MONICA

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

(Grant Agreement No 732350)

D8.1 Site Surveys and Pilot Plans for MONICA IoT Platform Pilots

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0.4	Olga Michel (Fraunhofer, FIT)	2018-05-25	Adjusted Layout of the document and made updates in the List of Figures
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0.6	Olga Michel (Fraunhofer, FIT) Marco Jahn (Fraunhofer, FIT)	2018-05-29	Ready for internal review.
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1 Executive Summary

This deliverable has the main objective of documenting the pilot surveys and the current status of the pilot plans for each of the MONICA events. It has been developed under the scope and objectives of WP8 which is responsible for preparing, deploying and executing the MONICA pilots.

It is expected that this report will be used by MONICA partners involved in the deployments as a guide that to refer to for general information in relation to the context of each event, allocated use cases and its direct relation to the technical solutions to be deployed.

Furthermore, being the dissemination level of this deliverable public, it is also expected that external readers who are interested in the MONICA project can be informed through this document of the current status of the conceptualized MONICA solutions and the demonstration plans.

The content of this report reflects input provided by pilot owners, technical partners and representatives of diverse work packages. In this way, the engagement of demand-side and supply-side stakeholders has allowed the definition of pilot specific plans that are aligned with pilot goals as well as with the MONICA platform capabilities.

The key points documented in this deliverable are:

- **MONICA solutions:** overview of solutions that have been conceptualized based on the mapping of available MONICA technologies and the use cases defined by WP2 (see also *D2.1 Scenarios and Use Cases for use of IoT Platforms in Event Management and D2.3 Initial Requirements report)*
  The objective of the solutions overview is to summarize what MONICA can offer in terms of functionalities. MONICA provides solutions to the following groups:
  - Sound Monitoring & Control
  - Crowd & Capacity Monitoring
  - Missing Person
  - Locate Staff (interaction with staff)
  - Health, Security & Safety Incidents
  - Access Control

  It is worth mentioning that the boundaries are not always strict. There are technical solutions which can contribute to more than one use case. For example, the use case group Event Information has been merged together with several other relevant use case groups (e.g. Crowd & Capacity Monitoring, Sound Monitoring & Control, etc.) because most of the event information that will be communicated to visitors through the MONICA App is information deriving from more global use case groups.
- **Pilot surveys and the pilot plans,** i.e. the mapping between pilot use cases and solutions are described. The pilot surveys cover basic information about each event, i.e. location & surroundings, attractions, visitations, site plans, current infrastructure (in terms of communication infrastructure), and relevant stakeholders. The pilot plans describe how the concrete technical solutions are envisioned to be demonstrated at each event. Further, the purpose and objective for each concrete pilot demonstration case and the selected solutions are described.
- **Process and toolchain for coordination and management of the demonstrations.** Description of the approach followed at MONICA to coordinate and manage the planning, deployment, and operation of the demonstrations at 11 different events in 6 cities. For each pilot a core management team has been defined to cover the relevant project perspectives: one pilot representative, one technical manager, one requirements manager, and one coordinating person. The overall coordination of the pilot demonstration activities is done by the Pilot Coordinator. The toolchain consists of the pilot demonstration wiki as the main knowledge repository, pilot event master plan and planning tool to provide an overview of the relevant dates, and the asset management tool for organizing the hardware assets.

The pilot plans described on this deliverable as well as the chosen functionalities to be demonstrated on each pilot aim at documenting the current status of the planned demonstrations. The plans could be updated as new

functionalities are conceptualized or the decision comes to test different technologies on different pilots depending on the evolution of the project, new identified opportunities or unexpected limitations.

2 Introduction

The primary objective of WP8 in the MONICA project is to manage the preparation and the deployment of the MONICA pilots. Concretely, the content reflected in this deliverable corresponds to the outputs of task 8.1: Pilot preparation:

Pilot Preparation

The pilot preparation within the context of MONICA involves several aspects which are documented within this report:

- **Pilot Surveys**
  Collection of relevant material that describes each pilot and can be particularly useful when planning the demonstrations. This material includes description of the type of event, location and surroundings, relevant insights on the available infrastructure, possible limitations that might influence the selection of technologies to be demonstrated, etc.
- **Pilot Plans**
  Definition of how the MONICA Use Cases (defined by WP2) will be implemented specifically in each one of the events. The pilot plans describe the functionalities to be demonstrated on each event per year, as well as the technologies required.

In order to enable pilot representatives and technical partners to discuss and agree on what technologies and applications will be demonstrated, an overview of all MONICA Solutions (including functionalities per technology) has been created as a base to guide the discussions. This overview can also be found as part of this report.

Beyond the **pilot preparation** activities mentioned above, it has been identified that the planning of the different demonstrations is an ongoing activity which goes beyond of the static content of a deliverable. To account for these dynamics, processes and tools have been established and are also presented within this report.

It is also relevant to mention, that after the DoA amendment, the title of this deliverable was updated, removing the part for pilot specific KPI´s out of the main scope of this report. It was then decided to document the work related to pilot specific KPI´s in a working document (WD9.2) under the scope of WP9 and impact assessment.

2.1 Content and Structure

The content of this deliverable is organized in the following way:

Chapter 3 provides an overview of the MONICA Solutions. The purpose of this chapter in this deliverable is to provide a general overview of MONICA´s functionalities and technologies, before diving into pilot specific information. The content of the *MONICA Solutions Overview* chapter drives the definition of the Pilot plans described in chapter 4.

Chapter 4 contains one section per pilot where the following aspects are documented: *Pilot Surveys* and *Pilot Plans: Selected solutions and Demonstration* per pilot.

Finally, Chapter 5 describes the different tools that have been created to guide the continuous management of MONICA demonstrations.

2.2 Definitions

Pilots: The six partners who provide the physical spaces for demonstrating the MONICA IoT solution.

Events: The venues, in which the demonstration of MONICA solutions are going to take place. Venues can run over longer period of times and can be repeated.

Demonstrations: The physical setup of the MONICA solution during one of the planned events. A demonstration can be a single day or several days. A demonstration can be repeated.

Use Case Group (UCG): A use case group refers to a collection of use cases that are directly related to each other. (e.g. the use cases *2.1 Monitor Sound level* and *2.2 Adjust sound level* are under the use case group 2. *Sound monitoring and control*). In this deliverable, we refer often to use case groups instead of referring to

each individual use case. The detail list of the individual use cases per group has already been documented in *D2.1 Scenarios and Use Cases for use of IoT Platforms in Event Management* and its relation to each pilot in *D2.3 Initial Requirements report.*

3 MONICA Solutions Overview

The objective of this chapter is to provide an overview of the different MONICA solutions that have been conceptualized based on the mapping of available MONICA technologies and the selected MONICA use cases (See *D2.3 Initial Requirements report*).

Definition of MONICA Solutions

The approach for defining the MONICA solutions starts by referring back to the use case groups (e.g. Crowd and Capacity Monitoring) specified within the work of WP2. For each one of these use case groups, a list of functionalities[1] was identified (e.g. monitor crowds, communicate with staff, etc.) As a next step, the different MONICA technologies that enable that concrete functionality have been mapped correspondingly. The result of the mapping of these three aspects (use case groups, functionalities and technologies) constitutes each one of the Solutions documented here.

When working on the detailed functionalities for each use case group, it was identified that often functionalities belonging to different use case groups complement each other making two or more of them interdependent. As a consequence, the MONICA solutions described here might, in some cases, make reference to more than one use case group at a time (although the main focus is set on the one giving the name to each section). Examples of this interdependence are:

- The functionalities for the use case group for Evacuation are the same as the Crowd and Capacity Monitoring functionalities. For this reason, both topics have been merged in this deliverable as one solution (Section 3.2).
- The use case group Event information has been merged together with several other relevant use case groups (e.g. Crowd and Capacity Monitoring, Sound Monitoring and Control, etc.) The reason for this is that as far as it has been agreed until now, most of the event information that will be communicated to visitors through MONICA APP is information deriving of more global use case groups.
- A similar situation as the one mentioned in the last paragraph applies for the Locate Staff member use case. Nevertheless, in this case it was decided to also keep it as a separate MONICA solution since it might be used by pilots independently of the bigger context and other chosen solutions.

The MONICA solutions described here present the current status and represent a general overview of what MONICA can offer. It might be the case that for some pilots, more concrete functionalities will be demonstrated, but this will be then described directly within the corresponding pilot plan. It could be that as the project evolves more functionalities are included or removed from this general overview.

Before diving into the catalogue of solutions, we would like to use this section to communicate that a new use case group (Safety incidents, UCG14) has been added to the list of selected MONICA use cases (defined by WP2). The decision was made based on talks with pilot stakeholders who presented their interest on having a solution that could help detect safety incidents related to high wind speed and weather conditions. In fact, under unsuitable weather conditions, some stalls and attractions have to take precautions to prevent catastrophe. By installing environmental sensors that can measure wind speeds, MONICA expects to be able to support pilots in solving this challenge. The solution for Safety Incidents use case is presented in section 3.5.1 of this report.

[1] aspects that the system can do for a user or aspects that the system can support the user with.

3.1 Sound Monitoring and Control

The objective of the MONICA sound monitoring and control solution is to provide users with tools that enable them to have a full overview of the sound levels during and after the event. It has as well the objective to enhance sound technicians to make informed decisions when it comes to controlling the sound levels. A global objective of this solution is to provide an optimal experience to concert goers, while avoiding discomfort provoked by the sound propagation to neighbouring areas.

Monitor sound

The system is able to monitor sound levels inside and outside of the venue making use of its sensor technologies. Additionally subjective feedback will be collected in order to receive a full overview of the perceived sound quality from the visitors, the staff members and the neighbours´ point of view.

The collection of data coming from the different sources will be visualized in the form of heat maps and graphs through the COP (Common Operational Picture) interface, which provides an overview of the situation directly to the control room. Furthermore, the solution will send alerts when sound overcomes thresholds in specific locations to enable sound technicians and event organizers to act on time and avoid overcoming the official sound limits.

Additionally, the MONICA app for the public will be used to inform visitors or neighbours about sound quality or sound levels in a specific area.

Control sound

MONICA provides an optimized sound field in the audience area and minimizes the impact on neighbouring areas through the Adaptive Sound Field Controller (ASFC).

Quiet Zones

Additionally, MONICA also offers a quiet zone application through which local quiet areas can be installed in the event in locations where there is the need to minimize the exposure to noise for staff and public.

3.1.1 Involved Use Cases

The following use cases are part of the Sound monitoring and control solutions:

Sound monitoring and control
- 2.1 Sound Monitoring
- 2.2 Sound control

Event Information
- 13.1 Get event information

3.1.2 Functionality Overview

	UC	Functionality	Application	Required Technologies
Monitor Sound Levels	**UC 2.1**	**Monitor sound levels**	COP	• Contribution Algorithm (built in IoT microphones) • Annoyance Comfort Index • Heat map (requires almost full ASFC functionality)
	UC 2.1	**Receive feedback from visitors, staff and neighbours**	COP MONICA App (for staff) MONICA App (for visitor)	• Harmonica Index • Staff wristband • Smart glasses • Smartphones

			MONICA App (for neighbours)	
	UC 2.1 **UC 13.1**	**Inform Visitors / Neighbours/ staff of current sound quality and sound levels**	MONICA App (for visitor) MONICA App (for neighbours)	• Smartphones • Harmonica Index
Control sound levels	**UC 2.2**	**ASFC (Adaptive Sound Field Controller)**	COP	• IOT Microphones • Environmental Sensors • ASFC Computational Core • Additional Sound speakers
		Quiet Zones	Self-contained solution	• Self-contained solution

3.2 Crowd and Capacity Monitoring

The goal of the MONICA Crowd and Capacity monitoring solution is to provide users with tools that allow them to have a full overview and control of the crowd levels in different areas of the event and prevent ab normal events by making sure that the venue capacity and the crowd density do not exceed specific limits and that no queues or other blockages obstruct the flow of people.

MONICA´s Crowd and Capacity Monitoring solution will support evacuation simulation scenarios. When it comes to evacuation, MONICA does not intend to substitute existing processes, but to support them.

Crowd Monitoring

MONICA enables people counting and crowd flow analysis through different technologies. The information collected can be directly compared to the capacity of the venue: if the capacity is over the limit or there are more people in a square meter than allowed then an alert is raised. If the system detects high-risk queues then the user will be informed and advised to re-direct them. The overview of the situation is then delivered to the control room through the Common Operational Picture interface using vectors in a georeferenced map indicating location, direction and magnitude of the flow as well as providing the user with alerts.

Crowd Management

MONICA´s communication support applications simplify coordination between staff members and the control room in order to react faster when visitors have to be re- directed. Route suggestions can also be communicated to visitors through different means depending on the requirements of each event. (E.g. light guidance, airborne, digital displays, etc.)

The MONICA app for visitors is also able to provide users with a functionality to discover shorter queues, closer exits or suggestions on the fastest way.

Simulation and Analysis of Crowd Behaviour

MONICA proposes a simulation tool that enables the user (e.g. fire brigade team, event organizer, etc.) to simulate crowd flows and movement based on different variables.

In order to create the simulation, the user of the tool starts by creating a potential scenario by defining certain characteristics of a particular situation in the venue (e.g. location of an incident, amount of people in a specific area, location of exits, special needs for people with disabilities, etc.) Based on this information the system provides a simulation of the crowd behaviour (visualized on a map) of such a scenario.

In this way, the tool allows users to quickly explore and compare different scenarios, and gather a better understanding of aspects such as usage of venue space, safety risks, optimal usage of exit and access routes, etc. In this sense, it is expected that the tool can also support the improvement of the plans for the events:

- Simulate crowd movement in different scenarios
- Improve evacuation plans based on the analysis of the simulations
- Gather a better understanding of crowd movement in a specific venue
- Evaluate the capacity and accessibility of the venue
- Explore consequences of potential incidents happening in different locations
- Evaluate the capacity of tunnels, walkways, etc.

The simulation works by specifying the event area using a graphical user interference, initial population, as well as exit points for the moving crowd. The implementation is based on cellular automaton and it combines algorithms for finding the shortest path along with several dynamic social models (e.g. wall and collision avoidance, inertia effect, group effect), in order to realistically simulate pedestrian's motion. In addition, different parameters and velocities can be used for a certain group of people, in order to diversify the initial sample (e.g. minors, people with mobility issues etc.). The output, apart from the visual depiction, consists of the number of evacuated people at any given moment and the total time until the site is completely evacuated. More detailed information on the Evacuation Simulation tool is provided in deliverable D6.4.

3.2.1 Involved Use Cases

The following use cases are part of the Crowd and Capacity Monitoring solutions:

Crowd and Capacity Monitoring
- 3.1 Detect high risk queues
- 3.2 Re-direct high risk queues
- 3.3 Monitor Crowd based on capacity
- 3.4 Manage Crowd based on capacity

Locate Staff
- 5.1 Locate staff member

Event Information
- 13.1 Get event information

Evacuation
- UCG 11 Evacuation

3.2.2 Functionality Overview

	UC	Functionality	Application	Required Technologies
Monitor Crowds	**UC3.1** **UC3.3** **UCG 11**	**Monitor direction and magnitude of crowd flow**	COP	• Cameras • Staff wristband • Visitor wristband • Blimps to install cameras
	UC3.1 **UC3.3** **UCG 11**	**Monitor number of people in an area**	COP	• RFID/NearField • Staff wristband • Visitor wristband • Cameras • Digital Tickets

Manage and re-direct crowds	**UC 3.4** **UC 3.2** **UC 5.1** **UCG 11**	**Locate and communicate with staff**	**C**OP MONICA App (for staff)	• Cameras • RFID system • Staff Wristband • Smart glasses • Smartphones
	UC 3.4 **UC 3.2** **UC 13.1** **UCG 11**	**Visitor Guidance**	COP MONICA APP (for visitors)	• Visitor Wristband (led colour coding) • Airborne • Digital Displays • Smartphones
Crowd Simulation	**UCG 3** **UCG 11**	**Simulate and analyse crowd behaviour**	Simulation tool	• Historic data from crowd monitoring (cameras, wristbands, etc.)

3.3 Missing Person

The MONICA missing person solution aims to support the fast reunification of a lost child with his/her parents or guardian. It provides direct support to children and parents through the MONICA app for visitors as well as the possibility to rapidly escalate reports when such a scenario takes place.

Enable parents and children to be reunited

The pairing of the MONICA app for visitors with wristbands creates a solution to enable parents and children to find each other if separated:

- Children can easily send an alert when lost through the wristband
- Parents receive an alert with the location of the child through the app
- Parents can monitor the location of the child through the app/wristband functionality

The same functionality can be potentially used as a Friend Finder tool during the events.

Internal communication support

Reports of a missing child can quickly be escalated to inform the control room and receive further support through the MONICA app for visitors and staff.

The control room receives the report with information of the missing child and forwards targeted alerts and an action plan to security staff.

3.3.1 Involved Use Cases

The following use cases are part of the Missing Person solution:

Missing Person
- 4.1 Report lost person
- 4.2 Locate lost person
- 4.3 Report Found person
- 4.4 Locate parent or guardian

Locate Staff

- 5.1 Locate staff member

3.3.2 Functionality Overview

	UC	Functionality	Application	Required Technologies
Locate child or parent	**UC 4.2** **UC 4.4**	**Children finder (Or Friend finder)**	MONICA app (for visitors) COP	• Visitor wristband • Smartphone
	UC 4.1 **UC 4.2** **UC 4.3** **UC 4.4** **UC 5.1**	**Internal communication support**	COP MONICA App (for staff) MONICA App (for visitor)	• Cameras • RFID system • Staff wristband • Smart glasses • Smartphones

3.4 Locate staff (interaction within staff)

The MONICA solution for locating and monitoring current status of staff members aims at facilitating the management of resources by providing an overview of the location of actors as well as their current tasks, status and activity history through the COP:

- Monitor the location, state and availability of staff members
- Locate staff members who are close to crowded areas
- Forward targeted alerts to staff members

This solution is easily integrated with other MONICA solutions (crowd management, incidents, etc.)

3.4.1 Involved Use Cases

Locate Staff

- 5.1 Locate staff member

3.4.2 Functionalities overview

	UC	Functionality	Application	Required Technologies
Interaction among staff	**UC 5.1**	**Locate, monitor and communicate with staff**	COP MONICA App (for staff)	• Cameras • RFID system • Staff wristband • Smart glasses • Smartphones

3.5 Health, Security and Safety Incidents

The objective of the MONICA Health, Security and Safety incident solutions is to support the detection, reporting and handling of health, security and safety incidents that occur during the events.

Detect incidents

The system is able to detect incidents automatically through different technologies such as cameras, microphones, accelerometers and environmental sensors (measure wind speed). The control room is then informed that an incident has been detected, where exactly it is located and in some cases even with the type. In this way, it is possible to minimise response time and facilitate crisis management.

Report incidents

MONICA allows staff members to forward incident reports directly to the control room through MONICA applications. Evidence such as video of the incident, description or extra details can also be forwarded in an easy and targeted way to the relevant actors.

Handle incidents

A real-time overview of staff and resources is accessible to the control room staff through the COP. The location of actors, role and activity history can be visualized in order to ease the management of staff members and resources. MONICA staff applications support also the communication between actors and forwarding of alerts.

Additionally, support for handling health incidents is provided to the relevant actors: staff can receive more information about the patient they are handling through the MONICA app or digital ticket used at some events.

3.5.1 Involved Use cases

The following use cases are part of the Health, Security and Safety Incidents solutions:

Health, Security and Safety Incidents

- 7.1, 14.1 and 8.1 Detect incident
- 7.2 and 8.2 Report incident
- 7.3 and 8.3 Handle incident

Locate Staff

- 5.1 Locate staff member

3.5.2 Functionality Overview

	UC	Functionality	Application	Required Technologies
Detect Incident	**UC 7.1 UC 8.1 UC 14.1**	**Fall detection**	COP	• Staff wristband/Smartphone (accelerometer)
		Incident detection through video		• Cameras
		Incident detection through sound		• IoT Microphones (Stream Sound data/ or processed sound)
		Measure wind speed		• Environmental sensors
Report Incident	**UC 7.2 UC 8.2 UC 5.1**	**Create and forward incident report**	COP MONICA App (for staff)	• Cameras • RFID system • Staff wristband • Smart glasses • Smartphones
Handle Incident	**UC 7.3 UC 8.3 UC 5.1**	**Locate and communicate with staff**		
	UC 7.3 UC 8.3	**Access health information**	MONICA App (for staff) MONICA App (for visitor)	• Digital ticket • Smart glasses • Smartphones

3.6 Access Control

The goal of the MONICA Access Control Solution is to support gated events in managing the access control of visitors.
MONICA´s system is able to recognize banned persons using the face recognition functionality. If a banned person is identified by the system, the user could then receive an alert through the COP.

As for now, due to ethical implications when it comes to privacy and identification of individuals, it has been decided to discard the face recognition solution within the scope of the MONICA project.

3.6.1 Involved Use Cases

Access Control

- 1.3 Recognise banned person

3.6.2 Functionalities Overview

	UC	Functionality	Application	Required Technologies
Recognise banned person	**UC 1.3**	**Recognise banned person**	COP	• Cameras

4 Pilot Surveys and Pilot Plans

This chapter contains one section per pilot where the following aspects are documented:

- Pilot Surveys
- Pilot Plans: Selected solutions and Demonstration.

The aim of the pilot surveys is to provide an overview of the contextual characteristics of each event and in this way, facilitate the definition of how the use cases from WP2 shall be implemented and demonstrated in each particular case.

The pilot surveys collect information that describe the context of each pilot such as location, surrounding areas, attractions, visitation, etc. In the same way, particular aspects related to each pilot´s infrastructure are documented.

It is important to mention that the pilot surveys described in this document are complemented by the pilot analysis and scenario definition done by WP2 and documented in *D2.1 Scenarios and Use Cases for use of IoT Platforms in Event Management* which has the objective of communicating domain knowledge as well as pilot challenges, needs and interests gathered from stakeholder interviews or workshops.

The pilot plans describe the purpose and objectives of each event in relation to the use case groups that have been selected. Additionally, the functionalities to be demonstrated on each event per year, as well as the technologies required are listed.

The process to define the pilot plans included communication and alignment between pilot representatives and technical partners who together analysed the objectives of each pilot, the allocated use cases and defined what MONICA technologies were more relevant and appropriate for each case. This was done by evaluating the feasibility of demonstrating the use of the technologies while taking into account the contextual limitations of each event.

4.1 Rhein in Flammen

4.1.1 Pilot Survey

Rhein in Flammen[2] is a festival happening once a year. 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 Rhine. This part of the program is considered to be the highlight of the event. Rhein in Flammen exists since 32 years. It welcomes an average of 90,000-120,000 visitors per day making it one of the most popular festivals in the area.

Figure 1 – Rhein in Flammen 2012 / Michael Sondermann

4.1.1.1 Location and Surroundings

Rhein in Flammen takes place in a public recreational park in the city of Bonn called Rheinaue.The Rheinaue is located close to the city centre of Bonn and surrounded by residential areas, a hospital, the highway and the Rhine river. The total area of the park has about 160 hectares. The festival takes place in a specific area of the park of about 200,000m2.

4.1.1.2 Attractions

Visitors that come to the festival can enjoy several attractions of different kind:

Three different stages with music: live music and bands in the different stages play usually on Friday and Saturday from midday until midnight. The type of music offered is various attracting visitors of all ages.

Food and drink stalls: visitors can enjoy a broad variety of food and drink options throughout the entire festival. Traditional food and other fast food options are always available.

Fireworks show and Illuminated boat parade: both activities take place on Saturday evening, when thousands of people join to witness the events. This is considered the highlight attraction of the event. Around 23:00 on Saturday, a synchronised music and firework show takes place, bringing together thousands of spectators in the park area and along the Rhine River.

[2] (http://www.rhein-in-flammen.com/)

4.1.1.3 Visitation

Rhein in Flammen welcomes an average of 90,000-120,000 visitors per day. Families and groups of friends are usually present during the festival. The pick hour when the most visitors attend the event is on Saturday evening during the boat parade and firework show.

4.1.1.4 Site Plan

As seen in the site plan shown below (Figure 2), the area where the festival takes place is located right next to the Rhine river, which extends the area on which activities are happening during the festival since a boat parade takes place on the river.
Right below the river, it is possible to identify an extensive field where the fireworks infrastructure is installed during the festival. That area is usually not meant to be visited by visitors.

On the left side, the main U-bahn station can be seen in the map. This is the station which is used by most of the people that visit the event, making it also a crowded and critical area in the evenings.

The main stage is located in a central area of the park and the techno stage is located to the right. The latest will be part of the sound monitoring tests for 2018.

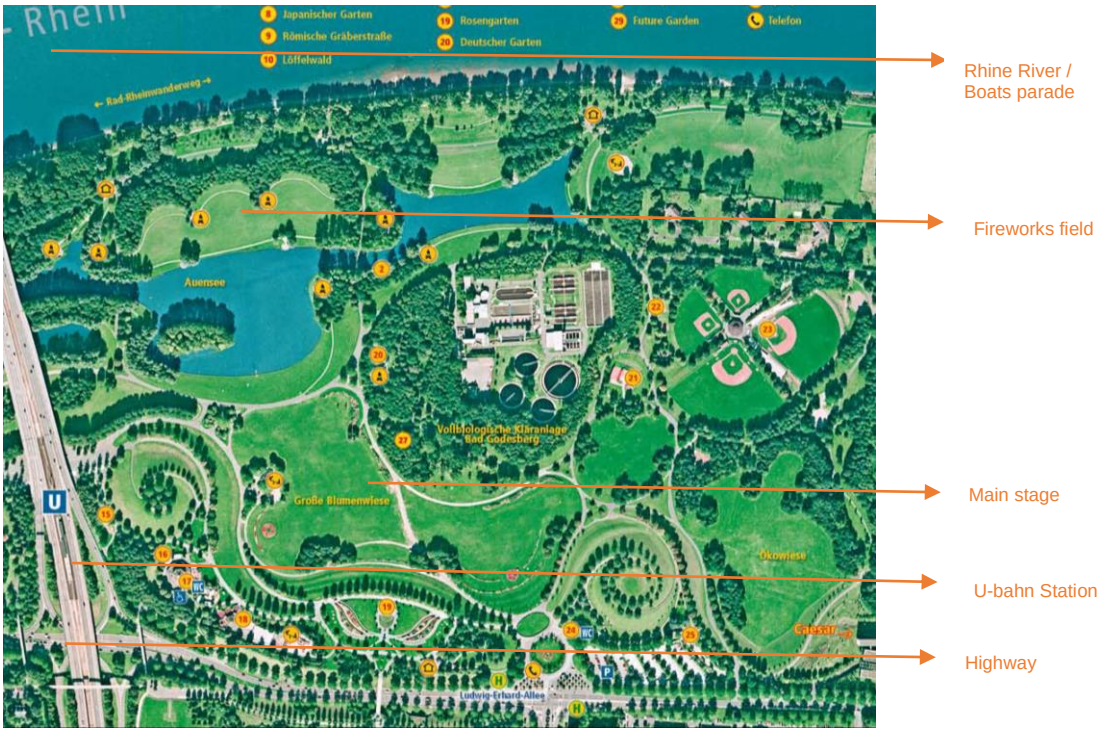


Figure 2 – Rheinaue Overview[3]

4.1.1.5 Current Infrastructure

Rhein in Flammen is located in a park, i.e. there is no dedicated wired communication infrastructure available. Mobile network is generally available but usually breaks down during the event, when a certain level of visitors is reached. Therefore, MONICA solutions can't rely on public internet access during the event.

Communication between staff members, such as security, fire brigade, etc. mainly takes place through radio.

4.1.1.6 Stakeholders

Name	Description

[3] Source of map image: http://www.bonn.de/tourismus_kultur_sport_freizeit/freizeitpark_rheinaue/

Visitor	Any attendant who 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 Centre 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.

4.1.2 Pilot Plan: Selected Solutions and Demonstration

4.1.2.1 Allocated Use Cases

ID	Use Case Group
UCG 2	Sound Monitoring and Control
UCG 3	Crowd & Capacity Monitoring
UCG 5	Locate Staff
UCG 7	Security Incidents
UCG 8	Health Incidents
UCG 11	Evacuation
UCG 13	Event Information

4.1.2.2 Sound Monitoring and Control

4.1.2.2.1 Purpose and Objectives

The general goal for Rhein in Flammen in relation to sound monitoring and control is to monitor sound levels from the techno stage. This stage is of particular interest since it is one of the main sources of noise at the event. This shall help the event organizers to better evaluate the impact of sound in the surrounded areas and make informed decisions to improve sound levels and sound quality while meeting the requirements of visitors, artists at the same time. Additionally, it is expected to gain knowledge about how to improve the setup and orientation of the stages.

Rhein in Flammen is also interested in visualizing the sound levels through a simplified heat map in the COP.

As a second step, feedback from visitors and staff members in relation to sound will also be collected through the MONICA app. This information is intended to be used in correlation to the automatic sound level monitoring in order to improve the sound quality and experience.

4.1.2.2.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	UC 2.1	**Monitor sound levels:** Monitor sound levels in techno stage and implementation of a simplified heat map through the COP to visualize sound levels in the desired area	COP	• IoT microphones	Staff in the control room
2019	UC2.1	**Receive feedback from visitors, staff** Test of the MONICA app for visitor´s and staff members in order to collect their feedback related to sound quality.	COP MONICA App (for staff) MONICA App (for visitors)	• Smart glasses • Smartphones • Staff wristband (if feasible)	Staff in the control room Visitor recruitment through joint information campaign (Fraunhofer + City of Bonn)
	UC 2.1 UC 13.1	**Inform Visitors / staff of current sound quality and sound levels**	MONICA App (for visitors) MONICA App (for staff)	• Smartphones • Staff wristband (if feasible)	Visitor recruitment through joint information campaign (Fraunhofer + City of Bonn)

4.1.2.3 Crowd and Capacity Monitoring

4.1.2.3.1 Purpose and Objectives

Rhein in Flammen faces a challenge with crowds gathering in the path towards the main tram station and its entrance: particularly, after the firework show when a big part of the visitors want to leave the event simultaneously high or potentially high risk queues are formed.

MONICA Crowd and Capacity Monitoring solutions will support Rhein in Flammen to tackle this scenario by monitoring crowds with cameras and be able to:

- Detect critical situations at the tram station entrance queues
- Predict critical situations or high crowd density at the tram station entrance

Additionally, Rhein in Flammen is interested in analysing crowd density and flows of the whole event area. Therefore, cameras on blimps are considered as part of the functionalities to be demonstrated for this event.

4.1.2.3.2 Functionalities and timeline

Year	UC reflected	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC3.3** **UCG 11**	**Monitor direction and magnitude of crowd flow**: Cameras will be installed in the area of the tram station, which is the most frequented entrance/exit. 2 Cameras will overview the area while 2 will monitor the main roads leading to/from that area.	COP	• Cameras	Staff in the control room
	UC3.3 **UCG 11**	**Monitor number of people in an area** Using the same Cameras mentioned in the previous point, also counting of people in the selected area will be tested.		• Cameras	Staff in the control room
2019	**UC3.1** **UC3.3** **UCG 11**	**Monitor direction and magnitude of crowd flow**: Cameras will be installed on blimps. This should allow the monitoring of crowds not only in one fixed spot, but in different areas of the event.		• Cameras • Blimps	Staff in the control room
	UC 3.4 **UC 5.1** **UCG 11**	**Locate and communicate with staff** In order to manage crowds and keep staff members informed (forward alerts and relevant information, forward route suggestions, etc.)	COP MONICA App (for staff)	• Staff wristbands (if feasible) or other location devices (GPS) • Smart glasses	Staff from public order office / fire brigade
	UC 3.4 **UC 13.1** **UCG 11**	**Visitor Guidance**	COP MONICA APP (for visitors)	• Airborne • Digital Displays • Smartphones	Visitor recruitment through joint information campaign (Fraunhofer + City of Bonn) Staff in the control room

4.1.2.4 Locate staff (interaction within staff)

4.1.2.4.1 Purpose and Objectives

Rhein in Flammen is interested in knowing the location of the different staff members and resources through a digital map in the COP.

This functionality should help the event organizers and managers in Rhein in Flammen to keep a constant overview of the work force and be able to assign tasks to specific actors in order to make the event management activities more effective and agile.

4.1.2.4.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC 5.1**	**Locate and monitor and communicate with staff:**	COP	• Staff wristbands (if feasible) or other location devices (GPS)	Members from public order office will be recruited

2019	**UC 5.1**	The main focus for this pilot is being able to visualize the location and status of different staff members within the COP		• Smart glasses	In 2019 in addition to public order office, test persons will be recruited from fire brigade

4.1.2.5 Health and Security Incidents

4.1.2.5.1 Purpose and Objectives

Rhein in Flammen is interested in improving response time when it comes to incident handling. This should be achieved through MONICA solutions that help to detect incidents through the system, as well as being able to easily locate the different staff members and resources through a digital map in the COP. The objective behind is to be able to keep a clear overview of the resources that are in charge to handle incidents to be able to assign tasks in a more targeted and effective way.

4.1.2.5.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC 7.1** **UC 8.1**	**Incident detection through video**	COP	• Cameras	Staff in the control room
	UC 7.1 **UC 8.1**	**Incident detection through sound**	COP	• IoT Microphones (Stream Sound data/ or processed sound)	Staff in the control room
	UC 5.1	**Locate and communicate with staff**	COP	• Staff wristbands (if feasible) or other location devices (GPS)	Members from public order office will be recruited
2019	**UC 5.1**	The main focus for this pilot is being able to visualize the location and status of different staff members within the COP to keep a better management of actors when handling incidents		• Smart glasses	In 2019 in addition to public order office, test persons will be recruited from fire brigade
	UC 7.2 **UC 8.2** **UC 5.1**	**Create and forward incident report** Allowing staff members to forward incident reports directly to the control room through MONICA applications.	COP MONICA App (for staff)	• Staff wristband • Smart glasses • Smartphones	In 2019 in addition to public order office, test persons will be recruited from fire brigade

4.2 Pützchens Markt

4.2.1 Pilot Survey

Pützchens Markt[4] 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 550 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. The opening hours vary from midday to midnight or until the early hours of the next morning.

Figure 3 – Pützchens Markt

4.2.1.1 Location and Surroundings

Pützchens Markt is located in a residential area of Bonn Pützchen located in the Bonn neighbourhood of Beuel. The area where the event takes place is surrounded by streets with houses and stores providing space for active neighbourhood life in this area.

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.

4.2.1.2 Attractions

Approximately 550 businesses including large amusements rides such as carrousels, giant wheel, and bumper car ride. Furthermore, smaller attraction such as shooting gallery, beer stalls, and food stalls. One large beer tent is also present.

4.2.1.3 Visitation

Pützchens Markt attracts around 1,35 Mio visitors (2014) from all ages.

[4] http://www.freundeskreis-puetzchensmarkt.de/

4.2.1.4 Site Plan

Figure 4 shows the publicly available site plan of Pützchens Markt.
As depicted in the map, there are 4 main roads and 6 open entrances. The attractions are distributed in the whole area which is 80.000 square metres, and small streets surround the attractions.

Figure 4 – Site Plan Pützchens Markt

4.2.1.5 Current Infrastructure

4.2.1.5.1 Sound

There are no concerts at the Pützchens Markt. For this reason, this section of the deliverable is not within the scope of this particular festival.

4.2.1.5.2 Security

On the scope of activities performed for security purposes the following infrastructure is currently used in the event:

- Light banners, and light tables, megaphones: mainly used for guidance and control of crowds and visitors
- Crowd control barriers, to manage crowds and redirect to different routes. Used in areas which are known to be overcrowded and where flows need to be managed and organized.
- Analogue cameras: used for monitoring and to recognize or predict critical density of people.

4.2.1.5.3 Communication

At the moment the following infrastructure is in place to achieve communication between staff and visitors:

- Megaphones: mainly used by staff
- Microphone from stages

In relation to infrastructure used for internal communication between staff members, control room, organizer, authorities, etc., the following means are used:

- Radio
- Phones
- Pager

4.2.1.6 Stakeholders

Name	Description
Visitor	Any attendant who 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 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.
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 Room 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.

4.2.2 Pilot Plan: Selected Solutions and Demonstration

4.2.2.1 Allocated Use Cases

ID	Use Case Group
UCG 3	Crowd and Capacity Monitoring
UCG 5	Locate Staff
UCG 7	Security Incidents
UCG 8	Health Incidents
UCG 11	Evacuation
UCG 13	Event Information

4.2.2.2 Crowd and Capacity Monitoring

4.2.2.2.1 Purpose and Objectives

Pützchens Markt faces a particular challenge with crowds and bottlenecks due to the characteristics of the venue area: narrow streets within houses. There are 6 entrances and 4 main roads that lead to the main attractions of the event. One of these entrances gathers a critical density of people during peak hours.

MONICA Crowd and Capacity Monitoring solutions will support Pützchens Markt to tackle this scenario by monitoring crowds with cameras and be able to:

- Detect critical situations were limits of people per sqm are about to exceed.
- Predict emerging critical situations e.g. were limits of people per sqm are about to exceed.
- Use the simulation tool in order to improve evacuation plans as well as the general event plans.

4.2.2.2.2 Functionality and timeline

Year	UC reflected	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC3.3** **UCG 11**	**Monitor direction and magnitude of crowd flow** 4 IP Cameras are installed at critical locations. The use of blimps to monitor the event from above will be evaluated. However, this depends on the regulations.	COP	• Cameras • Blimps to install cameras	Staff in the control room
	UC 3.3 **UCG 11**	**Monitor number of people in an area** Using the technology mentioned in the previous point, also counting of people in the selected area will be tested.		• Cameras	Staff in the control room
	UC 3.4 **UC 5.1** **UCG 11**	**Locate and communicate with staff** In order to manage crowds and keep staff members informed (forward alerts and relevant information, forward route suggestions, etc.) Event organizer shall be able to broadcast messages to stall owners in cases of emergency.	COP MONICA App (for staff)	• Staff wristbands (Depending on the feasibility of deploying the UWB infrastructure at the event) or other location devices (GPS) • Smart glasses (optional)	20 people public order office / fire brigade
2019				• Staff wristband (if feasible) other location devices (GPS) • Smart glasses (optional)	In 2019 in addition to public order office, test persons will be recruited from fire brigade
	UC 3.4 **UC 13.1** **UCG 11**	**Visitor Guidance**	COP MONICA APP (for visitors)	• Airborne • Digital Displays • Smartphones	Visitor recruitment through joint information campaign (Fraunhofer + City of Bonn)
	UCG 3 **UCG 11**	**Simulate and analyse crowd behaviour (for improving evacuation plans)** Simulation of scenarios of the event should be tested. This will be done in terms of crowd flow simulation modelling the event areas and the crowd with the intention of improving evacuation plans based on the analysis of the simulations.	Simulation tool	• Historic data from crowd monitoring	Event organizer and event planning team

4.2.2.3 Locate staff (interaction within staff)

4.2.2.3.1 Purpose and Objectives

Pützchens Markt is interested in knowing the location of the different staff members and resources through a digital map in the COP.

This functionality should help the event organizers, to keep a constant overview of the work force, facilitate the coordination of tasks and achieve a more effective coordination among staff members.

4.2.2.3.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	UC 5.1	**Locate and monitor and communicate with staff:** The main focus for this pilot is being able to visualize the location and status of different staff members within the COP. This should include different types of staff such as people in charge of guiding crowds or dealing with incidents.	COP	• Staff wristbands (if feasible) or other location devices (GPS)	20 people from public order office will be recruited
2019	UC 5.1			• Smart glasses	In 2019 in addition to public order office, test persons will be recruited from fire brigade

4.2.2.4 Health and Security Incidents

4.2.2.4.1 Purpose and Objectives

Pützchens Markt is interested in improving response time when it comes to incident handling. This should be achieved through MONICA solutions that help to detect incidents through the system, as well as being able to easily locate the different staff members and resources through a digital map in the COP.

4.2.2.4.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	UC 7.1 UC 8.1	**Incident detection through video**	COP	• Cameras	Staff in the control room
	UC 5.1	**Locate and communicate with staff** The main focus for this pilot is being able to visualize the location and status of different staff members within the COP to keep a better management of actors when handling incidents	COP	• Staff wristbands (if feasible) or other location devices (GPS)	20 people from public order office will be recruited
2019	UC 5.1			• Smart glasses	In 2019 in addition to public order office, test persons will be recruited from fire brigade
	UC 7.2 UC 8.2 UC 5.1	**Create and forward incident report** Allowing staff members to forward incident reports directly to the control room through MONICA applications.	COP MONICA App (for staff)	• Staff wristbands (if feasible) or other location devices (GPS) • Smart glasses • Smartphones	In 2019 in addition to public order office, test persons will be recruited from fire brigade

4.3 Kappa FuturFestival

4.3.1 Pilot Survey

Kappa FuturFestival is the first dance Italian daytime summer 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.

Kappa FuturFestival promotes employment and tourism, about 700 people are involved in the organisation of the festival and many are the collaborations with companies and suppliers based in Piedmont, with an economic impact estimated around 2.5 million Euros and limited funding from local institutions.

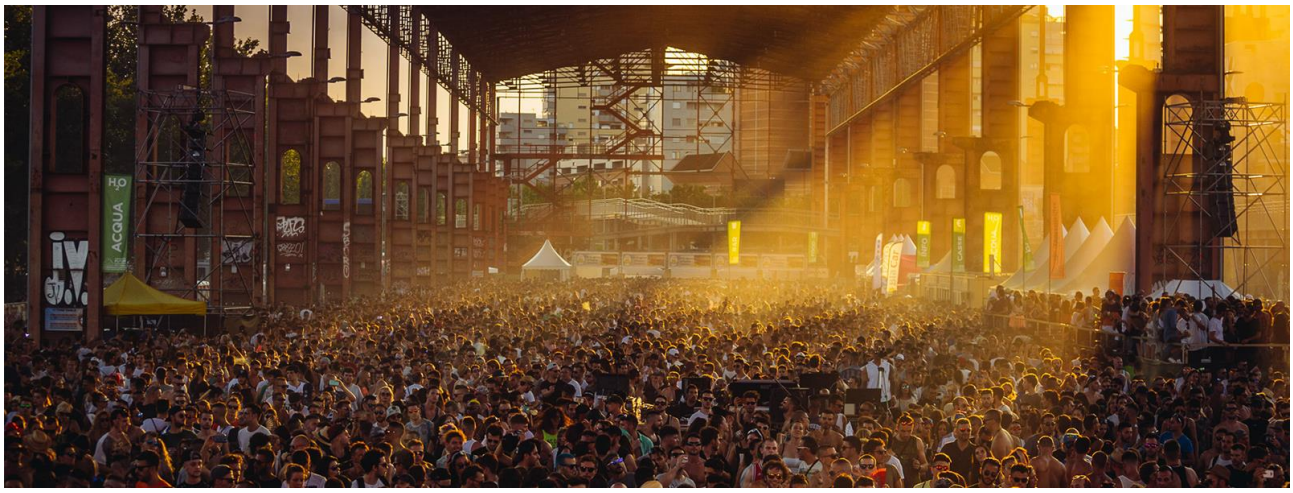


Figure 5 - Kappa FuturFestival

4.3.1.1 Location and Surroundings

Kappa FuturFestival takes place in the new Parco Dora, which has recently completed the overall urban transformation of this area. The park offers its residents, but also others inhabitants and tourists, 450 thousand square metres of green areas for sports, entertainment and relaxing, and giving them back a river that was exploited for decades by factories, 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).

Concerts take place in a “fenced” area of about 10000 mq.

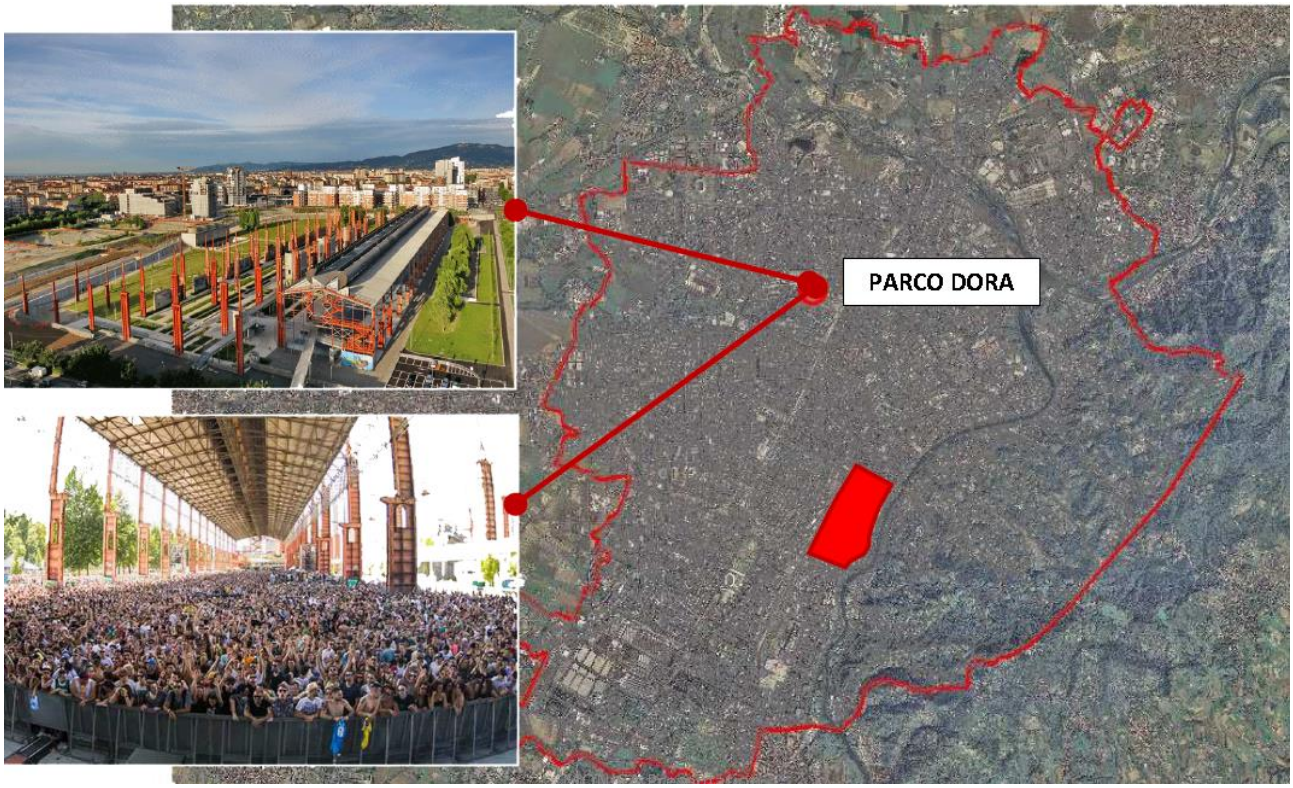


Figure 6 - Kappa FuturFestival location and surrounding

4.3.1.2 Attractions

The main attractions of the festival are the electronic and techno music concerts. Every year three stages perform concurrently with globally known DJs plus a selection of local young artists.

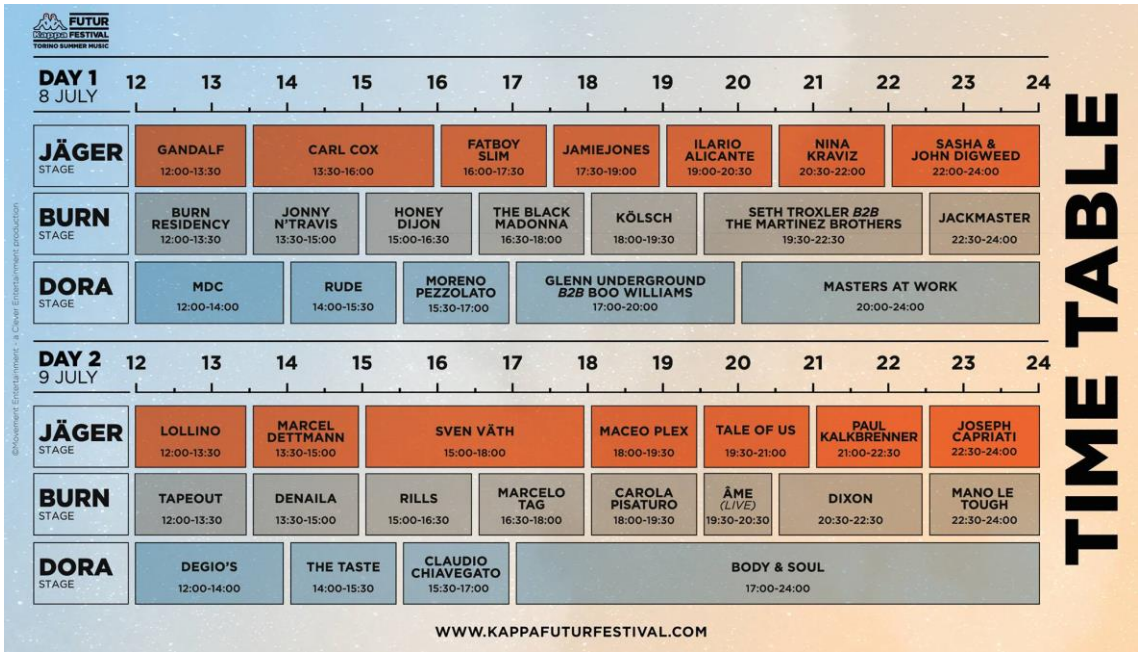


Figure 7 - Kappa FuturFestival Lineup 2017

Inside the venue, food and drinks stands meet different needs: people can find sandwiches, vegetarian and gluten free food. Chill out areas are also available to the public where they can rest far from the stages.

Figure 8 - Carl Cox @ Main Stage DAY 1

Figure 9 - Front Main Stage DAY 1

Figure 10 - Front Burn Stage DAY 2

Figure 11 - Paul Kalkbrenner @ Main Stage DAY 2

Figure 12 - Main Stage DAY 2

4.3.1.3 Visitation

Figure 13 - Kappa Futur Festival visitors

Visitors during 1st day: 20.000
Visitors during 2nd day: 19.000

Access to the Festival is allowed only from 16 years old.

Figure 14 - 62 nationalities at KFF17

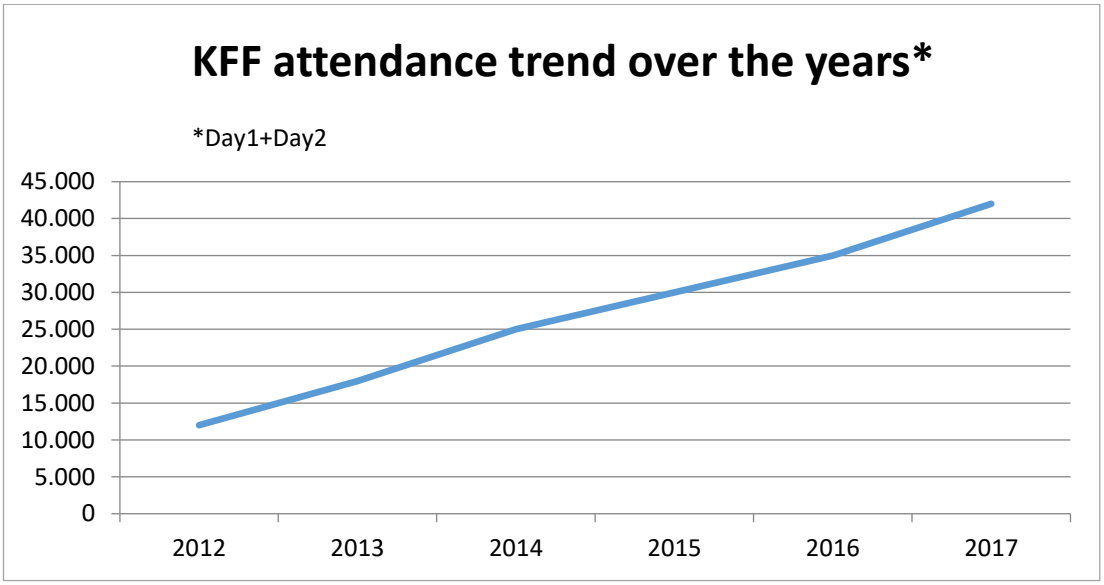


Figure 15 – KFF Attendance

4.3.1.4 Site Plan

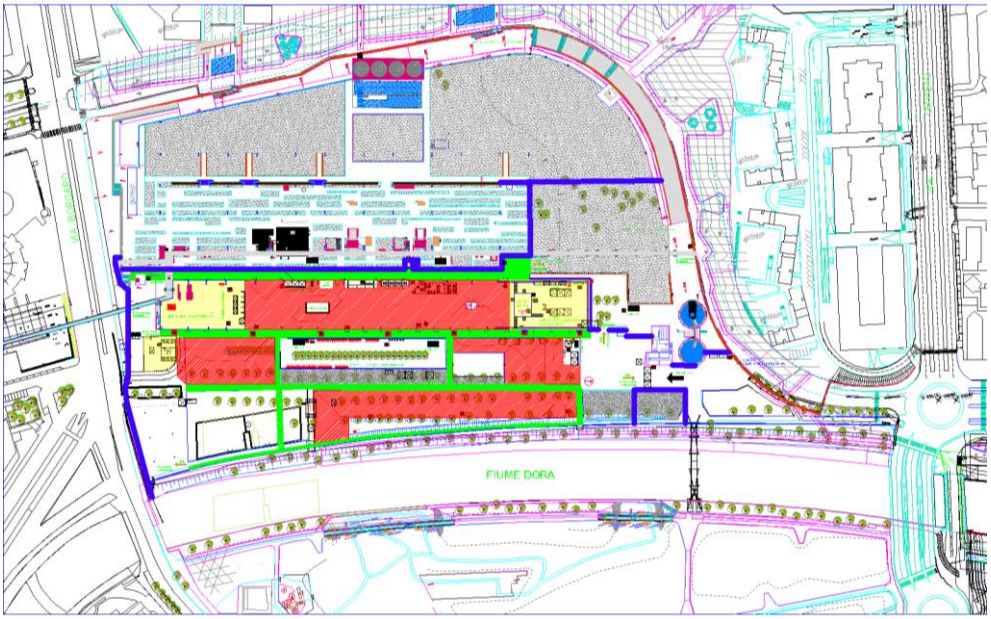


Figure 16 - Kappa FuturFestival Site Plan

Every year event organizers define the site plan that needs to be handed out to local authorities. The plan has to comply with Italian regulations regarding public events. If security concerns arise, authorities can ask for changes, such as add entrances/exits.

The perimeter of the KFF is limited and closed and defines an area of almost 44.000mq. For 2018 Movement Entertainment has asked the concession of an adjacent area in order to improve the Festival capacity.

In 2017 plan, Kappa FuturFestival had two access points: one gate with 11 doors and one extra gate for emergency only. Three exit points were available.

Inside the venue three stages (Main aka Jager, Burn and Dora) hosted concerts and performances. In the figure below stages orientation is indicated, as well as their position. Three VIP areas were available: Jager (reserved access with full VIP ticket), Burn and Dora (access with both full VIP ticket and VIP upgrades).
Food and drinks zones were distributed all around the site (cf. map below) and a chill out zone (aka the Beer Garden) was set up.

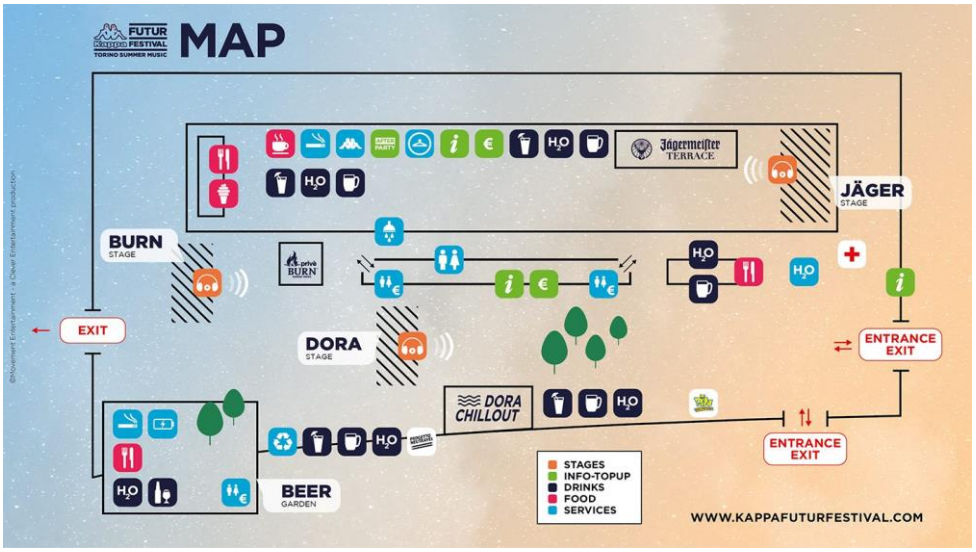


Figure 17 - 2017 Festival Map

4.3.1.5 Current Infrastructure

4.3.1.5.1 Sound

City of Turin is in charge of sound monitoring outside the venue. In particular Class 1 sound meters are hosted by citizens living in the neighbours. These objects are placed in different locations during the event. In addition to these, 1-2 sound meters form Regional Environmental Protection Agency are used to make measurements.

Movement manages 2 sound check points that moves within the venue: one measures the frequencies continuously in whole event and the other one takes samples of sound. One of the two (the main one) can be also remotely controlled.

Movement has also one sound monitoring point on a terrace in a nearby building.

Sound level is adjusted by sound technicians both before the concerts, according with test sessions, and during the concerts according with the results of noise monitoring. The stage manager gives directions to service providers (in 2017 Dada[5] and Engovers[6]).

4.3.1.5.2 Security

Public areas outside the venue are monitored by police staff deployed for the event, eventually supported by private security staff.

At the entrance doors (one gate with 11 doors), 14 body scanners and 30 hand scanners are used at the gates before admitting people to the festival.

Inside the venue a Recording Video Surveillance System (with 10 IP Cameras) is present and active and it is controlled and managed by Local Police. At the moment they are not connected to a Wi-Fi network. Videos recorded during the event are locally stored.

The number of people attending the event is estimated by manual counting made by security staff at the gates.

4.3.1.5.3 Communication

In case of emergency radio communication is used by local police to contact the operation centre. Furthermore, panels and megaphones on police's vehicles are available, as well as the loudspeakers of the festival.

Handheld transceivers are used by security personnel and for communication between security and emergency personnel.

WhatsApp and Telegram chat is used by security staff, technical staff and event organisers.

From the visitor point of view, information is available on the website, Facebook, by phone and at Info Points on site.

4.3.1.6 Stakeholders

Name	Description
Visitor	Any attendant who 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.
Police officer	Policemen in charge to supervise and control the festival area, included 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.
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.

[5] http://www.dadaservice.it/

[6] http://www.engovers.it/

Name	Description
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).
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

4.3.2 Pilot Plan: Selected Solutions and Demonstration

4.3.2.1 Allocated Use Cases

ID	Use Case Group
UCG 2	Sound Monitoring and Control
UCG 3	Crowd and Capacity Monitoring
UCG 5	Locate Staff
UCG 7	Security Incidents
UCG 8	Health Incidents
UCG 11	Evacuation
UCG 13	Event Information

4.3.2.2 Sound Monitoring and Control

4.3.2.2.1 Purpose and Objectives

Sound Monitoring and Control is one of the core MONICA use case that will be demonstrated during the KFF pilot. The adoption of Sound Monitoring and Control solutions address two main challenges related to this pilot:

1. Enhancement of the sound experience quality inside the concert area
2. Mitigation and reduction of the sound propagation in the surrounding neighbourhood

The main purpose of the pilot is to exploit MONICA solutions to enable a more accurate monitoring and control both of the sound quality inside the venue and the impact of sound propagation outside the venue. The solutions implemented by the pilot will provide a detailed analysis of the acoustic levels and propagation. For this reason KFF is very interested in the visualization of the related data through the COP.

Information about sound monitoring and control will also provide quantitative details, which the event manager could use for post-event reporting and communication towards the local stakeholders, such as the City of Turin and neighbours.

KFF will finally test MONICA solutions to collect feedback from staff members and visitors on the sound quality.

The Sound Monitoring solution will be demonstrated in the whole event venue (sound level monitoring, collection of feedback, etc.). Particular attention will be devoted to the new stage 4 that has been identified as the main experimental area to test the MONICA solutions for the Sound Control.

During the pilot the following performance will be evaluated:

- Enhancements of sound monitoring (accuracy, propagation, levels...) inside the venue
- Accuracy of the outside levels of sound monitoring
- Visualization features of the COP (e.g. sound heat maps)

4.3.2.2.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC2.1**	**Monitor sound levels:** Monitor sound levels in all four stages including the Sound heatmap (only for the stage 4) through the COP. The Sound heat map is calculated by using the ASFC from DTU. 4 SLMs (from B&K) will be used for the ASFC. 2-3 SLMs (from B&K) and 4-6 SLMs (from TO and ACOU) will be used for the sound monitoring in the most exposed dwellings.	COP	• Contribution Algorithm ○ IoT microphones • Annoyance Comfort Index • Sound heat map	Production Staff
	UC 2.1	**Receive feedback from visitors, staff and neighbours** MONICA APPs will be developed, which will be used by visitors, staff and neighbours, to assess the quality of sound in all the four stages as well as the level of annoyance in the neighbourhood.	COP MONICA App (for staff) MONICA App (for visitor) MONICA App (for neighbours)	• Smartphones • Harmonica Index	4 people from the MOV production staff. Visitors' engagement will be implemented by means of ad-hoc news letters that will be sent by MOV. Neighbours engagement will be managed by Città di Torino (TBD).
	UC 2.2	**ASFC (adaptive sound field controller)** The ASFC (from DTU) will be deployed to limit the sound level outside the stage 4. It uses 4 SLMs (from B&K), 20 sound speakers (J-SUB) and amplifiers.	COP	• IoT Microphones • Environmental Sensors • ASFC Computational Core • Additional sound speakers	Production Staff
2019	**All the solutions demonstrated in 2018**	All the above solutions will be tested again in the 2019 with enhanced features.	See 2018 tested solutions	• See 2018 tested solutions	See 2018 tested solutions
	UC 2.2	**Quiet Zones** This solution will be tested for a little area in the cross red stand.	Self-contained solution	• Self-contained solution	TBD

4.3.2.3 Crowd and Capacity Monitoring

4.3.2.3.1 Purpose and Objectives

KFF is highly interested in this use case that aims to increase the security level. Crowd movement and its behaviour inside the venue is a relevant aspect to monitor as well as knowing the flow of people in specific points of interest of the event over time, such as stages, info points, drinks, food, services, etc. The crowd heat maps and crowd flows pictures represent a strategic decision tool both in short and in medium terms.

KFF is going to improve its current countermeasure devoted to the crowd monitoring mainly at the access points and inside the venue. An extremely interesting feature is the possibility to identify and classify the queues in order to take most suitable actions to efficiently move/redirect people to other points.

Around 2000 wristbands will be distributed to the visitors, who will have to return the devices before the end of the event. To this purpose, MOVE has set-up a plan to organize the distribution, returning and reward operations.

The demonstrated features will be:

- the crowd density estimation in real-time
- the visualization on the COP (crowd heat maps)

The data will also enable post-event analysis.

4.3.2.3.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	UC3.3 UCG 11	**Monitor direction and magnitude of crowd flow** 10 additional cameras will be installed along the main stage, which is the most crowed one, and about 2000 visitor wristbands will be used for crowd monitoring.	COP	• Cameras • Visitor wristband • Blimps to install cameras	About 2000 visitors will be engaged for the visitor wristbands. The distribution of the wristbands could be located at the Info Point close to the entrance, during which the visitors will receive as incentive a bottle of water. When returning the wristbands they will receive 2 bottles of water. The time for the return could be managed by a communication through the MONICA APP.
	UC3.3 UCG 11	**Monitor number of people in an area** This functionality will be enabled by using the same camera system and visitor wristbands mentioned in the previous point.	COP	• Cameras • Visitor wristband	See above point related to the visitor wristbands.
2019	UC3.3 UCG 11	**Monitor direction and magnitude of crowd flow** In 2019, cameras will be used along the main stage and more than 2000 visitor wristbands will be used for crowd monitoring.	COP	• Cameras • Visitor wristband • Blimps to install cameras	More than 2000 visitors will be engaged for the visitor wristbands. The distribution approach might be different with respect to one of the 2018.
	UC3.3 UCG 11	**Monitor number of people in an area** This functionality will be enabled by using the same camera system and visitor wristbands mentioned in the previous point.	COP	• Cameras • Visitor wristband	See above point related to the visitor wristbands.

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
	UC 3.4 **UC 3.2** **UC 5.1** **UCG 11**	**Locate and communicate with staff** An APP will be developed and used by the staff to communicate with the COP about crowd management related issues with a particular focus on the UC3.2 (re-direct high-risk queues) to be tested in the food service areas. Staff wristbands will be used for the localization of the staff.	COP MONICA App (for staff)	• Staff wristband • Smartphones	People from the security staff and from the MOV production staff will be recruited.
	UCG 3 **UCG 11**	**Simulate and analyse crowd behaviour** Collected crowd data from the KFF18 pilot based both on cameras and visitor wristbands will be used to analyse the crowd behaviour and simulate evacuation strategies useful for the KFF19 pilot.	Simulation tool	• Historic data from crowd monitoring (cameras, wristbands, etc.)	TBD
	UC 3.4 **UC 3.2** **UC 13.1** **UCG 11**	**Visitor Guidance** The result of the above simulation evacuation activity could led to the creation of a training video for the evacuation to be used for the KFF19 pilot.	COP MONICA APP (for visitors)	• Smartphones	Festival Staff

4.3.2.4 Locate staff (interaction within staff)

4.3.2.4.1 Purpose and Objectives

KFF is highly committed in optimizing the efficiency of the security staff. In fact, knowing the precise locations of the staff members will allow a more accurate supervision of both the venue and the event. To this purpose, staff members will be supported by real-time information about other staff members' locations as well as the crowd behaviour. Locating staff members should improve the response time in case of emergency as well as the efficiency of the involved professionals.

KFF is interested both in visualization solution on the COP and in communication features made available from the wearable solutions.

For the KFF18 pilot, the wearable devices will be tested also by production staff members, those who move the most during the event. During the KFF19 more test persons will be recruited from the security staff.

The demonstrated features will be:

- Real time localization and accuracy
- Visualization features of the COP

4.3.2.4.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC 5.1**	**Locate and monitor and communicate with staff** The main focus for this pilot is being able to visualize the location and status of different staff members within the COP	COP	• Staff wristband	At least 3 people from the security staff and about 12 people from the MOV production staff will be recruited.
2019	**UC 5.1**			• Staff wristband	In 2019 more test persons will be recruited from the security staff.

4.3.2.5 Health and Security Incidents

4.3.2.5.1 Purpose and Objectives

During the events, health and security aspects related to both visitors and professionals are of utmost priority. To this purpose, KFF is highly interested in testing MONICA solutions to prevent and promptly detect critical situations and incidents. These solutions will provide better and quicker response of the personnel in case of incidents.

On the base of the same technical solutions used for the crowd monitoring, the pilot will demonstrate:

- critical events recognition and notification
- visualization on the COP

The integration of other solutions for incident handling will be evaluated according to the existing procedures and systems.

4.3.2.5.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC 7.1** **UC 8.1**	**Incident detection through video** About 20 cameras will be used along the main stage for fight detection.	COP	• Cameras	Security Staff / Festival Staff
	UC 7.1 **UC 8.1**	**Incident detection through sound** 2 SLMs (from B&K) will be used for the detection of incidents based on sound processing.	COP	• IoT Microphones (Stream Sound data/ or processed sound)	Security Staff / Festival Staff
	UC 5.1	**Locate and communicate with staff** The main focus for this pilot is being able to visualize the location of different staff members within the COP to keep a better management of actors when handling incidents.	COP	• Staff wristband	At least 3 people from the security staff will be recruited.
2019	**UC 5.1**		COP MONICA App (for staff)	• Staff wristband • Smartphones	In 2019 more people will be recruited among the security staff to run the test.
	UC 7.2 **UC 8.2** **UC 5.1**	**Create and forward incident report** Allowing staff members to forward incident reports directly to the control room through MONICA applications.	COP MONICA App (for staff)	• Staff wristband • Smartphones	In 2019 more people will be recruited among the security staff to run the test.

4.4 MOVIDA San Salvario

4.4.1 Pilot Survey

Starting from the 90s, the nightlife grew in San Salvario district thanks to pubs, low-cost bars, restaurants, liquor stores and wine cellars, boutiques and multi-ethnic shops that have been opened. These venues stay open until late and have completely reshaped the map of city entertainment, known as “Movida” [from Spanish: movement, happening].

Since 2010, the Movida phenomenon has been increasing due to the amount of people that are in the streets every night. A large number of new pubs, bars, restaurants, discotheques, wine cellars and boutiques, have reshaped the map of entertainment, causing great disturbances to the neighbours.

The nightlife hot spots in San Salvario are in Largo Saluzzo and Via Baretti, where crowds gradually increase, from the areas in front of bars until occupying all public spaces, thus causing huge side effects: noise (chatting, shouting, quarrels), traffic blockages, irregular parking, obstruction of driveways, rubbish on the ground, etc.

It has also attracted a large number of drug dealers and micro-criminality has increased, so that security is becoming a high-priority issue.

4.4.1.1 Location and Surroundings

The city district of San Salvario is located near the city centre of Turin.

The area of interest is part of the historic district of San Salvario, located near the central railway station and bounded by Vittorio Emanuele II (North), Nizza (West), Madama Cristina (East) and Marconi (South) boulevards.

This residential area is characterized by the grid plan typical of the old neighbourhoods of Torino; with about 470 four/five floors buildings with an internal court; about 7300 people live in the area with a surface of 0,26 km^2 .

The district hosts a daily big open market and offers various commercial activities. Home to an increasing immigrants' community, the district is an example of cultural integration.

Largo Saluzzo with an area of 5000 m2 is the focus of the Movida pilot. It is a small square with a street junction in the middle (two narrow carriageways) and 4 pedestrian areas around junction (hot spot “Largo Saluzzo”). These hot spots affect around 2000 inhabitants.

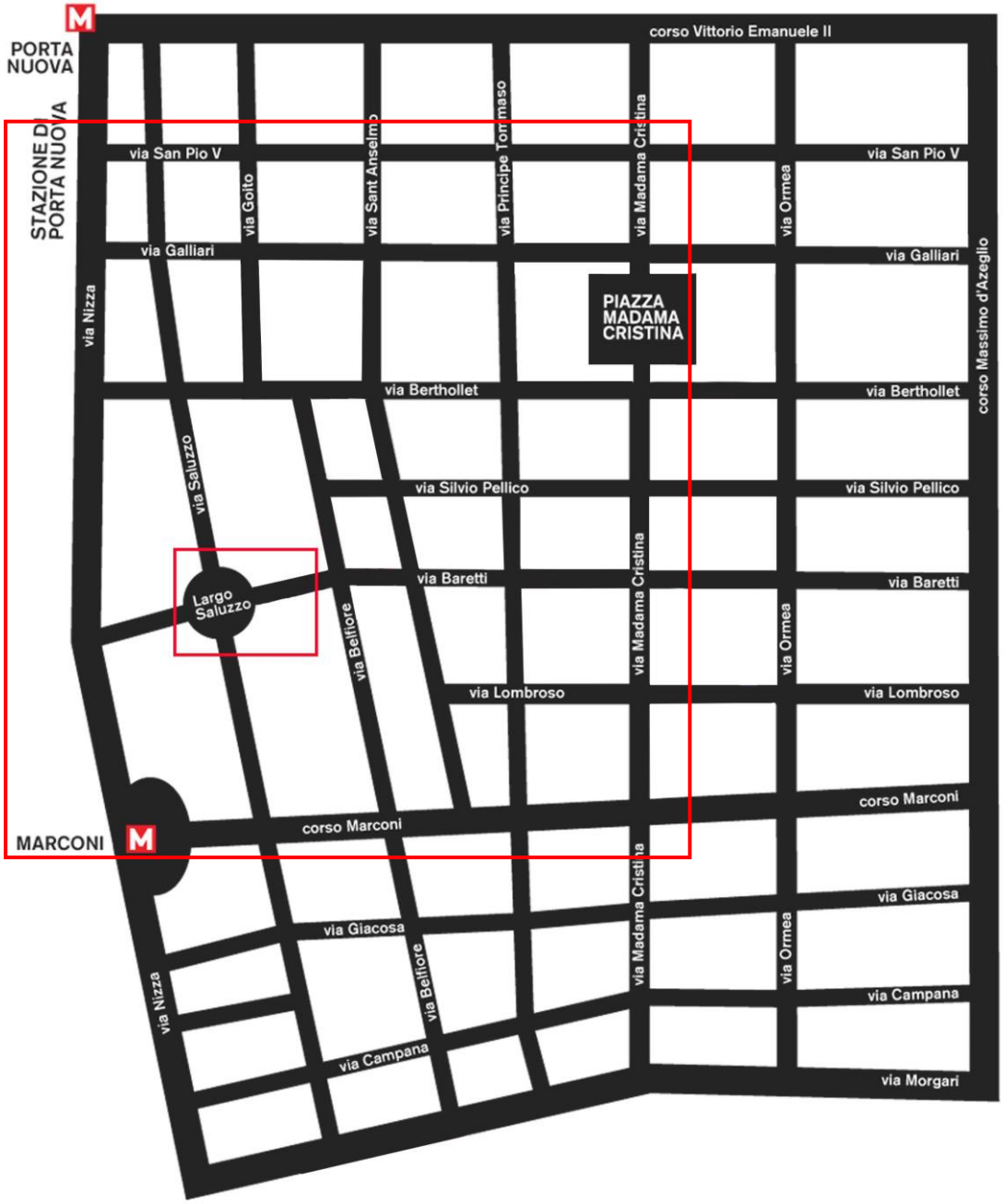


Figure 18 – San Salvario neighbourhood

4.4.1.2 Attractions

Movida attractions in San Salvario, are mainly due to a high density of restaurants, pubs, bars and wine stores.

In the most crowded area, about 120 activities selling food and beverages are counted by the Economic Affair Dept of the City, together with about 10 discos and private clubs.

4.4.1.3 Visitation

People in San Salvario (Largo Saluzzo) are not counted. Just a raw estimation can be done. (10000 people when very crowded).

The amount of people is definitely higher during the summer than during the cold season, as well as it is higher during the weekend than during the rest of the week.

Figure 19 - People in Largo Saluzzo

4.4.1.4 Current Infrastructure

4.4.1.4.1 Sound

Considering the high variability of leisure noise of Movida, and the difficulty to model its local effects in a deterministic way, (due to the joint presence of people and bars with music) a low-cost sound level meter monitoring network was preferred. Through this solution it was expected to achieve a good spatial noise distribution based on a high number of sensors despite a limited detrimental of level precision, like in other European cities.

Smartphones where investigated as IoT sensors, because different studies demonstrate that, under specific conditions, their use, if equipped with adequate microphones and specific mobile applications, is suitable for environmental noise measurements.

The Regional Environmental Agency of Piedmont (ARPA Piemonte), in order to assess the accuracy of environmental noise measurements using entry-level smartphones, carried out two different types of tests, comparing output data of smartphones using different external microphones and a Class I sound level meter, in an anechoic room, and carrying out, for more than three months, a long-term environmental noise monitoring.

Based on this experience, ARPA Piemonte developed “OpeNoise”, a dedicated app for real-time noise level monitoring. OpeNoise allows Real-time A-weighted sound pressure level measurement, minimum and maximum level, third octave and FFT analysis, data saving in a text file, sampling time setting and calibration.

Tests demonstrated that these solutions could be adequate for a long-term environmental characterization of Movida, with a standard deviation of less than 2 dB(A) between 40 e 80 dB(A) on average levels for Lnight if compared with class 1 sound level meters. A monthly calibration was planned to verify the quality of measurements (Figure 20); tuning is applied in case of differences higher than 1 dB(A).

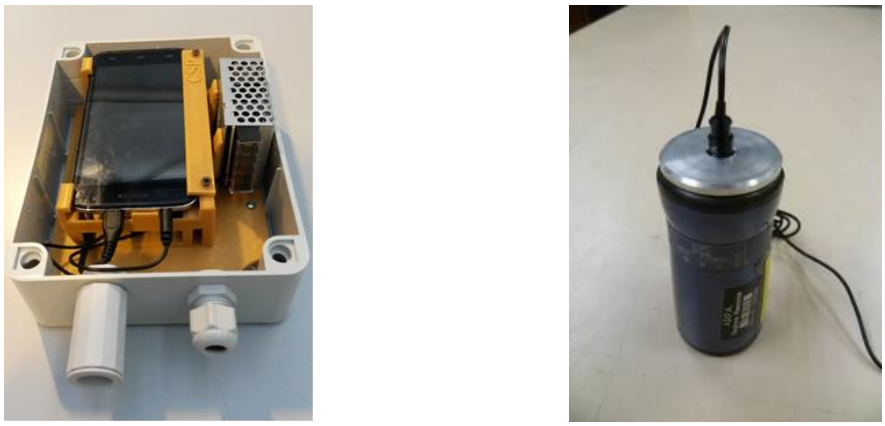


Figure 20. Kit for external installation and calibration of Lavalier microphone with a Class 1 source.

The new prototypal low-cost noise monitoring system based on smartphone devices, Lavalier external microphones and OpeNoise app (Figure 20) was deployed in San Salvario area, where six measurement points were installed in summer 2016.

The location of sensors was optimized to cover all significant feature of “Movida” area (Figure 21): one in Largo Saluzzo (S_03, not active in daytime), three in narrow streets with pubs and bars (S_01, S_04, S_05), one in a boulevard for traffic noise measurement (S_06) and the last one in a quieter area with no crowd and low traffic (S_02), for global reference. The choice of points of installation was driven also by the power supply, so light poles, public offices and bike sharing stations where preferred.

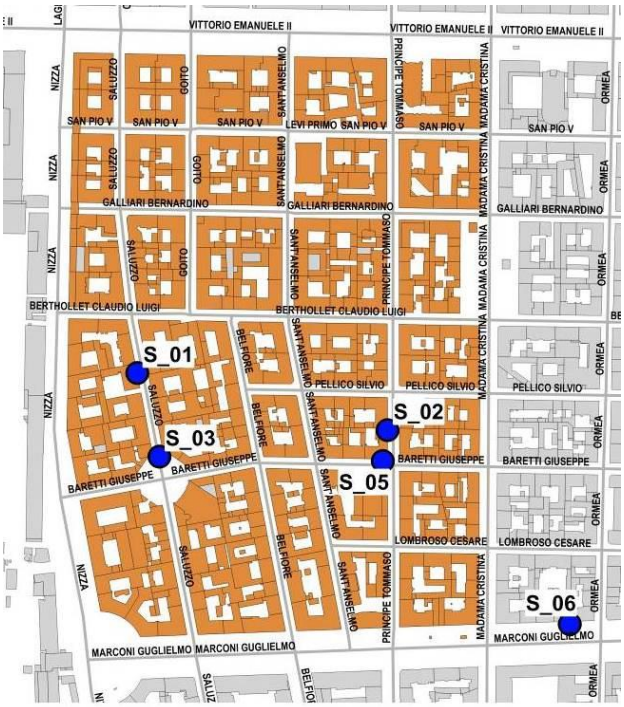


Figure 21. San Salvario area and monitoring network

Data collected by OpeNoise app with a sampling interval of 1 seconds are continuously sent via Wi-fi or 4G to the regional IoT Open Data Platform and published on institutional websites.

Despite the overall satisfying results, the noise monitoring network suffers from vandalism (one point was decommissioned) and high temperature in summer (damages to batteries of smartphones).

Data availability allowed a first robust assessment of noise impact of Movida on the residential area on a yearly basis; first analysis led by ARPA focused on long-term Lnight average levels and on comparisons between levels in different days of the week (Figure 22).

Sensor ID	Lnight dB(A)	Lnight - Ldaytime dB(A)	Lnight FRI+SAT - Lnight MON dB(A)
S_01	62.4	-0.1	8.9
S_02	57.0	-2.6	4.7
S_03	69.4	Ldaytime NA	9.8
S_04	60.9	-1.1	5.2
S_05	60.2	-0.2	5.5
S_01	62.4	-0.1	8.9
S_02	57.0	-2.6	4.7

Figure 22. Noise levels of Movida

Data collected confirmed that Lnight levels exceeded the limits stated by local noise zoning; that levels are very close to daytime ones. The noise levels have a typical distribution during the week, with more than 9 dB(A) of difference between Friday/Saturday nights and Monday ones.

By assigning levels to buildings, a first estimation of the population exposed to leisure noise was completed, showing that almost 50% of inhabitants live in dwellings with more than 60 dB(A) Lnight on the façade.

A more detailed analysis was performed on an hourly basis, pointing out that weekly, a significant increase of duration and intensity of noise is verifiable each day, with a maximum reached on the night between Saturday and Sunday (more than 72 dB(A) between 2 AM and 3 AM).

4.4.1.4.2 Security

Near the square there is the 8th district of local police that hosts patrols that operate in the area even at night time, both by car and on foot. During the summer season patrolling services are carried out with the collaboration of the various police forces.

In San Salvario there are numerous video surveillance cameras operated by the police. In particular there are three HD IP cameras in Largo Saluzzo square, which are powered only at night, when public lighting is on. A fourth HD IP cameras has been recently installed at nearby 8th district local police station. Video streams are transmitted via radio antennas and cables from the square to a Network Attached Storage located into 8th district premises.

No remote live view available currently, due to weak data transmission infrastructure. 24h power supply dedicated to cameras and ultra large band are supposed to be available by summer 2018, this will allow proper video streaming to MONICA video processing units which will be located at local police headquarter for video analytics deployment.

Inside the premises where nightlife takes place, security is guaranteed by the same personnel who work there according to their own procedures and in case of necessity contact the police forces. Many venues have their own video surveillance systems.

Figure 23. HD IP Cameras San Salvario

4.4.1.4.3 Communication

The communication of information between the police patrols on the territory and the central control room passes through the traditional radio systems used by the police. For emergency situations, people use traditional channels, especially telephone, or require assistance from police and/or security personnel in the street.

In the event of an emergency, patrols in cars can communicate with the public using the devices fitted with the service vehicles: light panels and megaphones.

4.4.1.5 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
Public Administration	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
Local development agency of San Salvario	A laboratory space for social and cultural activities involving associations, citizens, artistic and cultural operators, supporting subjects / associations (giving them spaces, visibility, support, co-design, helping them to seek funding)
Citizens Associations	They encourage the involvement of citizens, promoting participation and solidarity in the district, in order to oppose disturbance, noise pollution and degradation of night life

4.4.2 Pilot Plan: Selected Solutions and Demonstration

4.4.2.1 Allocated Use Cases

ID	Use Case Group
UCG2	Sound monitoring & control
UCG3	Crowd and Capacity Monitoring
UCG7	Security Incidents
UCG8	Health Incidents
UCG11	Evacuation
UCG13	Event information

4.4.2.2 Sound monitoring & control

4.4.2.2.1 Purpose and Objectives

In Summer 2017, two City Ordinances entered in force, with the aim to limit noise pollution of “Movida” in the central area, San Salvario district included.

The first one, Ordinance n. 46, limits alcohol takeaway selling, as many people reach the area of “Movida” and buy alcohol in bottles at a low price, spending all night wandering or sitting in the streets, chatting and shouting. So, takeaway selling alcohol in bottles was forbidden after 8 PM and for all night, establishing the same rules for bars, shop, and store. This Ordinance stayed in force from 8th June until 30th September.

The second one, Ordinance n. 60, limits serving food and beverage in terraces or outside bars and shop, as many people stay outside these venues enjoying mild weather, or smoking, or because of overcrowding, disturbing inhabitants with an increasing din. Serving food and beverage was forbidden after 1:30 AM (from Monday to Thursday), after 2 AM (Friday) or after 3 AM (Saturday, Sunday and feast day). Furthermore, a compulsory presence of stewards was introduced, to limit bad behaviours of customers. This Ordinance stayed in force from 8th July until 30th July.

Data collected allowed the assessment of effects induced to the new regulations on Lnights levels, proving that both Ordinances led to a noise reduction, with a cumulative benefit of more than 3 dB(A)

As new regulations will start in Summer 2018, the noise monitoring network implemented with Class 1 sound level meters in San Salvario will help long-term monitoring, allowing more robust analysis of collected data.

To evaluate benefits of noise reduction actions, a quantitative and qualitative analysis on annoyance will be developed, also using surveys and synthetic index, like HARMONICA index based on short Leq 1 sec.

Applications for smartphone will also introduce a more integrated approach that includes event information, marketing and behavioural strategies to motivate noise reduction. This approach is expected to be defined during the MONICA hackathon devoted to Urban Spaces[7].

1.1.1.1.1 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	UC 2.1	**Monitor sound levels** 1 sound level meter (B&K) in Largo Saluzzo (changes to the power supply of the current measurement point) + 2 sound level meter (B&K) in a residence (via Baretti/via Saluzzo)	COP	• Heat map	Identification and involvement of 2 resident in via Baretti/via Saluzzo for weekend of the pilot
2019	UC 2.1	**Monitor sound levels** 1 sound level meter (B&K) in Largo Saluzzo (changes to the power supply of the current measurement point) + 6 sound level meter (B&K) in a residence (via Baretti/via Saluzzo)	COP	• Heat map • Contribution Algorithm (built in IoT microphones) • Annoyance Comfort Index	Identification and involvement of 6 resident in via Baretti/via Saluzzo for weekend of the pilot

4.4.2.3 Crowd and Capacity Monitoring

4.4.2.3.1 Purpose and Objectives

To guarantee public security, MONICA's solutions will allow constant monitoring of the number of people in the area involved in the experimentation and precisely estimating the density of people in order to activate an alert when the critical threshold is reached. Through the use of enabling technologies, especially cameras and sensors, the area will be constantly monitored to activate police procedures in a timely fashion to prevent and deflect potentially dangerous situations, or disturbance to the resident population (e.g. sudden overcrowding of the area, sudden mass movements of people, violent behaviours, street brawls, etc.) Three HD IP cameras are located in the centre of the square to allow precise monitoring in real time. On the streets of access / exit from the square will also be installed additional sensors and cameras to get an estimate of the amount of people who approach / leave the square and their direction.

4.4.2.3.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	UC 3.3	**Monitor number of people in an area** **Monitor crowd based on capacity** It should predict critical situation, to avoid place overcrowding.	COP	• Cameras	Bars/Pubs owners, Local police staff

[7] https://www.monica-project.eu/monica-hackathons/

	UC 3.4	**Visitor Guidance** **Locate and communicate with staff** Informing people entering overcrowded areas and providing alternative routes or areas where to re-direct people.	COP MONICA app	• Cameras • Smart glasses • Smartphones	Local police staff
2019	**UGC3.4** **UCG 11** **UCG 13**	**Visitor Guidance** **Locate and communicate with staff** Informing people entering overcrowded areas and providing alternative routes or areas where to re-direct people. When it comes to support in an evacuation scenario: - Possibility for staff user to initiate evacuation if necessary. - Direct and strong communication channels between operation centre and security staff. - People must be quickly directed to escape routes in case of emergency, to avoid panic and massive accidents. Driving all attendees at meeting points and cross-check of empty area after evacuation.	COP MONICA app (for staff) MONICA app (for visitors)	• Cameras • Smart glasses • Smartphones	Local police staff, visitors

4.4.2.4 Security and Health Incidents

4.4.2.4.1 Purpose and Objectives

Intelligent monitoring of the area could allow immediate action in the event of an incident enhanced also by effective communication approaches between the central operation room and the security staff on site. For Movida the transfer of images and short videos between security staff is essential to effectively manage emergency situations.

4.4.2.4.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC 7.3**	**Locate and communicate with staff** Support police staff handling incidents, easing communication and data exchange with operation centre.	COP	• Cameras • Smart glasses	Local police staff

2019	**UC 7.1** **UC 8.1**	**Incident detection through sound** **Incident detection through video** The system should promptly detect an incident (health or security) so that the user can take action when needed. Incidents detected by the system can help to react faster and handle it as soon as possible, in this way, users do not only rely on incidents being reported by other humans.	COP	• IoT Microphones (Stream Sound data/ or processed sound) • Cameras	Local police staff
	UC 8.2 **UC 7.2**	**Create and forward incident report** Staff members/ visitors should have an easy and direct way to report incidents directly to the control room. Staff in charge of handling incidents should be quickly notified that an incident has been detected.	COP MONICA App	• Smart glasses • Smartphones	Local police staff
	UC 8.3	**Locate and communicate with staff** Different actors in charge of handling incidents have to keep constant communication in order to report status of the incident, ask for support, etc.	COP MONICA App (for staff)	• Cameras • Smart glasses • Smartphones	Local police staff
	UCG 13	Emergency information and general advices to prevent accident and request assistance	COP MONICA App (for visitors)	• Smartphones	TBD

4.5 Friday Rock

4.5.1 Pilot Survey

Figure 24 Tivoli's main entrance (source: Tivoli Database)

Tivoli Gardens (Tivoli) is Copenhagen's famous amusement park located in the heart of the city. The park opened in 1843 and is the second-oldest amusement park in the world. The park offers a wide variety of rides, shows and attractions with around 4.5 million visitors annually. Tivoli also features a considerable selection of shops and restaurants. The park operates along four distinct seasons annually from February to end of December, closing off to the public between the seasons. The park's perimeter facilities (food hall, restaurants, hotel, gaming halls) operate full year as well as indoor venues located inside the park.

In addition to an amusement park, Tivoli functions as a venue for a variety of live entertainment, featuring performances ranging from small scale, intimate concerts, classical performances, theatre and musicals to international pop/rock concerts. The park contains a number of in- and outdoor stages that facilitate Tivoli's entertainment profile. From April through September, Tivoli organises Friday Rock[8]: a recurrent annual open-air concert-series with national and international performers.

4.5.1.1 Location and Surroundings

Tivoli is one of the very few amusement parks in the world located in a city centre. It neighbours Copenhagen's Central Train Station and is situated approximately 500 m from Copenhagen City Hall. Many of the city's most famous museums and attractions are within walking distance and the pedestrian shopping street is located app. 600 m from the Tivoli main entrance.

At the north-eastern border of Tivoli is located the headquarters of Dansk Industri (Confederation of Danish Industry), shops and restaurants, whereas at Tivoli's southern border there is a limited residential area (indicated with the blue circle in Figure 25) Within this area, certain residents complained about Tivoli's sound emission in terms of sound pressure level and frequency content' over the past years stemming from the park's amusement rides and notably the Friday Rock concerts.

In Figure 25 the main stage area for Friday Rock concerts is indicated in red.

[8] http://www.fredagsrock.dk

Figure 25 Aerial shot of Tivoli Gardens (source: Tivoli A/S)

4.5.1.2 Attractions

The first edition of Friday Rock was held in 1997, and since then Tivoli organises +20 outdoor concerts on Friday evenings from April to September, featuring both national and international performers, with up to 500.000 concert guests attending these concerts each year. Each Friday Rock concert starts at 10:00 pm and ends no later than 00:00 pm.

Figure 26. View of Friday Rock (source: Tivoli pictures database)

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

Numbers and facts about Friday Rock:

- +20 open air pop/rock concerts
- Friday evenings during Tivoli's summer season (April – September)
- Performance time fixed: 10:00 – 00:00 pm
- Up to 500,000 guests during a Friday Rock season
- Outdoor concert area +/- 2.700 square metres
- The capacity of the whole concert area is 25.000 people

- Up to +50.000 visitors in the whole Tivoli park per day.

4.5.1.3 Visitation

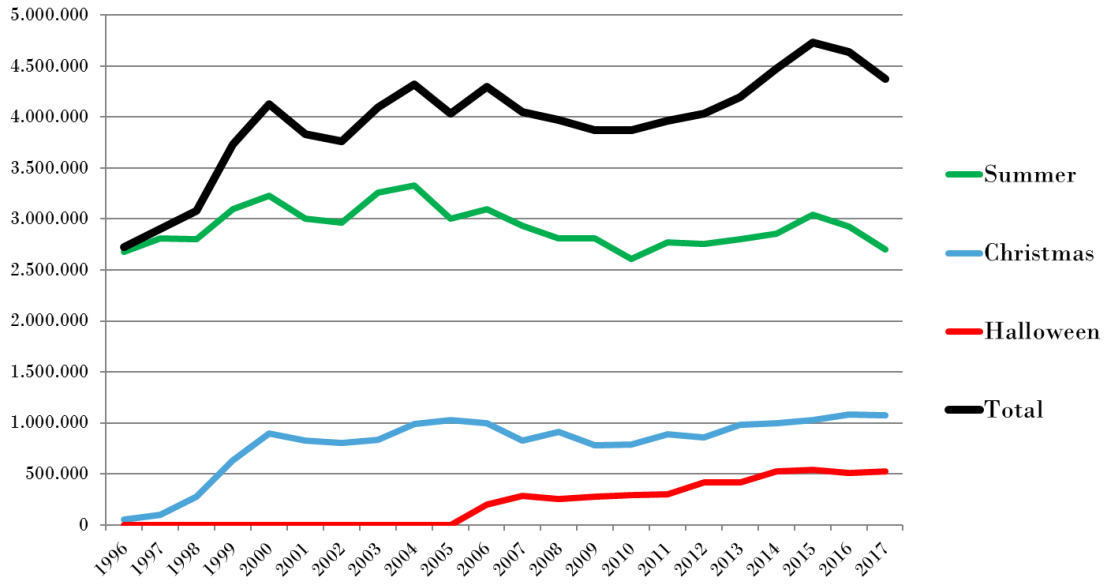


Figure 27. Tivoli´s visitors (source:Tivoli A/S)

Up to 500.000 guests during a Friday Rock season. The capacity of the entire concert area is 25.000 people.

At 1.500 visitors before maximum capacity, Tivoli staff closes the main entrance, then the secondary entrance at 500 visitors before the max capacity and finally the third entrance.

Figure 28. View of the concert stage and the audience area (source: Tivoli pictures database).

4.5.1.4 Site Plan

As described in the map of Figure 29, there are three entrances in Tivoli: the main entrance is at Vesterbrogade 3, the secondary access is opposite the Central Train Station at Bernstorffsgade and a third access, called “Museum entrance”, is at the corner of Tietgensgade and H.C. Andersen’s Boulevard.

For the MONICA purposes, the prioritised test areas are:

1. Friday Rock stage and prime and secondary audience areas
2. main entrance.

The railway entrance has a secondary priority, while the Museum entrance is not involved in the MONICA project.

The whole Tivoli Gardens' area is 82.000 square metres, and the main stage area for Friday Rock is around 2.700 square metres.

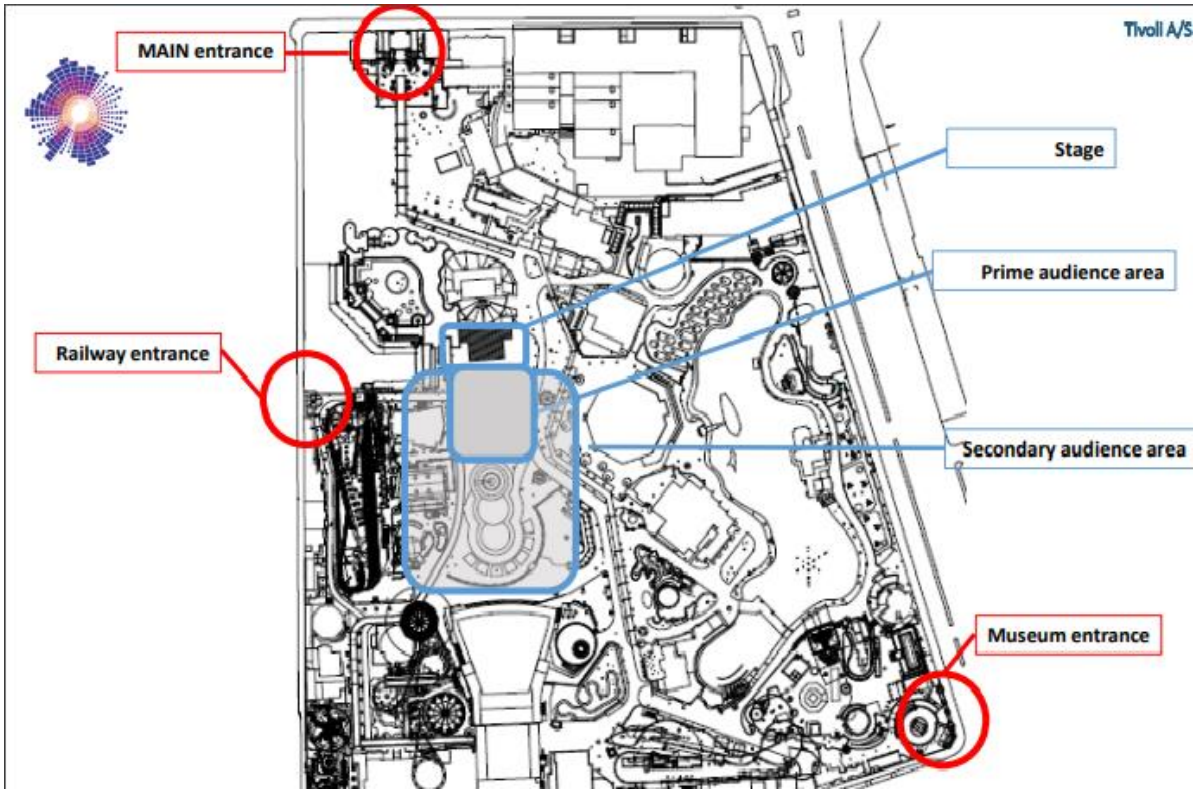


Figure 29. Map of Tivoli Gardens (source Tivoli A/S)

Outside the main entrance, there are currently two locations where fixed CCTV cameras have been installed. The minor yellow rectangle area indicated in Figure 30 is currently under surveillance. The Pilot would aim to extend the area to the street along Tivoli (the longer yellow rectangle in Figure 30).

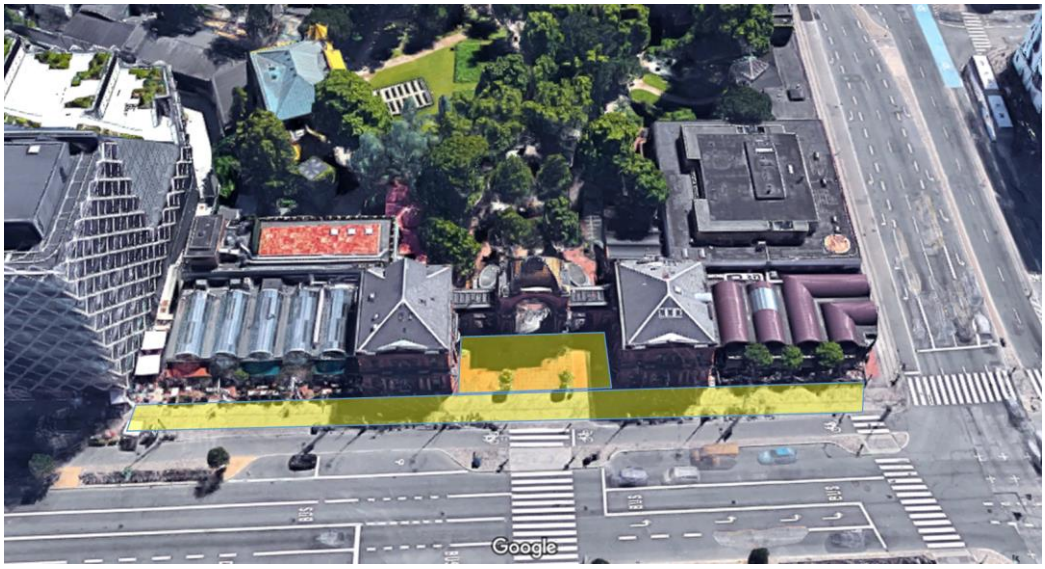
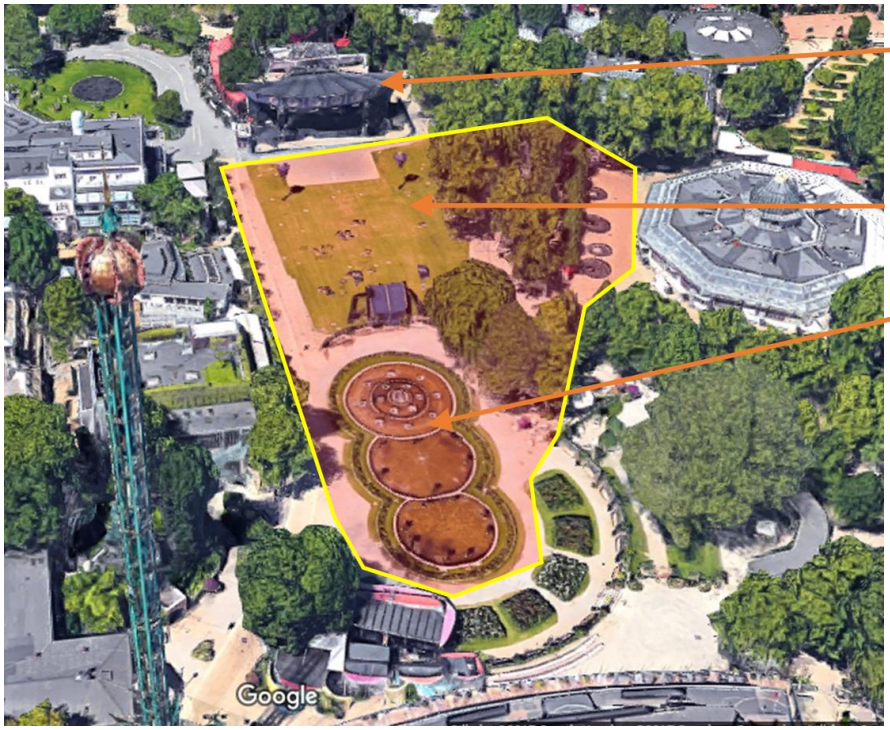


Figure 30. Preferred surveillance areas during MONICA (yellow demarcations) (source Tivoli A/S)



Concert stage

Audience area

The audience area is in principle the blue-shaded area in front of the concert stage.

At larger concerts, audiences 'spill over' to the surrounding red-shaded areas.

Besides buildings and landscaping elements, there is no fencing or other structures limiting crowd movement/density

Figure 31. Tivoli Friday Rock concert & audience area.
Focus area for the implementation of MONICA surveillance cameras setup (Source Tivoli A/S)

4.5.1.5 Current Infrastructure

4.5.1.5.1 Sound

Within MONICA project, the sound monitoring (sound level/volume, quality, low/high frequency) will be done at Tivoli's main outdoor stage area.

All outdoor concert sound emissions (which primarily relates to Tivoli's 'Friday Rock' concerts) must adhere to Tivoli's environmental permit concerning sound emission. According to the permit, which is enforced by Copenhagen Municipality, sound emission may not surpass 60 dB (A) LEQ 60 minutes at a specific street address located immediately outside Tivoli Garden's southern perimeter. The maximum permitted emission level (60 dB (A) LEQ 60 minutes) is measured as 77 dB (A) LEQ 60 minutes at the roof top of Tivoli Garden's

'Concert Hall' which is located along Tivoli Garden's southern perimeter and directly opposite the Friday Rock outdoor concert stage. The maximum sound emission limit of 60 dB (A) LEQ 60 minutes may not be surpassed during the execution of the MONICA project.

Currently, '10 Easy' sound level meter are applied at every Friday Rock concert to monitor the sound.

For the MONICA platform deployment, light poles, buildings, trees and other infrastructures are available in the park for the installation of sound level meters, speakers and other devices.

There is also a guest Wi-Fi in the Garden available for the technical partners.

4.5.1.5.2 Security

Tivoli contains numerous security cameras throughout the park for cash monitoring, monitoring of entrances, monitoring of gaming arcades, monitoring of outdoor areas, monitoring of guest flow at major events, monitoring of vehicles outside the main and secondary entrances.

There are from 2 up to 18 security staff at each entrance.

In-house security staff (guards) and CCTV cameras detect the potential forming of high-risk queues outside one or all of Tivoli's three entrances.

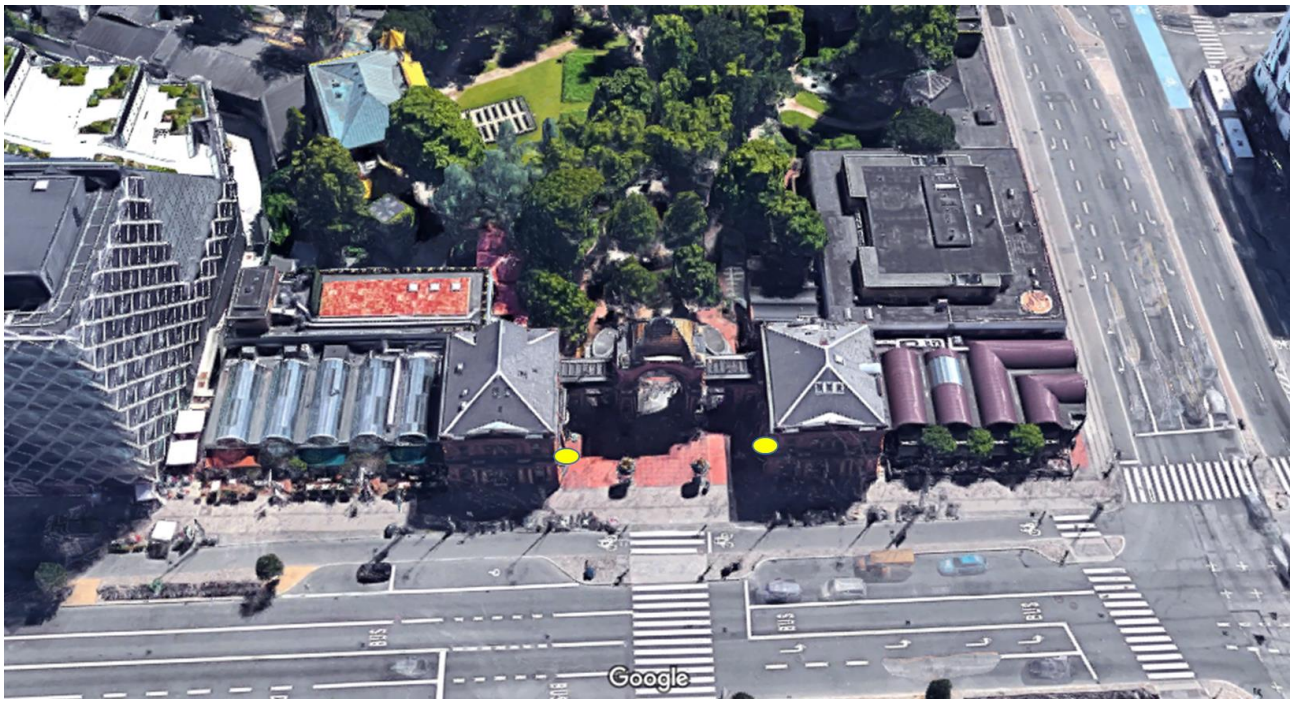


Figure 32. Tivoli main entrance: existing surveillance cameras location (two yellow dots) (source Tivoli A/S)

Guest recognition is only applicable within Tivoli's annual membership/loyalty card system which applies photos of the cardholder. CCTV video recordings within Tivoli are stored on a local server and erased no later than 30 days, in accordance with Danish regulation.

Guest incidents are detected by security staff (guards) and other Tivoli personnel working/patrolling in the park. The security personnel in the central command station observe CCTV cameras feeds. Park guests can report to security staff (guards) in the park or other uniformed Tivoli-personnel who report by radio/mobile to the central command station.

4.5.1.5.3 Communication

The security personnel use radios Motorola GP340 with repeater on two of Tivoli's channels and six channels to use. The mobile phones and IP phones are also an option.

In regard to the Wi-Fi, there is a 'guest' and a 'Tivoli staff' Wi-Fi-connection, but they are both operated by the same hardware. In principle a separate 'MONICA'-connection can be created for conducting tests in the park. With regards to the strength of the Wi-Fi coverage and setup, the Tivoli IT department will need to know more precisely about the scope of tests to be conducted in Tivoli and the hardware/software-profile before Tivoli

could determine the viability of Wi-Fi to support the tests. This is also dependent on the pressure on the network on the day (i.e. number of guests). Visual data is more 'heavy' than audio, but audio data transfer during Friday Rock is conducted by fibre cables – so this is an indication of the challenges that might be expected with respect to Wi-Fi-transfer of visual data (if not impossible).

4.5.1.6 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 the direction of the Friday Rock 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, guarantying the respect of the limitations imposed by the law. It handles also the neighbours' complaints.
Sound technician[9]	He/she is in charge to manage all the sound aspects before, during and after a Friday Rock, dealing with the performer's technical staff and the Tivoli's Head of production.
Security staff	He/she is in charge of all the security aspects in Tivoli and can work also 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 security and the one of the concertgoers in addition to the sound emission limit enforced by Copenhagen Municipality.

4.5.2 Pilot Plan: Selected Solutions and Demonstration

4.5.2.1 Allocated Use Cases

ID	Use Case Group
UCG2	Sound monitoring & control
UCG3	Crowd and Capacity Monitoring
UCG4	Missing person
UCG7	Security incidents

4.5.2.2 Sound monitoring and control

4.5.2.2.1 Purpose and Objectives

The general goal for Friday Rock in relation to sound monitoring and control is to improve sound quality within the primary and secondary Friday Rock audience area while observing the sound emission, in terms of sound pressure level and frequency content, that are emitted beyond the Tivoli park's southern perimeter, and as minimum comply with the sound level restrictions set forth in Tivoli's environmental permit.

Sound fields will be optimised with respect for both the performers and the concert audience in terms of loudness, directionality and quality. The Sound Zone System and actuation layer of the MONICA platform allows for dynamic adjustment of the Adaptive Sound Field Control loudspeakers. The neighbours of the concert venue can be accommodated with up to 10dB frequency attenuation of the sound travelling into the neighbouring areas, where it is unwanted and annoying.

[9] In any Friday Rock concert there are different sound technicians with different roles: one from Tivoli, one from the performer's staff, and one from the PA system rental company.

Real-time display of noise levels on ground plans in 2D can be displayed based on professional IoT enabled sound level meters used by staff in bracelets and/or Smartphones.

Quiet spots can be created close to the audience area ("Silence Showers"). These spots can be used for security personnel and the organizers' staff. They can be created for other people a distance away from the primary audience area (e.g. restaurants, ticket offices, etc.). The number, size and location of the Silence Showers are specific to each concert and can be controlled through the IoT actuation layer.

The sound control system is going to be built on top of the existing PA system. It is thus not independent of the existing system so that it will be able to run by itself if the sound control system fails.

4.5.2.2.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	UC 2.1	**Monitor sound levels** Monitor sound levels at the concert in August during Tivoli Friday Rock and implementation of a simplified heat map through the COP to visualize sound levels in the desired area	COP	• Contribution Algorithm • IoT microphones • Sound heat map (requires full ASFC functionality)	Select permanent Tivoli production and technical staff involved with arranging Friday Rock.
	UC 2.1	**Receive feedback from staff** Test of the MONICA app for staff members in order to collect their feedback related to sound quality.	COP MONICA App (for staff)	• Smartphones	Select permanent Tivoli production and technical staff involved with arranging Friday Rock.
	UC 2.1	**Inform staff of current sound quality and sound levels** Test of the MONICA app for staff members in order to collect their feedback related to dissemination of sound quality.	COP MONICA App (for staff)	• Smartphones	Select permanent Tivoli production and technical staff involved with arranging Friday Rock.
	UC 2.2	**ASFC (adaptive sound field controller)** Test the insertion loss (in dB) when using a simplified semi-static version of the ASFC	COP	• IOT Microphones • Environmental Sensors • ASFC Computational Core • Additional loudspeakers	Select permanent Tivoli production and technical staff involved with arranging Friday Rock Sound engineers PA rental company Performing artist
	UC 2.2	**Quiet Zones** Test base functionality during select Friday Rock concert	Self-contained solution	• Self-contained solution	Select permanent Tivoli health and safety staff Volunteers (Tivoli staff).
2019	UC 2.2	**ASFC (adaptive sound field controller)** Test the insertion loss (in dB) when using the full adaptive version of the ASFC	COP	• IOT Microphones • Environmental Sensors • ASFC Computational Core • Additional loudspeakers	Select permanent Tivoli production and technical staff involved with arranging Friday Rock Sound engineers PA rental company Performing artist

	UC 2.2	**Quiet Zones** Test functionality, potential upgrades and different versions during select Friday Rock concert	Self-contained solution COP	• Self-contained solution	Select permanent Tivoli health and safety staff Volunteers (Tivoli staff).

4.5.2.3 Crowd and capacity monitoring

4.5.2.3.1 Purpose and Objectives

The general goal for Friday Rock in relation to crowd and capacity monitoring is to (in the following order):

1. improve the guest counting method, avoiding imprecise manual and deductive counting of concert guests within the prime and secondary guest audience area and at any given time during a Friday Rock concert (UC 3.3);
2. minimise unwanted/critical crowd movement at the prime and secondary guest audience area at any given time during a Friday Rock concert (UC 3.3);
3. improve the communication and guidance of the park controllers to mitigate critical crowd build up and provide first aid and to mitigate unwanted guest behaviour and provide first aid (UC 3.4);
4. develop an early warning system in order to minimise unwanted crowd/queuing build-up outside Tivoli's two most important entrances/exits during specific events, days and/or hours (UC 3.1 and 3.2);
5. improve the guest tracking system (UC 3.3).

All solutions should apply new MONICA surveillance cameras/hardware and software in a closed loop application, independent of Tivoli's existing security hard-/software setup.

4.5.2.3.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC3.1** **UC3.3**	**Monitor direction and magnitude of crowd flow** 4 CCTV cameras will be installed around the Friday Rock audience area. 2 CCTV cameras will be placed immediately outside Tivoli's main entrance. Cameras will monitor crowd build-up and flow during Friday Rock concerts.	COP	• Cameras	Select permanent Tivoli security and park guards staff involved with arranging Friday Rock.
	UC3.1 **UC3.3**	**Monitor number of people in an area** Applying above-mentioned CCTC cameras, the number of guests at Tivoli's main entrance and Friday Rock audience area will be counted at any given time.	COP	• Cameras	
	UC 3.2 **UC 3.4**	**Locate and communicate with staff** CCTV cameras will provide early warning to Tivoli command centre via COP of	COP MONICA app (for staff)	• Cameras • RFID system • Smart glasses • Smartphones	

		high risk queues, and alerts will be sent to park guards			
2019	**Same UC as in year 2018**	Upgrade and refine tests conducted during 2018.	Same as in year 2018	• Same as in year 2018	Same as in year 2018.

4.5.2.4 Missing person

4.5.2.4.1 Purpose and Objectives

Attractions continuously experience children lost from their parents or guardian. There are also comparable incidents with disabled adults who are separated from their guardian and must be found immediately. This creates a critical situation and potentially the drawing on many personnel resources simultaneously.

The general goal relation to missing person is to provide an integrated system, using a wristband solution, where a missing person can be quickly found by Tivoli security staff (UC 4.2 and 4.4) wherever that missing person may be in the Tivoli park and/or provide a warning to security staff if such missing person is leaving the park's premises. The system shall provide information to security staff or guardian (UC 4.1 – 4.4) about location of the missing person and which person who is taking action to locate the missing person.

The system can be tested at any given time during Tivoli's operating seasons.

4.5.2.4.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2019	**UC 4.2** **UC 4.4**	**Children finder** Select children are provided a wrist band which is 'matched' to the MONICA App used by Tivoli park controllers	MONICA App (for staff) COP	• Visitor wristband • Smartphone	Select permanent Tivoli security and park guards staff involved with arranging Friday Rock.
	UC 4.1 **UC 4.2** **UC 4.3** **UC 4.4**	**Internal communication support** MONICA App to provide real-time information to Tivoli park controller of the precise whereabouts of the wristband holder.	MONICA App (for staff) COP	• RFID system • Smartphones	

4.5.2.5 Security incidents

4.5.2.5.1 Purpose and Objectives

Not all areas of Tivoli are covered by CCTV and eventual unwanted activities/crisis situation may go undetected, if not noticed by staff or guests. In such uncovered areas it could equally be beneficial to provide guidance and communication to staff controllers arriving to the area based on real-time visualization of the unwanted activity/crisis situation.

The general goal in relation to security incidents during Friday Rock is to provide an integrated system using wearables – smart glasses and existing Tivoli audio applications (radio and mobile phone) – that will assist Tivoli's central command station in communicating with and providing guidance (UC 7.2 and 7.3) to Tivoli security staff controllers to specific areas of the park that are not covered sufficiently by CCTV cameras with the objectives of mitigating critical crowd build-up and unwanted guest behaviour and provide first aid (UC 7.1).

The system shall provide information about the location of the security staff in Tivoli and the wearer of the system's condition (UC 7.1).

Another goal is to detect fights inside the park premises, applying MONICA CCTV and underlying software algorithms, and provide immediate information to Tivoli security staff via the MONICA COP and through existing Tivoli audio applications.

The systems can be tested at any given time during Tivoli's operating seasons, but most effectively during a Friday Rock concert or other large-scale outdoor event.

4.5.2.5.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	UC 7.1	**Fall detection** Gyroscope in smart glasses shall provide early warning about the situation of a park controller.	COP	• Smart glasses	Select permanent Tivoli security and park guards staff involved with arranging Friday Rock.
		Incident detection through video Provide live ground feed from specific park areas from the wearer of smart glasses to the Tivoli central command station. Provide a fight detection system applying the six MONICA CCTV cameras, mounted at Tivoli main entrance and Friday Rock audience area, and MONICA fight detection algorithm,		• Smart glasses • Cameras	
	UC 7.2	**Create and forward incident report** Record and stream recording from specific park areas applying the smart glasses. directly to the Tivoli central command station. Report a fight situation that has occurred within the range of the MONICA CCTV cameras to Tivoli security staff at the central command station.	COP MONICA App (for staff)	• Smart glasses • Cameras	
	UC 7.3	**Communicate with staff** Tivoli central command station to provide wearer of smart glasses appropriate and timely information to handle an incident.	COP MONICA App (for staff)	• Smart glasses	
2019	**Same UC as in year 2018**	Upgrade and refine tests conducted during 2018.	Same as in year 2018	• Same as in year 2018	Same as in year 2018.
	UC 7.1	**Incident detection through sound** SLMs (from B&K) will be used for the detection of incidents based on sound processing	COP	• IoT microphones (Stream Sound data/ or processed sound)	

4.6 Emerald Headingley Stadium- Cricket Games

4.6.1 Pilot Survey

Yorkshire County Cricket Club is one of eighteen first-class county clubs within the domestic cricket structure of England and Wales. Yorkshire are the most successful team in English cricketing history with 33 County Championship titles, including 1 shared. The team's most recent Championship title was in 2015, following on from that achieved in 2014. Yorkshire play most of their home games at the Cricket Ground in Leeds, part of the Stadium complex which will be redeveloped in 2017/18 and its former name of Headingley Carnegie Stadium replaced by Emerald Headingley Stadium .

Professional cricket is played in four different competitions under three global brands:

- Specsavers County Championship Division 1 (SSC1) – team is known as the Yorkshire County Cricket Club and play is over four days.
- Royal London One Day Cup (RLODC 50) – the team is known as the Yorkshire Vikings and play is over one day and limited to 50 overs per team.
- Nat West Twenty20 Blast (T20) – the team is known as the Yorkshire Vikings and play is normally over an evening and limited to 20 overs per team.
- Kia Women's Super League T20 – the team is known as the Yorkshire Diamonds and play is limited to 20 overs per team.

4.6.1.1 Location and Surroundings

Headingley Cricket Ground has been home to The Yorkshire County Cricket Club since 1890 and a venue for International Test Matches since 1899 (Figure 34).

Figure 34. Aerial shot of the Stadium

The Stadium is situated in a densely populated residential area in the northern Leeds suburb of Headingley which is also home to Leeds Beckett University's (LBU) sporting campus to the North West of the Stadium.

Access to and from the Stadium is via three routes, all of which remain open to traffic on match days. The full perimeter of the Stadium cannot be viewed although cameras at each entrance can view the immediate road. The only car parking capacity within the Stadium is Car Park A and limited car parking slots for players and staff behind the White Rose Stand. On match days only Car Park A is available for VIPs, Directors etc. Public bookable parking is available in Car parks close to the Stadium perimeter or there is street parking in some local streets. The coach park is over the narrow one-way bridge at the bottom of St Michael's lane – at busy times pedestrian access to and from the ground can be problematic and there is no sight over the bridge to view issues.

The cricket ground forms part of the Stadium sharing facilities and services with Leeds Rugby who operate from their own offices to the south of the complex. The Carnegie Pavilion is shared with LBU who use it for offices and teaching and have their own security staff and cameras present in the building and players area.

4.6.1.2 Attractions

From the staging of the England versus Australia Test Match in 1890 to last summer's first ever Test Match at the venue between England and Sri Lanka, the Stadium has hosted 73 Tests. England have won 31 times at Yorkshire's home with 23 defeats and 18 draws. The ICC Cricket World Cup 2019 sees the Stadium host four games at the World Cup next summer:

- Friday 21 June – England v Sri Lanka
- Saturday 29 June – Pakistan v Afghanistan
- Thursday 4 July – Afghanistan v West Indies
- Saturday 6 July – Sri Lanka v India

The attractions for visitors and home fans have increased as the Stadium has developed its services and now include a variety of activities – many to welcome children and young people to the ground and recruit a new generation of cricket lovers. These activities range from an outdoor climbing wall, face painting, mascot photos, mini cricket, competitions and interactive tweets. The Stadium also hosts the Leeds Children's Day which for 2017 doubled in size to over 4,000 and has hosted the popular band – Madness on the sacred Headingley cricket turf! YCCC also opens its doors to a variety of amateur cricket competitions, school events and charity functions. It is a popular venue for weddings and family celebrations, sports dinners and the Long bar in the East Stand provides post-match entertainment for Leeds Rugby games (Figures 35 – 38)

Figure 35.Yorkshire Vikings mascot with young fans

Figure 36. Fans in fancy dress in the Fanzone area in the White Rose Stand

Figure 37. Madness Concert on the pitch

Figure 38. YCCC Fundraising Charity Dinner

For the purposes of MONICA T20 has been selected as most appropriate for the research outcomes. The laws of T20 cricket essentially follow those of traditional one-day, 40 and 50-over cricket matches. In T20 cricket, each team is allowed one innings to try and score as many runs as they can within a period of 20 overs (120 balls). However, whilst T20 shares many of the laws of the longer versions of the one-day game, it also possesses certain individual rules that are designed to speed up the passage of play. Though some cricket traditionalists have argued that these specific laws cheapen the image of cricket, they are ultimately designed to give T20 a fresh and more exciting edge. T20 has a wide appeal due to the fast pace of the game and the crowd is much more diverse than for the County games with a large number of younger people and families attending.

The ground has been 'lightly' segregated to accommodate this diversity, facilitating a high satisfaction rate from visitors. Figure 46 shows the various named areas such as 'Fanzone' - lively experience where the famous 'Beer snakes' are tolerated; Community Stand – which is family orientated and alcohol free.

Although all forms of the game have sell out fixtures one of the highlights is the local Yorkshire/ Lancashire game which is one of two or three broadcast on Sky TV (Figure 39). Match highlights are broadcast on Sky Sports and BBC sport online.

Figure 39. T20 Yorkshire V Lancashire – sell-out crowd

4.6.1.3 Visitation

In 2016 the competitions welcomed 195,214 spectators when international matches are included. In 2017 spectators numbered 187,750 across all competitions. The most popular and fastest growing competition is the T20 Blast with an average of 7,000 spectators per game. It is planned that T20 games will be selected for the MONICA pilot. Figure 40 shows the attendance figures since 2014.

Season	LVCC	RCL/RLODC	ODI	Test match	T20	Yorks Diamonds	Total
2014	40230	11473	16264	36299	31353		135619
2015	59329	21436	16500	44522	55655		197442
2016	66016	18037	15823	36648	57159	1531	195214
2017	34606	14857	14198	56005	64938	3142	187746

Figure 40. Season attendance by competition

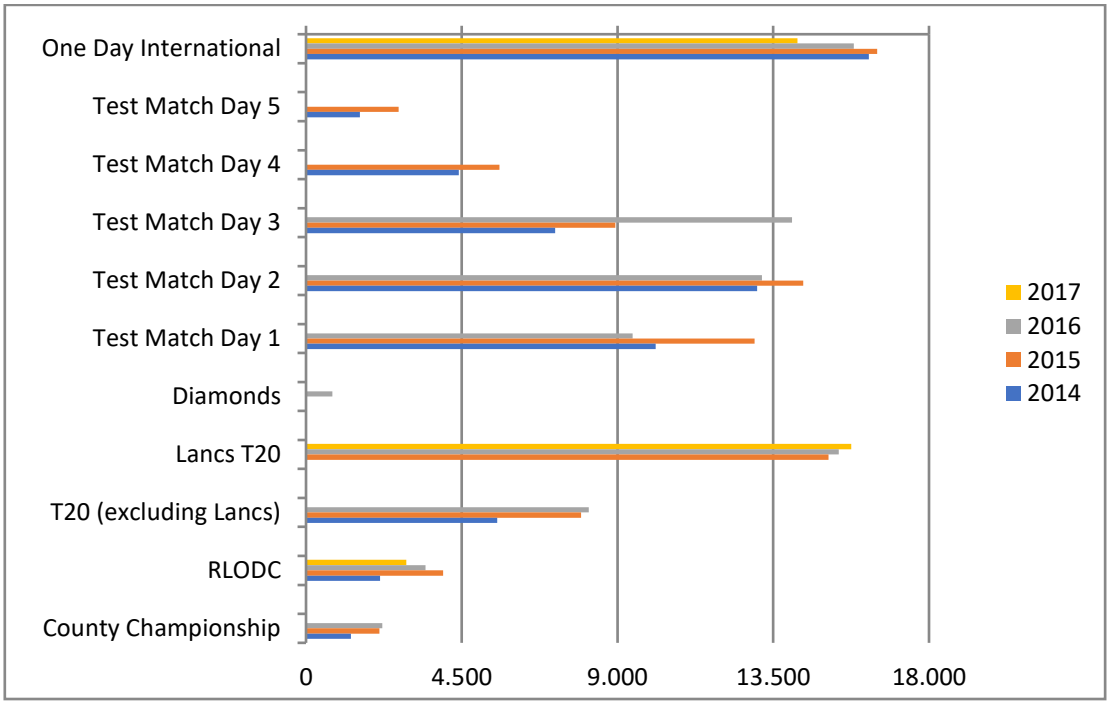


Figure 41. Average attendance by competition

Customer satisfaction is measured in a variety of ways by YCCC using social media, fans phone and e mail. The English Cricket Board (ECB) is responsible for an annual survey across al the Championship grounds which measures customer satisfaction across a number of areas including food, atmosphere, queues, stewards, view etc. and also picks up on positive and negative comments which can include safety and security issues. Figure 42 shows customer priorities, Figure 43 compares 2015 to 2016 performance indicating that stewarding has made the most positive change.

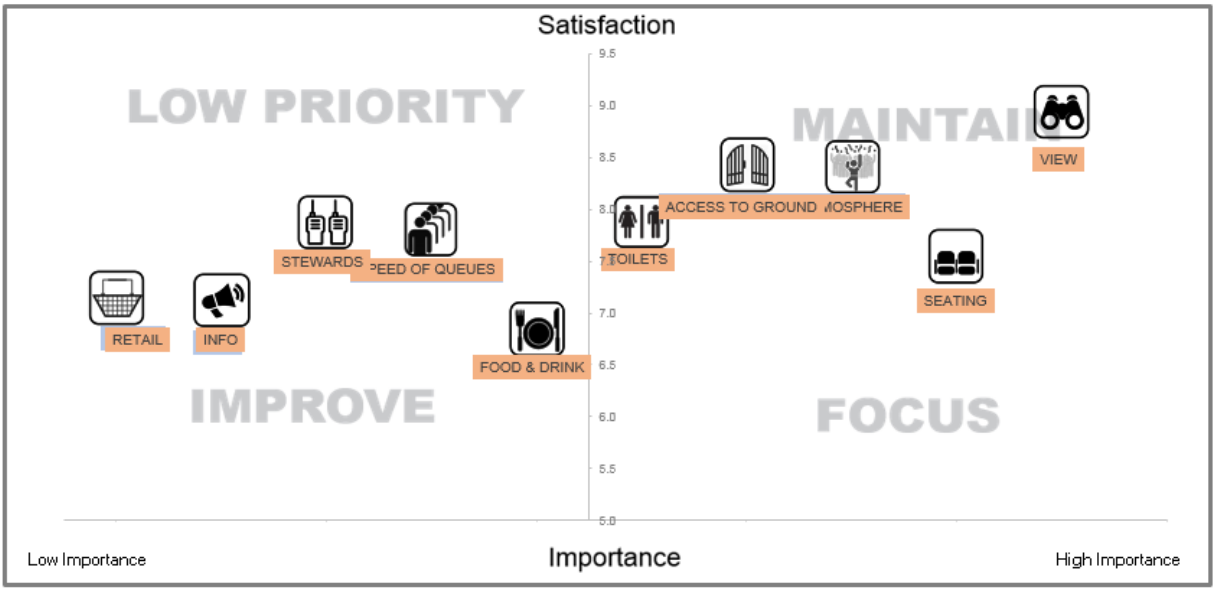


Figure 42. Customer priorities v satisfaction scores

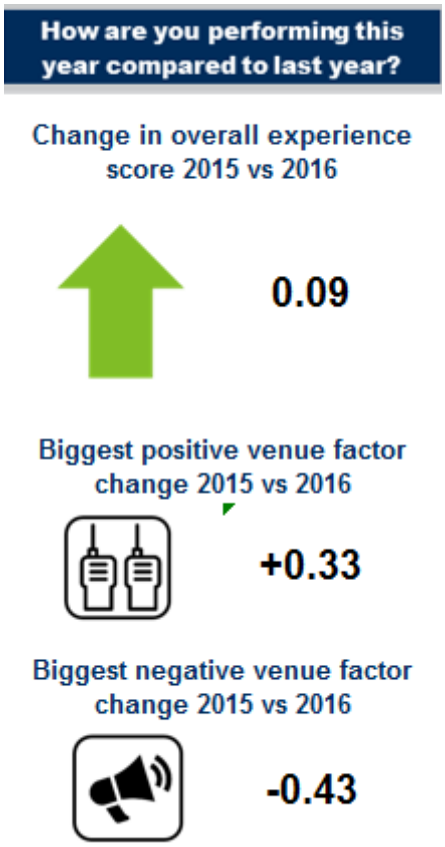


Figure 43. 2015 v 2016 performance

Figure 44 provides an overview of the food and beverage with price showing most dissatisfaction. G4S stewards (which includes gate personnel) scores well reflecting the improved performance in Figure 43. Figures 44 and 45 review the match day atmosphere indicating fun, social and relaxed reflecting the G4S approach.

Figure 44. Venue and staffing satisfaction

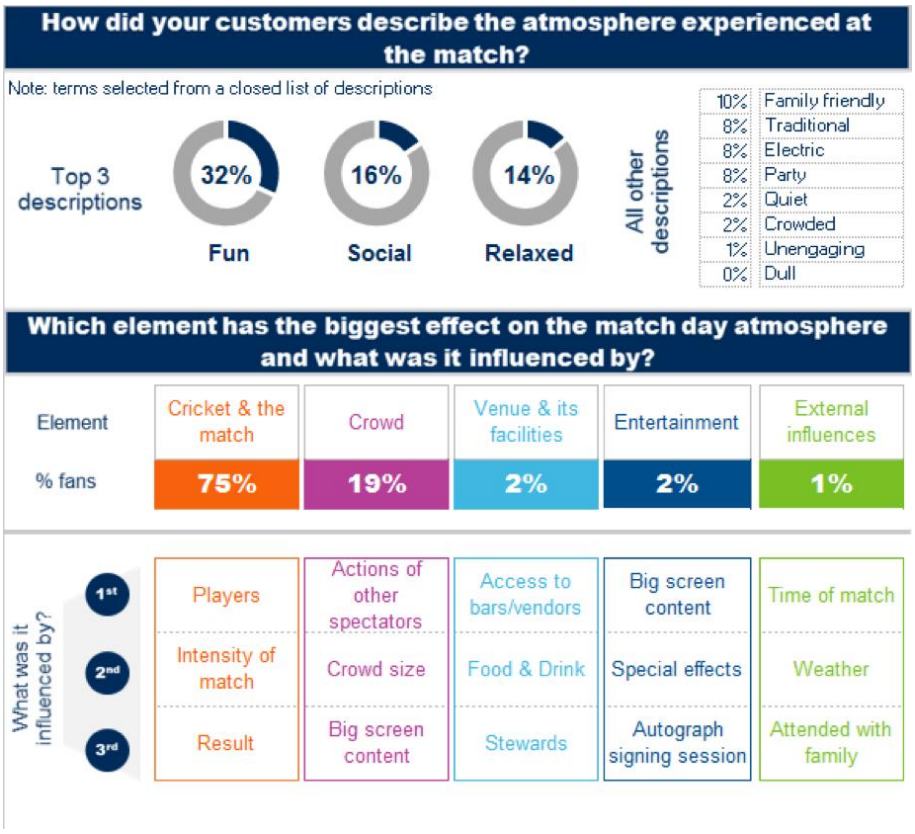


Figure 45. Match day atmosphere

As well as an understanding of the customer in terms of satisfaction scores further feedback from ticket sales and on line surveys has enabled the market segmentation of the visitors to International matches and to categorise them into segments for more targeted sales, particularly in relation to seating. Figure 46 shows the market segments and Figure 47 the site plan with targeted spectator zones suited to specific markets. For example ticket sales to families may be directed to the non-alcohol Community Stand and the Fanzone Fanatics to the more ebullient Fanzone.

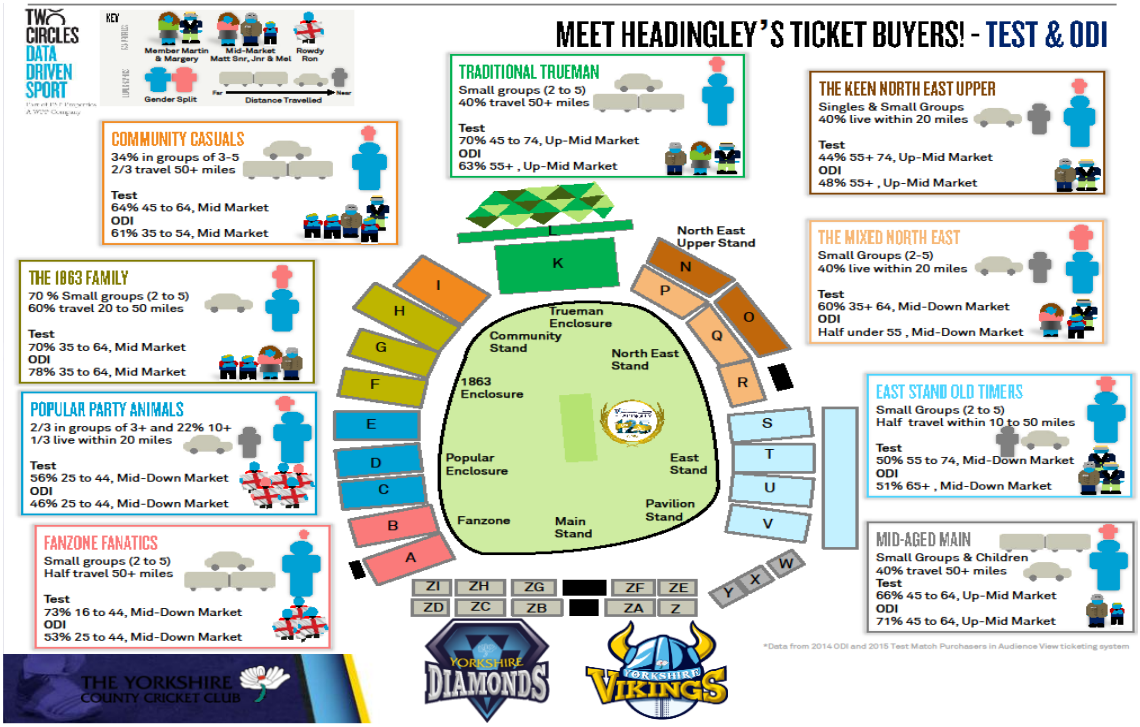


Figure 46. Shows the diversity of the visitors by international games

4.6.1.4 Site Plan

The Cricket Ground Main Stand backs onto the North Stand of the rugby ground and shares egress, corporate hospitality and bars on their respective match days. From October 2017 both Stands are being redeveloped as part of a joint initiative to improve their respective facilities. For YCCC this investment in the ground capacity and facility is necessary to ensure Headingley remains an international cricket venue. As well as increased seating, a 500-seat corporate dinning facility and executive boxes are planned which can be used by each club or separately when both have coinciding home fixtures. Figure 47 shows the Stadium site plan. Leeds Rugby own the rugby ground and the areas inside the St Michael's Lane boundary, including all the car parks. It holds the contracts with Sodexo who provide hospitality and functions through the Headingley Experience brand and also manage the hotel. YCCC have access to all these areas and use on match days as part of a legal agreement.

The Cricket Ground has recently been loosely segregated in recognition of the increasingly diverse fan base and new competition in women's cricket. The Community Stand is alcohol free and mainly families, the Fanzone can get very noisy and is often frequented by groups in fancy dress. The Carnegie pavilion was built in partnership with Leeds Beckett University in the late 1990s and houses some University staff as well as YCCC offices, the Boardroom, team dressing rooms, match official and media facilities and match day corporate hospitality.

Figure 47. Emerald Headingley Stadium

4.6.1.5 Current Infrastructure

4.6.1.5.1 Sound

Generally, sound is at an acceptable level and ebbs and flows with the passage of play and depending on the competition. There are few complaints about noise from the local neighbourhood. During the matches noise levels are inconsistent with loud cheering when, for example, there is an exciting passage of play, a wicket is taken, a boundary is hit or when a milestone is reached. For the boundaries a burst of music and an announcement on the PA system is made. There are some areas around the ground where the PA system is less clear and announcements can also be affected by the crowd noise.

4.6.1.5.2 Security

Group 4 Secure Solutions UK Ltd (G4SSUK) is responsible for the safety and security of the Stadium and contributing to an excellent customer experience. They are part of G4S which is the world's leading integrated security company, specialising in the delivery of security and related services across six continents. The aim of G4SSUK is to provide high calibre event staff whilst supporting the needs of YCCC by providing trained, competent and customer focussed managerial staff and stewards.

There is a permanent G4SSUK staffing presence at the Stadium which includes the Ground Safety Officer (GSO), 4 Gatehouse security stewards and 2 Operations staff. There are between 35 and 40 regular supervisors/ stewards who operate on match days and other events as required. The GSO works with the YCCC Operations Manager for all safety and security matters and match day delivery. Emergency services attend based on risk but there are always paramedics and first aiders on site for match days.

4.6.1.5.3 Communication

Pre-match briefings are given to all stewards using information sheets and key messages. Supervisors are then responsible for relaying messages from the control room to their stewarding team. The Control room uses digital radios and mobile phones. Spectators are communicated with primarily through face to face with stewards, the PA system and the scoreboard can be used for important / urgent messages. Further non-urgent information can be via the website/social media, the match day programme and fliers.

4.6.1.6 Stakeholders

Because of the complex nature of the Stadium ownership, which is historical, there are a wide range of stakeholders who have an interest in its success shown in the table below. Following the completion of the redevelopment of the Main Stand in May 2019 the ownership of half of this will be transferred to YCCC to become part of their Stadium footprint. This includes the hotel in the East Stand which is leased back to Leeds Rugby. The new development will comprise a jointly owned and managed Main Stand with the facility for each partner to open up the partner side on their match days to increase corporate hospitality to nearly 600 places. A special legal entity has been established to oversee the operational, legal and financial aspects of this joint venture with representation from YCCC and Leeds Rugby.

Other stakeholders include the Stadium Safety and Advisory Group (SAG) with representatives from Yorkshire Ambulance, St John's Ambulance, West Yorkshire Police including the Anti Terrorism Unit, G4SSUK, Leeds City Council, SODEXO (in house caterers) and West Yorkshire Fire Services. In addition, there is the England and Wales Cricket Board and the Members Forum. The following table describes the stakeholders who might directly interact with MONICA applications.

Name	Description
Spectator	Any attendant who 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 Control Centre (CC) via radio.
Anti-corruption official	To ensure all requirements of ECB match day 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.

4.6.2 Pilot Plan: Selected Solutions and Demonstration

4.6.2.1 Allocated Use Cases

ID	Use Case Group
UCG 3	Crowd and Capacity Monitoring
UCG 5	Locate Staff
UCG 7	Security Incidents
UCG 8	Heath Incidents
UCG 13	Event Information

4.6.2.2 Crowd and Capacity Monitoring

4.6.2.2.1 Purpose and Objectives

The challenge for YCCC is the management of queues at bars positioned behind the White Rose Stand where visitors flow around the perimeter, queue for toilets and for food, as well as visit the bars. These areas become particularly congested during T20 games and the International fixtures when many visitors are unfamiliar with the Stadium.

The objectives for YCCC in relation to Crowd and Capacity Monitoring is to better understand behavior in relation to queues and movement around the Stadium and be able to detect and redirect high risk queues to better enhance the customer experience during busiest match days and times. This will help the event organisers to safely manage queues and optimize supply and demand at bars and hospitality outlets and increase customer satisfaction and revenue from sales.

The first solution will be the deployment of cameras in a selected location which will gather data to support the development of software which detects high risk scenarios. These cameras will:

- Monitor congested areas and queues
- Monitor movement into and out of the area

In addition, an overview of the situation will be delivered to the control room through the Common Operational Picture (COP) to enable communication to be sent to stewards to actively manage high risk queues and redirect crowds to less busier outlets using communication tools such as smart bracelets.

If there is an APP available it would be advantageous to be able to send alerts to visitors of less busy options.

Cameras will be installed at the cross on the left of the map below (Figure 48). Figure 49 indicates the area the solution will be deployed and tested.

4.6.2.2.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018 June-September	**UC3.1** **U3.3**	**Monitor direction and crowd flow** **Monitor number of people in an area** 3 x Cameras will be installed at the location indicated above. 1x ToF camera will be installed to count queues 2 x cameras will capture flow and behavior and triangulate with data from UC3.1 to alert to build up of congestion and potential high risk queues	COP	• Cameras	3 x 500 visitors
2019	**UC3.2** **UC5.1** **UC3.4**	**Locate and communicate with staff** Smart staff wristband will enable COP to identify and communicate action with steward closest to high risk queue Camera will alert control room via COP of high risk queue and alert will be sent to steward to redirect visitors to less busy outlets Display on COP from camera alerts Control room to send message to Steward closest to high risk queue to redirect away from congested area to less busy outlet	COP	• Cameras • Staff wristband/smartphone	3 x 1 Control Room staff 3 x 5 stewards
	UC13.1	**Visitor Guidance** Alerts can be sent via an APP to visitors to inform them of less busy options	COP MONICA App (for visitors)	• Smartphones	Visitors

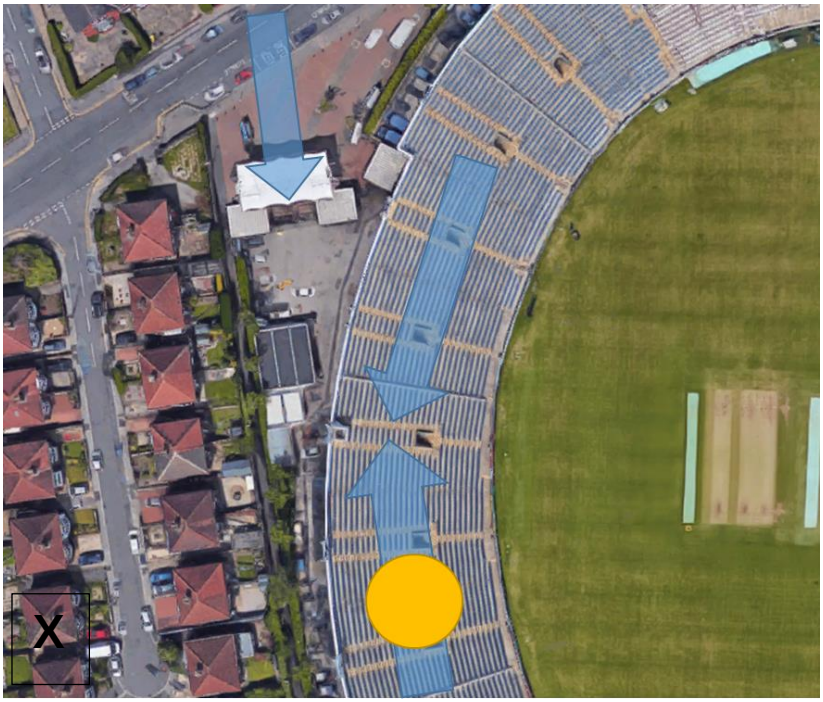


Figure 48. Cameras installation point at Emerald Headingley Stadium

Figure 49. Cameras installation area (49a & 49b)

4.6.2.3 Locate staff

4.6.2.3.1 Purpose and objectives

The challenge for YCCC is to locate an incident during matches when there are capacity crowds. Often an incident is reported by a visitor or steward who cannot be accurately pinpointed due to the congested area. The control room has to manually search using the nearest camera and then direct assistance to the area. Knowledge of the location of the stewards and their roles through a digital map in the COP would facilitate more effective and efficient use of resources and speed communication.

In addition, a functionality that enabled the nearest camera to automatically search and locate an incident and / or also automatically locate a steward alert would improve response time and free up control room staff to focus on response.

4.6.2.3.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2019	UC 5.1	**Locate and communicate with staff** The main focus for this pilot is being able to quickly view the location and status of different staff members within the COP. In addition the visualization of a camera alert from a stewards wristband within the COP would be a very useful function. (see Incident detection in next section)	COP	• Staff smartphone or a dedicated localisation device Camera	3 x 5 stewards
				• Cameras	In 2019 an interactive function with cameras is planned to be tested

4.6.2.4 Health and Security Incidents

4.6.2.4.1 Purpose and objectives

YCCC is interested in improving reaction time when it comes to handling incidents. This should be achieved through MONICA solutions that help to detect incidents through the system, as well as being able to easily locate the different staff members and resources through a digital map in the COP. The objective behind is to be able to keep a clear overview of the stewards and their specific specialisms to be able to assign tasks in a more targeted and effective way.

4.6.2.4.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC 7.1** **UC 8.1**	**Incident detection through video**	COP	• Cameras	Control room staff
	UC 7.3 **UC 8.3**	Handle an incident Direct appropriate resources accurately to incident		• Staff smartphone or a dedicated localisation device	3 x 5 stewards 3 x1 Control room staff
2019	**UC 5.1**	**Locate and communicate with staff** **Incident detection through video** Staff communicate with camera and / or Control room Enable staff to alert camera remotely to search for an incident		• Staff smartphone or a dedicated localisation device Camera	3 x 5 stewards 3 x 1 Control room staff
	UC 7.2 **UC 8.2** **UC 5.1**	**Create and forward incident report** Allowing staff members to forward incident reports directly to the control room through MONICA applications.	COP MONICA App (for staff)	• Staff smartphone or a dedicated localisation device	3 x 5 stewards 3 x 1 Control room staff

4.7 Emerald Headingley Stadium - Rugby Games

4.7.1 Pilot Survey

Leeds Rugby Limited is the world's first dual rugby partnership between the leading rugby league and rugby union sides in Leeds. Leeds Rhinos and Yorkshire Carnegie, respectively, have shared the rugby ground at Headingly Carnegie Stadium since 1991 and the Rhinos have played there since their formation in 1865 when the ground was part of a multi sports facility. As well as the two professional sports clubs, the Stadium is also home to Yorkshire County Cricket Club (YCCC) making it a unique and word famous venue for three different international sports. The rugby teams play their home games at the Headingley Rugby Ground in Leeds, part of the previously named Headingley Carnegie Stadium which will be redeveloped in 2017/18 and renamed Emerald Headingley Stadium beginning with the South Stand – traditionally for home fans (Figures 50 – 52).

Figure 50. Construction of the South Stand 1931

Yorkshire Carnegie rugby union plays in the RFU Championship where they finished second in the 2016/17 season narrowly missing out on promotion to the Premiership.

Leeds Rhinos compete in the Super League, the top level European rugby league competition, and have won the competition a record seven times since its inception in 1996, most recently in 2015. They also compete in the Challenge Cup which is an open competition to amateur and professional rugby league sides. Included amongst their fans are actor Russell Crowe, footballer Wayne Rooney and Olympian and former world champion triathlete Jonny Brownlee.

Figure 51. Sell-out crowd in the South Stand 2011

Figure 52. Demolition of the South Stand September 2017

4.7.1.1 Location and Surroundings

The Stadium is situated in a densely populated residential area in the northern Leeds suburb of Headingley which is also home to Leeds Beckett University's (LBU) sporting campus to the North West of the Stadium (Figure 53).

Access to and from the stadium is via three routes, all of which remain open to traffic on match days, although there are some restrictions to St Michael's Lane. The full perimeter of the Stadium cannot be viewed from the control room via CCTV, although cameras at each entrance can view the immediate road and pedestrian access. The main car parks are within the Stadium perimeter and the coach park is over the narrow one-way bridge at the bottom of St Michael's lane – at busy times pedestrian access to and from the ground can be problematic and there is no sight over the bridge to view issues. The bridge is closed to traffic for up to 30 minutes for pedestrian egress at the end of games.

Figure 53. Aerial shot of the Stadium.

The rugby ground forms part of the Stadium, sharing facilities and services with Yorkshire County Cricket Club who operate from their own offices to the North of the Stadium within the Carnegie Pavilion.

4.7.1.2 Attractions

The Stadium has been venue to international rugby matches as well as a regular facility for community competitions, women and girl's rugby, charity matches and junior club tag rugby festivals. It has hosted opera, world record challenges and been the location for films including Tina and Bobby (docudrama about the life of Bobby Moore who captained the England World Cup winning team in 1966 – Figure 54). In July this year the rugby ground was used to film for a major Bollywood movie 'Gold' starring Akshay Kumar and Mouni Roy which tells the story of India's first ever gold medal as an independent nation when they won Men's Hockey Gold at the 1948 Olympic Games in London.

Figure 54. Tina and Bobby docudrama film shoot.

Leeds Rhinos had a highly successful season in 2015, winning all the major honours - the Challenge Cup, the League Leaders Shield and the Grand Final - completing the rugby league treble and becoming only the third team in the Super League era to achieve this. Their success saw an average attendance increase of 3% in the subsequent season and they welcomed a total home crowd of 258,022. In 2017 the attendance increased to 266,309. Figure 57 provides an analysis of the Rhinos match day attendance for 2016.

The attractions for visitors and home fans have increased as the Stadium has developed its services and include a variety of activities, many linked to match days including Stadium tours of the historic buildings, world record challenges, half time mini tag rugby competition and the Rhinestones cheerleaders. Ronnie the Rhino is a popular mascot and pitch side on match days as well as attending numerous events throughout the year (Figure 55). The Stadium also hosts the Leeds Children's Day, which for 2017, doubled in size to over 4,000 attending the event which had many exciting attractions. Leeds Rugby also opens its doors to a variety of amateur rugby competitions, school events and charity functions. It is a popular venue for weddings and family celebrations, sports dinners and the Long bar in the East Stand provides post-match entertainment for Leeds Rugby games. Earlier this year The Leeds Rhinos Foundation welcomed HRH Prince Harry to the Stadium to showcase their charitable work (Figure 56).

For the Purposes of MONICA the Leeds Rhinos games have been selected as most appropriate for the research outcomes. Match day attendance is on average 22,000 and includes a high number of families and females. Sky TV regularly broadcast games which adds an additional dimension to the spectacle.

Figure 55. Ronnie the Rhino abseils into the Stadium before a Super League game.

Figure 56. HRH Prince Harry is escorted by Super League Leeds Rhinos hero Kevin Sinfield during a recent visit to the Stadium.

4.7.1.3 Visitation

In 2016 the Rhinos competitions welcomed a total of 258,022 spectators to their home games which shows an increase of 3% on last season with a 70:30 male: female split and 21% under 21 which reflects the growth in family support. Figure 57 below provides an analysis of the 2016 match day attendance.

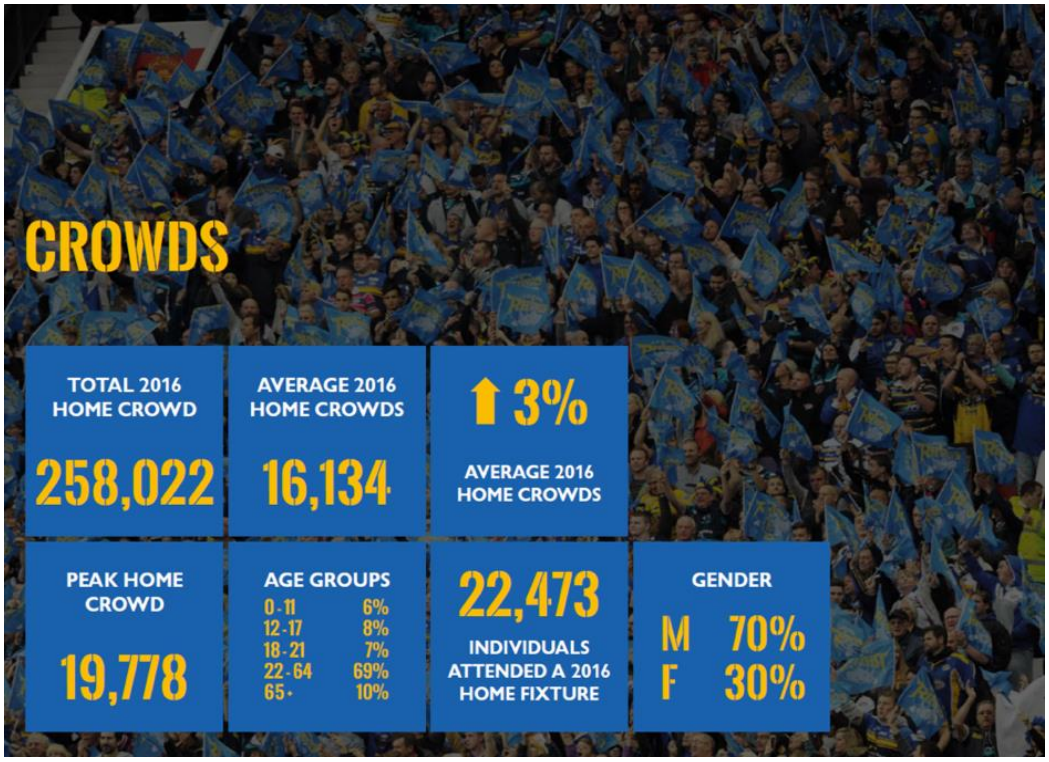


Figure 57. 2016 Season – spectator analysis

Leeds Rhinos main form of interaction with their fans and visitors to the Stadium is though their web site with online views for 2016 of 5,169,399 (Figure 58).

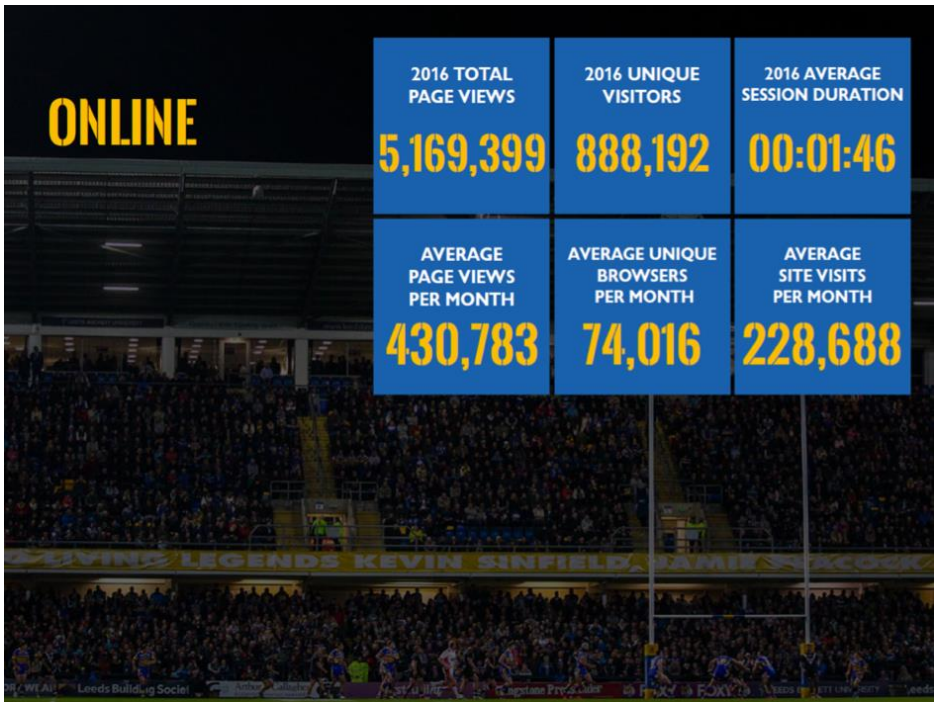


Figure 58. 2016 Rhinos Online statistics.

They have a huge social media reach, including internationally. This is their main form of communication and 2016 witnessed a tremendous growth of @ 33% on twitter alone. Figure 59 provides an analysis of social reach for 2016.

Customer satisfaction is measured in a variety of ways using social media, fans phone and e mail and across a number of areas including food, atmosphere, queues, stewards, view etc. Social media picks up both positive and negative comments (of which there are few of the latter).

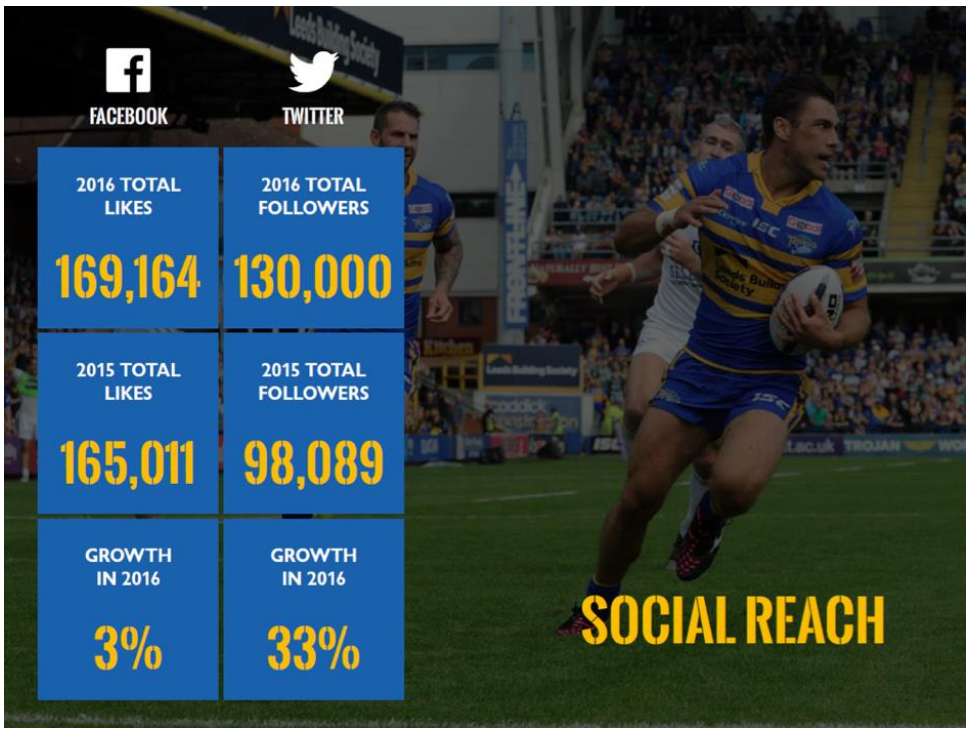


Figure 59. 2016 Rhinos Social Reach.

4.7.1.4 Site Plan

The North Stand of the rugby ground backs onto the cricket ground. The Carnegie Stand was built in 2006 to incorporate executive boxes into Headingley and also expanded the capacity to 21,000 adding extra seating on the top tier and terracing on the bottom. From 18th August 2017, the South Stand will be demolished and replaced with a new stand that combines seating and standing areas.

Leeds Rugby and YCCC are also redeveloping the North Stand as part of the redevelopment of the cricket ground to rebuild it and to add the seating on both sides to expand the capacity of both grounds, including a 500-seat corporate dinning facility and executive boxes which can be used by each club or separately when both have coinciding home fixtures. Leeds Rugby own the rugby ground and the areas inside the St Michael's Lane boundary, including all the car parks. It holds the contracts with Sodexo who provide hospitality and functions through the Headingley Experience brand and also manage the hotel. Figure 60 shows the Stadium site plan.

Figure 60. Site Plan - Rugby

4.7.1.5 Current Infrastructure

4.7.1.5.1 Sound

Generally, sound is at an acceptable level and there are few complaints about noise from the local neighbourhood. During the rugby games noise levels are inconsistent with loud cheering when there is an exciting passage of play, when there is an infringement or when a try is scored. For the latter this is accompanied by a burst of music and an announcement on the PA system. The games will finish by 10 pm and the stadium empties within 30 minutes with the exception of the Long Bar where players meet fans. Those leaving later are generally well behaved.

4.7.1.5.2 Security

Group 4 Secure Solutions UK Ltd (G4S) is responsible for the safety and security of the Stadium and contributing to an excellent customer experience. They are part of G4S who is the world's leading integrated security company, specialising in the delivery of security and related services across six continents. The aim of G4S is to provide high calibre event staff whilst supporting the needs of YCCC by providing trained, competent and customer focused managerial staff and stewards.

There is a permanent G4S staffing presence at the Stadium which includes the Ground Safety Officer (GSO), 4 Gatehouse security stewards and 2 Operations staff. There are between 35 and 40 regular supervisors/ stewards who operate on match days and other events as required. The GSO works with the Leeds Rugby Operations Manager for all safety and security matters and match day delivery.

Emergency services attend based on risk but there are always paramedics and first aiders on site for match days.

4.7.1.5.3 Communication

Pre-match briefings are given to all stewards using information sheets and key messages. Supervisors are then responsible for relaying messages from the control room to their stewarding team. The Control room uses digital radios and mobile phones. Spectators are communicated with primarily through face to face with stewards, the PA system and the scoreboard can be used for important / urgent messages. Further non-urgent information can be via the website/social media, the match day programme and fliers.

4.7.1.6 Stakeholders

Because of the complex nature of the Stadium ownership, which is historical, there are a wide range of stakeholders who have an interest in its success. Following the completion of the redevelopment of the Main Stand in May 2019 the ownership of half of this will be transferred to YCCC to become part of their Stadium footprint. This includes the hotel in the East Stand which is leased back to Leeds Rugby. The new development will comprise a jointly owned and managed Main Stand with the facility for each partner to open up the partner side on their match days to increase corporate hospitality to nearly 600 places. A special legal entity has been established to oversee the operational, legal and financial aspects of this joint venture with representation from YCCC and Leeds Rugby.

Other stakeholders include the Stadium Safety and Advisory Group (SAG) with representatives from YCCC, Yorkshire Ambulance, St John's Ambulance, West Yorkshire Police including the Anti-Terrorism Unit, G4S, Leeds City Council, SODEXO and Yorkshire Fire Services. Other stakeholders include the Leeds Rhinos Foundation, Rugby Football League, Rugby Football Union, local resident's groups and Emerald Publishing – the Stadium sponsor. The following table describes the stakeholders who might directly interact with MONICA applications.

Name	Description
Spectator	Any attendant who 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 Control Centre (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.

4.7.2 Pilot Plan: Selected Solutions and Demonstration

4.7.2.1 Allocated Use Cases

ID	Use Case Group
UCG 3	Crowd and Capacity Monitoring
UCG 5	Locate Staff
UCG 7	Security Incidents
UCG 8	Heath Incidents
UCG 13	Event Information

4.7.2.2 Crowd and Capacity Monitoring

4.7.2.2.1 Purpose and Objectives

The challenge for Leeds Rugby is the management of queues at hospitality outlets positioned in busy walkways where visitors flow in different directions and queues form across pedestrian access points. These areas become particularly congested just before kick-off, at half time and from 10 minutes before the match ends.

The objectives for Leeds Rugby in relation to Crowd and Capacity Monitoring is to better understand behaviour in relation to queues and movement around the Stadium and be able to detect and redirect high risk queues to better enhance the customer experience during busiest match days and times. This will help the event organisers to safely manage queues and optimize supply and demand at bars and hospitality outlets and increase customer satisfaction and revenue from sales.

The first solution will be the deployment of cameras in a selected location which will gather data to support the development of software which detects high risk scenarios. These cameras will:

- Monitor congested areas and queues
- Monitor movement into and out of the area

In addition, an overview of the situation will be delivered to the control room through the COPto enable communication to be sent to stewards to actively manage high risk queues and redirect crowds to less busier outlets using communication tools such as smart bracelets.

Cameras will be installed at the cross on the right of the map below shown in Figure 61-63 indicate the area for cameras to be deployed and tested.

Figure 61. Emerald Headingley Stadium

Figure 62. Congested area for camera deployment and tests

Figure 63. Camera to be mounted on the walkway above

4.7.2.2.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018 Jan - July	**UC3.1** **U3.3**	**Monitor direction and crowd flow** **Monitor number of people in an area** 3 x Cameras will be installed at the location indicated above. 1x ToF camera will count crowd. 2 x cameras will capture flow and behavior supporting the identification of high risk queues. Gate camera will monitor flow into the area and triangulate with crowd data from UC3.1 to alert to build up of congestion and potential high risk queues	COP	• Cameras	3 matches x 1,000 visitors
2019	**UC3.2** **UC5.1** **UC3.4**	**Locate and communicate with staff** Smart staff wristband will enable COP to identify and communicate action with steward closest to high risk queue Camera will alert control room via COP of high risk queue and alert will be sent to steward to redirect Display on COP from camera alerts Control room to send message to Steward closest to gate to redirect away from congested area	COP	• Cameras • Staff wristband/smartphones	3 x 1 Control Room staff 3 x 5 stewards
	UC13.1	**Visitor Guidance** Alerts can be sent via an APP to visitors to inform them of less busy options	COP MONICA App (for visitors)	• Smartphones	Visitors

4.7.2.3 Locate staff

4.7.2.3.1 Purpose and objectives

The challenge for Leeds Rugby is to locate an incident during matches when there are capacity crowds. Often an incident is reported by a visitor or steward who cannot be accurately pinpointed due to the congested area. The control room has to manually search using the nearest camera and then direct assistance to the area. Knowledge of the location of the stewards and their roles through a digital map in the COP would facilitate more effective and efficient use of resources and speed communication.

In addition, a functionality that enabled the nearest camera to automatically search and locate the incident from a steward´s alert would improve response time and free up control room staff to focus on response.

4.7.2.3.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	UC 5.1	**Locate and communicate with staff** The main focus for this pilot is being able to visualize the location and status of different staff members within the COP. In addition a camera alert from a stewards wristband would be a very useful function. (see Incident detection in next section)	COP	• Staff wristband/ smartphone	10 stewards
2019	UC 5.1			• Cameras	In 2019 an interactive function with cameras is planned to be tested

4.7.2.4 Health and Security Incidents

4.7.2.4.1 Purpose and objectives

Leeds Rugby is interested in improving reaction time when it comes to handling incidents. This should be achieved through MONICA solutions that help to detect incidents through the system, as well as being able to easily locate the different staff members and resources through a digital map in the COP. The objective behind is to be able to keep a clear overview of the resources that are in charge to handle incidents to be able to assign tasks in a more targeted and effective way.

4.7.2.4.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018 Jan - July	UC 7.1 UC 8.1	**Incident detection through video**	COP	• Cameras	Control room staff
	UC 5.1 UC 7.3 UC 8.3	**Locate and communicate with staff** Handle an incident Direct appropriate resources accurately to incident	COP	• Staff wristband/ smartphone	3 x 10 stewards 3 x 1 Control room staff
2019	UC 5.1	**Incident detection through video** Staff communicate with camera and / or Control room Enable staff to alert camera remotely to search for an incident	COP	• Staff wristband/ smartphone • Cameras	3 x 10 stewards 3 x 1 Control room staff
	UC 7.2 UC 8.2 UC 5.1	**Create and forward incident report** Allowing staff members to forward incident reports directly to the control room through MONICA applications.	COP MONICA App (for staff)	• Staff wristband • Smartphones	3 x 10 stewards 3 x 1 Control room staff

4.8 Hamburger DOM

4.8.1 Pilot Survey

The Hamburger DOM is Northern Germany's biggest funfair with 7-10 million annual visitors during the 91 DOM days.[10]

In the 1930s, the original wintertime market was expanded with a spring market in an effort to help local merchants through the economic crisis. After the end of World War II, a summer market was added as well. With its three recurring festivals in spring, summer, and winter the DOM is today the largest fair in Northern Germany, and the longest running fair in the whole of Germany.

The funfair takes place in the premises of the Heiligengeistfeld with a total of around 251 attractions[11].

4.8.1.1 Location and Surroundings

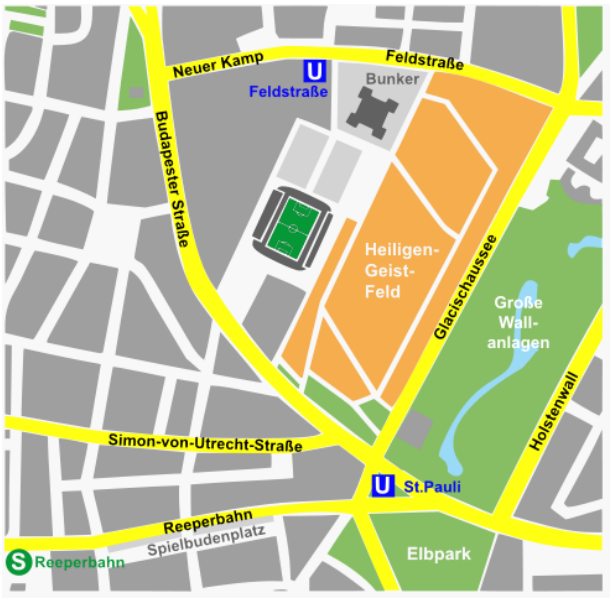


Figure 64. Map of DOM area (source Hamburg municipality)

Heiligengeistfeld is an event area in the St. Pauli residential quarter right next to the Millerntor-Stadion[12], in central Hamburg.

Since 1893, the funfair Hamburger DOM has been held here. When this area is not used for exhibitions, circuses or for the DOM, it is a car park. A building from German Telekom, a swimming complex, Millerntor-Stadion, a school, a patrol station, a historic defensive tower (Flakturm IV) and a shopping mall are fixed structures on the field.

[10] 2017 Edition: March 24 - April 23 2017, July 28 - August 27 2017, November 3 - December 3 2017

2018 Edition: March 23 – April 22 2018; 27 July - 26 August 2018, November 9 - December 9 2018

2019 Edition: March 22 – April 22 2019; 26 July - 25 August 2019, November 8 - December 8 2019

[11] http://www.hamburg.de/dom/

[12] It's a stadium mainly used for football matches and it's the home stadium of FC St. Pauli.

Figure 65. Aerial shot of the Hamburger DOM site (source Hamburg municipality)

4.8.1.2 Attractions

From roller coasters, haunted houses and bumper cars to an old-fashioned game of duck fishing: in total, there are around 251 attractions (it depends on the season). There are also around 60 food stalls.

Figure 66. Detail of one of the entrance of Hamburger DOM (source Hamburg municipality)

Figure 67. View of Hamburger DOM (source Hamburg municipality)

Figure 68. Night overview of Hamburger DOM (source Hamburg municipality)

4.8.1.3 Visitation

There are on average 7-10 million annual visitors during the 91 DOM days of the three editions in spring, summer and winter. In the busiest days there are up to 250.000 visitors.

DOM Edition	2014	2015	2016	2017
Spring	3 million	2,4 million	2,5 million	2,5 million
Summer	4 million	3 million	3 million	
Winter	3 million	2 million	2 million	

Figure 69. Number of visitors in the current and three past three editions

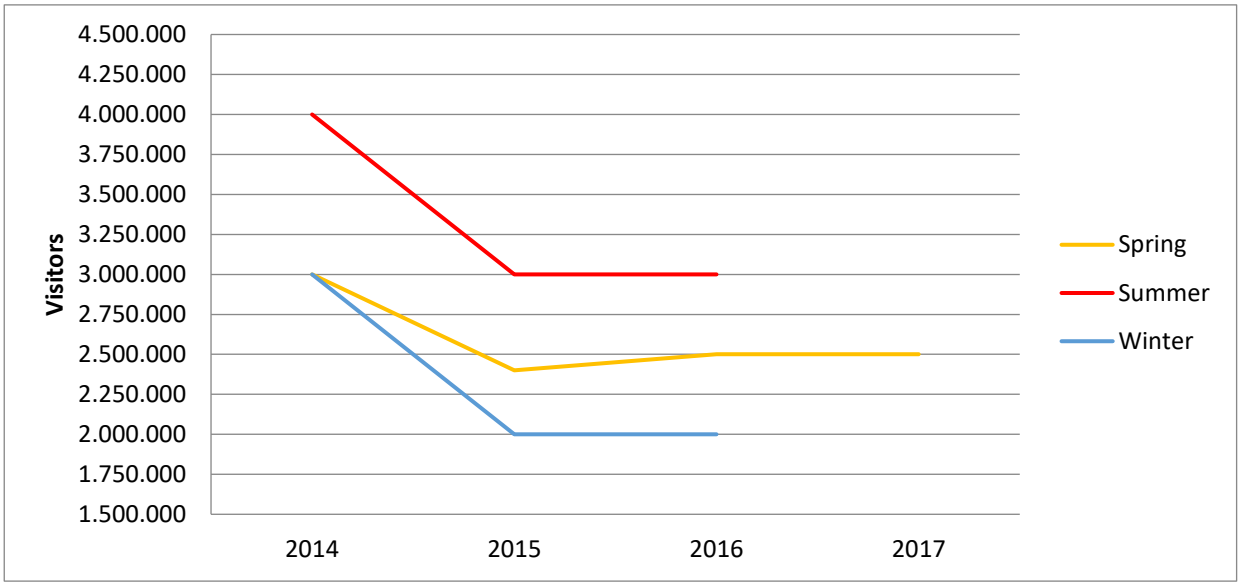


Figure 70. Visitors per year per edition

4.8.1.4 Site Plan

The area is 160,000m², fenced, with 9 free entrances. As described in the map below in Fig.71[13], four entrances are in Glacischaussee, four in Heiligengeistfeld and one in Budapester Strasse. These are open entrances with no gates. The whole area is surrounded by anti-terror concrete blocks. The area is always accessible, even when the stalls are closed down. The opening times are:

- Mon – Thu: 3:00 pm – 11:00 pm
- Fri and Sat: 3:00 pm – 0:30 am
- Sunday: 2:00 pm – 11:00 pm

Visitors usually leave as soon as the stalls close. There is no security hired by the event organisers at night but the stall owners appoint their own security company to take care of their property.

Glacischaussee is partly closed to the traffic and used as parking space only from Friday to Sunday, the busiest days.

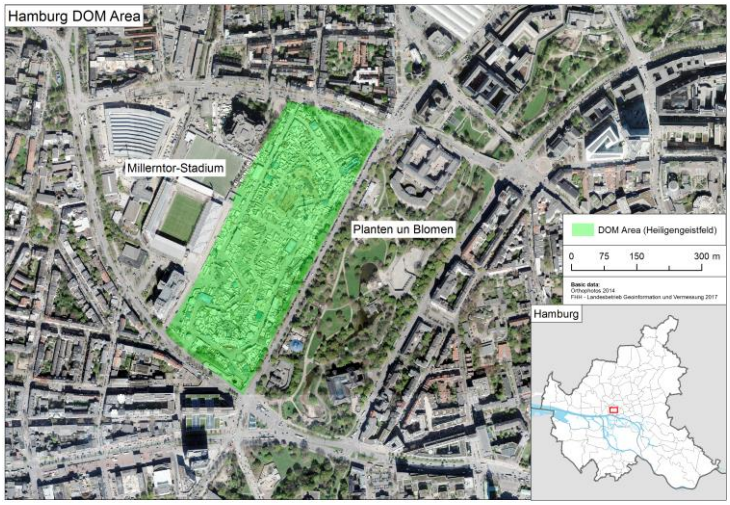


Figure 71. Hamburger DOM site and surroundings (source Hamburg municipality, LGV)

[13] http://www.hamburg.de/contentblob/2598942/9033c6a025025d60c898d44547c9d49b/data/dom-lageplan.pdf

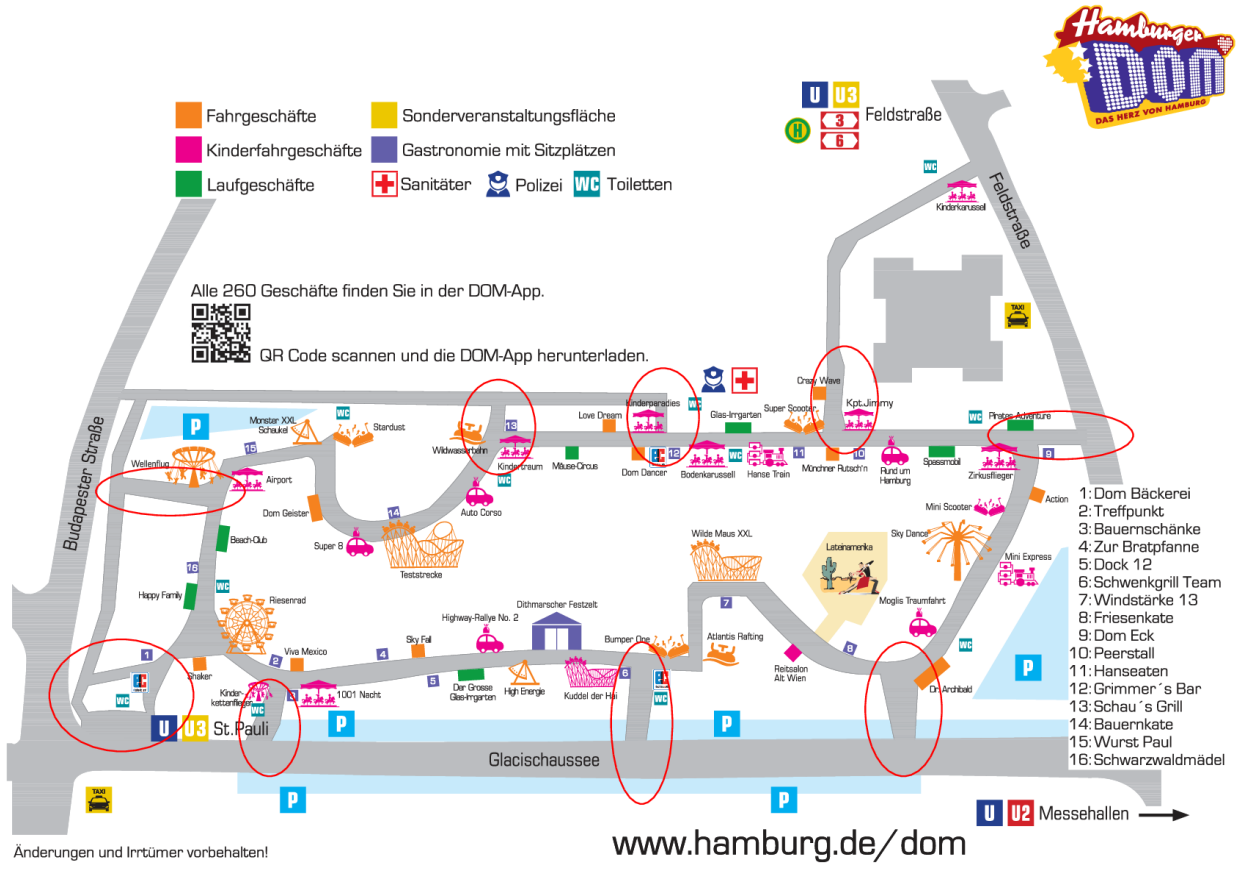


Figure 72. Hamburger DOM map (source Hamburg municipality)

4.8.1.5 Current Infrastructure

4.8.1.5.1 Sound

Sound management is not a current issue for FHH in Hamburger DOM, so no information to be provided on this regard.

Anyway, the loudspeakers are owned individually by each stall owner. There are around 371 stalls involved in DOM along the year, of which up to 260 stalls play music or have announcements.

4.8.1.5.2 Security

The staff, equipped with mobile phones and radio phones, monitors the site by walking through the event area. They are always in touch with the control room.

In regards to the video streaming infrastructure, there are no cameras so they cannot be used by MONICA.

The site is under development. During spring DOM 2018 illuminated exit signs were installed by the event organizer.

To prevent and to solve lost child cases, parents can use the "Kinderfinder" bracelet, made of paper and distributed at the entrance, to write the child's name and their phone number on it.

To prevent truck attacks, concrete blocks and trucks have been installed as deterrent around the DOM area.

4.8.1.5.3 Communication

The staff communicates only by radio phones and mobiles.

As of early 2018, there is no network infrastructure that can be used for the MONICA project – definitely not for the summer DOM 2018. Internet access is available only in the control room. Plans are under way to install a fibre-optical network infrastructure, which could be available for the winter DOM in November 2018.

4.8.1.6 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.
Local District Offices (Bezirksamt Altona / Mitte)	It is responsible for the permits, licences from the municipality and it gives permission for transaction of the event to the event organizers. Furthermore, 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	It's 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 exists and the parking lots around the venue.
Visitor	He/she is the event participant. Any age is in this group.
Stall owner	He/she is the entrepreneur who owns the amusement rides, food truck, or other private business in the event venue.

4.8.2 Pilot Plan: Selected Solutions and Demonstration

4.8.2.1 Allocated Use Cases

ID	Use Case Group
UCG 3	Crowd and Capacity Monitoring
UCG 5	Locate staff
UCG 14	Safety Incidents

4.8.2.2 Crowd and Capacity Monitoring

4.8.2.2.1 Purpose and Objectives

Hamburg is interested in determining the number of visitors in a specific area called the "Sonderfläche". This 2500m^2 big area has only one entrance for the visitors and is situated in the centre of the DOM. Every DOM event presents a different topic, for example farm life or the medieval days, is adopted and stalls, food and decoration take up this topic.

The area is a known meeting spot and a favoured place to view the fireworks every Friday at 10:30pm. As this area has only one entrance, we need to have a good overview and control of the crowd levels in the specific area of the event to prevent catastrophes by making sure that the venue capacity of 2 visitors per square meter[14] is not overloaded.

[14] see: Merkblatt „13-01 Sicherheitskonzepte für Großveranstaltungen" (vfdb) https://www.vfdb.de/fileadmin/download/merkblatt/MB13_01_sicherheitskonzept.pdf

4.8.2.2.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC3.1** **UC3.3**	**Monitor de number of people in an area** Installation of two cameras in order to count the number of people entering and exiting the given area and monitoring the area's crowd capacity. The number of people is visualised through an app.	COP	• Cameras	**Event Organizer:** the person responsible for the execution of the event. This is one specific individual working for the Ministry of Economy, Traffic and Innovation. He has the responsibility and is the main decision maker on ground. He is in constant communication with the police, the fire brigade and the private security company.
2019	**UC3.1** **UC3.3**	**Monitor de number of people in an area** **Monitor direction and magnitude of crowd flow** The installations in 2018 are the initial test of the software and hardware. In 2019, the implementation can be optimised and former challenges can be addressed.			

4.8.2.3 Locate staff

4.8.2.3.1 Purpose and Objectives

Since the threat of a terror attack through trucks is present, the entrances of the DOM have to be blocked. Beside conventional concrete blocks on the entrances, for the DOM some entrances need to remain flexible and accessible for emergency cases. This is needed, for example, when a mass of people wants to leave the area or when the emergency, police or fire brigade have to access it. The current solution consists of vans with a driver each from a security provider blocking those entrances. By providing wristbands the event organiser can monitor and contact the van security staff and further staff members that walk around on the DOM and react in critical moments in a fast and efficient way.

4.8.2.3.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC 5.1**	**Locate, monitor and communicate with staff**	COP	• Staff wristband	**Security Staff:** Staff sitting in vans in front of the entrances as well as those moving around in the DOM area. **Event Organizer:** the person responsible for the execution of the event. This is one specific individual working for the Ministry of Economy, Traffic and Innovation. He has the responsibility and is the main decision maker on ground. He is in constant communication with the police, the fire brigade and the private security company.
2019	**UC 5.1**	**Locate, monitor and communicate with staff** The installations in 2018 are the initial test of the software and hardware. In 2019, the implementation can be optimised and former challenges can be addressed.			

4.8.2.4 Safety incidents

4.8.2.4.1 Purpose and Objectives

Due to its geographical location, the weather in Hamburg is famous for being windy and wet. It often rains and, more so, cold winds and gusts of wind are common. With its proximity to the Elbe, the DOM area is an exceptional windy area. The DOM has to develop their new security concept. One of the measures taken in order to improve the security and safety on ground is that all stall owners have to hand in their "stall book". This includes information about the capacity of the stall as well as recommendations on the conditions under which parts have to be closed or retrenched. Under unsuitable weather conditions, some shops have to take precautions. By installing wind sensors, we will be able to visualise the speed of winds with an app or on a screen in the control room of the DOM. The event organiser no longer has to rely on his own instinct but can easily check out which stalls need to take measures under which conditions. The plan is to measure wind speeds and, in case of critical weather conditions, send an automated alarm to the event organiser. With the information the event organizer will proceed with safety measures and decide e.g. stop or keep certain stalls running. By doing so, we can prevent health and safety incidents.

4.8.2.4.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018 2019	UCG 14	**Measure wind speed** Sensors measuring wind speeds will be installed across the DOM area. The data will be visualised through an app to which the event organiser has access. In case of high winds, an automated alarm will warn the organiser. Precautions can then be taken.	COP	• Environmental sensors	Event Organizer: the person responsible for the execution of the event. This is one specific individual working for the Ministry of Economy, Traffic and Innovation. He has the responsibility and is the main decision maker on ground. He is in constant communication with the police, the fire brigade and the private security company.

4.9 Hafengeburtstag (Port Anniversary)

4.9.1 Pilot Survey

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 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.

It is a street event of 3-4 days in May[15], usually opening on Thursday (from 10 am to 10 pm), Friday and Saturday (from 10 am to 12 pm) and Sunday (from 10 am to 9 pm).

It is a free access event without fixed boundaries, with open air concerts in urban densely populated areas.

4.9.1.1 Location and Surroundings

The area is 800.000m², six kilometres along the waterfront of the river Elbe. There are up to 15 road accesses and 6 pedestrian accesses. The whole area is closed down for traffic and it includes the riverside, dense dwellings, restaurants and bars and a park.

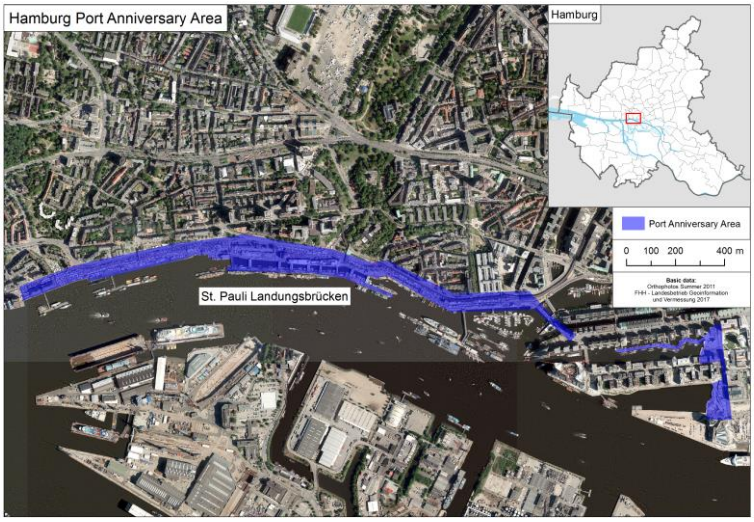


Figure 73. Aerial shot of the event site (source: Hamburg municipality)

[15] Editions: May 5-8 2017, May 10-13 2018, May 10-12 2019

4.9.1.2 Attractions

Figure 74. Detail of the ship parade (source: Hamburg municipality)

Figure 75. Night view, fireworks (source ©Hamburg Messe und Congress/Fotografenname)

Ships are undoubtedly the biggest attraction in the city's celebrations: more than 300 vessels participate to the parade each year, including tall ships, traditional sailing boats, historic ships and cruise ships.

The attractions of the Hamburg Port Anniversary extend from Kehrwiederspitze to the Fish Auction Hall, and include displays on land and in the water in HafenCity, Hamburg's newest and most progressive urban district. A maritime programme is also held at the Heritage Harbour in the traditional warehouse district Speicherstadt and at the Oevelgönne Museum Harbour.

Food is a key part of the Port Anniversary festival, with stalls along the harbour.

There are fireworks too, over the ships in the harbour. Lasting for 15 minutes, the display attracts around 1.5 million visitors.

4.9.1.3 Visitation

Each year more than one million visitors from Germany and abroad come to this maritime event.

Port Anniversary	Duration (days)	Visitors (million)
2013	4	1,5

2014	3	0,8
2015	3	1
2016	4	1,6
2017	3	1

Figure 76. Number of visitors in the past five editions

4.9.1.4 Site Plan

In the event area, there are two metro stations (Landungsbrücken and Baumwall), museums, City Sporthafen Hamburg (port of call and berth), historical sites like Kehrwieder and Elbphilharmonie.

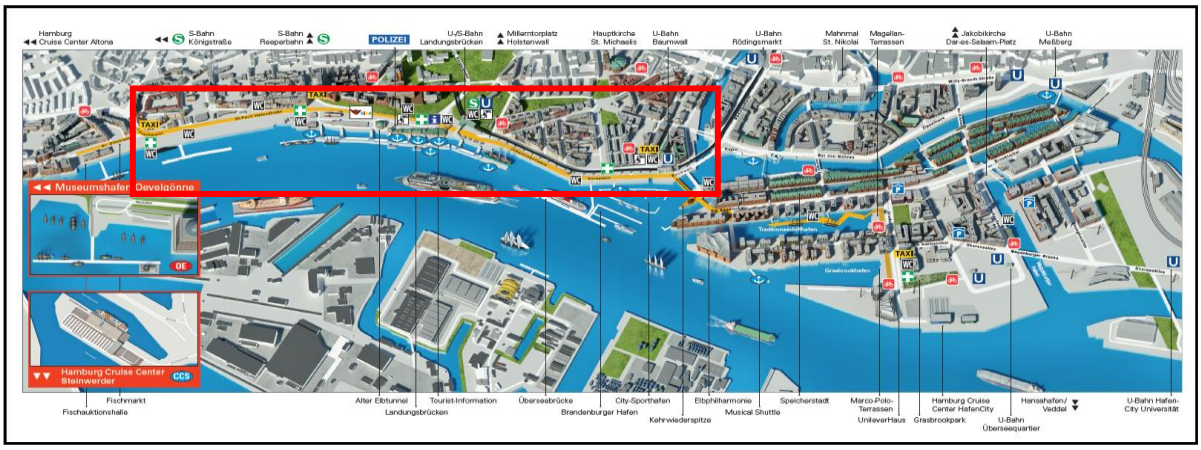


Figure 77. Map of the event site (source: City of Hamburg)

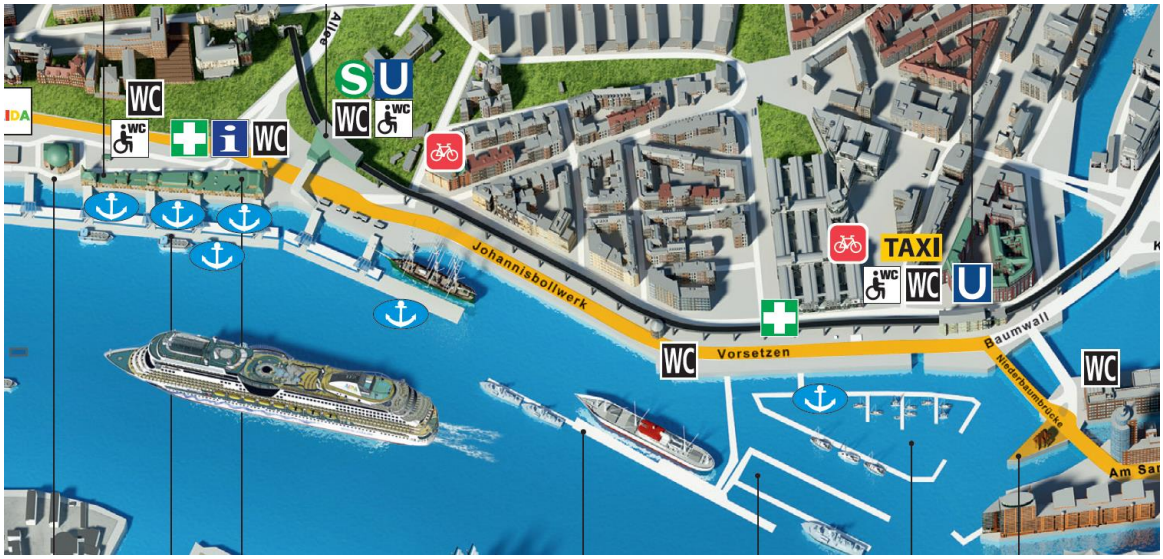


Figure 78. Detail of the red rectangle area (source: City of Hamburg)

4.9.1.5 Current Infrastructure

4.9.1.5.1 Sound

The sound management is not a current issue for FHH in Hamburger DOM, so no information is provided on this regard.

4.9.1.5.2 Security

In general, the Port Anniversary has a very advanced security concept.

Basically, the most prevalent security issues are health incidents and petty crimes.

To prevent and to solve lost child cases, parents can use the "Kinderfinder" bracelet, made of paper and distributed at the entrance, to write the child's name and their phone number on it. Loudspeakers can be used for lost children.

During Port Anniversary, several security corps are involved: Four more external security companies (e.g. securitas) operate in different locations of the event site and are hired by sub-organizers; the Harbour Port Authority also hires its own private company.

There's a cooperation among event organizers, the police, water police (Wasserschutzpolizei), fire brigade, THW[16], HPA[17], HMC[18].

The security staff communicates via radio phones and sometimes via mobile phone.

Cameras are deployed in the event area for crowd management, but it is not possible for MONICA to access and use them.

All the roads leading to the site are blocked with heavy stone blocks. The police checks the entering vehicles.

There's a speaker system: the control room can make an announcement via speakers if needed. The event site is divided into six or more announcement zones. Each zone can be addressed separately from the control room. The message is normally directed to the security staff and to the visitors.

The visitor in need can report to the nearest security staff who will contact the control room by radio phone.

In regards to the people counting procedure, it is a manual counting. The crowd manager can use screen shots of the cameras to estimate the number of visitors in given areas of the event site.

4.9.1.5.3 Communication

The staff uses mainly the radio phone to communicate with the control room, more rarely the mobile phone.

Mobile network often breaks down during the event because of the huge amount of visitors.

4.9.1.6 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 events 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 the sound issues. It is in touch with the event organisers to make sure that they comply with the rules and regulations. It deals also 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.)
Police	It is in charge of the security of the event venue and its surroundings. It is also present in the control room.
Fire brigade	It is the corps in charge of the security in the venue area. It is also present in the control room.

[16] Technischen Hilfswerk in Hamburg (Technical Relief Agency)

[17] Hamburg Port Authority

[18] Hamburg Messe und Congress gmbh

"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.

4.9.2 Pilot Plan: Selected Solutions and Demonstration

4.9.2.1 Allocated Use Cases

ID	Use Case Group
UCG 14	Safety incidents

4.9.2.2 Safety Incident incidents

4.9.2.2.1 Purpose and Objectives

Due to its geographical location, the weather in Hamburg is famous for being windy and wet. It often rains and, more so, cold winds and gusts of wind are common. With its direct location next to the Elbe, the Port Anniversary is an exceptional windy area. One of the measures taken in order to improve the security and safety on ground is that all stall owners have to hand in their "stall book". This includes information about the capacity of the stall as well as recommendations on the conditions under which parts have to be closed or retrenched. Under unsuitable weather conditions, some shops have to take precautions. By installing wind sensors, we will be able to visualise the speed of winds with an app or on a screen in the control room of the Port Anniversary. The event organiser no longer has to rely on his own instinct but can easily check out which stalls need to take measures under which conditions. He also does not have to rely on the measurements of the German weather forecast, whose stations are located in Finkenwerder, several kilometres away. The setting of the Port Anniversary is particularly different and challenging as it is located in the aisle and wind speeds can accelerate. The plan is to measure wind speeds and, in case of critical weather conditions, send an automated alarm to the event organiser. With the information the event organiser will proceed with safety measures and decide e.g. stop or keep certain stalls running. By doing so, we can prevent health and safety incidents.

4.9.2.2.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2019	**UCG 14**	**Measure wind speed** Sensors measuring wind speeds will be installed across the DOM area. The data will be visualised through	COP MONICA App (for staff)	• Environmental sensors	Event Organizer: the person responsible for the execution of the event. This is one specific individual working for the Ministry of Economy, Traffic and Innovation. He has the

		an app to which the event organiser has access. In case of high winds, an automated alarm will warn the organiser. Precautions can then be taken.			responsibility and is the main decision maker on ground. He is in constant communication with the police, the fire brigade and the private security company.

4.10 Fête des Lumières

4.10.1 Pilot Survey

Fête des Lumières is a free cultural event hosted by the city of Lyon. It is a festival composed of light installations with sound animations. It takes place every year during the 8th, 9th and 10th of December.

Before the event, the city is updating the official website and the mobile app with maps and descriptions of the programme or animations. The event is also listed in detail in the town magazine and several meetings are made with local residents. The tourist office communicates on social networks and LED display panels updates about the festival (also in real time during the event). The inhabitants near an attraction are also notified by regular mail.

During the event visitors can use free paper plans or the official mobile app allowing to:

- Access to all programming and animations around them, (list, map or augmented reality)
- Choose a neighbourhood or thematic pathways of animations

4.10.1.1 Location and Surroundings

The installations are located in well-known public areas of Lyon (places, streets, squares, parks).

4.10.1.2 Attractions

For three nights a variety of different artists light up buildings, streets, squares and parks all over the city or in the city centre since 2016. Around 50 light performances take place sometimes with sound playing. Depending on the year, the event can last 1 to 4 days and people can use free public transportation to admire the shows. The timeslots are usually from 6p.m. to midnight.

Among the different attractions there are light performances in different locations (e.g. Place Bullecour) as well as iterative light and sound projections (e.g Colline de Fourvière, Cathedrale Saint Jean). (Figure 79)

Figure 79. Place Bellecour, Colline de Fourviére, Cathédrale Saint Jean

4.10.1.3 Visitation

This site welcomed approximately 2 000 000 visitors in 2016, this low attendance was caused by terror risk. The 2015 edition was cancelled for this reason too.

Year	2010	2011	2012	2013	2014	2015	2016

Visitors	3.000.000	3.500.000	4.000.000	3.500.000	3.000.000	2015 cancelled	2.000.000

Visitation rate of the festival since 2010

4.10.1.4 Site Plan

The configuration of the site is re-evaluated each year by the event organisers. The size of the site may vary every year. In order to prevent terrorism-related risks, the perimeter of the 2016 edition had been particularly limited. Fête des Lumières was held for the most part on a perimeter closed to traffic on the peninsula of Lyon with checkpoints. Among public transports services (bus, tramway, underground, funicular), only the underground service was accessible within the perimeter. The control was carried out at the exit of the underground station. Below is the plan of the 2016 edition:

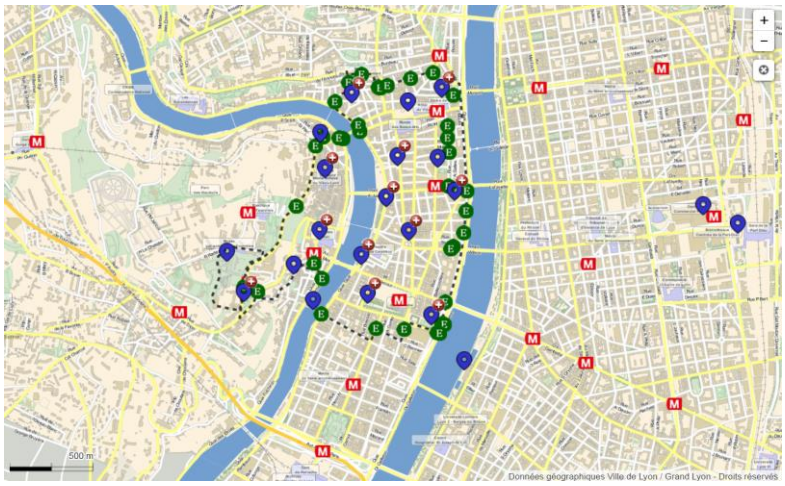


Figure 80. Map of the Festival shows (blue dots) in 2016

The symbols E represent the entry points accessible for pedestrians with random checking. The dotted line represents the perimeter of Fête des Lumières. Pedestrian exits are possible on the whole perimeter. The area size of the event is over 1km^2.

The perimeter of the 2017 edition is still in consideration by the event organisers. Fête des Lumières should a priori take place over the nine districts of Lyon but each part of the site might remain fenced and accessible through checkpoints.

4.10.1.5 Current Infrastructure

4.10.1.5.1 Sound

Class 1 sound level Meters are available to monitor sound level. Information on which performance is louder than the other can be collected through monitoring. Every year the city receives a few complaints directly related to the shows. For instance, a show playing loud music will make the neighbours react and call the city hall then a technician will be sent to lower the music. The average complaints rate is between 2 and 5 per year.

4.10.1.5.2 Security

The global available infrastructure is 11 emergency stations, 1 command post, around 2000 people for security (1 000 agents from national police, 200 agents from city police, 350 agents from private security companies, 160 firemen, 150 volunteers) , electricity and gas companies, tourism office staff for communication, IT staff for social networks etc. The city centre is on ORSEC[19] plan (and security is managed by state. Emergency services are deployed within the perimeter festival.

[19] https://en.wikipedia.org/wiki/ORSEC_plan)

The security personnel are using walkie-talkies to communicate.

Surveillance cameras of the city are used. Security cameras managed by external suppliers are installed.

The active measures against bomb threats and / or terror attacks are: the use of one military drone, entrance gates with searches, presence of policemen and military, no bags for visitors.

There is currently no data about the in-flow of people (per time unit).The number of people that are present is actually estimated by statistics from public transports and data from mobile phone providers.

The measures to limit the amount of visitors when necessary are the fencing of the main spots and entrance gates with visual control of crowd density.

If incidence happens, the crowd can notify the security points.

Projections on walls guide people to next events. The projections are shown in an automatic way without considering the current situation. There is no coordination on when is the best moment to guide people, which areas are full or overcrowded.

4.10.1.5.3 Communication

In case of emergency, the city can send messages through the mobile app. Some LED display panels are used at key locations to inform spectators on general purpose or specific issues. The staff use mainly mobile/radio to communicate with each other.

4.10.1.6 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.

4.10.2 Pilot Plan: Selected Solutions and Demonstration

4.10.2.1 Allocated Use Cases

ID	Use Case Group
UCG 2	Sound Monitoring & Control
UCG 3	Crowd & Capacity Monitoring
UCG 4	Missing Person
UCG 5	Locate Staff

UCG 8	Health Incidents
UCG 13	Event Information

4.10.2.2 Sound Monitoring & Control

4.10.2.2.1 Purpose and Objectives

In 2017, long and short term measurements were held at Place des Terreaux with classic Sound Level Meter. These tests allowed to:

- Compare the noise levels observed during the festival days and during those of the week before the festival
- Identify specific events outside the show period (ex: concert of music, not being part of the Festival of Lights program, sound tests)
- Localize acoustic impact in the surrounding streets
- Comparison of the sounds measured during the broadcast of the show and during the interlude: differences in amplitude, spectral composition, sound dynamics

During the next phase of MONICA, it is expected to renew those measurements and to enhance the potential of using IoT sound level meters by displaying the sound levels in real time for each site through the COP. The COP will be used by the event manager.
The contribution algorithm will allow identifying state of the music (on or off). Additionally, an Index on a scale from 0 to 10 will be used to base talks and discussion with the neighbors after the events as well as to make comparisons based on feedback provided by spectators and neighbors in the area.

4.10.2.2.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC 2.1**	**Monitor sound levels** Monitor sound levels and implementation of a simplified heat map through the COP to visualize sound levels in the desired area. Advanced sound monitoring with more IoT Sound Level Meters: • Sound recordings • Sound pressure level • Spectra • Contribution Algorithm	COP	• IoT Sound Level Meters • Annoyance Comfort Index • Contribution algorithm	Professional sound staff Neighbours will be informed in dedicated meetings
	UC 2.1	**Receive feedback from visitors, staff** Initial test of the MONICA app for visitor´s, staff and residents in order to collect their feedback in terms of sound perception.	COP MONICA App (for visitors)	• Annoyance Comfort Index • Smartphones	Neighbours will be informed in dedicated meetings

	UC2.1 **UC13.1**	**Inform Visitors / staff of current sound quality and sound levels**	COP MONICA App (for visitors)	• Annoyance Comfort Index • Smartphones	Neighbours will be informed in dedicated meetings
2019	**UC2.1**	**Monitor sound levels** Monitor sound levels and implementation of a simplified Heat Map through the COP to visualize sound levels in the desired area. Increase the number of sound level meters and accuracy of heat map. Advanced sound monitoring with more IoT Sound Level Meters: • Sound recordings • Sound pressure level • Spectra • Contribution Algorithm	COP	• IoT Sound Level Meters • Annoyance Comfort Index • Contribution algorithm	Professional sound staff Neighbours will be informed in dedicated meetings
	UC 2.1	**Receive feedback from visitors, staff** Final version of the MONICA app for visitor´s, staff and residents in order to collect their feedback in terms of sound perception.	COP MONICA App (for visitors)	• Smartphones	Neighbours will be informed in dedicated meetings

4.10.2.3 Crowd & Capacity Monitoring

4.10.2.3.1 Purpose and Objectives

During the Fete Des Lumières Event, the city of Lyon receives millions of visitors walking through a part of the city. The crowd is especially dense near the projections which attract a huge amount of people. Every 15, 20 or 30 minutes, the places are filled and the density increases and decreases continuously. When the density is high, (above 5 people per square meter), any incidents can be transformed into an accident spreading among the crowd. The MONICA solutions for crowd and capacity monitoring will help to control the density of the crowd by displaying a heat map and to count people entering the places for each performance through the COP. Due to the fact that events take place at night time, the solutions will be tested with the low light exposure to try to achieve optimal results.

The city of Lyon will implement security cameras for this solution and the WP5 partners will implement algorithms allowing crowd density maps, spectator counting, object/person detection and abnormal event detection. The installation will take place on an emblematic site of the festival of lights (Place des terreaux, Place Saint Jean, Parc de la Tête d'or). The COP will be deployed to the city command post.

For 2018, all attention will be drawn on a single site. For 2019, efforts will be made to deploy the solutions on different sites.

4.10.2.3.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC 3.1** **UC 3.3**	**Monitor direction and magnitude of crowd flow** **Monitor number of people in an area** Crowd density Estimation: displaying in real time a heat map that visualises crowd density. Receive alerts through the COP if the density is above 5 people per square meter Counting in real time the number of people entering the area by the entrance road	COP	• Cameras • Crowd density estimation algorithm • Counting Algorithm Processing unit in the control center	Event organizer Ethic committee
2019	**UC 3.1** **UC 3.3**	**Monitor direction and magnitude of crowd flow** **Monitor number of people in an area** Improvements of the system tested in 2018 Fully working COP Give information to the staff to open the closed road if the density is way too high	COP	• Cameras • Crowd density estimation algorithm • Counting Algorithm • Processing unit in the control center	Event organizer Ethic committee

4.10.2.4 Missing Person

4.10.2.4.1 Purpose and Objectives

Fete des Lumieres has interest on a MONICA solution using the MONICA App for visitors in order to help parents to find missing children as well as to help friends find each other.

It is important to mention that only GPS can be used on a wide area like the festival´s area and the use of Wristbands would not be feasible in such a scenario. Therefore, other MONICA solutions using the App and Smartphones might also be considered for this solution.

4.10.2.4.2 Functionality and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	**UC 4.2** **UC 4.4**	**Child/Friend finder app** A solution to enable parents, children or friends to find each other if separated.	MONICA App (for visitors)	• Smartphones	Public meetings with ACOU and City of Lyon are planned to explain MONICA and communicate with citizens. Security Staff
2019	**UC 4.2** **UC 4.4**			• Smartphones	

4.10.2.5 Locate Staff

4.10.2.5.1 Purpose and Objectives

The objective of Fete des Lumieres in relation to Locate Staff functionalities is to allow the event manager to locate in real time the different members of the staff. That information will be checked in the control room by the COP. It is important to mention that only GPS can be used on a wide area like the festival´s area and the

use of Wristbands would not be feasible in such a scenario. Therefore, other MONICA solutions using the App and Smartphones might also be considered for this solution.

4.10.2.5.2 Functionality and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	UC 5.1	**Locate and monitor and communicate with staff:** The main focus for this pilot is being able to visualize the location and status of different staff members within the COP	COP MONICA App (for staff)	• Smartphone or other dedicated location device (GS)	Security staff Event organizer
2019	UC 5.1				

4.10.2.6 Health and Security Incident

4.10.2.6.1 Purpose and Objectives

The objective of Fete des Lumieres is to detect and report an incident in a timely fashion to avoid any inconvenience on the crowd. IP cameras will be deployed enabling high risk queue identification, fight detection, abnormal event assessment, etc. The incident will be then reported to the event manager through the COP.
In 2018, one site will be the area to test and it is expected that in 2019 more sites will also be included to the demonstration.

4.10.2.6.2 Functionality and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	UC 8.1	**Incident detection through video**	COP	• Cameras • Algorithms • Process unit in the control room	Security Staff Event organizer
	UC 8.2	**Create and forward incident report**	COP MONICA App (for staff)	• Smartphone or other dedicated location device (GS)	
	UC 8.3 UC 5.1	**Locate and communicate with staff**			
2019	UC 8.3 UC 5.1 UC 8.2 UC 8.1	**Same solutions and functionalities as in 2018**			

4.11 Nuits Sonores

4.11.1 Pilot Survey

Nuits Sonores is a paid cultural event taking place in the city of Lyon. It is a festival that dives in the world of design, image, graphic art, food culture, architecture and particularly music. It takes place every year for five days and five nights, from the 24th and the 28th May. Spectators can attend the day events from 3pm to 9pm and the night events from 9pm to 5am. Day and night events take place on different sites.

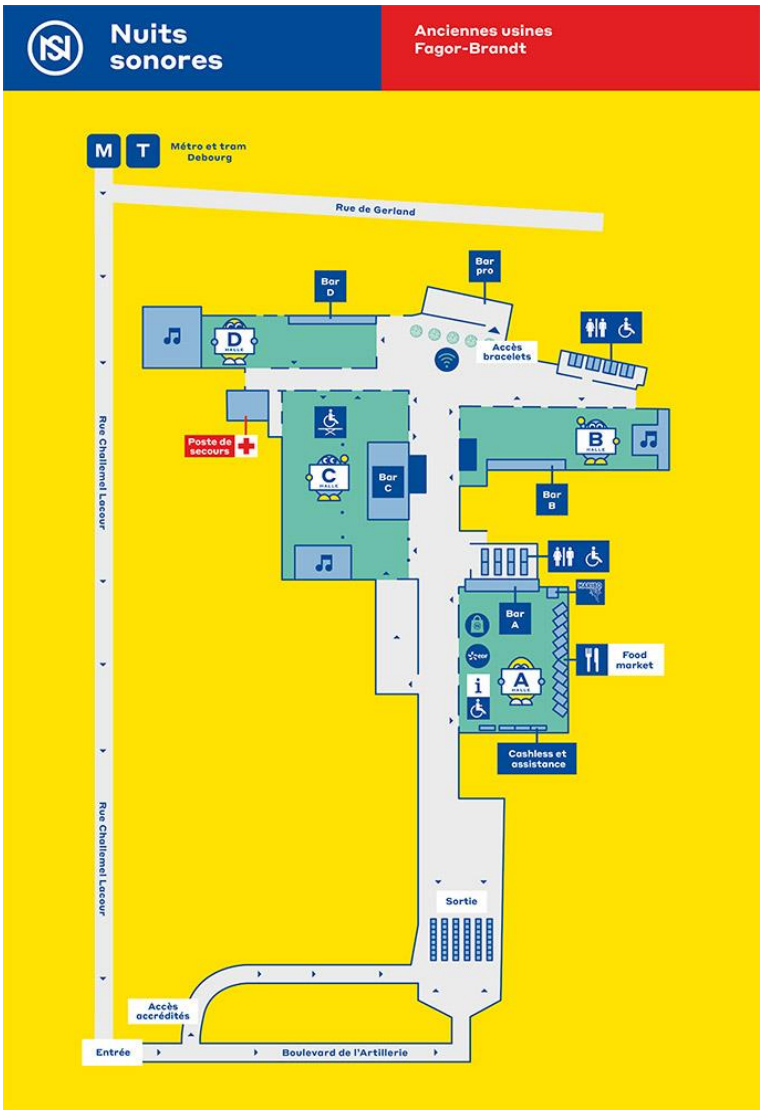


Figure 81. Fagor Brandt's Old Factory (2017th Night Site)-Ground Plan

Figure 82. Fagor Brandt's Old Factory (2017th Night Site)- Pictures with copyright © Brice Robert, Kevin Buy, Gaétan Clément, Marion Bornaz, Anne Simmonot, Laurie Diaz

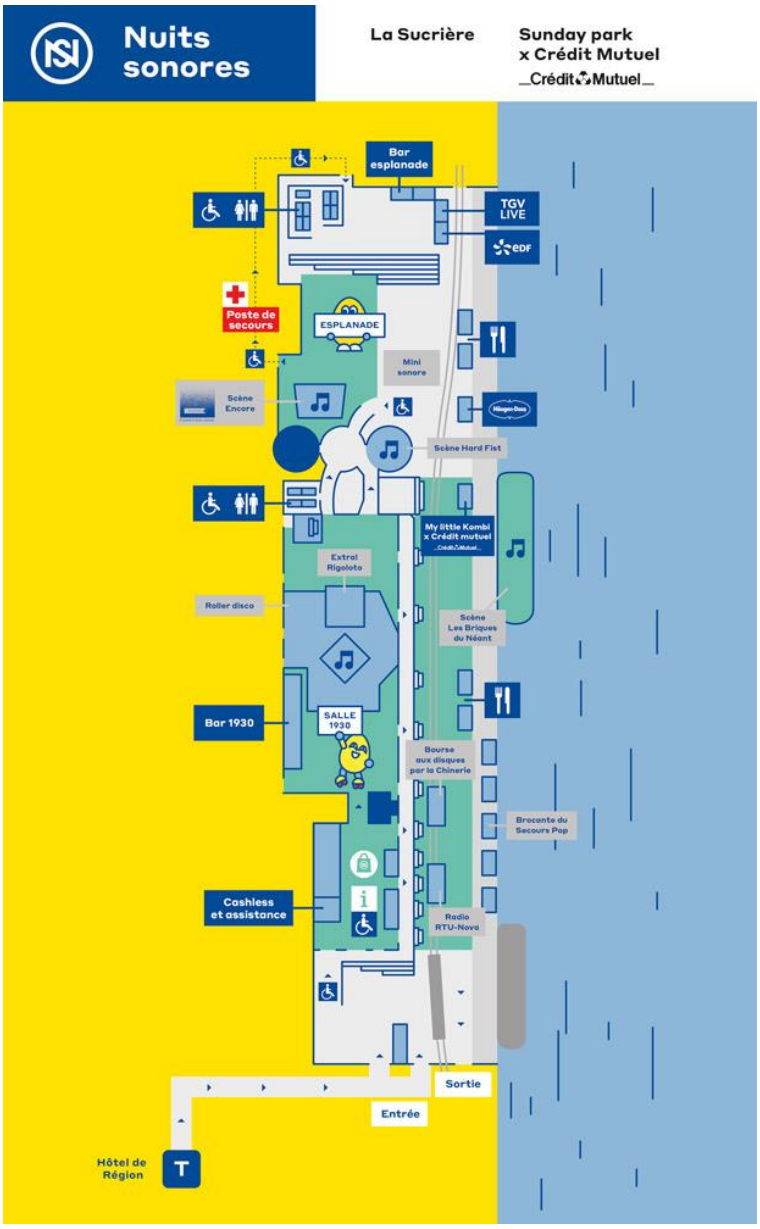


Figure 83. La sucrière (2017th Day Site) -Ground Plan

Figure 84. La sucrière (2017th Day Site) - Pictures with copyright
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4.11.1.1 Location and Surroundings

For each edition, the festival invests emblematic venues in the city of Lyon: museums, cultural sites and industrial wastelands. For its 15th birthday, the festival took place on several sites in parallel. The day events took place in the town centre at events venues (the Subsistances, the Sucrière and the Sucre nightclub). The night events took place in the old Fagor-Brandt factories in Gerland in the 7th district of Lyon.

With respect to MONICA pilot, one relevant venue is the site of Fagor-Brandt old factories. It is located in a mixed urban environment (residential areas, industrial areas, railway). The closest residential facades are within a hundred meters of the festival.

4.11.1.2 Attractions

The main venues of Nuits sonores 2018 are listed below. Some of those venues might change in the next version of the festival:

- **ANCIENNES USINES FAGOR-BRANDT (Main nights)**

  For its 16th edition, Nuits Sonores' principal night-time location will remain unchanged from last year: the Fagor-Brandt. However, the factory will be boasting a redesigned layout and the site will feature three stages in addition to several social areas.

- **LE SUCRE (NS Days and special events)**

  This magnificent rooftop venue, perched above La Sucrière, will play a key role in the NS Days program, hosting one of its stages. At night it will be the setting for special events, particularly those organised in collaboration with the festival's partners.

- **THE LYON AUDITORIUM (special concert)**

  Having become part of Nuits Sonores for the first time in 2017, this year the Lyon Auditorium – one of the city's most iconic venues – will host a special concert by Kamasi Washington.

- **LE TRANSBORDEUR (Sunday Park)**

  A historic partner of Nuits Sonores, Le Transbordeur will host the new-look Sunday Park to inaugurate the 2018 festival.

- **CENTRE NAUTIQUE TONY BERTRAND (special concert)**

  Despite being a significant part of the festival's history, La Piscine du Rhône has not hosted a Nuits Sonores event for over seven years. That will change in 2018, when this mythical site will be the location for a Carte Blanche programme dedicated to the city of Amsterdam.

- **LA SUCRIÈRE (NS Days • Closing day)**

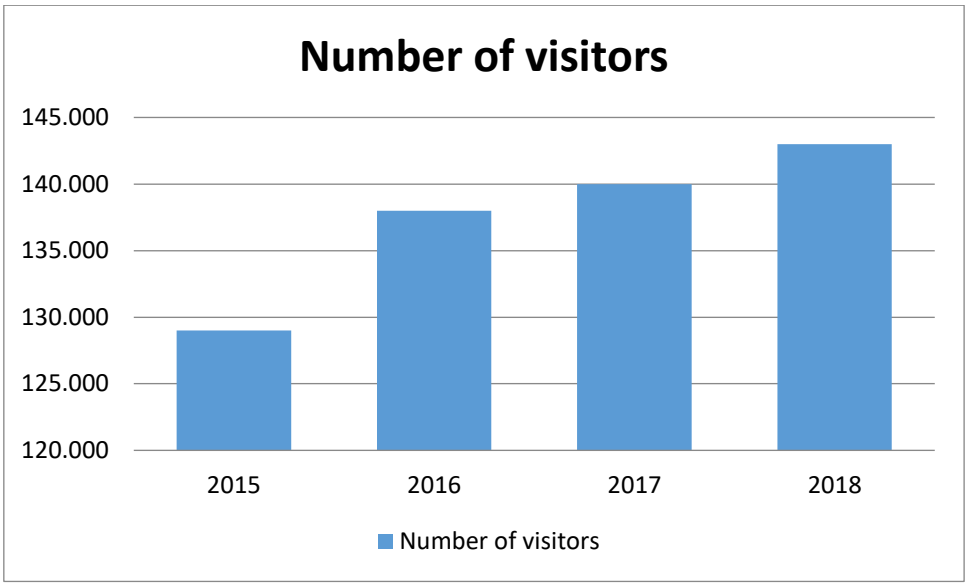
  Back in 2002, Arty Farty was the first organisation to invest in La Sucrière. It has since become one of the strongest symbols of the festival and, thanks to its riverside location, it is the ideal setting for NS Days, the daytime festival.

4.11.1.3 Visitation

During the 6 days of the festival, more than 140,000 spectators were counted on all the festival's free and paying venues in 2017, compared with 138,000 in 2016. Many delegations of professional European and international events were also represented within the framework of the festival.

This estimate takes into account the various ticketing networks, as well as the number of visits made by the various co-producers of the festival. The overall attendance of the festival does not take into account the public gathered in the forum European Lab.

In one night in Fagor-Brandt, the attendance is about **14,000 visitors** at night.



4.11.1.4 Site Plan

The site of Fagor-Brandt factories has three stages. The stages are installed in old industrial warehouses, whose doors remain open (mixed indoors/outdoors configuration).

The site has a size of approximately 70,000 m².

Figure 85. Google Earth View - In Purple the site area

Figure 86. Ground Plan

Four halls are used for that Nuits Sonores' event with three of them dedicated for electronic concerts and one for the restaurant. The alleys are free and allow moving from one building to another. The entrance and the

exit are located at the same side. The Challemel Lacour Street and Artillerie Boulevard allow the spectator pedestrians to commute from the subway to the event site.

4.11.1.5 Current Infrastructure

4.11.1.5.1 Sound

Sound level meters with control panel and limiter are used at each three consoles in Hall B, C and D (at loudspeaker exit). The limiter set to 105 dB(A) can cut the loudspeaker if the music is too loud. The event manager advised sound technicians to go below 101 dB(A). The sound technicians or event managers can decide to lower the volume if needed.

4.11.1.5.2 Security

Security is a top priority. The old factory is set up from A to Z by Arty Farty: phone landline, water, electricity etc. The security visit made by firemen and city expert is mandatory and every difficulty must be cleared.

90% of spectators are coming with public transportation (Tram or Metro). Security people/volunteers are guiding them from the closest station (Debourg) with light sticks.

Several incident scenarios are expected with different reaction time:

- 0 second, handled immediately
- 3 minutes handled after communication with an expert (during the whole festival, at least 2 people of Arty Farty [event manager] are on site and one has at least 10-15 years of experience)
- 15 minutes if there is enough time for an emergency meeting
- Anyone of the organising or security people with enough security clearance is allowed to decide to close/open an access or take the proper action while facing an incident. A lot of security training is done. Security mainly communicates with walkie-talkies and it has always been fine.

The crowd flow at the entrance is regulated with the artist playlist. Main artists are playing late and not at the same time. Fences can be taken off if needed (e.g panic scenario). Concrete barriers are in place.

If an evacuation is needed, lighting arrows indicate closest exits and security staff guide the spectators. Pre-recorded voice messages are played in several languages.

Half of the venue (separated in two by green dotted line) can be shut down by trained technicians. The buzzer is manual and the decision is human. 10-15 years of experience are allowing quick reactions. Gates remain open during the event to prevent panic rush.

To prevent any noise annoyance, Arty Farty works with the city to inform citizen several months before the event. Meetings, mailing, door to door information are done doing the last 2 months. In the end, NS can even pay potentially annoyed citizen a transportation for holidays during the event or nights away from their home. They have a dedicated budget.

To improve easy payment and security, NS is using a cashless system. They plan to extend it with ID documents to avoid any wallets on site and ease spectators experience by prevent pickpocketing.

On site, there are:

- One emergency trained doctor. Red Cross is patrolling the whole area to detect any health incident.
- Two lines for tickets. One is for accredited people and the other one is for general public with bags/coats checks + several fences to avoid crowd rush.
- Firemen ways in (trucks etc.)

4.11.1.5.3 Communication

The neighbourhood is informed several months before the event and meetings are organised with local authorities to inform people and avoid any later issue. Staff is also doing mail and door to door campaign to reach all the local residents. People who might be annoyed (e.g. sleep disturbed by noise) are offered transportation tickets or night in a remote hotel. Half of the planned budget to do this is spent every year.

Local communication in case of emergency is done through pre-recorded messages in several languages. Blinking arrows and security staff can direct people to the nearest exits. The messages and arrows have their own batteries and networks.

4.11.1.6 Stakeholders

Name	Description
Visitor	Any attendant who 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)

4.11.2 Pilot Plan: Selected Solutions and Demonstration

4.11.2.1 Allocated Use Cases

ID	Use Case Group
UCG 2	Sound Monitoring & Control
UCG 4	Missing Person
UCG 5	Locate Staff
UCG 8	Health Incidents

4.11.2.2 Sound Monitoring and Control

4.11.2.2.1 Purpose and Objectives

The objective of the MONICA Solutions for Nuits Sonores is to measure the sound in real time in the audience and neighbourhood area as well as to visualise the measured values in the COP in the control room of the event. The aim is to assure that the event conforms with the regulation. The objective is also to keep neighbours informed on the sound levels and the corresponding limits.
Indicators in dBA and dBC are needed as well as an index which should be easy to understand. A sound heat map should allow to calculate and display the distribution of the low frequencies.

Active solutions are also in the scope of the event manager interests: the Quiet Zones, and the ASFC which would allow to create a quiet zone on a residential area.

The sensors needed are the IoT SLM (Sound Level Meter) from B&K that can be completed by Classic SLM and a weather station.

4.11.2.2.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2018	UC 2.1	**Monitor sound levels** Acoucité will use IoT Sound Level Meters and their own devices and hardware to monitor audience, neighbours and gather data to start building the annoyance index. Gather data for annoyance index and get a reference point to compare 2018 and 2019 measurements	COP	• Sound Level Meters	• Professional sound staff
2019	UC 2.1	**Monitor sound levels** Advanced sound monitoring with more IoT Sound Level Meters: • Sound recordings • Sound pressure level • Spectra • Sound Heat map	COP	• IoT Sound Level Meters • Annoyance Comfort Index • Heat map	• Professional sound staff • Neighbours will be informed in dedicated meetings
	UC 2.2	**ASFC (adaptative sound field controller)** Measure sound inside the event and outside the event. Adapt the sound level if necessary Mitigate annoyance for neighbours and provide medical staff a quiet place to work.	COP	• IoT Sound Level Meters • ASFC Computational Core	• Professional sound staff
	UC 2.2	**Quiet zones**	COP Self-contained solution	• Self-contained solution	• TBD (Staff or visitors)
	UC 2.1	**Inform Visitors / Neighbours/ staff of current sound quality and sound levels**	COP MONICA App (for neighbours)	• Smartphones	• Neighbors from the area

4.11.2.3 Missing Person

4.11.2.3.1 Purpose and Objectives

Nuits Sonores has the objective of providing a solution to enable friends to find each other during the event. A MONICA solution using visitor wristbands and the MONICA App would be of interest for Nuits Sonores.

4.11.2.3.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2019	**UC 4.2** **UC 4.4**	**Children Finder App and Friend Finder App** The pairing of the MONICA app for visitors and the visitor wristband create a solution to enable parents, children or friends to find each other if separated.	MONICA app (for visitors) COP	• Visitor Wristband • Smartphone	Festival Staff Control Room Staff

4.11.2.4 Locate Staff

4.11.2.4.1 Purpose and Objectives

The objective of Nuits Sonores in relation to Locate Staff functionalities is to allow the event manager to locate in real time the different members of the staff (first aid, organization, security). That information will be checked in the control room by the COP.

4.11.2.4.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2019	**UC 5.1**	**Locate and communicate with staff** The control room is able to locate staff members and forward alerts	COP	• Staff wristband or other location devices (GPS)	Festival Staff Control Room Staff

4.11.2.5 Health Incidents

4.11.2.5.1 Purpose and Objectives

The main aim for Nuits Sonores in relation to the solutions for health incidents is to help the first aid staff to locate incidents to react faster. Nuits Sonores would be interested in solutions involving Smart Glasses and staff wristband.

4.11.2.5.2 Functionalities and timeline

Year	UC	Functionality + Concrete action	Application	Required Technologies	Recruitment
2019	**UC 5.1** **UC 8.3**	**Locate and communicate with staff** The control room is able to locate staff members and forward alerts in order to reduce reaction times when a health incident has occurred	COP	• Staff wristband or other location devices (GPS)	Festival Staff Control Room Staff
	UC 8.2 **UC 5.1**	**Create and forward incident report** Allowing to forward incident reports directly to the control room through MONICA applications.	COP MONICA App	• Staff Wristband or other location devices (GPS) • Smart glasses (if available) • Smartphones	Festival Staff Control Room Staff

	UC 8.3	**Access health information** Staff members can access health information if needed	MONICA App (for staff) MONICA App (for visitor)	• Digital ticket • Smart Glasses (if available) • Smartphones	Festival Staff

5 Processes and Tools to manage the MONICA Demonstrations

Coordinating demonstrations at six different pilots and 11 events, which partly run in parallel is a complex task. To address this complexity, the MONICA project has appointed a Pilot Coordinator to manage the overall demonstration activities. Furthermore, for each pilot a management team has been defined, with the aim to cover all relevant perspectives on the planned demonstrations. This team comprises a representative of each of the following areas of expertise:

1. Pilot: One person representing the pilot itself
2. Technical: One person representing the technical side of the project
3. WP2: One person representing the use-cases and requirements perspective
4. WP8: One person for coordinating the pilot demonstration tasks

To support the complex organisation of such large-scale pilot project, a toolchain has been set up. These tools account for the iterative and dynamic nature of the project as compared to a rather static deliverable.

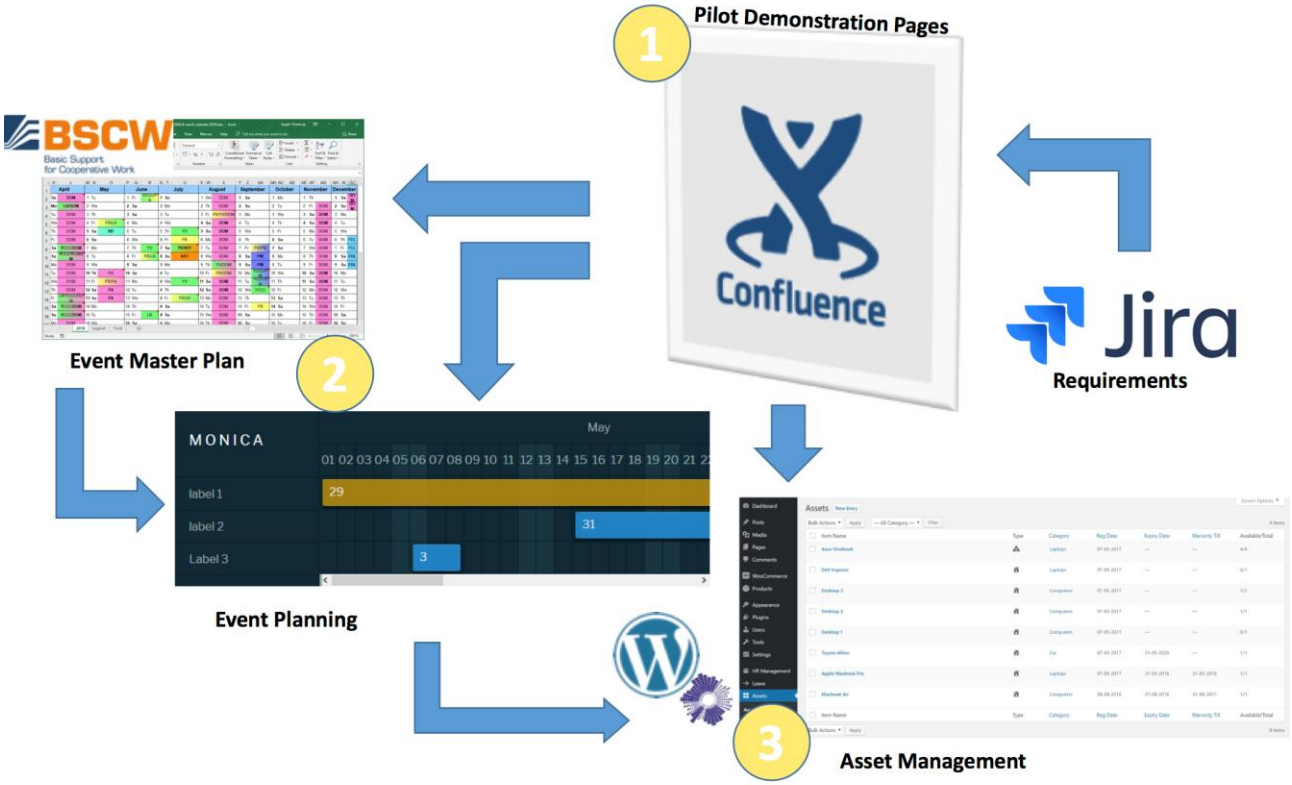


Figure 87 - MONICA Pilot Planning Toolchain

Figure 88 shows the pilot planning toolchain consisting of the following tools:

1. Pilot Demonstration Pages (confluence) are the main knowledge and planning repository, describing:
    - MONICA technical solutions and available hardware (supported by requirements managed in Jira)
    - Planning of each pilot's demonstrations per year including:
        i. Selected use cases
        ii. Concrete realization of solutions for the specific event
        iii. Shipment of technologies

iv. Plans for the actual deployment of technologies on site with local companies
v. Planning of partner's presence, required for operating the MONICA tests, etc.
vi. Recruitment of test users
vii. A lot of day-to-day organization such as conferences with involved partners and information exchange

2. Pilot Event Master Plan and Event Planning Tool providing an overview of all events and the dates of the planned demonstrations. Since some events run over a longer period it is important to define the dates at which the actual MONICA demonstrations will take place.
3. Asset Management Tool providing the list of available hardware assets to be used in the demonstrations. This includes both, assets provided by technology partners, as well as assets bought by the pilots. This tool helps to keep track of the available technologies and organize their usage at the different events.

6 Conclusion

This deliverable documents the pilot surveys and current status of pilot plans for each one of the MONICA events. It has the intention of providing material that can guide the demonstrations and deployments by presenting a collection of insights which technical partners as well as pilot representatives can use when further defining the specific MONICA demonstrations per event under the guidance of WP8.

It is important to mention that while creating this report, it has been proved that constant communication between pilot representatives and technical partners is crucial to identify new opportunities and build up the planed demonstrations. It is expected that this exchange of insights between different stakeholders will continue during the planning and deployment. In this sense, the content collected in this deliverable should be understood as information that presents the current status of the pilot plans. It might be the case that as the project evolves, changes might occur as new opportunities or limitations are identified.

The planning and coordination of the demonstration is ongoing work, which will be surely enriched by lessons learned after the first demonstrations taking place in 2018 across all different events.

7 List of Figures