This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 607881

Petty cRiminality diminution through sEarch and Analysis in multi-source video Capturing and archiving plaTform

Instrument: Research and Innovation Action
Thematic Priority: FP7- SEC - 2013.7.2-1
Grant Agreement: 607881

Trials results evaluation

Deliverable Number	D5.2
Title	Trials results evaluation
Version	1.0
Date	14 May 2016
Status	Final version
Dissemination Level	PU (Public)
Nature	Report

EC Distribution

Project Partners: Vicomtech-IK4 (VICOM); Kinesense (KS); Aditess (ADI); Future Intelligence (FINT); Center for Research and Technology Hellas (CERTH); Center for Security Studies (KEMEA); Societa Reti e Mobilita (SRM)

Contributors: Main: Georgios Kioumourtzis (KEMEA)
Others: Vasilios Kasouras (KEMEA), Liza Charalampous (ADITESS), Mauro Borioni (SRM), Sarah Doyle (KINESENSE), Anargyros Sideris (FINT)

Document Control

Version	Date	Author	Modifications
0.1	10/03/2016	Georgios Kioumourtzis	Definition of TOC
0.2	15/04/2016	Georgios Kioumourtzis	Inputs in Sections 1,3,4
0.3	18/04/2016	Georgios Kioumourtzis Mauro Borioni	Finalising Sections 1,3 and 4
0.4	25/04/2016	Sarah Doyle Anargyros Sideris	Inputs in Section 5 Finalising Section 2
0.5	06/05/2016	Ethical Advisory Board	Finalising Section 6
1.0	14/05/2016	Georgios Kioumourtzis	Final version based on internal review and quality procedures

Table of contents

Annexes

Tables

Figures

1. Overview

The DoW describes this deliverable as:

D5.2) Trials results evaluation: This deliverable will provide post validation and evaluation of feedback from the end users during the trials.

The aim of this document is to provide the results and the end-user feedback of the two project trials that were conducted in Athens, Greece on 25th of February and Bologna, Italy on 31st of March 2016.

The rest of the document is composed of the following sections:

- Section 2 Trials Installation: In this section, we provide details on the installation of the solution in both trial sites to provide the reader with insights on the trials' environment and the technologies in use.
- Section 3 End-user Participation: In this section, we provide an overview of the participation of various organisations in both trials.
- Section 4 Trials Results: In this section, we provide the results of the trials, summating end-user feedback from the structured questionnaires prepared specifically for the trials.
- Section 5 Recommendations for Future Enhancements: In this section, we provide a set of the most important recommendations made by the end-users and the consortium partners of the P-REACT components that need further development, towards a ready to market product.
- Section 6 Ethics and Data Privacy: In this Section, we provide the observations made by the Ethics Advisory Board (EAB) in both trials related to the level of compliance with the ethics and data privacy provisions along with the EAB recommendations
- Section 7 Conclusion: In this section, we conclude the document with the main findings of the trials results.

2. Trials Installation

In this Section, we provide details on the installation of equipment in both trial sites for the reader to get a better understanding on the trials' environment and the technologies in use. In summary, in both trial sites a set of Embedded Systems (ES) was installed for detecting the petty crime events that were described in the use cases scenarios. All ESs were connected to P-REACT's cloud via 4G mobile technology. Finally, it is noted here that the installation of the ESs at the trial sites was based on an "ad-hoc" fashion, as several challenges, ranging from technical issues (4G availability to administrative issues such as permission to activate the ESs) had to be tackled on the spot.

2.1. Athens Trial

The Athens trial was performed in two distinct sites, namely the KEMEA's coffee shop and the gas station located at a Police campus few kilometres from KEMEA. At the former, the glass breaking and break-in events were tested whereas in the latter a scenario implementing a robbery event was carried out. For each site an indoor and an outdoor Embedded System (ES) unit was utilised. The indoor units were to detect the pre-mentioned events whereas the outdoor ones were used for capturing the criminals' escape. Each unit was exploiting a 4G module for connecting to P-REACT's cloud.

2.1.1.Coffee-shop

Inside the coffee-shop the indoor unit, depicted in Figure 1, was installed on the wall opposite to the door used as an entrance/exit from the actor performing the burglar. This indoor unit was comprised of one embedded device, one USB camera, one USB mic (included in the camera) and one wireless USB module used to connect to the 4G module that was acting as the indoors unit gateway to the P-REACT cloud. Outside the coffee-shop the outdoor unit, depicted in Figure 2, was installed on top of a metal grid that was above the coffee-shop yard. The outdoor unit was comprised of two network (RTSP) cameras, two embedded devices and a 4G module, all of them placed inside a protection case. Both the embedded devices and the cameras were connecting to the same local network, provisioned from the 4G module. Each embedded device was paired with one of the network cameras; one pair was used for carrying out the trial whereas the other was used as a backup.

Figure 1 – ES Indoor Unit (Coffee Shop)

Figure 2 - ES Outdoor Unit (Coffee Shop)

2.1.2.Gas Station

Gas station's indoor unit, depicted in Figure 3, was installed on the wall opposite to the clerk's office. This indoor unit was comprised of one embedded device, one USB based *kinect*[1] camera and one USB microphone. All the sensors were connected to the ES that in turn was utilising an Ethernet cable for connecting to the 4G module that was acting as the indoors unit gateway to the P-REACT cloud.

[1] https://msdn.microsoft.com/en-us/library/hh438998.aspx

Outside the gas station, the outdoor unit depicted in Figure 4 was installed on a metal fence. The outdoor unit was identical to the one used for the coffee shop case. The unit's cameras were covering the gas station's office entrance and the fuel pumps. It is noted here that in this site the 4G network was providing low networking capacity that was increasing the Clips upload time and therefore was also increasing the system's overall response time. This was partially addressed with lowering the clip-data encoding rates.

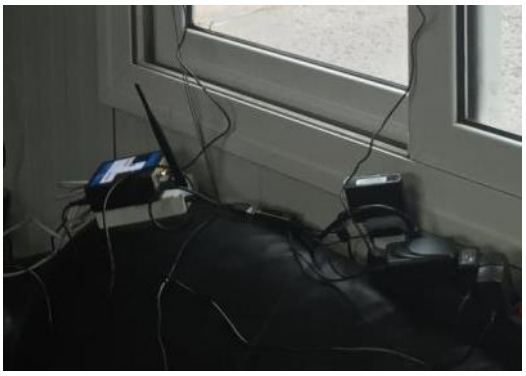

Figure 3 - ES Indoor Unit (Gas Station)

Figure 4 - ES Outdoor Unit (Gas Station)

2.2. Bologna Trial

The Bologna trial was performed at TPER's (the company in charge for providing the public transport service in the city of Bologna) bus depot. There three events were tested, namely the fighting, the bag snatching and the graffiti. A bus station was used for the first two events whereas a stationed bus was used for the last event. For all cases outdoor Embedded System (ES) units (identical to the ones used for Athens trials) were utilised. Each unit was exploiting a 4G module for connecting to P-REACT's

cloud.

2.2.1.Bus station

The outdoor unit was installed on a metal pillar with its two cameras facing diagonally the bus station (Figure 5). As already mentioned, the outdoor unit was identical to the ones used in Athens, but in this trial the second pair of embedded device and camera was used for live streaming the event to the control room where the participants were seated. This was feasible because the 4G network in the bus depot was providing sufficient network bandwidth (~4.5Mbps for each one unit).

Figure 5 - ES Outdoor Unit (Bus Station)

2.2.1. Stationed Bus

In this case, the outdoor unit was installed also on a metal pillar with its two cameras facing the side of the stationed bus (Figure 6). As in the bus station cases, the second pair of embedded device and camera was used for live streaming the event to the control room where the participants were watching the trial. A protective film was applied on part of the bus in order to avoid any damage during the graffiti scenario.

Figure 6 - ES Outdoor Unit (Stationed Bus)

3. End-User Participation

In this section, we provide profiles of end-users that participated in both trials. The consortium made an effort to invite key influencers, potential users, and future buyers of the P-REACT solution.

3.1. End-Users in Athens Trial

The Athens trial took place in two different locations. The first one, a small coffee shop, was located inside the campus of the Ministry of Citizen Protection, in the urban area of the city of Athens. KEMEA offices and control room were located in the same campus. The second location to simulate the gas station theft was located in a Police campus, few Kilometres from KEMEA.

The trial in Athens concentrated on use cases in indoor environments, considering petty crimes in small shops and gas stations. The main scenario involved a break-in in a small coffee bar and assault in a gas station, as two of the prominent issues identified by retailers.

Real time notifications of the incidents transmitted to P-REACT control room with the use of P-REACT cloud management technology.

The invited experts and project partners were accommodated in the KEMEA conference room where presentations were given about the P-REACT concept, technologies and trial scenarios. After that, all experts watched the trials in the KEMEA control room, which had all required infrastructure and IT services for the trial execution, including a pair of projectors, video wall screens, white boards, large size touch screen etc. The control room fully supported all trial phases.

In relation to external experts, the consortium invited stakeholders from organisations familiar with the trial scenarios, including security companies, Police departments, shop owners associations, representatives from Municipalities and the public sector etc. There were eighteen (18) representatives from twelve (12) organisations, as shown in Table 1.

Participant Organisation	Business Area	Country
Pyrsos Security	Security Company	GR
G4S Security	Security Company	GR
ICTS Hellas	Security Company	GR
International Athens Airport	Transportation Sector	GR
Athens Traders Association	Commercial Association	GR
Athens Urban Transport Organisation	Security Company	GR

Participant Organisation	Business Area	Country
Attika Prefectural	Public Administration	GR
Hellenic Police– ENLETS NCP	Law Enforcement	GR
CYTA S.A Cyprus	Telecommunications Company	CY
Cypriot Police – ENLETS NCP	Law Enforcement	CY
Bulgarian Ministry of Interior – ENLETS NCP	Public Administration	BG
Spanish National Police – ENLETS NCP	Public Administration	SP

*Table 1 - **Participant Organisations in Athens Trial***

3.2. End-Users in Bologna Trial

The final P-REACT trial was conducted in Bologna, within a bus depot area managed and operated by TPER (the company in charge for providing the public transport service in Bologna). TPER provided a bus and a bus station to be used for the trials, and all required logistics support and equipment. Three different use cases were successfully tested in a restricted area, to check and demonstrate the effectiveness of the P-REACT platform in detecting and managing typical anti-social behaviours and petty crimes in the transport sector. People fighting at the bus stop, a bag snatching at the bus stop and graffiti on a parked bus were staged by actors and duly detected by the P-REACT.

Live videos from the trial area were viewed in the Control Room arranged in the SRM premises, where more than 40 targeted stakeholders and potential end-users coming from public authorities, law enforcement, security agencies, transport companies and operators, researchers and developers, were introduced P-REACT and had the opportunity to attend the trial with real time videos showing the action underway. The meeting, and the rich panel discussion that followed the test demonstration, represented a fruitful opportunity for project partners to thoroughly describe the potential of the platform and the benefits of its implementation in a real world scenario.

After the demonstration and the discussion, the P-REACT consortium received a first evaluation and feedback directly from potential end-users, coming from several business areas through a questionnaire.

More specifically, the 43 attendees came from 17 organisations (Table 2): organising and public authorities (16 representatives), law enforcement and security agencies (7 representatives), transport companies and operators (4 representatives), researchers and developers (15 representatives), and communication body (1 representative). This way, the project reached a number of public and private bodies coming from different business areas, all of them potential end-users of the P-REACT system.

The participation in the meeting of such a multidisciplinary panel, and in the related panel discussion, was very productive and insightful for the project. Indeed, they actively contributed describing their main requirements and asking several questions about the solutions function and operation, from a technical and work practice point of view. As a result, the project partners had the opportunity to go deeper into the description of P-REACT platform and its potential applications in the real word. Additionally, feedback provided by attendees on the P-REACT platform has been very useful for fostering and addressing future development potential for full commercialisation. Indeed, as a result of the successful demonstration, some attendees showed their interest for a further evaluation of P-REACT, and requested future pilot testing.

Participant Organisation	Business Area	Country
ANAS	Motorway	IT
ATR Forlì	Organising Authority	IT
COTABO Taxi	Taxi Company	IT
Metropolitan City of Bologna	Public Body	IT
Polizia Municipale Bologna	Law Enforcement	IT
Polizia Torino	Police	IT
Researcher/expert on Ethics	Ethical Advisory Board	IT
SRM	Organising Authority	IT
Tecoms	SW developers	IT
TPER - PT Operator	PT Operator	IT
University of Bologna	University	IT
Vigilanza La Patria	Security Company	IT
Engineering	SW developers	IT
CYTA	Telecom	CY
ThePTA	Organising Authority	EL
Madrid Transport Operator	PT Operator	ES
Treelogic	SW developpers	ES

*Table 2 - **Participant Organisations in Bologna Trial***

4. Trial Results

In this Section, we present the results of the end user evaluation of the P-REACT solution, its components and performance in the field trials. A survey was completed by the end-users using the P-REACT trial questionnaire, which is part of Deliverable D5.1, Annex IV [1]. The sample of this analysis is based on fifty five (55) responses. In addition to this, a panel discussion with the end-users revealed interested points that were not covered by the questionnaire and are included in this analysis.

4.1. Intuitiveness

The results in this sub-Section are related to the overall framework of P-REACT, on its efficiency, speed and accuracy. Our general impression, based on the end-user responses, is that P-REACT as a concept is very well accepted by the end-users.

Q5: What is your first reaction to P-REACT?

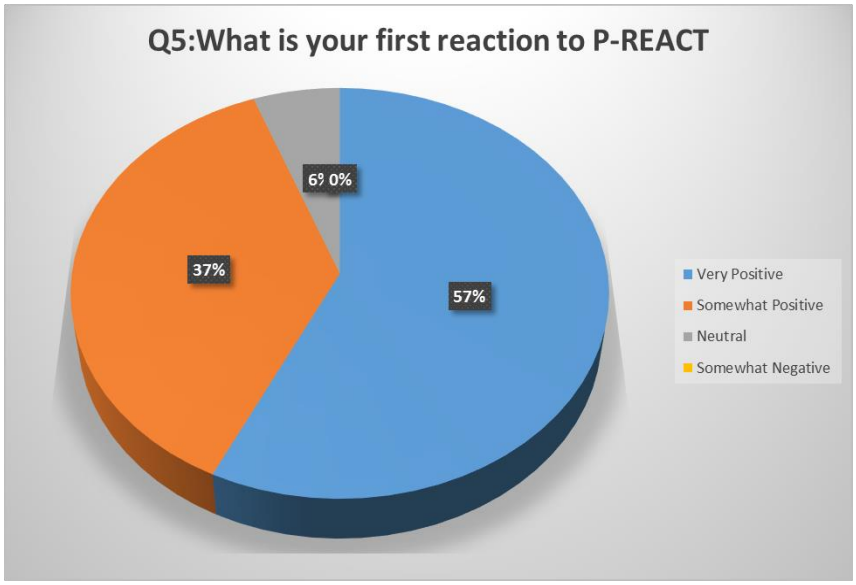

Figure 7 – Graph of obtained responses on Question-5

We can observe in Figure 7 that 90% of the end-users express a positive feeling for P-REACT regardless of their business area. There exists, however, a small percentage that seems not to be impressed by P-REACT. This is clear indication that P-REACT is well accepted by the majority of end-users.

Q6: How innovative is the P-REACT offering?

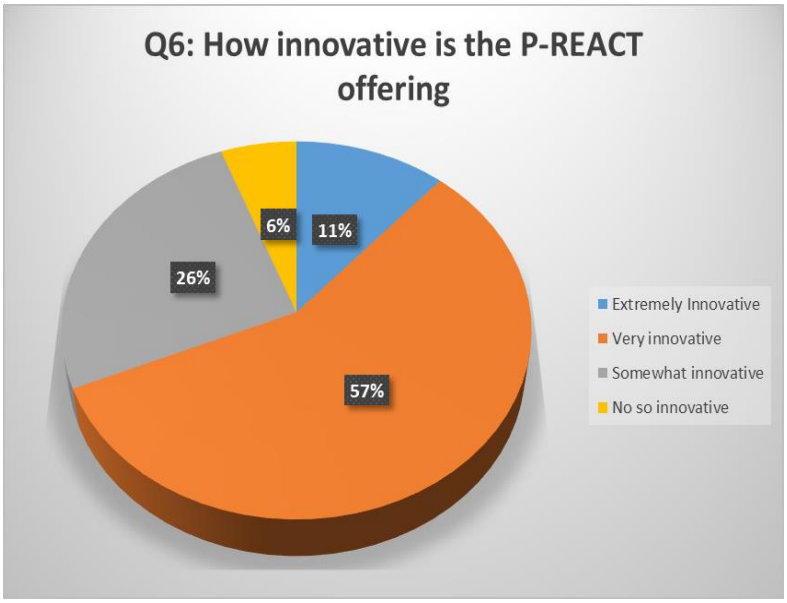

Figure 8 – Graph of obtained responses on Question-6

Almost 60% of the users find P-REACT a very innovative solution, with an additional percentage of 11% that find P-REACT an extremely innovative solution (Figure 8). This is again a clear indication that P-REACT is regarded by the end-users as a promising solution in the area of security and particularly in the area of surveillance systems. There exists, however, a 26% that just see P-REACT as "Somewhat innovative". Although questionnaires are anonymised we infer that the most sceptical end-users come from the area of security companies based on our discussions we had with the representatives of this target group. These companies are very familiar with such solutions in the market. Therefore, for the consortium is important to deeper investigate the specific needs of this target group (security companies) because these a key stakeholder in the supply chain who introduce new solutions in the market.

Q7: Do you agree that P-REACT could reduce petty crime in your business area?

Most of the end-users agree that any security system increases the level of security in any facility and as such, P-REACT would also increase security and also help crime prevention. However, many end-users indicate that only few cameras installed in a small number of shops or other facilities would not make the big difference from current systems and practices. They argue that P-REACT should seek for a greater installation in city areas, large shopping malls and other infrastructures and that the system should be controlled by security operators with direct link to Police. Therefore, a large P-REACT based surveillance system would increase security in an area, a small town or in a whole city.

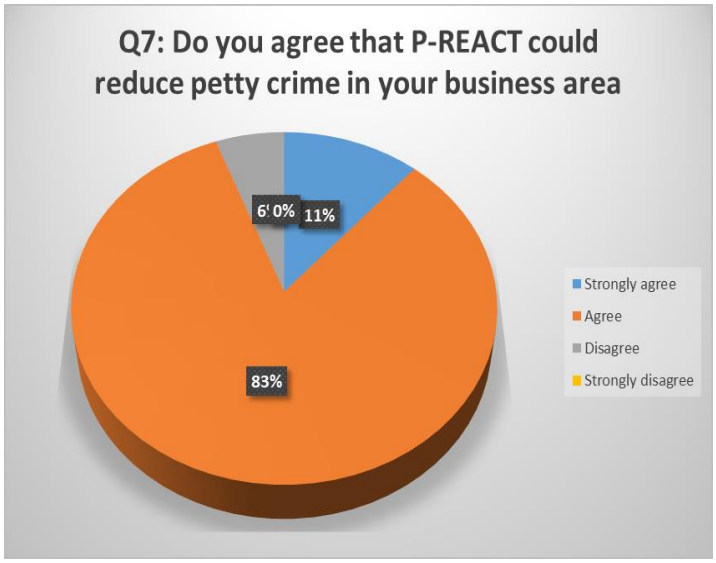

Figure 9 – Graph of obtained responses on Question-7

Q8: In your own words, what are the things that you like most about P-REACT?

In this question we have received a number of interesting comments and observations that we summarise below. The most interesting points are related to:

- P-REACT modular approach relating to the number of different video and audio analytics that can be installed in the embedded system.
- Turn normal cameras into "smart" ones by deploying P-REACT embedded system and algorithms.
- P-REACT simple interface (GUI), which is easy to use and learn.
- Classification of security alerts.
- Use of cloud computing for storage and further video analytics.
- Use P-REACT also as a forensic tool/post event tool for LEA's.
- P-REACT response time for detecting a threat, which was between 3-5 seconds in both trials.
- Real time notifications and view of video clips in the area of interest.

Q9: In your own words, what are the things that you would most like to improve in P-REACT?

A general assessment by studying the end-user responses in this question are related to system accuracy and its ability to respond to concurrent security events. It seems that at the current version of P-REACT, having multiple video generation for a single security alert (pre-alarm, current and post-alarm video clips) introduces high overhead from the operator's perspective when we consider that P-REACT

operator will have to manage multiple events at the same time. Another important comment is related to system accuracy, as video and audio analytics are tailored and calibrated to specific test cases. The end-users expressed the opinion that by extending the video and audio algorithms functions, the system could be used for other type of crimes including serious crime, except for the ones that were investigated by P-REACT.

Some of the specific responses are outlined below:

- It is important to integrate P-REACT with additional sensor technology (e.g. noise sensors, smog sensors, chemical sensors).
- Increase the accuracy of the system (low rate of false negatives and false positives).
- Object detection capabilities (important for the transportation sector).
- Testing P-REACT under low lighting conditions, bad weather and in crowded places.
- Consider to use P-REACT not only in fixed installations. Many vehicle fleets are already equipped with surveillance cameras, which could become P-REACT enabled.
- Ability of P-REACT to respond and follow-up with a number of simultaneous events.
- Consider to concatenate pre-during-post video clips on a single video per case.
- Consider to have all videos available on a 24/7 basis as foreseen in 99% of cases today.
- Consider audio triggering with "alarm words".
- It would be useful to have the possibility to fine-tune the algorithm for each camera depending on timing (lower alert level during the night) to avoid false positives.
- Consider local storage capabilities in the embedded system in parallel to video clip uploading to the cloud.
- Consider to replace USB interfaces by BNC so that the system could operate with current DVR systems.
- Grouping of IP cameras, based on location or installation.
- Drivers ready to install for various type of cameras.
- P-REACT should be ready to support a number of IP cameras (1000-2000).
- P-REACT to consider DOS attacks, especially for IP-enables cameras.
- Investigate deeper if the current legal framework permits storage of video clips in a cloud infrastructure.

4.2. Usability

In this sub-Section we provide the results on a more technical/user-experience basis. This will provide P-REACT partners a better understanding on the needed functionality towards a future evolution of the system. A general assessment is that at its current phase P-REACT, although a prototype, supports a rich set of functionalities as seen by the end-users. They suggest, however, additional functionalities in order for P-REACT to become a business-ready commercial product. The most important observations are related to GUI customisation based on user profiles, the possibility to configure alerts not only on the platform but also on other devices (e-mail, sms, etc.), and the ability to offer a costumer tailored solution.

In the following paragraphs we present the results based on statistical analysis.

Q10: The P-REACT system works the way I expected it to work

We can observe in Figure 10 that 70% of the responses express the feeling that P-REACT operated in a way that end-users expected, based on P-REACT presentation prior to trials. However, almost one third of the end-users (29%) do not agree that P-REACT operated in an efficient way. This is almost the same percentage we have seen previously in Question 6 and probably comes for the same end-user group (security companies).

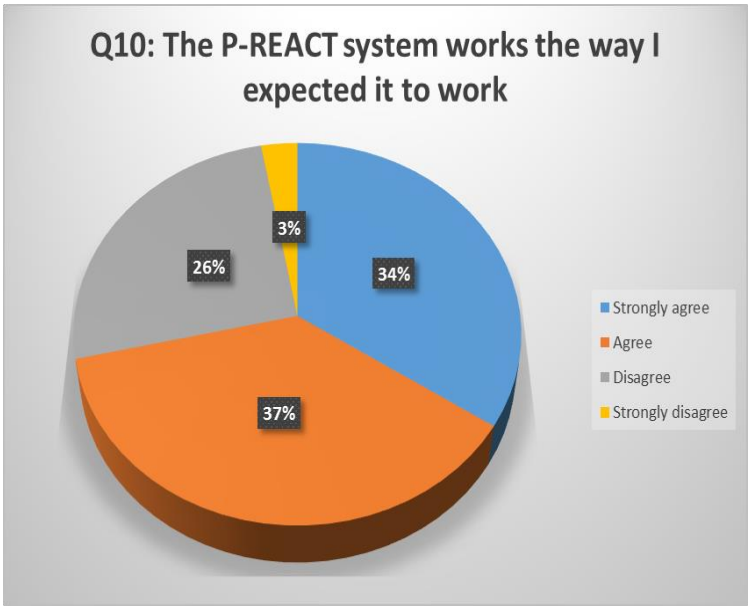

Figure 10 – Graph of obtained responses on Question-10

Q11: The P-REACT end-user interface is generally easy to learn how to use

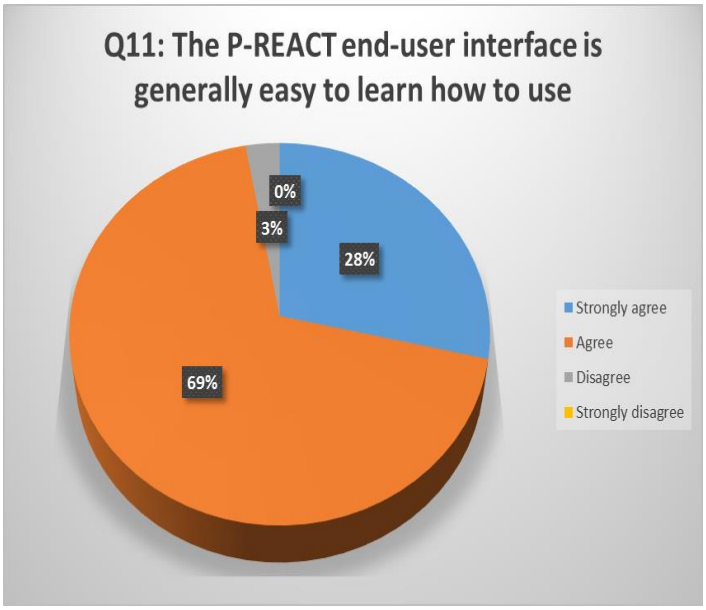

Figure 11 – Graph of obtained responses on Question-11

The majority of end-users (97%) find the GUI as a simple and easy to use interface (Figure 11). This is a clear indication that P-REACT GUI is comparable with available commercial products and in many cases even better. There are some minor improvements that can be done and most of them are related to the ability of P-REACT to reconfigure and add more functionalities based on the end-user business area. This is illustrated in the following question.

Q12: I think the P-REACT's user interface is (please tick all that apply)

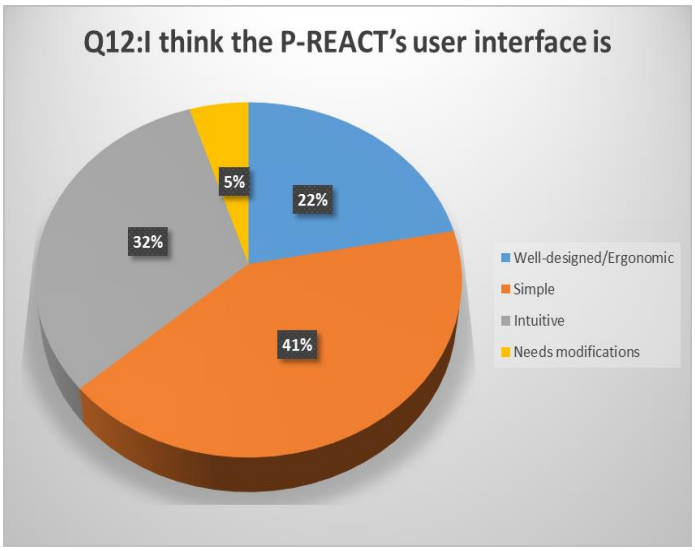

Figure 12 – Graph of obtained responses on Question-12

We confirm again with this question (Figure 12) that P-REACT GUI is very well accepted by the end-

users (95%). A small percentage (5%) of the end-users feel that it needs modifications. From the open panel discussions the end-users indicate that these modifications are mainly related to GUI customisation based on end-user business area.

Q13: I find the information provided by P-REACT to Control Room to be

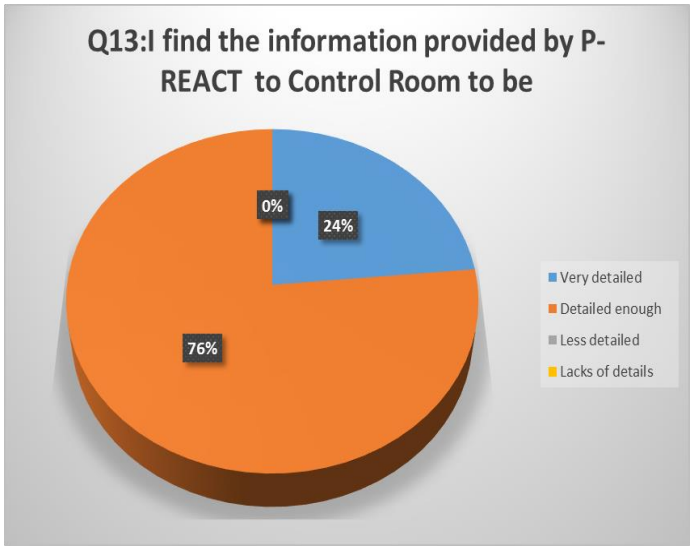

Figure 13 – Graph of obtained responses on Question-13

The responses in this question verify the consortium observations in both trials. We have received excellent comments on the way information is presented to P-REACT operator. There are, however, areas for improvements that are related to dispatching of identified threats to another operator and the ability to create cases files for easier observation and follow-up of an alert. And indeed, this is an important attribute in Decision Support Software (DSS) tools.

Q14: I find the P-REACT's responsiveness to be

It was obvious during the trials that P-REACT response was depending on network conditions. In the Athens trial, 4G network was slower than in Bologna and as a result the end-to-end network delay was much higher. There have been cases in which it took 5 minutes for a video clip to "reach" the control room during the Athens trial. In the Bologna trial this delay was between 5 and 7 seconds. However, the time needed for P-REACT to identify a threat was in the range of seconds, in both trials.

Despite network delays, all end-users expressed that P-REACT response time to identify a threat and to provide notifications to control room was very satisfactory (Figure 14). We expect though that P-REACT connectivity will be mostly based on fast wired data networks with higher capacity than existing 4G networks. New advances in mobile network technologies (4G+, upcoming 5G) will further favour P-REACT's response time.

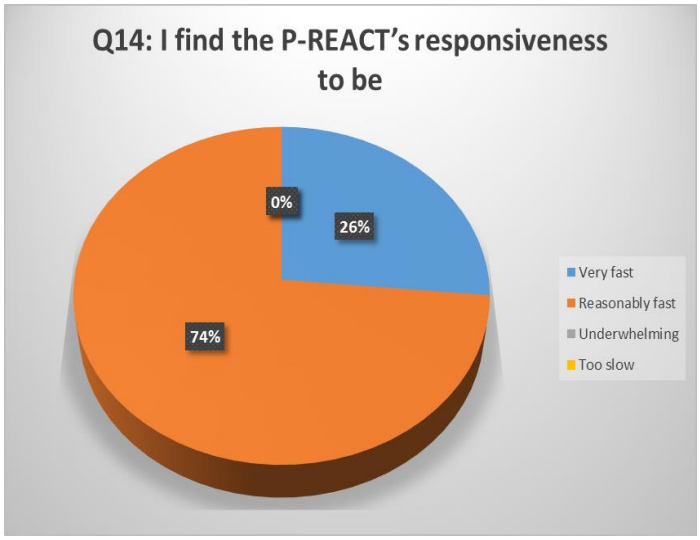

Figure 14 – Graph of obtained responses on Question-14

Q15: Did you encounter errors during the P-REACT use in the related pilot scenario?

One could argue that P-REACT performance in the live field trial was a direct result of multiple field tests, during the integration and testing phases, and that the errorless performance of P-REACT was a direct result of those extensive tests. However, a live field trial for a prototype is always an error-prone procedure and as a matter of fact we would expect P-REACT to introduce even minor errors during the live trials. In contrary, P-REACT performed extremely well and did not introduce any error. To confirm this behaviour, in the Bologna trial the consortium run an additional test case that was given by the end-users in the control room. Therefore, we are not surprised that the end-users did not observe almost any error in the P-REACT system during the trials (Figure 15).

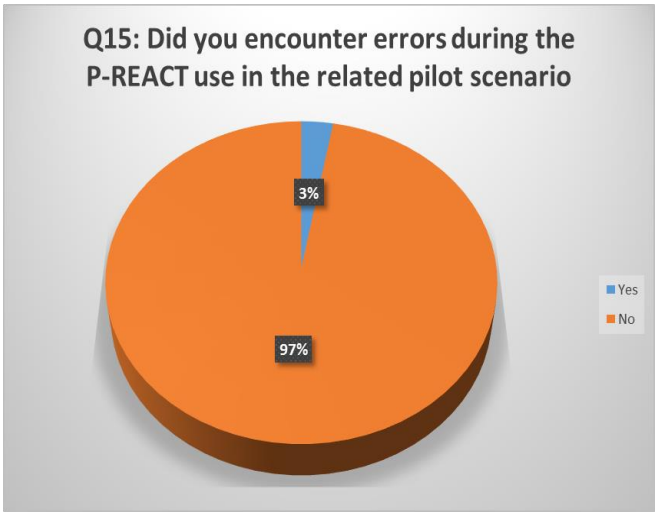

Figure 15 – Graph of obtained responses on Question-15

Q16: Overall, I find P-REACT to be

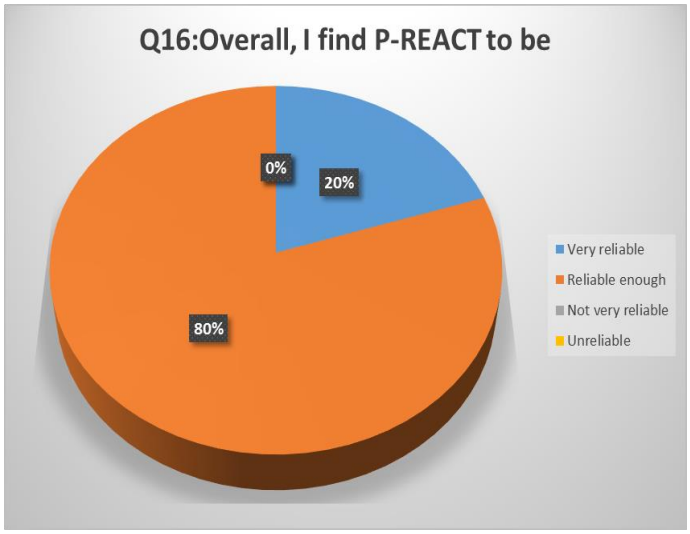

Figure 16 – Graph of obtained responses on Question-16

This question confirms the results in the previous Question15. The vast majority of end-users regard P-REACT as a very reliable solution (80%) with an additional 20% to regard P-REACT as a very reliable solution (Figure 16).

Q17: Could you rank please the following features of P-REACT in terms of usefulness?

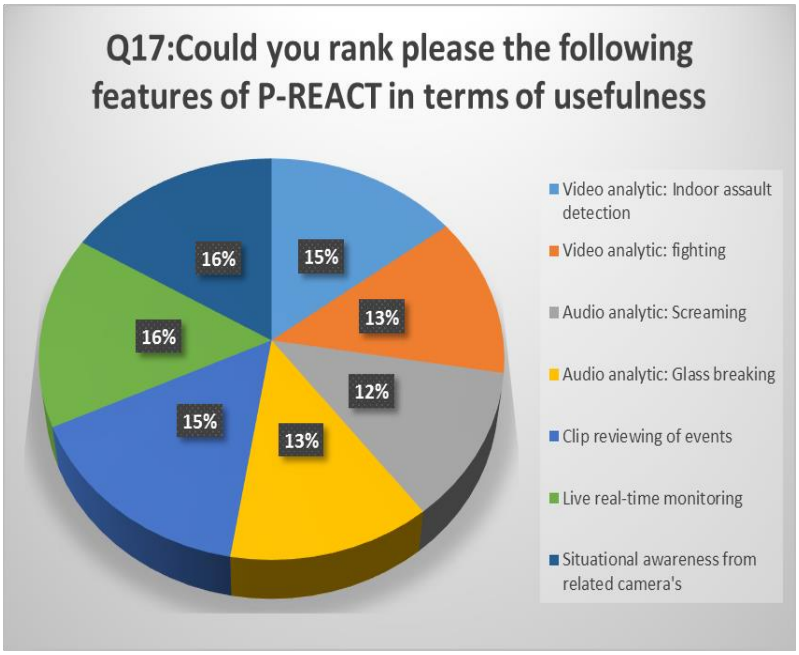

Figure 17 – Graph of obtained responses on Question-17

This question related to overall assessment of the P-REACT features and individual components. We

can observe from the obtained responses (Figure 17) that all P-REACT features/Components receive almost an equal percentage between 12% and 16%. In the panel discussion the end-users indicated scalable cloud computing storage of selected video clips related to specific security events as an additional advanced feature of P-REACT.

Q18: What other information or functionality would you like to see in P-REACT?

With this question we discovered very interesting points from the responses of the end-users. It is obvious that most of the end-users want to see how new security products can combine widely used devices (e.g. smart phones), which can extend the coverage of the surveillance area. Another interesting point is related to metadata analysis of video clips in order to extract useful data like crime-maps and other related statistical information. This data is considered very important not only for LEAs but also for business intelligence and public administration.

Following, we report all the responses below:

- P-REACT cameras in some cases should be able to have also track and follow-up capabilities (e.g. Person Of Interest - POI)
- P-REACT should be able to install inside trains, buses, taxis.
- Use of P-REACT metadata for crime analysis and statistical purposes.
- Examine on how P-REACT could be integrated with other Automatic Vehicle Location (AVL) Systems in Police cars.
- P-REACT should provide functionality and mobile Apps to connect with smart phones
- P-REACT should be able to receive video feeds from wearable cameras of security personnel

Q19: Do you have any further comments about P-REACT usability?

This question is related mainly to P-REACT usage and the targeted business area. Some end-users suggested that P-REACT should be introduced to cover security in stadiums for sport events with embedded video and audio analytics and some of them could see P-REACT as a global solution, interconnected to Police or owned by Police to provide surveillance services in a city. In our opinion, these suggestions are beyond the current functionality of P-REACT and sound very ambitious. This probably could be investigated only if external funding is in place for the further development of the system.

4.3. Business Model – Marketability

This is an important part of the P-REACT evaluation and is particularly designed to aid the consortium in

the exploitation of project results and a possible market exploitation of P-REACT. Our general sense, based on the end-user responses, is that there is a real market opportunity if the consortium or individual partners decide to invest more on the evolution of the system. Any further development should take into account IPR agreements made in the consortium GA. Other funding opportunities, for extending the research made within this project, can be found in HORIZON 2020 financial tools and specifically within the "Fight against crime and Terrorism" research area, the Fact Track Innovation (FTI) area and the HORIZON 2020 SME Instrument. However, this discussion will be covered in P-REACT Deliverable D6.4 “Final Exploitation and Standardisation Plan”, which is under development.

Following, we provide a statistical analysis based on end-user responses:

Q20: If P-REACT were available today, how likely would you be to buy it?

We can observe in Figure 18 that there is a real customer interest for P-REACT when we consider that almost the 1/3 of the responses state that if the P-REACT were available today they would buy it. However, we consider these responses just as an indication; further market studies and analysis will provide more accurate results. As many end-users express, during the trials, the will to have a P-REACT pilot installation in their premises we can infer that the consortium could work towards this direction. For the time being, the consortium has been working on a short list with the most promising end-users in order to examine the opportunities and the requirements for P-REACT pilot installations. The results will be reported in Deliverable D6.4 “Final Exploitation and Standardisation Plan”.

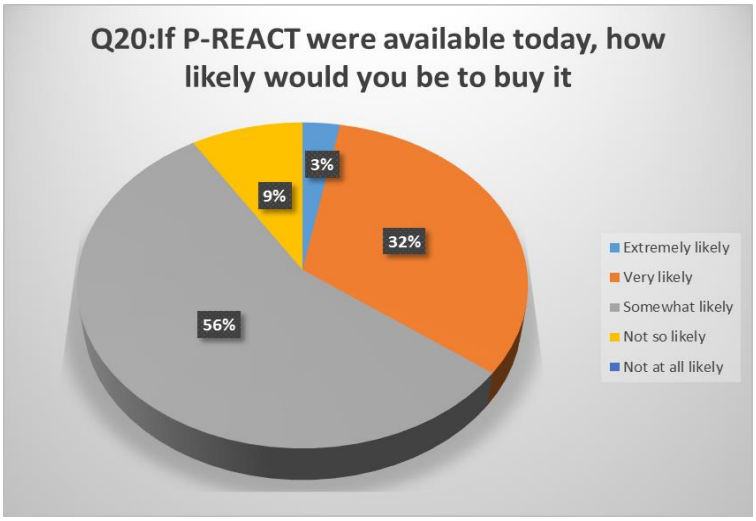

Figure 18 – Graph of obtained responses on Question-20

Q21: If you are not likely to buy P-REACT, why not?

Although, there is a 9% that state it is not likely to buy P-REACT the end-users provided no justification. That means they could not precisely justify their decision; most probably those end-users are not related

to any potential business area that P-REACT targets.

Q22: How would you rate the P-REACT solution in terms of competitive offerings you are familiar with?

The end-user opinion in this question favours P-REACT, when we consider that it is just a prototype and not a business-ready solution. However, P-REACT grasped the interest of the end-users based on innovative architecture and the use of alerts with video and audio analytics algorithm at the camera level. This is the reason why almost 60% (Figure 19) of the end-users state that P-REACT is somewhat or much better than other existing solutions. Again, this is strong point for the consortium to base the future evolution of P-REACT.

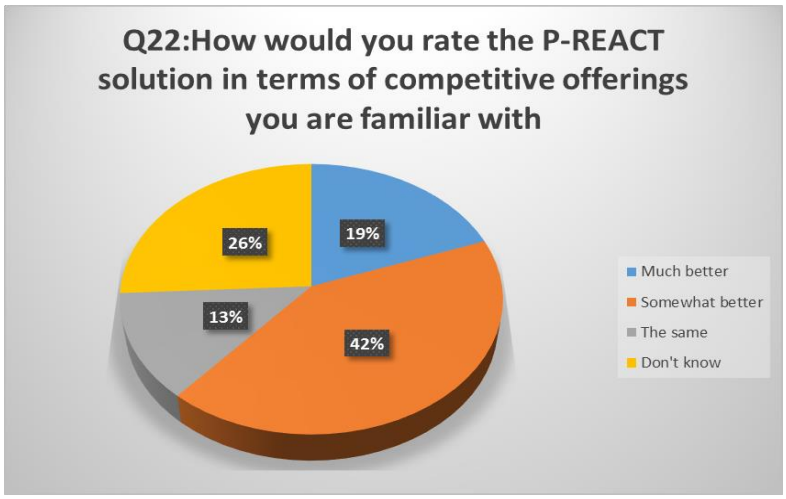

Figure 19 – Graph of obtained responses on Question-22

Q23: If you were to buy the P-REACT solution, how many cameras would you need to monitor?

The outcome of this question is directly linked to the profile of end-users. Half of end-users are interested in a large deployment (between 100-1000 cameras) and the rest are interested in smaller deployments. This is another indication when combining the results of Question 19, in which P-REACT is seen by many end-users as a solution for wider area surveillance, and confirms results obtained in previous responses.

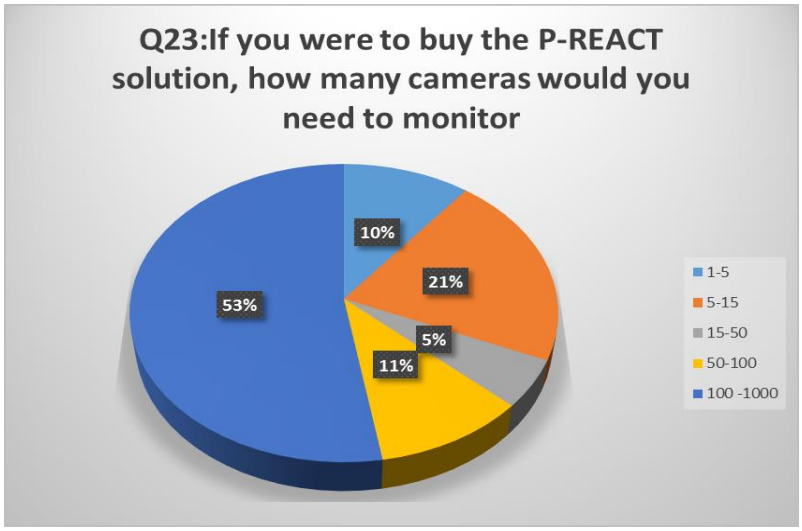

Figure 20 – Graph of obtained responses on Question-23

Q24: If you were to buy the P-REACT solution, what would you be interested in purchasing? Please tick all that interest you

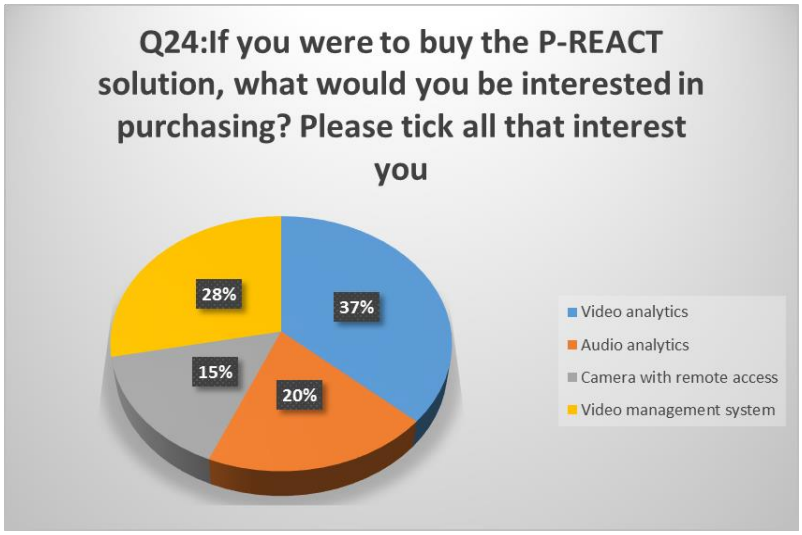

Figure 21 – Graph of obtained responses on Question-24

In appears in this question that the majority of end-users are mostly interested in video analytics, while P-REACT Video Content Management Software (VCMS) takes the second position followed by audio analytics. Form our discussions with end-users and related research, video analytics stand as the weak point in all current surveillance systems, while current video content management tools are very expensive. Therefore, the end-users response really concentrate on existing gaps in current technological solutions in video surveillance.

Q25: If you were to buy the P-REACT solution, would you want it integrated with your existing surveillance system:

The absolute majority of end-users state that they would integrate P-REACT with their existing surveillance systems. This is strong indication that P-REACT should seek not to antagonise with existing solutions but rather to augment them with additional functionalities and business logic. This has both route to market and development implications.

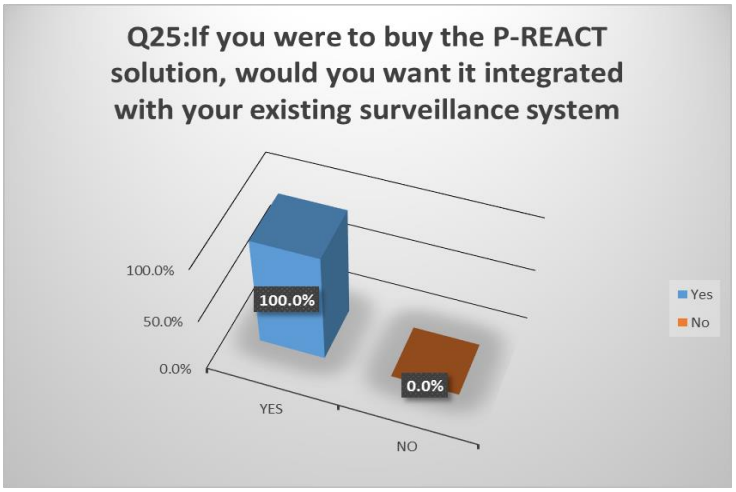

Figure 22 – Graph of obtained responses on Question-25

Q26: If you were to buy the P-REACT solution, how would you like to pay?

Almost 80% of the end-users prefer to pay yearly licence fees rather than ownership of a complete P-REACT system. This depends mainly on the specific business profile of end-users. Security companies would rather prefer ownership of a P-REACT system in order to provide security solutions to their customers, while an operating company of the transport sector would prefer a yearly fee per camera. This is further elaborated in the next question.

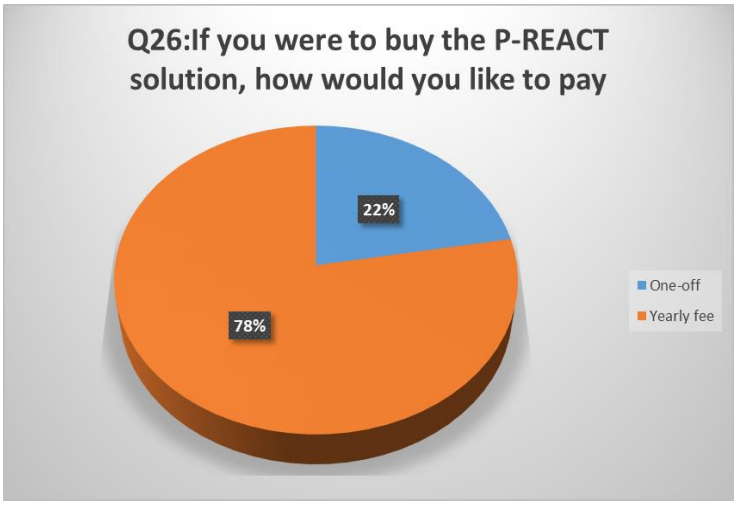

Figure 23 – Graph of obtained responses on Question-26

Q27: How much would you expect to pay for a solution like P-REACT per camera per year?

The obtained answers in this question provide important information for the P-REACT Exploitation Plan. We have observed in a number of questions that many end-users see P-REACT as a global solution for wide area surveillance. When we combine the answers of this question with the ones in questions 19 and 23 we can even be able to make a rough estimation of P-REACT annual turnover. What is more, those customers with P-REACT services would be even willing to pay for having additional functionalities and features (new video and audio algorithms, business logic tools, new VCMS features etc.)

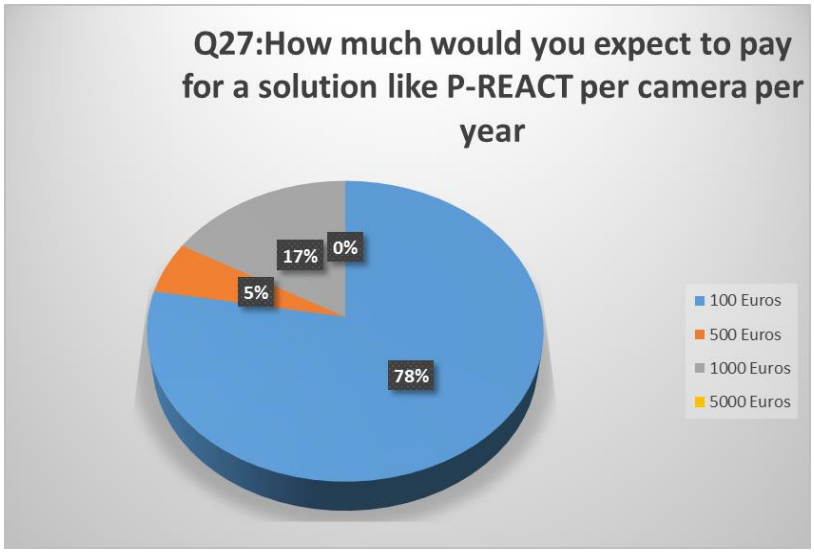

Figure 24 – Graph of obtained responses on Question-27

Q28: How likely is it that you would recommend P-REACT in a friend or colleague?

Not at all likely Extremely likely

0	1	2	3	4	5	6	7	8	9	10

We can observe from the obtained responses (Figure 25) that almost 70% (combined rating of 8, 9 and 10) of the end-users stated that they would possibly recommend P-REACT. This is again a clear indication of the P-REACT acceptance and confirms previous observations and comments for the market potential of the project.

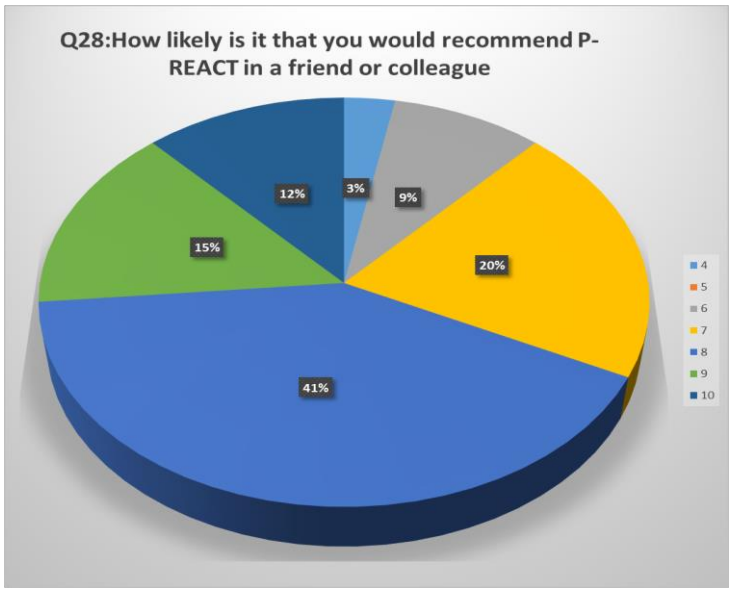

Figure 25 – Graph of obtained responses on Question-28

4.4. Summary

In this section, we provide a short summary of the results covered in the previous sections, as follows:

P-REACT was perceived by end-users as an innovative solution that offers new capabilities and features that are missing from current surveillance systems. The combination of video and audio analytics at the camera level, scalable cloud storage, VCMS solutions and the advanced P-REACT GUI make P-REACT a very attractive solution in a large number of application areas.

P-REACT is seen as a global solution to cover even large urban areas and/or whole towns and cities. It is also able to provide additional intelligence based on video and audio metadata like crime maps, business intelligence, and forensics capabilities for crime investigation and prosecution, and as a result reducing crime rates and enables LEAs for better human resource management.

P-REACT can be regarded as a TRL 5/6 level product after the demonstration of the system in relevant operational environment, in two countries (Greece and Italy), under different test cases and IT infrastructure.

There exists a real market potential for P-REACT, as it was expressed by many end-users participating in the project trials. Many of them raised their interest to have P-REACT installed and operating in their premises under a pilot programme.

Additional funding is required, however, so that P-REACT can become a customer-tailored solution with

a real market potential although many advanced solutions do exist in the market.

5. Recommendations for Future Enhancements

Overall the P-REACT feature set are market ready and would be easily adopted by the market. There are a number of features that have been outlined by end-users as desirable. Furthermore, certain enhancements would make the solution more rapidly adopted by the market due to the current surveillance infrastructure and supply chain evident in the market. The key recommendations for future enhancements are outlined below.

- **Interoperability with existing surveillance infrastructures**
  One of the key end-user questions was "*can this solution use our existing camera infrastructure or do new cameras need to be added*?" One of the key aspects of the P-REACT solution is that it can be integrated with existing solutions to a large extent, but more work to make it plug&play is necessary. Furthermore, if alerts were to be displayed in existing control room software interfaces there would need to be a number of plug-ins with a large number of potential systems. The issue of dealing with alerts and the workflow around deferring or assigning a response would all require integration with other solutions.

- **Detection functions**
  It would be advantageous to add other detection algorithms to the solution to detect events indicative of other behaviours. In the P-REACT project, only a small number of the more prevalent crimes types were focused on. Additional ones could seek to address not only petty crime scenarios but also those indicative of serious or terrorism events. Some key algorithms that have been identified as useful include 'key word' and 'gunshot' audio detection, loitering, crowd formation, suspect tracking and camera heath check using video analytics.

- **Configurability**
  The algorithms developed for the use cases were designed to require as little configuration as possible. However, configuration is required and there is a requirement to make this as easy as possible for installers and end customers. Ideally, customers should also be able to turn on and off various new algorithms functions as it comes relevant for their organizations. This would mean that the P-REACT solutions could easily evolve to help in business operation management as well as security. Furthermore end-users have reverted to say that they would like various user access levels to restrict certain functionalities to certain users.

- **Scalability**
  The P-REACT solution has been designed to be scalable on all fronts, from adding more camera's to adding new algorithms. This needs to be tested on a large scale encompassing how the solution works in relation to working practices. Furthermore, a number of customers have expressed the interest in having 30-90 days cloud storage of their video so that they can access the video for general purposes or post incident should they require. They would also like to have remote live view. This would require the P-REACT solution to scale.

6. EAB – Final Recommendations

6.1. Introduction

The EAB considers appropriate, for the sake of clarification, to mention that twelve (12) Initial Recommendations were made [1] for the Consortium in order to ensure that the development of the project and the implementation of the architecture of the platform were conducted in respect of all the applicable ethical values and legal principles. These recommendations covered several relevant aspects regarding the processing of personal data within the life cycle of the project: conditions of informed consent, the scope and purposes of data collection, notice and rights of the individuals, uses of data collected, technical aspects and security.

The EAB monitored the implementation of the Initial Recommendations. In that sense, the Consortium provided the EAB with a set of Principles and Guidelines that rose from the results of the PIA and the implementation of the Initial Recommendations. These guidelines were presented as the implementation of the ethical and legal issues in terms of fundamental rights. The EAB proceeded to check the implementations of the previous work [2] and therefore the potential risks that had been dealt with. Although the EAB valued the efforts made by the Consortium to implement the initial feedback received from the monitoring tasks of the EAB, further information and small changes where still needed in order to ensure full respect of individual's rights.

The concrete needs where included in the Mid-term Recommendations that focused on: the purpose of data processing; the need to include technical measures to make impossible searching within the platform based on discriminatory features; the need to define the type of requests for access to data; and the cloud system, among others.

Finally, the EAB took the trials, developed during the P-REACT Project in Athens and Bologna, as the opportunity to check the implementation of the initial and mid-term recommendations in the actual platform. Furthermore, the possibility of checking how the platform works in real time allowed the EAB members to prepare the Final Recommendations. In order to do so, the EAB performed an exhaustive assessment of the implementation by the consortium of the EAB input during the development of the project[2].

The result of this assessment is the set of final recommendations that are presented in this document. These recommendations are focused mainly in the potential future exploitation of the P-REACT platform

[2] P-REACT Ethical Advisory Board Report (2016)

and the need to ensure that in that case it would be done in compliance with the data protection requirements as identified during the project. These final recommendations are structured on a set of specific recommendations and a summary of the internal and external control strategy proposed for the P-REACT platform.

6.2. Specific Final Recommendations

The EAB has identified the specific recommendations on the basis of: i) the general issues that affect the P-REACT platform as a whole and, ii) the different stages of the data processing and transfer that may occur within the platform.

6.2.1. General Issues

Access control

Recommendation 1: All access has to be restricted to specific bodies/ persons with specified tasks and duties. Accesses to the platform should be logged in detail.

Recommendation 2: In case of future exploitation of the P-REACT platform the EAB considers that a good strategy in order to mitigate risks related to the access to data is the appointment of an internal Data protection officer (DPO). A more detailed explanation of the proposal for a DPO in the P-REACT Platform can be found in section III of these recommendations. Furthermore, the entry into force of the new Data Protection General Regulation [3] means that the appointment of a DPO becomes mandatory in data processing contexts such as the case of P-REACT platform: article 35 of the Regulation establishes the need to appoint such a figure in several cases (public sector/private sector over 250 people/nature of the activities). The EAB considers that the P-REACT platform falls within the scope of article 35.

Recommendation 3: The EAB also recommends an external control trough periodical audits and the involvement of the competent Data Protection Authorities.

Data storage and retention

Recommendation 4: Although the overall measures adopted during the project are considered very positive, a risk mitigation strategy (appointment of internal DPO/external audits/consultation with national DP authorities) is strongly recommended for the scenario of a future exploitation of P-REACT. This strategy ensures that there is an appropriate control over the compliance with the rules on the storage of personal data and, that data retention periods are respected.

Notice and access rights

Recommendation 5: In case of future exploitation of the P-REACT platform and considering that different European and national data protection legislation may be applicable, the EAB recommends that the Consortium pays close attention to the specific requirements for each future deployment of the platform.

6.2.2. Stages of the data flow.

In order to identify all relevant risks within the P-REACT platform the EAB devised a visualization of the different stages of the personal data flow within it (Figure 26):

- The collection of data through cameras and embedded platform.
- Use of cloud.
- The possibility to activate other cameras in case of an alarm.
- The possibility to review the alarm.
- The rejection feature in the users' interface.
- The assignment feature in the users' interface.
- The potential transmission of data to third parties.

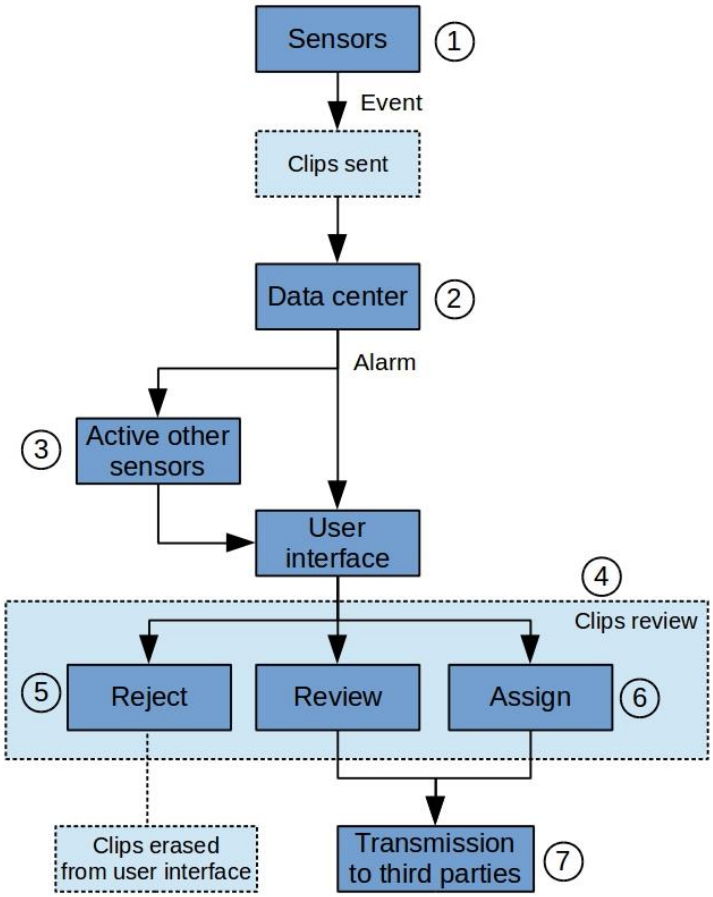

Figure 26 – Stages of data flow

Cameras and embedded platform

Recommendation 6: The complete colour, non-depth images should only be kept/ stored and used in case there may be a need for the use of the video for the purposes of investigation and prosecution of crime in compliance with the legal and procedural guarantees established by the applicable legal framework.

Recommendation 7: The potential scenarios of use of the P-REACT system is very wide and this means that the situation regarding the level of connectivity present at each site and each moment can vary highly from case to case. Therefore the developers of the platform have foreseen the possibility for the quality of the video being registered to automatically adjust to that level of connectivity, in order to ensure that the size of the video (that depends on the quality) allows for its transmission to the cloud without delays. The recommendation of the EAB is that the platform should set a minimum standard in video quality that would ensure that video analysis is not affected.

The cloud

Recommendation 8: Although the measures taken to address the risks associated to the use of cloud computing were adequate during the lifecycle of the project, it is important to take into account that the EAB recommends that such technical measures should be put in place as well in case of a future exploitation of the P-REACT platform. There are still concerns regarding the risks of security, subcontracting, transparency regarding the location, processing standards, security and transparency with regard to processing features towards the cloud customer.

Alarm: activation of other cameras

Recommendation 9: In relation to the capability of situational awareness that allows an alarm to activate other sensors, the EAB strongly advices the Consortium to define a protocol that clearly establishes the circumstances under which this interconnection of sensors is allowed.

Recommendation 10: This protocol should be elaborated in compliance with European and national rules concerning the responsibility of the data controller and the data processor (see for instance articles 22 and 26 of the General Data Protection Regulation), the rights of the persons and the specific requirements and guarantees provided.

Review of the alarm

Recommendation 11: The Consortium implemented a reliable digital logging system (register of all the interaction occurred within the platform) as requested by the EAB. This was verified by the EAB during the development of the trials. The EAB recommends that such a log system should be implemented also in case of a future exploitation of the platform.

User interface: rejection

Recommendation 12: The EAB recommends that the rejection option should be used to reduce the potential risk of false positives. In this sense the EAB recommends that a notification should be sent to the administrator of the platform when a user has rejected a video. The EAB considers that it may be useful to include the possibility for the user to provide information about the reason for rejecting the clip. That way, the administrator would have the possibility to check whether that is a false positive of not.

Recommendation 13: In case that the administrator detects that the clip is a false positive it should be erased to comply with data minimisation requirements.

User interface: assignment

Recommendation 14: The EAB remarks that the existence of the assign option should not be used to avoid the strict roles and permissions system. This option allows the user to assign a specific clip to

another user for review. When opening the assign option, only authorized users should appear as possible recipients of the assignment to review that specific alarm.

Transmission to third parties

Recommendation 15: The EAB recommends the definition of a clear protocol for the transmission of data to third parties defining lawful and proportionate processing purposes, possible/possibly regular (authorised) recipients, conditions for transmitting. In this regard it is necessary to distinguish between the different potential third parties interested in the data including, but not limited to LEAs, administrative authorities, and media.

Recommendation 16: Should the P-REACT platform be exploited it is recommended by the EAB, that in case of requests to access data collected by P-REACT, the internal Data Protection Officer should be consulted. This will allow mitigating the risks associated to the unfair transmission of data.

6.3. Summary of the Internal and External Control Strategy of the P-REACT Platform

In order to ensure that, in case of future exploitation of the P-REACT platform, the ethical and legal requirements- specifically those related to data protection- are met the EAB proposes and recommends the implementation of a control strategy, both at an internal and external level.

At an internal level the EAB reminds the Consortium the need to appoint a Data Protection Officer (DPO). This is a well-known figure in the context of public bodies that process personal data. It is defined by the European Commission as the person that is required to keep a register of all the processing operations on personal data carried out by the Institution which has appointed him/her. The new General Data Protection Regulation [3] further extends the responsibilities of DPO, defining her/him as the designated person, within an organization that collects the personal data of Union citizens, who is responsible for making sure that the organization follows the new regulations. Article 35 of the proposal contains the specification as to what are the cases in which a controller and processor of personal data is obliged to appoint such a figure. Among them, the third scenario is that of cases where "... the core activities of the controller or the processor consist of processing operations which, by virtue of their nature, their scope and/or their purposes, require regular and systematic monitoring of data subjects." This is the case with the P-REACT as video surveillance clearly falls within the scope of this scenario. Thus the EAB suggests that the roles and responsibilities of the DPO for P-REACT be consistent with the recently approved General Data Protection Regulation.

The role and the responsibilities of such a figure, as defined in article 37, are directed to the monitoring of the respect of data protection legislation by the controller of the data. The first role assigned to a data

protection officer is that of informing the controller or processor of their obligations regarding data protection. As proposed in the case of this strategy, this first role is that of an adviser that helps those responsible for the data in their strategies for compliance with the existing rules. The DPO is also granted an implementing role, as the person in charge of making sure that the company/system data protection policies are respected by all the stakeholders/users involved. And finally the data protection officer has a reporting task as the contact point for the competent supervisory data protection authority.

In this sense the recommendation is the appointment of a DPO within the P-REACT platform in order to make sure that ethical issues as well as legal constraints are respected in the most sensitive topic that the platform touches, that is the processing of huge amount of personal data in the form of images and video footage of citizens in such public spaces as stations, transport means or roads.

The appointment of a DPO is, therefore, proposed as the key role in the internal control strategy, that is, in the process of compliance within the platform. Following the recommendations of the Article 29 Working Group[3] the establishment, by the controller of the data, of concrete measures to ensure the compliance with the regulations, and the protection of the rights of individuals, has been considered as a basic idea in the field of data protection, and theorized as the accountability principle[4].

In order to ensure that the strategy operates in the right way and that individuals' rights are protected, the role of the DPO needs to be accompanied by the existence of a strict log file to keep track of all the actions performed by the different users in the platform. This log file will in the first place allow for a control of the access to the platform through the ID that the platform itself assigns to each user. On a second phase, the file log should keep a record of the queries performed by the different users as well as the results obtained from those. The idea behind the insistence on the need for a detailed file log is that of allowing the DPO to perform his/her tasks by being able to check the level of compliance with the regulatory and ethical requirements of all the users of the platform. This will allow the DPO to perform its duties appropriately especially regarding the implementing and control tasks defined previously. The log file was requested and implemented during the life-cycle of the project.

Once the elements of the internal control of the legal and ethical requirements have been defined it is necessary to take into account as well the need for some form of external control of the compliance. In this sense it is important to take into account that an external audit process should be foreseen. The need for external supervision is deemed to be especially strong in those cases in which the users are LEAs as "… on several occasions, the European data protection authorities assessing developments in

[3] Article 29 Data Protection Working Party; Working Party on Police and Justice. The future of privacy. WP168, paragraph 79

[4] Article 29 Data Protection Working Party. Opinion 03/2010 on the principle of accountability. WP 173.

the area of law enforcement stressed the need for effective supervision in the law enforcement field[5]". Therefore the recommendation for the specific case of the P-REACT platform,-where we have a system that "require(s) regular and systematic monitoring of data subjects…"[6] as Article 35 defines it, and has the potential to be used by LEAs- is the schedule of regular external data protection audits. In this sense the proposal is the performance of an audit once a year in which there is an external control of the file log so that in case of any breach of the legal and ethical requirements the auditor can notify the proper authority. The possibility to search through a cloud computing system within an enormous amount of video files containing millions of personal data can pose serious risks to individual's rights, and therefore requires the existence of clear and transparent mechanisms to alert of those situations, should the risk become an actual violation.

The strategy foresees the involvement of the competent[7] Data Protection Authority in two different ways:

- On a permanent basis through regular contact with the internal DPO.
- On a punctual basis through the annual report prepared by an external auditor.

[5] Alonso, Diana; Ensuring effective data protection in the field of police and judicial activities: some considerations to achieve security, justice and freedom; ERA Forum (2010) 11: 233–250.

[6] Article 35 of the Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the protection of individuals with regard to the processing of personal data and on the free movement of such data (General Data Protection Regulation), COM (2012) 11 final

[7] The competent authority will of course have to be identified for each producer as several countries are involved. Each producer should notify of the competent authority in their case, as in several countries of the European Union this could also be a sub-national authority.

7. Conclusion

We described in this document the results of the trials conducted in two different locations in Athens, Greece and Bologna, Italy on 25th of February and 31st of March, respectively.

The results were based on the end-user feedback that participated in the trials and had the opportunity to watch on real time the P-REACT technological solutions, its functionality and the ability of the system to track and monitor a number of security threats related to petty crime, in indoor and outdoor environment.

Sixty one (61) representatives from twenty eight (28) organisations from Police, Public administration, Operating authorities, Security companies, RTOs, Telecommunication companies, Transportation authorities and Academia participated in the trials.

The analysis of the results disclosed many interesting points related not only to the acceptance of P-REACT concept as a novel project, in the field of public security, but also as a project with real market opportunities. There have been a number of operating authorities that expressed their interest to have P-REACT installed in their business area for a pilot testing. That was further analysed by the P-REACT consortium and certain actions were initiated towards the possible pilot testing of P-REACT in real operational environment.

P-REACT trials were conducted in line with the Ethical Advisory Board recommendations. Representatives of the EAB were present in the trials to ensure proper handling of all related data protection and ethical issues, and prepared important recommendations to be taken into account should the project go towards commercialisation.

It was our understanding and our feeling after extensive discussions with the end-user community that P-REACT not only has met all the objectives described in the project but also it proved that EU research funding could provide excellent results for end-users and market opportunities for SMEs.

Finally, related the maturity of P-REACT results, we assessed that the project have reached at least a Technology Readiness Level – 6.

ANNEX I. GLOSSARY AND ACRONYMS

Term	Definition / Description
CCTV	Closed-Circuit television
EAB	Ethical Advisory Board
ENLETS	European Network of Law Enforcement Technology Services
IaaS	Infrastructure as a Service
LEA	Law Enforcement Agency
NCP	National Contact Point
PaaS	Platform as a Service
FOV	Field Of View
PIA	Privacy Impact Assessment
VCMS	Video Content Management Server
VPN	Virtual Private Network
VSaaS	Video Software as a Service

*Table 3 - **Glossary and Acronyms***

ANNEX II. REFERENCES

The table below shows the most significant references used and/or cited to prepare this document:

Reference	Source
[1]	P-REACT Deliverable D5.1 "Trials Scenarios", available on-line at: http://p-react.eu/wp-content/uploads/P-REACT_Deliverable_D5.1_v1.0.pdf.
[2]	P-REACT Deliverable D1.6 "Guidelines for Ethical, Privacy and data protections issues".
[3]	Regulation (EU) 2016/679 Of The European Parliament And Of The Council of 27 April 2016, avalibale on-line at: http://ec.europa.eu/justice/data-protection/reform/files/regulation_oj_en.pdf

ANNEX III. P-REACT ATHENS TRIAL AGENDA

25th February 2016

Time	Subject	Objective	Lead
10:30 - 11:00	Registration		KEMEA
11:00 – 11:30	Presentation of P-REACT project	Overview of P-REACT project/Achieved Objectives	P-REACT Coordinator
11:30 - 12:00	Introduction to Trial scenario and Questionnaire	Make end-users familiar with the Trail scenario and the questionnaire	KEMEA
12:00 – 12: 15	Coffee Break		
12:15 – 13:00	Presentation of P-REACT prototypes	Present P-REACT technologies	Technical Partners
13:00 – 14:00	Lunch		
14:00 – 15:00	Trail execution	Actual execution of the scenario in a field exercise	KEMEA
15:00 – 15:45	Completion of Questionnaire	Questionnaires will be used to assess P-REACT Intuitiveness, Usability and Market opportunities	KEMEA
15:45 – 16:00	Coffee Break		
16:00 – 17:00	Open discussion – additional feedback from end-users	End-users are asked to freely discuss any issue related to P-REACT concept, objectives and performance	P-REACT Coordinator
17:00 - 17:30	Closing Remarks	Wrap up of the event	P-REACT Coordinator

ANNEX IV. P-REACT BOLOGNA TRIAL AGENDA

31st March 2016

Time	Subject	Objective	Lead
10:30 - 11:00	Registration		SRM
11:00 – 11:05	Welcome	Welcome note, agenda and introduction of attendees	SRM
11:05 – 11:20	Presentation of P-REACT project	Overview of P-REACT project/Achieved Objectives	P-REACT Coordinator
11:20 - 11:50	Introduction to Trial scenario and Questionnaire	Make end-users familiar with the Trial scenario and the questionnaire	KEMEA
11:50 – 12:15	Presentation of P-REACT prototypes	Present P-REACT technologies	Technical Partners
12:15 – 13:00	Exhibition and networking	Present P-REACT technologies	Technical Partners
13:00 – 14:00	Lunch		
14:00 – 14:45	Trial execution	Actual execution of the scenario in a field exercise	SRM
14:45 – 15:30	Completion of Questionnaire	Questionnaires will be used to assess P-REACT Intuitiveness, Usability and Market opportunities	SRM
15:30 – 15:45	Coffee Break		
15:45 – 16:15	Open discussion – additional feedback from end-users	End-users are asked to freely discuss any issue related to P-REACT concept, objectives and performance	P-REACT Coordinator
16:15 - 17:15	Presentation of relevant on-going EU research project (SMART-	Present relevant on-going EU research efforts	SMART-PREVENT, LASIE and

Time	Subject	Objective	Lead
	PREVENT, LASIE and EUSTO)		EUSTO project representatives
17:15 - 17:30	Closing Remarks	Wrap up of the event	P-REACT Coordinator