RUGGEDISED
Designing smart, resilient cities for all

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Executive summary

The deliverable defines data sets that are necessary to evaluate the performance of smart solutions and other interventions in RUGGEDISED. Particularly, it will be used for technical performance assessment, economic, environmental and social impact assessment. The templates have been developed based on data set definitions outlined in the monitoring and evaluation manual. Also, the structure of evaluation templates follows the clustering of smart solutions and interventions defined in the manual. All data sets are however brought together to have a comprehensive overview on all necessary data sets per solution or cluster of solutions. This allows us to have one sheet with data over the whole duration of the project and combine baseline information collected before the implementation with monitoring data provided after the implementation finished. Data sets for different kinds of assessment are in the same sheet (technical performance, economic, environmental). In addition, a general data sheet has been included to cover also data sets that cannot be directly allocated to any cluster but are necessary to show the impact on demonstration area level (i.e. economic and demographic data).

The templates represent the comprehensive data set common to the situation in lighthouse cities. Subsequently, the templates will be adapted to local situation because the scope of implementation differs in each city. To ensure it is clear whom to ask to provide data each data set is accompanied by a field for the definition of the responsible entity. The target group for this deliverable are local coordinators and stakeholders involved in the implementation of smart solutions. The process of data collection will be managed and supervised by AIT on project level. On the level of local consortia local coordinators with support and advice of local research organisations will manage the collection of data. The data will be collected in three phases:

- Before the implementation – for baselines, references and design data.

- One year after the implementation– for the data of the first monitoring year and other data that are expected to be available after the implementation is finished (e.g. other economic and social impacts).

- Two years after the implementation – for data of the second monitoring year and information on social impact.

In addition, social impact will be assessed for each lighthouse city's urban development project and smart solutions by means of two survey campaigns (before/after implementation) where citizens belonging to the targeted stakeholder groups in the respective target districts provide feedback via questionnaires. The questionnaire which is presented in this deliverable addresses three levels of impact: Quality of Life (QoL) impact of the city's urban development project, awareness and perceived impact of the RUGGEDISED project, and acceptance of smart solutions. The process of social impact assessment will be supervised by AIT on project level, while the preparation and execution of the specific survey campaigns will be executed by the local coordinators in each lighthouse city.

The document has been prepared to get a common agreement on the data sets that need to be collected in order to show the impact of RUGGEDISED. At the same time the tables provide a basis for the tailored-made evaluation of each lighthouse city while ensuring a common approach is followed. As a next step the templates will be filled in with the information that is available already. This allows us to see which information or data, which is to be collected before the implementation, is still missing. All data sets are accompanied by indication of the responsible entity. The application will happen in cooperation with local coordinators of lighthouse cities and local research partners.

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1. Introduction

RUGGEDISED aims to make an important contribution to improving the quality of life of citizens, reducing environmental impacts of activities and to creating a stimulating environment for sustainable economic development. To reach this challenge lighthouse cities in RUGGEDISED set a variety of different targets and planned the implementation of smart solutions to reach those. Lighthouse cities aim to be forerunners, allow for the replication of the smart solutions they are developing and show how these contribute to reach their city strategies. To support lighthouse cities in their activities WP5 analyses and evaluates implementation, performance and the impact of smart solutions from different perspectives.

The present document defines data sets that are necessary to evaluate the performance of smart solutions and other interventions in RUGGEDISED. Particularly it will be used for technical performance assessment, economic, environmental and social impact assessment.

Chapter 1 explains the background of this document, its purpose, target group and way of its preparation. Chapters 2 and 3 are the core part of this deliverable. These include the evaluation templates for technical performance, environmental and economic data sets (Chapter 2) and social impact assessment templates (Chapter 3). Each chapter begins with an explanation of its structure and key to fill in the data. Chapter 4 provide information on the further application of evaluation templates and its time planning.

1.1 Purpose and target group

Evaluation templates accompany RUGGEDISED monitoring and evaluation manual. They will be used to collect data and information to make the assessment of smart solutions possible. The templates have been developed based on data set definitions outlined in D5.1 Monitoring and evaluation manual. In different way to D5.1 the structure of data sets is divided by each unit or field of assessment. This allows us to have comprehensive set of data over the whole duration of the project and combine baseline information collected before the implementation with monitoring data provided after the implementation finished.

The templates represent the comprehensive data set common to the situation in lighthouse cities. Subsequently the templates will be adapted to local situation because the scope of implementation differs in each city. To ensure it is clear whom to ask to provide data each data set is accompanied by a field for the definition of the responsible entity.

The target group for this deliverable are local coordinators and stakeholders involved in the implementation of smart solutions. The process of data collection will be managed and supervised by AIT on project level. On the level of local consortia local coordinators with support and advice of local research organisations will manage the collection of data. The data will be collected in three phases:

- Before the implementation (until month 24) – for baselines, references and design data
- One year after the implementation (months 36 to 48) – for the data of the first monitoring year and other data that are expected to be available after the implementation is finished (e.g. other economic and social impacts)
- Two years after the implementation (months 48 to 60) – for data of the second monitoring year and information on social impact.

1.2 Drafting process and contribution of partners

The templates were developed as calculation sheets in one file. Their development began during preparations for local monitoring workshop in each lighthouse city to have a basis for discussion with local stakeholders. During these workshops the scope and design of smart solutions beyond the description given by the project proposal were discussed. The workshops have been held in the first half of the first project year:

- on January 18 2017 in Umeå,
- on May 22 2017 in Rotterdam and
- on June 12 2017 in Glasgow.

The aim was not to use a general methodology provided by the literature but to find a way to consider local setups, understanding of different professions involved in the implementation and consider particular responsibilities of each smart solution. The workshops have been organised by AIT in cooperation with local coordinators (Gemeente Rotterdam, Umeå Kommun and Glasgow City Council). In case of larger group of stakeholders, sessions for clusters of solutions were defined (morning session for energy and building interventions, afternoon for mobility and data issues). The development of a common approach for cities in different countries is a challenging task (e.g. the definition of gross conditioned area is different) even if some implementation fields do have common or standardised approaches and data sets (e.g. JRC-approach for the assessment of air quality). Therefore local research partners provided valuable support to this process by bringing in expertise on national conditions and differences – TNO for Rotterdam, RI.SE for Umeå and University of Strathclyde for Glasgow.

After enhancements and corrections that followed local monitoring workshops the adapted versions of the evaluation sheets were sent to local coordinators for several feedback rounds. The result was used as basis for the development of a common methodology in D5.1 and of the present document.

1.3 Relation to other developments and alignment

Activities of WP5 are embedded into a complex system of activities of RUGGEDISED and therefore cannot be seen decoupled from the rest of the project. On top of that, the results of RUGGEDISED are planned to be exploited together with the results of other European lighthouse projects for replication purposes. Therefore alignment during the preparation of the evaluation approach was very important. In general two ways of alignment were required:

- Internal alignment with approaches and activities of other work packages,
- External alignment with frameworks on European level, e.g the Smart Cities Information system (SCIS).

D5.2 is based on implementation actions carried out in WP2 (Rotterdam), WP3 (Umeå) and WP4 (Glasgow). These work packages are the source of data for the assessment in WP5. The evaluation templates will be used internally within WP5 to provide results of performance and impact assessment (task 5.4) to other work packages further using results of WP5 (e.g. WP1, WP8).

Through the alignment carried out during the preparation of D5.2, which is documented in D5.1 evaluation templates are also aligned externally to be in line with the approach commonly used in European lighthouse cities and be able to provide data to replication inventories requiring a certain format. For this alignment Smart Cities and Communities Information System and CITYkeys project have been used as reference.

2. RUGGEDISED evaluation templates

2.1 Description of the structure

The structure of evaluation templates follows the clustering of smart solutions and interventions defined in D5.1 Monitoring and evaluation manual:

- Energy efficiency at building and district level – includes interventions in buildings, smart street lighting and smart waste management.
- Smart thermal grid – All smart solutions for the smart thermal grid implementation except thermal storage which will be entered in a separate table.
- Smart electric grid – Similar to the thermal grid solutions all data related to the implementation of smart electric grid are included in one comprehensive table with the exception of electric storage which will be assessed by a separate table.
- Mobility – evaluation tables are separated for e-cars and e-buses.
- ICT on city level – all smart solutions related to ICT and data applications on city level.

All data sets are however brought together to have a comprehensive overview on all necessary data sets per solution or cluster of solutions. This means data sets for different kinds of assessment are in the same sheet (technical performance, economic, environmental).

In addition, a general data sheet has been included to cover also data sets that cannot be directly allocated to any cluster but are necessary to show the impact on demonstration area level. This includes:

- General economic and demographic data about the area (residents, total investments, jobs created).
- Further economic and societal impact data including data on household income and bills for the calculation of societal benefits.
- Definition field for the discount rate that will be used throughout all smart solutions to calculate the payback period.

In certain cases a data set for each demonstration item is necessary. These cases are indicated with a note. The template table is then replicated for each item. This is the case for building assessment and environmental assessment of e-mobility:

Note: This table should be replicated for each building.

Note: the following table can be multiplied should this be necessary due to the amount of data sets

Figure 1 Indication of notes

2.2 Guidelines for data entry

Each evaluation template consists of general specifications and data entry fields. Two specification fields are used throughout the templates:

Lead Partner	RUGGEDISED-Partner in charge of the implementation (not necessarily of the data collection)
Scope	Identification shortcuts of smart solutions concerned.

Figure 2 Specification data entry fields for all clusters

The field scope is not used in case it is not applicable. This is the case for general data queries and buildings. Buildings are not classified as smart solutions and have additional specification fields:

Sample Identification Name	Name of the building as used in the project
Complete address	Street, house number and town
Type of building	Types: residential, industrial, municipal, tertiary (non-municipal)
Number of buildings	Amount of buildings (in case several buildings with similar construction properties)
Total gross floor area [m^2]	Area inside the building envelope excluding roofs.
Total gross conditioned floor area [m^2]	Floor area of the building that is heated.

Figure 3 Specification data entry fields for buildings

Data entries use a colour code indicating the kind and sequence of data provision to simplify the orientation in the document. Magenta fields indicate data collected at the beginning of the project. Blue fields indicate entry fields for data collected after the end of the implementation. The special field to indicate entity in charge of data collection is marked green. An overview is available in Figure 4.

Data and information collected before the implementation

Baseline	Data for the business as usual case (local conditions or national standard)
Design	Target value (calculation of technical performance)
Predicted	Target value (calculation of economic impact)
Target	Target value (calculation of societal benefits)
Factor	Local or project-related factors used for calculations
Type …	Multiple data entry (used for baseline or design data)
Responsible entity	RUGGEDISED-Partner in charge of data set collection

Data collected after the implementation

Monitored year 2	Monitoring data for a particular year after implementation
Actual after implementation	Data enquiry after the implementation (economic and societal benefits)

Other fields

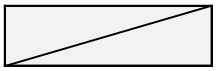	This field is not relevant and must not be filled in

Figure 4 Explanation of the different kinds of entry fields

2.3 General data

Table 1 Evaluation template for general data of the demonstration area

EVALUATION TEMPLATE - General data

Lead partner	

Definition and unit	**Predicted**	**Actual after implementation**	**Responsible entity**
Residents in district [#]			
Employees or visitors in district [#]			
Persons directly involved [#]			
Investment in construction [€]			
Investment in energy interventions [€]			
Investment in mobility interventions [€]			
Investment in ICT interventions [€]			
New business models deployed [#]			
Jobs created directly [#]			
Jobs created indirectly [#]			

Definition and unit	**Baseline**	**Target**	**Actual after implementation**	**Responsible entity**
Energy bill per household in refurbished buildings [€/yr]				
Maintenance costs per household in refurbished buildings [€/yr]				
Total housing costs per household in refurbished buildings [€/yr]				
Disposable income of citizens in district [€/month]				
Discretionary income of citizens in district [€/month]				

Definition and unit	**Factor**	**Responsible entity**
Discount rate [%]		

2.4 Energy efficiency at building and district level

Table 2 Evaluation template for general data set for building interventions

EVALUATION TEMPLATE - General data for buildings

Lead partner	

Data definition and unit of measurement	Baseline	Design	Monitored year 1	Monitored year 2	Responsible entity
Heating degree days - $HDD_{15/18}$ [Integer]					
Cooling degree days - $CDD_{22/18}$ [Integer]					
Global solar radiation [kWh/m^2-a]					
Primary energy factors of the gas grid [kWh primary energy / kWh final energy]					
CO_2 factors of the gas grid [g CO_2 / kWh final energy]					

Table 3 Evaluation template for building interventions

EVALUATION TEMPLATE - Building #1

Note: This table should be replicated for each building.

Sample identification name	e.g. 100 zero energy residential buildings
Complete address	
Lead partner	

Type of building	
Number of buildings	
Total gross floor area [m^2]	
Total gross conditioned floor area [m^2]	

Note: If several buildings share similar characteristics (e.g. U-value, energy demand), they can be clustered together and therefore reported as one.

Note: Floor area that is heated or cooled.

Definition and unit	Baseline	Design	Monitored year 1	Monitored year 2	Responsible entity
Final space heating energy demand [kWh/m^2.yr]					
Final domestic hot w ater energy demand [kWh/m^2.yr]					
Final cooling energy demand [kWh/m^2.yr]					
Final electrical energy demand [kWh/m^2.yr]					
Total investment [€]					
Total investments in a standard building [€/m^2]					
Thermal energy price [€/kWh] - please specify					
Electric energy price [€/kWh]					
ICT investment in Building [€]					

Table 4 Evaluation template for street lighting interventions

EVALUATION TEMPLATE - Street lighting

Lead partner	
Scope	

Data definition and unit of measurement	Baseline	Design	Monitored year 1	Monitored year 2	Responsible entity
Final electrical energy consumption of the street lighting [kWh/y]					
Installed capacity of street lighting [MW]					
Total investment for street lighting [€]					
Investments in a standard solution of street lighting [€/MW]					
Average electricity price for lighting [€/MWh]					

Table 5 Evaluation template for waste management implementation

EVALUATION TEMPLATE - Waste management

Lead partner	
Scope	

Definition and unit	Baseline	Design	Monitored year 1	Monitored year 2	Responsible entity
Annual savings in fuel for waste collection [€/yr]					
Investment in smart waste management system [€]					
Annual savings in operational costs (fuel) for waste collection [€/yr]					
Operational costs (fuel) for waste collection [€/yr]					
Cost of fuel for waste collection [€/yr]					

2.5 Smart thermal grid

Table 6 Evaluation template for smart thermal grid interventions

EVALUATION TEMPLATE - Smart thermal grid

Lead partner	
Scope	

Definition and unit	**Baseline**	**Design**	**Monitored year 1**	**Monitored year 2**	**Responsible entity**
Total capacity of the individual generation systems [MW]					
Total capacity of the individual generation systems solar thermal [m^2]					
Thermal peak load [MW]					
Output of the thermal grid [MWh/yr]					
Investment [€]					
Grants received [€]					
Standard investment [€/MW]					
Revenue from heat sales [€/MWh]					
Revenue from cooling sales [€/MWh]					
Fuel, operational and maintenance costs [€/MWh*year]					

Definition and unit	**Carrier 1**	**Carrier 2**	**Carrier 3**	**Carrier …**	**Responsible entity**
Energy carrier [type]					
Total input per energy carriers into the thermal grid [MWh/yr]					
Primary energy factors of the energy carriers used in the thermal grid [kWh primary energy / kWh final energy]					
CO_2 factors of the energy carriers used in the thermal grid [g CO_2 / kWh final energy]					

Table 7 Evaluation template for thermal storage

EVALUATION TEMPLATE - Thermal storage

Lead partner	
Scope	

Definition and unit	Baseline	Design	Monitored year 1	Monitored year 2	Responsible entity
Total amount of heating energy fed into the thermal storage [kWh/yr; MWh/yr]					
Total amount of cooling energy fed into the thermal storage [kWh/yr; MWh/yr]					
Total amount of heating energy extracted from the thermal storage [kWh/yr; MWh/yr]					
Total amount of cooling energy extracted from the thermal storage [kWh/yr; MWh/yr]					
Renew able thermal energy not injected [kWh/yr; MWh/yr]					
Investment [€]					
Operational and maintenance costs [€/MWh*year]					
Grants received [€]					

2.6 Smart electric grid

Table 8 Evaluation template for smart electric grid interventions

EVALUATION TEMPLATE - Smart electric grid

Lead partner	
Scope	

Definition and unit	Baseline	Design	Monitored year 1	Monitored year 2	Responsible entity
Total capacity of the individual generation systems [kW]					
Electrical peak load [kW]					
Renew able electrical energy fed into the grid [kWh/yr]					
Renew able electrical energy not injected after-the intervention [kWh/yr]					
Renew able electrical energy used on site after the intervention [kWh/yr]					
Nominal pow er of charging stations [kW]					
Number of e-cars before implementation [#]					
Total investment in smart grid solutions incl. DSM [€]					
Estimated investment associated to the conventional increase of hosting capacity in the infrastructure [€]					
Electricity used by e-cars [kWh]					
Average electricity price [€/kWh]					

Definition and unit	Overall	Carrier 1	Carrier 2	Carrier …	Responsible entity
Energy carrier [type]					
Total input per energy carrier [kWh/yr]					
Primary energy factors [kWh primary energy / kWh final energy]					
CO_2 factors [g CO_2 / kWh final energy]					

Table 9 Evaluation template for electric storage

EVALUATION TEMPLATE - Electric storage

Lead partner	
Scope	

Definition and unit	Baseline	Design	Monitored year 1	Monitored year 2	Responsible entity
Total amount of electrical energy fed into the electrical storage [kWh/yr]					
Total amount of electrical energy extracted from the electrical storage [kWh/yr]					
Revenue from electricity sales [€/kWh*yr]					
Investment [€]					
Grants received [€]					
Operational and maintenance costs [€/kWh*yr]					

2.7 Mobility

Table 10 Evaluation template for e-mobility interventions

EVALUATION TEMPLATE - E-mobility

Lead partner	
Scope	

Definition and unit	**Baseline**	**Design**	**Monitored year 1**	**Monitored year 2**	**Responsible entity**
Output of the charging stations [kWh/yr]					
Nominal power of charging stations [kW]					
Number of e-vehicles [#]					
Investment in the solution [€]					
Annual operational and maintenance costs [€]					
Average electricity price for e-charging [€/kWh*yr]					
Distance driven by conventional cars [person.km/yr]					

Note: the following table can be multiplied should this be necessary due to the amount of data sets

Definition and unit	**Car type 1**	**Car type 2**	**Car type 3**	**Car type …**	**Responsible entity**
Average type of the vehicles in the city [year]	e.g. 2003-2007				
Average type of the vehicles in the city [fuel characteristics]	e.g. diesel				
Share of the average vehicle type in the city [%]	e.g. 12				

Table 11 Evaluation template for e-bus

EVALUATION TEMPLATE - E-bus

Lead partner	
Scope	

Definition and unit	**Baseline**	**Design**	**Monitored year 1**	**Monitored year 2**	**Responsible entity**
Output of the charging stations [kWh/yr]					
Nominal power of charging stations [kW]					
Number of e-bus vehicles [#]					
Investment in the solution [€]					
Annual operational and maintenance costs [€]					

Definition and unit	**Factor**				**Responsible entity**
Average electricity price for e-charging of a bus [€/kWh]					

2.8 ICT on city level

Table 12 Evaluation template for ICT on city level interventions

EVALUATION TEMPLATE - ICT on city level

Lead partner	
Scope	

Definition and unit	**Baseline**	**Design**	**Monitored year 1**	**Monitored year 2**	**Responsible entity**
Number of open solutions [#]					
Number of applications for interoperability with 3rd parties [#]					
Number of integrated ICT systems [#]					

3. Social impact assessment templates

3.1 Description of the structure

The template consists of five parts: an introduction for campaign developers to the overall concept and questionnaire parameters (documentation for representatives of the different lighthouse cities only who distribute the questionnaire). The remaining four parts describe the actual questionnaire meant to be filled out by respondents (members of each relevant stakeholder group of the districts targeted in each lighthouse city)[1]:

- Quality of life (L1) – Assesses the Quality of Life (QoL) from individual and community perspectives.
- Awareness and perceived impact of the RUGGEDISED project (L2) – Inquires respondents' general awareness of the project as well as the nature of their involvement.
- Acceptance of smart solutions (L3) – Assesses respondents' likely acceptance of the different smart solution (see next paragraph below).
- Demographic background (DEM) – A basic set of questions about the respondent's demographic background.

As regards the acceptance of smart solutions questionnaire (L3), the solutions are categorized into four smart solution types (SC1-4):

- SC1: Electric vehicle charging infrastructure
- SC2: Smart mobility support (new e-bus fleets, heated bus stops, etc.)
- SC3: Demand-side energy management for building control
- SC4: Intelligent and efficient street lighting

Note that only smart solutions are addressed whose impact is directly perceivable by users. Furthermore, only certain smart solutions apply to the different lighthouse cities, leading to different variants of questionnaire L3, as illustrated by the following matrix:

Cluster Nr.	Rotterdam	Glasgow	Umea	Smart Solution Name
1	x	x	x	SC1: EV charging infrastructure
2	x		x	SC2: Smart mobility support (e-bus, bus-stop)
3		x	x	SC3: Demand-side energy management & building control
4	x	x		SC4: Intelligent & efficient street lighting

Figure 5 Allocation of smart solution clusters to lighthouse cities.

3.2 Guidelines for data entry

The resulting questionnaire (L1, L2, L3, DEM) is meant to be filled out by members of each relevant stakeholder group (residents, commuters, visitors, etc.) of the districts targeted in each lighthouse city, i.e. end users and not representatives of the lighthouse cities. This is supposed to happen during campaigns where the questionnaire is advertised and participants fill out the questionnaires online via the web[2]. The online questionnaires will be created using LimeSurvey[3] and hosted by AIT. Please note that for reasons of space and clarity, the templates in this document are concepts that specify type and content of the questions but do not depict the final visual questionnaire design details (like spacing and size of checkboxes).

Each questionnaire consists of several items (i.e. questions) which are specified in the following way:

- Aspect (grey): the aspect or quality dimension is addressed by the item.
- Question (grey): the concrete question asked in the questionnaire.

[1] Note that in the concrete implementations of the questionnaires for each different city, an introduction will precede the actual questionnaires in order to brief respondents about the purpose of the questionnaire, the local urban development project as well as the concrete interventions referred to.

[2] If required, cities can also provide participants with a paper-based offline version of the questionnaire. However, increased effort for handling the questionnaires as well as digitizing the responses have to be taken in to account.

[3] https://www.limesurvey.org/

- Scale (cyan): the type of question asked (Likert-7[4], multiple choice, binary, free text).
- Scale specification (green): description of the different scale items or options.

Aspect	Question	Scale	Min	Middle	Max
Perceived benefit	To which extent will the SMS yield benefits to you (convenience, comfort, reliability, less	Likert-7	Significant disadvantages	Neither	Significant benefits

Figure 6 Example of a questionnaire item specification.

[4] A Likert-7 scale lets users rate a construct on behalf of an ordinal scale consisting of seven discrete equidistant steps.

3.3 Concept and parameters of social impact assessment

Table 13 Template for the overall concept and parameters of the social impact questionnaire

Overall Concept and Parameters of the Social Impact Questionnaire

Introduction:

This is a concept of questionnaire for surveying stakeholders with regard to the social impact of urban development activities in each lighthouse city of the H2020 project RUGGEDISED.

To this end, a representative sample of each target stakeholder group has to fill out the questionnaire (in electronic of paper form).

The survey is meant to be performed multiple times throughout the project.

This version of the survey is meant to be used for the first campaign (before the fact, ex-ante).

Questions relate to three Levels:

L1	Urban Development Project as a whole -> QoL Individual + QoL Community
L2	Awareness of Ruggedized Project
L3	Acceptance of Smart Solutions

In addition, respondents are asked some basic demographic background variables (DEM).

Parameters:

City Nr:	1	**Target Area:**	Heart of South District (Rotterdam)
		City Name:	Rotterdam

City Nr	City Name	Target Area
1	Rotterdam	Heart of South District
2	Glasgow	Area around George + Duke Street from GCC Chambers Complex to Meat Market
3	Umea	Area around university campus and hospital

There are four types of user-perceivable smart solutions of which three apply for each city:

Cluster Nr.	Rotterdam	Glasgow	Umea	Smart Solution Name
1	x	x	x	SC1: EV charging infrastructure
2	x		x	SC2: Smart mobility support (e-bus, bus-stop)
3		x	x	SC3: Demand-side energy management & building control
4	x	x		SC4: Intelligent & efficient street lighting

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3.4 Quality of life

Table 14 Template for questionnaire on quality of life on individual level

QUESTIONNAIRE: L1a - Quality of Life on Individual Level

Aspect	Question	Scale	Min	Middle	Max
	To which extent does the urban development of the Heart of South District (Rotterdam) impact the quality of …				
Social	… your social life? (Family, Community, Social Stability, Culture, Recreation)	Likert-7	Highly negative	Neutral	Highly positive
Economy	… your economic situation? (income situation, ability to accumulate wealth, work satisfaction, eco. safety)	Likert-7	Highly negative	Neutral	Highly positive
Energy	… your supply with fuel and energy? (electricity, gas stations, renewable/clean energy;affordability,availability,reliability)	Likert-7	Highly negative	Neutral	Highly positive
Mobility	… your personal mobility? (bike routes, public transport, parking space, support for pedestrians, etc.)	Likert-7	Highly negative	Neutral	Highly positive
Policy/Governance	… decision-making on city and community level? (transparency, ability to participate, fairness, quality of outcomes, etc.)	Likert-7	Highly negative	Neutral	Highly positive
Ecology/Environment	… your immediate environment? (air quality, water quality, waste management, noise)	Likert-7	Highly negative	Neutral	Highly positive
Access publ. Svcs/amenities	… your access to public and commercial services and amenities? (Parks, places, shops, hospitals, schools, etc.)	Likert-7	Highly negative	Neutral	Highly positive

Table 15 Template for questionnaire on quality of life on community level

QUESTIONNAIRE: L1b - Quality of Life on Community Level

Aspect	Question	Scale	Min	Middle	Max
	To which extent does the urban development of the Heart of South District (Rotterdam) impact the quality of …				
Social	… life of the people in the area? (Family, Community, Social Stability, Culture, Recreation)	Likert-7	Highly negative	Neutral	Highly positive
Economic	… the economic situation of people in the area? (income situation, ability to accumulate wealth, work satisfaction, economic safety)	Likert-7	Highly negative	Neutral	Highly positive
Energy	… the supply of fuel and energy for people in the area? (electricity, gas stations, renewable/clean energy;affordability,availability,reliability)	Likert-7	Highly negative	Neutral	Highly positive
Mobility	… personal mobility of people in the area? (bike routes, public transport, parking space, support for pedestrians, etc.)	Likert-7	Highly negative	Neutral	Highly positive
Policy/Governance	… decision-making on city and community level as perceived by people in the area? (transparency, ability to participate, fairness, quality of outcomes, etc.)	Likert-7	Highly negative	Neutral	Highly positive
Ecology/Environment	… the immediate environment for people in the area? (air quality, water quality, waste management, noise)	Likert-7	Highly negative	Neutral	Highly positive
Access publ. Svcs/amenities	… people's access to public and commercial services and amenities? (Parks, places, shops, hospitals, schools, etc.)	Likert-7	Highly negative	Neutral	Highly positive

3.5 Awareness of the RUGGEDISED project

Table 16 Template for questionnaire on the awareness of the RUGGEDISED project

QUESTIONNAIRE: L2 - Awareness of the RUGGEDISED Project

Aspect	Question	Scale	Options					
Awareness	Have you already heard of the RUGGEDISED project before?	binary	yes	no				
Media	If yes, through which channels have you heard of the RUGGEDISED project?	multiple-choice	Internet	TV/Radio	E-Mail	Print	Word of mouth	Other: ……..
Involvement	What does your involvement in the RUGGEDISED project currently look like?	multiple-choice	No involvement	New sletter	Public project events	Active Contributions		Other: ……

3.6 Acceptance of smart solutions

Table 17 Template for questionnaire on acceptance of electric vehicle charging infrastructure

QUESTIONNAIRE L3-SC1: Electric Vehicle Charging Infrastructure (EVCI)

Aspect	Question	Scale	Min	Middle	Max
Perceived benefit	To which extent will the EVCI yield benefits to you (convenience, time savings, cost savings)?	Likert-7	Significant disadvantages	Neither	Significant benefits
Perceived benefit (community)	To which extent will the EVCI yield benefits to your fellow citizens/community?	Likert-7	Significant disadvantages	Neither	Significant benefits
Perceived ease of use (indiv+community)	The EVCI will be easy to use for me or other people	Likert-7	Fully disagree	Neutral	Fully agree
Intention to use the solution	How often will you use the EVCI?	Likert-7	Never		Daily/Regularly
Intention to change behavior (individual)	To which extent will the EVCI change your behavior towards increased adoption and use of EVs?	Likert-7	No change		Significant change

Table 18 Template for questionnaire on the acceptance of smart mobility support

QUESTIONNAIRE L3-SC2: Smart Mobility Support (SMS)

(SMS = Rotterdam -> New E-Buses on different Lines, Umea -> Heated bus stops)

Aspect	Question	Scale	Min	Middle	Max
Perceived benefit	To which extent will the SMS yield benefits to you (convenience, comfort, reliability, less noise, less pollution)?	Likert-7	Significant disadvantages	Neither	Significant benefits
Perceived benefit (community)	To which extent will the SMS yield benefits to your fellow citizens/community?	Likert-7	Significant disadvantages	Neither	Significant benefits
Intention to use the solution	How often will you use the SMS?	Likert-7	Never	Monthly	Daily/Regularly
Intention to use the solution - Motivation	Why? What is the main reason for using/not using the SMS?	Free Text Field			
Intention to change behavior (individual)	To which extent will the SMS change your behavior towards increased utilization of public transport?	Likert-7	No change		Significant change

Table 19 Template for questionnaire on acceptance of demand-side energy management for building control

QUESTIONNAIRE L3-SC3: Demand-side energy management for building control (DMBC)

Aspect	Question	Scale	Min	Middle	Max
Bkg: known buildings	Do you work or live in one of these buildings?	Multiple choice	building 1	….	building n
Bkg: prior knowledge	Have you ever heard of the concept "Demand-side energy management" before?	binary	yes		no
Bkg: DSM awareness	Are you aware of the fact that Demand-side energy management is implemented in the buildings mentioned above?	binary	yes		no
Perceived benefit	To which extent will the DMBC yield benefits to you (convenience, comfort, time savings, cost savings, flexibility, etc.)?	Likert-7	Significant disadvantages	Neither	Significant benefits
Perceived benefit (community)	To which extent will the DMBC yield benefits to its users/affected citizens?	Likert-7	Significant disadvantages	Neither	Significant benefits
Perceived ease of use	The DMBC will be easy to use for me	Likert-7	Fully disagree	Neutral	Fully agree
Intention to change behavior (individual)	To which extent will the DMBC change your behavior towards more ecological use of energy and resources?	Likert-7	No change		Significant change
Perception of data privacy	The DMBC maintains data privacy of its users	Likert-7	Fully disagree	Neutral	Fully agree

Table 20 Template for questionnaire on the acceptance of intelligent and efficient street lighting

QUESTIONNAIRE L3-SC4: Intelligent and efficient street lighting (IESL)

Aspect	Question	Scale	Min	Middle	Max
Perceived benefit	To which extent will the IESL yield benefits to you (convenience, increased safety, comfort)?	Likert-7	Significant disadvantages	Neither	Significant benefits
Perceived benefit (community)	To which extent will the IESL yield benefits to other citizens in the area?	Likert-7	Significant disadvantages	Neither	Significant benefits
Impact	What do you think will be effects/impact of the IESL?	Multiple choice	Energy savings, visability of sustainability, convenience, safety, comfort		

3.7 Demographic background

Table 21 Template for questionnaire on demographic background

QUESTIONNAIRE: DEM - Demographic Background Questions

Question	Options						
Your Sex	male	female					
Your Age	below 25 yrs	26-40 yrs	41-60 yrs	61-80 yrs	above 80 yrs		
Highest education completed	Primary school	Secondary school	Vocational Train	University	Postgraduate/PhD	Other	
In relation to the Heart of South District (Rotterdam), which kind of stakeholder are you? (multiple choices possible)	Work/Business	Student	Resident	Building Owner/Manager		Visitor/Tourist	Other: ……

4. Implementation of evaluation templates

4.1 Application of evaluation templates

The document has been prepared to get a common agreement on the data sets that need to be collected in order to show the impact of RUGGEDISED. At the same time the tables provide a basis for the tailored-made evaluation of each lighthouse city while ensuring a common approach is followed. Subsequently, three evaluation files will be created based on this template, one for each lighthouse city. In each file, specific setup within the demonstration area will be taken into account. At the same time, the templates will be filled in with the information that is available already. This allows us to see which information or data, which is to be collected before the implementation, is still missing. The allocation of responsibilities will happen in parallel to the preparation of D5.3 Maintenance plan. Both tasks will be finished due month 24.

All activities will happen in cooperation with local coordinators of lighthouse cities and local research partners. Evaluation sheets will be basis for the work in task 5.3 Data collection and its result D5.4 Monitoring documentation.

As regards the social impact assessment, the templates represent questionnaires to be filled out a large number of users (>200 for each stakeholder group)[5] in the two campaigns in the different lighthouse cities. The target groups will be defined together with each lighthouse city based on relevance and exposure of audience groups to the planned interventions in the respective demonstration areas[6]. For example, in Umeå, primarily students of Umeå University will be targeted, while in Glasgow, employees of the Glasgow City Council and members of the University of Strathclyde will provide their feedback. The purpose of this design is to enable a statistically reliable comparison of social impact over time for the well-defined, most relevant citizen stakeholder groups rather than for a complete representative cross-section of the city population. After each campaign, the results data from all returned questionnaires will be validated and aggregated for further statistical analysis.

All activities will happen in cooperation with local coordinators of lighthouse cities and local research partners. The impact questionnaire templates will be the basis for the work in task 5.5 Process evaluation.

4.2 Time schedule

The work on the collection of data has already started and will continue throughout the project. The adaptation of evaluation sheets will be performed as the following step and should be completed by month 14 at latest. In the same step the adapted sheets will be filled with already available data and responsibilities for data collection allocated. In parallel, the devices for monitoring equipment and data provision from them (automated or manual) will be set up in Task 5.2. The sheets will be directly further used in tasks 5.3 and 5.4. The following work will happen in three major phases:

- Collection of the remaining baseline and design data – this phase will start after the finalisation of adapted evaluation sheets in month 14. The collection of this data will be finished by month 24. The assessment of this data will happen right after within task 5.4.

- Collection of first monitoring data – this phase is scheduled after the finalisation of the first smart solutions. In some cases (buildings, mobility) one year is necessary to obtain the data. The data will be subsequently analysed and checked towards the target values. The results are basis for the interim report on the assessment of lighthouse cities (D5.5-1) and will be included in the draft of D5.4 Monitoring evaluation.

[5] In order to obtain a valid quote random sample, a sufficiently large share of each targeted population needs to participate in the survey. Subject participation thus represents a risk that needs to be monitored during campaign execution.

[6] The key here is that respondents must be citizens truly affected by the developments in the targeted demonstration areas. This is to be ensured by taking geography into account when advertising the surveys as well as by integrating checks (like a clickable map) in the survey to make sure that respondents truly live or commute in the respective target district.

- Final collection of monitoring data – Two years after the end of the implementation the second year monitoring data will be collected. This (more reliable) data will be used for the final assessment of lighthouse cities (D5.5-2) and for the final version of D5.4 Monitoring documentation.

As regards the social impact assessment, the template sheets will serve as basis for the process evaluation in Task 5.5. The following work will happen in two major phases:

- Clarification and preparation of the survey campaigns with the three light house cities – this includes the detailed design of the social impact survey campaigns (including definition of target groups and data formats) and the actual responsibilities and structures for executing them. In this context, AIT will provide a LimeSurvey instance of the questionnaires for each lighthouse city. Each city (local coordinator, with advice from local research organizations) will be responsible for questionnaire translation to the local language, adding the city-specific introduction and participant briefing, and pre-testing[7] the questionnaire. This phase will be finished by month 18.

- Actual monitoring of social impact – The actual survey campaigns are to be performed two times throughout the project in order to enable comparison between before-implementation and after-implementation conditions in each lighthouse city. In this sense, the first survey campaign will run from month 19 until month 25, while the second survey campaign will run from month 35 until month 41. Note that the monitoring of social impact will be implemented together with the organizational monitoring for efficiency reasons. During the survey campaigns, AIT will host the different instances of the questionnaires on a LimeSurvey server. Each lighthouse city (local coordinator, with advice from local research organizations) will be responsible for advertising the survey, ensuring that a sufficiently large number of respondents of the target groups participates in the survey[8], and that results data is provided in the right format and quality according to the guidelines[9] specified in the previous phase. AIT will then analyse the survey results data in order to quantify social impact of the different implementations. The results will be will be used for the final assessment of the lighthouse cities (D5.5-2).

[7] Based on the feedback of the pre-testing, AIT provide an improved LimeSurvey questionnaire instance for the actual campaign.

[8] Each city will need to monitor survey participation of each target group and in case of problems decide on corrective action in close coordination with AIT.

[9] The guidelines for survey data storage and exchange will be developed until month 18. They will address survey data structure, format, quality and timing of transfers.

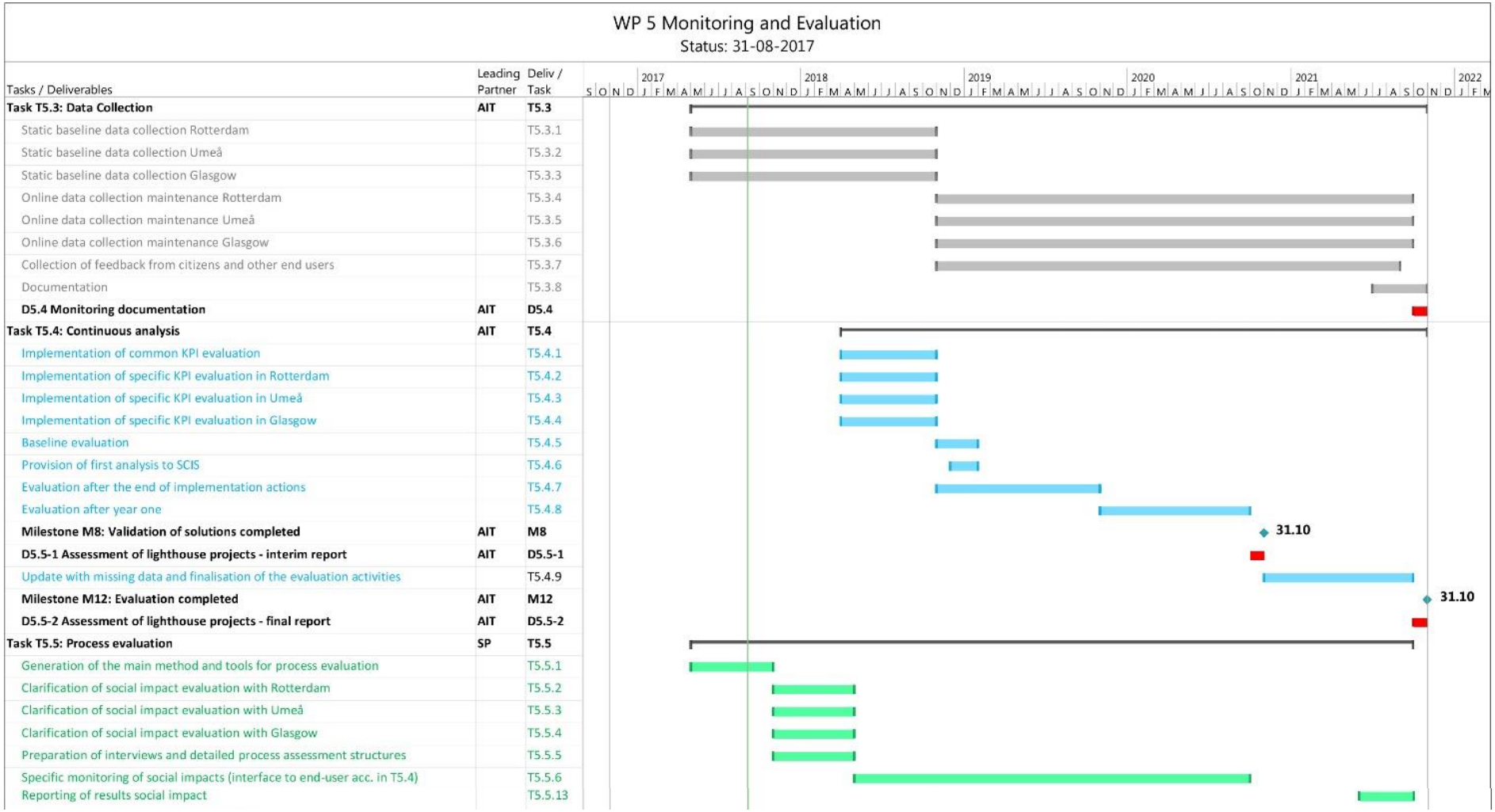

Figure 5 GANTT-chart showing tasks and subtasks with application or further use of evaluation templates

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