ANIMA

Aviation Noise Impact Management through Novel Approaches

Public version of D3.1

Study to identify the gaps – QoL indicators

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 769627

Project Information	
PROJECT ID	769627
PROJECT FULL TITLE	Aviation Noise Impact Management through Novel Approaches
PROJECT ACRONYM	ANIMA
FUNDING SCHEME	RIA – Research and Innovation action
START DATE OF THE PROJECT	01.10.2017
DURATION	48 months
CALL IDENTIFIER	H2020-MG-2017-SingleStage-INEA
PROJECT WEBSITE	www.anima-project.eu

Project Information	
DELIVERABLE N° AND TITLE	D3.1 Review of indicators of Quality of Life
BENEFICIARY NUMBER AND NAME	3 STICHTING NATIONAAL LUCHT- EN RUIMTEVAARTLABORATORIUM (NLR)
AUTHORS	Rui Roosien (NLR) Dirk Schreckenberg (ZEUS) Sarah Benz (ZEUS) Julia Kuhlmann (ZEUS) Paul D. Hooper (MMU)
CONTRIBUTORS	
WORK PACKAGE N°	3
WORK PACKAGE LEADER WP LEADER VALIDATION DATE	STICHTING NATIONAAL LUCHT- EN RUIMTEVAARTLABORATORIUM (NLR)
COORDINATOR VALIDATION DATE	26/11/2018

TABLE OF CONTENTS

TABLE OF ABBREVIATIONS

Acronym	Meaning	Explanation
ANIMA	Aviation Noise Impact Management through novel Approaches	Horizon 2020 project of which this study is a part
BA	Balanced Approach	ICAO guideline for mitigating aircraft noise consisting of noise source reduction, noise abatement procedures, land-use planning and operational restrictions
GDP	Gross domestic product	Monetary value of produced goods and provided services in a country
ICBEN	International Commission on Biological Effects of Noise	Non-profit organisation dedicated to promote high level scientific research on noise induced effects including preventive measures
ISO	International Organisation for Standardisation	Body that sets international standards in industry and commerce
MMU	Manchester Metropolitan University	English public university and partner in ANIMA
NLR	Netherlands Aerospace Centre	Dutch non-profit aerospace research institute and partner in ANIMA
OECD	Organisation for Economic Co-operation and Development	EU body to discuss, assess and coordinate social and economic policy
ONS	Office for National Statistics	Government statistics office of the UK
PWI	Personal Wellbeing Index	General QoL index developed by The International Wellbeing Group
QoL	Quality of life	Objective environmental parameters related to and a person's subjective reflections on current and future wellbeing
SCP	Social and Cultural Planning Agency (*Sociaal Cultureel Planbureau*)	Dutch independent research institute for social and cultural studies related to government policy
WHO	World Health Organisation	Body of the United Nations to assess, coordinate and improve worldwide health
WHOQOL	World Health Organisation Quality of Life	Group within WHO tasked with assessing QoL
ZEUS	Zentrum für angewandte Psychologie, Umwelt- und Sozialforschung	German centre for applied psychology, social and environmental research and partner in ANIMA

1 Executive Summary

This deliverable refers to ANIMA subtask 3.1.1 and comprises a critical review to establish the relevant indicators to be studied in WP3 on annoyance and residential quality of life and to inform WP2 'case studies' and WP4 'tool development' on the state-of-art related to quality of life (QoL). This task includes:

- Literature review to provide an overview of existing indicators for the quality of life.
- Identify gaps and lack of data for further improvements
- Alter the original experimental plans in WP3 accordingly
- Collects the findings in D3.1

For the purpose of this study, QoL is defined as the objective environmental parameters related to and a person's subjective reflections on current and future wellbeing. Indicators for QoL can help airports and governments to assess wellbeing of its community, monitor its impact on the community and compare the impact of different intervention options. A good indicator is accurate and measurable, but mostly either within an airport's sphere of influence or affected by the airport in a significant degree. For the compilation of the indicator database, indicators from different national and global initiatives were assessed in terms of use, relevancy and limitations. In all, 52 indicators were mapped onto 9 different dimensions of QoL.

A comparison of the available research on QoL to the present day practice of three European airports highlighted a lack of a systematic approach. However, the airports do acknowledge the need for such an approach as the historic focus on noise no longer suffices for getting and maintaining a 'license to operate'. An audit framework was created to allow airports to handle the broad topic of QoL in a more coherent, meaningful manner.

The findings have impact on WP2, WP3, and WP5.

2 Introduction

2.1 ANIMA context

The task described in this deliverable – ANIMA ST 3.1.1 – comprises a critical review to get the relevant indicators of quality of life (QoL) to be studied in WP3 as part of investigations into residents' annoyance and quality of life. This critical review is a thorough evaluation to ensure that ANIMA WP3 examines the most relevant and promising indicators from a more academic perspective and therefore goes beyond the 'best practice' review foreseen in WP2, notably ST2.2.1, ST2.2.2, and ST2.3.1. Where relevant, the findings of this subtask can be included in the best practices portal of WP5.

2.2 Relevance of topic

For decades airports, governments and communities have taken a limited approach in measuring the impact of airports on their environment. The positive impact is measured using the contribution to the gross domestic product (GDP), whereas the negative impact is often measured in terms of noise and other environmental consequences. In the meantime, 'Quality of Life' is getting increasingly attention from academics, from industry and from the general public (EUROSTAT, n.d.). Several indices for overall QoL, 'happiness' or 'wellbeing' already exist in addition to a vast array of indicators that address specific elements under the umbrella of QoL. Using a broader assessment of the impact of an airport on its surroundings, allows for a better balance of for the full range of positive and negative consequences associated with airport/aviation activity. Indicators for QoL could help airports and governments to better measure their impact, monitor progress and identify options for improvement.

2.3 Readers guide

This task includes:

- Overview of the approach and methods
- Literature review to provide an overview of existing indicators for the quality of life, this review goes beyond the field of aviation and noise, encompassing human factors in general
- Guidance for airports on how to include QoL in their engagement strategy
- Impact on other work packages within ANIMA

3 Approach

The deliverable is guided by two core principles:

1. The deliverable is to provide new insights that allow airports and authorities to move forward with their community strategy. Therefore, we will look beyond the domain of airport community engagement into other domains that deal with wellbeing and quality of life.
2. The deliverable is not only to provide interesting insights on QoL and QoL-indicators, but to give airports and authorities the means to apply these concepts in their corporate and community strategies. Therefore we will

focus on elements of QoL that are affected by aviation and or that can be influenced by the airports.

Guided by these principles, we have taken a phased approach consisting of a literature review, a gap analysis and a mechanism for the selection of indicators.

3.1 Literature review

The literature review starts by scoping the many definitions of quality of life into a single, clear definition of what is meant by 'quality of life'. To move beyond the aviation domain this started with a simple Google-search "definition quality of life". Quickly, this proceeded to a comparison between the definition of the World Health Organisation (WHO), EUROSTAT and local studies such as that by the Dutch Social and Cultural Planning Agency (SCP) and the British Office for National Statistics (ONS). The definitions were combined into a single definition using expert judgement that reflects the combination of objective environmental factors, subjective perceptions and expectations about the future.

To deal with its complexities, QoL can be segmented into multiple dimensions. These segmentations can stem from academia such as Manfred Max-Neef's 'Fundamental human needs' (1991) to more practically oriented approaches based on the UN's sustainable development goals (UN, 2015). Since the segmentation is merely used as a tool to help airports divide the broad concept of QoL into manageable topics, a practical segmentation was needed. The result was a segmentation that used elements from multiple sources, primarily from the Fundamental Human Needs and the Doughnut of Social and Planetary Boundaries (Raworth, 2012). However since the resulting segmentation was so close to the EUROSTAT segmentation (EUROSTAT, n.d.), the latter was opted to provide a framework that allows categorisation of various aspects of QoL.

For the collection of indicators, the team reviewed common general indices for QoL, 'wellbeing' and 'happiness' from multiple global sources such as the WHO, EUROSTAT and the 'Happiness Report' by the Sustainable Development Solutions Network (Helliwell, Layard, & Sachs, 2017) as well as national sources from Germany, the UK, and The Netherlands. The indicators that are used to calculate these general indices were included into a database (see Annex 8.5). For each indicator the field of origin, typical use, and how they are determined were listed.

Next, all indicators were mapped onto one of the QoL dimensions. Using expert judgement, the indicators were assessed in terms of data availability, sensitivity to changes in QoL, general advantages, general limitations and relevance to the airport. Although by no means complete, the database shows good coverage among all dimensions of the EUROSTAT segmentation of QoL. The most promising indicators were then described per dimension.

3.2 Gap analysis

The gap analysis looks into the current airport practice on the subject of QoL. What do airports define as QoL? Why do airports look into QoL? What ambitions do airports have and what actions are undertaken to realise these?

By answering these questions gaps between current practice and QoL state-of-art were determined. This resulted in an audit framework that airports can use to

effectively assess their current engagement with QoL issues and thereby inform the development of a more strategic and systematic approaches.

4 Literature review of QoL indicators

4.1 Defining Quality of Life

Research reveals that there are multiple efforts to illustrate a "concept of quality of life" and assess quality of life either on a national basis from different countries (e.g. 'Measuring National Well-being', ONS; the Dutch 'Leefsituatie index', SCP; the Italian 'Benessere Equo e Sostenibile'; the Austrian 'Wie geht's Österreich?', STATISTIK AUSTRIA) or through initiatives such as the Organisation for Economic Co-operation and Development (Eurofound, 2013; OECD, 2017).

Garcia Diez (2015) compared the assessment of quality of life from different national initiatives and the approach of EUROSTAT and concluded that there is a comparable basic structure within these quality of life assessments with regard to dimensions but also differences in methods used. These different approaches to classifying quality of life by dimensions often overlap in terms of topic and differ in wording. Overall, the majority of studies regard aspects such as health, education, employment, governance, social relationships, environment, security and overall life satisfaction as essential factors/as being aspects of QoL.

According to The International Wellbeing Group (2006), it is crucial to differentiate between objective and subjective dimensions of QoL as they do not reflect the same aspects. Therefore, the researchers developed the Personal Wellbeing Index (PWI) in order to measure the subjective dimension of QoL. The importance of this distinction as well as the necessity to assess both is also emphasized in a final report about QoL indicators by EUROSTAT (2017). EUROSTAT combined objective indicators of QoL with the individuals' subjective (perceived) situation. A total of nine different dimensions were considered: material living conditions, productive or main activity, health, education, leisure and social interactions, economic and physical safety, governance and basic rights, natural and living environment, and overall life satisfaction.

4.2 Rating the indicators

The compilation of indicators comprises both indicators from studies with a multidimensional approach to assess quality of life and indicators that cover a part of a dimension (e.g. residential satisfaction as part of housing/environmental quality of life). It also contains both objective and subjective indicators.

The following information about identified indicators was gathered as those aspects that are considered being relevant for the purpose: field, use, method, advantages, sensitivity, limitations, capacity to influence by aviation and classification to a specific aspect of quality of life dimension (e.g. health, education, etc.). Some indicators cover subjective well-being, others are objective criteria for a good life in general.

The compilation of the 52 collected indicators for QoL is presented in Annex 8.5. Indicators are assigned to the EUROSTAT dimension with the best fit (EUROSTAT, 2015a).

The indicators need to be of good quality and need to match the goals of the airports. Therefore the indicator needs to be easily monitored and ideally have

data available of a high quality. To match the goals of the airport it is also important that the aspect captured by the indicator can be influenced by the airports.

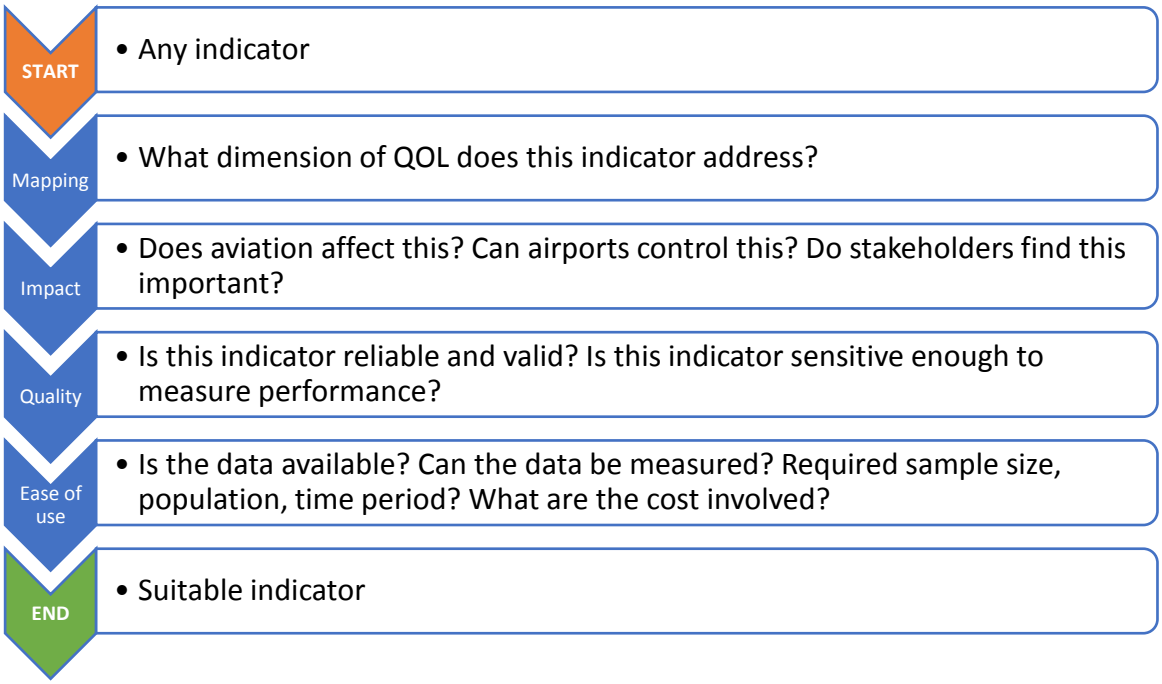

Figure 1: selecting a suitable indicator

4.3 Indicators for health

The dimension 'Health' divides into the topics 'outcome' (including self-perceived health and health effects), determinants of health and access to healthcare.

Outcomes take into account the health status of individuals including physical and mental health aspects. Further short-term outcomes and long-term outcomes should be considered. For the topic healthcare the availability and accessibility as well as the quality of medical care are the focus. Personal health determinants like physical activity, diet, tobacco consumption and alcohol consumption are considered due to their influence on overall health. But also external stimulus such as noise and air quality influence health.

Indicators differ in their method of assessment, their level of detail and their scope. Subjective and objective measurements mainly differ in methods of assessment. While objective measures are measured or observed from a third party (e.g. % cancer patients) and often derived from public data, subjective data is gathered via one's own rating of a situation or subject (e.g. self-perceived health status). Furthermore, there are high-level indicators (e.g. life expectancy) and more specific indicators that address a specific part of a topic (e.g. sleep quality as part of overall health). Finally, the perspective of an indicator can be on a community level (e.g. infant mortality in a country state) or on individual level. The classification of indicators into the types described above is not always straightforward and it should be recognised that there can be overlap as the categories are not necessarily strictly exclusive.

A common objective indicator in the aviation industry (and other industries) is the sound level. Sound levels can be used to assess the health impact of aircraft noise on the community. After establishing the noise contours, industry standard dose-response relationships can be used to derive estimated impact on the affected population measured in terms as 'people highly annoyed by noise'. (Miedema & Oudshoorn, 2001). Although widely used, the correlation between sound levels and annoyance is debated. Other indicators that might be appropriate for noise annoyance could be the frequency of (high noise) events or the length and frequency of periods with low noise levels (respite).

A subjective measure of noise annoyance is assessable via standardized single question items recommended by the International Organization for Standardization (ISO/TS 15666; Fields, et al., 2001) with a numerical or verbal rating scale.

As a high-level indicator health-related quality of life can be assessed by various standardized questionnaires, e.g. the short-form health survey questionnaire SF-36 or the WHOQoL developed by QoL-group of the WHO. Both are rather long and as a consequence rather time-consuming and cost-intensive. Often short forms are available, for example with a short form of the SF consisting of 8 items (SF-8; German version by (Beierlein, Morfeld, Bergelt, Bullinger, & Brähler, 2012)).

For the selection of appropriate indicators, the relevance for use by airports must be considered. An important aspect is that indicators can be addressed and influenced by stakeholders or interventions. Another important selector is data availability. The airport must have access to the indicators or have access to qualified experts who can do the measurements.

4.4 Indicators for economic and physical safety

Indicators of the dimension 'economic and physical safety' encompass measures of economic stability and safety from physical harm. Therefore, these indicators are less about the level of income and material living conditions and more about resilience, financial and physical stability and a positive outlook on these variables in the future. Economic and physical safety can come from one's own means or from friends, family or the government.

EUROSTAT (2015a) identifies subjective high-level indicators for economic safety such as the binary response to the question: "Are you able to cope with unexpected financial expenses?". Other subjective indicators are the binary responses to questions as such "Do you have someone to count on in times of need?" (SCP, 2017) and "Do you have someone for support?" (Helliwell, Layard, & Sachs, 2017). These indicators measure resilience and possible sources of economic security at an individual level.

In addition, several objective indicators can be used to measure enablers of economic safety. Relevant examples are job security (type of contract), minimum wage (at a national level) and the availability of social securities (as part of the job benefits or at a national level) (SCP, 2017). These indicators can be measured at both the community and the individual level.

Regarding physical safety, EUROSTAT distinguishes between acts of crime, the perception of crime and the perception of physical safety. Objective indicators for the prevalence of crime are reported crime rates. Example sources are the Crime Survey for England and Wales and police crime data (ONS UK, 2018). Reported crime does not always go hand-in-hand with the perception of crime. Therefore it is useful to include indicators on perceived safety. A subjective indicator is the response to questions like "Do you ever feel unsafe in your own neighbourhood?", "Do you regularly feel unsafe in your own neighbourhood?", "Do you ever feel unsafe in general?" (CBS, 2017).

Airports can use the above indicators to monitor the economic and physical safety of their community. Sub-indicators related to the economic safety and community are probably the most relevant as they are closest to the airport's span of control. Furthermore, economic safety is also closely related to indicators for the main activity.

4.5 Indicators for natural and living environment

This dimension refers to environmental aspects of quality of life. It focuses both on perceived environmental influences and perception of the environmental surrounding as well as objectively measured appearance of green and/or recreational areas close to the place of residence, surrounding environment in general and environmental pollution.

"Environmental conditions affect human health and well-being both directly and indirectly, while residents value their rights to access environmental resources. Moreover, environmental factors indirectly affect other quality of life aspects, including economic prosperity and inequality, e.g. by directly affecting property prices and housing conditions." (EUROSTAT, 2015a)

An objectively measured indicator is population or housing density in the studied area whereas a subjectively examined indicator in this dimension is self-reported exposure to any kind of pollution, grime and the perception of environmental problems.

Noise is a theme already common to airports. On a community level another objectively measured or calculated indicator is traffic noise exposure. In many countries there are noise maps that are created/compiled and provided by authorized authorities for the purpose of documentation and the monitoring of regulatory limits. EU countries are even obliged to make strategic noise maps following the Environmental Noise Directive, (Directive 2002/49/EC). In return self-perceived exposure to noise is an evaluation on an individual level. The EUROSTAT set identifies explicit indicators referring to noise: 'noise from neighbours' and 'noise from the street', which are described as 'noise from neighbouring apartments, staircase or water pipe" and "noise linked to traffic (street or road, plane, railway), linked to business, factories, agricultural activities, clubs and yard' (EUROSTAT, 2015b).

On a high-level basis the corporate consulting company Mercer for instance provides an annually Quality of Living ranking for cities that comprises information about local living conditions summed up in ten categories like natural

environment (Mercer, 2017) (Information available on homepage, for detailed information about assessment and underlying information a report is available for purchase).

On both a more specific and individual level, perceived residential satisfaction is an appropriate indicator to provide information about specific qualities of the residential area of interest, for example measured with the 16-item questionnaire 'satisfaction with residential quality' by Wirth (2004).

Indicators in the dimension natural and living environment can be directly addressed by airport interventions. Perception of the surrounding environment is directly influenced by nearby airports and associated with attached infrastructure. Further built landscape and environmental pollution is often directly linked to airports therefore interventions can target environmental pollution such as noise exposure as noise is a common and relevant sub-dimension to consider. Other interventions like communication campaigns could be used emphasizing the positive influence of airports on the surrounding environment.

4.6 Indicators for work or other main activity

A main activity refers to a person's paid or unpaid work and can be split into having a main activity and qualitative aspects of that main activity.

Having a main activity is very important for quality of life. Several objective indicators are available. A common indicator is the unemployment rate. The unemployment rate is the number of people without work as a percentage of the labour force[1]. Another objective indicator is the percentage of people aged 15/16 to 74 not in employment education or training. The former excludes students and people not looking for work, the latter does not (ONS UK, n.d.).

Qualitative indicators relate to work-life balance and job satisfaction. A subjective quantitative indicator for the work life balance is the number of hours worked. According to the third European QoL survey, wellbeing improves with the number of hours worked up to 41 hours per week (Eurofound, 2013). Job satisfaction can be measured with a subjective questionnaire with a Likert-scale. For example "How satisfied are you with your job?".

Airports are often a major generator of job opportunities. This happens directly via jobs with the airport operator, the airline or the air traffic control, via suppliers of the airport, and via induced economic activity (e.g. in tourism or international business) (Economic_impact_SPL). Therefore, airports can easily monitor and record their impact on QoL using the indicators stated above.

4.7 Indicators for education

Education is another pillar of QoL as it raises a person's potential. Moreover, education increases the chances at a meaningful and well-paid job that increases the standard of living. As such it has a positive impact on a person's future outlook. Finally, education appears to have a positive impact on health, with

[1] all aged between 15/16 and 74 who are willing and able to work within two weeks (EUROSTAT, 2010)

higher reported happiness and fewer mental illnesses associated with higher levels of educational attainment (EUROSTAT, n.d.).

A common objective indicator is the expected and mean years of schooling for a community as tracked by UNESCO (UNDP, 2016). Another objective indicator is the percentage of people aged 15 to 74 without any formal qualifications (ONS UK, n.d.). The indicator 'percentage of people aged 15/16 to 74 not in employment education or training' as described in section 4.6 also applies to education. Special consideration can be paid to internet and computer skills.

Airports can improve the level of education of their community by offering educational packages and internship opportunities to students and computer training for seniors. On-the-job training opportunities for the airport's workforce can lead to 'life-long learning'.

4.8 Indicators for material living conditions

The dimension 'material living conditions' is related to economic safety and main activity but deals with a person's possessions and consumer power. It can be divided into income and material conditions.

'Income' covers the income levels, poverty, and the distribution of wealth. An objective indicator is the natural log value of the income capped at an annual income of $70.000. The rationale behind using a logarithmic scale is that the impact of additional income on quality of life diminishes as the income becomes higher. At approximately $70.000 (exact amount differs per region), additional income cannot be correlated to increased QoL (UNDP, 2016). Poverty can be measured by the percentage of households with an income below 60% of the median income (ONS UK, n.d.). Distribution of income can be expressed using the Gini-index. A (theoretical) Gini value of 0 indicates that all households earn an equal amount, whereas a (theoretical) value of 1 indicates that all income is earned by just one household. The optimal Gini value is a highly political topic. Income inequality can stimulate entrepreneurship and incentive to do better. However, extreme inequality can lead to a low satisfaction among those worse off.

'Material conditions' can refer to material deprivation and housing conditions. An important example index for material conditions is the Dutch 'Life situation index', an aggregated index on housing and having certain items such as a television, computer, etcetera (SCP, 2010). The index can be augmented with questionnaires on the content with the material conditions.

As a job provider, airports have a direct impact on income. Other elements of income are harder to influence. If the distribution of income is a hot-topic, the compensation for the airport's top management could be a consideration for financial satisfaction of the nearby community. To stimulate material conditions, airports have different options as well. Insulation programmes are common. Other options could be improving access to computers for the deprived or the funding of job training programs (e.g. for refugees).

4.9 Indicators for leisure and social interactions

The dimension 'Leisure and social interactions' includes the topics leisure and social interactions. Subtopics of leisure are quantity, quality and access to leisure in terms of availability of time to do things people enjoy and participation in certain leisure activities. Subtopics of social interactions are activities with and for people, supportive relationships and social cohesion.

Leisure and social interactions can also be observed at a community and an individual level. As an indicator at a community level the percentage of people engaging in voluntary work could be, whereas satisfaction with the voluntary assignment represents leisure on an individual level.

Referring to the ANIMA-set of indicators, the UK's Office for National Statistics (ONS) for instance identifies in the assessment of National Wellbeing subjective measurements for leisure in form of single-item-measurements. Satisfaction with amount of leisure time is assessed using a 7-point Likert scale with responses ranging from "Completely dissatisfied" to "Completely satisfied" (ONS, 2017). Engagement in voluntary work is examined with the question 'How frequently do you do unpaid voluntary work?' again responses are collected on a 5-point-likert scale from 'at least once a week' to 'never/almost never' (ONS, 2017), whereas objectively measured engagement in voluntary work could derive from national public data.

For the subtopic social interactions there are mainly subjective indicators that refer to social interactions both at a community and individual level, these are supplemented by high-level and specific indicators such as the overall satisfaction with personal relationships or frequency of getting together with relatives (EUROSTAT, 2015a). The ANIMA set contains further examples in the field of social interactions from the ONS and the Dutch 'Life situation index'. Supportive relations can be investigated by asking whether respondents have someone to rely on (in case of serious problems), using questions like "How much can you rely on your spouse/family member/friend if you have a serious problem?" with responses categorised using a 5-point Likert scale from 'a lot' to 'no friends, family or spouse' (ONS, 2017). Similar items are included in the 'Life situation index' with questions about social isolation, including items that focus on having someone to communicate with or having someone to turn to (SCP, 2010).

Airports can address this dimension by offering events to join for people's everyday life. Organizing events for residents is an opportunity to give an insight and has the positive side effect of getting to know the neighbouring company. This can be implemented in form of open days for kindergartens, schools or residents in general, the hosting of leisure activity competitions or sponsoring (sports-)wear for surrounding (sports) clubs. Some airports already implement such interventions. And certainly airports can contribute to leisure and social interactions by getting their community to holiday destinations and to their loved ones.

4.10 Indicators for governance and basic rights

The dimension 'governance and basic rights' breaks down in attitudes towards institutions and public services, aspects related to discrimination and equal opportunities as well as active citizenship. Subtopics for institutions and services for instance refer to trust and/or satisfaction in institutions and trust and/or satisfaction in public services.

Based on the ANIMA-set of indicators the assessment of UK's ONS on national Wellbeing offers indicators in the segment government via an objective and a subjective measure: voter turnout and trust in government. Voter turnout is an objective high-level measure that reflects a direct active civil participation in political process. Comparison is possible over time and region thus it is usable at a community level. Trust in government however, is a subjective indicator and is assessed by the ONS by asking about the tendency to trust a range of institutions (ONS, 2017). Trust can thus be measured at a community and individual level.

Focusing on basic rights, EUROSTAT provides an objective high-level indicator referring to equality in form of gender pay gap using statistical data (EUROSTAT, 2017). Other examples for objectively measured indicators for equality are indicators that have influence in the Gender Equality Index (European Institute for Gender Equality, 2017) such as power in the form of gender distribution in share of ministers.

Some indicators in this dimension might be difficult to address or hardly applicable in the present study since the influence of airport authorities and interventions in this field tends to be small or might be inappropriate. Thus criteria for relevance are aimed in terms of capacity to influence and relevance to QoL. Airports could however lead by example by having transparent procedures and governance.

4.11 Indicators for overall quality of life

Eurostat's ninth dimension of quality of life is 'overall experience of life'. It contains the subjective rating of quality of life for three aspects: life satisfaction, affects (presence of positive feelings respectively absence of negative affects) and meaning and purpose of one's life.

For the present study we expand the subjective evaluation within the ninth dimension 'overall quality of life' by global indices from established initiatives to the dimension "overall quality of life". Various national and international initiatives have developed their own approaches to measure quality of life in general addressing multiple topics, including the OECD with its Better Life Index, the Dutch 'Life situation index' or UK's Office for National Statistics with its Measuring National Well-being programme, that all cover relevant topics of quality of life (and often overlap in terms of addressed topics). In various approaches by initiatives no summaries or aggregation of the indicators to one global indicator are carried out but rather subtopic indicators are summed up.

Subjective measures are the rating of overall life satisfaction (Eurofound, 2012), similarly assessed by the ONS asking participants to rate their satisfaction with

their lives overall on a scale of 0 to 10 (with 0 'not at all' to 10, 'completely') or the Personal wellbeing index (The International Well-being Group, 2006) comprising eight items to rate satisfaction in eight different life domains.

Criteria for relevance in this dimension are capacity for influence and scale of influence.

5 Supporting airports to make rational decisions on QoL

Our review of different QoL schemes and attempts by national and other bodies to capture and track the full range of criteria and indicators adopted across the EU has demonstrated the following:

- *There is considerable consensus among national governments and other organisations and researchers as to the core elements that inform QoL*
- *A range of 'meta' dimensions exist (e.g. those used by EUROSTAT) within which there are a number of topics and associated indicators*
- *Indicators fall into two primary categories; objective and subjective. The former often relate to existing data sets, collected for a range of reasons (e.g. regulatory compliance, policy implementation, etc.) on an aggregated level, whilst the latter are most commonly extracted via questionnaire surveys referring to an individual level.*

As highlighted in the interview summaries with representatives from airports at the lead-edge of engagement with QoL (see Annex 8.1 – 8.4), initiatives to address QoL issues are being pursued in a piecemeal fashion, often in response to particular challenges (e.g. new infrastructure) and/or in response to political pressure.

Thus engagement with QoL issues is not systematic, often lacking an overall rationale, conducted by different parts of airport organisations and seldom evaluated for impact on specific QoL topics, let alone QoL dimensions.

Nevertheless, airports recognise that there is a need to address QoL issues if the industry is to maintain/secure a 'licence to operate/grow' and further that more effective engagement with QoL issues may have a positive impact on those non-acoustic factors known to affect annoyance responses to noise. Thus a more systematic and critical approach to QoL may help mitigate noise impacts, as well as providing a framework for the evaluation of the efficacy of individual interventions.

So what should a more systematic approach for airport engagement with QoL issues look like?

A good starting point is to audit engagement with QoL issues in order to:

- *Determine which topics and dimensions are already addressed*
- *Understand how specific interventions within topics are being evaluated and whether a link to QoL outcomes can be made*
- *Identify topics/dimensions that are not being addressed that the airport could/should be engaging with. Indeed these 'gaps' could form the basis of discussions with local communities as to what is regarded as most useful/beneficial*

This activity could then inform the *development of a QoL Strategy* with defined activities, evaluation processes, targets, etc. Such an approach would also allow airports to provide a rationale for why certain QoL dimensions and topics are being given precedence whilst other may not be a priority (i.e. ones that airports could not reasonably influence).

Thus the conclusion from the review of QoL schemes and airport engagement with QoL issues is to propose the development of an audit framework to capture and categorise airport QoL interventions and gaps, with follow-up action to establish priorities and develop a comprehensive QoL strategies informed by community engagement. This approach would enable airports to:

- Build on existing strengths
- Address gaps in coverage
- Evaluate interventions based on indicators, which in turn can be assessed for their quality using the criteria; frequency, timeliness, breakdown by sub-categories and relevance (as defined by EUROSTAT).

5.1 Audit framework: from interventions to QoL Dimensions

The audit framework outlined below would allow airports to categorise their existing QoL interventions against a comprehensive list of QoL topics and dimensions. For example:

Table 1: example audit framework

QoL Aspects		
Dimensions	Topics	Examples of Airport Actions/Interventions
Health	Personal health	LAQ improvement campaigns, noise abatement
	Access to healthcare	-
Economic and physical safety	Economic safety	-
	Physical safety	Third-party risk control
Natural and living environment	Environmental conditions	LAQ monitoring Noise mitigation interventions Support for litter collection schemes
	Access to basic services, recreational/green areas	Investment in community sports facilities
	Access to basic services	Support for public transport services
Education	Educational attainment	Support for local schools
	Educational activity (formal and informal)	Staff volunteering in local educational institutions
	Population going on to tertiary education	Staff volunteering in local educational institutions
Main activities	Having a main activity	Hire locally
	Satisfaction	Offer on the job training, career opportunities
Material living conditions	Income	Sensible and transparent compensation for top management

	Material conditions	Insulation program to improve housing
Leisure and social relations	Availability	Sponsorship for local community groups
	Quality	-
	Access	-
Governance and basic rights	Attitude	Fair and transparent procedures
	Equality	-
	Active citizenship	-
Overall QoL	Life satisfaction	-
	Affects	-
	Purpose	-

NB – Airports interventions listed here are for illustrative purposes only (i.e. they are not intended to be representative nor recommended)

Using the framework above, airports could identify the range of their QoL activities, understand how these relate to QoL topics and dimensions, develop a rationale for why certain dimensions/topics may be out of scope, and highlight priority areas for development.

Further, airports would appreciate the availability of QoL data at a topic and dimension level that might reasonably be affected by their interventions in the medium/long term. This combined with the use of intervention-specific monitoring (short-term impact) should enable more systematic evaluation of the outcomes of QoL actions, which again could inform strategy going forward.

5.2 Conclusions on relevant indicators for Quality of Life

The identified indicators found in annex 8.5 can be used by airports to monitor and improve the 9 dimensions of Quality of Life. In general, high quality indicators are readily available. When the required data is not available or not available for the right population, established questionnaires can be used to fill these gaps with relative ease. Selecting from the vast pool of available indicators is more difficult, not to mention weighing the different dimensions against each other. Can an improvement in the health dimension offset a decrease in the main activity dimension? This question is impossible to answer in general fashion. Among others, cultural factors make communities value different dimensions in different ways, the existing baseline impacts the perceived improvement or reduction of QoL and airport operations can differ greatly.

It is important to remember that all changes, even interventions for improved QoL, have winners and losers. Assuming the airport is already within legal limits, the audit framework shown in table 1 can be used to review existing measures in a single coherent overview. It is then the shared responsibility of airport and community to identify priorities among the dimensions, select the indicators for tracking performance and set goals to strive for. This enables community buy-in for the airport interventions which is desirable for three reasons: community input makes it easier to set local priorities, different groups among the community can be heard, and the responsibility of the outcome (both positive and negative) is shared. Together, airport and community can use the concept of

QoL, the indicators and the audit framework to improve airport-community relations and make more effective interventions that provide real benefit to those living near an airport.

6 Impact on other work packages

The availability of the QoL audit framework proposed here will be of direct use in the following STs.

6.1 WP2

ST2.3.1 - will provide a detailed understanding of the motivation for, nature and implications of specific Balanced Approach (BA) interventions, which in turn will help clarify expectations in terms of intended outcomes both acoustic and non-acoustic. The QoL framework should help inform this assessment of outcomes.

6.2 WP3

ST3.1.2 – understanding the link between specific BA interventions and implications for QoL is part of establishing the efficacy of interventions in terms impact mitigation. In other words, evaluation has to extend beyond monitoring and reporting the impact on noise exposure resulting from a given intervention. Indeed it is expected that *how* interventions are designed implemented (e.g. extent of community engagement) may have implications for the ultimate impact on QoL, which can be informed by a comprehensive understanding of all aspects of QoL.

ST3.2.1 - while ST 3.1.2 aims to evaluate existing interventions in terms of an improvement in quality of life of residents within an ex post study design, ST 3.2.1 aims to investigate whether more effective communication and engagement can help reducing levels of annoyance. This is done within a before-after study of a communication and engagement campaign that is developed by ANIMA partners within the subtask. To obtain a comprehensive impression of the impact of the introduced intervention the evaluation in ST 3.2.1 is undertaken with an innovative mix of quantitative and qualitative approaches for the annoyance assessment. This requires adopting a broader perspective of the concept of annoyance including the assessment of coping to the noise situation, perception and acceptability of the communication campaign and the communicators and the further environmental and/or health-related quality of life indicators. For this, ST 3.1.1 provides input in terms of indicators of QoL beyond the usual single annoyance questions as recommended by the International Commission on Biological Effects of Noise (ICBEN).

6.3 WP5

WP5 – as part of the Best Practices portal the audit framework should assist those airports already engaging with QoL issues to address these in a more systematic fashion, whereas for those airports just starting on the journey the framework should inform/structure discussions with local communities to establish QoL interventions tailored to airport-specific contexts. Further the framework should assist with developing appropriate targets and evaluation metrics.

7 Works cited

Beierlein, V., Morfeld, M., Bergelt, C., Bullinger, M., & Brähler, E. (2012). Messung der gesundheitsbezogenen Lebensqualität mit dem SF-8. Deutsche Normdaten aus einer repräsentativen schriftlichen Befragung. *Diagnostica, 58*(3), 145-153.

CBS. (2017). *Veiligheidsmonitor.* The Hague, The Netherlands: Centraal Bureau voor de Statistiek.

Directive 2002/49/EC. (2002, July 18). Directive 2002/49/EC of the European Parliament and of the Council of 25 June 2002 relating to the assessment and management of environmental noise. Official Journal of the European Communities No. L189/12. Retrieved from http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32002L0049&from=EN

Eurofound. (2012). Third European Quality of Life Survey - Quality of life in Europe: Impacts of the crisis. Luxembourg: Publications Office of the European Union.

Eurofound. (2013). *Quality of life in Europe: Subjective well-being.* Luxembough: Publications Office of the European Union.

European Institute for Gender Equality. (2017). *Gender Equality Index 2017 - Measuring gender equality in the European Union 2005-2015.* Retrieved from eige.europa.eu/sites/default/files/documents/20177277_mh0517208enn_pdf.pdf .

EUROSTAT. (2010, June 30). *Glossary:Unemployment*. Retrieved from EUROSTAT website: http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Unemployed

EUROSTAT. (2015a, March 18). *Quality of life indicators*. Retrieved from EUROSTAT website: http://ec.europa.eu/eurostat/statistics-explained/index.php/Quality_of_life_indicators

EUROSTAT. (2015b). *Quality of Life. Facts and views.* Luxembourg: Publications Office of the European Union.

EUROSTAT. (2017). *Final report of the expert group on quality of life indicators.* Retrieved from http://ec.europa.eu/eurostat/web/products-statistical-reports/-/KS-FT-17-004

EUROSTAT. (n.d.). *Background - GDP and beyond*. Retrieved from EUROSTAT website: http://ec.europa.eu/eurostat/web/gdp-and-beyond/background

EUROSTAT. (n.d.). *Quality of Life (QOL)*. Retrieved from EUROSTAT website: http://ec.europa.eu/eurostat/web/gdp-and-beyond/quality-of-life

Fields, J., DeJong, R., Gjestland, T., Flindell, I., Job, R., Kurra, S., . . . Schuemer, R. (2001). Standardized general-purpose noise reaction questions for community noise surveys: Research and a Recommendation. *Journal of Sound and Vibration, 242*(4), pp. 641-679.

Garcia Diez, S. (2015). Indikatoren zur Lebensqualität. Vorschläge der europäischen Expertengruppe und ausgewählte nationale Initiativen. *WISTA, 6*, pp. 11-21.

Helliwell, J., Layard, R., & Sachs, J. (2017). *World Happiness Report.* United Nations.

ISO/TS 15666. (2003). Technical Specification, Acoustics-Assessment of Noise Annoyance by Means of Social and Socio-acoustic Surveys. Geneva, Switzerland: International Organization for Standardization.

Max-Neef, M. (1991). *Human scale development.* New York, New York, USA: The Apex Press.

Mercer. (2017, March 14). *Vienna tops Mercer's 19th Quality of Living ranking.* Retrieved from https://www.mercer.com/newsroom/2017-quality-of-living-survey.html.

Miedema, H. M., & Oudshoorn, C. G. (2001). Annoyance from transportation noise: relations with exposure metrics DNL and DENL and their confidence intervals. *Environmental Health Perspectives, 109*(4), pp. 409-416.

OECD. (2017). *How's life?* Paris, France: Organisation for Economic Co-operation and Development.

ONS. (2017, April 6). *Measuring National Well-being: Domains and Measures*. Retrieved from https://www.ons.gov.uk/peoplepopulationandcommunity/wellbeing/datasets/measuringnationalwellbeingdomainsandmeasures.

ONS UK. (2018). *Crime and Justice*. Retrieved from Office for National Statistics (GB) website: https://www.ons.gov.uk/peoplepopulationandcommunity/crimeandjustice

ONS UK. (n.d.). *Education and childcare.* Retrieved from Office for National Statistics (GB): https://www.ons.gov.uk/peoplepopulationandcommunity/educationandchildcare

ONS UK. (n.d.). *Employment and labour market*. Retrieved from Office for National Statistics (GB): https://www.ons.gov.uk/employmentandlabourmarket

Raworth, K. (2012). *A safe and just space for humanity.* Oxford, UK: Oxfam.

SCP. (2010). *Wellbeing in The Netherlands - The life situation index since 1974.* The Hague, The Netherlands: The Netherlands Institute for Social Research.

SCP. (2017). *De sociale staat van Nederland.* The Hague, The Netherlands: Sociaal en Cultureel Planbureau.

The International Well-being Group. (2006). *Personal Wellbeing Index - Adult (PWI-A). Manual (4th ed.).* Melbourne: Australian Centre on Quality of Life, Deakin University.

UN. (2015, September). *Sustainable development goals*. Retrieved from United Nations website: http://www.un.org/sustainabledevelopment/sustainable-development-goals/

UNDP. (2016). *Human Development Report 2016.* New York, NY, USA: United Nations Development Programme.

Wirth, K. (2004). Lärmstudie 2000. Die Belästigungssituation im Umfeld des Flughafens Zürich. Aachen: Shaker.