Management Of Networked IoT Wearables – Very Large Scale Demonstration of Cultural & Security Applications

(Grant Agreement No 732350)

D2.1 Scenarios and Use Cases for use of IoT Platforms in Event Management

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Index:

1. Executive Summary

The aim of WP2 in the MONICA project is to transfer the user needs of the pilot cities in terms of functionality, performance, scalability, interoperability, etc. into technical requirements for the platform and applications, which form the primary drivers for the supply-side work packages. The output of WP2 will also inspire the design of privacy compliant, innovative applications and services and new socio-economic relations and business models, where also the involvement of citizens and businesses will take place together with societal uptake preparations. The supply-side packages WP3-7 will develop the IoT infrastructure (WP3) and two closed-loop systems with actuation (WP4 and WP5). The applications will closely mirror the user needs expressed in WP2 and WP10.

The overall objective of WP2 is to manage a requirement engineering and specification methodology and to coordinate the contributions from all demand-side users (organisers, public authorities, users).

The major part of the domain knowledge has been acquired by presentations from the demand partners as well as workshops conducted during the kick-off meeting in Bonn. After the kick off meeting 1-2 day follow-up workshops were organised at each pilot site (city). The acquired domain knowledge has been used to formulate so called user scenarios which are categorised per pilot event. Subsequently, generic use cases have been derived from these scenarios. The use cases are “solution agnostic” in contrast to the user scenarios. Basically, the user scenarios represent the “as-is” situation for a particular pilot event and describe the current process, using solutions and technology that are currently available.

Many pilot events have formalised these processes in official documents describing precisely how to act and communicate in different situations. These situations can be evacuations, crowd control, handling disabled people, finding lost children, etc. Although the described user scenarios in this document are probably not complete, they are expected to be accurate. The user scenarios and use cases have been validated by the pilot event representatives by letting them review their scenarios and by further discussing them during the plenary meeting in Turin and thereafter. After each validation step, either the use cases or user scenarios will be amended accordingly. This validation/amend cycle is iterative and will continue, even after the delivery of this report.

The scenarios described in this report are the result of a thorough investigation of all the relevant stakeholders and processes that were encountered during the various workshops. Some scenarios could either not be relevant for MONICA or are not feasible for implementation due to technical and/or business constraints. The technical partners in MONICA will need to categorise the scenarios based on relevancy and feasibility by either denoting them “relevant” or “not-relevant”. After this categorisation step detailed, but generic, use cases will be created based on all the “relevant” scenarios. The use cases will be written in enough detail such that both functional- and non-functional requirements can be derived from them. These requirements should give the technical partners enough food-for-thought to design various technical solutions based on each of the partner’s expertise and the given use cases. Note that various technical solutions will probably emerge due to the fact that each technical partner has its own focus. For example, “detecting a fight” can be implemented using camera’s, wristbands, mobile apps, and even noise monitors. Also “finding a person” can be implemented using camera’s, wristbands or mobile apps. Even combinations of technologies can be valid technical solutions.

Deploying a specific solution during a pilot event can be dependent on yet many other constraints which can be of technical, sociological, logistical, economical or of some other nature. Deploying camera’s in a green field site might not be feasible because of an expensive network infrastructure on which the camera’s are depending. Using wristbands could be an issue because of the logistics involved in distributing and collecting all the wristbands to/from the visitors. Mobile apps may require decent cellular networks, which could not be available when tens of thousands of people are attending an event. The result of insufficient performing cellular networks is that these mobile apps won’t work in all cases because they need an internet connection. Therefore, in future work, the limiting capabilities of a pilot event will need to be assessed as well.

2. Introduction

2.1. Purpose, context and scope of this deliverable

The aim of WP2 in the MONICA project is to transfer the user needs of the pilot cities in terms of functionality, performance, scalability, interoperability, etc. into technical requirements for the platform and applications, which form the primary drivers for the supply-side work packages. The output of WP2 will also inspire the design of privacy compliant, innovative applications and services and new socio-economic relations and business models, where also the involvement of citizens and businesses will take place together with societal uptake preparations. The supply-side packages WP3-7 will develop the IoT infrastructure (WP3) and two closed-loop systems with actuation (WP4 and WP5). The applications will closely mirror the user needs expressed in WP2 and WP10.

The overall objective of WP2 is to manage a requirement engineering and specification methodology and to coordinate the contributions from all demand-side users (organisers, public authorities, users). As such, WP2 is structured as follows:

- Task 2.1 - use case definition
- Task 2.2 - initial user requirements
- Task 2.3 - architecture specification

This deliverable documents the use cases that have been derived from the various scenarios (Task 2.1).

2.2. Structure and content of this deliverable

The document starts with an introduction to the approach and methodology to come to scenarios and the derived use cases. Chapter four describes the six different pilot events, their challenges and interests, followed by the scenarios. In chapter five the use case analysis is described and finally the generic use cases are listed. All the information in this document is based on:

- Workshops conducted during the Kick-off meeting in Bonn (January 2017)
- Follow-up workshops (interviews) (March - May 2017)
- Event visit: Leeds Rugby match at Headingley Carnegie Stadium (March 2017)
- Focus group meeting Movida (May 2017)
- Event visit: Rhein in Flammen (May 2017)
- Event visit: Hamburger DOM (April 2017)
- Event visit: Hamburg Port Anniversary (May 2017)

3. Approach and Methodology

3.1. Introduction

The objective of this deliverable is to acquire domain knowledge for each of the pilot events in order to get to a complete list of use cases. Eventually, these use cases will be used to develop detailed requirements and a corresponding architecture to support these requirements. A qualitative research methodology is followed with active stakeholder participation by means of presentations, interviews, discussions, focus group meetings, formal event (security/noise) plans and incident logs. The last two items are not always available for all the pilot events though. Since active stakeholder participation is proposed, inclusive modelling techniques throughout the information gathering process and also within the reports are used.

The major part of the domain knowledge is acquired by presentations from the demand partners as well as workshops conducted during the kick-off meeting in Bonn. After the kick off meeting 1-2 day follow-up workshops were organised at each pilot site (city). The acquired domain knowledge is used to formulate so called user scenarios which are categorised per pilot event. Subsequently, generic use cases are derived from these scenarios. The use cases are supposed to be “solution agnostic” in contrast to the user scenarios. Basically, the user scenarios represent the “as-is” situation for a particular pilot event and describe the current process, using solutions and technology that are currently available. Many pilot events have formalised these processes in official documents describing precisely how to act and communicate in different situations. These situations can be evacuations, crowd control, handling disabled people, finding lost children, etc. Although the described user scenarios in this document are probably not complete, they are expected to be accurate. The user scenarios and use cases have been validated by the pilot event representatives by letting them review their scenarios and by further discussing them during the plenary meeting in Turin and thereafter. After each validation step, either the use cases or user scenarios will be amended accordingly. This validation/amend cycle is iterative and will continue, even after the delivery of this report.

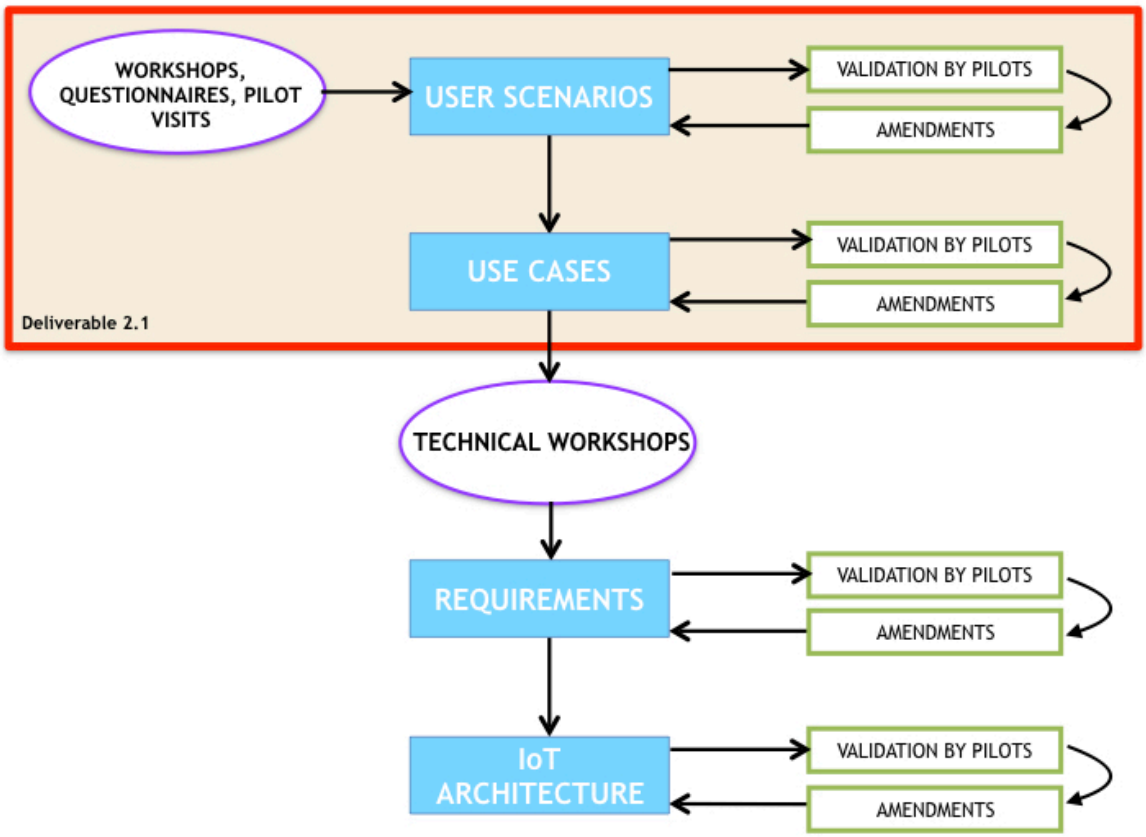

Figure 1 - Process flow diagram of iterative requirements engineering.

Besides workshops with event experts and promotors focus group meetings have been held. These meetings involve stakeholders that are not represented in the workshop and typically represent a larger group of people. These stakeholders include visitors/party goers, neighbours/residents and bar/restaurant owners. The stakeholders will be asked about their opinions, perceptions and attitude towards the event. This information will also be used to draft additional user scenarios and use cases. Since it is not always feasible to have these focus groups meetings for all the events, these will certainly not be complete in a strict sense.

As a next step, the final list of use cases will be used to define the corresponding requirements. These requirements will be based on both domain knowledge as well as available technology. Therefore, the input of solution providers will be vital in order to reach a complete and feasible(!) set of requirements. A series of technical workshops, bringing together domain- and technical knowledge will be planned after the first iteration of a list of use cases. These requirements will in turn be validated by the pilot event representatives as well.

3.2. Workshop planning

The workshop participants consist of requirement engineers from FIT, IN-JET and DEXELS and various experts and stakeholders from the participating pilot events. These experts are supposed to have hands-on experience with security, safety and noise related operations, taking place pre-event, during the event and post-event. During the workshops the experts have been interviewed by the requirement engineers. These interviews resulted in notes taken by the requirement engineers and audio-visual recordings. In addition, written documentation, logs, maps and other relevant material have been requested during the workshop. Since it was expected that the level of expertise would vary a lot, an exploratory style of requirement engineering by means of interviews and discussions instead of using a strict script has been opted for. Depending on the availability of certain experts the workshops have been planned. Based on a briefing by the WP2 team, explaining the WP2 objectives, the planning of the workshops was left to the pilot event point of contact. Being dependent on the availability of experts with more or less hands-on operational experience, the quality of the gathered domain knowledge varies. Since the validation/amend cycle is iterative, it is expected that the initial “gaps” in the domain knowledge of a particular pilot event will eventually be closed. Subsequently, the user scenarios are drafted based on the various notes, available formal documents and audio-visual recordings.

3.3. Pilot event characteristics

The relevant characteristics of a pilot event will be summarised (see also Appendix A). These include:

- Type of event
- Duration of the event
- Date(s) or frequency of the event
- Number of visitors
- Type and size of the venue
- Free/ticketed
- Maturity of the technical infrastructure

In addition to this factual information, the challenges and interests, as indicated by the promotor(s) will be be described. The challenges and interests can be used to steer and prioritise the available technological solutions offered by the supply side partners. If for example there are no sound related issues whatsoever, it does not make sense to implement any solutions from the sound domain.

3.4. Stakeholders

In important part of the requirements analysis is the identification of stakeholders. Stakeholders play some role in the relevant processes taking place during- and in the organisation of the event. For each pilot event we will publish a list of stakeholders and a short description of their function(s) and objective(s). Instances of stakeholders act as the users in the user scenario’s. Examples of stakeholders are: visitor, police officer, event promotor, head of security, resident/neighbour. In this document the terms stakeholder, role and actor all have the same meaning. The stakeholders lists might change or be extended in the course of time as more and more about the pilots is learned.

3.5. User scenarios

A user scenario is a story in which so called personae play a role. The roles correspond to the identified stakeholders. A persona is basically an instance of an identified stakeholder. User scenarios are a kind of thought experiments in which the personae “interact” with other personae, certain situations and events that occur. User scenarios are used to communicate the domain knowledge that we have gathered during our workshop sessions to the reader. Writing down a user scenario as a real story is effective for various reasons. A user scenario will sketch the scene/environment in which the story will take place. The mood of the persona clarifies the emotional state in which the persona operates, this is relevant since it can determine relevant non-functional requirements for the digital tools that the persona will be exposed to (or use) in a MONICA implementation. Besides mood, external factors, like weather conditions, noise, crowd density, also play an important role in determining those non-functional requirements. Last but not least, the user scenario should reflect the objective or goal of the persona in this particular story. In addition, it is relevant to know what situation or event triggered the persona to act like this. All this information is useful to derive use cases. The scenarios in this document represent “as-is” (real) situations. They are based on processes (formalised by pilots), solutions and technologies currently available and adopted. In this sense, they are not “wished” situations.

3.6. Use cases

From the pilot specific user scenarios, we will derive generic high level use cases. The use cases that we will describe in this document are solution agnostic and used to define the very basic objectives of the involved stakeholder(s) in abstracted situations. Since the use cases are not yet assuming any actual technology or (software/hardware) tool, only the basic flow will be described. Probably a better term would be business process, but we have decided to stick to the term use case.

A use case is structured as follows:

- ID. Numbering scheme x.y.z. First number denotes the use case category, the second is used for grouping use cases that belong together, the last number denotes the use case number within the group.
- Name
- Category (for grouping use cases that belong together)
- Actors, list of all actors involved in the use case
- Pre-condition, the situation/event that will trigger the use case
- Description
- Post condition, the situation after the use case is completed

The use cases will only describe basic flows. No alternative or exception flows are defined at this stage.

4. Pilot Analysis

4.1. Bonn

4.1.1. Pützchens Markt

4.1.1.1. Pilot Summary

Pützchens Markt (http://www.freundeskreis-puetzchensmarkt.de/) is a street festival that takes place in Bonn every year in the second week of September. During five days, the event offers all kinds of attractions such as traditional merry-go-rounds, more than 500 commercial stalls and two stages. This massive offer extends over the length of 4.5 km in an area of 80,000 m2. Visitors can enjoy the festival for free and can access it from 6 different open entrances.

Pützchens Markt is considered a cultural heritage event with a tradition of more than 650 years. It is important to highlight this fact, as cultural heritage events in Germany are given more tolerance in relation to sound level limits. Its long tradition, also reflects on the level of acceptance that the neighbours, who live around the area, have for the event in most of the cases.

4.1.1.2. Challenges

Pützchens Markt faces a big issue in relation to the characteristics of the venue: narrow streets and bottlenecks are very common. The crowd movements in opposite directions cause blockages that prevent people from moving. In this sense, crowd and visitor management is a challenge, in particular for the fire brigade and security services who have to control and prevent incidents. There are 6 entrances and 4 main roads, one of them with a critical density of people.

4.1.1.3. Interests

The following points list general topics or applications for which this pilot expressed interest during the interview sessions, pilot visits or questionnaires. It is important to know that this information might change, adapt as the project evolves:

- Crowd management tools (solutions for routing people to various entrances/exits)
- Live data that supports prediction of critical situations
- Wearables for communication and real time information (a particular interest of the Fire Brigade)
- Means to improve the communication between staff and visitors
- Software applications to improve customer experience
- Having a common operational picture, with a common data base, live data on maps, predictions, etc. (a particular interest of the public order office and fire brigade)

4.1.1.4. Stakeholders

Name	Description
Visitor	Any attendant that accesses the festival area
Stall/ride owners	People that are manning the stalls and attractions on Pützchens Markt.
Event organiser	Person in charge of managing budget, logistics and external stakeholders that are part of the festival. Responsible for assuring the success of the festival at a practical level.
Public Order officer	Officer representing the City of Bonn and the Public Order department during the event. During the event he communicates with the event organiser as well as with all the City of Bonn stakeholders that are involved in terms of security (e.g. police, public transport, etc.) and contacts the corresponding stakeholders when needed.
Fire brigade	Representatives of the fire brigade during the festival. They are in charge of coordinating all 'non-police' organisations, mostly aid organisations in case of emergency or catastrophe, from the temporary Control Centre.
Local state police	Present in the event area and surrounding areas. In charge of dealing with bigger incidents such as criminal acts, drug dealing, etc.
Private security staff	Person working for an external security company that has been hired to do control walks and deal with minor incidents during the event.
Public Transportation department	They are in constant communication with the rest of the actors who are in the Control Center in order to inform about amount of people using public transportation, do crowd estimations, and flow of people in relevant stations in order to inform security and emergency activities.

Table 1 - Stakeholders for Pützchens Markt.

4.1.1.5. Scenarios

4.1.1.5.1. Visitor experience at the festival

Tina **(visitor)** and her kids are already looking forward to Saturday as they have planned to visit Pützchens Markt then. For Tina, the whole situation awakes some memories of the past: the event is a tradition for her family. She used to go there with her own parents when she was little and the thought of involving her own kids in the event, as her parents did back in the days, makes her smile. However, some concerns pop to her mind. Based on her own experience, she knows that the event can get crowded and the very narrow streets that characterise the venue tend to get packed with people walking in both directions. She decides to try to plan ahead and makes use of the paper leaflet she was given some days ago which has some information about the event. There, she is able to find what the schedule of the public transportation will be and information about the venue. She makes use of this to plan her visit but sadly it is not enough for her to estimate at what time it is best to go with her kids, or to know what areas get the most crowded. She really hopes to be informed in time at the event to be able to avoid getting stuck in the crowd and be unable to enjoy the event as she expects.

4.1.1.5.2. Crowd estimations and management

Mathias is part of the **public order department** who is supporting the activities at Pützchens Markt. During the 5 days of the event, he is mostly situated in the control room making sure all incidents are handled

properly by informing the right people and taking the right actions. His digital radio and phone are always with him during these days. Today is Sunday, and due to the good weather, the team is expecting more people than in the previous days. By observing the video coming from the 8 available cameras, he has realised that the area in front of the big tent is quickly getting crowded. The most popular concert in the tent stage will start in a few hours and based on his experience, they should take preventive measures before too many people reach the area. He decides to call the **public transportation office** in order to get information on the amount of people using the trams at the moment. This will help him to make a more accurate estimation of how fast the area might get crowded. Sequentially, he talks to the **event organiser** who is also with him in the control room to share his findings, they decide it is time to contact a **private security staff** member who is around the tent. They make use of the phone, hoping to get an immediate answer. Based on past experience, the communication and coordination between all stakeholders can sometimes be challenging. As soon as they manage to reach one of the staff members, they instruct him to start redirecting people to other paths for the next minutes in order to avoid reaching the limits of full occupancy in the area.

4.1.2. Rheinauer events - Kunst!Rasen

4.1.2.1. Pilot Summary

Kunst!Rasen (http://www.kunstrasen-bonn.de/) is a private open air music festival that takes place every year in the Rheinauepark. The festival offers various concerts during June and July attracting between 50,000 and 70,000 visitors per year. The festival area is close to the Rhein river. It has a capacity of 10,000 people and its size is 18,000 m2. In the venue, visitors can find one main stage and a beer garden. With the exception of one classic concert that is offered free of charge to the audience, visitors have to buy a ticket either online or directly at the box office to attend the concerts that take place at the festival.

4.1.2.2. Challenges

Kunst!Rasen is struggling with complaints from the neighbours who live close to the venue. Since the nearest neighbour is only 439 metres away from the sound systems the sound needs to be reduced by 40 dB/A over this short distance. In between the venue and the neighbour is the Rhein river. This is also part of the problem as sound is easily carried by the different air layers above the water of the river.

They have been working on techniques to raise the sound level within the venue and lower the sound outside but they have not found an optimal solution yet. At the moment, they are able to stay within the required limits but the problem still remains since the artists are using more and stronger low frequencies in their music. There is a need to find new techniques to cut their range while still maintaining a sound level around the stage that satisfies both the visitors and the artists. Kunst!Rasen has an increasing need to find technical solutions to solve this problem that they have been facing for years.

4.1.2.3. Interests

The following points list general topics or applications for which this pilot expressed interest during the interview sessions, pilot visits or questionnaires. It is important to know that this information might change, adapt as the project evolves:

- Optimisation of the sound fields
- Use of Adaptive Sound Field Control System
- Advanced techniques to separate music from other noise
- As part of the Rheinaue event location, they are also interested in having a common noise monitoring infrastructure for all events that take place there.

4.1.2.4. Stakeholders

Name	Description
Visitor	Any attendant that access to the festival area
Event organizer	Person in charge of managing budget, logistics and external stakeholders that are part of the festival. Responsible for assuring the success of the festival at a practical level and making sure the visitors are satisfied with their event experience.
Fire department	Representatives of the fire brigade during the festival. Responsible for coordinating aid organisations in case of emergency or catastrophe. They are also present at the event.
Local state police	Present at the event in small amounts. Responsible of handling major incidents that are out of the responsibility of the private security staff.
Sound monitoring staff	Person in charge of monitoring the sound levels for each concert during the event.
Neighbour	Person living close to the venue and affected or disturbed by the noise produced during the concerts.
Private security staff	Person working for an external security company that has been hired to do control walks and deal with minor incidents during the event.
City of Bonn	Stakeholder that has to be informed about general activities planned by the private organiser for the event. Their telephone line for incidents and complaints sometimes is called by neighbours who complain about the festival's sound levels.

Table 2 - Stakeholders for Kunst!Rasen.

4.1.2.5. Scenarios

4.1.2.5.1. Access to the event

Axel **(visitor)** lives in a small town close to the city of Bonn. He, as many other people that live in the area, come to Bonn to be part of one or more of the concerts that are offered by Kunst!Rasen. This year, Axel´s favourite band is playing at the festival. He and his friends decided to buy their tickets through the online service to make sure that they will not miss the event. Today finally the concert day has come. Prior to the concert, Alex meets his friends at the supermarket to buy some beers. They are planning to bring them inside the venue in their backpacks. As they approach the entrance they realise that about 16 staff members are gathered around the gate in order to do a check before they let in visitors. Axel wonders if they will look into his backpack and spot the beers he has bought. He lines up in one of the crowd dividers and hopes to get away with his plan. He approaches the security staff member who asks him to open his bag. Just as he thought, he will have to leave the beer bottles at the entrance. Axel is a bit disappointed that his plan did not work out, but his excitement for the concert is bigger. He soon forgets what just happened and prepares his ticket to be checked by the next staff member who holds a hand scanner. After a few seconds he and his friends are all in. Now it is time to have fun!

4.1.2.5.2. Sound levels in the event

Fran is part of the **event organisation** team. His role involves making sure that the festival is successful and that visitors as well as artists can make the most out of the event. His task is not always easy, as it involves communicating with different stakeholders and authorities in order to achieve favourable circumstances for the event. One of the big challenges he faces is handling problems that arise from the sound limits that are allowed in the area. His main objective is to find a balance between providing visitors and artists with the best sound quality possible in order to enjoy the event, while still fulfilling the requirements of the neighbourhood that surrounds the area and does not like to be disturbed by noise. Fran is in continuous communication with Andreas who leads the **sound monitoring** team. He has been supporting the sound monitoring tasks for every concert in the festival since 2012. Andreas and his other two colleagues monitor

each concert from 3 different locations and communicate this data to Fran in individual reports by the end of the event. This information is very valuable for him as it ensures the possibility of showing the current status of the sound levels to the authorities. At the same time, the reports help him make informed decisions in order to drive improvements for the sound issues for the next years. After reading the last report he has come to a conclusion: it seems that at the moment they are being successful in sticking to the limits required by the authorities. Nevertheless, in order to achieve this, they needed to lower the level around the stage which definitely is a big disappointment for visitors as well as for the artists.

4.1.2.5.3. Neighbour complaints

Lena **(neighbour)** has just moved to a new house right next to the Rhein river. From her window she can see the beautiful Rheinauepark which is located across the water, at the other side. This morning she was surprised with an invitation sent by the **event organiser** to join an information meeting for neighbours who live close to the Rheinauepark. The meeting has been arranged to talk about the concerts that will be happening in the area. She is very curious and decides to attend. As she arrives, she realises that this is actually a one-to-one meeting. She is then informed that the Kunst!Rasen festival will take place in some months at the park in the other side of the river and since her house is in the near proximity of the venue, the water in between might carry sound easily. They tell her that she might be affected by the noise reaching her home. By the end of the meeting, she is kindly asked to provide a written confirmation of her consent and approval of the festival events. After thinking about the situation she decides to send the approval. Nevertheless, she is still quite skeptical about it. After all, this is the first year she will experience this situation and she would not like to be disturbed on a Sunday afternoon by high sound levels while resting at home. She then decides to keep the telephone number for complaints which is run by the **city of Bonn**… just in case.

4.1.3. Rheinauer events - Rhein in Flammen

4.1.3.1. Pilot Summary

Rhein in Flammen (http://www.rhein-in-flammen.com/) is a festival happening once a year in the Rheinaue, an extensive public park located next to the Rhein River in the city of Bonn. The festival takes place in a fence-free area of about 200,000 m2.
Visitors can join the free event from Friday to Sunday. During this time, a variety of concerts take place in three different stages and food stalls surround the whole area. On Saturday evening, the most crowded day out of the three, thousands of people join to witness the firework show and the illuminated boat parade along the Rhein. This part of the program is considered to be the highlight of the event. Rhein in Flammen takes place since 32 years and welcomes an average of 90,000-120,000 visitors per day making it one of the most popular festivals in the area.

4.1.3.2. Challenges

Even though the event takes place in a spacious park which is open, the critical density of the crowds can be reached in certain areas and at certain times. One of the main challenges for the event in relation to crowds happens towards the end of the firework show on Saturday evening when many visitors try to leave the event at the same time and try to access the main tram station. This station is a critical area where a bottleneck is produced.

In relation to sound, there are concerts happening constantly during the festival and although the complaints are not massive, there is still room for improvement in order to reduce complaints and improve the sound quality.

4.1.3.3. Interests

The following points list general topics or applications for which this pilot expressed interest during the interview sessions, pilot visits or questionnaires. It is important to know that this information might change, adapt as the project evolves:

- Crowd management and analysis tools
- Live data that supports prediction of critical situations

- Wearables for communication and real time information (a particular interest of the Fire Brigade)
- Means to improve the communication between staff and visitors
- Having a common operational picture, with a common data base, live data on maps, predictions, etc. (a particular interest of the public order office and fire brigade)
- Software applications to improve costumer experience
- As part of the Rheinaue event location they are also interested in having a common noise monitoring infrastructure for all events that take place there.
- Use of Adaptive Sound Field Control System
- Advanced techniques to separate music from other noise

4.1.3.4. Stakeholders

Name	Description
Visitor	Any attendant that accesses the festival area
Event organizer	Person in charge of managing budget, logistics and external stakeholders that are part of the festival. Responsible for assuring the success of the festival at a practical level.
Public Order officer	Officer representing the City of Bonn and the Public Order department during the event. During the event he communicates with the Event Organiser as well as with all the City of Bonn stakeholders that are involved in terms of security (e.g. police, public transportation, etc.) and contacts the corresponding stakeholders when needed.
Fire brigade	Representatives of the fire brigade during the festival. They are in charge of coordinating all 'non-police' organisations, mostly aid organisations in case of emergency or catastrophe, from the temporary Control Centre.
Water police	Part of the local police. Dealing with incidents that take place on the river.
Local state police	Present in the area of the event and surrounding areas. In charge of dealing with bigger incidents such as criminal acts, drug dealing, etc.
Private security staff	Person working for an external security company that has been hired to do control walks and deal with minor incidents during the event.
Public transportation department	They are in constant communication with the rest of the actors who are in the Control Center in order to inform about amount of people using the public transportation, do crowd estimations, and flow of people in relevant station in order to inform security and emergency activities.
Control Room	In charge of guiding security and emergency activities for the entire city of Bonn. They are located in a central location far away from the festival´s venue. Constantly supporting the coordination and direction of activities to deal with major incidents in the event.

Table 3 - Stakeholders for Rhein in Flammen.

4.1.3.5. Scenarios

4.1.3.5.1. Planning of the event

Today is the kick-off meeting that opens the planning phase for Rhein in Flammen. Every year, all the different stakeholders involved in the planning activities start working months ahead of the event in order to make sure that the whole festival will be successful. Maria, the **event organiser** sits around a table together with **fire brigade**, **city representatives**, **public order officers** and other people involved in the organisation. After a few welcoming words, they immediately start: there are so many points on the agenda! Maria starts by presenting the tentative proposal for the location of the stages and stands. As a reference, she takes out a paper map to visualise where the attractions have been placed last year. She points out the need of relocating the toilet area a few meters north. This is a suggestion coming from the **security staff** since last year the line in front of the toilets was blocking one of the main exit roads. Just like in this case, most of the planning is done based on experiences from past years which need to be improved. After agreeing in the toilet relocation, they jump to the second point in the agenda: the need of opening an a new route to an

alternative tram station. As this point is addressed, many people express their concerns. An officer of the **fire brigade** mentions how this could affect the emergency plan while somebody from the **event management** highlights his concerns on how this information should be communicated to the **visitors** in order to assure that they will be directed to the right place. Meanwhile, Maria takes notes and prepares for the next months of planning action.

4.1.3.5.2. Sound and concerts

As the meeting moves on, Maria guides the conversation to the next point in the agenda: neighbour complaints in relation to sound. They all take a quick look at the report from last year. As they do so, they notice that complaints are actually not massive, but there is of course room for improvement. Having three stages playing music at the same time can, in some cases cause noise issues in the surrounding areas. They decide that this is definitely a topic that should be considered for the planning of this year´s festival, perhaps finding new technologies that help improve the sound quality would be a first step. After all, the organisers are very interested in keeping a good relationship with the neighbours while at the same time, providing visitors with an ultimate concert experience and the optimisation of sound levels around the stages could benefit the festival's image and increase the visitor's satisfaction.

4.1.3.5.3. Visiting the festival

Paul and Anna (**visitors**) live in the city of Bonn. As both of them love fireworks and music, they never miss the chance to join the Rhein in Flammen event. This year, they decide to arrive early in the Rheinauepark in order to assure having a good place on the hill and enjoy the show from the spot that offers the best view. As soon as they arrive, Anna takes out her picnic blanket and two sandwiches she prepared at home. She sits and waits for Paul who is buying some beers at one of the bars. After some minutes, she realises that Paul is taking longer than expected and she decides to call him to see if all is ok. As she takes out her phone, she realises that there is no network coverage and calling is useless. She has no other option than to wait and reserve the spot they found. After about 30 min, Paul comes back. He explains to Anna how long the queues for beer are as more and more people are arriving to the festival. Luckily, he still managed to come back before the next concert starts. They both sit and enjoy the event while listening to the music coming from the nearest stage where the crowd starts going crazy.

4.1.3.5.4. Leaving the event: crowds and alternatives

Late in the evening, right after the firework show has finished, Anna and Paul (**visitors**) stand up and get ready to leave the area and catch the public transportation to get home as soon as possible. In a matter of seconds, they find themselves stuck in a crowd that is trying to go to the nearest tram station. All move at the same time. This makes Paul remember the very bad experience they had last year as they approached the station: thousands of people pushing each other and a lot of waiting for empty trams to come. He just hopes this year this will not be repeated. Paul and Anna decide to turn around and go through a parallel path that leads to a secondary exit. He read at a bus stop some days ago that the **Public Transportation** in Bonn would have a special service operating from the parallel streets in order to avoid crowds in the stations. He hopes to find an alternative bus stop and avoid the struggle. After a few minutes and without much problems, they succeed to exit the park and go home. He feels sorry for all the other visitors who did not know about the alternative exits and are now probably still stuck in the tram station.

4.1.3.5.5. Bottleneck in tram station area

It is around 00:00, the fireworks show has finished and the crowd wants to get home as soon as possible. Although the Rhein in Flammen event takes place in an open area and the options to exit the event are abundant, most of the people at the festival leave through one path that leads to the main tram station. Today, Thomas and Tim, staff members of the **private security** at the event, are in charge of controlling the crowd that approach the station area. Tim directs people who want to take the train through the crowd control barriers that have been installed while Thomas observes the crowd movement from the bridge, located right over the tram station and tries to predict when the limit of the area will be reached. As the minutes pass, more and more people gather around and find themselves suddenly stuck in a tight bottleneck. Thomas decides to contact the **event organiser** to ask for support, they have to block the path and redirect people or otherwise it will be too late. He remembers, how last year the barriers were not enough as the crowd from the back kept pushing the rest and some of the barriers collapsed and accidents happened. This area has always been critical and he does not want bad experiences to be repeated.

4.1.3.5.6. Event coordination

As in previous years, Maria, the **event organiser** is present at the event. After all the organisational matters and logistic plans she has been working on for the last months, she is glad to see that now things are finally coming to life. Nevertheless, she knows it is not yet the moment to relax. Maria has to be present during the event and make sure that all the external people she hired for different activities such as private security and stage managers are working in an orchestrated and successful way. Having an easy, fast and functional way to communicate with all the people that she is relying on is critical to fulfil her responsibilities. As the evening approaches, Maria receives a call from one of the security points run by the **private security company** that supports the event. It seems that they are struggling with a teenager who has drunk more than what he could take. They tried to talk to him and ask him to leave the event but he has rejected to do so and they need support. Maria knows that her responsibility also involves escalating issues that her team cannot solve on their own. She knows that the right person to contact is John from the **public order department** who is in the temporary Control Centre. She calls him and in a matter of seconds his team comes to pick up the teenager. John takes over the issue and contacts the relatives of the boy who is now forced to wait until his family comes and picks him up.

4.1.3.5.7. Updates in the Central Control room

John is a representative of the **public order department** of the City of Bonn. During the days when the festival takes place, his working location changes as he joins the temporary Control Room that has been set directly at the location of the event. He, together with representatives of the **local police**, **fire department**, **event organiser** and **public transportation** join forces in this location to assure that security and successful reaction to emergencies is provided during the event. Punctually at 18:00, all the people in the room get together for their regular update meeting which happens every two hours. There, they talk about how things are going, share what minor incidents have happened during the last hours and analyse the current situation in order to prevent potential disasters. Maria, the **event organiser**, starts with the updates. She points to the paper map hanging on the wall to show that two of the food stalls have been relocated and renumbered due to space management issues. This is valuable information for all, since in case of an incident knowing the exact location of each attraction is needed in order to react fast and successfully. As John´s turn comes, he prepares to share the information he got from the public transportation department on an estimation of the amount of people that are arriving to the festival area. The estimation is that at the moment 60,000 people might be already in the area and probably about 30,000 more will join in the next hours. This data is pinned to the board so that it is visible to all. He also shares a picture captured by a drone some hours ago, which shows an overview of the festival area from above. This is analysed by the people in the room and they identify that the crowd at the second stage seems to be reaching its limit. In this way, they decide to contact **security staff** and ask them to start control walks in the area as a preventive measure.

4.1.3.5.8. Emergency in the boats

Marius is part of the **fire brigade** who is present at the temporary Control Centre in the Rheinauepark. Together with his colleagues, he is in charge of coordinating the aid bodies in case of emergencies. During the three days of the festival Marius and his team are always ready to react, particularly on Saturday evening, as experience form previous years has shown that the rise in the amount of people joining the festival during the fireworks and boat parade also increases the chances of major incidents happening during that time. As the boat parade takes place, Marius receives information on his phone coming from the **public order officer**: a person located in one of the boats just had a heart attack. Marius reacts immediately following the emergency plan of the event. He quickly makes a call to the Central Control Room responsible of the whole city of Bonn which take over and inform the **water police** of the situation. He then takes a quick look to the list they put up in the wall with contacts details of the relevant actors. He reaches the **aid workers** who are closer to the water through radio and tells them to prepare for the arrival of the boat in the next minutes. Meanwhile, advised by the representatives in the control room, the parade is stopped and the boat is instructed to go to the closest aid and emergency point located right at the border of the river. As it reaches this point, an ambulance is already waiting for the person who suffered the attack.

4.1.3.5.9. Bad weather and storms

Sunday has come, the last day of Rhein in Flammen is about to start and so far John is very satisfied with the work the supporters at the control centre have done. He expects today to be a calm closing day at the event. As he arrives, he decides to start with his tasks. He opens his e-mails and finds some new information from the **weather forecast office**. They are predicting a heavy thunderstorm towards the evening. This information has caught John by surprise and he decides to call the weather office to get more detailed information about it. After his call, he immediately calls for a meeting with the rest of the people in the control room. He informs them about the situation and he highlights the fact that the weather office suggested to

cancel the last concert of the evening. The alert level is quite high. The bad weather and heavy winds might be too strong and the probabilities of having an increase in the number or quality of the incidents during the storm is not low. A decision like this is not easy to make, all people at the table including the **event organiser** and the **fire brigade** have to make a quick assessment of the situation. After analysing the amount of people expected and the risks of continuing with the program, they decide to cancel the last concert. Maria, the event organiser at the table takes a big breath as her task now is to inform **security staff** and other companies she has hired about the decision that has been made. Such a spontaneous decision might create some confusion around. Unfortunately, visitors will soon have to be asked to leave the area.

4.2. Copenhagen

4.2.1. Friday Rock (Tivoli Gardens)

4.2.1.1. Pilot Summary

The Tivoli Gardens (Tivoli) is a famous amusement park and pleasure garden in Copenhagen, Denmark. The park opened in 1843 and attracts around 4.7 million visitors annually. From April through September, Tivoli organises Friday Rock (http://www.fredagsrock.dk): around 20 outdoor concerts on Friday evenings featuring both national and international performers, with up to 500,000 concert guests attending these concerts each year.

The Friday Rock concerts are a major source of revenues for Tivoli and important in terms of branding the park. Copenhagen Municipality has a strong interest in outdoor events in order to develop an attractive city environment with an international flavour.

The MONICA solutions will be demonstrated during four Friday Rock concerts during 2018 and 2019, to be selected in cooperation with the Pilot and the technical partners.

4.2.1.2. Challenges

Tivoli is struggling with sound emissions from the outdoor music performances:

- Copenhagen Municipality strictly enforces a maximum cap on sound emission levels from the Friday Rock concerts.
- Certain performers will not perform at Tivoli due to the sound emission cap, which they find is too low. Friday Rock audiences complain about low sound volume during concerts.

Tivoli has over the past decade focused on optimising the acoustics. This aims primarily at improving the audio experience for the concertgoers, but also the noise impact on the neighbours.

Despite many good technical initiatives, Tivoli still faces challenges in order to balance the demand from the artist and concertgoers and the one from the neighbours and the city.

On the security and safety side, the Tivoli Gardens is not a typical concert venue, as the rest of park is open for normal guests during concerts, and as there are many buildings, trees and rides close to the concert area. The guest flow control during concerts is thus complex and requires many safety personnel.

4.2.1.3. Interests

The following points list general topics or applications for which this pilot expressed interest during the interview sessions, pilot visits or questionnaires. It is important to know that this information might change, adapt as the project evolves:

- Wearables on security staff
- Wearables/app on certain categories of guests (children, disabled people)
- Video and audio recording devices (to track individuals)
- Video analytics for crowd size estimation
- Heat maps for crowd behaviour real-time visualisation
- Active Sound Field Control loudspeakers
- Silence Showers
- Real-time display of noise levels (for internal use)
- Dissemination of segregated noise emission levels towards public authorities

4.2.1.4. Stakeholders

Name	Description
Friday Rock Visitor	He/she is a concertgoer. Depending on the concert, the age profile is +18.
Neighbour	He/she is a person who lives in Tivoli's immediate neighbourhood, specifically residing opposite to the direction of the concert stage's loudspeakers, and thereby directly and indirectly affected by Friday Rock concerts.
Copenhagen Municipality – Environmental Agency	It is the local authority that negotiates with Tivoli the terms and conditions of the Friday Rock events, guaranteeing the limitations imposed by the law are respected. It also handles the neighbours' complaints.
Sound technician	He/she manages all the sound aspects before, during and after a Friday Rock event, dealing with the performer's technical staff and Tivoli's head of production.
Head of production	He coordinates and supervises all aspects of an event in Tivoli. This includes overseeing operations, directing staff, coordinating technical and production aspects, for Friday's Rock concerts too.
Security staff	He/she is in charge of all the security aspects in Tivoli and can also work for Friday Rock. He/she deals with the visitors, the security crowd manager and supervisors.
Performer	The musician who performs at Friday Rock. The performer is required to respect the Tivoli behaviour code for artists in order to guarantee his/her own and the concertgoers' security in addition to the sound emission limit enforced by Copenhagen Municipality.

Table 4 - Stakeholders for Friday Rock.

4.2.1.5. Scenarios

4.2.1.5.1. Lost child

Mary and Leonard (**visitors**) are two Canadian tourists visiting Copenhagen for the first time. They have a 6 year old child, Bernard, so they decide to spend one day in Tivoli. Leonard is also very happy to be in Tivoli, because in the evening one of his favourite bands is playing at the Friday Rock concert. Bernard is hungry, so the parents decide to have a quick sandwich before the concert starts. All the bars near the concert area are crowded, and the family's situation is becoming a little tense as many concertgoers are arriving at the stage area. Leonard is in the queue at one of the bars, thinking that Bernard is in a quiet corner with his

mother. Mary thinks that Bernard is queuing with his father…the child is lost. Mary and Leonard start looking in the surroundings for their child, but there are too many people. They stop a **security staff member** who is passing by, asking for help. The security staff member immediately informs the CCC (Central Command Centre) about the lost child, asking for more colleagues to join him in the search. He asks the parents for information about the child (a picture, physical traits, last place they saw him). He passes all this info to the CCC by radio. In a few minutes all the security staff in Tivoli are alerted by radio, the ones at the gates too. Five security staff members are allocated for the search of the child: one will stay with the parents, while the other four will go around looking for the child. Finally one of the security staff members finds a child corresponding to Bernard's description. He is walking alone, clearly looking for somebody. The steward approaches him, asking for his name in English. He confirms that he's Bernard and has lost his parents. The steward immediately calls through the radio his colleague who remained with the parents. It has taken considerable time and resources to find Bernard: luckily he hasn't gone too far from the concert area.

4.2.1.5.2. Crowd management

Jesper is part of the **security staff** in Tivoli. He is one of the **crowd managers** and he supervises his colleagues at the three gates. Tonight, one of the biggest concerts for Friday Rock will take place and about 33,000 people are expected. He has just received information by radio that the queue outside Tivoli at the secondary gate in Bernstoffsgade is very long, and that hundreds of visitors waiting outside are creating problems for pedestrians, cyclists and cars. The security staff on site is trying to organise the queue in a proper way, but the situation is becoming critical in Bernstoffsgade. Jesper informs the **CCC** about it and after a few minutes, the decision is taken: the crowd must be redirected to the main entrance at Vesterbrogade and to the third, minor entrance, at H.C. Andersen's Boulevard. The two security staff members outside the secondary gate are promptly informed about it, so they start soliciting the concertgoers to move to the other two entrances. They walk around, shouting out and requesting the concertgoers to move to the other two gates. The concertgoers slowly start walking towards the other two gates and after around 40 minutes, the situation goes back to normal: the queue is still long, but at least the street and bike line are clear.

4.2.1.5.3. Sound management

Thomas has been working as **head of production** in Tivoli for many years. Among other tasks, he's responsible for the sound management during the events in the park, including the Friday Rock concerts. Together with his production team, he is responsible for the concert sound levels not exceeding the limitations imposed by Copenhagen Municipality's Environmental Agency, while at the same time providing optimal sound levels for the performer as well as audiences. Thomas and his team have perfected a system that ensures concert sound emissions do not exceed the limit set by the Municipality, and practically eliminated neighbour complaints. Yet at times Friday Rock faces negative feedback from audiences and performers who do not believe sound levels are high enough inside the park. Some performers will not play at Tivoli due to this circumstance. In total, Tivoli needs the combined support of the Municipality, performers, concert goers and neighbours to ensure a continued positive recognition of Friday Rock. The limit imposed on Tivoli is 77 db (A) LEQ 60 minutes, which is measured on the roof of the Tivoli Concert Hall, located approximately 130 metres in the opposite/southern direction of the outdoor concert stage. Tivoli rents its complete top-of-the range speaker system setup from one supplier and tries to aim sound emissions from these speakers so that it is directed towards audiences yet limits outflow unto Tivoli's southern perimeter. Tivoli's infrastructure, audiences, meteorological conditions among many other factors affect the movement of sound from the speakers, requiring a constant surveillance and control of sound levels in accordance to the limitation.

4.2.1.5.4. Providing assistance in a noisy environment

Karin works as **nurse** in Tivoli and tonight she's on shift. From experience from other Friday Rock concerts, she knows this night's shift may be busy which means there's a good chance she will be contacted for some emergency interventions. Tonight's concert is with the international American rapper Snoop Dogg, and is therefor associated with certain guest behaviour and risk. She expects that many **concertgoers** may be significantly influenced requiring assistance. It's 22:30, the concert has just started and she has received the first call. It's a young man who fainted: Karin diagnoses ethylic coma and requests an ambulance for him. After 15 minutes another call for her, and then another one. At the fourth call for intervention, Karin is very annoyed by the loud music, the crowd and the upbeat atmosphere making it difficult for her to carry out her work. Now finally the concert will end soon and Snoop Dogg and his band are pumping up the volume for a great conclusion. It is now very difficult for Karin to understand what her new patient is saying to her: he's drunk, disoriented and doesn't talk clearly. She would really need to operate and communicate in a quieter area, but near the concert zone it's not possible.

4.2.1.5.5. Guest counting at the concert stage

Steffen works in the **crowd management** staff in Tivoli and one of his tasks is crowd monitoring of the main stage area. It's Friday and there's a concert on the main stage. The audience is approaching and Steffen and his colleague are on the west side of the area, connected by radio with their colleagues on the opposite side and with the **crowd manager** in the control room. The concert is about to start and Steffen and the rest of the crew have to estimate how many guests have already occupied the concert area. The maximum capacity of the garden is 43,000 visitors and they know that around 25,000 people can fit in the concert area so the crowd management staff has to be careful not to exceed this number, for security reasons mainly. Steffen and his colleagues have a long experience in crowd counting estimation, but still, for some events they need more time for the assessment: the crowd is fluid, the movements between the bars and the stage area are continuous. Their counting technique for the concert area does not imply the use of any technology, rather approximation so every now and then it takes some time for Steffen and the colleagues to come to an agreement about the guest counting there. Tonight this is definitely the case.

4.2.1.5.6. Fight detection

Viggo is one of the **security staff members** in charge of the control room. Tonight there is a Friday Rock concert and he is busy looking at all the videos from the cameras displaying the situation from the crowded stage area. Suddenly, he notices a change in the behaviour of the people in the west side of the area: he's not sure because it's getting dark now, but it seems that a small group is too "lively". He gets in touch with his **supervisor** and they agree on alerting the field security staff in the stage area. Through the radio, Viggo indicates to his colleagues where the critical point is. After some minutes, the staff is there and confirms that actually a fight is ongoing among too drunk concert goers. Viggo's colleagues manage to eject the people involved in the fight from Tivoli.

4.3. Hamburg

4.3.1. Port Anniversary

4.3.1.1. Pilot Summary

The Port of Hamburg is the most important port in Germany, and one of the leading cargo handling centres in the world. Each year, more than one million visitors from Germany and abroad come to the Hamburg Port Anniversary (http://www.hamburg.de/hafengeburtstag-english/) to join the atmosphere generated by ships from all parts of the world in the heart of Hamburg. The attractions of the Port Anniversary extend six kilometres along the waterfront and include displays on both land and water. There are more than 200 programme items on shore, with music, cultural and culinary displays, and a wide range of activities.

4.3.1.2. Challenges

At present, vehicles have to register prior to the event in order to have access to the restricted area. If unregistered, the vehicles that need access to the zone have to pass a time-consuming process between the present staff, the control room and stand owners.

The internet connection is not very good in the event area: internet disconnects often during the event, so all the stakeholders have restricted internet access. Cellular network does not always work either.

Sound management: the sound level can be too high during the event.

High crowd density during the event: children get lost easily and it is especially exhausting for elderly or disabled people to move around or to take a rest.

4.3.1.3. Interests

The following points list general topics or applications for which this pilot expressed interest during the interview sessions, pilot visits or questionnaires. It is important to know that this information might change, adapt as the project evolves:

- Real-time display of noise levels or sound field data to show where the “rest areas” are (silent and less crowded areas).

- Devices/tools to locate missing children in crowds (via radio).
- Devices/tools to speed up the process of permitting access of unregistered vehicles to the restricted area.

4.3.1.4. Stakeholders

Name	Description
Event organiser (Authority for economy, transport, innovation - Department for event organisation of DOM and Port Anniversary)	It is the local authority in charge of all security issues, of the event design, planning and execution. It is also in touch with sub-organisers to make sure that they comply with the rules and regulations.
Authority for environment and energy	It is the local authorities in charge of sound issues. It is in touch with the event organisers to make sure that they comply with the rules and regulations. It also deals with citizens' complaints.
Local District Offices (Bezirksamt Altona / Mitte)	It is the authority responsible for the permits, licences from the municipality; it is the contact point for contradictions against administrative decisions (i.e. from citizens in terms of complaints for noise, etc.)
Market supervision staff	Two responsible persons from authority / local district office are always present during the event (Rotation system), patrolling along the venue.
Police	In charge of the security of the event venue and its surroundings. They are also present in the control room.
Fire brigade	It is the corps in charge of the security in the venue area. They are also present in the control room.
"Security task force" in the control room, coordinated by: Authority for economy, transport, innovation: Department for Event Organisation of DOM and Port Anniversary	It is the local authority that coordinates all the several stakeholders involved in the security of the event venue. It is present in the control room. There are two security divisions: land and water in which several actors are involved: Land: Hamburg Port Authority, Wasserschutzpolizei (River Police Hamburg), Bundeswehr (Military), Police, Fire Brigade; Water: Technisches Hilfswerk (Federal Agency for Technical Relief): public social aid, Fire Brigade, Hamburg Port Authority, Deutsche Lebensrettungsgesellschaft -DLRG (water rescue association) These actors are sufficiently connected via mobile radio communication.
Visitor	He/she is the event participant. Any age is in this group.
Stand owner	He/she is the entrepreneur who owns the amusement rides, food truck, or other private business in the event venue.
Private security company "Securitas"	Under the supervision of the event organisers, the private security is responsible for controlling the security zone.

Table 5 - Stakeholders for Port Anniversary.

4.3.1.5. Scenarios

4.3.1.5.1. Rest areas needed

Linda (**visitor**) is a 60 year old woman from Lübeck who is in Hamburg to visit her son who studies there at the University. She has chosen this weekend because she wants to see the Harbour Port Anniversary. It has been years since she tried to arrange the trip to Hamburg to participate to that amazing event, so she is very glad that she could finally make it with her husband. It is a warm day and Linda decides to walk from her son's apartment to the venue. It is a long walk and when she approaches the area, she realises that she chose the wrong pair of shoes. But never mind, she really wants to enjoy the day. The music, the old ships, the unbelievable food offer…everything makes this happening unique and Linda and her family are really trying to see as many things as possible, although the crowd is massive: there are people everywhere, and after more than two hours in that confusion, Linda starts to feel tired: the music is now just noise to her, the smiling people are annoying, and the smell of the food stalls start nauseating her. Linda needs to rest, to sit somewhere, to enjoy the quietness for a while because all this is becoming too much for her and it is not funny anymore. The family starts looking for a quiet corner, but there are people everywhere and they simply cannot find a place where the mother can rest for a while. They decide that for today it has definitely been enough and start walking away from the venue. Only on the way home, far from the harbour, they find a quiet cafe where to sit and enjoy the silence for a while.

4.3.1.5.2. Lost child

Franziska (**visitor**) is from Hamburg and every year she goes to the harbour to see the ships parade. It is a big event in town and she would not want to miss it for the world. Year after year, the number of visitors who turn up in Hamburg to experience the event increases, and Franziska – while walking towards the harbour, has the impression that the confusion has never been as high as today. But maybe it is just that she is not used to the crowd since she normally tries to avoid extremely crowded places. Close to a food stall, a little girl is crying. She seems to be lost and without parental care. Franziska decides to approach her to understand the problem. Franziska asks for the girl's name, age and where her parents are. The girl cannot stop crying, cannot talk, she is panicking. Franziska tries to calm her down. She starts looking for help, for a security officer who could assist her and the girl, but the confusion is high and she cannot see anybody. The only idea Franziska has is to ask for the help of a **food stall owner**, who suggests her to look for a paper bracelet on the girl's wrist: normally staff members of the mobile info team and stand owners distribute these paper bracelets to parents so they can write their phone number on them. In this way, people finding a lost child can easily reach the parents. Franziska luckily finds the bracelet and promptly calls the number. However, no network is available and the connection breaks down twice. When she finally gets through to the girl's father, the loud music and high sound level make it difficult to communicate. It also takes a while for Franziska to exactly explain where she is, but finally the parents arrive and the girl can go home with them.

4.3.1.5.3. Vehicle has to access the venue area

Karl works as a **security officer** for a private company that is often hired by the Hamburg Municipality. Today he has been assigned to the Port Anniversary, one of the biggest events in the city. Basically, all his colleagues are involved in it. He has participated in several meetings where all the staff has been trained specifically on this event. He is in charge of one of the restricted area's entrances. At 2 pm, a car approaches the entrance and Karl stops it. The **driver** is very nervous and explains that he has to deliver an additional amount of 300 sausages to a food stall. Due to the high number of visitors, the food stall has run out of food supplies. Karl checks on his list, but the vehicle has not been registered. All those who want to have access to the restricted event area have been requested to register in the previous days. The driver explains that he actually has not expected to use the car but now it is very urgent and hungry visitors are waiting. Karl now starts a time-consuming procedure. He begins by checking the vehicle's plaque, the driver's ID, and calling the **control room** via radio to explain the situation. The control room then communicates with the **food stall owner**. As he is not connected via radio, a nearby **staff member** has to walk through the crowd to the food stall to talk in person. Meanwhile, a small traffic jam has developed behind Karl as the vehicle blocks the road for others. Back in the crowd, the security staff confirms the food stall's order to the control room and from there, the permission is communicated to Karl. The driver is finally allowed to enter the restricted event area. The food stall owner and his hungry customers had to wait for 20 minutes.

4.3.2. Hamburger DOM

4.3.2.1. Pilot Summary

Hamburger DOM is Northern Germany's biggest funfair with 7-10 million annual visitors during the 91 DOM days. The funfair takes place in the premises of the Heiligengeistfeld with a total of 251 attractions. (http://www.hamburg.de/dom/).

4.3.2.2. Challenges

Guarantee the visitors a high level of security during the event. In the past years, Germany has been a terrorists' target, so there is an urgent need to adopt effective measures to prevent any attack.

Crowd management: on some days, a peak of 250,000 visitors can be recorded. At the moment the staff manages the event only with radios.

Sound management: in the past, complaints have been reported to the municipality and the organisers had to move some of the most noisy rides to an area of the park adjacent to a less densely populated zone. The concentrations of hundreds of thousands of people, the music, the congestion noise: all contributes to make Hamburger DOM a quite demanding venue in terms of health and sound for the visitors, the staff and the neighbours too.

Communication infrastructure: the present communication infrastructure has a low standard and is out of date, making communication between the event organisers and operators difficult and inefficient.

Acoustic announcement system is so far non-existent.

The development of a security concept is under way. In general, there are many opportunities for MONICA to get involved in this planning.

4.3.2.3. Interests

The following points list general topics or applications for which this pilot expressed interest during the interview sessions, pilot visits or questionnaires. It is important to know that this information might change, adapt as the project evolves::

- Cameras that can capture images and behavioural characteristics.
- Crowd size estimations.
- Heat maps for crowd behaviour visualisation.
- Real time display of noise level and/ or sound field data to individuate the “rest areas”.
- Devices for the security staff and first aid workers to be guided through crowds to spot disturbances or injured people. These should enhance the overall communication among responsible stakeholders on the ground.
- App/tools/devices for the child lost situation (network is working in the DOM area).

4.3.2.4. Stakeholders

Name	Description
Event organiser: Authority for economy, transport, innovation - Department for Event Organisation of DOM and Port Anniversary	It is the local authority in charge of all security issues, of the event design, planning and execution.
Authority for environment and energy	It’s the local authorities in charge of the sound issues. It’s in touch with the event organizers to be sure that they comply with the rules and regulations. It deals also the citizens’ complaints.
Local District Offices (Bezirksamt Altona / Mitte)	The responsible for the permits, licences from the municipality gives permission for transaction of the event to the event organizers and it is the contact point for contradictions against administrative decisions (i.e. from citizens in terms of complains for noise, etc.)
Market supervision staff	Two representatives from authority/local district office are always present during the event (Rotation system), patrolling along the venue.
Police	In charge of the security in the event venue and its surroundings.
Fire brigade	It’s the corps in charge of the security in the venue area.
Private security organization (same as Port Anniversary)	Patrolling along the event, also responsible for protecting the 9 main exits and the parking lots around the venue.
Visitor	He/she is the event participant. Any age is in this group.
Stand owner	He/she is the entrepreneur who owns the amusement rides, food truck, or other private business in the event venue.

Table 6 - Stakeholders for Hamburger DOM.

4.3.2.5. Scenarios

4.3.2.5.1. Fainting at the fair

Jonas (**visitor**) is a pensioner who lives in Hamburg. Every year, he visits Hamburger DOM during the summertime: it is a long-lasting tradition that has started with his children and now goes on with his

grandchildren. As the years have passed, he feels more tired during the event: it is an open-air fair and very hot in the summertime. Maybe he is getting too old for this. Jonas also perceives the noise higher and more annoying every year. But it does not matter, Jonas wants to be faithful to the family tradition. Today, the sun is shining with 25 degrees. After two hours standing, walking, dealing with the crowd, Jonas starts feeling dizzy and finally faints. The family looks for help immediately and, luckily, some **workers** from the closest stands come to check the situation and take Jonas to a restricted emergency area located in the centre of the DOM. Meanwhile, a couple of visitors run to one of the gates to inform the **security staff** about Jonas' status. The security staff requests by radio the intervention of the **ambulance** which is parked in the Hamburger DOM area. However, before the ambulance can reach Jonas, it must pass the emergency entrance which is blocked with a vehicle from the private security company to keep off unwanted intruders. Once in the DOM area, a crowd of visitors block the vehicle's way and it can only slowly find its way. After around 20 minutes, Jonas is inside the ambulance. Before heading to the hospital, the ambulance has to take the same difficult route out of the DOM zone.

4.3.2.5.2. Lost child (similar to Port Anniversary)

Same scenario as with Port Anniversary except from the fact that the mobile network is working due to less visitors.

4.4. Leeds

4.4.1. Headingley Carnegie Stadium

4.4.1.1. Pilot Summary

The iconic Headingley Carnegie Stadium is the location for the Leeds Pilot and is situated in the suburb of Headingley in Leeds, West Yorkshire, England. It is home to Yorkshire County Cricket Club (https://yorkshireccc.com) and Leeds Rugby (http://www.therhinos.co.uk) and the only stadium in the world that hosts three different, and very successful, professional sports –Leeds Rhinos Rugby League team, Yorkshire Carnegie Rugby Union team and Yorkshire County Cricket team. Recently a Women's Cricket Superleague team – the Yorkshire Diamonds – was established which plays in the National Women's Superleague.

The Stadium hosts international fixtures in both codes of rugby (capacity of 21,000) and cricket (seated capacity of 17,500), attracting international audiences from around the world. Last season (2016/17) the Stadium welcomed over 500,000 visitors with little incident.

4.4.1.2. Challenges

The key focus for the stadium is maintaining and enhancing the enjoyment of the visitors by providing a 'first class' visitor experience within a safe and secure environment. The main challenge is the busy and complex sporting calendar and ensuring the appropriate service is provided for the end user. In addition, the location poses some challenges in relation to crowd safety management.

On some match days both cricket and rugby matches are in play which can cause logistical challenges. In addition, steward numbers increase to meet the additional visitors requiring stewards to be used who are unfamiliar with the stadium.

The stadium is looking to further enhance security in the context of the day to day management of crowds but also to increase its preventative measures in the event of extreme threats such as acts of terrorism. They wish to increase their security and communication capability by introducing state of the art methods for automated image and video analysis and situational awareness to support the control centre staff as well as the stewards who mingle with the crowds. The goal is to increase the number of detected and speed of response to events that pose a threat to security inside the stadium and its immediate surrounding e.g. identifying cars unusually stationed near entrances. In the case of an emergency e.g. a major threat,

Headingley Carnegie Stadium has in place an evacuation strategy that uses loud- speakers as the primary means for informing and directing the crowds to exits.

4.4.1.3. Interests

The following points list general topics or applications for which this pilot expressed interest during the interview sessions, pilot visits or questionnaires. It is important to know that this information might change, adapt as the project evolves:

- Headingley Carnegie Stadium strives to become a police-free stadium. In order to achieve this, they have to prove that they can handle security on their own based on records. This would reduce costs (expensive to have police presence) which could be utilised to provide more training of stewards (upscaling of stewards)
    - stewards being able to report directly to control in a crisis
    - need for sending key short messages quickly in case of evacuation/ emergency. Currently radios and coded messages through the PA system are used
    - provide stewards with stadium detail and updated information in real time for easier decision making and customer care (see also 'Customer Experience App')
    - voice activation/picture recognition is desired and could support the easy usage of equipment for staff members who come from various backgrounds
    - improve speed and reach of 'lost child' description circulation to avoid lock down situation which is expensive and time consuming
- Headingly Carnegie Stadium would like to monitor flow of people within the grounds for stadium logistics (re-route people to the most appropriate entrance or exit to avoid crowds and make crowd movement as smooth as possible) or to inform people of alternative routes, bars, etc. (also for commercial purposes), see also 'Customer Experience App'
- Real-time tracking of staff to aid with location of incidents and staff welfare
- Cameras outside the stadium to monitor outside crowd movement, particularly St Michael's Lane and the railway bridge exit routes
- Integrated access control:
    - new automated turnstiles
    - vehicle recognition, suppliers ID (wristband?), car parks linked to some kind of recognition/ registration
    - scanners
- Provide visitors with a multifunctional 'customer experience app' that provides different services while at the same time engages the visitors with the stadium and in their personal safety. The app could feature:
    - real-time information such as busiest travel routes, weather warnings, major incidents etc.
    - historic information such as Stadium Plan, team sheet, competitions etc.
    - customer experience driven - interactive / friends alert
    - guide people on foot to and from the stadium from train station, buses
    - update information on when cars can leave (following pedestrians)
    - customised to suit International matches and visitors from other countries
    - alert feature in case of emergency
    - panic button and location sensor
    - car park passes and ticketing
    - cashless payments
    - commercial possibilities (sponsors, sales, competitions, marketing etc)
    - during construction re route around building works
- Headingley Carnegie Stadium would like to get a license to host large concerts, but since the stadium is not able to control sound, they are interested in some form of sound control

4.4.1.4. Stakeholders

Name	Description
Spectator	Any attendant that accesses the stadium to watch a game. Can also be a child.
Steward	Event safety staff member. Role: to ensure anyone coming to the stadium either to work, participate in the event or as a paying spectator, feels safe and welcome.

Supervisor	Head of a team of stewards.
Ground Safety Officer (GSO)	Head of all safety staff members. Responsible for establishing suitable systems and controls for the safety and security of spectators attending at the stadium. Ensures compliance with the terms and conditions of the current safety certificate and the Club's Safety Policy Statement.
CCTV operator	Monitoring all CCTV cameras. Able to retrieve recorded footage.
Complainant (spectator)	A spectator that files a complaint for example: smoking, bad behaviour, etc.
Complainant (neighbour)	A neighbour living in the residential areas around the stadium that files a complaint about for example noise, parking, bad behaviour etc.
Response team	To ensure all requirements of Safety Certificate and ground regulations are met at all times. Conduct vehicle searches; responsible for removal of disruptive customers. Notify Control of any incidents of concern.
Event Control	Responsible for safe operation of G4S for the duration of the event and is the main link between G4S and the customer.
Police officer	Policemen in charge to supervise and control the stadium and the area around the stadium, included policemen in normal clothes. They can be part of the several involved bodies. Each of them refers and reports to the coordinator at the CC via radio.
Anti-corruption official	To ensure all requirements of Safety Certificate and ground regulations are met at all times. Monitor egress and access to restricted areas within the dressing rooms. Check and adhere to Anti-Corruption Protocols at all times.
Fire brigade	Representatives of the fire brigade during the event.
Health worker	Professional and/or volunteer in charge to provide first aid and health assistance to the spectators and staff, in case of need. Ambulance people included.
Health/safety officer	Coordinator of the health workers assigned to the event. From the CC, he/she coordinates the health workers, the actions as well as the ambulances and equipment available in the stadium.

Table 7 - Stakeholders for Headingley Carnegie Stadium.

4.4.1.5. Scenarios

4.4.1.5.1. Lost child

Ed (**spectator**) has a season pass/ticket and attends every game with his family (wife Eva, son James and daughter Marian). In 20 years he has has only missed 2 games. Ed decides to buy some drinks and burgers for their kids and takes Marian with him. At the burger bar, he loses sight of Marian and can't find her anymore. He panics and runs to the nearest **steward** (Oscar) and tells him that he has lost his daughter. Oscar stays calm and reassures Ed that they will do everything to find her as soon as possible. Oscar finds his **supervisor** who directly contacts Kim, the **Ground Safety Officer** (GSO) in the control room by radio while providing the child's name, age, accompanying person's name, child's address or name of school/ group, a physical description and where and when the child was last seen. Oscar asks for Ed's name and a contact number and any other useful information he wishes to give. He also asked for a photograph. Kim sends out a message to all supervisors and **gate managers** to ensure that no little girl has made her way to the exits. Cameras will be positioned. During a lost child incident no child must leave the stadium unchallenged. All staff must remain vigilant and assist in the search for a lost child. Also all exits will be locked down immediately. Supervisors brief all stewards to look out for a an 8-yr old girl (based on description). Within 10 minutes Marian is found and reunited with her family.

4.4.1.5.2. Racism

During the game all of a sudden a **spectator** (Chris) starts to offend the referee by shouting insulting comments because he's black. Since racism is against the law, the stadium has established a regime of

"zero tolerance" with regard to racist behaviour of any type. Spectators are reminded that racially abusive comments and actions will result in ejection from the ground and possible further action such as criminal prosecution, identification by way of photographing and/or capturing by video camera of the images of such persons and life-bans being imposed on such persons. James, another spectator doesn't like this at all and goes to Dean (**steward**) to tell him about the offensive behaviour of his neighbour spectator. Dean asks James for his name and his seat/row number and ensures details of any potential witnesses are retained. Dean is not taking any action towards Chris and speaks to his stand **supervisor** Josh, who contacts **Event Control**. Josh gives a description of the problem and Chris' seat and row number. Jim (**Safety Officer**) deploys additional team members to observe the incident in an attempt to hear and record the offending comments - this enables a prosecution to be more easily carried out. CCTV will also record Chris and location and Josh comes to assist Dean. When Event Control is satisfied that an offence is being committed, Chris will be apprehended by **security officers**. Dean, Josh, Jim and any other staff involved in the incident complete an incident report. **Security & Response Teams** will apprehend offenders for action by **Police**. This maybe followed by an ejection scenario.

4.4.1.5.3. Banned person

Sam (**spectator**) loves a good game and he loves some riot too. This has resulted in him being banned from the stadium. He's eager to go to the game and he dresses up so that the stadium staff won't recognise him. He puts on a hat and a pair of sunglasses. Banned persons are checked manually/visually, with a photograph or by checking their social media profiles. **Event Control** checked Sam's Facebook page prior to the game and he was posting that he would try to get in in disguise. Event Control issued a photograph of Sam during the **supervisor**'s briefing. Josh showed this photograph to all the **stewards** in his team. When Sam arrives at the gate, Joel who just started as a steward sees him and think he looks funny but Sam's appearance doesn't ring a bell. He lets Sam enter. During the game Sam starts a riot with some of his friends. This incident is picked up by the CCTV cameras and Event Control recognises Sam. Event Control contacts William, the supervisor nearest to the incident and Lin, **head of the Security Team** to assist in escorting Sam to the nearest exit gate. William asks Sam to hand over his ticket. Once Sam has left the stadium William reports back to Event Control with Sam's description for the benefit of external radio holders. Event Control will then monitor Sam on CCTV and off the premises. A detailed incident report is submitted by William to the **Safety Officer**.

4.4.1.5.4. Looking for staff

Supervisor Nick is called by **Event Control** because an emergency phone call has been received that Aileen's (**steward**)father has been admitted to the hospital due to an accident. Nick is asked if he can pass this message on to Aileen. Not sure if Aileen is on duty during this game, Nick asks Event Control if Aileen is really working during this game. Event Control checks the paper staff list and confirms that Aileen checked in. Nick is looking for Aileen but can't find her. He asks several of her colleagues but they don't know where she is. Aileen had an asthma attack and went to First Aid without notifying Nick, because she forgot to take her medicine with her. Aileen doesn't know she is being looked for and is recovering from the attack after having received some medicine. When she feels better she returns to her post. Mike, a colleague, tells her that Nick was looking for her. She realises that she should have notified Nick and she doesn't dare go to him and stays on her spot. After some time, Nick sees her and runs towards her, a little agitated because she left her post without notifying him but he decides not to become angry because of the news he's about to tell her. Nick tells Aileen that her father is in the hospital and that she needs to call her mother as soon as possible.

4.4.1.5.5. Evacuation

4.4.1.5.5.1. General stewards

While he's having a break, **general steward** Philip in the north stand hears the standby emergency message repeating on the PA and knows that there is an incident or emergency. He knows he must return to his post and await further instructions. Philip immediately starts identifying possible exit routes for people in his area and sees some spectators forming an obstruction. He walks over to the spectators and tells them to move away and go to their allocated seats. From the code words that are used, Philip knows that a suspect package has been found in the north stand. It seems to be serious because an evacuation (code words) is announced repeatedly on the radio. He goes to his **supervisor** who tells him that there will be a partial evacuation from the north stand to a designated area. As the message over the PA to inform public and staff to commence an evacuation is repeating, Philip returns and remains on his allocated post and starts directing **spectators** clearly to the designated area saying clearly "This way". He doesn't stop answering questions and takes care that spectators leave without delay. He sees a mobility impaired man and helps him to leave safely. After his area is clear, Philip follows the last spectators to ensure they leave the north stand.

4.4.1.5.5.2. Entrance gate staff/turnstiles stewards

Entrance gate steward (Amanda) hears the standby emergency message repeating on her radio and the PA and knows that there is an incident or emergency. As she must stay on her post she decides not to have her break and await further instructions. Amanda prevents entry into the ground explaining people that an incident has arisen in the ground that is currently being dealt with. From the code words that are used, Amanda knows that there is a fire in the south stand. She closes the turnstiles and keeps any cash inside/ locked. The public is now informed that due to unforeseen circumstances it is no longer possible to continue with today's match and that they have to make their way quickly and calmly out of the stadium using the nearest exit indicated to them by a steward. Amanda forms a cordon outside the ground and asks **spectators** to move well away from the entrances in order to prevent re-entry. As the evacuation takes place and the stadium is locked down, she hears that someone inside the stadium had a heart attack and that an ambulance is on its way. As she is also responsible for the emergency services entrance gate, she makes sure this is opened once the ambulance has arrived. After all people have been evacuated from the ground, a coded message on Amanda's radio indicates that all is safe, so she can return to her normal duty and have her well-deserved break.

4.4.1.5.5.3. Disabled area stewards

Disabled area steward Barbara is on her post as she hears the standby emergency message repeating on the PA and knows that there is an incident or emergency. She prepares for evacuation and ensures there are no obstructions on escape routes that may impede wheelchairs etc. After a few minutes the evacuation message (code words) is announced. From the code words that are used, Barbara knows that there is a fire in her stand and that she needs to start directing and assisting **disabled spectators** to the nearest exit. She is aware that there are some local restrictions that mean disabled spectators in these particular areas are to be evacuated after other spectators to make sure they are not slowing down evacuation. Depending on the emergency they may have to remain in refuge areas. Barbara reassures the disabled spectators that this is not unsafe. After her area is cleared, Barbara awaits further instructions from her **supervisor**.

4.4.1.5.5.4. Response teams

Beth and John are on duty in one of the **response teams**. Suddenly they hear the standby emergency message repeating on their radio and they know that there is an incident or emergency. Shortly after the announcement Beth and John proceed to the tunnel area to assist **players** and **officials** in case of evacuation. After a few minutes the evacuation message (code words) is announced. From the code words that are used, Beth and John know that there is structural damage in the north stand and via Event Control they have been informed that spectators need to be evacuated from the north stand to the pitch. They have to transfer players and officials to a designated place of safety: the Rugby Players' Tunnel. When a new message on Beth and John's radio indicates that all is safe, they will return to their normal duty.

4.4.1.5.6. Problems with supporters

Kim is **Ground Safety Officer** (GSO) and is a little nervous today because today's game is considered to be a high-risk game. The **supporters** of the team visiting the stadium are known for their 'wild' behaviour. Kim is in touch (phone) with the **police** at the pub area and until now everything is pretty quiet. One of her subordinates Hugh is checking the social media profiles of some notorious supporters and discovers an appeal to riot once they have entered the stadium. He notifies Kim who calls up the police at the pub area to make sure they are on the lookout. She also sends a photograph of the 'hooligan' (Tony, **spectator**) by means of WhatsApp to the police officer in charge. Ken, the police officer, discovers Tony in the crowd and notices that he's having a good time, but already had too much too drink. Ken instructs one of his colleagues Harry to keep an eye on Tony, especially when they are leaving the pub. As the game is about to start, the majority of the people decides to leave the pub and they join a large group of people all heading to the stadium. Harry keeps walking near Tony to make sure he stays calm. He sees that Tony is starting to get excited and starts yelling all kinds of anti-hometeam stuff which annoys a large part of the other people walking to the stadium. Harry contacts Ken and lets him know that Tony is starting to be a nuisance to others. Ken contacts one of his colleagues at the entrance of the stadium and lets Kim know that Harry is about to enter the ground and that he is already bothering people. Kim notifies Amanda (**steward**) about this and makes sure that she receives a printout of a photograph. She also decides to open the gates to the facilities (not the stadium) to decrease the pressure at the entrance gates. Once Tony has arrived at the entrance there is still quite a large queue which pisses him off. Tony starts to call names and picks a fight. Amanda recognises him and calls (radio) Kim for assistance. Kim sends a response/security team to the right entry gate. They successfully calm down Tony so he's admitted to the ground. His seat/row number is communicated to Kim who ensures that Tony stays calm and behaves appropriately. Tony is quiet during the game and leaves without causing any issues after the game has ended.

4.4.1.5.7. Turnstiles failure scenario

Amanda (**steward**) is working at the turnstiles. Suddenly the turnstiles lose power. Amanda contacts her **supervisor** Gary to notify him of the power failure. Gary contacts Kim at **Event Control** who tells Gary to switch turnstiles staff to the big gates and provide them with hand scanners so people can still enter the ground without causing too much queues. After 10 minutes the power failure is solved and entry through the turnstiles is restored again.

4.4.1.5.8. Search people scenario

Jill is an **entrance gate steward** and needs to search people after coming through the turnstiles. Today there is an international match so every person and all bags need to be searched throughout the entire day of the match, as briefed by the Safety Officer. Tim (**spectator**) is coming through the turnstiles. Jill asks Tim politely to consent to being searched (condition of entry). She first searches his backpack and his cool box and checks for prohibited items or items with the potential to cause harm. She finds an unsealed plastic bottle and tells Tim this bottle can't be admitted. Tim nods, he's ok with that. Jill throws the bottle in a large bin. Once Tim's belongings have been searched, he's asked to consent to a personal search. Tim is OK with that. Jill clarifies that Tim doesn't have any sharp objects or items upon him that may inflict injuries. During the search Jill has a nice conversation with Tim. Jill can't find anything, so Tim is allowed to enter the ground. Jill continues to search belongings and people during her duty.

4.4.1.5.9. Prohibited item

Tom (**spectator**) doesn't have a very good day. He's picking fights with people around him and is annoying the hell out of them. One person tells him to stop being such an idiot. In spite of the search at the entrance gates, Tom has managed to get a knife into the ground. He pulls it and suddenly people are making way. Fred, a **CCTV operator** notices this and calls the **police** and the **response team** (a.o. John). They head for the right location right away and move people away from Tom. The police then handles Tom who gets arrested.

4.4.1.5.10. Fight detection

Brian, a **CCTV operator** in the control room, notices a change occurring within the crowd on the south stand. He zooms in with the nearest camera but doesn't seem to get a good picture of what is happening from this area due to the fact that there is no constant light (twilight zone). This causes bright and dark zones which makes the clarity of the recordings quite bad. He switches over to another camera to see if that gives him a better picture. It looks like people are fighting. Together with Kim (**Ground Safety Officer**) he quickly decides to send a **response team** to that location as fast as possible. The response team confirms that there is a fight and ejects the persons from the ground using the nearest exit.

4.4.1.5.11. Flare detection

Josh, the **stand supervisor**, sees people lighting flares on the western terrace. There are too many of them to deal with so he contacts Kim (**Ground Safety Officer**) at Event Control to ask for assistance of a **firefly** (Ray) and a **response team**. Brian, a **CCTV operator** in the control room, positions the right cameras and sees who is lighting the flares. Since the use of any type of flare is illegal, the response team ejects the persons from the ground at nearest exit where they will be arrested.

4.4.1.5.12. Post-event complaint

Elizabeth (**spectator**) is at a game, the atmosphere is great and her team is winning! She would be so happy if it wasn't for some people that are smoking all the time. She can't understand that people ignore the smoking ban and that no-one from the stadium staff is doing something about it. After the game, when she is at home she decides to send an official complaint to the stadium. She includes her row/seat number. Maria, the **complaint handler** will check the event log file and also checks camera footage and sees Elizabeth's complaint is more than justified. She apologises to Elizabeth on behalf of the stadium and offers her a voucher for merchandise. Maria will also check which **stewards** (including **supervisor**) and makes sure that they receive feedback so they will improve monitoring during future events.

4.4.1.5.13. Parking on the ground

Paul (**spectator**) is traveling to the stadium by car. He's late and he doesn't want to cruise around the area looking for a parking spot. He decides to try to get into the stadium car parking. When he presents himself at the gate he makes up a story that he is on the list and should be admitted to the parking area. Amanda (**steward**) checks the list and can't find his name/license plate, so she kindly tells him that he can't park his

car inside the grounds. He starts a discussion that something must have gone wrong and asks if she can recheck. Amanda calls Toby, who is the only **one that can authorise additions** to the list. He confirms that Paul is not to park on the grounds. In the meantime a queue of cars wanting to enter the car park area has formed. They start to honk and are getting impatient. Paul can't back up so a jam starts. Only when all the cars have backed up a little, Paul manages to drive out of the queue. 30 minutes later he finds a parking spot in the residential area. He's late for the game.

4.4.1.5.14. Ejection

Tony (**spectator**) keeps standing in a seated area, even when fellow spectators have asked him to sit down. He is therefore breaking the ground regulations. John (with the rest of his **response team**) is sent to John to warn him and have him sit down. **Event Control** is monitoring any action on CCTV and to be sure that everything is recorded, also sends Mick (**steward**) who is wearing a body camera. John introduces himself and his role. He's informed a colleague, because he is not allowed to act by himself (also a direct witness in some cases is needed). John informs Tony why his behaviour is in contravention of ground regulations and states clearly that he should refrain from this behaviour and may be asked to leave the stadium if he continues (classed as a "warning"). However, Tony persists in standing up. John updates Event Control at all times while he's dealing with the situation. Since Tony refuses to sit down, he is ejected from the premises with the help of a **security team**.

4.4.1.5.15. Truck attack

Background: as seen in Nice, London and Stockholm, trucks can be used to conduct terror attacks.

It is "rush hour" just before an international game with approx. 15,000 tickets sold. Thousands of people – children, elderly, young people - are standing by the entrances, waiting to get into the stadium, when a truck (**terrorist**) comes with high speed, driving along the sidewalk and queues. It drives recklessly, and purposely injuring and killing people and damaging the venue. **Stewards** are also hit – some killed, other injured. Police cars are called to the site by the control room within approx. 30 seconds and arrive within just a few minutes. The Fire Department is also alarmed immediately, and 5 trucks arrive within 7 minutes. Ambulances arrive within 4 minutes. The truck continues its mission to damage, injure and kill as much and as many as possible. **Crowd**, stewards, **security personnel** and other staff have no methods, arms or equipment to stop the truck. Thousands of people panic and run, many injuring themselves and others, tripping, falling, crying. Some people crawl up in trees, on top of buses etc. to save themselves. Some broadcast live on Facebook, others film the attack and take pictures. The **police** are using their firearms, before managing to kill the attacker without any bullets hurting innocents. The press arrive within 8 minutes, filming dead people before their relatives have been informed, and asking questions to people before the police.

4.4.1.5.16. Bag suspect

Background: bags with a broad range of possible weapons are often used to commit attacks and other crimes.

A ticket holder (**spectator**) entering the stadium during "rush hour" carries a backpack, which he refuses to open for the steward. The person appears determined and harsh in his attitude and walks through the security ignoring the **steward**´s request completely.

4.4.1.5.17. Ticking bag

Background: bags are often left in public places and oftentimes people ignore these, assuming "someone probably forgot it" or "not my responsibility" rather than realising and acting on the actual security risk.

A large sports bag is left in the stadium´s men´s toilet. Hundreds of people ignore it. A **spectator** advices a **steward** that "someone forgot a bag in the men´s room". The steward picks up the bag without realising the danger, until he hears the bag is ticking. He panics and has no idea what to do. He speaks to a fellow steward, who advises the control room. Meanwhile, the bag could have a ticking bomb and go off and kill the entire stadium at any time. The **control room** calls the **police**. Within approx. 6.minutes a special police force arrives and immediately places a bomb carpet over the bag and activate the evacuation plan along with the stadium´s control room. Some crowd members panic and get injured, while trying to run out. An emergency door can't open properly. A steward gets scared and takes off leaving his responsibilities undone. Another steward does not know how to react in an emergency case. Crowd do not know which exit to use and too many use the same exit rather than dividing them. Some crowd members start broadcasting live on Facebook, putting themselves and others in further danger. The players on the field and the teams run to the changing room, not realising that they are also in danger there. As thousands of people are using their cell phones, the net is overloaded and doesn't work. Social media and press immediately catch up on the story

writing incorrect facts, as they are not known yet. Relatives and friends panic thinking their loved ones might be dead. The police, hospitals and city council receive thousands of calls from concerned citizens, relatives and press. They demand answers, which are not yet available. It turns out the bag is just a false alarm, possibly a prank. Police go over security camera material to identify who left the bag, but cannot identify the person due to blurry footage and the fact that the suspect wears a cap and his face is not shown.

4.4.1.5.18. PA announcements

Helen, Rob and Paul (**spectators**) were planning to go to the One Day International match England v South Africa. Rob is a rugby fan and doesn't really understand cricket but hopes the announcer will explain the game. They arrive in good time and settle into their seats in the White Rose Stand. Very quickly it becomes apparent that not only is there no explanation from the match day announcer but they can't even hear it! That means that they have to rely on the scoreboard which is clearly visible. Still they would have felt happier if they could hear what was being announced as there may have been something important.

4.4.1.5.19. Delivery

Steve, the **Security Officer**, is once again on duty inside the Gatehouse and checking his log list of expected deliveries for the upcoming rugby Championship game. However this is not a usual day as this is the start of the construction works for the new stand and he isn't convinced that everyone expected is logged in advance. There will also be much coming and going as rubble is removed and the lorries return for more. It will be a very busy day and he has already turned away a van not on his list - which later turned out to be genuine. The **driver** was not pleased with the delay in the delivery nor was the Head Chef who was without key ingredients for his signature dish - the Headingley Steak Pie. There must be a more efficient way of checking deliveries and vehicle visiting the stadium, thought Steve.

4.5. Lyon

4.5.1. Fête des Lumières

4.5.1.1. Pilot Summary

Fête des Lumières is a light festival with often sound or music playing (http://www.fetedeslumieres.lyon.fr/en) hosted by the city of Lyon. The festival attracts millions of visitors on a yearly basis and takes place in the densely populated city centre, being an open-air event during 3 nights. Throughout this time, over 70 light installations created by different artists light up buildings, streets, squares and parks. As part of the organisation efforts for the event, each one of the installations and shows is assigned to a concrete location and a detailed program with show schedules and recommended routes is prepared for the visitors.

Fête des Lumières is a free cultural event. Visitors can wander across the streets and experience the different shows from 8pm to 12pm. Business that are permanently located inside of the perimeter, such as restaurants or stores stay open during the event and are also frequented by the visitors.

It is important to mention that since 2016 the decision was taken that the perimeter of the area where the festival takes place should be fenced in order to reduce security risks in relation to terrorism. As a result, access points were positioned in the perimeter and bag and open-coat checks take place at the entrances. Cars are also not allowed to be parked inside of the perimeter.

Fête des Lumières is not only important to the city as a local event, but also as an attraction for tourists from all around the world. The variety of the visitors that attend each year, makes the festival a multicultural event.

4.5.1.2. Challenges

Due to the big amount of visitors that gather in the public space during the event, the approval of the state police is needed year after year in order to make sure that the event complies with security standards. This situation presents a big challenge for the event organisers as they need to have a broad and detail overview of the amount of visitors that come to the event, predictions on crowd density and meaningful data in order to make informed decisions that support the implementation of proper security measures. This difficulty increased since 2016 (the 2015 edition was cancelled due to high terrorism threat) when additional security measures were implemented. One of them, is the fencing of the festival´s perimeter. This brought new challenges such as management of access and check points. Although the installation of a fence has helped to prevent some security issues, the challenge of not being able to control what is inside of the perimeter previous to the fence installation is still present.

In terms of sound, the event does not face massive complaints since there are no concerts. Nevertheless, there is room for improvements in the quality of the sound for the installations and an interest in understanding the impact of noise in the city i.e. noise for neighbours during event set-up, during the event (music and crowd) and noise during breaking up.

4.5.1.3. Interests

The following points list general topics or applications for which this pilot expressed interest during the interview sessions, pilot visits or questionnaires. It is important to know that this information might change, adapt as the project evolves:

- Crowd management and monitoring tools
- Live data that supports prediction of critical crowd density
- Wearables for staff and visitors for use in emergencies
- Real-time display of noise levels (relevant for staff who is posted near speakers for longer periods of time
- Health monitoring of sound level exposure / Sound heat maps
- Sound meter apps to monitor sound levels and compare them with city ordinance noise regulations.
- Applications to improve comfort of visitors
- Citizen engagement widgets

4.5.1.4. Stakeholders

Name	Description
Event visitor	Any attendant that accesses the festival area.
Event organiser	Person responsible for managing stakeholders, budget and logistics of the event, assure the success of the festival and visitors experience. In addition, this person guides the pre-approval process of the festival.
Neighbour	People living inside of the perimeter and that suffer/complain about the produced noise, crowds or activities performed during the event set up.
Technician (sound, etc.)	Person responsible for the correct performance of the technical equipment that is needed for the installations and adjusting the sound levels of the installations according to the environment.
Artist	Person who has been selected to conceptualise and direct a light and sound show for a specific location in the event.
Security staff	Person responsible for assuring safety of the visitors in the festival, controlling access points, performing coat checks and conducting control walks.
Volunteer	Person who supports the event staff and is responsible for concrete tasks such as visitor support and information, crowd guidance, etc.
State and local police	In charge of approving the event year every year. They make sure that the security standards are met by the event organisers and other stakeholders.

Table 8 - Stakeholders for Fête des Lumières.

4.5.1.5. Scenarios

4.5.1.5.1. Planning to visit the event

Michel (**visitor**) has planned to visit Fête des Lumières on next Friday afternoon with two friends. This is the first time that Michel and his friends will be attending the event, so he decides to look for information in advance in order to make sure that they can make the most out of their evening together. While scanning the website, he finds out that there is a free app which provides route suggestions and other practical information such as description of the installations and even push notifications in case of an emergency inside of the perimeter. Michel decides to download it. After going through the route suggestions, he selects one which covers most of the highlights of the festival, including a light show in the City hall, one of the highlight points in the whole area.

4.5.1.5.2. Accessing the event

Michel (**visitor**) is aware that this year the festival perimeter will be fenced. Since cars are not allowed inside of the event area, he and his friends decide to travel by public transportation. They get off close to one of the access points through which visitors can access the festival. They have decided to enter through the access point, suggested by the app as the start of the selected route. As they get closer to the entrance, they see that a long queue before the backpack and coat check awaits them. Michel and his friends line up. Unfortunately, there is nothing to do but wait and be patient.

4.5.1.5.3. Route and crowd movement

Once the three friends have made it through the security check, they find themselves in the middle of one of the main roads. For Michel (**visitor**), it is clear that at this point they should just follow the crowd. After all, the flow seems to move forward only in one direction. After strolling a few meters, they see a big arrow projected on the wall which indicates the direction they should follow in order to make it to the first installation that is part of the selected route. Michel and his friends reach a tiny square and are asked by a **staff member** to wait 2 minutes before entering the area. The staff member explains that the last performance is about to finish and then, the new visitors will be welcome to join for the next loop. Once in the square, they get the chance to enjoy the lights and sound show which lasts a little less than 10 minutes. Once the show has finished, they are asked to move out of the area in order to let new visitors experience the next show. A volunteer standing in the back of the crowd shows people the right direction through which they should keep walking in order to get back to the main road.

4.5.1.5.4. Neighbour experience

Maria (**neighbour**) has lived in the centre of Lyon since a couple of years. Her house is located inside of the perimeter where the festival takes place. This makes her one of the citizens who actually experience the festival from the moment the fences are put up until they are taken down. In general, Maria supports cultural events and considers Fête de Lumières a symbolic festival that creates part of the identity of her city. In the past, she did not really have bad experiences with the crowds gathering in the square in front of her house or sound disturbances. Nevertheless, this year she had an unpleasant experience: at some point during the evening she noticed that the sound of one of the installations was increasing constantly. She assumed that due to the increased amount of visitors, the artists decided to also increase the volume of the sound. She found this very annoying as it prevented her from sleeping. Maria manages to find an email address and telephone of the **event organisation** office and she decides to call hoping for immediate response. Luckily the call is answered and she explains the situation. Her complaint is immediately communicated to the **team in charge of the installation** and the **artist** is asked to regulate the sound and keep it to a certain limit to avoid disturbing the neighbours.

4.5.1.5.5. Adjustment of sound levels

Jean is part of the **technical team** at Fête de Lumières. His main responsibility is to assure the correct performance of the technical equipment that is needed for the installations. He is particularly in charge of assuring sound quality during the event and making sound adjustments. At the moment, he is giving support to the installation happening in the City Hall. Jean is in constant communication with the **artist** in charge of this installation, as he has to make sure that the adjustments he makes in the sound are aligned with the concept the artists has envisioned for his piece. As the night moves on, more and more **visitors** gather in the City Hall. Jean notices this and realises that the sound levels used for the last two loops of the installation are now not high enough, since the chatting of the people in the area diminishes the sound of the installation.

After a quick catch-up with the artist, they decide to increase the sound levels and adjust them to the requirements of the environment at that moment. Such situations require that Jean pays constant attention to the amount of people in the area in order to react to immediate requests and assure the visitor´s experience is satisfactory. As the evening goes on and the amount of people decreases, he reduces the sound levels one more time.

4.5.1.5.6. Artist application process and limitations

As a light and environment **artist,** Lou has a big interest in Fête des Lumières. The event is very appealing to her in particular because of its international reach. This year she applied with her installation concept and made it as one of the (around) 50 selected artists. The application process was challenging. After getting the open call, she got hands on preparing her application. Even though she had a rough idea on how the show should look like, she had to integrate the Festival's requirements to her concept. After all, many security standards have to be met by the applicants and their installations such as restricted length of their loops (4-10 mins) in order to guarantee the continuous movement of crowds and avoid crisis in the public space. Once her application was accepted, Lou was also asked to provide all communication material needed in order to integrate it to the program and join meetings with the organisers in order to assure the success of the show. Today, is the first night when Lou´s performance will take place after some alignment talks with the **light and sound technicians** and all seems to be in place. She keeps some energy for later on during the night in case last-minute adjustments in sound level or loop frequency have to take place and fast decisions have to be taken.

4.5.1.5.7. Common security practices (crowd monitoring, check points)

Maurice and Philippe are part of the **security staff** at Fête des Lumières. They have been working together with the rest of the emergency and security team (including **firemen**, **volunteers**, **private security**, **local and national police**, etc.) in order to assure high security levels during the festival. Maurice and Philippe have a clear overview of their tasks and responsibilities by the day the event starts. By the first day, a fence around the perimeter has already been installed. Even though this practice has increased security levels since 2015, Maurice and Philippe know that they still should stay alert to avoid catastrophes. Many private houses and businesses are inside of the perimeter and there is always the uncertainty of not having a complete controlled environment inside of the fences. For this reason, it is important to integrate other security practices. Today, Maurice is in charge of supporting the entrances and checkpoints, where he performs open coat checks. He has to make sure that no **visitor** enters with a backpack or bottles. Another critical aspect to avoid crisis is to make sure that the crowds are managed and balanced inside of the perimeter. Philippe is in charge of making sure that the amount of people gathered simultaneously in the same place doesn't reach the limits. To achieve this, he monitors the routes and visually estimates if a square or street is overly crowded. While monitoring the entrance to one of the installations, he estimates that the crowd is reaching the limit in the area. He communicates with two of the volunteers and instructs them to ask visitors to continue walking towards the next installation. Unfortunately, this first attempt to ease the situation has not been enough as more and more people come towards this area and suddenly there is a bottleneck at the end of the bridge. He and his team have to make a quick decision: they decide to proceed with public sound announcements and a notification through the app in order to inform the visitors that the route has been closed until further notice. After a few minutes, they can already see positive results: the crowd has dispersed through other streets and the flow and crowd movement is back to normal. Philippe instructs to reopen the route at this point.

4.5.1.5.8. Volunteer supporting crowd movement and visitor guidance

Julia is part of the **volunteer** team at the festival. Experiencing the atmosphere of such an event motivated her to support as a volunteer member. Today is the second day of the festival, and she is assigned to support the crowd movement in one of the installations located on a small square. The characteristics of the location, make this area particular: the small area in front of the building where the installation is projected is only big enough for a few **visitors**. From what she has experienced, most of the times, people leave the square as soon as the performance is finished by following the arrows projected in the walls. Nevertheless, in the last session, she is instructed by security staff to try to increase the speed with which people leave the square as many new visitors started to gather at the entrances and it was predicted that soon the festival will be more crowded. After receiving this instruction, Julia starts approaching the groups immediately after the last image has been projected asking them to continue to the next installation in their suggested route.

4.5.2. Nuits Sonores

4.5.2.1. Pilot Summary

Nuits Sonores (http://www.nuits-sonores.com) is a festival that dives in the world of design, image, graphic art, food culture, architecture and particularly music. It takes place every year in May in the city of Lyon lasting for 5 days and 5 nights. The festival occupies around 40 venues throughout the city: from industrial heritage sites, to everyday areas and iconic landmarks. In the focus of the MONICA pilot, one relevant venue from Nuits Sonores is the Node Factory. This venue has three entrances, an indoor and outdoor area as well as three stages.

Visitors can access the venue with a ticket and enjoy the corresponding events included in the type of ticket they have bought.

Nuits Sonores is an event that has started taking shape since 2002. Over the last 15 years, the festival has transformed into what today is perceived as a modern and cutting edge event in the fields of independent, electronic and digital culture.

4.5.2.2. Challenges

Nuits Sonores struggles to find proper measures to avoid neighbour complaints and tries to offer an optimal sound quality for concertgoers although electronic music played at high levels could cause hearing issues. People living in the area, constantly express their discomfort due to the sound levels of the concerts. The venues where the concerts take place (e.g. industrial heritage sites) are not always sound proof. This makes the situation very challenging. For the event organisers, keeping a good relationship with neighbours in the proximity is very important.

4.5.2.3. Interests

Stakeholders from this pilot, mentioned particular interest in applications and solutions that deal with sound levels, sound monitoring and citizen engagement.

4.5.2.4. Stakeholders

Name	Description
Visitor	Any attendant that accesses the festival area with a ticket.
Event organiser	Person responsible for coordinating stakeholders, planning of budgets and logistics.
Neighbour	People living in the surrounding area and that suffer from/complain about the produced noise.
Artist	Performer who provides enjoyment to the public.
Technician	Responsible for respecting a fixed noise limit (given by the event manager) and checking the sound quality (no distortion / accuracy ok)

Table 9 - Stakeholders for Nuits Sonores.

4.5.2.5. Scenarios

4.5.2.5.1. Sound level concerns

Clara is one of the **event organisers** of Nuits Sonores. Every year, she and her team make sure to provide the best experience possible for the **visitors** by organising a program that promotes local and new artists. This year, the festival is expanding to a new venue. Clara is aware of the fact that the **neighbours** living in the surrounding areas might complain since the sound levels can be high, in particular during night concerts. For Clara and her team, it's very challenging to keep the balance between offering a full concert experience to the visitors and artists while at the same time keeping a good relationship with the neighbours.

4.5.2.5.2. Visitor's experience at the festival

Paul (**visitor**) is a fan of electronic and digital culture. For Paul, the music and the selected venues of the event together is what makes the experience worthwhile. Even though the old factories where the concerts take place are now equipped with full acoustic architecture as in a regular concert hall, he knows that the atmosphere of this places is what makes the event special. Every year, he makes sure to get one of the early bird tickets that are sold online to be able to attend the festival for at least 3 full nights. This year he decides to join the first day of the outdoor event starting at 15:00. After approaching one of the entrances and passing the security check, he already finds himself in the event. Concerts take place all day. Paul is able to move from indoors to outdoors freely allowing him to enjoy the good weather and join friends in the open air as well. As the night approaches, Paul and his friends move to the indoor stage.

4.5.2.5.3. Neighbour compensations

Tom (**neighbour**) lives in a street behind the new venue where concerts of Nuits Sonores will take place. Since he heard the news in the community newspaper, he has been highly concerned that the high sound levels produced during the concerts could reach his street and disturb the sleep of his kids and family. He knows that the stage will be located inside an old factory which is not prepared to isolate the sound. Yesterday, Tom was surprised by a communication from Nuits Sonores (**event organiser**). He and all of the neighbours in his building were offered free hotel nights or free tickets to the festival, sponsored by Nuits Sonores. Although the surprise has raised his mood and he is pleased with the idea of having some days out during the holidays, he is still concerned on how the night concerts will affect his neighbourhood.

4.6. Turin

4.6.1. Kappa FuturFestival

4.6.1.1. Pilot Summary

Kappa FuturFestival (http://www.kappafuturfestival.it) is the first Italian daytime summer dance festival. Dedicated to electronic and techno music, it takes place every year with two full days of concerts from midday to midnight featuring both national and international performers. 70% of the audience comes from the rest of Italy and almost 16% from abroad (2017 data). Kappa FuturFestival promotes employment and tourism. Hundreds of people are involved in the organisation of the festival and there are many collaborations with companies and suppliers based in Piedmont, with an economic impact of about 2.5 million Euros and "0 impact" on public finances. The concert takes place in the new Parco Dora, that has recently completed the overall urban transformation of this area. The park offers its residents, but also other inhabitants and tourists, 450,000 m2 of green areas for sports, entertainment and relaxing, and giving them back a river that was exploited by factories for decades, making it polluted and inaccessible. The park, however, keeps alive the memory of the industrial past of this part of the city, maintaining some of the pre-existing structures (pools, steel pillars, smokestacks).

4.6.1.2. Challenges

The Kappa FuturFestival stakeholders have been working on a lot on security issues. One challenge they are currently facing concerns the improvement of the security controls at the entrance as well as the monitoring of the people flow in and out of the festival areas.

The noise is a matter especially for the neighbourhood. The real-time monitoring activities should be extended to a wider area and the real-time data should be used to inform all the interested stakeholders, both event managers, allowing them to tune the sounds when needed, and citizens, to be aware of the real noise level thanks to reliable data sources.

4.6.1.3. Interests

The following points list general topics or applications for which this pilot expressed interest during the interview sessions, pilot visits or questionnaires. It is important to know that this information might change, adapt as the project evolves:

- Crowd management and monitoring tools with specific interest for emergency situations
- Live data that supports prediction of critical crowd density (analytics on movement and presence)

- Wearables for staff and visitors for use in emergencies and for access regulation in different areas (e.g. backstage, cash registers, bar…)
- Health monitoring of sound level exposure / sound heat maps
- Sound meter apps to monitor sound levels and compare them with city ordinance noise regulations
- Citizen engagement widgets
- Glasses for supporting staff in administrative and/or safety operations

4.6.1.4. Stakeholders

Name	Description
Noise technician	Person dealing with noise monitoring and reporting.
Stage manager	Technician in charge of managing all aspects of a certain stage during the event.
Health worker	Professional and/or volunteer in charge to provide first aid and health assistance to the festival attendees and staff, in case of need. Ambulance people included.
Health/safety officer	Coordinator of the health workers assigned to the festival. From the CC, he/she coordinates the health workers, the actions as well as the ambulances and equipment available in the event area.
CC-Central Command	Group of representatives and coordinators of all the authorities involved in the event (Police bodies, Health Services).
Event visitor	Any attendant that accesses the festival area.
Neighbour	People living in the surrounding residential areas and that suffer from/complain about the produced noise.
Security staff Security officer	Hired personnel in charge to monitor the event area and keep it safe. They refer and report to the event organizer.
Police officer	Policemen in charge to supervise and control the festival area, including plain-clothes policemen. They can be part of the several involved bodies. Each of them refers and reports to the coordinator at the CC via radio.
Event organiser	Person responsible for coordinating stakeholders, planning of budgets and logistics.

Table 10 - Stakeholders for Kappa FuturFestival.

4.6.1.5. Scenarios

4.6.1.5.1. Sound level monitoring and mitigation

Clara (**sound controller**) is hired by the **event organiser** to monitor the sound levels in the adjacent residential area. The day before, long loop tests are performed to set up the impressive loudspeaker system, looking for the right alchemy to satisfy artist, public, legal limits and neighbour's expectations not to be annoyed. This year the loudspeakers seem biddable, she has a good feeling about a successful job. During the festival she resides in an apartment close to the festival premises. In her apartment she has deployed a sound level meter. In another location, a few 100 meters away, she has deployed a second sound level meter. During the event she finds that the sound level is not within compliance limits averaged over a certain amount of time (< 70dB(A) on 30'). In this case, she contacts the **stage manager** of the stage, that produces the sound using her phone or WhatsApp. The stage manager makes sure that the sound level is adapted, which is checked again by Clara until it is within limits. A while later, Clara has to physically move the sound level meter to be in such a position that it picks up the sound from the main stage that is playing at that moment instead of the other stage that she was checking previously. Since the prime-time set at the main stage is typically responsible for possible sound level breaches, she also walks to the other location where the second sound level meter is deployed. At this location she tweaks the position of the sound level meter as well, after which she returns to her "home base". The rest of the evening goes smoothly without any sound level breaches.

4.6.1.5.2. First aid (volunteer and/or professional)

At the event there are several “mobile health/safety” units roaming around. Enrico is deployed as a **health worker** in one of those units. He is scanning the crowd looking for **visitors** that experience health issues. At some point he notices a person that seems to be unwell. Friends of this person are already trying to help him to keep him standing up. Using a radio, Enrico informs the **health/safety officer** in the Central Command Centre (CCC) that he has detected a possible health issue. He reports his location and gives a very short description of the case, not wasting any time to help the poor visitor. Subsequently he approaches the group. He tells the people to take a step back and quickly examines the victim. Since his condition looks rather critical, the person seems to suffer from serious de-hydration, he decides to take the person to the nearest first aid location. Again, he informs the health/safety officer in the CCC about the situation. Giving a short description of the problem and reporting that he will transport the victim to the nearest first aid station. After arrival at the first aid station, he performs a thorough examination and concludes that this person should go to the hospital as soon as possible. Contacting the CCC he orders an ambulance to his location. Since the first aid location is located “back of house” and there are clear routes to this location, the ambulance can easily reach it. The victim is transferred to the ambulance people and driven to the nearest hospital. At this point Enrico is done handling this issue, reporting it “closed” to the CCC. By contacting his health/safety unit he finds their location and heads back to them to resume his patrolling routine.

4.6.1.5.3. Feeling a bit “dizzy”

Francesco (**visitor**) is a real party animal. He enjoys the music mostly in combination with various types of drugs. He has already been standing and dancing on his feet in the sun for more than 8 hours. At a certain point he feels that his body starts complaining. He starts to feel dizzy. He would like to go to one of the nearest “relax areas” that were installed in this year’s version of the festival. Using the map on the festival app, one of Francesco’s friends checks where the nearest relax area is located. They head off through the dense crowd to the relax area.

4.6.1.5.4. React to a fight

Police officer Gianpaolo is watching over the main stage when he spots a fight starting in the vicinity of the fences in front of the stage. Using a radio, Gianpaolo informs the **security officer** in the Central Command Centre (CCC) that he has detected a possible scuffle. He reports his location and gives a very short description of the people involved and of the situation. While approaching the hassle, 2 other plain-clothes police officers enter to the same spot to stop the fight. Meanwhile other attendants walk away trying not to be involved, and others try to divide the two hotheads. Arriving at the group, Gianpaolo tells the people to take a step back and together with his colleagues he soothes the disturbance, while taking away the brawlers. After assessing any possible injuries, he informs the CCC that the situation is under control. The policemen will proceed to file a formal complaint and press charges against the **fighters**.

4.6.1.5.5. Enter your Festival

Antonio (**visitor**) enjoys music festivals very much and is eager to attend Kappa FuturFestival for the first time. After meeting with his friends at a nearby bus stop, he is headed to the main entrance gate of the venue. Arriving on site, he is confronted with a big queue of people, waiting to enter the festival. On the site there is another queue of people waiting in line to buy tickets at the box office. When it’s Antonio’s turn to enter the festival, he shows his ticket to the staff at the gates and afterwards he is invited to open his backpack for a security check performed by the **security officers**. Because of the rules related to allowed objects that can be brought to the premises, Antonio sadly has to agree to leave his water bottle at the checkpoint, but he is reassured that he will get plenty of water and other beverages in the appointed areas of the festival. No more waiting for Antonio, it’s time for him to party hard!

4.6.1.5.6. People-counting

Two hours before the festival opening, Gianni (**event staff**) together with the **police** and **security officers**, takes position at the entrance of the festival. His task consists in counting the event **visitors** that access and leave the area. He has to overlook all the active queues of visitors waiting for the check-in. Later on the day there will be a colleague that will do the same thing for egress. Each visitor, before entering, has to show a ticket and undergo a security check. When both these checks are done, Gianni records the person with the manual counter. Moreover he periodically fills in a paper form that helps to track the people flow. Periodically or when required, these data are communicated via radio to the **event organiser**, to handle the ticket selling in accordance with the recorded attendance. Moreover, during the event, the information about the number of visitors is transmitted to the CCC, to keep them informed about the compliance with the security plan (e.g. in case of evacuation). After the event, Gianni aggregates all the data collected in a report addressed to the

event organiser, that they will use for press releases, communication purposes and as input for the event planning of next year.

4.6.1.5.7. Be heard

Alice's (**neighbour**) dining room has a great view over Parco Dora. For the large part of the year this is a relaxing landscape, with the exception of those festival days. During the event, the comfortable position of her home becomes one of the most exposed places to the noise. In particular, it is impossible for her to limit the effects of the low frequencies that beat on windows and nerves. Several times she has reported the discomfort, documented with measures performed via an app that she has downloaded on her smartphone. She wrote articles about the problem in local newspapers and has proceeded with formal complaints to the **local police**. She discovered that a number of other neighbours suffer the same problem, especially for low frequencies. Based on this, she decides, after the last edition of the festival, to start a class action, including neighbours, exhibitors and citizens interested in finding a way to mitigate the noise level during the event. The **event organiser** provides all the documentation both on the pre-event planning and the noise recording during the event, constantly monitored with professional sensors (scenario 1). This documentation specifies the authorised thresholds, with a specific focus on the frequencies below 100 Hz, which is monitored by the event **sound controller**, in order to find a good balance between annoyance reduction and hard effects on public and stages.

4.6.2. Movida

4.6.2.1. Pilot Summary

From the '90s San Salvario has been the centre of Turin's nightlife. Since 2010, the Movida phenomenon has been increasing due to the increasing amount of people in the streets every night. A large number of pubs, bars, restaurants, discotheques, wine cellars and boutiques, and a lively programme of events have reshaped the map of entertainment, known as Movida, causing great disturbances to the neighbours. It has also attracted a large number of drug dealers and micro-criminality has increased, so that security is becoming a bigger issue.

4.6.2.2. Challenges

The nightlife crowd is the big challenge that the neighbourhood of San Salvario is facing. In general, the main need is to increase the predictability of the Movida phenomenon. Data and measurements are not significant by themselves. To formalise the problem, the partners should collaborate and share knowledge. This is a very complex phenomenon, it takes a multidisciplinary approach and a wide panel of stakeholders in order to build a context able to implement and accept the MONICA solutions. The need of real-time data, in particular on noise levels, is strong especially for local residents. They could use these tools to make complaints and monitor noise levels. The analysis in real-time of the information concerning noise is not exploited.

4.6.2.3. Interests

The following points list general topics or applications for which this pilot expressed interest during the interview sessions, pilot visits or questionnaires. It is important to know that this information might change, adapt as the project evolves:

- Crowd monitoring tools
- Live data that supports prediction of critical crowd density (analytics on movement and presence)
- Health monitoring of sound level exposure / Sound heat maps
- Sound meter apps to monitor sound levels and compare them with city ordinance noise regulations
- Citizen engagement widgets

4.6.2.4. Stakeholders

Name	Description
Neighbour	People living/working in the San Salvario district.
Police Officer	Policemen from the several police bodies.
Owner	Owner or manager of pub, bar, restaurant.
PA	Representatives of the Public Administration departments interested in the health and safety of the area (e.g. Città di Torino, ARPA technicians).
Visitor	Any Movida goer.
Pub/bar/ restaurant customer	Customers of restaurants, pubs and bars

Table 11 - Stakeholders for Movida.

4.6.2.5. Scenarios

4.6.2.5.1. Complaining about the noise

Matilde (**neighbour**) has lived in San Salvario for many years. Every night, especially during the weekend, the Movida emerges. **People** are standing in front of the pub talking loudly and laughing. She can hear all that noise from her windows, as well as the music coming from the disco bars. Dense traffic in surrounding streets also contributes to the environmental noise though the central part of the district is a very quiet area, and mostly Movida noise emerges. The constant exposure to such disturbances becomes unbearable, heavily annoying her during sleep time. Considering that she is often forced to wake up very early in the morning for work (she is a nurse), her situation becomes unsustainable. The condition is even worse during the summer, when warm weather attracts more visitors for a longer period of time. She needs to sleep in the kitchen as she has to keep the windows opened due to the very high temperature: in her bedroom the noise rising from streets impedes sleep. In addition, in her opinion, in the last month, one of the pubs has significantly raised the music volume. She called the local police several times in order to complain about excessive noise that makes sleeping almost impossible. Immediately, the police has given some formal reassurance by phone without any concrete intervention. A few weeks later, Matilde is contacted by the police for planning a noise measurement. Gennaro is one of the three **policemen** that has been sent by the police headquarters to check the **pub owner**'s behaviour; he is an expert on environmental noise. When he arrives at the location, he personally checks the noise status with one of the two noise meters available for the local police. In the dwelling, low frequencies emerge, but it is really difficult to distinguish from which of the two pubs the noise is coming from. The environmental noise is extremely high, as tipsy people are chatting and laughing loudly. One of the pubs is full of people, windows are open, music can be heard from outside. Gennaro decides to fine Steve, the pub owner and needs to speak with him in one of the following days in the local police station. He recommends him to turn down the volume and control people just outside his pub because lots of neighbours are complaining. Steve explains that he is compliant with the rules and neighbours do not have any reliable proof to provide that his pub and customers are responsible (maybe someone can have a “dB app” on a mobile phone, but it is not certified proof). Anyway, after Gennaro's intervention, Matilde observes that the pub’s music sound level has been scaled down and less low frequencies can be heard. However, the problem of high environmental noise levels persists.

4.6.2.5.2. Long term monitoring

Matilde (**neighbour**) decides to join a volunteer’s district association in order to collaborate to collect signatures from the neighbourhood to attach to the complaining letter to be sent to the town hall about noise in San Salvario. As a consequence, the **City Council** requests ARPA intervention (Agency for Regional Environment Protection) to verify the situation. Elio, **ARPA operator**, is a **sound engineer**. He is in charge to perform long term monitoring to certify noise conditions in relevant areas. According to official protocol, he has to collect sound level measures continuously for many days using professional sound meters placed on balconies or on the façade. After the measurements have been executed for some summer weekends, a report is sent to the City Council, both to the **Environmental and Economic Activities Departments**: Elio officially reports very high levels, but it is impossible to exactly identify and measure the noise input coming from each different source (pubs, people, traffic, etc...). The Environmental Department, in order to start a

wider action, decides to put in place a real-time noise monitoring network consisting of 5-10 points. As each point will cost between 5,000 and 10,000 euros using professional instruments, only low-cost sound meters are put in place with Elio's support in order to reconstruct a detailed and reliable picture of noise during the four seasons. Such devices are just "homemade" simple prototypes composed by: an Android smartphone, a power supply and an external cheap microphone. A dedicated mobile app runs on the smartphone and sends acquired measures to a regional Open Data Platform. Such a device has some limitations in terms of measuring accuracy and a limited dynamic range (maximum limit is 80 dB, not enough in many cases). Furthermore, it is still not possible to distinguish how different noise sources contribute and there are not enough available devices to accurately estimate the spatial distribution of the noise level. At the end of the year, according to Elio's report, the City Council has realised that the noise is a real, measurable problem not only in summer. Legal limits of acceptable noise (60 dB on 1 hour) are usually exceeded, creating dangerous acoustic pollution for neighbours. Therefore, it is necessary to reduce the impact of noise. Today some preventive strategies could be put in practice, as the following:

- Club closure anticipation
- Forbid selling alcohol beverage after a certain time
- Attracting people earlier in the evening by offering cultural events
- Encourage people to take public transportation so people have to respect the last trip time
- Anticipate cleaning roads time
- Supporting the rise of new areas dedicated to Movida far from residential areas

It has to be remarked that all the aforementioned solutions could meet neighbours needs (Matilde should sleep better) but can be very negative for club owners (Steve risks reduced revenues). Main challenge is still involving people spending their nights in the streets in adopting a better behaviour (less alcohol consumption, less shouting, go home early).

4.6.2.5.3. Short term monitoring

The Economic Activities Department receives Elio's reports. They need very detailed information to start a legal action. Noise coming from people wandering in the streets and drinking alcohol bought in a supermarket during afternoon often overlaps the noise coming from pubs, so Elio's report is more or less useless. A detailed investigation is asked from the local police: Pietro is a **policeman** of the scientific investigation group. He positioned a video camera and started an activity in plain clothes, writing down **pub owner**, private bodyguards and **customer** behaviours of each pub near Matilde's home. After putting in a lot of effort during several weeks, the investigation shows that between 24:00 and 2:00 the noise mainly comes from customers and music from windows of a single pub; from 2:00 to 3:00 from people in the streets. From 3:00 to 4:00 the noise comes from a group a young drunken people. Thanks to Pietro's investigation, robust legal actions against specific behaviours can be started.

4.6.2.5.4. Drunk customer

Arturo is a **bouncer**. He is hired by the **pub owner** to monitor the situation inside the pub and avoid noise issues outside the pub. Suddenly, Arturo realises that Tommy, a **customer**, is drunk and disturbs other people. He is trying to provoke a fight, turning up his voice and annoying the pub attendees. The pub is overcrowded and Arturo, a well experienced bouncer, recognises potential troublemakers and "easy fight" people. He notices that Tommy is not alone and knows that his hasty actions can suddenly lead to an explosive situation. First of all, Arturo asks the pub owner Steve to stop serving alcohol beverages to Tommy. Then he intervenes speaking calmly but firmly to Tommy asking him to step down and avoid creating trouble. As a first reaction, Tommy calms down. However, after a few minutes, Tommy restarts again, too loud. Arturo comes back again to Tommy inviting him to go outside the pub. Once Tommy has left the place everything returns to normality.

4.6.2.5.5. FlashMob

On a Tuesday night in June, the local police station of San Salvario receives several phone calls from citizens. All of them report an abnormal amount of people in the main square of the neighbourhood and complain about a stronger noise than usual. There seems to be an on-the-road and self-organised party celebrating the end of the university courses. Federico, the **local police chief commander**, sends two patrols to monitor the situation. It is very difficult to reach the square because of crowded roads. This could be a bigger problem in case of an emergency. Once at the square, the police officers talk with Giorgio, one of the **pub owners** at the square. He explains that people are bringing drinks and bottles from home. The policemen can only check that no dangerous situations are occurring and analyse video recordings during the days after the event, in order to pinpoint the responsibles of some acts of vandalism.

4.6.2.5.6. Street brawl

It's Saturday night and Gabriele and Michela (**visitors**) go to have a drink after dinner in San Salvario. When they arrive at the pub, they meet a lot of people on the road drinking and chatting loudly. Some of them seem to be drunk. At a certain point a street brawl starts and immediately people gather around, urging them to stop fighting. The noise grows. Michela and other persons call **the police** and the **ambulance** because someone is wounded. Other people are recording videos and taking pictures to post on social networks. Streets are crowded and the ambulance encounters difficulty to pass and to reach the injured person, delaying the intervention. Policemen ask people about the brawl and persons involved. They obtain some descriptions to better identify the people involved and they will analyse public social network posts about the fight to gain more intel about the identities of the involved rioters.

4.6.2.5.7. Drug dealers

Pietro has been working as Carabiniere (Italian **police**) since many years. He has been recently transferred to Torino, one of the most demanding Italian city in terms of security. It's a very challenging experience for him. As soon as he arrived in Torino, his department involved him in a quite delicate investigation: San Salvario, an epicentre of the city's nightlife, is also one of the fundamental spots for drug trafficking in town. Many **Movida goers** directly buy any kind of drugs there. The police, carabinieri and **other security corps** constantly monitor the drug situation there. Last night Pietro participated in a bust that lead to the arrest of several **pushers**: mainly 20-35 years old men from Central Africa. They have been under observation since many weeks, to study their movements and their way they operate. Basically they were "working" between via Berthollet and via Saluzzo, during the peak hours of Movida. The pushers never met their clients, they simply dropped off the booked doses in prearranged places: plants vases in the street, between the parked cars, in the garbage bins. The clients used to leave the money in the same places. They used to receive their client's orders by WhatsApp or calls. In the confiscated mobile phones, Pietro and his colleagues found hundreds of numbers of clients who used to order drugs. The pushers and the **clients** (many minors and students too) have been tailed for weeks before the bust, and several San Salvario **residents** cooperated, signalling to Pietro's department the hided deposits for the drug doses used by pushers and Movida clients. During the bust, Pietro caught one of these traffickers and the guy tried to ingest all the doses he had. Luckily Pietro managed to prevent this and during the pat-down he found on him 40 doses of among others cocaine, heroin, crack and hashish.

5. Use case analysis

In software and systems engineering, a use case (UC) is a list of steps, typically defining interactions between the actors and the system in order to achieve a goal. The involved actors can be human or an external system. Usually use cases are used at a higher level, representing missions or stakeholder goals. This section focuses on the methodology and the detailed description of use cases for all the MONICA pilots.

The aim of this section is to describe various aspects of the use case analysis. Starting with identifying the stakeholders and various actor roles to defining domain specific rules, regulations, constraints and limitations. This section also defines the templates for use case description and diagram which will be used throughout this document to describe several use cases. In the end are the detailed descriptions of all the identified use cases.

5.1. Stakeholders

A stakeholder is a role played by a person, place or thing that has some sort of interest in the outcome of the processes and activities. Stakeholders are not to be confused with people, since stakeholders are not persons in an organisation but rather roles that a person can have. In many cases a person can be assigned with more than one role, while also a role can be associated with more than one person. As a result, a stakeholder is a role that a person, the environment, a place or a thing can have.

5.2. Actors and roles

In order to identify the actors, we need to consider who or what uses the system, and what roles they play while interacting with the system. Roles are defined for each actor on the basis of the kind of interaction he has with the system. Asking the following questions helps in identifying actors of any system.

- Who or what uses the system?
- What roles do they play in the interaction?
- Who installs the system?
- Who starts and shuts down the system?

5.3. Use case template

The following section introduces the templates of the use case description and diagram. These templates will be used throughout this document to describe several use cases.

5.3.1. Use case description

A use case description consists of the following attributes (see table 12).

Attribute Name	Description
Use Case ID	Internal ID for use case identification
Use case group	Name of the group the use case belongs to
Use Case Name	Use case name describes the targeted action
Version	Stage the use case has reached
Involved Actors	Actors involved in the use case i.e. people or system(s) who/which directly interact with the system
Preconditions	Preconditions specify the conditions that must hold true before the scenario of the use case starts
Description	Brief description of the use case
Post-conditions	Post-conditions specify what must be achieved at the end of a successful use case

Table 12 - Use case description attributes.

The template to describe the identified use cases is shown in Table 13.

Use Case ID	
Use case group	
Use Case Name	
Version	
Involved Actors	
Preconditions	
Description	
Post-conditions	

Table 13 - Use case description template.

5.3.2. Use case diagram

Figure 1 shows the template to be used for the visual representation of the identified use cases.

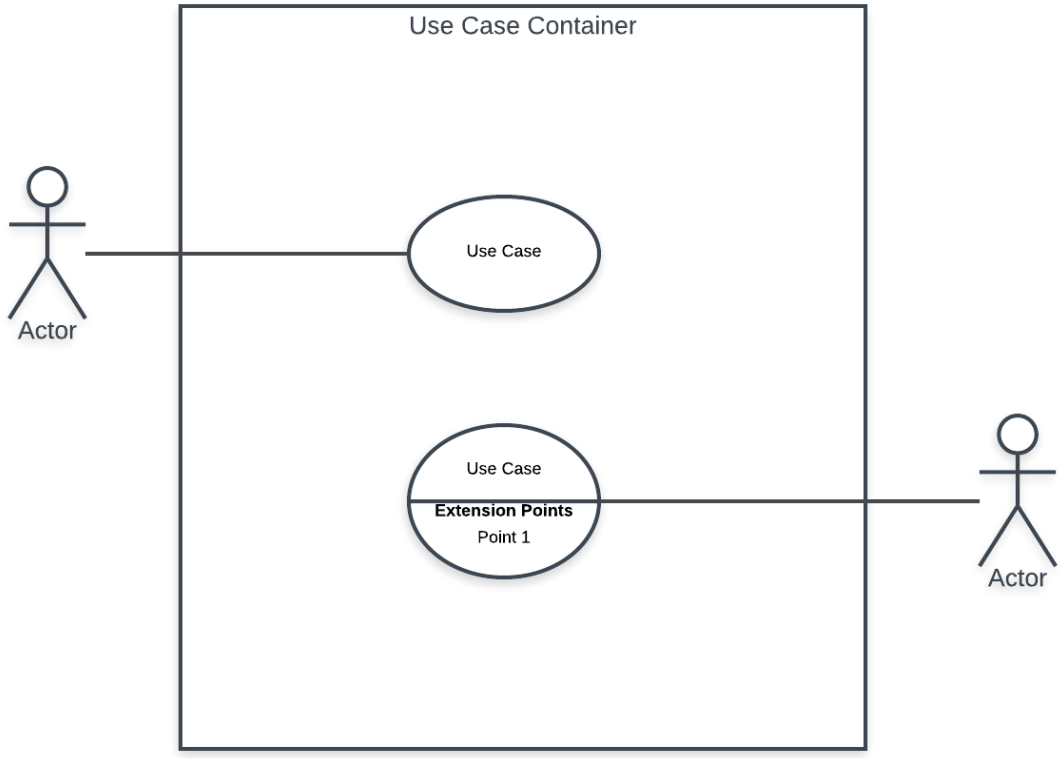

Figure 2 - Use case diagram template.

5.4. Use cases

5.4.1. Access control

Use case ID	1.1
Use case group	Access control
Use case name	Access the event
Version	0.1
Involved Actors	Visitor
Preconditions	Need to enter event
Description	This use case enables the involved actor to successfully enter the event
Postconditions	Event is successfully entered

Use Case ID	1.2
Use Case Group	Access control
Use Case Name	Exit the event
Version	0.1
Involved Actors	Visitor
Preconditions	Need to exit event
Description	This use case enables the involved actor to successfully exit the event
Postconditions	Event is successfully exited

Use Case ID	1.3
Use Case Group	Access control
Use Case Name	Recognise banned person
Version	0.1
Involved Actors	Visitor, Security staff, Control room staff
Preconditions	Banned person tries to enter event
Description	This use case enables the involved actor i.e. Security staff, Event Control staff to successfully recognise banned person (Visitor)
Postconditions	Banned person is successfully recognized

Use Case ID	1.4
Use Case Group	Access control
Use Case Name	Search visitor (including bags)
Version	0.1
Involved Actors	Visitor, Security staff, Control room staff
Preconditions	Visitor is entering event
Description	This use case enables the involved actors i.e. Security staff, Event Control staff to successfully search visitor
Postconditions	Visitor is successfully searched

Use Case ID	1.5
Use Case Group	Access control
Use Case Name	Park vehicle in venue
Version	0.1
Involved Actors	Visitor
Preconditions	Visitor is entering event by car
Description	This use case enables the involved actor to successfully enter the event by car
Postconditions	Event is successfully entered by car

5.4.2. Sound monitoring and control

Use Case ID	2.1
Use Case Group	Sound monitoring & control
Use Case Name	Monitor sound level
Version	0.1
Involved Actors	Production staff, Control room staff
Preconditions	Event is happening
Description	This use case enables the involved actors to successfully monitor sound levels
Postconditions	Sound levels are successfully monitored

Use Case ID	2.2
Use Case Group	Sound monitoring & control
Use Case Name	Adjust sound level
Version	0.1
Involved Actors	Production staff, Control room staff
Preconditions	Sound level is too high
Description	This use case enables the involved actors to successfully adjust sound levels
Postconditions	Sound levels are successfully adjusted

5.4.3. Crowd and capacity monitoring

Use Case ID	3.1
Use Case Group	Crowd & capacity monitoring
Use Case Name	Detect high risk queues
Version	0.1
Involved Actors	Security staff, Control Room
Preconditions	Bottlenecks are occurring
Description	This use case enables the involved actors to successfully detect high risk queues
Postconditions	High risk queues are successfully detected

Use Case ID	3.2
Use Case Group	Crowd & capacity monitoring
Use Case Name	Re-direct high risk queues
Version	0.1
Involved Actors	Security staff, Control room staff
Preconditions	High risk queues are detected
Description	This use case enables the involved actors to successfully re-direct high risk queues
Postconditions	High risk queues are successfully re-directed

Use Case ID	3.3
Use Case Group	Crowd & capacity monitoring
Use Case Name	Monitor crowd based on capacity
Version	0.1
Involved Actors	Security Staff, Control room staff
Preconditions	Event is happening
Description	This use case enables the involved actors to successfully monitor crowd levels. The purpose of this use case is to make sure that the venue of the event does not have more visitors than the allowed capacity.
Postconditions	Crowd levels are successfully monitored

Use Case ID	3.4
Use Case Group	Crowd & capacity monitoring
Use Case Name	Manage crowd based on capacity
Version	0.1
Involved Actors	Security Staff, Control room staff
Preconditions	Capacity is going to be reached soon
Description	This use case enables the involved actors to successfully manage crowd based on capacity.
Postconditions	Crowd levels are successfully managed

5.4.4. Missing person

Use Case ID	4.1
Use Case Group	Missing person
Use Case Name	Report lost child
Version	0.1
Involved Actors	Security staff, Control room staff, Visitors
Preconditions	Child is missing
Description	This use cases enables the involved actors to successfully report a lost child
Postconditions	Lost child is successfully reported

Use Case ID	4.2
Use Case Group	Missing person
Use Case Name	Locate lost child
Version	0.1
Involved Actors	Security staff, Control room staff
Preconditions	Lost child is reported
Description	This use cases enables the involved actors to successfully locate a lost child
Postconditions	Lost child is successfully located

Use Case ID	4.3
Use Case Group	Missing person
Use Case Name	Report found child
Version	0.1
Involved Actors	Visitor, Security staff, Control room staff
Preconditions	An unaccompanied child is found
Description	This use cases enables the involved actors to successfully report a found child
Postconditions	Found child is successfully reported

Use Case ID	4.4
Use Case Group	Missing person
Use Case Name	Locate parent / guardian
Version	0.1
Involved Actors	Visitor, Security staff, Event Control staff
Preconditions	An unaccompanied child is reported
Description	This use cases enables the involved actors to successfully locate the parent(s)/guardian of a found child
Postconditions	Parent(s)/guardian is successfully located

5.4.5. Locating staff

Use Case ID	5.1
Use Case Group	Missing person
Use Case Name	Locate staff member
Version	0.1
Involved Actors	Security staff, Control room staff
Preconditions	Security staff member is not on his/her post
Description	This use case enables the involved actors to successfully locate a security staff member
Postconditions	The security staff member is successfully located

5.4.6. Complaints

Use Case ID	6.1
Use Case Group	Complaints
Use Case Name	Filing a complaint
Version	0.1
Involved Actors	Neighbour, visitor
Preconditions	There is something to complain about
Description	This use case enables the involved actor to successfully file a complaint
Postconditions	The complaint is successfully filed

Use Case ID	6.2
Use Case Group	Complaints
Use Case Name	Get complaint feedback
Version	0.1
Involved Actors	Neighbour, visitor
Preconditions	A complaint is previously filed
Description	This use case enables the involved actor to successfully receive feedback on a complaint
Postconditions	The complaint feedback is successfully received

Use Case ID	6.3
Use Case Group	Complaints
Use Case Name	Receive a complaint
Version	0.1
Involved Actors	Complaint handler
Preconditions	Someone has a complaint
Description	This use case enables the involved actor to successfully receive a complaint
Postconditions	The complaint is successfully received

Use Case ID	6.4
Use Case Group	Complaints
Use Case Name	Handle complaint
Version	0.1
Involved Actors	Complaint handler
Preconditions	A complaint is previously filed
Description	This use case enables the involved actor to successfully handle a complaint
Postconditions	The complaint feedback is successfully handled

5.4.7. Security incidents

Use Case ID	7.1
Use Case Group	Security incidents
Use Case Name	Detecting an incident
Version	0.1
Involved Actors	Visitor, Staff, Control room staff
Preconditions	An incident is occuring
Description	This use cases enables the involved actors to successfully detect an incident
Postconditions	The incident has been successfully detected

Use Case ID	7.2
Use Case Group	Security incidents
Use Case Name	Reporting an incident
Version	0.1
Involved Actors	Visitor, Security staff, Control room staff
Preconditions	An incident occurred
Description	This use cases enables the involved actors to successfully report an incident
Postconditions	The incident has been successfully reported

Use Case ID	7.3
Use Case Group	Security incidents
Use Case Name	Handling an incident
Version	0.1
Involved Actors	Security staff, Control room staff
Preconditions	An incident has been reported
Description	This use cases enables the involved actors to successfully handle an incident
Postconditions	The incident has been successfully handled

Use Case ID	7.4*
Use Case Group	Terrorist activities
Use Case Name	Report & handle terrorist attack
Version	0.2
Involved Actors	Visitor, Security staff, Control room staff, Counter Terrorism Unit (CTU)
Preconditions	Terrorist activity detected
Description	This use cases enables the involved actors to successfully report and handle a terrorist attack
Postconditions	Terrorist attack successfully reported and handled

** In contrast to use case groups 7.1 - 7.3, use case group 7.4 has been grouped into 'Report & handle terrorist attack". This has been done because at the time this deliverable was written, it was not clear if terror related use cases would be part of the MONICA project. Also, if terror related use cases would be part of the MONICA project, the WP2 team did - at that time - not know yet how to handle these use cases. This is the reason that these use cases have been grouped like this. In the meantime terror related use cases have been discussed during the Plenary Meeting in Kingston (September 2017). Terrorism is a quite complex matter. The MONICA project does not specifically address "terror attacks" as a use case itself but a couple of others like detecting security incidents, which are related.*

5.4.8. Health incidents

Use Case ID	8.1
Use Case Group	Health incidents
Use Case Name	Detecting an incident
Version	0.1
Involved Actors	Visitor, Security staff, Control room staff
Preconditions	An incident is occurring
Description	This use cases enables the involved actors to successfully detect an incident
Postconditions	The incident has been successfully detected

Use Case ID	8.2
Use Case Group	Health incidents
Use Case Name	Reporting an incident
Version	0.1
Involved Actors	Visitor, Security staff, Control room staff
Preconditions	An incident occurred
Description	This use cases enables the involved actors to successfully report an incident
Postconditions	The incident has been successfully reported

Use Case ID	8.3
Use Case Group	Health incidents
Use Case Name	Handling an incident
Version	0.1
Involved Actors	Security staff, Control Room, First Aid
Preconditions	An incident has been reported
Description	This use cases enables the involved actors to successfully handle an incident
Postconditions	The incident has been successfully handled

5.4.9. Technical incidents

Use Case ID	9.1
Use Case Group	Technical incidents
Use Case Name	Detecting an incident
Version	0.1
Involved Actors	Security staff, Control room staff, Visitor
Preconditions	An incident is occurring
Description	This use cases enables the involved actors to successfully detect an incident
Postconditions	The incident has been successfully detected

Use Case ID	9.2
Use Case Group	Technical incidents
Use Case Name	Reporting an incident
Version	0.1
Involved Actors	Security staff, Control room staff, Visitor
Preconditions	An incident occurred
Description	This use cases enables the involved actors to successfully report an incident
Postconditions	The incident has been successfully reported

Use Case ID	9.3
Use Case Group	Technical incidents
Use Case Name	Handling an incident
Version	0.1
Involved Actors	Security staff, Control room staff
Preconditions	An incident has been reported
Description	This use cases enables the involved actors to successfully handle an incident
Postconditions	The incident has been successfully handled

5.4.10. Offenses

Use Case ID	10.1
Use Case Group	Offenses
Use Case Name	Identify law infringement
Version	0.2
Involved Actors	Security staff, Control room staff, Visitors
Preconditions	Law infringement occurring
Description	This use cases enables the involved actors to successfully identify law infringements
Postconditions	Law infringement is successfully identified

Use Case ID	10.2
Use Case Group	Offenses
Use Case Name	Report law infringement
Version	0.2
Involved Actors	Security staff, Control room staff, Visitors
Preconditions	Law infringement detected
Description	This use cases enables the involved actors to successfully report law infringements
Postconditions	Law infringement is successfully reported

Use Case ID	10.3
Use Case Group	Offenses
Use Case Name	Handle law infringement
Version	0.2
Involved Actors	Security staff, Control room staff
Preconditions	Law infringement reported
Description	This use cases enables the involved actors to successfully handle law infringements
Postconditions	Law infringement is successfully handled

Use Case ID	10.4
Use Case Group	Offenses
Use Case Name	Ejection of a person
Version	0.1
Involved Actors	Security staff, Control room staff
Preconditions	Offense is reported and visitor is not complying to regulations
Description	This use cases enables the involved actors to successfully eject a person from the venue
Postconditions	Person is successfully ejected from the venue

5.4.11. Evacuation

Use Case ID	11.1
Use Case Group	Evacuation
Use Case Name	Initiate full evacuation
Version	0.1
Involved Actors	Security staff, Control room staff
Preconditions	Need to evacuate
Description	This use cases enables the involved actors to successfully initiate a full evacuation
Postconditions	Evacuation successfully initiated or canceled

Use Case ID	11.2
Use Case Group	Evacuation
Use Case Name	Lock down entry gates
Version	0.1
Involved Actors	Security staff
Preconditions	Need to lock down
Description	This use cases enables the involved actors to successfully lock down entry gates
Postconditions	Entry gates are successfully locked down

Use Case ID	11.3
Use Case Group	Evacuation
Use Case Name	Open exits
Version	0.1
Involved Actors	Security staff
Preconditions	Need to open exits (prepare to evacuate)
Description	This use cases enables the involved actors to successfully open exit gates
Postconditions	Exit gates are successfully opened

Use Case ID	11.4
Use Case Group	Evacuation
Use Case Name	Inform staff (with no radio)
Version	0.1
Involved Actors	Security staff
Preconditions	Need to prepare for evacuation
Description	This use cases enables the involved actors to successfully inform staff without any communication equipment
Postconditions	All staff without any communication equipment have successfully been informed

Use Case ID	11.5
Use Case Group	Evacuation
Use Case Name	Inform visitors
Version	0.1
Involved Actors	Security staff, Event staff, Visitor, Control Room staff
Preconditions	Need to prepare for evacuation
Description	This use cases enables the involved actors to successfully inform all visitors that an evacuation will take place
Postconditions	All visitors have successfully been informed about the upcoming evacuation

Use Case ID	11.6
Use Case Group	Evacuation
Use Case Name	Guide people to exits
Version	0.1
Involved Actors	Security staff, Event staff, Visitor
Preconditions	Need to start evacuation
Description	This use cases enables the involved actors to successfully guide all visitors to outside the venue
Postconditions	All visitors have successfully been evacuated outside of the venue

Use Case ID	11.7
Use Case Group	Evacuation
Use Case Name	Finalizing the evacuation
Version	0.1
Involved Actors	Security staff, Police
Preconditions	Evacuation in progress
Description	This use cases enables the involved actors to successfully finalise the evacuation
Postconditions	Everyone evacuated, venue is cleared

Use Case ID	11.8
Use Case Group	Evacuation
Use Case Name	Initiate partial evacuation
Version	0.2
Involved Actors	Security staff, Control room staff
Preconditions	Need to evacuate to a designated area
Description	This use cases enables the involved actors to successfully initiate a partial evacuation (a partial evacuation is an evacuation where only a part of the crowd is directed to a designated area, so in this case there is no need to completely evacuate the venue)
Postconditions	Partial evacuation to a designated area successfully initiated or canceled

5.4.12. Traffic

Use Case ID	12.1
Use Case Group	**Traffic**
Use Case Name	**Find parking space**
Version	0.1
Involved Actors	Visitor
Preconditions	Need to park car
Description	This use cases enables the involved actors to successfully locate a parking space
Postconditions	Parking space is successfully located

Use Case ID	12.2
Use Case Group	**Traffic**
Use Case Name	**Find car**
Version	0.1
Involved Actors	Visitor
Preconditions	Car is parked in the area of the venue
Description	This use cases enables the involved actors to successfully locate a car parked in the area of the venue
Postconditions	Car is successfully located

Use Case ID	12.3
Use Case Group	**Traffic**
Use Case Name	**Identify traffic jams**
Version	0.1
Involved Actors	Visitor, traffic police
Preconditions	Need to go home by car
Description	This use cases enables the involved actors to successfully identify traffic jams in the venue area
Postconditions	Traffic jams are successfully located

Use Case ID	12.4
Use Case Group	Traffic
Use Case Name	Present alternative routes
Version	0.1
Involved Actors	Visitor, traffic police
Preconditions	Traffic jams have been identified
Description	This use cases enables the involved actors to successfully identify alternative routes home
Postconditions	Alternative routes are successfully presented

5.4.13. Event information

Use Case ID	13.1
Use Case Group	Event information
Use Case Name	Get event information
Version	0.1
Involved Actors	Visitor
Preconditions	Need for event information
Description	This use case enables the involved actor to successfully receive event information
Postconditions	Event information is successfully received

Use Case ID	13.2
Use Case Group	Event information
Use Case Name	Give event feedback
Version	0.1
Involved Actors	Visitor
Preconditions	Need to give feedback
Description	This use case enables the involved actor to successfully submit the feedback
Postconditions	Event feedback is successfully submitted

Use Case ID	13.3
Use Case Group	Event information
Use Case Name	Evaluate event
Version	0.1
Involved Actors	Event staff
Preconditions	Event is finished
Description	This use case enables the involved actors to successfully evaluate the event
Postconditions	Event is successfully evaluated

Use Case ID	13.4
Use Case Group	Event information
Use Case Name	Navigate event site
Version	0.2
Involved Actors	Visitor
Preconditions	Visitor entered the event
Description	This use case enables the involved actor to successfully navigate the event site
Postconditions	Vistor successfully navigated the event site

5.5. Use case diagrams

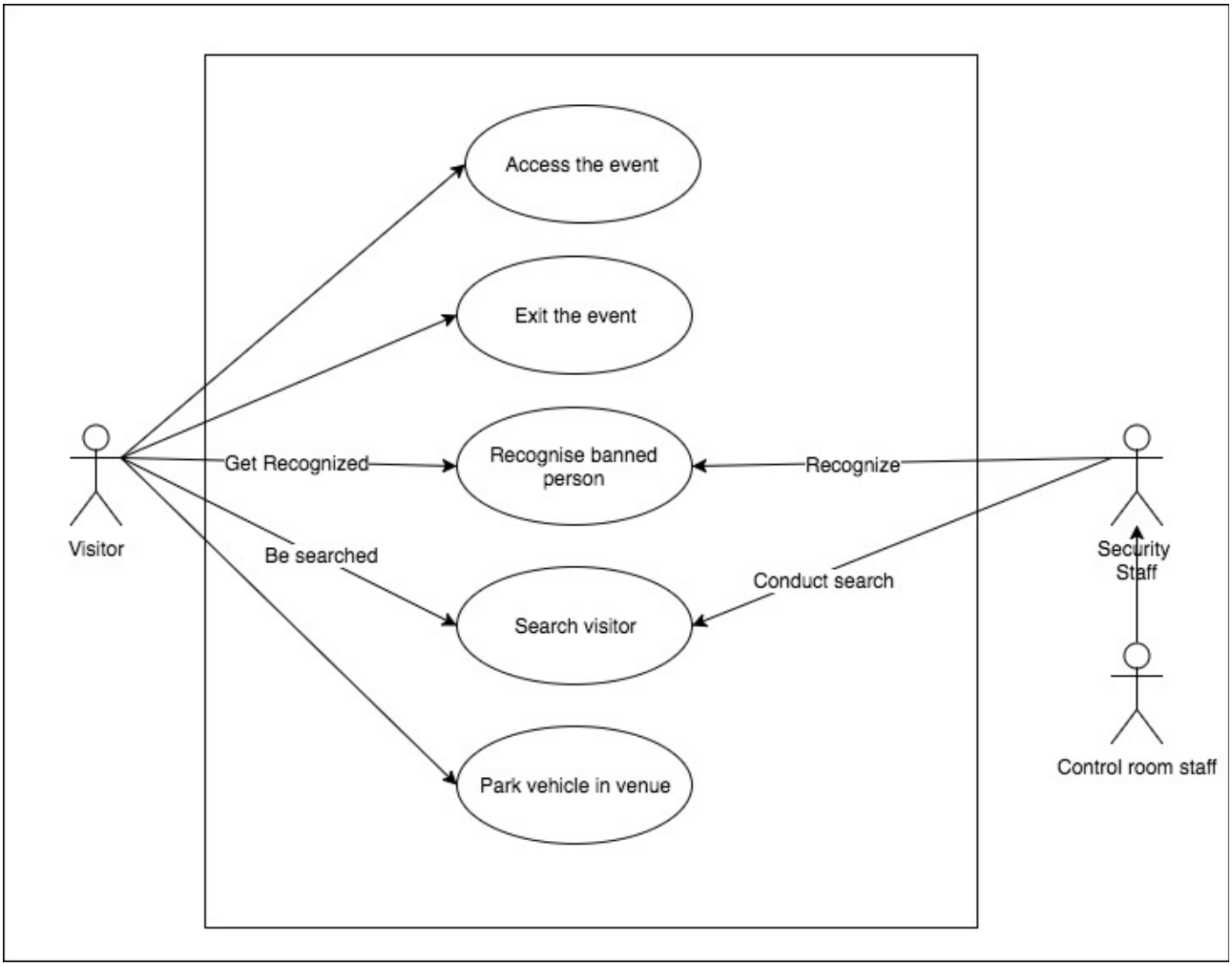

Figure 3 - Use case diagram Access control.

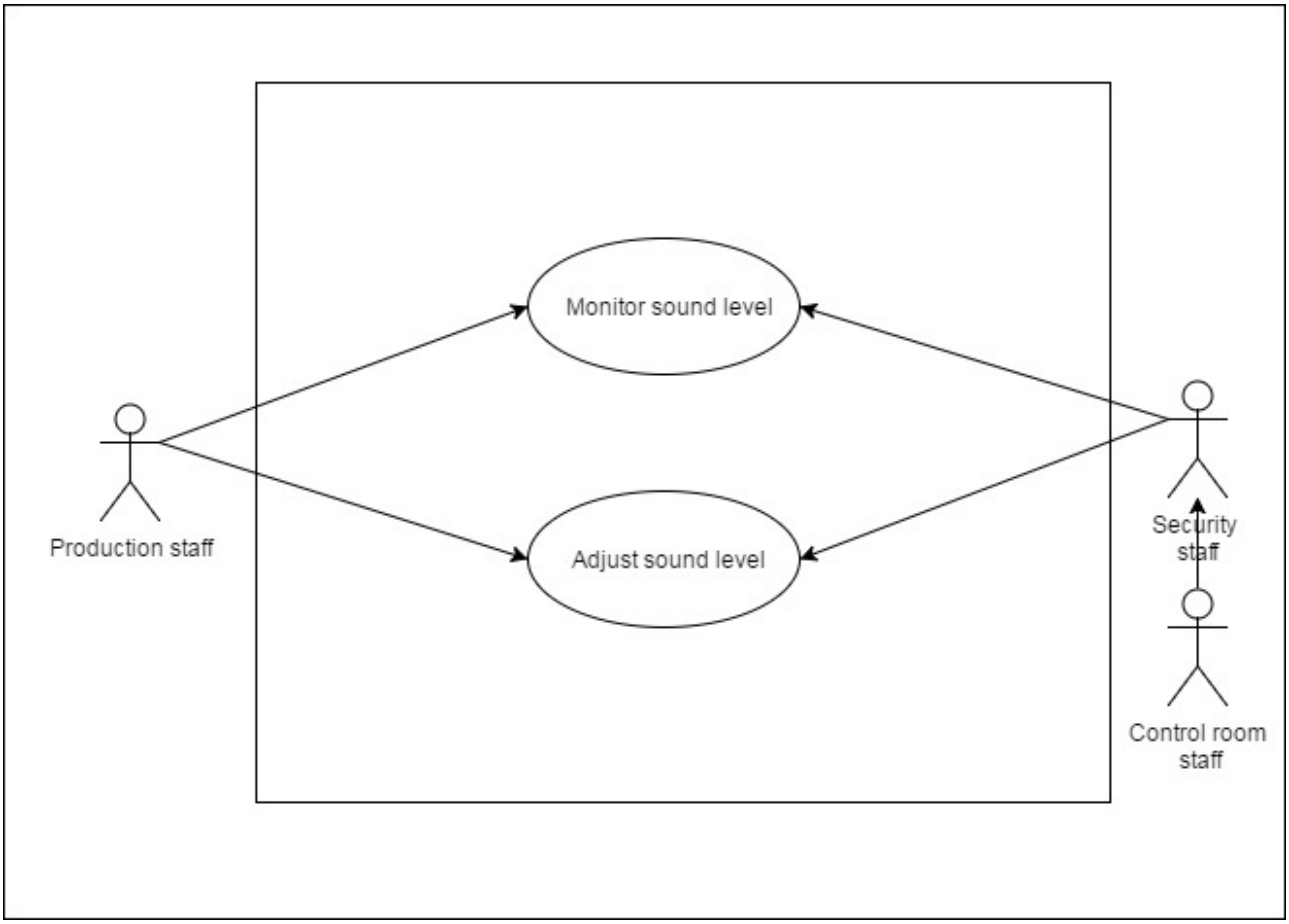

Figure 4 - Use case diagram Sound monitoring and control.

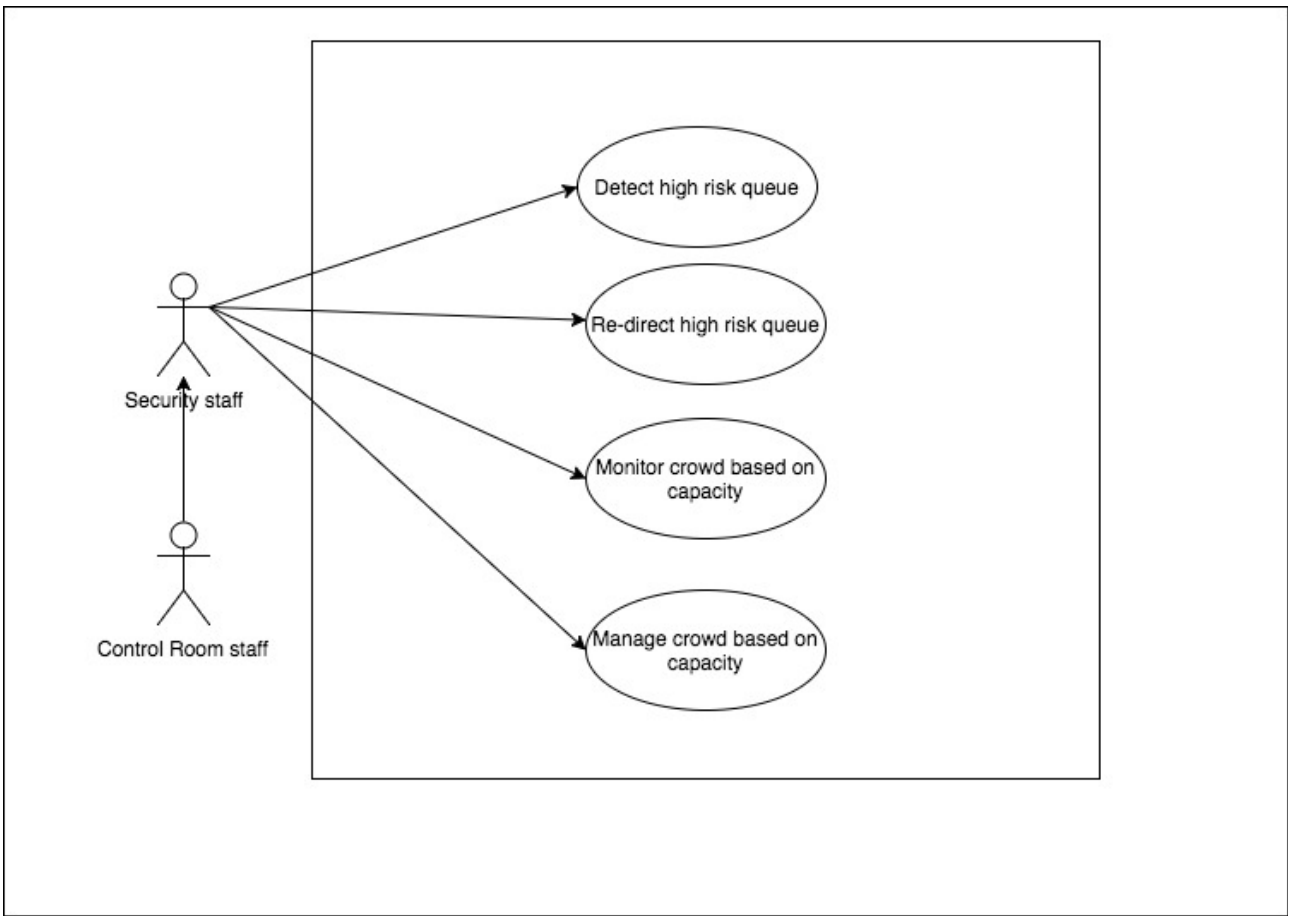

Figure 5 - Use case diagram Crowd and capacity monitoring.

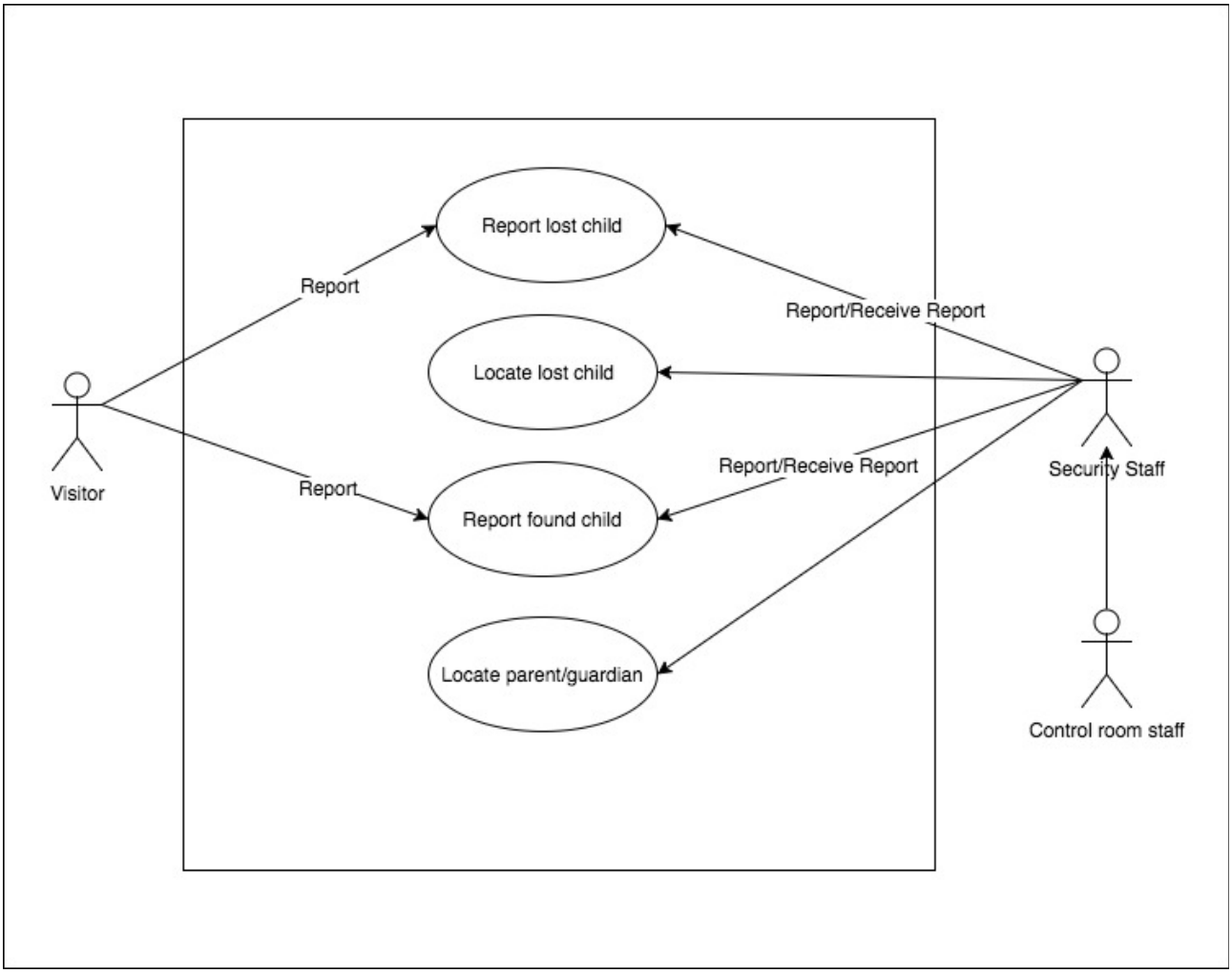

Figure 6 - Use case diagram Missing person.

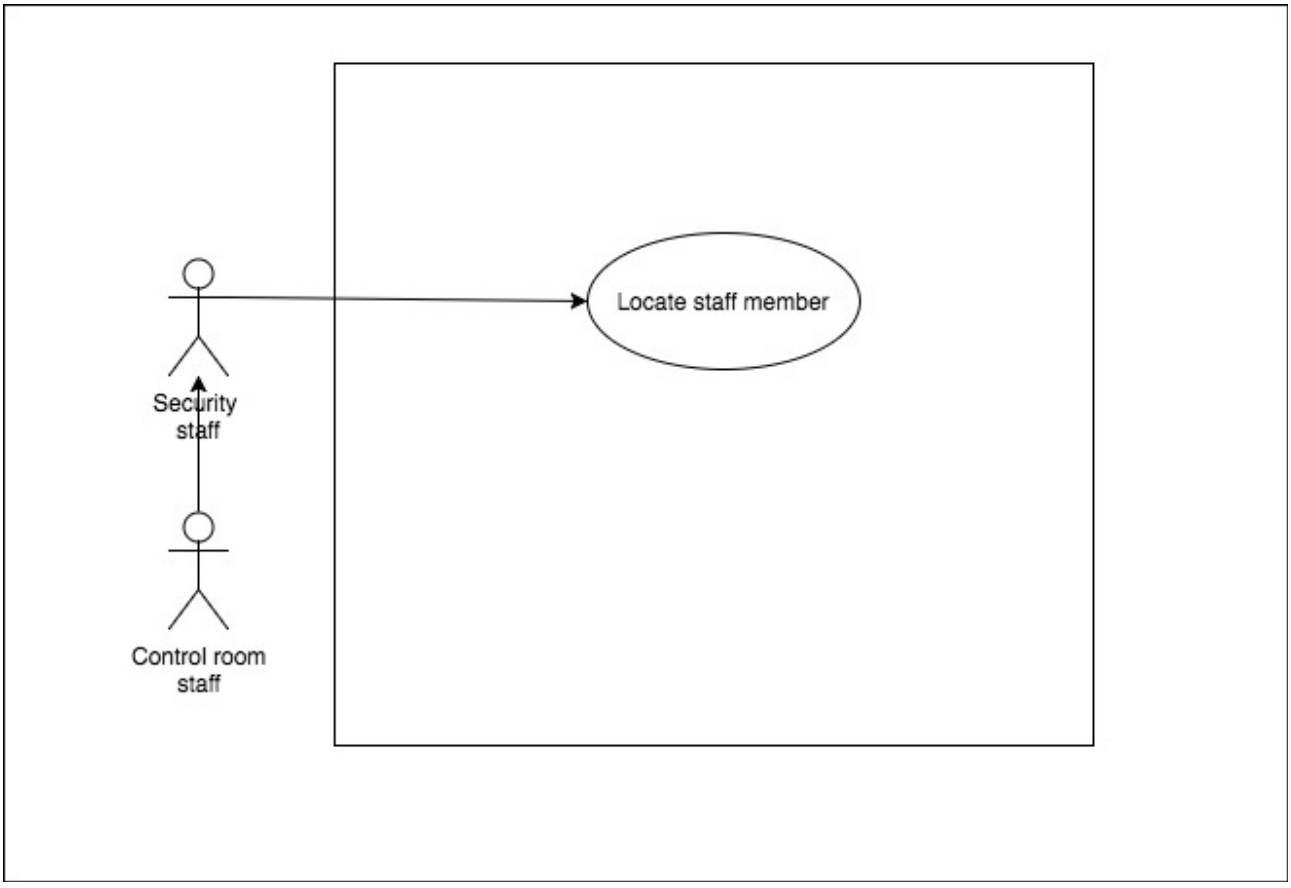

Figure 7 - Use case diagram Locating staff.

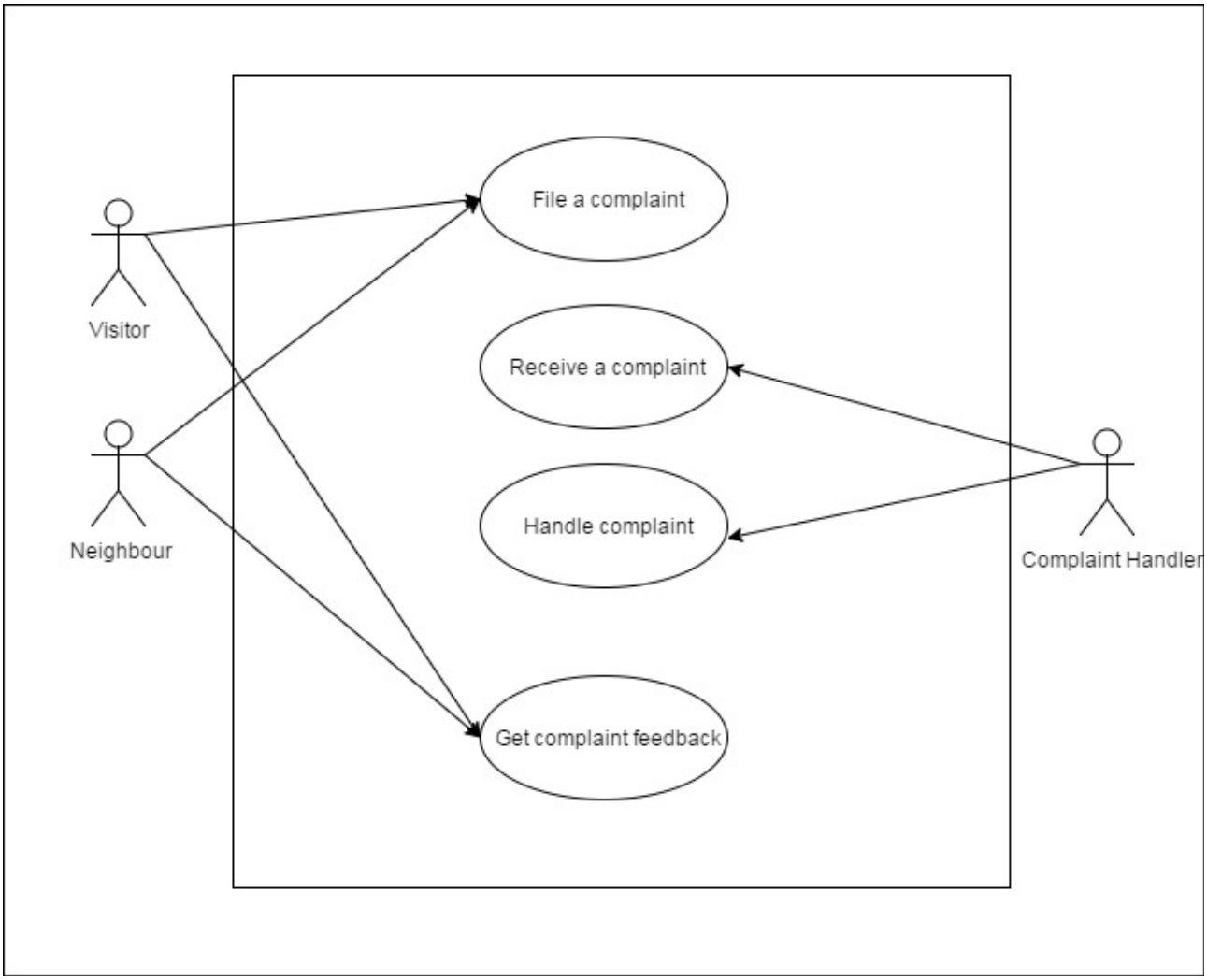

Figure 8 - Use case diagram Complaints.

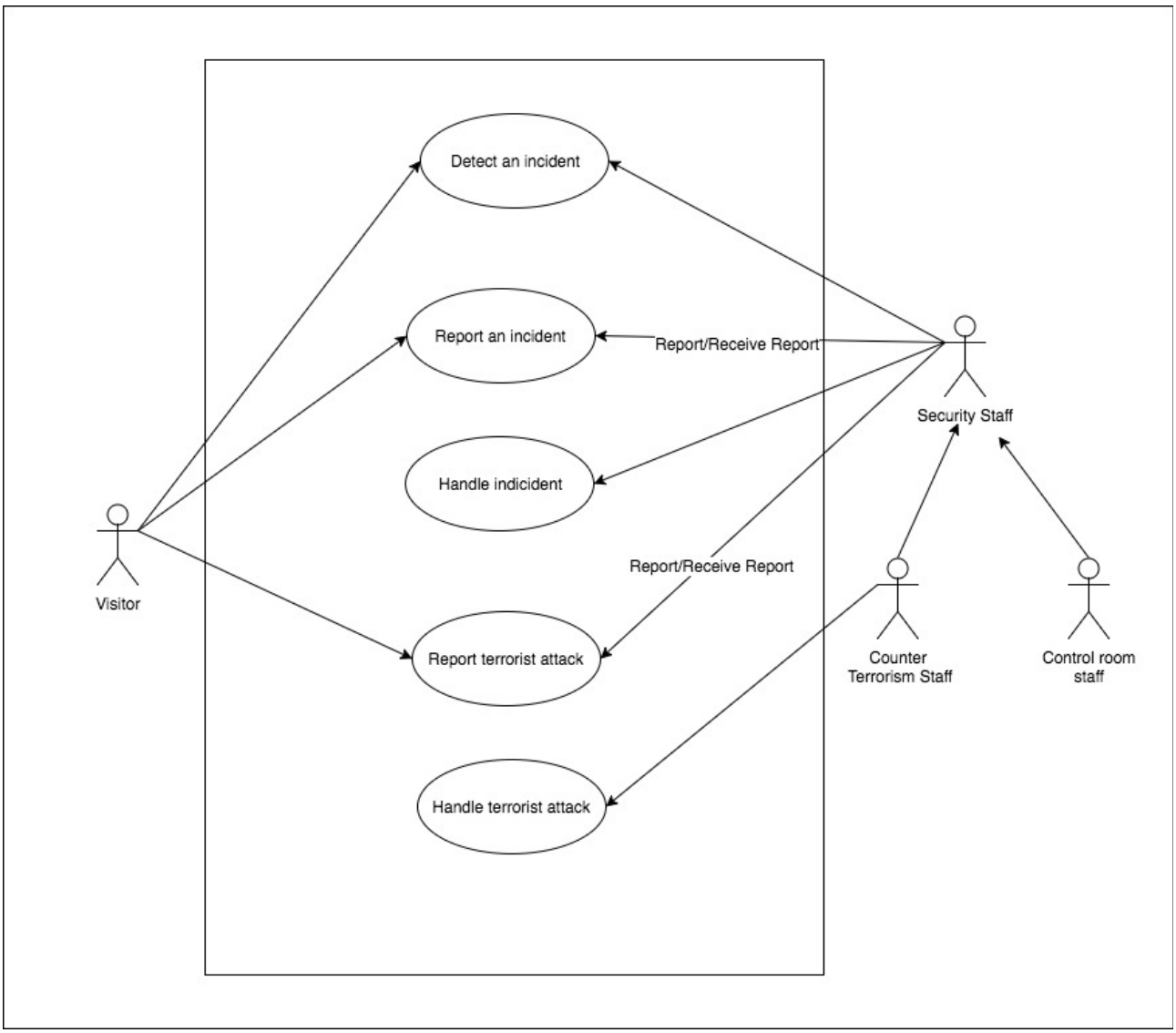

Figure 9 - Use case diagram Security incidents.

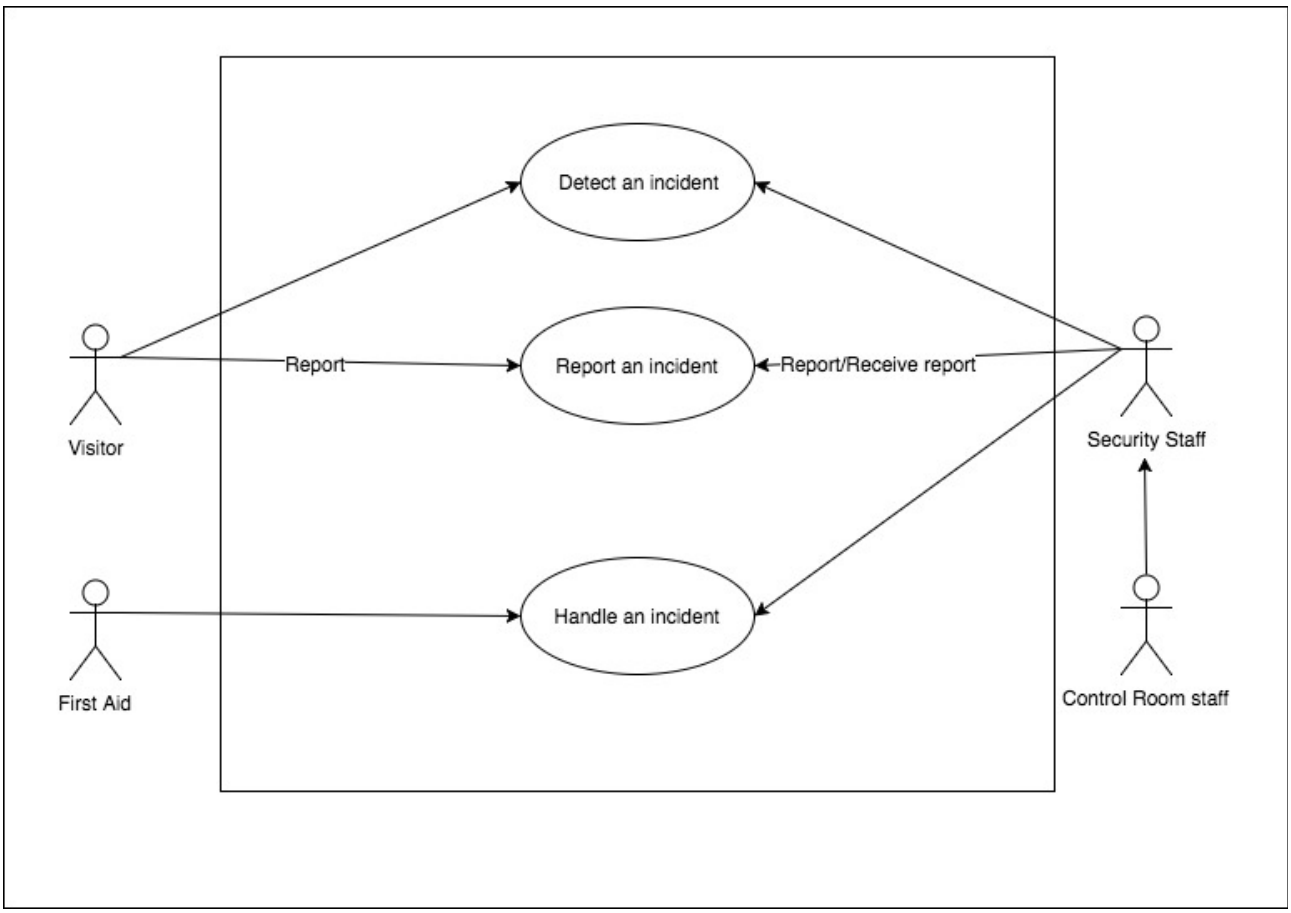

Figure 10 - Use case diagram Health incidents.

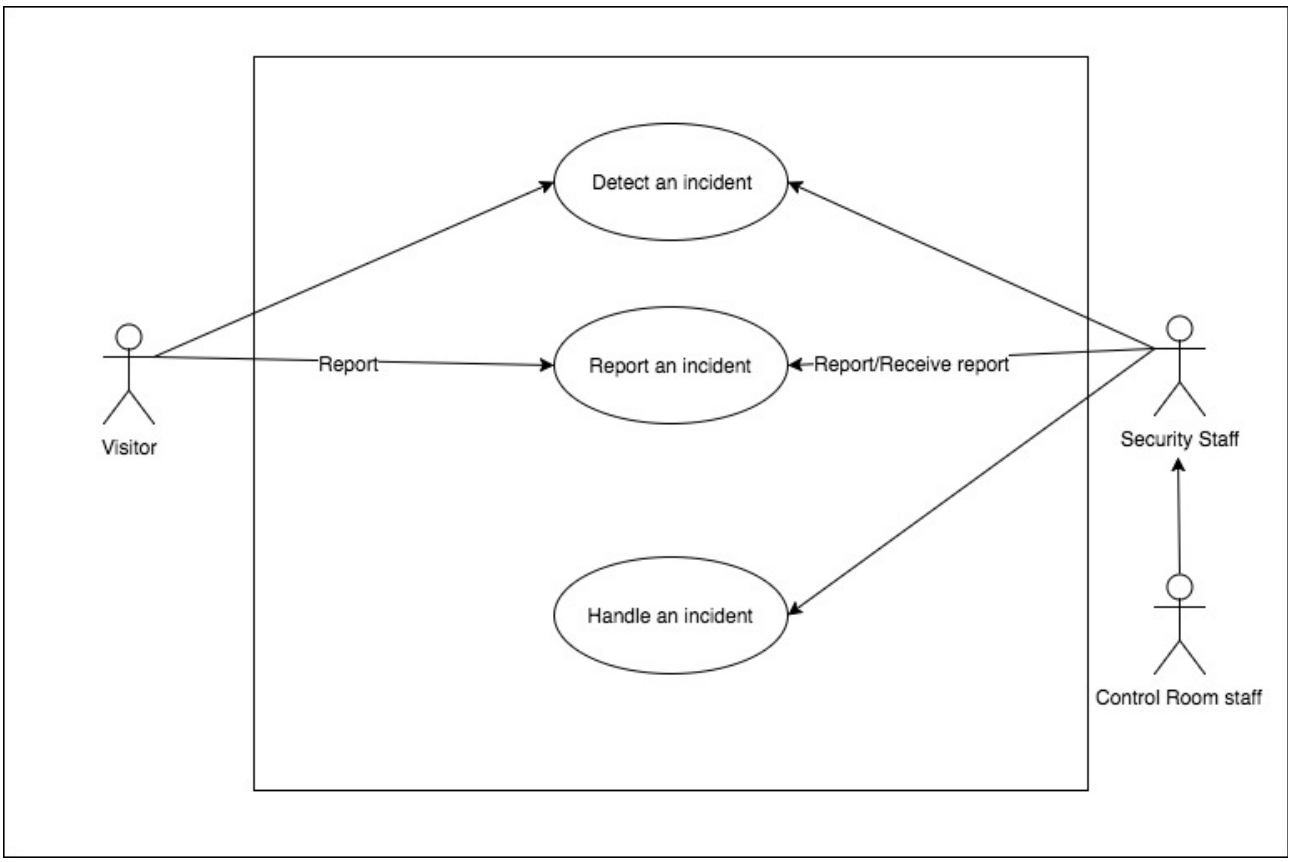

Figure 11 - Use case diagram Technical incidents.

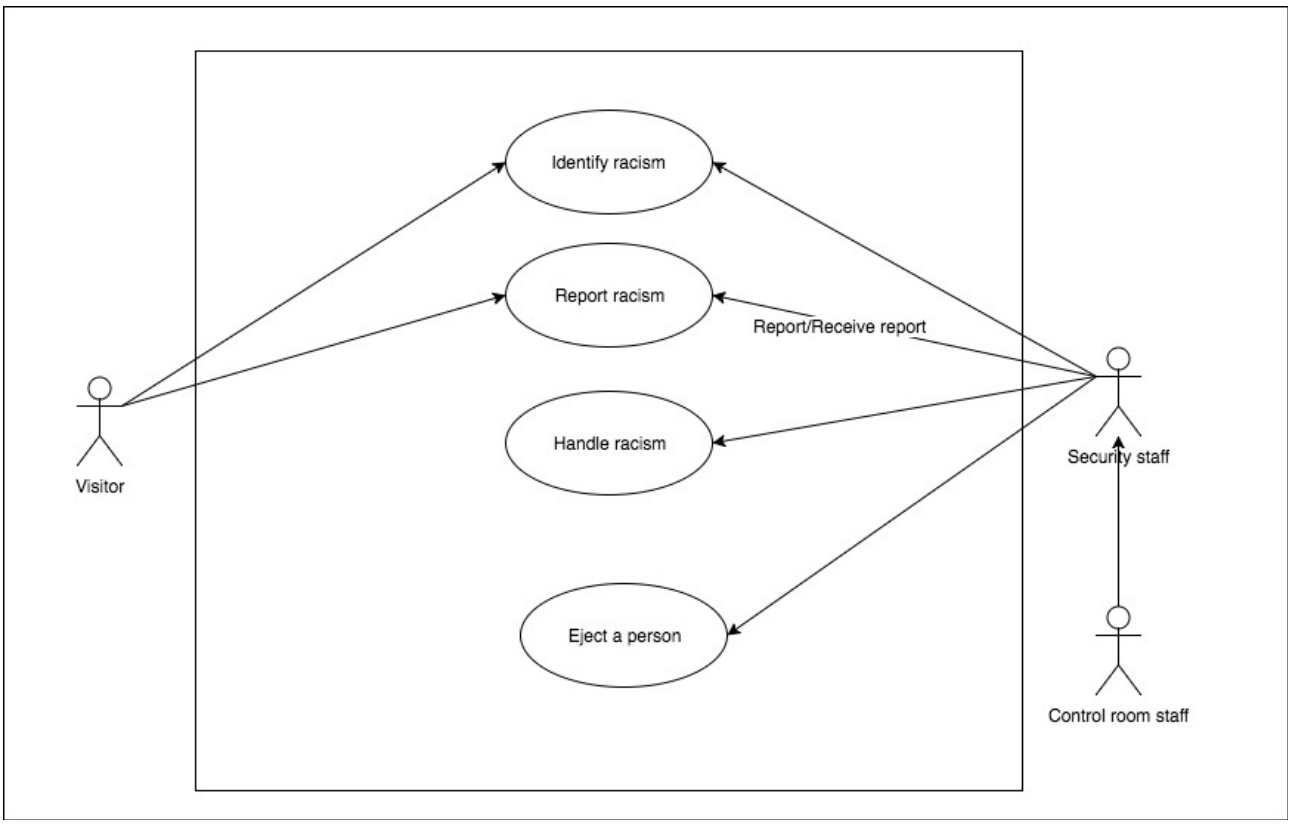

Figure 12 - Use case diagram Offenses.

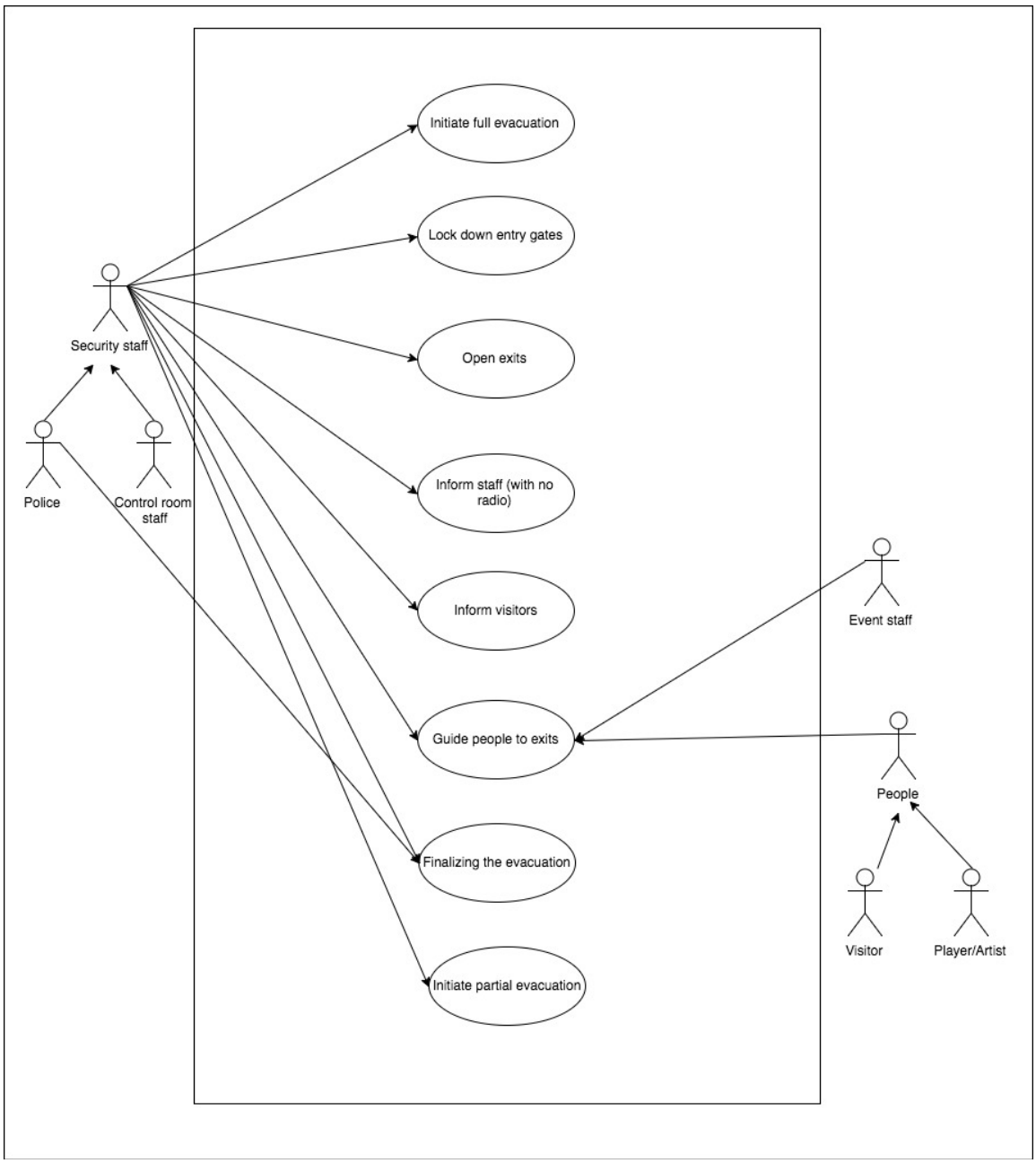

Figure 13 - Use case diagram Evacuation.

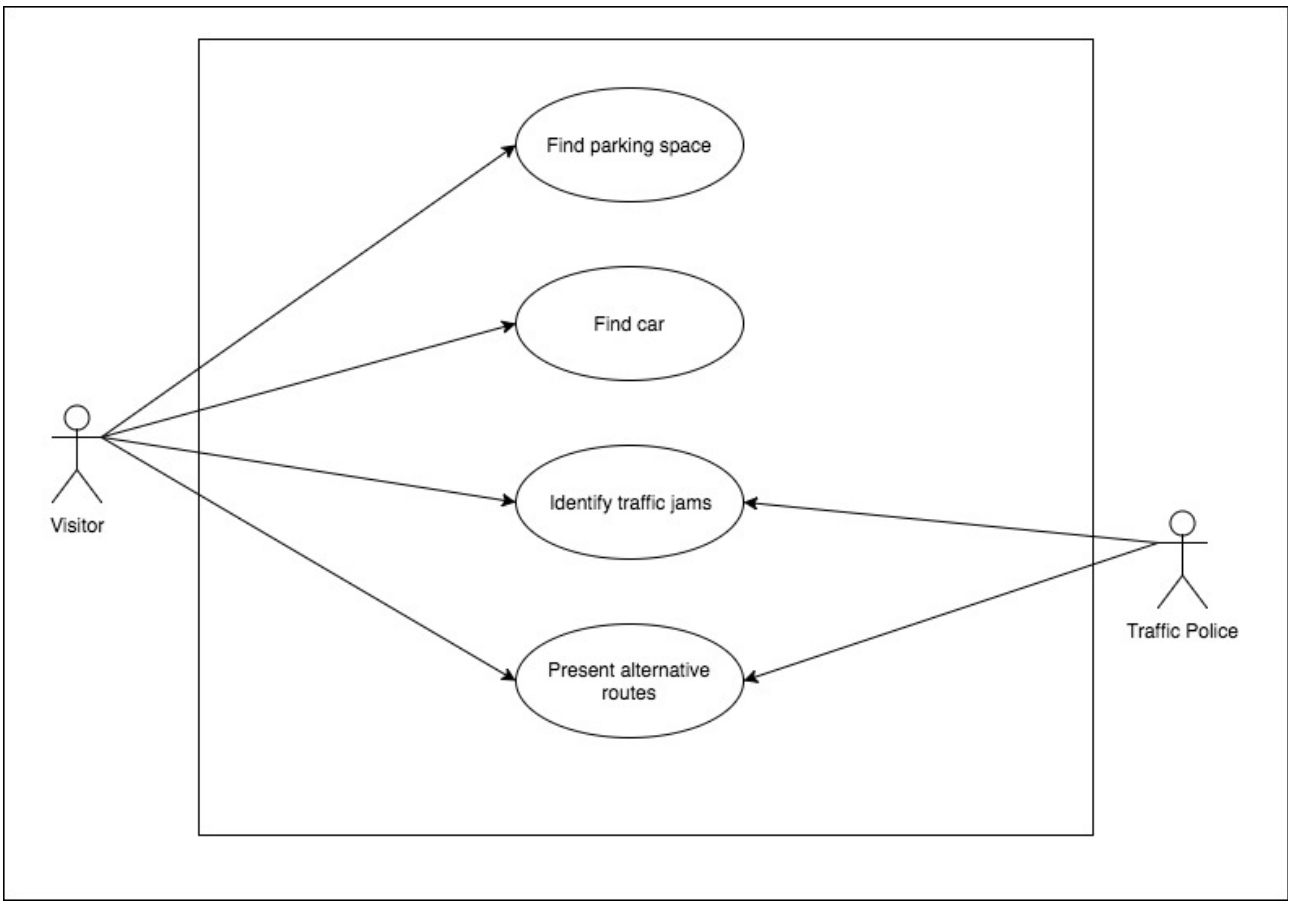

Figure 14 - Use case diagram Traffic.

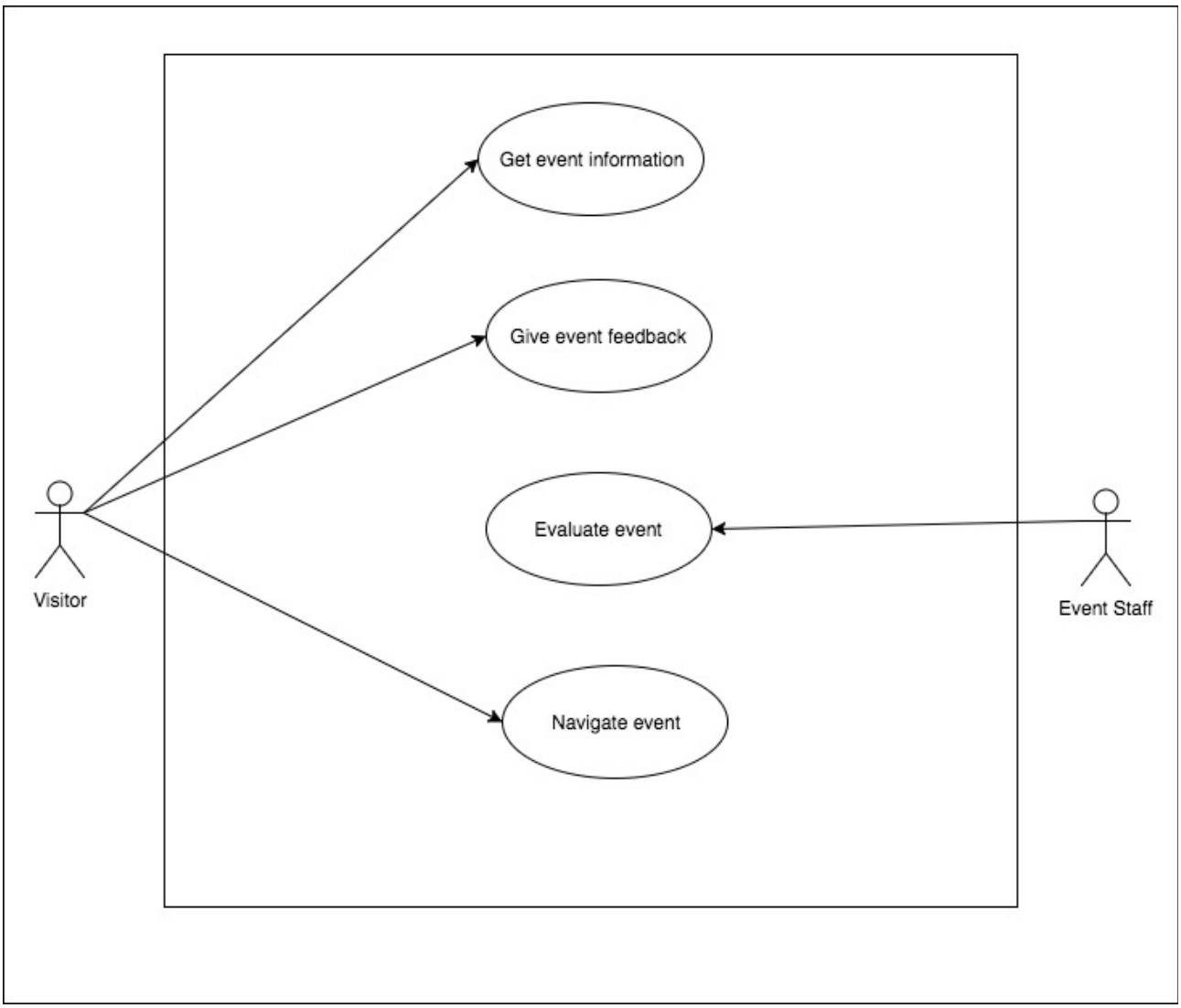

Figure 15 - Use case diagram Event information.

6. Conclusion

The objective of this deliverable is to acquire domain knowledge for each of the pilot events in order to get to the most possible complete list of use cases. The “user scenarios” describe the as-is situation for a particular pilot event, with solutions and technology available at the present.

The user scenarios and use cases are validated by the pilot event representatives by letting them review their scenarios and by further discussing them during the plenary meeting in Turin and thereafter.

The scenarios described in this report are the result of a thorough investigation of all the relevant stakeholders and processes that were encountered during the various workshops. Some scenarios could either not be relevant for MONICA or are not feasible for implementation due to technical and/or business constraints. The technical partners in MONICA will need to categorise the scenarios based on relevancy and feasibility by either denoting them “relevant” or “not-relevant”. After this categorisation step detailed, but generic, use cases will be created based on all the “relevant” scenarios. The use cases will be written in enough detail such that both functional- and non-functional requirements can be derived from them. These requirements should give the technical partners enough food-for-thought to design various technical solutions based on each of the partner’s expertise and the given use cases. Note that various technical solutions will probably emerge due to the fact that each technical partner has its own focus. For example, “detecting a fight” can be implemented using camera’s, wristbands, mobile apps, and even noise monitors. Also “finding a person” can be implemented using camera’s, wristbands or mobile apps. Even combinations of technologies can be valid technical solutions.

Deploying a specific solution during a pilot event can be dependent on yet many other constraints which can be of technical, sociological, logistical, economical or of some other nature. Deploying camera’s in a green field site might not be feasible because of an expensive network infrastructure on which the camera’s are depending. Using wristbands could be an issue because of the logistics involved in distributing and collecting all the wristbands to/from the visitors. Mobile apps may require decent cellular networks, which could not be available when tens of thousands of people are attending an event. Therefore, in future work, the limiting capabilities of a pilot event will need to be assessed as well.

Eventually, the use cases will be used to develop detailed requirements in T2.2 and to build a corresponding architecture to support these requirements in T2.3.

7. Appendix A: key figures of pilot events

Event	Kappa FuturFestival	Movida	Friday Rock	Port Anniversary	Dom	Rhein in Flammen	Kunst!Rasen	Putschens Markt	Rugby games	Cricket games	Festival of Lights	Nuits Sonores
city	Torino	Torino	Copenhagen	Hamburg	Hamburg	Bonn	Bonn	Bonn	Leeds	Leeds	Lyon	Lyon
month of event	July	All year	April - Sep	May	April/August/ November	May		September	February - October	April - September	December	May
# days	2	multiple	20+	3-4	multiple	3 (1 main event day with fireworks on Saturday)		5	multiple	multiple	4	5
opening times	12:00 - 00:00		22:00 - 00:00	Thu: 10:00 - 22:00 Fri/Sat: 10:00 - 00:00 Sun: 10:00 - 21:00		Fri/Sat: 13:00 - 00:00 Sun: 11:00 - 18:00		12:00 - 03:00 12:00 - 03:00 10:00 - 01:00 12:00 - 01:00 12:00 - 00:00			20:00 - 00:00	
avg. # people per day	20,000	8,000 (hotspots)	20,000	1,000,000 (4 days)	250,000	90,000		200,000	16,000		750,000	
type of venue	public park	city areas	amusement park	city areas	fair-ground	public park		fair-ground / city areas	stadium	stadium	city areas	city areas
# m2	10,000	Largo Saluzzo: 5,000 (complete area: 0.25 km2)	2,700	800,000	160,000	1,600,000 Left side of Rhein: 1,250,000 Right side of Rhein: 350,000		80,000				
# stages	3	0	1	N.A.	0	3			N.A.	N.A.	N.A.	
gated	yes	no	yes	no	yes	no		no	yes	yes	no	yes
# of entries	1	N.A.	3	N.A.	9	Open area from all sides up to 5 main entrances		N.A.	3	3		
# exit gates	11	N.A.	3	N.A.	9	Open area and the possibility to exit anywhere		N.A.				
metal detector	yes	N.A.	no	N.A.	no	no		N.A.				
search people/bags	yes	N.A.	no	N.A.	no	Only on suspicion or occasion		N.A.	yes	yes	yes	
# emergency exits	yes	N.A.	yes	N.A.	no	Wide open space. Escape possible in all directions		8				
# cameras	10	4	399	6	N.A.	0		8	29	29		
type of cameras	PTZ	IP	AXIS, DOME and PTZ, HikVision, PTZ, Camvision		N.A.	N.A.			various	various		
# body worn camers	no	no	no	no	no	no		no	3	3	no	no
noise monitoring	yes	yes	yes	yes	no	yes			no	no	yes	no
type of noise monitoring	2 sound check points	6 RT noise level meters	sound level	sound level	N.A.	2 sound meters			N.A.	N.A.		N.A.
max. noise level	70dB (A) leq 30'	50-54 dB	77dB (A) leq 60'			Friday (pre-evening): 13:00-20:00 - 60dB 20:00-00:00 - 55 dB Saturday (main day): 80 dB Sunday (family day): 45 dB						
sound control	basic	no	basic	no	no	no			no	no	basic	no
WiFi available	no	no	yes			yes (control centre)			yes	yes		
Ethernet	no	no	yes			yes (control centre)			yes	yes		
Fiber optic available	no	no	no						no	no		
Cellular coverage			<100%									

8. List of Figures and Tables

8.1. Figures

8.2. Tables

9. References

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