Horizon 2020

Societal Challenge: Improving the air quality and reducing the carbon footprint of European cities

Project: 690105 – ICARUS

Full project title:

Integrated Climate forcing and Air pollution Reduction in Urban Systems

MS2: Literature reviewing protocol

WP1: Methodological framework development

Lead beneficiary: JSI

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Aim

According to DoW (WP1, Task 1.1.), literature reviews prepared within ICARUS will follow the *Extensive Literature Search (ELS)* approach to allow transparency and reproducibility of the outcomes. The systematic reviews will be conducted through the six-step procedure (EFSA, 2010):

(a) development of the *Literature reviewing protocol*;

(b) *search* which entails an extensive and sensitive search performed in order to retrieve as many studies as possible, fitting the eligibility criteria;

(c) *selection* which will consist of two consecutive steps: i) a first screening of the information contained in titles and abstracts, and ii) a selection based on full-text reports;

(d) *data collection* aiming at getting those information which answer previously defined research questions;

(e) *quality assessment/control* which covers the design, execution, analysis and outcomes of an ELS, and

(f) *data synthesis and reporting* through which the large amount of information collected will be clearly structured to make their interpretation transparent, consistent, and auditable.

This document addresses first step of the ELS procedure from the above list and serves as a <u>literature reviewing protocol</u>. It covers background for the reviews to be performed, review questions, objectives and inclusion criteria, search methods, selection and data collection. It provides guidance to support and facilitate literature reviews in the light of the objectives of the ICARUS project and in close consultation among WPs.

Theoretical framework

This section serves as a theoretical framework for modelling and assessments (evaluations) intended in ICARUS and should be considered when developing a protocol for literature review. The approach and related definitions in the framework of assessments have been adopted, after adequate adaptation, from the IAEAs BIOsphere Modelling and ASSessment (BIOMASS) programme report (IAEA, 2003), as follows:

The construction and implementation of a protocol for the derivation of data from literature reviewing is important to demonstrate rigour in the overall data management. The main steps identified in developing such a protocol have been identified as:

- an introduction, as a way to take into account the assessment context[1] and other external constraints, and to list the easily available information;

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[1] The assessment context answers fundamental questions about the ultimate purpose of the evaluations in ICARUS, namely:

• What are you trying to assess (measure, simulate/model, calculate)? and

• Why are you trying to assess (measure, simulate/model, calculate) it?

Based on these, the following components of assessment context may be identified: ***purpose of the assessment*** (e.g., healthy city policy development, identification of the most critical exposures - pathways, exposure groups, contributors, identification of the strongest air polluters , etc.); ***endpoints of the assessment*** (e.g., inhalation dose to the average member of the most exposed group(s) at different sites, concentrations of selected substances in air at selected site(s) and time sections, effectiveness of a pollution reduction measure, etc.); ***assessment philosophy*** (deals with the degree of pessimism to be introduced in the assessment, especially when defining assumptions for hypothetical most exposed group(s) in a longer time frames); ***emission source terms*** (deals with the known details of the emission sources or contaminants' modelling starting point of transport being considered, e.g., type of human economic activity at selected site, etc.); ***site context*** (e.g, coastal/inland, topography, climate); ***time frames*** (the selection of a specific time frame can have considerable impact on considerations in modelling; ***societal assumptions*** (as part of development of the evaluation models, assumptions of future human actions – measures and policies - will need to be defined, such as basis for habits and characteristics (e.g., present day local behaviour or other sources for assumed behaviour).

- the structuring of information, so as to define properly the quantities under scrutiny and to review the scientific and technical aspects which can govern their determination;
- conditioning, which is a step where qualitative decisions are taken in order to adapt the previous knowledge to specific studies;
- encoding, which is the step where quantitative decisions are expressed, leading to the determination/selection of data in its strict sense; and
- adoption of a formal output format, essential for enabling traceability and communication.

The protocol demonstrates the advantages embodied in any structured approach: it should be documented, leading to its understanding even by people who would not have been directly involved in its implementation; it should be traceable, allowing the performance of multiple iterations when updates are required; and it should be defensible.

The multiple steps that compose the protocol should not be perceived as a burden preventing the adoption of the common simplifications that have been developed through experience. The protocol can be greatly simplified when there is a consensus for justifying simplicity, when a certain level of technical arbitrariness is adopted (e.g. through the modelling of highly stylised situations), or when some parameters/characteristics are known to be of minor importance in the assessment (e.g., through sensitivity analyses). The requirement remains to document such decisions and the rationales which support them.

In the view of suitability of studies/data for a given assessment context the following should be considered:

At first glance, suitability seems merely to be the examination of the studies and data accuracy with a genuine understanding of the measurement/derivation techniques, but data suitability is more than this, for several reasons (adapted from Rykiel, 1996):

- data and models are two moving targets that are intimately linked;
- the validation of models/data is not absolute, it means only that models/data have met a specified expectation;
- the validation of models/data is really more akin to the validity of their interpretation;
- it is not possible to assume that any model/data accurately represent the real system;
- any measurement/derivation/evaluation is biased by analyst's perception of the system.

In practice, the way by which the suitability of studies/data is decided starts with an account or report from an existing background, then the parameter for which data are sought is assessed in order to decide if it is a key component of the assessment or not. Eventually, the ultimate decision is based upon the comparison of the existing background with regard to the assessment context, particularly the purpose of the assessment/evaluation.

Literature reviewing protocol for the ELS:

1. Background

In the frame of the overarching goal of the ICARUS project – *development of innovative tools for urban impact assessment in support of air quality and climate change* – number of literature reviews addressing current developments in the following areas are foreseen (Task 1.1 in DoW and associated deliverables D1.3, D1.4 and D1.5):

(a) Methods for integrated urban impact assessment in support of air quality and climate change governance in the EU,

(b) Technologies and methods for determining external exposures, including GPS-enabled personal sensors, remote sensing, agent-based models and influence of socio-economic status (SES) in relation to exposure and disease causation and

(c) State of the art modelling tools for air quality (AQ) and carbon footprint (CFP), source apportionment practices, methods for endogenous exposure and current approaches for estimating health effects at the individual and community level.

2. Review questions

While it is recognised that the topics addressed within ELS are very much interconnected, for the purpose of this protocol they are divided in three general groups: (i) urban impact assessment, (ii) methods for determining external exposure and (iii) modelling tools. Within individual group, the following main review questions are defined with intent to design the scope and focus of the review in the light of ICARUS objectives, setting the inclusion criteria and consequently guiding the search strategy. It should be noted, however, that one does not have to limit itself to these questions, as new relevant ones might evolve in the overall ELS process.

(i) Urban impact assessment

- Which approaches and tools are available for urban impact assessment in support of air quality and climate change?
- Which topics/areas are covered by these tools/approaches (e.g. transportation, infrastructure, land-use)?
- How are possible measures (various mitigation and abatement options) and their evaluation integrated in these approaches/tools?
- How are policies evaluated/integrated in these tools?
- What are the endpoints of urban impact assessment? How important is satisfaction of citizens in this context? What kind of city development do they desire (have in mind)?

(ii) Methods for determining external exposure

- How sensitive/accurate various personal sensors are?
- Are they fit for purpose? Are individual sensors able to indicate levels of external exposures?
- How useful are remote sensing techniques and what is their ability in the context of external exposure assessment?
- How capable are simulation methods like agent-based models for acquisition of information of human behaviour in relation to exposure and disease causation?
- What are the relationships between SES and exposure and disease causation?
- To what extent SES or other social group risk determinants can influence external exposure?
- What is a contribution of urban situation and land-use in a particular city to external exposure? How specific and detailed one needs to be in examining these issues? Is it a personal or rather a population (collective) topic?

(iii) Modelling tools

- Which approaches and modelling tools can be used for source apportionment as tools for urban impact assessment in support of air quality and climate change governance?
- Which approaches and modelling tools exist that can be used for evaluation of effectiveness of various measures and policies to improve the air quality and reduce the carbon footprint?

- How are the links between emissions, pollution levels and impacts integrated in different models and related tools?
- What is the ability (features) of an individual model to estimate health affects at the individual and community level? Are such models available?
- What is sensitivity of AQ and CFP models, their spatio-temporal resolution in relation to estimation of health effects?
- What are the approaches to cost-benefit analyses (CBA) of pollution reduction measures and policies and how useful they are in policy development and city level decision-making?

3. Characteristics of studies for their inclusion or exclusion

Considering the review questions defined in the previous step, this section provides some general rules that will guide the reviewers and help them to decide when a particular study should be included or excluded, respectively. In addition, the guiding reasoning when it comes to city's long-term (sustainable) development is as follows: the European society needs to find and effectively apply mechanisms for dealing with actual and future challenges like security, energy provision, transport, extreme weather events and related civil protection and rescuing, urban environment, resources, economy as a whole, democracy within changing political situation and policies, etc. Understanding and demonstrating practical sustainability is one of the special cross-cutting challenges related to all the issues mentioned above. However, in recent years, the gap between the ideal social environment in people's minds and what can be satisfied in reality has been gradually expanding due to improved knowledge levels and the rapid circulation of information (Yang & Sung, 2016). Subsequently, the term "social innovation" emerged and quickly spread around the world (Mulgan, Tucker, Ali & Sanders, 2007). Nowadays, more and more organizations tend to devote themselves to social innovation, including the rise of many social enterprises, which strive to find more effective solutions to address major social issues and challenges (Phills, Deiglmeier & Miller, 2008). In fact, the complexity of the challenges faced by current society cannot be solved by any single discipline or organization, and social issues often face a lack of resources. Therefore, discussions on social innovation should consider how to introduce and integrate multi-disciplinary talents and resources for "value co-creation" through open innovation and participation (Moulaert & Ailenei, 2005) in order to come up with innovative solutions to effectively deal with social and development issues. Approaches of education for sustainability, for example, therefore need to cover effective transposition of ideas and practices from abstract sustainability perception to the individualized and practical level (Liedtke, Buhl & Ameli, 2013; Yang & Sung, 2016). Studies, which ICARUS should build on, need to cover these issues, especially in the context of urban impact assessment.

(i) Urban impact assessment

- Study should deal with long term city development (vision on sustainability).
- Study should discuss citizens' needs and desires in terms of a city as their living, working, amusement, culture, education, recreation, etc. environment. Satisfaction and requirements for changes in the city need to be covered.
- Future city's needs/expectations in terms of economy, services, industry, transportation, administration, etc. are to be dealt with.
- Land use changes as to accommodate future citizen's and city development needs, e.g. transportation, recreation, housing, etc. are discussed.
- Healthy and vibrant city oriented and attractive for young population, investigating social networking towards inter-generational way of life with appropriate mobility, housing, access to services and other changes should be considered.

(ii) Methods for determining external exposure and health effects

- Study should address the use of personal sensor technologies in relation to exposure and disease causation.
- Study should address human behaviour simulation in relation to exposure and disease causation.
- Study should address relationship between SES and exposure and disease causation.
- Studies addressing the above mentioned technologies and approaches for determining external exposure in relation to health outcomes should be selected.

(iii) Modelling tools

- Study should address the use of modelling tools/methods for integrated urban impact assessment in support of air quality and climate change governance.
- Study should relate any source apportionment practice with health effects at either individual or community level.
- Studies dealing with development and applications of AQ and CFP modelling tools exclusively will be excluded.

4. Methods for searching for research studies

In this section some preliminary search terms (key words), associated Boolean operators and databases to be searched are suggested.

(i) Urban impact assessment

Search: ["urban" or "city" or "community" or …] and ["air quality" or "AQ" or "wellbeing" or "quality of life" or…] and ["climate" or "climate change" or…] and ["impact" or "impact assessment" or "integrated impact" or "integrated impact assessment"] and ["policy" or "directive" or "measure" or "planning" or "governance" or "cost-benefit"]

(ii) Methods for determining external exposure and health effects

Search: ["personal sensors" or "mobile sensors" or "micro sensing units" or "portable sensors" or …] or ["remote sensing" or…] or ["SES" or "agent-based modelling" or "behaviour simulation" or "built environment" or …] and ["health" or "health effects" or "exposure" or "DALY" or "YLL" or "mortality" or "morbidity" or cardiopulmonary mortality" or "life expectancy" or "respiratory hospital admission" or "cardiovascular hospital admission" or "acute respiratory health effects" or childhood asthma" or chronic bronchitis" or bronchitis episodes in children" or "restricted activity days" or "asthma attacks" or "lung cancer" or "health-outcome frequencies" or attributable number of cases"]

(iii) Modelling tools

Search: ["air quality" or "AQ" or "carbon footprint" or "CFP" or "source apportionment"] and ["model" or "modelling" or "dispersion modelling" or "receptor modelling" or "source apportionment"...] and ["health" or "health effects" or "exposure" or "disease" or …]

Databases/Information sources: Cochrane Database of Systematic Reviews (CDSR), Current Contents, EMBASE, MEDLINE, Scisearch, Scopus, Google Scholar, Medline-Ovid, Library-civitas, etc.

5. Selecting the studies and extraction of data

Decisions on study selection will be made in two stages. First, based on screening of titles and abstracts for relevance to the study question by working group/reviewers. For studies that pass first screening or for those that clear decision cannot be made, examination of full-text for eligibility will follow. For each of the topics/areas covered in the studies, clear eligibility criteria for inclusion or exclusion of individual study, in the light of ICARUS project objectives and activities (innovative tools, urban impact assessment, air quality and climate change, mitigation and abatement measures and policies) will be used. The review and selection by more than one reviewer should be made.

Examples of eligibility criteria:

- *Spatial extent:* studies addressing the above discussed topics/areas (in the context of ICARUS goals) in various urban agglomerations (cities/towns and surroundings) and with population >500.000 will be included only. More general (e.g. nation-wide) studies and studies dealing with meta-analysis will be excluded.
- *Comparability with, and applicability for, ICARUS cities:* in order to ensure usefulness and applicability of the outcome of individual study, literature review will be limited to studies taking place in areas comparable to ICARUS cities only. In this sense, factors like general climatic conditions, sociodemographic and socioeconomic status will be considered.
- *Policies and measures to be considered:* In essence, both technological and non-technological measures and policy options for reduction of air pollution and the carbon footprint in urban environments will be considered.
- *Cost-effectiveness and cost-benefit analysis of policies and measures:* for studies reporting any kind of monetary valuation of impacts and cost-benefit analysis of policies and measures, in order to be included, these have to report their outcomes in measurable terms (e.g. investment return period , B/C ratio); comparative assessment of alternatives measures/ policies are desired.
- *Time-frame of reported measures and policies to consider:* studies discussing feasible short and medium term measures and policies (up to 5±2 years) in the last 10 years will be included. For longer term evaluations timeframe of >20 years is expected.
- *Health studies to be considered:* studies reporting respiratory and cardiovascular health effects expressed as disability-adjusted life years (DALY) or years of life lost (YLL) will be included. Health outcomes to be considered are mortality/morbidity, life expectancy, restricted activity days, respiratory and cardiovascular hospital admissions, acute respiratory health effects, childhood asthma, chronic bronchitis, bronchitis episodes in children, asthma attacks, lung cancer. Studies reporting outcomes for persons/populations of all ages (children, adults, elderly) and different causes of pollution (e.g., traffic-related, stationary industrial sources) will be included. Similarly, different types of studies (longitudinal vs. cross-sectional, cohort, case-control) will be considered.
- *Personal sensors for determining external exposures:* Studies reporting the use of any kind of personal sensors for determination of exposure of an individual in a transparent and verifiable way, clearly describing methods of calculation/approach used, will be included. Relationships with health effects have to be clearly demonstrated in these studies.
- *Spatio-temporal resolution of AQ and CFP models considered:* studies discussing ground-level AQ and CFP modelling approaches/tools related to ICARUS measures and abatement strategies (different temporal resolutions, both city level and transboundary) will be reviewed.

6. Assessing the trustworthiness and usefulness of the included studies

In the view of suitability (i.e. trustworthiness and usefulness) of studies/data for the ICARUS assessment context, the adoption of an output format, essential for enabling traceability and communication of results should be applied. This format should enable insight into steps which contribute to the ultimate, synthesized evaluation on whether or not the reviewed studies can serve as reasoned (justified) references for measures and policies to be recommended to the cities in the framework of the ICARUS project (outputs of WP5 and WP6). The steps mentioned above could be:

- Step1: Introduction (topic covered, aims)
- Step2: Key words (string) applied in literature search, number and categorisation of hits
- Step3: Findings in the context of ICARUS assessment context by categories of hits (previous step)
- Step4: Summary in the view of ICARUS WPs 2-6 needs
- Step5: Recommendations (extraction from the studies) for WP5 and WP6

References:

EFSA, 2010. Application of systematic review methodology to food and feed safety assessments to support decision making http://onlinelibrary.wiley.com/doi/10.2903/j.efsa.2010.1637/epdf

IAEA, 2003. Report of BIOMASS Theme 1 of the BIOsphere Modelling and ASSessment (BIOMASS) Programme http://www-pub.iaea.org/MTCD/Publications/PDF/Biomass6_web.pdf

Liedtke, Buhl & Ameli, 2013, Microfoundations for Sustainable Growth with Eco-Intelligent Product Service-Arrangements, , Sustainability 2013, 5(3), 1141-1160; doi:10.3390/su5031141

Moulaert, F., & Ailenei, O. (2005). Social economy, third sector and solidarity relations: A conceptual synthesis from history to present. Urban Studies, 42(11), 2037-2053.

Mulgan, G., Tucker, S., Ali, R., & Sanders, B. (2007). Social innovation: What it is, why it matters and how it can be accelerated. Retrieved September 14, 2015, from http://youngfoundation.org/wp-content/uploads/2012/10/Social-Innovation-what-it-is-why-it-matters-how-it-can-be-accelerated-March-2007.pdf

Phills, J. A., Deiglmeier, K., & Miller, D. T. (2008). Rediscovering social innovation. Stanford Social Innovation Review, 6(4), 34-43.

Rykiel, E.J., Testing Ecological Models: the Meaning of Validation, Ecological Modelling, 90 (1996) 229–244.

Yang, C., & Sung, T. 2016 Apr 28. Service Design for Social Innovation through Participatory Action Research. International Journal of Design [Online] 10:1. Available: http://www.ijdesign.org/ojs/index.php/IJDesign/article/view/2456/725