Management Of Networked IoT Wearables – Very Large Scale Demonstration of Cultural Societal Applications
(Grant Agreement No 732350)

D9.1 Impact Assessment and Validation Framework

Date: 2017-09-30

Version 1.0

Published by the MONICA Consortium

Dissemination Level: Public

Co-funded by the European Union's Horizon 2020 Framework Programme for Research and Innovation under Grant Agreement No 732350

Document control page

Document file: D9.1 Impact Assessment and Validation Framework_v1.0.docx
Document version: 1.0
Document owner: LBU

Work package: WP9 – Pilot Impact Assessment and Replication
Task: T9.1 – Impact Assessment
Deliverable type: R

Document status: ☒ Approved by the document owner for internal review
☒ Approved for submission to the EC

Document history:

Version	Author(s)	Date	Summary of changes made
0.1	Rasha Ibrahim, Dorothy Monekosso (LBU)	2017-07-27	Initial Framework outline
0.2	Rasha Ibrahim, Dorothy Monekosso (LBU)	2017-08-24	Initial doc version: ToC, Methodology
0.3	Rasha Ibrahim, Dorothy Monekosso (LBU)	2017-09-20	Full version for internal review
1.0	Rasha Ibrahim, Dorothy Monekosso (LBU)	2017-09-29	Final version submitted to the European Commission

Internal review history:

Reviewed by	Date	Summary of comments
Marco Jahn (FIT)	2017-09-25	Approved with minor comments
Antonella Frisiello (ISMB)	2017-09-25	Approved with minor comments.

Legal Notice

The information in this document is subject to change without notice.

The Members of the MONICA Consortium make no warranty of any kind with regard to this document, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose. The Members of the MONICA Consortium shall not be held liable for errors contained herein or direct, indirect, special, incidental or consequential damages in connection with the furnishing, performance, or use of this material.

Possible inaccuracies of information are under the responsibility of the project. This report reflects solely the views of its authors. The European Commission is not liable for any use that may be made of the information contained therein.

Index:

Index of Tables

1 Executive Summary

Achieving impact is a central objective of MONICA Project. With an estimated figure of 100,000+ individuals to be using MONICA innovations, it is expected that MONICA will have a great impact on citizens, the event industries, IoT business partners and public services. We regard impact as an observable and measurable change on individuals, communities and industries from social, economic, technological, and environmental perspectives.

This report aims to establish a basis against which MONICA impact and future progress could be evaluated, measured, and valued. To help achieve that, this report produces a framework for assessing different types of impact of the project in a clear, rigorous and accessible manner to all stakeholders.

The objectives of Impact Assessment in the context of the MONICA project involve providing a framework for the impact assessment, validation and replication process, developing assessment tools to measure Key Performance Indicators (KPIs) and supporting qualitative evidence, supporting the work of all the stakeholders to undertake impact assessment activities, and participating in joint activities organised by the European Commission in policy groups and with other EU funded projects relevant to the MONICA Project.

Within this task the development and use of MONICA Impact Assessment and Validation Framework are demonstrated in this report. Grounded in international best practices, the document presents MONICA Impact Assessment and Validation Framework illustrated with indicators of impact evidence. It considers the drivers for measuring impact in an iterative process that ensures continuous improvement. The report provides an insight into the underpinning theory and methodology for practical application of the Framework. It also explores how identifying outcomes can contribute to our understanding of MONICA pathways to impact, as well as helping in gathering impact evidence.

The first dimension of the framework is concerned with planning for the impact: how to plan for impact and what are MONICA's pathways to impact? The dimension sheds light on the importance of assessing the relevance and the context of the expected outcomes as well as demonstrating the expected pathways to impact. The second dimension focusses on understanding the base-line environment represented in the project stakeholders and the base-line data. The following dimension tackles aspects of data collection, and data validation. The final dimension covers Implementation: how can we make impact assessment feasible? This involves the implementation process including time requirements as well as presentation and reporting of the results: how can we present this more simply and effectively.

The effectiveness of MONICA Impact Assessment and Validation Framework depends on our continuous dialogue with our partners and stakeholders about what difference they want to see, which measures work best, and learning from our findings on the impact in an iterative process in partnership.

The methodology reported showed that our impact assessment approach is replicable. It allows other projects to plan, implement and evaluate their own framework for impact assessment and validation.

2 Introduction

The aim of the Impact Assessment and Validation process in MONICA is to:

- Establish validation methods to assess the impact of the MONICA IoT Programme against Key Performance Indicators (KPIs) across and within the pilot sites.
- Undertake an assessment of the methods used in order to obtain qualitative and quantitative results, including lessons learned, that support replication and can be used in the communication and dissemination process.
- Analyse sufficient numbers of relevant data (before, during and after each pilot event), guided by stakeholders, to be able to undertake a formal assessment of the social, cultural and economic impact on the European work area and promote best practice.
- Demonstrate the generic applicability and interoperability of experimental testbeds and open platforms in validation of the Internet of Things technologies including identification of missing standards and pre-normative activities.
- Further the development and validation of new markets and business models aimed at involving all actors in the innovation value chain.
- Assess the impact of the MONICA IoT project on Europe's Cultural and Creative Industries.

In addition, the individual specifications of the MONICA pilots will be extracted to form comprehensive use cases and concrete business cases as defined by demand-side stakeholders and diverse end users. This methodology allows for diverse stakeholder input to be captured in the analysis of the use cases, the business ecosystem, value chain interactions and general societal, economic and environmental areas.

Active involvement of all stakeholders in the validation and impact assessment process is needed in order to establish the best possible foundation for creating the maximum impact and replication potential from the pilot demonstrations. Demand-side representatives are drawn from the fields of concert organisers, artistic performers, spectators, public authorities, citizens, civic engagement groups, and other relevant groups found inside and outside this consortium.

The demonstration pilot sites will be based in a mix of commercially available components and solutions, using open architectures and design approaches, from a portfolio of technologies and tools developed and demonstrated in reduced and controlled environments (e.g. in EU projects and fora). Pilot work plans will include feedback mechanisms to allow adaptation and optimisation of the technological and business approach for particular user cases as an ongoing feature of the process.

2.1 Purpose, context and scope of this deliverable

The purpose of this document is to establish and agree upon an Impact Assessment and Validation Framework with which to conduct the impact assessment and validation process within MONICA. Aiming to coordinate activities taking place at project, partner and community level.

The specific goals include:

• Provide a framework for the impact assessment, validation and replication process.

• Develop tools to use in this process, focusing on measurable goals in the form of Key Performance Indicators (KPIs) plus a range of supporting qualitative evidence.

• Define, agree and complete a series of impacts assessments and validation measures.

• Support the work of all the stakeholders to undertake impact assessment and validation activities to include planning, undertaking, gathering, analysing and reporting results to a broad range of actors, stakeholders and audiences.

• Participate in joint activities organised by the European Commission in policy groups and with other EU funded projects relevant to the MONICA Projects.

This deliverable is part of the Work Package 9 as defined in Task 9.1: and is related to task T12.2 Dissemination Coordination.

This document outlines the methodological framework within which this impact assessment and validation framework is embedded. The process is planned at a project level, indicating the roles and responsibilities of

partners in the process. This document will be revised as part of a continuous review process updating and informing actions taken throughout the project. Any changes will be reported to the Consortium on a regular basis and further permission sought should this becomes necessary.

2.2 Structure and Content of this Deliverable

Firstly, the rationale supporting the proposed framework is discussed demonstrating and locating this within an evaluation process in co-partnership and co-creation with diverse stakeholders. The dimensions of the framework and the methodology used in structuring it is discussed in Section 3. Each Sub-Section discusses a specific dimension of the framework. This starts with planning for the impact, and expected outcomes of the project in Sub-Section 3.2. This is followed by a discussion of our approach to understand the baseline environment and our process for data collection in Sub-Section 3.3. The validation process of the collected data is discussed in Sub-Section 3.4 followed by a summary of the associated KPI's in Sub-Section 3.5. The implementation and continuous refinement of the framework are discussed in Sub-Section 3.6 covering practical guidance on how to implement the framework, time requirements for assessing the impact, and proposed documentation templates and forms. Section 4 describes the efforts exerted to ensure the validation of the framework, and Section 5 draws attention to possible threats the impact assessment process may face. Tentative conclusions are drawn in Section 6.

2.3 Project vision and goals

The MONICA Project is a very large scale demonstration of multiple existing and new Internet of Things (IoT) technologies for Smarter Living deployed in 6 cities across Europe. MONICA is a large scale IoT ecosystem using innovative wearable and portable IoT sensors and actuators with closed-loop back-end services integrated into an interoperable, cloud-based platform capable of offering a multitude of simultaneous, targeted applications.
This ecosystem will be demonstrated in large scale city events but has general applicability when dynamically deploying Smart City applications in fixed locations such as airports, traffic arterials, and construction sites. In addition, within MONICA there is the potential for standardisation and innovation in all areas and stages of the project through open sharing, co-creation and an inclusive approach.

2.4 MONICA Project Objectives

As a large-scale pilot in the Horizon 2020 programme on the Internet of Things (IoT), the MONICA Project plays a central part in the ambition to foster the European take-up of IoT and enable open IoT ecosystems as part of digitising Europe, with the aim of encouraging public authorities, companies and researchers to make the most of new technologies. The challenge being to take-up the IoT on a grand scale. The vision of MONICA is to develop best practice in large-scale IoT deployment by demonstrating how European cities can implement multiple, existing and new IoT technologies for smarter living, focusing on security and acoustics applications during large scale cultural events. Innovative solutions include the establishment of sound zones at outdoor concerts for noise mitigation as well as security measures to improve crowd information and management in times of crisis or emergency.
The eleven pilots in the six cities Copenhagen, Bonn, Hamburg, Leeds, Lyon and Torino, will involve 100,000+ end users demonstrating that it is possible to implement an IoT ecosystem on a massive scale that is capable of handling a multitude of devices, sensors, networks and heterogeneous data integrated into an interoperable cloud-based platform, capable of offering multiple applications. With at least 10,000 simultaneous end-users, it is one of the largest IoT platform demonstrations that has ever taken place. In addition, to support wider uptake, MONICA will offer several business models showing the potential of IoT platforms and tools that are available for new market openings and as promotion packages for innovators and entrepreneurs as a development toolbox with enablers for integrating these with other Smart City platforms.
An additional challenge involved in enabling open IoT systems, is that they must be based on open technologies and architectures that can be used across multiple cases, to enable interoperability. This task involves identifying technology developed and used during pilot events that can contribute to existing standardisation.
Other anticipated challenges involve end user acceptance of IoT solutions and issues connected with safeguarding trust, privacy and data security, in line with reported end user requirements in this regard. All pilots aim to actively involve end-users in finding solutions to the challenges identified above. More than 10,000 people will be engaged in the evaluation and innovation process drawn from all key stakeholder groups. Neighbours affected by the events will be supported to create solutions to conflict created during cultural events

from noise disturbance. To safeguard trust, the MONICA IoT platform is being developed using Privacy by Design to ensure full data protection validated by local authorities and organisers.
One of the final goals in MONICA is to exploit the projects results through developing individual partner exploitation and sustainability plans. The project outcomes bridge the vision and domain challenges ensuring the project is goal oriented. Research and development aims to support project partners to achieve the following 14 objectives mapped onto corresponding Work Packages (WP) including:

2.4.1 Objectives for the demonstration of IoT Technologies

O1. Demonstrating an IoT platform on massive scale operating conditions handling 10,000 simultaneous real end-users with wearable, portable sensors using existing and emerging technologies (TRL 5-6) based upon open standards and architectures.
O2. Designing, developing and deploying a platform capable of integrating large amounts of heterogeneous, interoperable IoT enabled sensors with different data capabilities (video, audio and other data types), resource constraints (wearables, Smartphones and Smartwatches), bandwidth (UWB and M2M), costs and deployment (wearable, mobile, fixed, and airborne) in addition to actuators (lights, LED, cameras, alarms, drones, and loudspeakers).
O3. Demonstrating end-to-end, closed loop solutions covering everything from devices and middleware with semantic annotations through a multitude of wireless communication channels to cloud based applications and back to actuation networks. Humans-in-the-Loop is demonstrated through integrating Situational Awareness and Decision Support tools for organisers, security staff and sound engineering situation rooms.
O4. Deploying large numbers of cost-efficient wearable devices (TRL9) with sensing, actuating, localisation, and communication capabilities supporting several MONICA applications. The wearable devices can be deployed as actuators (LEDs) through automated closed-loop solutions and can be integrated with more powerful Smartphones and/or Smartwatch apps.
O5. Demonstrating seamless integration with other Smart City platforms through the MONICA enabling toolbox based on Open Architecture while compiling a toolbox of development processes and technology enablers for entrepreneurs and developers in order for them to rapidly develop new IoT applications.
O6. Develop and deploy a generic Data Security, Privacy and Trust Framework that ensures full data protection and privacy and allows role-based control measures to enforce information exchange only among authenticated and authorised entities.

2.4.2 Objectives addressing the real needs of users

O7. Developing, deploying and demonstrating two IoT ecosystems (security and sound/noise) that comprehensively address real end user challenges in the context of large culturally diverse events in inner cities helping to promote and preserve important elements of European culture.
O8. Demonstrating the platform under full operating conditions in pilot events. Each will select from the portfolio of MONICA applications needed to solve their contextualised problems in relation to the organisation of diverse large scale public events.
O9. Creating a Collaborative Awareness Platform for citizens who live in the event neighbourhoods, to engage in monitoring noise levels. This will also heighten performance for crowds and stimulate co-creation of solutions to the dualistic problem of attractiveness (from a city point of view) and nuisance (from a neighbours point of view).

2.4.3 Objectives for the validation of user acceptability

O10. Obtaining user acceptance through demonstrating and validating data security and privacy impacting on various security schemes dedicated to a range of services including: the police; security; public authorities; businesses of organisers and performers; and federated trust schemes for end-users (citizens and organisers).
O11. Involving 10% of the expected 100,000+ users in validation and evaluation activities over the course of the project using a mixed methodology with both quantitative and qualitative data gathering, for validation and impact evaluation purposes.

2.4.4 Objectives for the validation of social and economic impacts

O12. Creating an Open Data repository that allows cities to share the data from IoT sensor networks and wearables (privacy and security concerns permitting) with citizens and civic groups.
O13. Developing sustainable business models and cases based on value creation that will guarantee the sustainability of the solution beyond the project including performing a supporting market analysis.

O14. Promoting entrepreneurship and innovation through open calls for new, supporting applications for the MONICA IoT platform through an established incubator centre using the MONICA toolbox of open technology enablers and a comprehensive MONICA innovation services pack.

3 Methodology

This section discusses the methodology used in structuring the Assessment Framework, the evidence needed to fulfil the assessment, and the methodologies used to gather this evidence.

3.1 Impact Assessment and Validation Framework Structure

The proposed Impact Assessment and Validation Framework (IAVF) is informed by our theory of change explained below.

Our theory of change is essentially a comprehensive description and illustration of how and why the desired change is expected to happen in a particular context. Our theory of change is focussed on mapping the causal linkages between what MONICA Project does (its activities and interventions) and how these lead to desired goals being achieved.

Accordingly, our framework is composed of five stages:

Stage 1 **Planning for Impact:** involves the identification of the expected impacts, through consultation with key stakeholders in each of the pilot sites and the development of Key Performance Indicators (KPIs)

Stage 2 **Understanding Baseline Environment:** involves conducting "backwards mapping" to identify the preconditions necessary to achieve these impacts. This is done via a richer more complex understanding of how these impacts may occur through a broad range of quantitative and qualitative data gathered from individual end users, citizens and stakeholders using surveys, focus groups, apps and information gathered via technological processes.

Stage 3 **Baseline Data Validation:** involves a validation process and a thorough analysis of the different collected data with key stakeholders reviewing and assessing the usefulness and relevance of the preconditions that were monitored when the Pilots have been undertaken.

Stage 4 **MONICA Impact Indicators Development:** involves the development of an outline of indicators that will be used to assess the performance of MONICA interventions.

Stage 5 **Implementation & Refinement:** involves the refinement of the suggested Impact Assessment Framework through an iterative process of data collection and validation through the lens of social, economic, technological and environmental factors.

Below, we explain how this proposed framework integrates with our mission of impact assessment by going through each of the proposed stages.

3.2 Stage 1: Planning for Impact

Achieving impact is a fundamental objective of MONICA Project. With demonstrations involving massive number of end users (100,000+), it is expected that MONICA will have a high impact on citizens, the event industries, IoT business partners and public services. Our primary innovation themes encompass creativity, culture, and technologies for the future. These provide the foundation by which MONICA delivers benefit to the society.

Ensuring that the project makes a difference means an emphasis on demonstrable contribution to society and economy and a tangible improvement to quality of life, beyond academia. This is achieved via innovation and collaboration. Ensuring that MONICA achieves impact means working with those in a position to provide guidance and use the project innovations to change practice. Accordingly, the project should show evidence that it took steps in all areas to build mutually beneficial and enduring partnerships which achieve positive outcomes.

The Impact Assessment Framework ensures that MONICA Impact is assessed via the following criteria:

a) **Nature of the impact**

The nature of the expected impact is defined by the influence, effect, demonstrable contribution, change, or benefit resulted from the innovation. This covers MONICA's effect on an individual (such as pilots staff), a community (such as the cultural industry), and the creation of new products (represented in the technological innovations proposed by MONICA).

b) Relevance of impact

The context within which impact takes place must be relevant to each pilot requirements in terms of providing tangible contributions to solving the stakeholders' problems. To proof evidence of relevance of impact, MONICA should demonstrate:

- Developing and deploying IoT ecosystems that comprehensively address real end users' challenges in the context of large culturally diverse events helping to promote and preserve important elements of European culture via addressing security, noise, health and crowd management issues. Examples include providing technical solutions addressing the dualistic problem of attractiveness (from a city point of view) and nuisance (from events' neighbours' point of view) via collaboration and engagement with citizens who live in the events neighbourhood as well as city authorities and events' organisers. Scenarios and use cases for users' requirements are available in D2.1
- Tailored operating platforms that adapt to the different conditions of each pilot site in the cities covered by the project. The pilots should be able to select from the portfolio of MONICA applications needed to solve their contextualised problems in relation to the organisation of diverse large scale public events.

c) Pathways to impact

The Impact Assessment Framework ensures a breadth of impact is achieved. The context within which impact takes place must be broader beyond academia in the realms of the society, economy, public services, and quality of life. Below, we discuss different aspects of impact MONICA aims to achieve.

(i) **Cultural impact**

Our project contributes to the performance, interpretation, and enjoyment of cultural activities, bringing new experience of current and future events. With our partners in cultural institutions across the pilot sites, we aim to make a change and inspire the broader creative economy.

(ii) **Social impact**

MONICA addresses significant challenges including issues of limited resources that can contribute in improving quality of life. Our technology allows cities to share data of IoT sensor networks and wearables with citizens and civic groups. Through our technological innovations, MONICA aims to contribute to actions for positive social interactions, such as enhancing sound experience, controlling noise, managing security when dealing with large crowds, and engaging citizens to participate in smart cities platforms. To provide proof of societal impact, MONICA needs to provide evidence of impacts where the beneficiaries are the wider public or a particular public audience.

(iii) **Economic Impact**

MONICA seeks to have a positive impact on the economy through the development of new technologies that improve efficiency and provide solutions to the challenges faced by both public and private sectors. IoT innovations employed help to streamline business processes and improve efficiency. To provide evidence of economic impact, MONICA needs to demonstrate impacts where the beneficiaries include businesses or organisations, which undertake activities that may create wealth, and that MONICA technology has created new ways for businesses to serve their customers

(iv) **Regional Impact**

MONICA is proud to be an international project that is deeply embedded in six European cities (Copenhagen, Bonn, Hamburg, Leeds, Lyon, and Torino) that are hubs for major cultural events involving 100,000+ end users. To cater for the needs of this wide range of cultural events, MONICA offers several business models based on certain packages for innovators and entrepreneurs to serve as a development toolbox to support the integration of Smart City platforms.

To best achieve that, MONICA partners with several bodies across the six cities to grow the economy of our region and enrich the life of our community by taking all opportunities to invite its involvement and participation.

3.3 Stage 2: Understanding Base-line Environment

Understanding the environment where MONICA technology will operate is an integral part of the Assessment Framework. Understanding the baseline environment should include the followings:

a) Considering what is currently in place

b) Understanding the needs of stakeholders and drivers for change

c) Understanding the external factors that may influence the realisation of the expected outcomes and related impact.

In this section both the stakeholders and base-line data are explained.

3.3.1 Understanding Stakeholders

Stakeholders are those who can positively or negatively affect the output of the project. It was very important for MONICA Project to identify and engage with the key stakeholders at the very early stages of the project. This includes: who are the key stakeholders? What are their needs? Why should they support the change? What are their current attitudes and behaviours?

Assuring the inclusion of elements that build either relationships with or understanding of stakeholders is very essential to MONICA impact activities. Table 1 below outlines the key stakeholders of MONICA Project.

Table 1: MONCIA Stakeholders

The Cities	The Citizens	Technology Providers	Research and Innovation	Regulators	Internal Audiences
Event and festival organisers	Citizens and neighbours to events	IoT Smart City integrators	ICT and IoT research communities	Local and National politicians	MONICA Partners
		IoT platform companies		organisations	
The cultural and creative industry	Civic communities	Telecommunication companies	Support actions	Noise regulation communities	Advisory and ethical boards
The tourism industry	Entrepreneurs, innovators, developers	Security service providers	IoT large scale pilots	EU regulators	EC Project officer
Various communities of EU cities	General public	Acoustic industry	AIOTI - The European Alliance of IoT Innovation	Data protection experts	Partner internal organisation
Press		Standardisation bodies	IoT EPI, IoT Open platforms, Art community		

3.3.2 Understanding Base-line Data

Baseline data are these data that are collected to help improve our understanding of the current conditions of the area investigated, as well as how the project needs to be implemented. The effect of baseline data considerations can focus minds to appreciate and measure the impact. Whenever and wherever possible, efforts should be made to attain and collect baseline data.

a) Characteristics of Baseline Data

In attempting to understand the impact of MONICA, baseline data are essential to our understanding. The process of collecting data needs to be valued and appreciated, as data and information are of little value if it is not of specific use to their stakeholders.

Baseline data should be meaningful and focused on answering the project main requirements. Thus, the starting point for assessing the project impact is 'good enquiry questions'. Good inquiry questions should tell us what was our starting point, how far we progressed, which direction to be taken, and where do we want to be, and how will we know when we get there. The questions used in MONICA were selected to elicit answers that are of value to all those involved in the project (See Appendix B).

b) Base-line Data Collection

i) Participants' Selection and Recruitment

The sampling technique used in recruiting the participants is 'Cluster Sampling'. In this technique, participants are selected in groups, and a sample of participants is randomly selected from each cluster. In MONICA, we have several clusters per pilot which include:

- Event Managers and Production Staff
- Event Stewards and Security Staff
- Event Other Staff (Police, Medical, etc.)
- Community
- Neighbourhood and Residents
- Event Customers and Visitors

ii) Data Collection Methodology

Mainly there are two approaches to collecting data. The first is quantitative in nature, mainly numeric. The second is qualitative, which helps us answer the 'why' question by providing more depth in understanding an issue. Below we provide examples of both techniques.

Qualitative Techniques:

a) Interviews: Interviews are mainly conducted on one to one basis. They can be structured, or semi-structured. They need to be well managed and the interviewees need to be kept on topic, yet allowing them to provide reach data. It is advisable that interviews be reviewed and recapped periodically to check understanding. Also leading questions should be avoided.
b) Focus groups: This technique brings together a group of people. Good facilitation is needed that allows for managing dominant speakers to provide platform for everyone to provide their input.
c) Observation: In this technique, a set of events are observed without any involvement.

Quantitative Techniques:

a) Surveys: These are mostly used for mass data collection. Usually, they need significant effort to achieve good and representative response rates. Particular care needs to be given to the design of the questions.
b) Indicators: This technique depends on selecting and monitoring a set of figures as indicators of impact. This type of data can be misleading if represented without a narrative.

Examples of various formats to be used to increase response rate and to capture a wide population include:

- Online feedback – via social-media e.g. Facebook and others, Google Analytics,
- Online questionnaires – via survey monkey, Google forms, etc.
- Mobile device apps e.g. for Android
- Instant feedback via wearable (wristband)

Table 2 below describes the data collection methods followed over the different pilots.

Table 2: Pilots Data Collection Methods

Pilot events	Event managers & production	Event stewards & security	Other stakeholders (police & medical)	Other stakeholders (City, commune)	Other stakeholders (residents)	Customers: customers & visitors
1 Copenhagen (DK)- Friday Rock	Interviews	Focus groups	Pilot[1]	Pilot[1]	Pilot[1]	Surveys: door & online
2 Torino (IT) - KappaFutur festival	Interviews	Focus groups	Secondary Issue[2]	Secondary Issue[2]	Secondary Issue[2]	Pilot[1]
- Movida	Interviews	Secondary Issue[2]	Pilot*	Pilot[1]	Door Surveys	N/A
3 Hamburg (DE) - Hamburger DOM	Interviews	Focus groups	Pilot[1]	Pilot[1]	Pilot[1]	Surveys
- Port anniversary	Interviews	Focus groups	N/A	Pilot[1]	Pilot[1]	Surveys
4 Lyon (FR) - Nuit sonore	Interviews	interviews	Pilot[1]	-Extensive Community Program	Surveys: door & online	Surveys
- Fête des Lumières	Interviews	interviews	Pilot[1]	Surveys: door & online	Secondary Issue[2]	Surveys
5 Bonn (DE) - Pützchens Markt	Interviews & Focus groups	Interviews & Focus groups	Interviews & Focus groups	Interviews & Focus groups	Secondary Issue[2]	Pilot[1]
- Rhein in Flamen	Interviews & Focus groups	Interviews	Interviews & Focus groups	Interviews & Focus groups	Secondary Issue[2]	Pilot[1]
6 Leeds (UK) - Cricket matches	Interviews	interviews	Secondary Issue[2]	interviews	Secondary Issue[2]	Surveys: online
- Rugby matches	Interviews	interviews	Secondary Issue[2]	Secondary Issue[2]	Secondary Issue[2f]	Surveys online

c) Base-Line Data Handling data

All data are collected and archived in ways that make it easy to revisit. The repository used for data storage is the Basic Support for Cooperation Work (BSCW) document management system. Restricted access is given to the workspace. Information about security regulations and data protection procedures are available in WP10.1 deliverable.

3.4 Stage 3: Data Validation

This stage covers the process of validating the data collected via the pilots. This is a very important step to ensure the relevance and usefulness of the baseline data. The validation process is performed through triangulation. Triangulation of data is essential to improve the validity and reliability (quantitative data) and the rigour (qualitative data) of findings. The Impact Assessment and Validation Framework utilises methodological triangulation through the adoption of a mixed methodology drawing on indicators that involve both quantitative and qualitative data. Triangulation is assured through the active participation and inclusion of key stakeholders in the process via workshops managed by WP9.The inclusion of multiple data sets in the framework data gathering process also allows for triangulation of the data sources. Interpretation of the findings through the professional lenses used by all of the disciplines involved in the project will assure triangulation of interpretation and analysis. This supports the findings being validated through a range of methods including: case studies, quantitative data analysis (statistical regression) and qualitative data analysis (thematic analyses).

[1] Pilots are collecting this information either via interviews, focus groups or certain apps
[2] Secondary issues are those regarded as long term objectives

3.4.1 Establishing Common Data Interpretation

This step is mainly concerned with assuring that the datasets collected from different pilot sites are similar or identical in regards to the technical language used to map pilots' requirements, which is available in deliverable D2.1. This is very important to ensure evidence standards. Standardisation is performed via a mapping process of data structures and format available from different platforms. This includes mapping pilots' requirements into standard set of terminologies. This will form the baseline data used by all work packages.

3.4.2 Outcomes Classification

This step is concerned with getting a confirmation from the pilots on the new terminologies and classifying the expected outcomes into:

a. Primary Outcomes
b. Secondary Outcomes

A primary outcome is defined as an outcome that is likely to be achieved for the pilot. A secondary outcome is that which might be achieved but to a lesser extent than a primary outcome. The form is presented in Table 3 below.

Table 3: Primary and secondary Outcomes

Domain A: Staff Related Goals	P	S
1. Communication		
2. Incident/ Fight detection		
3. Portability of devices		
4.		
5.		
Domain B: Audience Related Goals		
1. Crowd Movement flows/ issues in Entrance and Exit		
2. Safety		
3.		
4.		
Domain C: Neighbour Related Goals		
1. Traffic issues		
2. Sound/Noise		
3. Safety		

3.5 Stage 4: MONICA Impact Indicators Development

This section discusses the development of the project impact indicators. Impact indicators are the specific, observable and measurable change that represents the achievement of an impact. Indicators need to demonstrably show progress towards the project objectives. They need to assess, communicate, and lead the change. Effective indicators must be measurable.

MONICA Indicators are either numeric indicators or qualitative ones that would define success. The development of MONICA indicators was informed by:

- Scenarios (stories) developed of Pilot case studies in consultation with stakeholders.

- Scenarios and use cases defined in WP2 from which requirements are drawn and subsequently impact indicators selected.
- A series of validation meetings taking place in the period (17 June 2017 until 14 July 2017) to capture information about current processes and procedures and to verify initial performance indicators.
    - The main goal of these meetings is to a) verify pilot agrees with suggested indicators, b) confirm what information has already been made available to MONICA, c) identify events WP9 team can observe and to d) give pilot the opportunity to suggest / participate in any further data collection.
- A combination of interviews, focus groups, and observations.
- The formation of an outline of indicators which then are collated and evaluated at a local level within each pilot. The full set of indicators are listed in the Appendices (Section 7). These are summarised in Table 4 below.

Table 4: Key Performance Indicators (KPIs)

Pathways to Impact	*Impact Indicators*
Socio-Cultural	Participant approval rate Acceptance of technology Adoption of technology Perception of service / technology Satisfaction with technology / service Number of security and health incidents Incident response/resolution time Incident severity
Economic	Audience figures and visitors' numbers at the events demonstrable collaborations with industry Business performance measures. Demonstrable cloud interoperability Product (e.g. App) downloads Product (e.g. App) usage
Social	Number of complaints Types/categories of complaints Ratio of complaints to positive comments Measures of improved social quality, welfare and inclusion Information about the number and profile of people engaged and types of audience.
Environmental / health	Nuisance (noise and general low-level petty crime) Congestion (traffic) Congestion (crowd)
Academic	Innovative methodologies, equipment, techniques and cross-disciplinary approaches Contribution to excellent research and/or academic advancement Training highly skilled researchers

3.6 Stage 5: Implementation and Refinement

This section discusses the implementation of the Impact Assessment Framework, and the iterative process for its refinement. This process is mainly concerned with breaking the assessment into more manageable tasks of data collection and validation in light of the expected social, economic, technological and environmental impact. This section also proposes a set of templates for the report of impact activities.

3.6.1 MONICA Planned Events

The starting point is the planned events for which MONICA technology is to be used. The timing, location, and size of the events guide the implementation of the impact activities. See Table 5 below for an overview of the planned MONICA pilots and demonstration events.

Table 5: MONICA Planned Events

Pilot Impact on citizens and private users	Total no. of events / days of operation each year Y2 and Y3	Avg. no. of people taking part each year (not all exposed to MONICA)	No. of people exposed to MONICA solutions in each year	No. of citizens affected neighbour - hood quarters	Total no. of participants exposed to solutions in each year	Total no. of people participating in demonstrations (Y2+Y3)*
1 Copenhagen (DK)- Friday Rock	4 events	48. 000	5.000	3.000	8.000	**13.000**
2 Torino (IT) - KappaFutur festival - Movida	2 days 2 weekends	18.000 80.000	5.000 7.000	2.000 5.000	7.000 12.000	**12.000** **19.000**
3 Hamburg (DE) - Hamburger DOM - Port anniversary	3 x 3 days 2 x 3 days	1.500.000 1.000.000	8.000 6.000	8.000 5.000	16.000 11.000	**24.000** **17.000**
4 Lyon (FR) - Nuit sonore - La Fête des Lumières	5 days 4 days	100.000 3.000.000	4.000 8.000	1.000 5.000	5.000 13.000	**9.000** **21.000**
5 Bonn (DE) - Pützchens Markt - Rhein in Flamen	5 days 2 days	120.000 80.000	5.000 4.000	5.000 3.000	10.000 3.000	**13.000** **7.000**
6 Leeds (UK) - Cricket matches - Rugby matches	2 events 2 events	48.000 42.000	3.000 3.000	1.500 1.500	4.500 4.500	**7.500** **7.500**
Total	**44 events**	**6.036.000**	**58.000**	**40.000**	**85900**	**150.000**

* The total number of people participating in the demonstrations only includes neighbours once, i.e. the impact is validated over the full 2 years of the pilots.

See Table 6 for the proposed dates for pilots' data collection.

Table 6: MONICA Pilots Data Collection Dates

Pilot events	2017	2018	2019
1 Copenhagen (DK)- Friday Rock	April to September	April to September	April to September
2 Torino (IT) - KappaFutur festival - Movida	8-9 July	July	July
	Summer	Summer	Summer
3 Hamburg (DE) - Hamburger DOM - Port anniversary	3 Nov. – 3 Dec.	23 Mar – 22 Apr 27 Jul – 26 Aug 9 Nov – 9 Dec	22 Mar – 22 Apr 26 Jul – 25 Aug 8 Nov – 8 Dec
	10 – 13 May	10 – 12 May	08 - 10 May
4 Lyon (FR) - Nuit sonore - Fête des Lumières	24 – 28 May 2017	9 – 13 May 2018	May 2019
	7 Dec. – 10 Dec.	6 Dec.- 9 Dec. 2018	Dec. 2019
5 Bonn (DE) - Pützchens Markt - Rhein in Flamen	08 -12 Sep 4-5 May	07 -11 Sep 5 – 6 May 2018	Sep. 2019 May 2019
6 Leeds (UK) - Cricket matches - Rugby matches	Apr. – Sep.	Apr. – Sep.	Apr. – Sep.
	Feb. – Sep.	Feb. – Sep.	Feb. – Sep.

3.6.2 Time Requirements

This section discusses the time requirements for the implementation of MONICA Impact Assessment. We believe that the involvement of the stakeholders, the methodology used, and the speed of the change desired affect the decision of how often the impact assessment will take place. We regard it as very beneficial to lay strong foundation by getting the consensus from the relevant stakeholders. This way, our Impact Assessment Framework is supported by the beneficiaries and is measuring what really makes a difference on the ground. However, it is equally important to note that such approach can be time consuming. Thus, special care needs to be given to ensure the impact assessment time requirements are in line with the whole project time frame.

We believe that the rigour of the project outcomes can be strengthened if impact measurements are conducted at regular time intervals, so that the results are entirely comparable. Table 7 below outlines the dates of the impact assessment process.

Table 7: Impact Assessment Cycles

Cycle	Year	Months	Actions
Cycle 1	Year 1	Month 1 (Jan) – Month 9 (Sept) 2017	Impact Assessment and Validation (IAV) process co-developed
Cycle 2	Year 2	Month 18 (June) – Month 24 (Dec) 2018	IAV process trialled at pilot events, analysis of results fed back to pilots and stakeholders, IAV process refined
Cycle 3	Year 3	Month 28 (April) – Month 34 (Oct) 2019	IAV process undertaken at events, analysis of results fed back to partners and stakeholders, IAV process further refined

3.6.3 Reporting

This section discusses the reporting and presentation of the impact activities. Generally, there are two approaches in this regard; customisation or standardisation. In the customisation approach, organisations use their own excel database, or data repository which organisations then turn into graphics, infographics and reports. Standardisation on the other hand is when the organisation uses standard metrics or frameworks such as IRIS, GRI, and SPI4. Many organisations prefer the customisation approach.

Although MONICA has decide to embrace the customisation approach, we propose a number of templates to be used by all pilots for the following reasons:

- Help pilots to collect data relevant for the impact assessment
- Collect data in interoperable format, that will facilitate the analysis and the interpretation
- Create a coherent knowledge base, where comparable data allow to provide an even wider picture of the actions, outputs and impacts created by MONICA.
- Monitor the evolution of the activities and impact over time in a systematic way

Below, we propose a number of templates and forms to be used for MONICA impact activities.

3.6.3.1 Impact Planning Template

This form is proposed to be used to gather all expected impact from all pilots. The participating stakeholders, the expected outcome, the mechanism of delivering each outcome, the timing frame, risks associated for each outcome, the resources required, and the impact evidence are outlined in Table 8.

Table 8: Impact Planning Template

Goals	Partners	Methods				Resources		Evidencing
Impact Outcome	Stakeholders	Key objective	Delivery Mechanism	Timing	Risks& Mitigation	Responsibilities	Resource Needs	Impact Indicators

3.6.3.2 Summarising Expected and Actual Outcomes Templates

The templates below will be used when mapping is taking place of 'Actual' impacts versus 'Expected' impacts based on the baseline data and pilots' requirements. This will give a clear image of which impacts have been fully achieved and which needs more time, and hence will be assessed in later phase of the project. Table 9 represents a template that measures outcomes of low complexity or short-term span.

Table 9: Low complexity outcomes

Pilot:	Date:
	Lower Complexity / Short Time Span
	Expected Impact/outcome	Actual impact/outcome
Technological	-	-
	-	-
	-	-
	-	-
Social	-	-
	-	-
	-	-
	-	-
Cultural	-	-
	-	-
	-	-
	-	-
Economic	-	-
	-	-
	-	-
	-	-

Table 10 below represents a template that measures outcomes of higher complexity or long-term span.

Table 10: High complexity outcomes

Pilot:		Date:
	Higher Complexity / Long Time Span	
	Expected Impact/Outcome	Actual Impact/Outcome
Technological	-	-
	-	-
	-	-
	-	-
Social	-	-
	-	-
	-	-
	-	-
Cultural	-	-
	-	-
	-	-
	-	-
Economic	-	-
	-	-
	-	-
	-	-
etc…		

3.6.3.3 Recording – Pre- and Post-interventions Templates

The templates in **Table 11** and **Table 12** below are proposed to record the situation before and after the use of MONICA technology. Each pilot will fill a separate form.

Table 11: Pre-intervention form

Pilot	Context	User Group	Test site	Nº & role of stakeholders	Methods	Date	Objectives	Outcomes	Actions to be taken	Re-test date
					e.g. focus groups, interviews		Understand current procedures			

Table 12: Post-intervention form

Pilot	Context	User Group	Test site	Nº of users	Method	Date of test	Technology	KPIs	Objectives	Results	Actions to take	Re-test date	Barriers to adoption

4 Framework Validation

This section discusses efforts made to ensure the validation of the proposed Impact Assessment Framework. Below, we list the validation tasks performed:

4.1 Guidance

The framework was informed by the guidance of the G8 Social impact and investment Forum (Impact Taskforce, 2014), REF2014 (REF, 2014), REF2020 (HEFCE, 2017), and Economic and Social Research Council (ESRC, 2017).

4.2 Comparison

The framework was compared to similar impact assessment frameworks from selected research projects such as:

a) AMITRAN Project, funded by the European Commission (Mahmod, Jonkers, Klunder, Benz, & Winder, 2014)

b) Investment Facility Project (IF), funded by the European Investment Bank (EIB, 2005)

c) Vitae Impact Framework (Bromley & Metcalfe, 2012)

4.3 Effectiveness

The following features are used for measuring the effectiveness of the impact activities:

a) **Balance of impact activities** via a demonstration of return on investment, as well as, indicators of innovation, academic impact, economic development and social benefit.

b) **Distinguish between the dissemination of research and instances where actual impact has occurred**. Many researchers get confused between achieving impact and disseminating impact. MONICA was very keen to dedicate two work packages for each (WP9 for impact assessment, and WP12 for impact dissemination), to ensure that both purposes are covered properly. This is in compliance with REF2014 which stresses on assessing impact from two point of views: reach and significant (Lackey, Rodgers, & Scoble, 2016).

c) **Embedded impact activities**: The impact-related activities recommended by the framework are integral to MONICA Project, not just bolted on the dissemination phase.

d) **Project specific impact activities**: The framework does pay lots of attention to the context of the impact to ensure that the impact activities relate to the work being funded, not to previous work or wider academic responsibilities. Evidence of a strong track record in wider engagement is useful and is covered by deliverable D12.1. However, the focus of this deliverable is on the activities that aim to achieve and assess impact not on the activities that aim to disseminate it.

e) **Relationships:** The framework stresses on evidence of a developing relationships between researchers and stakeholders to achieve an embedded strategy and facilitate a process of producing outputs that are usable by other partners. The involvement of beneficiaries to build feasibility to the project outcomes, is an integral part of the framework.

f) **Commitment:** The framework reflects commitment to both academic and non-academic impact, even if the former is the natural outcome of the project. The framework focusses on both knowledge exchange and impact rather than simple dissemination.

g) **Realistic impacts**: The framework ensures that the identified impacts are realistic and objective via different stages of multiple iterations, and via the involvement and consultation with concerned stakeholders and associates from similar projects such as the European Large-Scale Pilot Programme (“European IoT Pilots”, 2017).

5 Risk Analysis

Table 13 below lists potential weaknesses and threats that may possibly negatively impact upon the Impact Assessment process.

Table 13: Potential Risks and Threats

No.	Area	WP	Assessment of Risk	Potential Risk	Mitigation of Risk	Status
1.	Ownership disputes, Intellectual Property Rights (IPR), Access Rights	WP8, WP9	Medium	Problems with publishing MONICA open source platform components	IPR and access rights clauses are included in the Consortium Agreement. The IPR identification process is robust for early identification of IP and ownership distributions, as proved in other projects. It leans on the EC's IPR-helpdesk recommendations. The partners all have IPR and access rights for the solutions they bring in from previous projects.	Open
2	Timing problem	WP8, WP9	Medium	Delay in development of technology which causes impact delay	Appropriate deadlines are to be set and reviewed regularly taking into account needs of the pilots and dates of the events.	Open
3	Measurements	WP8, WP9	Medium	Failure to measure or accurately measure certain indicator	Verification of measurement methods with external parties .	Open
4	Negative impact	WP8, WP9	Medium	Unexpected outcome of the project that has a negative impact	The benefits of the project is to be weighed against the expected risk	Open
5	Unexpected External Factors	WP8, WP9, WP10	Medium	Unforeseen external circumstances such as: - change of legislations - change in current rules or regulations, such as standard sound limits in events. - change in data protection procedures in one of the countries where MONICA is expected to operate.	Technical or Procedural adaptation with consultation with concerned stakeholders.	Open

6	Lack of interest in the MONICA results from external stakeholders	WP8, WP9, WP12	Low	Lack of impact from the project	The WP9 is aimed at engaging stakeholders from the beginning of the project. User partners are also heavily involved in formulating requirements; have strong interest in the results and will manage communication with other stakeholders to obtain early feedback on the proposed solutions. Dissemination activities, in particular the webinars, will create awareness and interest.	Open

6 Conclusion

MONICA is committed to the effective assessment of the outcome of its innovation and technologies, as part of its mission for evidence-based impacts. Assessment is an important tool for examining the relevance, performance, efficiency and impact of MONICA IoT technologies in relation to its stated objectives and wider strategic goals.

This document proposes a framework for the impact assessment and validation of MONICA innovation activities. The framework was informed by well-established practices and guidelines from prominent bodies such as the G8 Social impact and investment Forum, REF2014, REF2020, and RCUK. The structure of the framework was informed by 'Theory of Change', and the framework dimensions represented impact planning, data collection and validation, implementation and refinement of the framework. Time requirements, issues of contribution, and reporting were covered by the framework. Collaboration and engagement with the stakeholders was a key element of the framework.

Seeking demonstrable excellence with impact is a core value of the MONICA Project and the context within which impact is taking place is broad beyond research in the realms of society, economy, health, the environment, and quality of life for 100,000+ end users. The MONICA impact assessment process ensures that impact is implicitly of benefit for society drawing on the ethical principles of non-maleficence and beneficence within an essentially utilitarian concept, namely the greatest good for the greatest number.

7 Appendix A - Indicators

7.1 Impact measures, KPIs and methods of assessment

Note: We acknowledge indicators being generic to facilitate future cycles of iterative validation.

7.1.1 Socio-economic impact

Impact on citizens & value chains		
Evidence	***How measured***	***KPI***
Approval rate related to noise & security	Qualitative (surveys ± focus groups)	>95%
Participation rate of public	Participant response rates (all events pre, during &post)	>20%
Participant approval rate	Surveys	>75%
Value chain actors involved	Qualitative (surveys ± focus groups)	>800
Impact on business processes & new business models		
Evidence	***How measured***	***KPI***
Number of validated business models		10
Demonstrated cloud interoperability		4
Quality of Life		
Evidence	***How measured***	***KPI***
Noise reduction (selected neighbourhoods)	Quantitative (sound sensors)	10 dB(A)
Satisfaction noise (neighbours)	Qualitative (surveys)	>90%
Satisfaction noise (musicians)	Qualitative (surveys ± focus groups)	>90%
Satisfaction noise (other professionals)	Qualitative (surveys ± focus groups)	>90%
Number of citizens engaged with CAP	Quantitative (click counts / surveys)	>5000
Impact on entrepreneurship		
Validation of incubator environments	Input from IN-JET	>95%

7.1.2 Technological impact

Impact on IoT technologies & IoT ecosystems		
Evidence	***How measured***	***KPI***
Total number of wearable users	Quantitative - count number distributed & interactions made	108000
Number of applications integrating wearables & sensors	Quantitative - count	17
Number of applications running on platform during an event	Quantitative - count of applications developed for & used during event	15
Largest number of simultaneous communications sessions during an event	Quantitative - connection count Input from ISBM / HWC	800
Largest number of interoperability hooks to Smart City platforms	Input from ISBM	4
Impact on standards (measurable contributions)		
Evidence	***How measured***	***KPI***
Contribution to ETSI, oneM2M, and radio spectrum regulation	Input from Ring	10
User acceptance validation		
Evidence	***How measured***	***KPI***
Number of users/citizens engaged with CAP and social media	Quantitative (click counts) Qualitative (surveys / focus groups)	>5000
Acceptability of data protection, privacy and trust schemes	Qualitative (surveys / focus groups)	>98%

7.1.3 Contributions to other EU initiatives

- Contribution to the consolidation and coherence work by the CSA supporting "Horizontal Activities".
- Contribution to the AIOTI WG 3 and 7 on the use of wearables.
- Contribution to the IoT EPI (European Platforms Initiative).

7.1.4 Impact on European innovation capacity and integration of new knowledge

The MONICA platform stimulates the innovation capacity and knowledge of IoT industry, public authorities, the cultural and creative Industry, fostering more rapid uptake of Smart City solutions by city and public authorities while at the same time facilitating businesses to be more agile and to be able to adapt to market changes, societal expectations, environmental and regulatory pressures, and rapidly changing demands from different markets.

7.1.5 Strengthening the Competitiveness and Growth of Companies

The MONICA project will:

- provide the IoT industry with the ability to adapt to changing demands from different markets;
- create the basis for new commercial products and services in EU Member States and worldwide, and stimulate growth in employment in the European ICT Industry in particular;
- contribute to European capacity building in wearable sensors;
- provide the IoT and Smart City industry with the ability to adapt to changing demands from different markets and thus create the basis for new commercial products, services, and thereby stimulate growth in employment in the European ICT industry in particular;
- create new market opportunities for both creative performers and organisers.

7.1.6 Other socially important impacts

- Impact on the European Agenda for Culture a) providing means for increased security at concerts, festivals and other events; b) allowing performers to use their creative needs for loudness without destroying the environment with unwanted noise; c) and allowing the cities to make large events more accessible in the inner-cities thus stimulating international tourism and promotion of local cultural heritage.
- Impact on Smart Cities, inspiring cities to expand their legacy Smart City concepts from traditional areas of traffic and waste and into the cultural ecosystems and trustworthy surveillance.
- Support of Responsible Research and Innovation Actions, advocating Responsible Research and Innovation (RRI) and Social Sciences and Humanities (SSH).

7.2 Pilot / YCCC & Rugby specific impact measures and methods of assessment

7.2.1 Socio-economic impact

Impact on operations / productivity		
Evidence	***How measured***	***KPI % improvement***
Number of predefined incidents detected, (e.g. caused by drunken behaviour)	Quantitative (reported)	
Speed of response to incidents	Quantitative (observed via video data)	
Speed of response to incidents	Quantitative (as reported by staff – fuzzy ranges)	
Ease of communication between control & stewards / steward & steward	Qualitative (reported – fuzzy ranges) Quantitative (reported)	
Steward management (localisation)	Qualitative (focus, surveys) Quantitative (observed via sensors)	
Steward management (recognition)	Qualitative (focus, surveys) Quantitative (observed via sensors)	
Crowd management (congestion at north east lower stand)	Quantitative (crowd density estimation s/w)	
Crowd management (dynamic routing to exits)	Quantitative (observed timing)	
Number of intrusions into forbidden zones	Quantitative (object/person detection, people counting)	
Improved traffic management	Quantitative (observed timing)	

7.2.2 Technological impact

Customers / fans technology usage		
Evidence	***How measured***	***KPI***
Number of fans engaging with stadium App	Quantitative (Apps download, usage stats)	
Number of banned persons recognised	Quantitative (count from face recognition s/w)	
User (stewards) acceptance validation		
Evidence	***How measured***	***KPI***
Usability of additional / new equipment carried by stewards	Qualitative (surveys / focus groups)	
Usability of productivity Apps / software	Qualitative (surveys ± focus groups) Quantitative (Apps download, usage stats)	
Satisfaction with new technology (control room staff)	Qualitative (surveys ± focus groups) Quantitative (usage rate per event)	
Satisfaction with new technology (stewards / ground staff)	Qualitative (surveys ± focus groups) Quantitative (usage rate per event)	
User (customers) experience		
Evidence	***How measured***	***KPI***
Usability of real-time stadium & event information system (large displays)	Qualitative (surveys) Quantitative (usage rate per event)	
Response rate / user engagement with customer Apps	Quantitative (counts) Qualitative (online surveys)	
Speed of entrance & exit of stadium	Qualitative (surveys) Quantitative (timed)	
Speed of clearing stadium neighbourhood	Qualitative (surveys) Quantitative (timed)	
Congestion / crowdedness	Qualitative (surveys)	

7.3 Pilot / TIVOLI specific impact measures and methods of assessment

7.3.1 Socio-economic impact

Impact on operations / productivity		
Evidence	***How measured***	***KPI***
Sound/noise thresholds not exceeded at boundary	Sound meter	
Number of predefined incidents detected,	Quantitative (reported)	
Crowd management (density)	Quantitative (crowd density estimation s/w)	
Crowd management (dynamic routing to exits)	Quantitative (observed timing)	
Impact on other stakeholders		
Evidence	***How measured***	***KPI***
Neighbours (perceived QoL improved)	Qualitative (surveys)	
Number of complaints	Quantitative (count)	
Musicians / production satisfaction with sound levels	Qualitative (surveys)	
First aid (trauma nurses)	Qualitative (surveys ± focus groups)	
Copenhagen City	Qualitative (surveys ± focus groups)	

7.3.2 Technological impact

Customers / fans technology usage		
Evidence	***How measured***	***KPI***
Number of fans engaging with event App	Quantitative (Apps download, usage stats)	
User (security) acceptance validation		
Evidence	***How measured***	***KPI***
Usability of additional / new equipment carried by event safety team	Qualitative (surveys / focus groups)	
Satisfaction with new technology (KST Command Centre staff)	Qualitative (surveys ± focus groups) Quantitative (usage rate per event)	
Satisfaction with new technology (event safety team)	Qualitative (surveys ± focus groups) Quantitative (usage rate per event)	
User (customers) experience		
Evidence	***How measured***	***KPI***
Satisfaction with sound	Qualitative	
Response rate / user engagement	Quantitative (usage stats)	
Speed of entrance & exit of park	Qualitative (surveys) Quantitative (timed)	
Speed of clearing park neighbourhood	Qualitative (surveys) Quantitative (timed)	
Congestion / crowdedness	Qualitative (surveys)	

7.4 Pilot / KFF_TORINO specific impact measures and methods of assessment

7.4.1 Socio-economic impact

Impact on operations / productivity		
Evidence	***How measured***	***KPI***
Number of intrusions into forbidden zones	Quantitative (object/person detection, people counting)	
Impact on other stakeholders		
Evidence	***How measured***	***KPI***
Resident association (perceived QoL improved)	Qualitative (surveys)	
local police, carabinieri, financial police, undercover police	Qualitative (surveys ± focus groups)	
Emergency medical service, anti-addiction sanitary programmes	Qualitative (surveys ± focus groups)	

7.4.2 Technological impact

Customers / fans technology usage		
Evidence	***How measured***	***KPI***
Number of fans engaging with event App in real time	Quantitative (Apps download, usage stats)	
User (security) acceptance validation		
Evidence	***How measured***	***KPI***
Usability of additional / new equipment carried by event safety team	Qualitative (surveys / focus groups)	
Satisfaction with new technology	Qualitative (surveys ± focus groups) Quantitative (usage rate per event)	
Satisfaction with new technology (security team)	Qualitative (surveys ± focus groups) Quantitative (usage rate per event)	
User (customers) experience		
Evidence	***How measured***	***KPI***
Usability of real-time event information	Qualitative (online surveys) Quantitative (usage rate per event)	
Response rate / user engagement	Quantitative (counts)	
Congestion / crowdedness	Qualitative (online surveys)	

7.5 Pilot / MOVIDA specific impact measures and methods of assessment

7.5.1 Socio-economic impact

Impact on operations / productivity		
Evidence	***How measured***	***KPI***
Number of predefined incidents detected,	Quantitative (reported)	
Speed of response to incidents	Quantitative (observed via video data)	
Ease of communication with control	Quantitative (reported)	
Crowd management (density)	Quantitative (crowd density estimation s/w)	
Impact on other stakeholders		
Evidence	***How measured***	***KPI***
Resident association (perceived QoL improved)	Qualitative (surveys)	
Local police, carabinieri, financial police, undercover police	Qualitative (surveys ± focus groups)	

7.5.2 Technological impact

Customers / fans technology usage		
Evidence	***How measured***	***KPI***
User (security) acceptance validation		
Evidence	***How measured***	***KPI***
Satisfaction with new technology	Qualitative (surveys ± focus groups) Quantitative (usage rate per event)	

7.6 Pilot / MONICA Communication & Dissemination specific impact measures and methods of assessment

7.6.1 Socio-economic and technology impact

Communication & Dissemination impact		
Evidence	***How measured***	***KPI***
MONICA Website visibility	Quantitative (site traffic, count downloads)	
MONICA social media visibility & engagement	Quantitative (site traffic, count downloads)	
Traditional media: press releases, flyers, & newsletters	Quantitative (count interviews, press releases)	
Traditional media coverage / reach	Quantitative (estimate reach)	
Attendance at webinar, attendee engagement, satisfaction	Quantitative (number of live viewers, of archived views) Qualitative (surveys)	
Attendance at workshops, attendee engagement, satisfaction	Quantitative (number attendee) Qualitative (surveys)	
Scientific conference attended by & presented at MONICA partners	Quantitative (count)	

7.7 Pilot / Lyon (FdL/NS) specific impact measures and methods of assessment

7.7.1 Socio-economic impact

Impact on operations / productivity		
Evidence	***How measured***	***KPI***
Crowd management (congestion at main entrance	Quantitative (crowd density estimation s/w)	
Crowd management (dynamic routing through event streets)	Quantitative (observed timing)	

7.7.2 Technological impact

User (visitor) experience		
Evidence	***How measured***	***KPI***
Response rate / user engagement with customer Apps	Quantitative (counts) Qualitative (online surveys)	
Speed of movement across streets	Qualitative (surveys) Quantitative (timed)	
Crowd management	Quantitative (crowd density estimation s/w)	
Crowd management (dynamic routing)	Quantitative (observed timing)	

7.8 Pilot / Bonn (RiF) specific impact measures and methods of assessment

7.8.1 Socio-economic impact

Impact on operations / productivity		
Evidence	***How measured***	***KPI***
Noise management	Quantitative (sensors)	

7.8.2 Technological impact

User (visitor) experience		
Evidence	***How measured***	***KPI***
Noise management / monitoring	Quantitative (sensors)	
Congestion / crowdedness	Qualitative (surveys)	

7.9 Pilot / Bonn (Markt) specific impact measures and methods of assessment

7.9.1 Socio-economic impact

Impact on operations / productivity		
Evidence	***How measured***	***KPI***
Crowd management	Quantitative (crowd density estimation s/w)	
Crowd management (dynamic routing)	Quantitative (observed timing)	

7.9.2 Technological impact

User (visitor) experience		
Evidence	***How measured***	***KPI***
Speed of entrance & exit of event area	Qualitative (surveys) Quantitative (timed)	
Speed of movement in event area	Qualitative (surveys) Quantitative (timed)	
Congestion / crowdedness	Qualitative (surveys)	

7.10 Pilot / Hamburg (Port/DOM) specific impact measures and methods of assessment

7.10.1 Socio-economic impact

Impact on operations / productivity		
Evidence	***How measured***	***KPI***
Noise monitoring (quiet zones)	Qualitative (face to face during event) Quantitative (observed via sensors)	
Vehicular access control (Port only)	Quantitative	
Crowd management (flow)	Qualitative (timed – paramedic round duration) Quantitative (observed via sensors)	
Communication between stakeholders (DOM only)	Qualitative (timed) Quantitative (observed via sensors)	

7.10.2 Technological impact

Customers / visitor technology usage		
Evidence	***How measured***	***KPI***
Number of fans engaging with event App	Quantitative (Apps download, usage stats)	
Acoustics assessment (App)	Quantitative (observed via sensors)	
User (visitor) experience		
Evidence	***How measured***	***KPI***
User appreciation of quiet zones	Quantitative (counts) Qualitative (online surveys)	

8 Appendix B – Templates

The templates of the data collection methods listed below were not included for data protection reasons, but are available on request.

8.1 Focus groups brief

8.2 Questionnaires

9 References

(Bromley & Metcalfe, 2012) Bromley, T., & Metcalfe, J. (2012). The Rugby Impact Framework 2012. *Revisiting the Rugby Team Impact Framework. Vitae*.(EC, 2007) European Commission (2007). A lead market initiative for Europe. Brussels. COM(2007) 860 final.

(ESRC, 2017) Economic and Social Research Council (2017). Developing Pathways to Impact. Retrieved from (http://www.esrc.ac.uk/research/impact-toolkit/developing-pathways-to-impact/

(EIB, 2005) European Investment Bank (2005). Developing Impact Assessment Framework of Investment Facility Project Retrieved from http://www.eib.org/attachments/thematic/eib_diaf_en.pdf

(HEFCE, 2017) Higher Education Funding Council for England. The Second Research Excellence Framework. (2017, March 17). Retrieved from http://www.hefce.ac.uk/rsrch/refconsultation/

(Impact Taskforce, 2014) Impact, S., & TASKFORCE, I. (2014). Impact investment: The invisible heart of markets.

(European IoT Pilots, 2017) European IoT Lareg Scale Pilots Programme (2017). Retrived from https://european-iot-pilots.eu/

(Lakey et al., 2016) LAKEY, J., RODGERS, G., & SCOBLE, R. (2013). What are the different characteristics of research impact?. *Achieving Impact in Research*, 33.

(Mahmod et al., 2014) Mahmod, M., Jonkers, E., Klunder, G. A., Benz, T., & Winder, A. (2014). Amitran methodology framework for evaluating the impact of information and communication technology-based measures on CO2 emissions in the transport field. *IET Intelligent Transport Systems*, *9*(4), 418-428.

(REF, 2017) Research Excellence Framework. (2014, December) Retrieved from http://results.ref.ac.uk/