D.T1.3.1 Framework concept for thematic working group 1

Concept of the working methods of TWG 1 and conceptual basis for developing a Model for smart UGS assessment and GI planning.

Final Version: January 2017

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TABLE OF CONTENTS

1 *Project context*

Urban Green Spaces (UGS) provide various environmental, social and economic benefits to cities and their population. UGS have a basic role in making residential and working environments more livable places, improving environmental performance (e.g. filtering pollutants and CO2 from air) and in climate resilience.

However, because of the ongoing (sub)urbanisation processes, (semi-)natural environment and all types of green spaces are increasingly getting under pressure, which leads to fragmentation of ecosystem networks contributing to biodiversity loss.

As green spaces and their thoughtful development and management enables us tackling a series of harmful environmental impacts and climate change related risks there is a common demand for better functioning operational models for Urban Green Space governance.

The Urban Green Belts (UGB) project's main objective is to improve planning, management and decision-making capacities of the public sector related to urban green spaces, thus creating integrated sustainable UGS planning and management systems.

The common challenges of weak, non-integrated UGS management in CE FUAs call for smart solutions that will be co-created and tested in the project. Following a comparative situation analysis partners will jointly elaborate innovative methods and tools aiming at sustainable UGS management focusing on:

1. Green Infrastructure as a smart tool for providing ecological, economic & social benefits through natural solutions which local decision-makers are generally not aware of. Therefore, a GIS-based spatial planning decision support tool will be elaborated for assessing and evaluating existing green spaces, facilitating the application of the GI approach in strategic planning.

2. Community involvement into planning and implementation processes are rarely applied yet in the region, though are crucial for ensuring social & economic sustainability of UGS management. Smart techniques for awareness raising and activation of civil society organizations and citizens through community building will be elaborated.

3. Multi-stakeholder governance is an inevitable but underexploited tool for effectively managing UGS. Smart solutions promoting cooperation of different governance levels, sectors and internally across various departments of authorities will be developed, as well as a training curriculum for municipalities on application of integrated UGS planning and management in the context of multi-stakeholder governance.

These solutions, methods and tools will be compiled into three UGB Smart Models that will be tested through Pilot actions during the project. The relationship among these elements is shown on *Figure 1.*

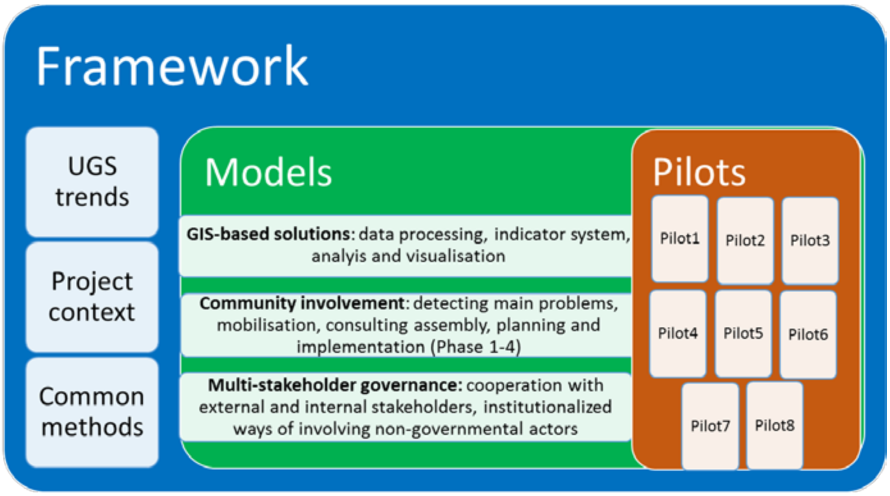

Figure 1 Connection among the Framework, the UGB Smart Models and the Pilot actions

The flowchart of the development process of the UGB Smart Models is shown on Figure 2. In line with this, as a first step, a draft model will be developed which then will be tested through Pilot Actions. The finalized model will be an integral part of the Smart UGS Governance Manual, that is one of the major outputs of the project.

During the whole process FUA level Stakeholder Platform meetings and UGB Transnational meetings will support the development. Furthermore, a Transnational Synergy Workshop with similar projects and initiatives will help to identify and include knowledge and experience on the topic outside the consortium.

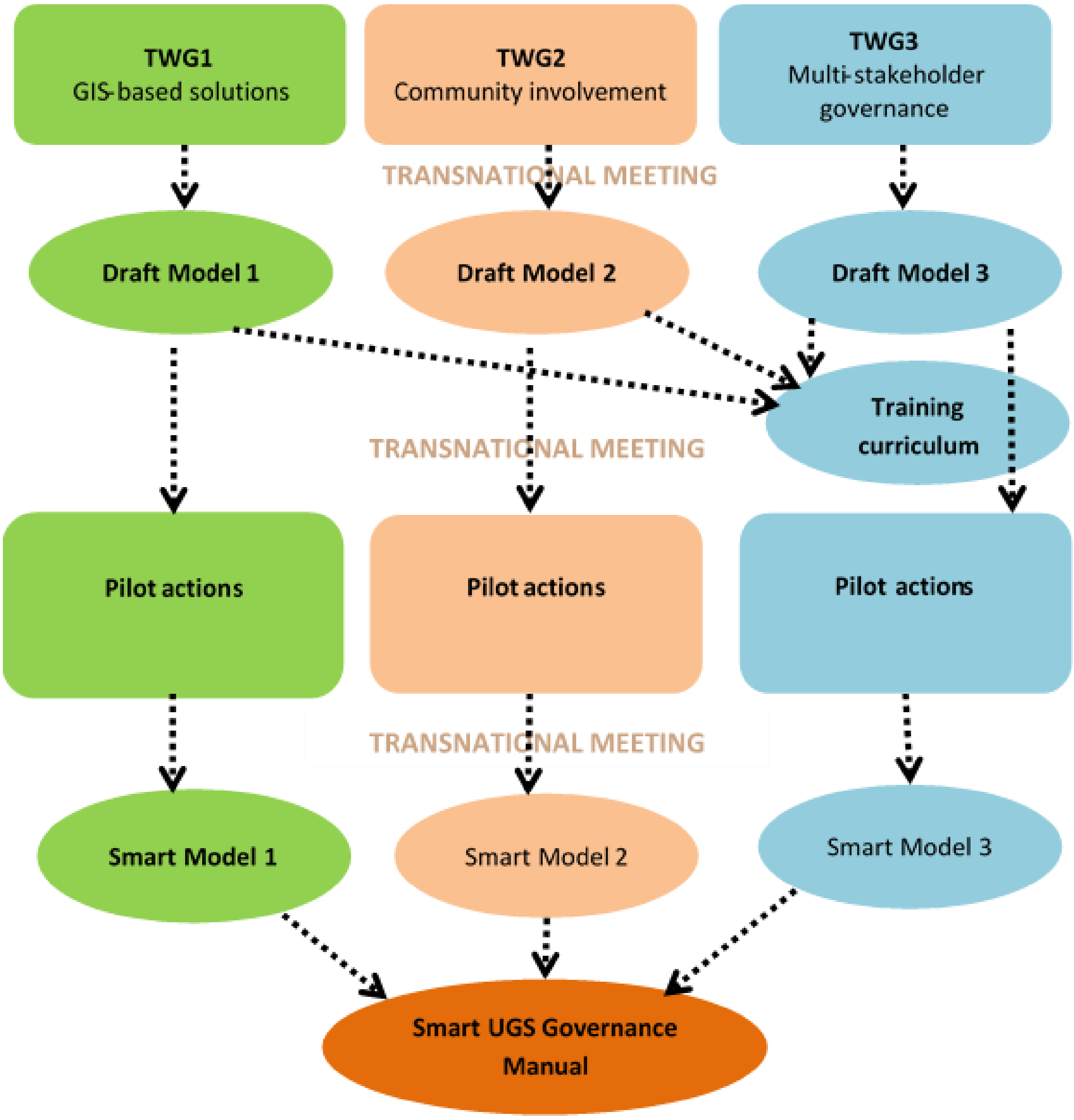

Figure 2 Flowchart of the development of the UGB Smart Models

2 Structures and procedures

2.1 Background and objective

2.1.1 Benefits of urban green spaces

Urban green spaces play an essential role for the sustainable development of cities of all sizes and regions as they assume many environmental, ecological, and social functions. The **variety of services** is essential for the wellbeing of the inhabitants and the prosperity of the region. This is especially important as more than half of the world's population nowadays lives in cities and the share is still growing mainly because of rural-urban and transnational migration. Rational use of natural resources along with new lifestyle trends makes smart and sustainable development strategies of urban green spaces essential. The current demand of such solutions is documented by many programmes and guidelines from cities around the world.

In order to determine and subsequently evaluate the nature of urban green spaces, a three step approach is recommended (HAQ 2011; HERZELE & WIEDEMANN 2003): They should be identified, classified, and quantified as share of the urban area at first. This was mainly done in the local assessments as a primary output of the UGB project. Secondly, the existing qualities must be identified in terms of acceptance and utilization. This is partly done via activities, personal experiences, and perceived benefits for the users in the state of the art analysis, but will also play a role in the deriving and modeling of social indicators. In a third step, the functionality is determined by analysing the distribution and accessibility in the whole urban area, which will also be part of the conceptualization of the **indicator system**. Essential part of the model concept is to develop an indicator system (see chapter 2) to represent the various functions and benefits of UGB in order to generate methods and tools to effectively assess and manage green spaces. These benefits include mainly (modified from HAQ 2011; BREUSTE et al. 2015):

- **Environmental benefits**
  - maintenance of ecosystem services, e.g. water cycle
  - reduction of air and noise pollution, CO_2 absorption
  - climate regulations (wind corridors, reducing heat islands)
  - conservation of biodiversity & habitats

- **Economic benefits**
  - energy saving for heating and cooling
  - increasing of property values
  - raise of working productivity
  - agricultural productivity and food supply
  - potentials in tourism and education

- **Social & psychological benefits**
  - recreation and wellbeing
  - health effect by reducing stress, pollution and heat load
  - preservation of cultural heritage

2.1.2 *Landscape planning using GIS and spatial indicators*

As there are many components that are mutually dependent and interact with each other, the envisaged approach to monitor green spaces will be holistic and examine the whole green system in an integrative way. According to the project title, the working group is encouraged to think in terms of **green infrastructure** (GI) and its development within the respective **functional urban areas** (FUA) which expresses the systematic approach, too. Green Infrastructure consists of interconnected natural areas, conservation and farming lands that among others maintain natural ecological processes, sustain air and water resources, and contribute to health and quality of life (McDONALD et al. 2005). The planning and conservation of green infrastructure should therefore be as important as the planning of grey infrastructure. The GREEN INFRASTRUCTURE CENTER (2016) highlights the importance of GI planning as "GI provides clean water, food, air quality, wildlife habitat, and recreation. It also supports cultural resources by providing scenic views and settings that enhance our enjoyment of the landscape. But we need to know where it is and how to conserve or restore it!". The **multifunctional value** is pointed out in the Green Infrastructure Principles by BENEDICT & McMAHON (2006) where GI is defined as "interconnected network of [landscape elements] that support native species, maintain natural ecological processes, sustain air and water resources, and contribute to the health and quality of life for communities and people" (p. 6). Initiatives to establish and maintain green networks are e.g. the European Green Belt[1], or Natural Connections[2].

Consequently, it is advised to think of cores and corridors instead of fragments in every **landscape planning** and UGS management approach and regard every single green space as part of the whole natural system. This systemic view will result in a **holistic indicator system** and is comparable to the additional benefit of the consideration of functional urban areas in the partner regions instead of single, administratively defined municipalities which both will be followed in the model concept. The importance of connectivity analyses like network based accessibility, air corridors, and tree canopy mapping is part of the model conceptualization. FIREHOCK (2017, slightly extended; 2015, p. 47 et seqq.) developed a six-step process for creating green infrastructure plans in communities and effectively implementing them:

1. **Set Goals:** focus on local conditions and values; improve the specific community's quality of life
2. **Review Data:** build up on existing knowledge; identify available and achievable relevant datasets
3. **Map Assets:** illustrate the community's ecological and cultural key functions
4. **Risk Assessment:** identify the most vulnerable zones, conflicts of interests and fragmentation threats
5. **Rank Assets:** set priorities and determine opportunities for protection or restoration
6. **Implement Opportunities:** apply results to actions, policies, projects or laws to protect natural assets

This approach seems to fit well to the intention of TWG 1 to implement smart tools for UGS planning and management and therefore serves as a useful fundament of the model concept. As this is supposed to be build up with the help of the methodological and technical GIS competences of the group members, it is planned to integrate spatial indicators into this process in order to effectively identify, analyse and monitor the key functions of the green spaces in the functional urban areas. Regarding the **derivation of landscape indicators** there are two approaches the indicator system to elaborate will take as a reference, which both are explained by BOTTERO (2011). The **DPSIR model** defines a circle of five categories, where every indicator should be linked to one or more of them. These key factors for evaluating green spaces are Driving Forces (e.g. human activities), Pressures (e.g. land consumption), State (current conditions), Impact (e.g. human

[1] *http://www.europeangreenbelt.org/*
[2] *http://www.greenmapping.org/*

beings affected by illness) and Response (e.g. measures for protection). The second one is the **CMEF** (Common Monitoring Evaluation Framework) consisting of a SWOT-Analysis as a starting point for defining the envisaged plans and strategies to reach the predefined goals. The indicator modelling serves for monitoring the implementation by defining input (e.g. budget and resources), output (successful actions that can be measured), result (direct effects of actions and interventions), and impact (benefits for the whole area and society) indicators.

GIS tools have their origin in landscape and environmental planning and thus have a great potential within this domains. They offer the possibility to support complex planning tasks, but their full potential often still is not exploited. Possible areas of application are:

- Land use analysis (e.g. detection of different types of usage, change detection)
- Landscape modeling
- Landscape planning (e.g. development of planning tools and decision support systems)
- Evaluation of landscapes, habitats, and their disturbances
- Detection of objects within landscapes
- Structure description and analysis (e.g. quantification of spatial configuration and diversity)

According to (LANG & BLASCHKE 2007) more precise tasks that can be performed with the help of GIS are:

- Biotope mapping
- Creation of distribution maps of endangered species
- Analysis of pollutant distributions
- Analysis of landscape diversity and landscape patterns
- Assessment of natural hazards and their impacts
- Planning of reforestation projects.

GIS is also very important within urban planning, where it is used both as a database and as a toolbox since it is capable of retrieving and processing data. Within urban planning, several sectors like transport or environmental planning, in which GIS tools offer great opportunities, can be distinguished. The main **applications of GIS in urban planning** are e.g. visualization, spatial analysis, and spatial modeling. Furthermore, it can be used for the storage of land use maps, socioeconomic and environmental data, and planning applications. Therefore, possible tasks are according to (YEH 1999):

- Identification of areas of conflicts of land development with the environment
- Prediction and projection of future population
- Development of environmental scenarios
- Creation of land suitability maps for the development of planning options
- Environmental impact assessment of proposed projects
- Monitoring of land use changes (in combination with remote sensing)

As a conclusion, some studies and methodologic approaches are presented that underline the importance of **integrative approaches** for the assessment and management of urban green spaces and may be used as a reference for the GIS model in the scope of the UGB project. DE RIDDER et. al. (2004) present a preliminary methodology that analyses and visualises selected indicators for the possible enhancement of green infrastructure on different scale-levels (from street canyon to urban regions) in European cities by using GIS and remote sensing techniques. BALRAM & DRAGICEVIC (2005) elaborated on attitude measurements as subjective part of UGS assessment using collaborative GIS techniques and interviews and identified UGS attitudes as multidimensional constructs that are mainly influenced by behaviour and usefulness at household level. A similar approach was used by DE LA BARRERA et al. (2016) who developed a set of mainly qualitative criteria for the analysis of UGS perception and use that was applied in three socio-economically different urban quarters and showed considerable differences. In a survey among municipal foresters, YOUNG (2010) found out that the pursuit of ecosystem services by urban green management is of growing importance regarding the goals of their departments and partly matching or exceeding the traditional services, like beautification or enhancing public health. Some methods for achieving these ecosystem objectives (e.g. climate management, water quality enhancement, biodiversity) are presented and assessed by the study participants. Finally, the need for multi- and interdisciplinary approaches in UGS research is highlighted by JAMES et al. (2009), who elaborated an integrated framework and a catalogue of key questions for this field based on expert discussions.

2.1.3 Objectives of the framework

General objective of this framework in the UGB project context is to elaborate the concept for a GIS-based model that enables the envisaged user groups and stakeholders to identify and assess relevant urban green spaces and facilitates the management and monitoring of them (see fig.1). Planners and public authorities should be given a set of certain methods and tools that alleviate their administrative tasks and duties. This shall happen in accordance with the preservation of primary functions of the particular green spaces.

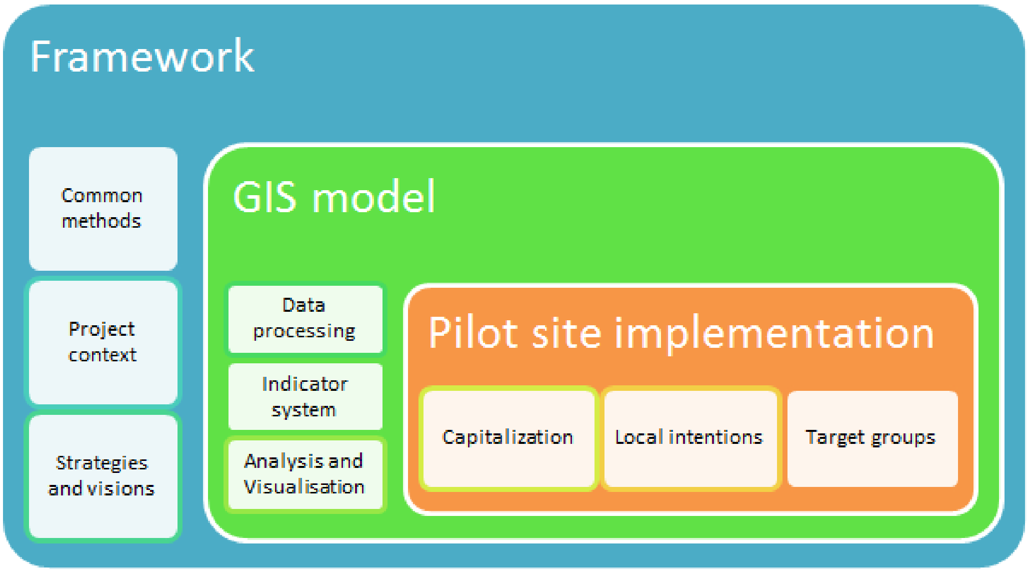

Figure 3 Connection among the Framework, the UGB Smart Models and the Pilot actions in TWG1

2.2 Timeline

Table 1 presents the timeline of the scheduled deliverables and deadlines for TWG 1 along with the responsible and cooperating partners.

Table 1 Timeline and responsibilities for the upcoming tasks for TWG 1

Delivarable	Deadline	Responsibility	Involved partners
D.T1.3.1 Framework concept	January 2017	iSPACE	Padova, Zadar
D.T1.3.2 Draft model	June 2017	iSPACE	Padova, Zadar
D.T2.1.1 Pilot activity concepts	June 2017	iSPACE, Padova, Zadar	
D.T2.1.2 Mid-term status report Zadar	December 2017	Zadar	iSPACE
D.T2.1.3 Mid-term status report Padova	December 2017	Padova	iSPACE
D.T2.1.4 Mid-term status report Salzburg	December 2017	iSPACE	iSPACE
D.T2.1.5 Report on study visits	April 2018	iSPACE, Padova, Zadar	
D.T2.1.6 Pilot evaluation reports	May 2018	iSPACE	Padova, Zadar
D.T1.3.3 Final model	October 2018	iSPACE	Padova, Zadar

2.3 *Working methods*

The members of TWG 1 discussed and agreed on the following methods as a fundament of their work. There will be a simultaneous work on documents online (e.g. Google Drive). Advantages are the permanent chance of contribution, monitoring of progress, and comment and discuss options for every user. Thus, much email traffic can be avoided. The results are uploaded to the project folder at Dropbox. The group members agreed to accept the deadlines and tasks displayed in Table 1 and work on their own responsibility. Online conferences will be held in general only for basic decisions at the beginning and end of work packages or if requested by all group members. iSPACE as lead partner and knowledge provider of TWG 1 will give thematic and formal expertise on any uncertainties within the group and coordinate the work. Monthly newsletters will document the working progress and contain a tasklist update.

3 *Conceptual basis*

There are three main methodological components of the GIS model as fundament for every upcoming tool and application building process in the context of thematic working group 1. The indicator system serves as scientific framework and defines the thematic scope of UGS assessment or monitoring. This is directly linked to the availability and characteristics of the required data. Thirdly, the choice of appropriate hard- and software as technical framework for the specific intentions is obligatory. This chapter describes each of these modules in more detail.

3.1 Indicator system design

The GIS model aims at preserving unique functions of UGS while making the green spaces "fit for the future" via effective management and smart monitoring techniques. The use of spatial indicators and GIS methodology is considered as best practice from literature review and own experiences. General idea is to elaborate a dynamic and interactive environment where different types of green are linked to various indicators. In such an approach, the relevance of the specific functional values in the urban setting can be expressed by **single facts and figures**, **combined indicators,** and **complex integrative indicator systems** applying certain weighting coefficients, which will be elaborated in more detail in the draft GIS model and finally in the implementation strategies. Obviously, this methodology includes quantitative and qualitative aspects, although the latter are hard to quantify since they are usually subjective by nature. Soft location factors like happiness and satisfaction with green spaces, recreation value or perception of attractivity and security have to be derived therefore by combining basic indicators with the help of previous studies' results and common scientific knowledge. There will be made certain assumptions and estimations for the respective indicators. On the quantitative side, the main methods to be used are GIS-based modeling and analysis techniques based on the available local data sources as described in the next chapter. The envisaged approach in the end generally intends a holistic and integrative view on the whole green system. Table 2 presents a broad set of possible basic, combined, and even complex indicators for GI assessment that serves as a fundamental collection for conducting holistic green space analyses. During the elaboration and refinement of the GIS (draft) model, each partner will choose the best-fitting topics and indicators for its specific region with regard to data availability, local assets to be preserved, and specific target groups.

Table 2 Compilation of possible indicators for a holistic assessment of Urban Green Spaces

Basic facts and figures → Input for combined indicators		
Topic	**Examples**	**Purpose and target groups**
Distribution and classification	• extent/share of green space in the FUA • extent/share of different UGS types (shrubs, hedges, meadows, forests etc.) • green spaces per capita • appearance of green facades/roofs	inventory, monitoring, demand analyses, modeling basis, visualisation for research and administration
Configuration and accessibility	• number of trees/average tree age • infrastructure: number of benches, playgrounds, sport facilities etc. • population within walking distance (1000m) • proximity and quality of public transport • proximity to local and regional centers/ working centers • height level differences in the green area • connection to bike/foot paths	inventory, monitoring, demand analyses, modeling basis, visualisation for research and administration → fundament for social functionality and acceptance
Natural (surrounding) conditions	• land use type • soil type • canopy cover • number of species (animals/plants/trees) • state of maintenance • air quality	mainly quantitative conditions: natural characteristics (of adjacent districts), stress factors → fundament for combined indicator modeling and integrative analysis
Anthropo-genic (surrounding) conditions	• demography (distribution of ages, genders, nationalities) • working state and dominant sectors • crime rate • noise pollution • share of paved surface	mainly qualitative conditions: socio-demographic characteristics (of adjacent districts), stress factors → fundament for combined indicator modeling and integrative analysis
Legal status	• access restrictions (public vs. private) • nature conservation areas	only restricted actions possible

Combined indicators → Output of analytic modeling				
Topic	**Examples**	**Scale**	**Purpose**	**Target groups**
Social functions and acceptance	● use of playgrounds, sport fields ● infrastructural quality ● usage by city inhabitancy / tourists ● risk of negative perception → level of stress, noise etc. ● location in the local context → characteristics of adjacent districts	grid cells, single object (e.g. park), city part	well-being, health, socialising, sojourn quality, cultural heritage, urban wilderness → surplus value by transfer to socio-demographic groups (heat stress for old people)	public sector, citizens
Ecological functions	● interconnection to other green areas → green infrastructure/ green belts ● species diversity in different green types	grid cells, single object (e.g. forest), city part	climate, biodiversity, well-being, health, stress reduction → surplus value by transfer to socio-demographic groups or types of green	public sector
Economic functions	● ground market value ● area of allotment gardens/urban farming ● touristic potential ● food production for human beings	grid cells, single object (e.g. acre), city part	agricultural value, ground productivity → surplus value by transfer to socio-demographic groups or types of green	public and private sector

Meta indicators → Result of integrative analysis ("Quality of Urban Green")			
Topic	**Scale**	**Objective**	**Target groups**
Fulfillment of UGS demand/ Green network	municipality, region	well-balanced supply of all UGS functions, connectivity, nature protection → prioritisation mainly by ecosystem functions, extensive use	public sector, spatial planners
Liveability/ Quality of life	municipality, region	conditions and requirements for happiness, feeling of safety → combination of social and ecological functions mainly focused on human needs	public sector, spatial planners
Productivity/ Sustainable agriculture, forestry	municipality, region	high productive, but environmental-friendly agriculture, effective logistics	public sector, spatial planners

		network to support an efficient value added chain → focus on economic surplus, intensive use	

This compilation offers a widespread but basic overview on GI indicators, which means that the refinement of indicators during the creation process of the GIS (draft) model is obligatory. It is supposed to keep the targeted impact and visions of green space development in a particular region in mind and pick the most fitting indicators from the system and evolve them with the help of the methodic approaches presented in chapter 1.2. This means, that not only the purpose has to be defined but also the corresponding actions and upcoming impact in order to effectively make use of assessment tools and capitalize the results. Some of the proposed indicators already built up on each other or are combinations of basic indicators, for example the market value depends on the soil type. Thus, the use of such analytic chains is highly recommended and may result in integrative meta-indicators which offer additional benefits. The development of indicators does not include only a combination of basic indicators ("facts and figures") but also the application on statistic data. It is therefore beneficial to define certain socio-demographic groups (e.g. persons of age 65+) in order to get a surplus of information out of an indicator (e.g. heat stress for elderly people). The concrete definition of such a set has to be elaborated in the draft GIS model by every partner and must contain a clear statement of targets and intentions in accordance with the regional assets and visions. The tool set directly reflects the main purpose of the work as well as the main target groups. Therefore, an ongoing feedback circle should be established during stakeholder workshops allowing necessary adaptations in the workflow. This process shall ensure an effective transfer to governance and foster durable capacity building.

For a next analytic step, three pillars of UGS quality are suggested which shall be pursued during the elaboration and pilot testing of smart methods and tools by the thematic working group members in their respective functional urban area. These meta-indicators include **productivity** of green land by intensive farming or forestry use, the fulfillment of **human needs** like sport or recreation to augment quality of life, and **protection and conservation** by extensive use in harmony with nature. The partners will not have to apply all indicators in their region, but ideally develop one or more of these topics further according to local demands and expertise. Overall aim of the GIS model would be to display and assess these (somehow) antipodes by specific indicator sets in order to finally construct a combined model that allows demand and competition analyses between different types and functions of green. The equilibrium of the mentioned topics is regarded as crucial aim in landscape planning and management. To offer such a holistically applicable tool set would be an innovative solution for governance and policy.

3.2 *Data requirements and limitations*

The backbone of generating indicators are data which contain the desired information or can be combined to derive the corresponding evidence. As the intention of the model is to generate spatially explicit information to support planning tasks within the FUA, not only data for the complete region but also for smaller units are necessary to compare the FUA within itself and find points of action. Regarding data requirements, it is hard to make general statements as the availability and quality of data varies considerably between different countries and regions. Each project partner has to define standards and intention of its GIS model contribution (method and tool set) based on the local conditions. Nevertheless some well-known transnational data sources can be identified: The European Union respectively the European Commission offer the following data:

- the **Eurostat database** for mostly socio-demographic statistics on NUTS-level
- the **CORINE land cover** data and the **URBAN ATLAS** as high-resolution version for urban areas
- the emerging amount of **open government data** (OGD) that feature administrative data and statistics of public interest fostered by the **INSPIRE initiative**

Great advantage of these data sets is the high level of harmonization in terms of reliable metadata (spatial reference, update cycle etc.) and OGC standard formats (shapefile, geojson, WMS, WFS etc.) which enables comparability across borders. Although they may be more suitable for deriving indicators for the complete FUA and not so much for detailed indicators based on individual green infrastructure elements. On the national side the first contact points should be public authorities like statistics agencies or planning and GIS departments of local administrations. There, one may find additionally these data:

- **aerial photos** of the specific region, which can be used for land cover/land use analyses by applying image analysis and segmentation techniques or just for visualisation reasons
- local **cadastres** or **zoning plans** to identify the designated and real land use and consumption

The before mentioned data are partially of supportive character to have an overview on green spaces on a bigger scale and to have demographic and spatial reference parameters to summarize and compare information on a smaller scale. More detailed quantitative data on green infrastructures that feed the indicators on a content level e.g. park perimeters, playgrounds, trees etc. though need to be collected at a local and regional level thus being in the responsibility of the **authorities in charge of the urban green structures** and likely the ones performing and implementing the indicator system for their daily work as they are responsible for ensuring the resident population a certain supply and quality of green spaces. Sources of existing data may still be distributed among different departments such as: Regional Planning, Spatial planning, Nature protection, Infrastructure, Recreation or Economy. Furthermore it may be useful to derive certain data on one's own initiative by e.g. on-site data acquisition (GPS/Database), spatial modelling (aggregation/disaggregation) or image analysis (segmentation/classification) from fundamental sources. When using qualitative data based on individual, subjective perceptions and interpretations in order to identify, measure and model acceptance or satisfaction with certain green spaces, it is advised to refer to some of the following possible data sources:

- **empiric scientific research** that is based on surveys, questionnaires, interviews carried out at local level in the pilot site or comparable areas
- **general assumptions and standardized values** which the landscape planning community agrees upon in key literature
- **local expert knowledge** gathered during stakeholder workshops and thus immediately applicable
- **own surveys, questionnaires or interviews** conducted within the scope of the UGB project

When setting up the GIS model each region will have to check and decide which existing data can be used and which have to be collected newly during the implementation phase. Thus the decision phase in which choosing indicators to use during drafting the GIS model is essential and also needs to take into consideration methods of (convenient) collection, updating, visualisation, presentation, and maintenance of the data and the derived indicators. For further specification, each partner has to describe the situation in the respective FUA in the formulation of specific goals and implementation plans in the course of the GIS model design. A basic supply of metadata is obligatory in order to make sure that data sets are reliable and thematically and formal comparable. This is essential for the transferability of the elaborated methods and tools to other regions.

3.3 Technical framework

The draft GIS model, which will be developed as a next step, consists of some basic elements which have to be defined for every FUA to seriously set up a an indicator based green infrastructure assessment and planning tool. The basis of the whole model are the data and definitions of indicators which have been discussed before but they need some technical framework to actually work with them. The rules of the technical framework need to be set for each FUA before the implementation or pilot testing of the actual green indicator GIS model. Figure 3 displays the conceptual design of the envisaged GIS model including infoboxes for indicator system design (ch. 3.1) and data acquisition (ch. 3.2). The highlighted box in the center presents the technical components of GIS application building followed by information on visualisation and implementation options. The following paragraphs are meant to aid the establishment of such a technical framework making the GIS based assessment and planning ready for long-term use.

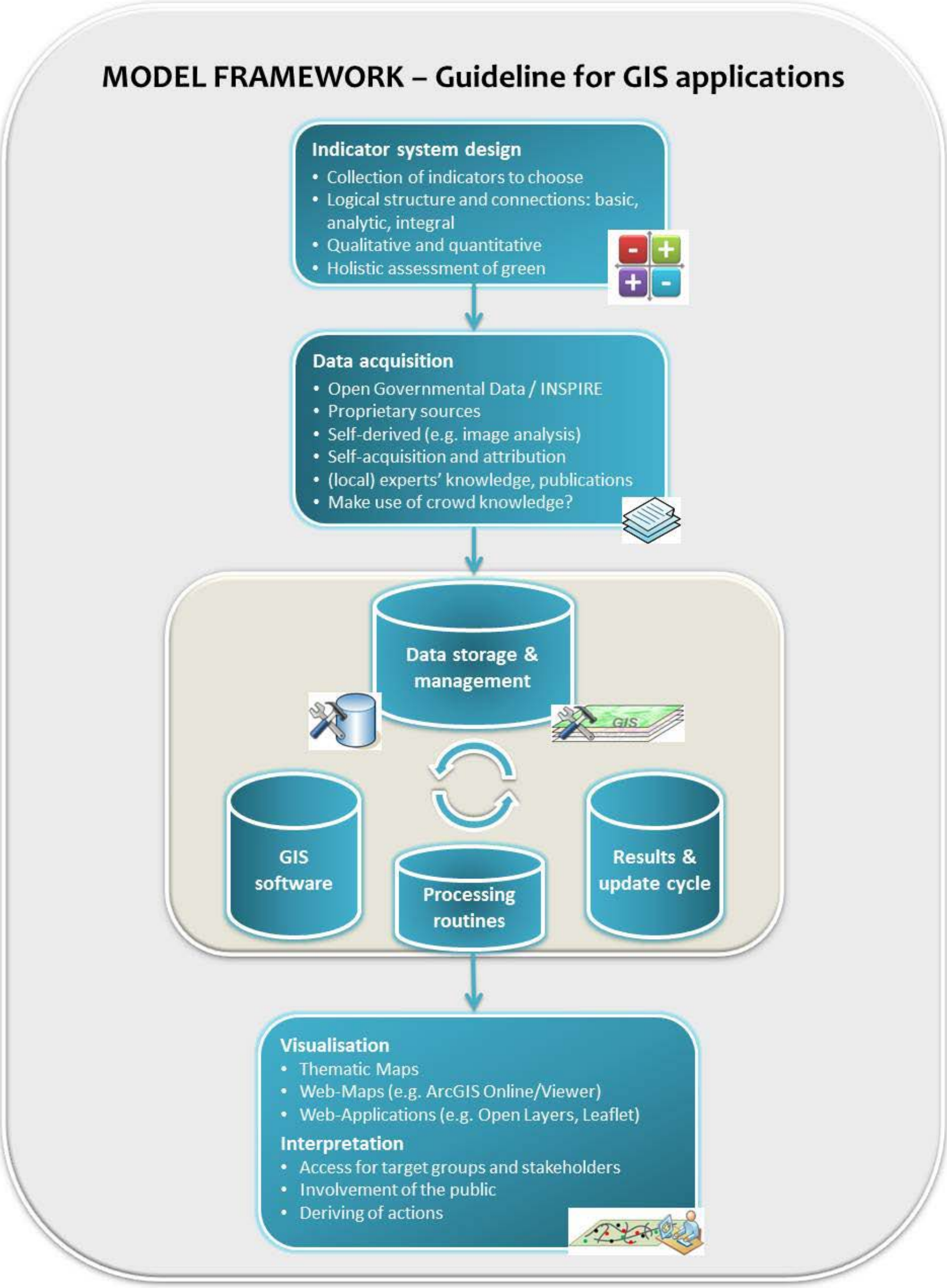

Figure 4 Framework for the GIS model including technical components

Data acquisition:

- Which data is needed?
- Do they already exist? Who owns them? Who does maintenance and updating work?

- Is there a need for collecting new data, which, in what detail (data specification), by whom, and how are they updated?
- Who is responsible for data acquisition?

Data storage and access:

- Where and in which format are the data stored? All in one place? e.g. File Geodatabase, Shapefiles
- Who has access and what rights?
- Backup and versioning of data?
- Who is responsible for data storage?

Software/Type of tools:

- Which software is needed/used? e.g. ArcGIS
- How is compatibility and long-term use and availability ensured?
- What are the costs? Is an open source solution desired?
- Interoperability between products?
- Who is using which software for what purpose? (generation/calculation/presentation of data/ indicators/mission)
- Are the tools offline or online?

Routines:

- In which software product are the indicators calculated?
- How does the routine work/look like for each indicator? Input data/processing/calculations/result
- How is it ensured that it can be updated with low effort? e.g. Model Builder in ArcGIS, direct data-feed from data sources with regular updates

Results/updates:

- What types of results exist and how are they stored?
- How often are they updated?

Visualisation/presentation:

- How are the indicators visualized? Maps, tables, graphs, a combination?
- What characteristics does the template for the presentation of indicators need to have?
- Are the templates filled automatically or manually filled?
- Where, when and by whom are indicators presented?

Interpretation/actions:

- Who is responsible for the interpretation?
- Is a guideline for the interpretation necessary?
- Who derives actions from the indicators?

Additional considerations:

- Is the public involved in the generation of data? e.g. Feedback or reporting platform
- Does the public gain access to the indicator results, if so how and where?
- How to manage, integrate and deal with feedback from stakeholders?

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