The Role of Law Enforcement Agencies and the Use of IT Tools for a Coordinate Response in Pandemic Crisis Management: The STAMINA project

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Abstract
Pandemic crises are disruptive events that imply a threat to the health of citizens, and also to public safety. In order to provide an adequate response, Law Enforcement Agencies (LEAs) organizations up to now had to adapt their structures, staffing conditions and competencies to the exceptional circumstances. At the same time, pandemics, such as COVID-19 that is currently a real scenario, require from LEAs to test their capabilities and thus to further identify their own gaps and get to know themselves better. The complexity of this kind of phenomena requires a coordinated and multidisciplinary response through Information Technology (IT) tools to mitigate the effects of pandemics. In this sense, our participation in the European H2020 STAMINA project: *"Demonstration of intelligent decision support for pandemic crisis prediction and management within and across European borders"* brings added value to our daily work as LEAs. The project implements a set of tools whose goal is twofold: improvement of management of information in all phases of the pandemic as well as improvement of response and coordination among all first responders involved in a pandemic. STAMINA attempts to achieve this through the combination of a number of IT tools ranging from Predictive models and Early Warning systems to Real-time Social Media Analytics and a Common Operational Picture (COP) platform that acts as the main interface for real-time situation assessment and coordinated responses of the involved LEAs.

Keywords: pandemic crisis management; Valencia Local Police; predictive analytics; early warning systems, law enforcement agencies

Introduction

The COVID-19 pandemic has created a range of unforeseen and unprecedented challenges for Law Enforcement Agencies (LEAs) including police departments worldwide. In light of these challenges, the goal of this article is to understand the potential short- and long-term effects of disasters and public health emergencies on policing organisations and officers. The most common issues and best practices identified in the literature are included in the research. At the same time, it is further discussed 'what works' in the context of policing such emergencies. The literature that is discussed below reveals a few categories of issues predominantly raised in this context, namely police-community relations, intra-organisational challenges, as well as inter-agency collaboration and cooperation. A number of open issues is presented below that have immediate implications for policing during COVID-19 but also cover long-term effects, providing valuable recommendations for after the crises has passed.

Currently, in the context of such pandemics and particular during COVID-19, LEAs play a crucial role in keeping the pandemic under control by both promoting safer communities and fighting criminals who take advantage of the outbreak. In this sense, to avoid the spreading of the disease, LEAs had to establish new plans and protocols and to adapt their internal structures to more flexible work schedules and bubble work groups.

In addition to day-to-day security challenges, LEAs had to pay special attention to activities in the private and public areas in order to avoid illegal parties. Informing citizens about new pandemic regulations, monitoring restrictive measures such as the correct use of masks and curfew compliance, as well as the assistance and support for vulnerable citizens at home are some relevant examples. The collaboration with the health sector has been crucial in tasks related to public health such as supporting the implementation of public health measures, controlling the compliance of infected citizens with quarantine measure and tracking of close contacts to avoid overwhelming the health services.

Citizens' trust in LEAs has been a cornerstone in maintaining citizen security. Trust-building must be worked on in the long term with a continuous and preventive approach in order to obtain the desired results. In the current COVID-19 crisis, the citizens' trust in LEAs has helped to engage citizens in respecting established norms and collaborating to reduce the risk of social unrest. In the specific case of the Valencia Local Police (PLV) in Spain, trust was promoted by establishing new communication strategies via social networks as well as using loudspeakers in patrol cars and drones with messages of encouragement, reassurance and requesting citizens to stay at home and collaborate in respecting the rules.

Furthermore, LEAs have reported new patterns of criminal activity and citizens' requirements. For instance, minor offenses have decreased while there has been an increase of neighbourhood complaints for breaches of regulation, illegal parties and curfew breaches. COVID-19 has already brought a rise in cyber criminality, mainly due to the increasing usage of internet and reliance on technology for entertainment and connection to the outside world. Besides, the rise of misinformation and fake news has undermined LEAs' efforts to protect citizens from COVID-19. Fake news has often caused confusion and mistrust in the governments' crisis management plans while fostering conspiracy or denial theories and causing altercations and demonstrations against the preventive measures.

To address these challenges, PLV participate in the EU STAMINA project that brings together first responders, policy-makers, technology and crisis management experts from across Europe and neighbouring countries to develop technologies and recommendations for improving pandemic crisis management practices. This paper presents the ways that STAMINA can support LEAs' practices in the preparedness and response phases of the crisis management cycle.

The rest of the paper is organized as it is shown further on. The next section discusses previous work on the use of technology in policing public health measures. Then, we set the case study of the Valencia Police actions during an airborne virus pandemic on the scene of the STAMINA EU project, providing the motivation and the details of a proposed action plan that could be adopted by LEAs in terms of using a combination of toolsets for a better coordinated response in pandemic crisis management. Finally, the paper concludes with a brief discussion about the proposed approach and how the STAMINA project can support LEAs in pandemic crisis management.

Experiences of the COVID-19 pandemic

The ongoing COVID-19 pandemic has infected millions and killed several hundreds of thousands of people worldwide[1]. The pandemic has, however, not only created unforeseen and in many ways unprecedented challenges for the public health sector but also for LEAs (Brooks and Lopez, 2020). Police officers and staff are often directly or indirectly involved in the pandemic response and have thus a higher risk of getting infected (Bates, 2020). In addition, many governments have taken emergency measures to protect their population and slow the spread of the virus. Such actions, including lockdowns, travel bans, and social distancing rules are often controlled and enforced by the police, creating additional service demand for LEAs (Laufs et al., 2020). This comes on top of existing duties as the police are expected to maintain order and continue neighbourhood policing operations (Bonkiewicz & Ruback, 2012), all while under a greater strain on resources (Kennedy, Brooks, & Vargo, 1969; Stogner, Lee Miller & McLean, 2020). To successfully understand and manage the plethora of challenges that emergency situations such as COVID-19 create, first responders such as the police need to learn from other agencies and from past experiences with similar scenarios. A key mechanism for this is the review and academic analysis of disaster management practices and policies. The literature on law enforcement and disaster management, and specifically research focusing on public health emergencies, however, is often not practical enough and remains unclear how COVID-19 may impact policing in the short- and long-term (Rojek & Smith, 2007). Our work seeks to address this gap by assessing the implications that pandemics and public health emergencies can have for policing. In doing so, it seeks to identify best practices and to offer recommendations for policing the current COVID-19 outbreak. PLV's participation in the EU STAMINA project that focuses on pandemic crisis management supports this claim. In this context, it is expected that this collaboration will provide recommendations that will help police organisations and leaders to design adequate public health emergency preparedness and operational protocols during public health emergencies. Given the growing interest in researching on and strengthening the intersections between law enforcement and public health through EU projects, this article provides a novel contribution in terms of developing this area and facilitating new ways of thinking about the role of police officers during public health emergencies (Punch and James, 2017; Dijk and Crofts, 2017; Dijk et al., 2019). Our article outlines experiences, gaps and issues that LEAs have faced during the current COVID-19 pandemic. It is further tailored to the specific national context of how police departments in Spain are currently experiencing this situation and how they could coordinate responses in a pandemic crisis management through the STAMINA tools.

Experiences, gaps and issues that LEAs have faced during the current COVID-19 pandemic

The coronavirus pandemic has been both a challenge as well as an opportunity to learn about the weaknesses of our own police organisations and investigate ways of improving our practices. The main gaps and problems LEAs have faced are listed below:

- The pandemic is being managed exclusively as a public health problem and not with a **multidisciplinary approach**. This situation involves not only health personnel and patients, but also other actors and first responders, such as the LEAs.
- The **lack of personal protective equipment** at the beginning of the pandemic (gloves, masks, hydro-alcoholic gel, etc.).
- The **lack of health information** regarding citizens the police must assist and support as well as the **lack of data sharing** (health system, control agencies, security bodies). First responders with a non-sanitary profile do not have access to medical resources or medical information.
- The **lack of a two-way and fluid communication between citizens and those who manage or combat emergencies** resulting in loss of valuable and useful information that would facilitate decision-making.
- The **lack of analysis of social networks** to verify citizens' trust in their leaders and to further check the degree of collaboration.
- Difficulty to **combat misinformation and fake news**.
- The **lack of coordination among different profiles of first responders** (local police, health workers, firefighters, social services,) due to the **absence of a common interface or emergency management platform** to share information and resources.

In addition to learning about the gaps and opportunities in our police organisations, the pandemic has helped us to create synergies with other multidisciplinary organisations through our participation in Research & Development (R&D) projects. In that sense, PLV are currently participating in the H2020 EU project STAMINA, which is designing different IT solutions to help better coordinate the efforts of first responders.

1 https://coronavirus.jhu.edu.

The STAMINA Project

The STAMINA research and innovation project focuses on pandemic crisis management. This includes developing a toolset for predictive modelling of pandemic outbreaks, along with early warning functionalities and a decision support system. To assist preparedness, a crisis management tool is developed, and is defining the roles and responsibilities of key actors, and implementing different training scenarios. Real-time web and social media analytics also assist in capturing societal feelings and reactions, raising awareness and increasing public trust in public health institutions and government authorities. Smart wearable diagnostic devices are used for first line screening and monitoring. All information is fed to a Common Operational Picture (COP) platform, as the main interface for real-time situation assessment and coordinated response of the involved actors. The STAMINA toolset, upon its completion, will be accompanied by a set of guidelines on effective implementation of risk communication principles and best practices in cross-organisational preparedness and response plans. The use of the STAMINA methods and tools will be finally demonstrated through 12 national and regional small-scale demonstrators and one large-scale cross-border simulation exercise involving all consortium partners.

Trial scenarios and EU Summit of pandemics national planners and stakeholders

In the STAMINA project, a large number of trials is planned in order to test and validate the developed solution on the field while iteratively providing adaptations based on real-life operational scenarios contributing to the overall STAMINA end-user-oriented approach. Besides, at the end of the project PLV will organise and host an EU Summit of pandemics national planners and stakeholders to present the projects outputs. Apart from presenting the project´s output, it will be an impressive forum where all the stakeholders can discuss the outputs and exchange knowledge about the latest findings and recommendations in pandemic crisis management. The main aim is the elicitation of best practices.

The Spanish trial will take place in Valencia in spring 2022 when the whole project is going be close to its completion. Its implementation will be based on the collaboration between PLV, the Valencia Port Foundation (VPF) and the Spanish Red Cross-TECSOS Foundation (CRE-TECSOS).

The trial will deal with an infected person with an airborne virus who has been ordered confinement at home. Valencia is under a wave of an airborne virus and he/she will break the lockdown to attend an open-air drinking party in a leisure area in the city of Valencia. The priority of the LEAs at that moment will be to search for the infected person as well as to initiate the tracking protocol in order to identify the people who have been in contact with that person.

Within the scope of the Spanish trial, four STAMINA tools - Web Social Media Analytics tool (WSMA), Flu and Coronavirus Simulator (FACS), Early Warning System (EWS) and Common Operational Picture (COP) - will be included. Their value with respect to the management of that pandemic crisis is given below, while at the same time, the interconnection of the particular tools is also discussed.

Real-time Web and Social Media Analytics tool (WSMA)

The Web and Social Media Analytics tool (WSMA) is an online web application aimed at monitoring and analysing social media content according to specifications given by the end-user and leveraging Artificial Intelligence (AI) and rule-based analytics engines. WSMA includes a dashboard through which end-users can provide filtering and searching parameters (e.g., keywords, language, location) that helps the tool to retrieve content most relevant to them (Figure 1). Once provided with these inputs, WSMA starts collecting data from available social media Application Programming Interfaces (APIs) (currently Twitter and Reddit) starting from seven days before the moment the analysis has started. While collecting them, it feeds the data to processing pipelines and generates statistics highlighting trends and topics most often discussed as well as indicators of the sentiment-polarity (positive, neutral or negative "tone") of the messages. These analytics are then visualised on the dashboard (through graphs such as trend lines, bar charts, networks, word clouds – Figure 2 and 3) and compiled into reports. As the tool collects more data (data is collected on an hourly basis), the visualisations on the dashboard are updated so that end-users can always have an up-to-date picture on the discourse on social media. The reports, delivered on a weekly basis, are meant to provide aggregated analytics over a larger time span to allow the user to evaluate the evolution of the social media discourse over time.

Figure 1: WSMA input parameters dashboard (preliminary version).

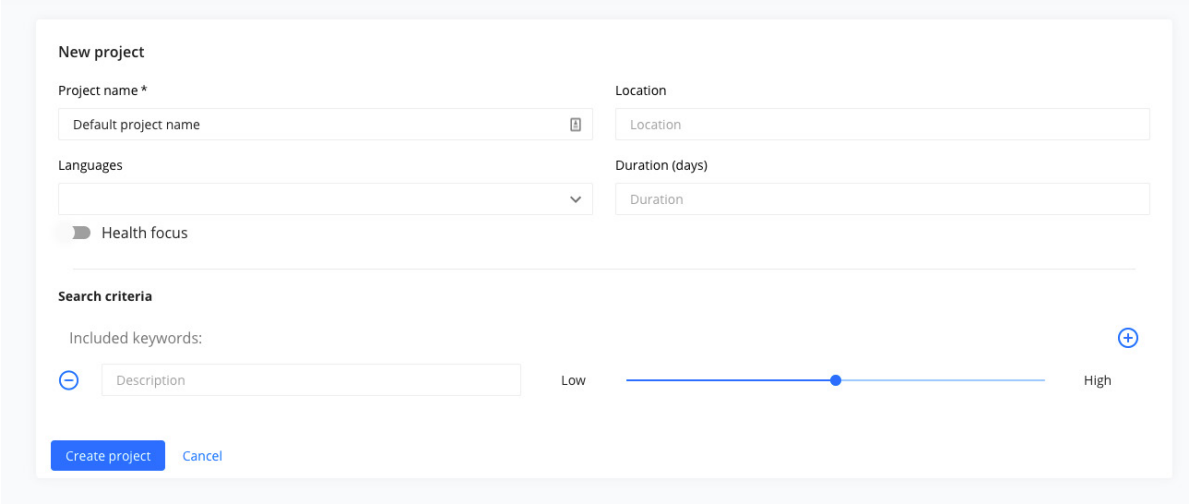


Figure 2: WSMA visualisation dashboard (preliminary dashboard).

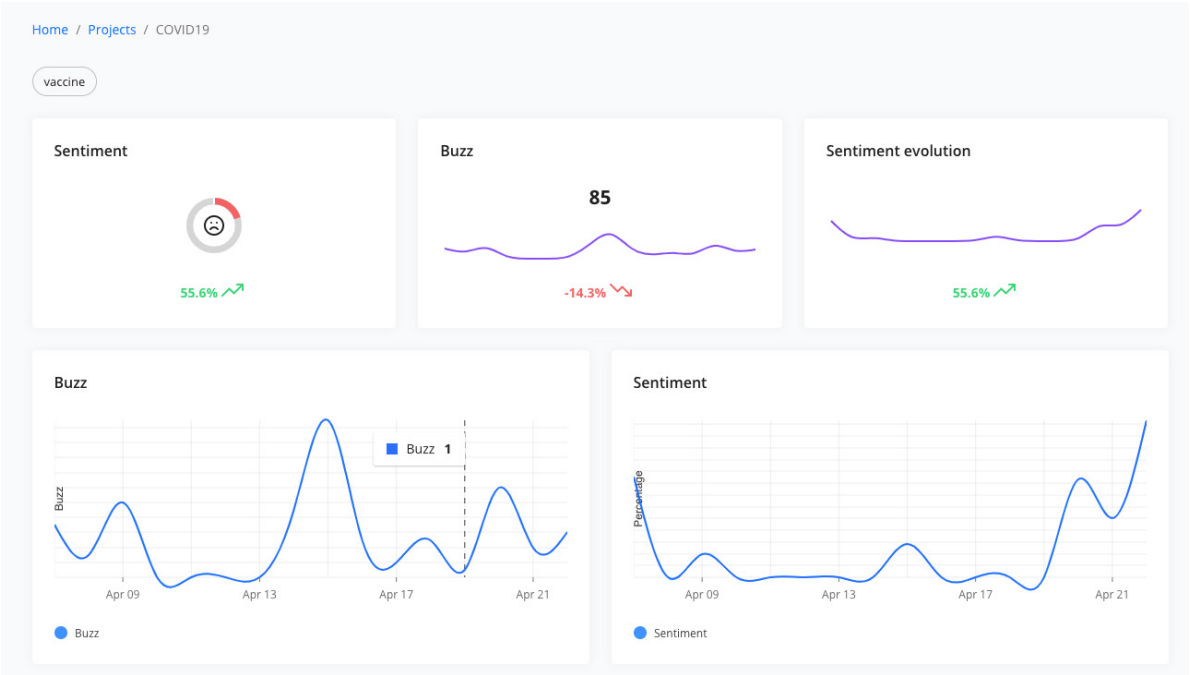
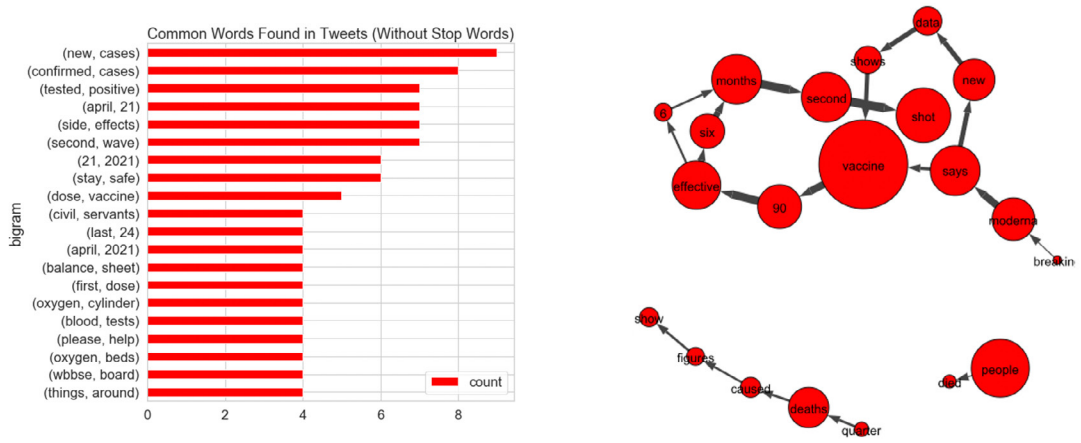


Figure 3: Example of text analytics.



With respect to the Spanish trial, PLV, VPF and CRE-TEC-SOS, in order to reduce the distrust towards the authorities that can undermine the efficacy of the containment measures and the compliance with them, decide to gather insights from social media data on the institutions' response to an "airborne virus", at both regional and country-level. Although social media users are not representative of all the demographics of citizens, PLV believe that these platforms can provide fast and easy access to a relevant and quite varied fraction of the population discourse. The police officers (end-users) may log in to WSMA and provide relevant input parameters such as the locations of interest (Valencia, Spain) and keywords to track ("Policia local de Valencia", "PVC", "Estado de alarma", "confinamiento domiciliario", "fiesta", "botellón", "ocio nocturno", "cierre de los bares"). WSMA dashboard shows, through the sentiment evolution trend line, what has been reported in the previous days, on average, from the social media users' side regarding negative sentiments in posts mentioning the authorities. From the graphs showing frequent words, co-occurring words and their relations, PLV may infer that those social media users are talking about unfair rules, desires to go to parties, impatience for the restrictions, etc. Based on these findings, PLV decide to: 1) share on their communication channels an article detailing their efforts in controlling confinement breaches and 2) gather citizens' perceptions on the police work during the "airborne virus" emergency through an online survey. In this way, PLV aim to strengthen even more the trust relationship with their audience by providing evidence regarding their actions and by showing interest in hearing the audience's voice.

Flu and Coronavirus Simulator (FACS)

The Flu and Coronavirus Simulator (FACS) is an Agent-Based Simulation (ABS) tool that focuses on "airborne viruses" transmission within the context of a town, small city, or borough. It combines disease properties, geospatial information and basic demographic information to attempt a forecast of expected infection and hospitalisation rates across the region (Mahmood et al., 2020). It supports the implementation of prevention measures such as lockdown and vaccination strategies as well as emergence of new strains. FACS uses OpenStreetMaps (OSM) geospatial data; epidemiological and intervention data published by public health authorities; and demographic data published by national statistics authorities. Secondary data is used when there is lack of or missing data. The FACS disease model is a Susceptible, Exposed, Infected, Recovered, Dead (SEIRD) model (Figure 4) and relies on bespoke disease transmission equations to resolve the likelihood of infections between individuals in a given indoor (or outdoor) space that considers aspects such as the size of space, ventilation, time spent in that space on a day, and the total time spent by infectious persons in that space. The output of the simulation is visualised on a scatter chart on a map. This mode makes it easy to identify infection hotspots. The output is also plotted on timeseries graphs with confidence intervals for more in-depth analysis. Example output graph visualisations is shown in Figure 5 and scatter map in Figure 6. PLV will be able to see the outputs of the simulations on the COP tool. PLV will also have access to raw output data, should they wish to perform further analysis.

Figure 4: FACS disease model.

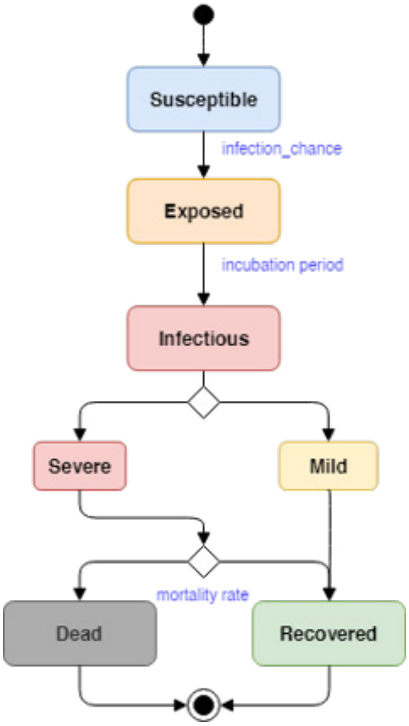


Figure 5: FACS graph output

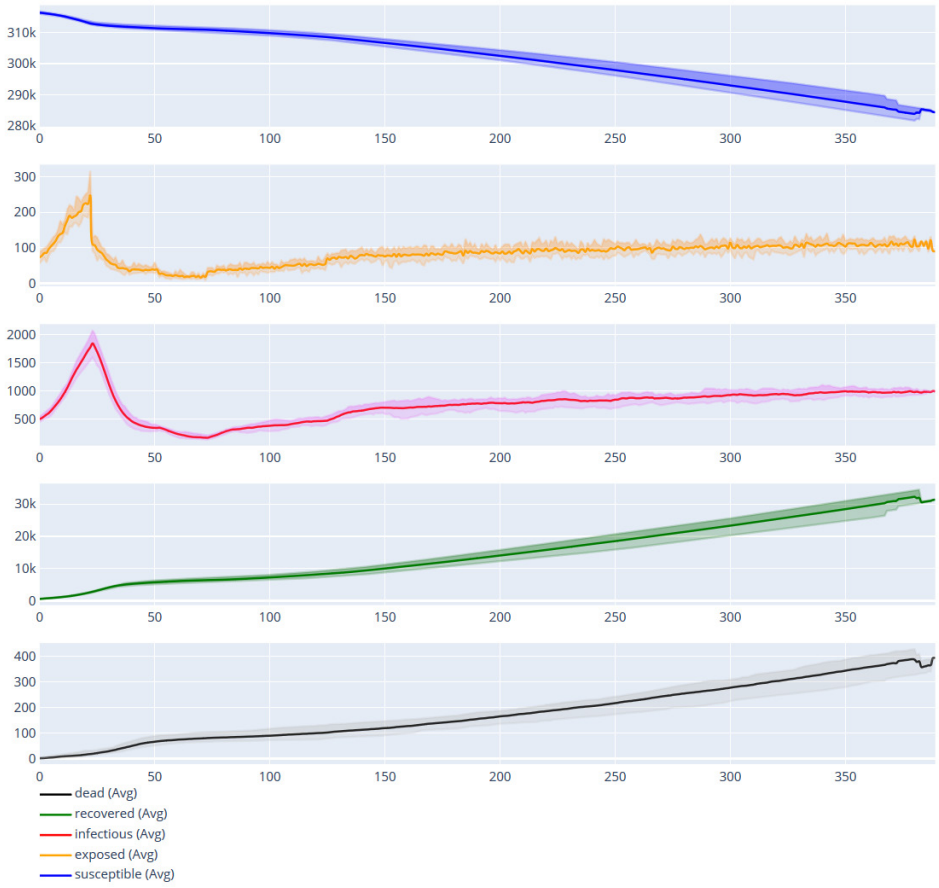
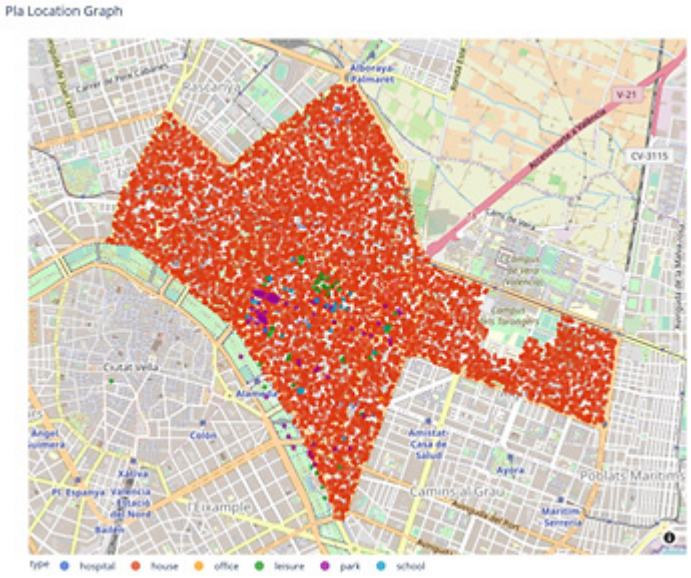


Figure 6: FACS map visualisation – Pla del Real, Valencia.



The trial scenario is as follows. There is a new wave of "airborne virus" infections in Valencia and the Town council decides to implement strict lockdown measures to prevent overwhelming the healthcare system.

PLV are already aware that confinement measures are not very popular and they expect that a small proportion of the population will breach the rules. In anticipation, they want to understand what the impact on infections and hospitalisations will be, should different population profiles breach the rules. PLV's aim is to be better prepared to take the appropriate enforcement actions, if they receive notification from the track and trace system of a lockdown breach.

PLV therefore runs FACS for the following hypothetical but realistic scenarios:

1) *A single individual with the following profiles does not abide by the rules:*
   i) A young adult with a very active social life.
   ii) A healthcare worker that continues to go to work.
   iii) A supermarket worker that continues to go to work.
   iv) A single household adult that visits their partner.
2) *All the four profiles breach the rules simultaneously.*

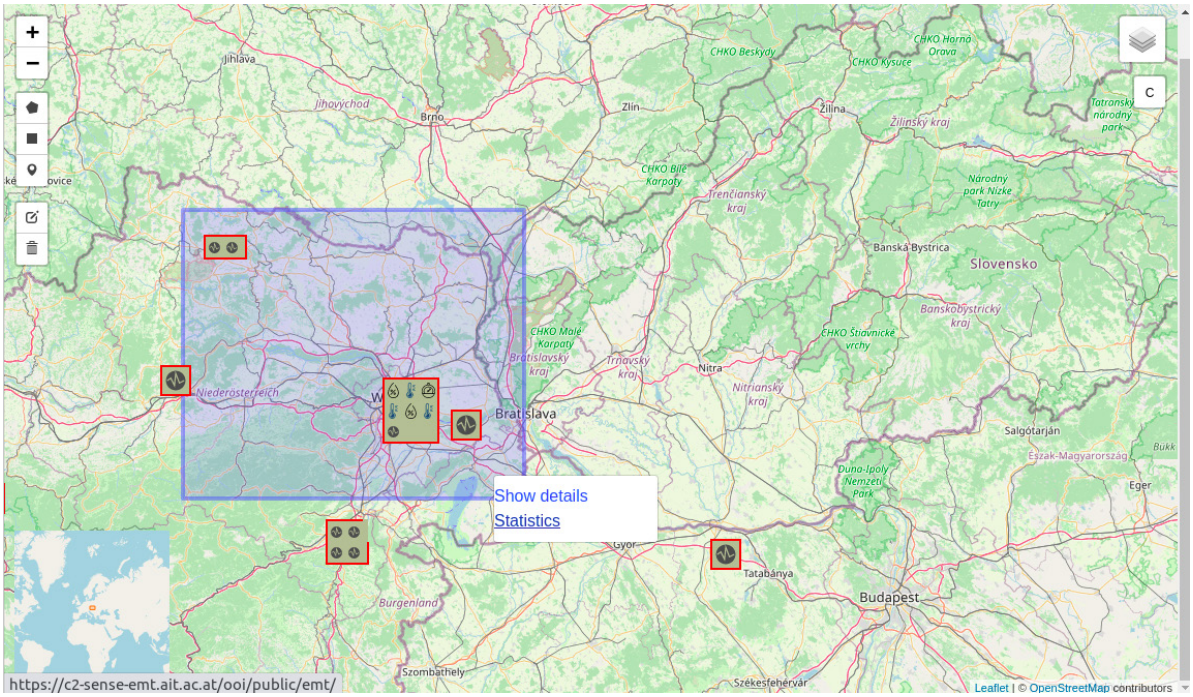
Based on the FACS predictions for each scenario, PLV will be able to prepare action plans and therefore act immediately when the track and trace system indicates that a person of a certain profile has breached the lockdown rules. PLV will also be prepared to prioritise actions when several incidents of disobedience occur at the same time.

ML-based Early Warning System (EWS)

Integral to STAMINA's promised value in the response phase of a pandemic is the proposed Early Warning System (EWS), which automatically notifies its users at the operational and the tactical level when certain values controlled by STAMINA exceed critical levels. The EWS operates on the basis of information gathered by other STAMINA tools and additional datasets, as visualised in Figure 7. Users want to be notified of the occurrence of (potential) outbreaks early on. The EWS can do this based on pre-determined thresholds in certain available indicators or by identifying alerting patterns based on historical data.

The potential use of the EWS within the Spanish trial, is to share the preliminary evaluations with respect to the number of people who came in touch with the infected person, at an early stage. The purpose of EWS is twofold: enhancing the preparedness of users (police officers, PLV and VPF) and processing various inputs of information (i.e., number of positive PCR test results, number of total PCR tests, number of tweets including words such as "airborne virus", Valencia party, etc.) in order to provide real-time parallel in-situ or remote situational awareness. As such, the Early Warning System has the potential to play a very important part in enhanced pandemic response by alerting the responsible parties of

Figure 7: EWS capability to operate on the basis of information gathered by other STAMINA tools



PLV and VPF to a potential outbreak, where they might otherwise have not realised its significance until later.

Additionally, all the imported data is processed and exported in real-time by assisting and supporting in this way the real-life situation of having an "airborne virus" infected person breaking the mandatory judicial confinement to which she/he has been imposed to. The output in terms of alerts, warnings and information messages is finally visualised through COP where the police authorities have a clear map-based observation showing the levels of alerts and warnings colour-coded in terms of their importance (i.e., low, medium, high).

Common Operational Picture (COP)

COP is a web-based software solution aiming to provide different kinds of visualisations by integrating external tools and data sources. The focus lies on map visualisations of georeferenced data (Figure 8). However, other types of visualisations such as graphs and tables are available (Figure 9). Moreover, messages can be included as a type of visualisation, for which there is multilingual support, allowing a more robust cooperation. COP is built to support decision-making, by integrating and displaying the most recent and relevant data from diverse sources, such as sensor data, in a birds-eye view of a situation. The visualisations are customisable to the specific needs of the users; however, it is best suited for showing the current states and not the historical evolution of these values.

Next to that, the overview can be complemented with basic data analysis functionalities for making short-term predictions and monitoring resources for incoming data. This is achieved by the user's ability in the tool to set and configure different threshold limits for parameters of interest. The tool then automatically monitors said thresholds and raises alarm once these thresholds are violated.

The main purpose within the Spanish trial will be to gather all relevant (meaning on a strategical level) information outputted by the other involved tools and present them in a structured and consistent way that will aid decision makers with their tasks. The visualisations displayed in COP will support authorities in their decision-making process and help them use their resources more effectively.

The authorities will have access to the results generated by FACS in order to assess the possible threat potentials from different hypothetical scenarios, while results from WSMA will help the authorities to analyse real-life events. All that will be complemented with notifications, warnings and alerts from the EWS that are going to be displayed on a map in order to allow authorities to keep track of the evolving situation.

Figure 8: Map visualisation of georeferenced data.

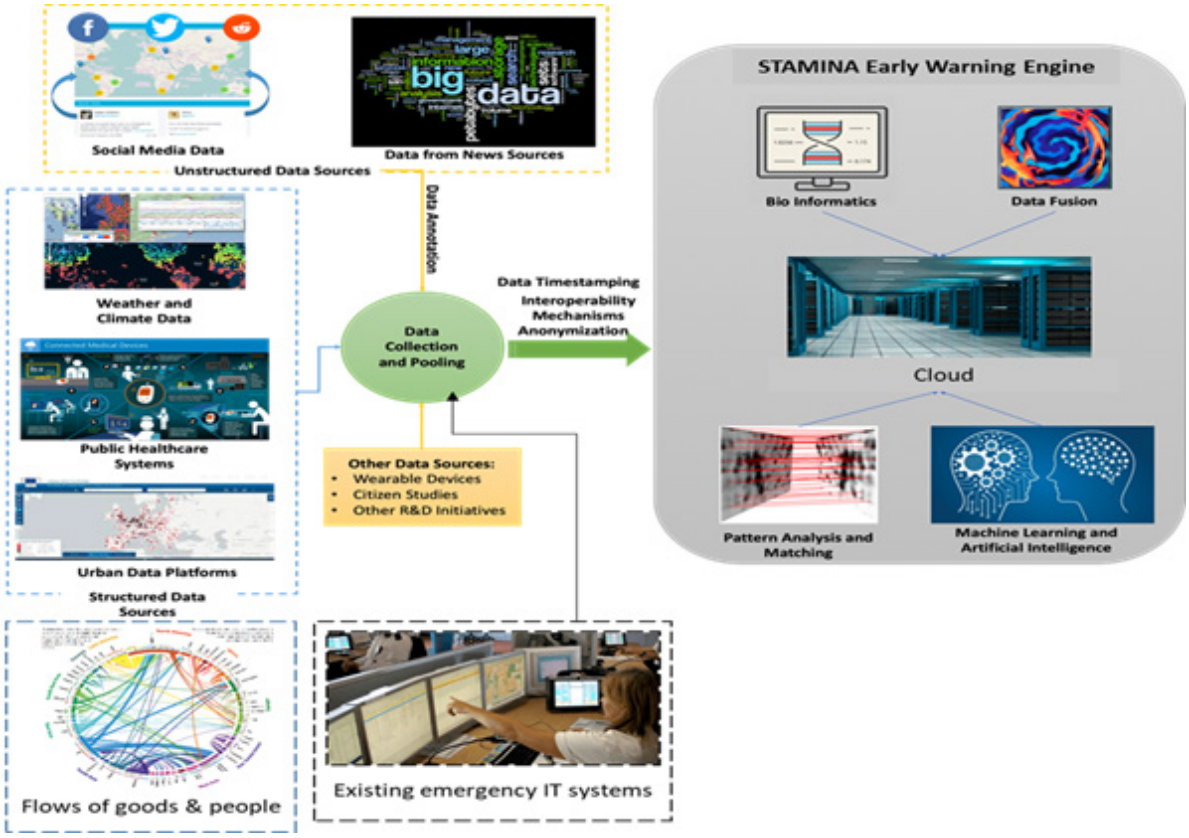


Figure 9: Alternative visualisation option showing a graph

Discussion and Conclusions

The COVID-19 pandemic has shown that many public sector organisations were not adequately prepared for crises of that scale. LEAs have faced challenges unparalleled with anything that they had to deal with prior to the pandemic. The fast pace of change of rules, the lack of public trust, the appearance of new patterns of criminal activity were some of the challenges that LEAs faced during the pandemic. Further, they had to adapt rapidly to new ways of communication with other emergency services.

Nonetheless, the current pandemic provided an opportunity to better understand our strengths and weaknesses and therefore identify ways to improve our practices. But, have we learnt the lessons? Are we prepared for the next big crisis? What actions can we take to improve our practices? To address these questions, PLV participate in R&D activities and advocate knowledge-sharing and innovation.

Such an activity is the EU STAMINA project that offers a set of IT tools that facilitate the performance of the LEAs' functions. It is necessary to use IT tools that facilitate the organisation and management of information among the different first responders in order to be able to provide a comprehensive response to pandemic crises. Adequate communication between the administration and citizens is a fundamental factor in maintaining public safety. Having IT tools with models that define the scope and spread of the disease allow police forces to take decisions in the most effective way. Having systems that analyse data and can warn of a potentially dangerous situation allow first responders to anticipate and minimise the effects of the crisis.

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