAPACITY

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ABSTRACT

The INGENIOUS project (EU Horizon 2020) aims to develop, integrate, test, deploy, demonstrate and validate a Next Generation Integrated Toolkit (NGIT) for Collaborative Response, which ensures high level of Protection & Augmented Operational Capacity to respond to the disaster scene. This will comprise a multitude of the tools and services required: 1) for enabling protection of the first responders with respect to their health, safety and security; 2) for enhancing their operational capacities by offering them with means to conduct various response tasks and missions boosted with autonomy, automation, precise positioning, optimal utilisation of available resources and upgraded awareness and sense-making; 3) for allowing shared response across first responders teams and disciplines by augmenting their field of view, information sharing and communications between teams and with victims. The NGIT armours the FRs at all fronts, by delivering novel, affordable, accepted and customised response tools and services as part of their uniform and as part of their operational assets. The NGIT will be provided at the service of the FRs for extensive testing and validation (at component and Toolkit levels) in the framework of a rich Training, Testing and Validation Programme – of Lab Tests (LSTs), Small-Scale Field Tests (SSTs) and Full-Scale Field Validations (FSXs) – towards powering the FR of the future being fully aware, fully connected and fully integrated.

Keywords: search and rescue, crisis management, security, wearables, UAVs.

1. INTRODUCTION

Today's First Responders (FR) are using technology of the past. During their primary mission of saving lives and preserving society's safety and security, FRs face a multitude of challenges. In both small scale emergencies and large scale disasters, they often deal with life-threatening situations, hazardous environments, uncharted surroundings and limited awareness. Threats and hazards evolve rapidly, crossing municipalities, regions and nations with speed and ease. Armouring public safety services with all the tools that modern technology has to offer is critical. Such tools holistically enhance their protection and augment their operational capacities, assisting them in saving lives as well as ensuring

their safe return from the disaster scene. However, “more technology and tools” is not necessarily a solution towards empowering FRs. When firefighters, police officers and emergency medical services work in the field, they are often faced with “silo-ed” operations and overwhelming information flows. This should be dramatically reduced. What they need instead are intelligent, integrated, interconnected and seamless tools & services that add layers of protection against the dangers of their working environment and augment their situational awareness rather than distracting them from their mission.

Now more than ever, first responders confront at a global level, an increasing exposure to natural and manmade disasters due to climate change, rapid and unplanned urbanisation, demographic pressure, construction and more intensive land-use in hazard prone areas, eco-system degradation [1], radicalisation and extremism as well as economic crisis. Notably, the World Economic Forum identified major disasters as one of the top five global risks in 2017 [2]. Europe remains vulnerable to a wide range of natural and manmade hazards (such as flood, earthquake, industrial accidents, terrorism, critical infrastructure losses, etc.) [3], with disasters causing tremendous repercussions in human life and financial losses [4].

INGENIOUS [5] will develop, integrate, test, deploy and validate a Next Generation Integrated Toolkit (NGIT) for Collaborative Response, which ensures high level of Protection & Augmented Operational Capacity to respond to the disaster scene. This will comprise a multitude of the tools and services required: 1) for enabling protection of the FRs with respect to their health, safety and security; 2) for enhancing their operational capacities by offering them with means to conduct various response tasks and missions boosted with autonomy, automation, precise positioning, optimal utilisation of available resources and upgraded awareness and sense-making; 3) for allowing shared response across FR teams and disciplines by augmenting their field of view, information sharing and communications between teams and with victims. The NGIT armours the FRs at all fronts. The NGIT will be provided at the service of the FRs for extensive testing and validation in the framework of a rich Training, Testing and Validation Programme – of Lab Tests (LSTs), Small-Scale Field Tests (SSTs) and Full-Scale Field Validations (FSXs) – towards powering the FR of the future being fully aware, fully connected and fully integrated.

2. METHODS

2.1. Operations

NGIT is directly utilised during response activities and upgrades protection and operational capabilities of the first responders whilst enabling collaboration and coordination among team members, agencies and between victims and infrastructure owners. From an operational perspective, NGIT supports and improves the following response activities: 1) Improving situational awareness by allowing local and remote detection, monitoring and analysis of passive and active threats and hazards at incident scenes in real time as well as empowering responders’ movements by accurately specifying their location and their proximity to team members, victims, assets, risks and hazards; 2) Delivering resilient data and voice communications between teams and with victims by interconnecting the HQ with the worksite crews and sensorial components deployed, exploiting the merits of edge/fog networking; 3) Augmenting command, control and coordination over a novel C3 and Common Operational Picture platform that allows collaborative incident management, monitors responders’ actions in real time whilst coupling with an expert reasoning system for all-source information fusion and analysis conveyed and intuitively visualised at those operating via traditional (mobile voice, data and app) and novel (augmented reality glasses, fully interoperable) interfaces; 4) Preserving responders’ health and safety and boosting performance by upgrading their uniform and body gear with resistive materials and wearable sensing,

communication and positioning components; 5) Enhancing logistics and resource management by tracking and tracing first responders and their assets across the operational scene, enabling effective sectorisation and optimal utilisation of resources based on the analysis of hazard-specific needs; 6) Improving casualty management by the use of novel applications for triaging and victim classification at a prehospital support level and for suspect/victim face recognition; 7) Upgrading Training and Exercises of the first responders' community delivering a rich programme of Command-Post, Small-Scale and Full Scale Exercises during which diverse teams of responders covering the entire range of disciplines (civil protection, fire brigades, emergency medical services and police services) shall synergistically test, evaluate and validate the full extent of capabilities offered by the NGIT.

2.2. Technology

NGIT armours the first responders with novel, affordable and reliable tools and services as part of their uniform and as part of their operational assets in an integrated manner, facilitating seamless and resilient interconnectivity and boosting awareness. More specifically, 1) the NGIT builds upon the concept of "smart" first responders by holistically equipping them to protect them and assist in conducting their response duties, empowering and enhancing their helmet, uniform, boots and accompanying K9 units with wearables, communication and localisation components, sensors and addons delivering augmented reality functions. 2) Moreover, the NGIT comprises of smart devices in the air and on the ground, that are essentially external response modules operated by first responders to monitor, map, analyse and assess the incident scene. These are: the fully customisable self-exploring drones perceived as FRs' companions, the standalone components for delivering worksite communications (interconnecting tools/sensors with FRs, among FR teams, FRs with HQ and FRs with citizens/victims) and the indoor and outdoor localisation modules used to track and trace FRs and their proximity to team members, victims, assets, risks and hazards in real time. 3) Ultimately, the NGIT supports first responders with multi-fusion and expert reasoning modules for improving situational awareness and threat and hazard detection, a C3 and a COP platform with augmented reality capabilities as addons for Command, Control and Coordination and with mobile applications to improve response activities (such as worksite declassification, victim triaging, victim/suspect recognition and identification, multilingual speech support across multinational teams and social media "push" & "pull" messaging).

3. CONSORTIUM

INGENIOUS consortium has a rich diversity of organisation types: "typical" End-users/Practitioners (6) (first responders teams of all disciplines, fire brigades, emergency medical services, civil protection, K9 units and law enforcement agencies) comprise 26% of the Consortium, followed by specialised SMEs and Industries (7) representing 30% of the Consortium providing focused solutions on sensors embedded on FRs, data fusion platforms, Augmented reality services and Common Operating Picture and C3 systems, coupled with the important legal, privacy, ethical and social, human and security factors dimension (TRI expert partner). The consortium is complemented and showcases a multi-disciplinary and prominent research, innovation and scientific dimension for the final solution with the participation of EU's finest RTOs and Universities as well as of. KIRO (pioneer research institute on disaster response robotics in Korea) (10) representing 44% of INGENIOUS.

4. PROJECT TIMELINE

INGENIOUS is part of the initiative "*H2020-EU.3.7.5: Increase Europe's resilience to crises and disasters*" and specifically the topic "*SU-DRS02-2018-2019-2020: Technologies for first responders*" (H2020-SU-SEC-

2018). It is a Research and Innovation Action (RIA) with a total budget of €8.9 million and duration of 36 months, starting from September 2019.

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