Erasmus+

KA220-HED - Cooperation partnerships in higher education (KA220-HED)

PROJECT NUMBER: 2023-1-EL01-KA220-HED-000164728

Project acronym: **DEMo4PPL**
Project full title: **Digital Education Modules 4 Participatory Planning**

OPT-G3: DIGITAL DECISION-MAKING SUPPORT SYSTEM

1. Short description

The European Commission (2020) stresses the importance of decision-making and assessment tools in policy development, which help achieve clear objectives and indicators. Monitoring and impact assessments are vital for tracking progress and determining whether goals are met. National Statistical Institutes play a key role by providing data for decision-making processes, which are crucial for monitoring and implementing sustainable development aligned with the SDGs. However, there is a need for tools that go beyond traditional statistics, integrating both government-collected and external data to support dynamic, responsive policies.
Sustainability Assessment is a comprehensive method that supports decision-making in environmental, economic, and social contexts. Indicator sets are considered essential for managing sustainability variables, with SDGs providing a global framework, though challenges exist in applying these indicators at local levels, especially in urban areas. Issues like data availability, fragmented information, and urban complexity hinder the effective use of these tools.
Despite these challenges, assessment tools such as multicriteria analysis and Sustainability Assessment Tools can assist in localizing SDG indicators and support urban transformation. These tools help planners, designers, and public authorities engage stakeholders and evaluate urban projects, promoting sustainable development and advancing sustainability goals effectively.
In this context, this module builds upon the research project of relevant national interest (PRIN) called "GLOcal knowledge-System for the Sustainable Assessment of urban projects" (GLOSSA) which develops and proposes a knowledge-system to support decisions in urban transformation projects, consistent with the development framework outlined by the National Resilience Plan (NRP). Within this framework, the research proposes to be innovative through a new use of existing and new indicators. The research proposes a "GLOcal knowledge-System for the Sustainable Assessment of urban projects" (GLOSSA), in which global indicators are localized and adjusted at

Co-funded by the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Education and Culture Executive Agency (EACEA). Neither the European Union nor EACEA can be held responsible for them.

both national and local levels, to support measuring progress towards sustainable development.
In particular, , this module builds upon one of the key tools developed under the GLOSSA project as the software Indicators' Based Tool (IBTool), a multicriteria evaluation tool able to manage specific set of indicators and to outline their level of importance and priority considering different territorial realities as well as multiple phases of the design problem (selection, design and monitoring). The module follows a **problem-based learning approach**, combining theoretical lectures, design activities, practical application of the IBTool, and collective discussions to let students address the complexities of urban transformation processes, engaging in analysis, reflection, and problem-solving.

2. Keywords

Sustainable Development; SDG11; Knowledge-System; Assessment Tool; Indicators; Urban Transformations

3. Content

3.1. State of the art

The European Commission (2020) emphasizes the need for decision-making and assessment tools to be actively utilized in policy development, contributing to more effective programs guided by clearly defined objectives and indicators. In policy-supporting monitoring and assessment systems, data play a crucial role by facilitating forecasting and planning for future actions. Accordingly, the role of National Statistical Institutes is pivotal, as they provide concrete data to support decision-making processes. This type of data serves as a foundation for monitoring and implementing sustainable development aligned with the Sustainable Development Goals (SDGs, Abastante 2020, 2021).
However, there is a pressing need for measurement tools that extend beyond traditional statistics, incorporating data generated, collected, and stored by governments as well as those obtained from external sources (Ernesto, 2021). Combining these data sources enables policymakers to design smart, agile, responsive, and strategic policies. Within this framework, Sustainability Assessment is defined as "a complex appraisal method conducted for supporting decision-making and policy in a broad environmental, economic and social context and transcends a purely technical/scientific evaluation" (Sala et al. 2015, p.314). Among the various assessment tools available (Bond et al. 2012), scientific literature highlights the importance of indicator sets as the most appropriate tools for managing and assessing different sustainability variables (Boggia and Cortina 2010). At the operational level, the SDGs provide a solid framework of indicators and statistical data to measure and monitor progress at the global level. However, these currently lack legislative authority and implementation responsibilities fall to individual countries, which must localise the indicators with obvious contextual problems.
Although there is growing awareness of the importance of SDG indicators, challenges persist in operationalizing these indicators at the urban, city, and neighborhood scales. Many of the indicators and measurement tools proposed by National and Regional

Sustainability Strategies are not specifically designed for these levels of territorial analysis.
This issue can be attributed to several factors, including the lack of timely data, the fragmentation of information, and the intrinsic complexity of urban dynamics, which influence all dimensions of sustainability.
As a result, it becomes particularly challenging for planners, designers, and public authorities (key actors responsible for driving urban sustainability through the design, promotion, and implementation of urban transformation interventions, plans, and programs) to meet the targets outlined in SDG11. This emphasizes the need to “make cities and human settlements inclusive, safe, resilient and sustainable” underling the crucial role of new and intelligent urban planning aimed at creating safe, accessible and resilient cities with green and culturally stimulating living conditions.
A variety of assessment tools, such as MultiCriteria Analyses (MCDAs) and Sustainability Assessment Tools, are available and could play a critical role in localizing these indicators having the potential to support the broader process of urban transformation by actively engaging territorial stakeholders. They can aid in identifying, defining, evaluating, and monitoring urban transformation projects with a strong emphasis on sustainable development, thereby enabling a more targeted and effective pursuit of sustainability objectives.
The research project of relevant national interest (PRIN) called A "GLOcal" knowledge System for the Sustainability Assessment of urban projects (GLOSSA, glossaknowledge.com) fits into this context with the primary objective of studying existing indicators, proposing new sets of indicators specific to territorial realities such as districts and neighborhoods, developing a software capable of measuring the importance of indicators in different situations and raising awareness/training planners, public administrations and students with regard to these issues. GLOSSA is conducted from Politecnico di Torino (Prof. Francesca Abastante) with Università Federico II of Naples (Doc. Giuliano Poli) and Università di Cagliari (Doc. Francesco Piras).

It is important to clarify that GLOSSA is an ongoing project, with completion planned for October 2025. As such, some outputs are yet to be delivered, and some software functionalities are still under development.

a. The GLOSSA project

The module here proposed is insert in the GLOSSA project, whose objective is to define a knowledge-system to support the decision-making and assessment processes of urban transformation projects through the use of existing and new methodologies and indicators. The knowledge-system that constitutes the final output of the research is called GLOSSA (a GLOcal knowledge-system for the Sustainable Assessment of urban projects).

There is already a global and European strategy for sustainable development (Agenda 2030), and governments are responsible for implementing, updating, and coordinating efforts to achieve the SDGs at all levels. Within this framework, national, regional, and local authorities can adapt their actions to meet these goals.

In Europe, member states pursue the SDGs collectively, using them as guiding principles for EU policies without imposing binding actions. Cities play a pivotal role in this effort, as urban areas significantly contribute to unsustainability by impacting social, environmental, and economic dimensions. Urban transformation projects must address all these aspects simultaneously, requiring planners, designers, and public administrations to design, evaluate, and monitor them using appropriate methodologies and indicators.

The GLOSSA developed through this research fits into this context with the desire to provide a transversal impulse to the implementation of the objectives and missions of the National Resilience Plan (NRP) with the priority of improving the administrative and technical capacity of the structures and professionals responsible for implementing urban transformation interventions/plans and programs. The objective of GLOSSA is threefold: i) to support Public Administrations (PAs) and planners/designers in the identification of urban areas to be transformed and in the design of urban transformation projects; ii) to support PAs in the evaluation phase of the urban transformation projects to be presented; iii) to monitor the performance of the funded projects.

The primary beneficiaries of GLOSSA are: i) PAs (national, regional and municipal) that will be supported in the identification of urban areas to be transformed, in the evaluation of projects and in the consequent allocation of monetary funds, as well as in monitoring the performance of the projects in an ex-post phase; ii) planners/designers that will be able to use GLOSSA to define projects oriented towards sustainable development. The secondary beneficiaries are: i) Master's and PhD students who will be able to be trained in new models and tools; ii) experts who will be consulted in the different project phases and will be able to find in GLOSSA a platform for exchange; iii) citizens who will benefit from the innovations brought about by GLOSSA in terms of improving the quality of life in the areas that will be transformed.

The GLOSSA is configured through 3 fundamental outputs in methodological, technical and didactic terms (Figure 1).

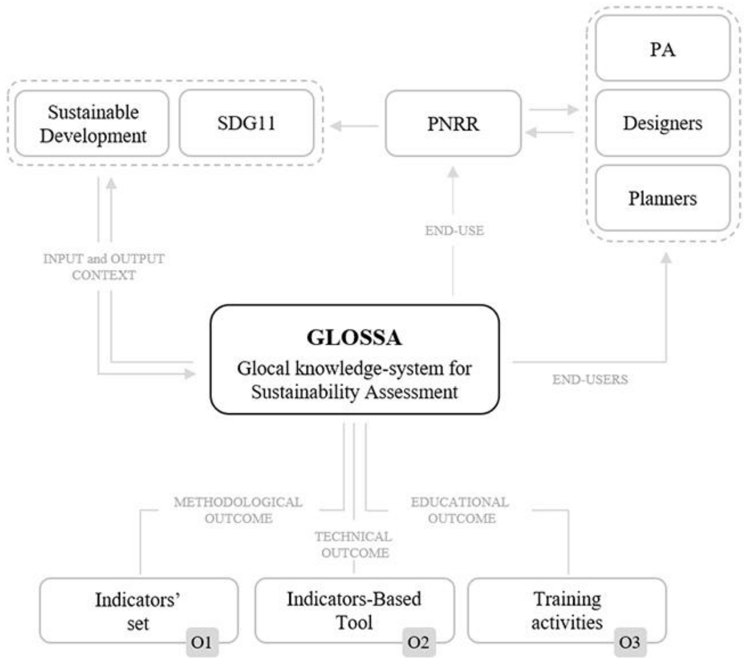

Figure 1: the GLOSSA scheme

O1_Indicators' set (Methodological Outcome) envisages a detailed analysis of the current indicators for measuring SDG11 and the expansion of these to structure operational indicator packages.
The general objective is to reason about the conceptual dimension of indicators understood not only as guidelines but as theoretical models capable of guiding the implementation of urban transformation projects and of quantifying and certifying their performance (Hiremath et al. 2013). Specifically, GLOSSA has developed a critical reflection on current local/Italian practices by involving experts in the field of decision-making and evaluation processes, in the dynamics of Sustainable Development and in urban policies, going on to define multiple sets of indicators useful in the different phases of the project process (*selection, design and monitoring*).
O2_ Indicators'Based Tool[1] (IBTool - technical result), a multicriteria evaluation tool able to manage the set of indicators developed in O1 and to outline their level of importance and priority considering different territorial realities (Cerreta et al., 2020).
O3_Training activities (Educational outcome) foresees the predisposition of free didactic courses that can be carried out online through GLOSSA.

The training activities will be aimed at PAs, planners/designers as well as Masters' and PhD students who will receive training on the constructive logic of O1 and the use of O2 selection, design and monitoring phases.

b. The Indicators ' Based Tool (IBTool)

i. Basic notions

The module proposed focuses on the second output of GLOSSA, the IBTool, which is currently under development. The IBTool is a software whose ultimate goal is to provide a ranking of key indicators (KPIs) identified and weighted from a site-based perspective, contributing to the evaluation of projects or urban areas according to the performance and weighting of the indicators. In this sense the IBTool is addressed to PAs, planners and students who will be able to apply it in the different phases of a project decision-making process in a flexible way with particular reference to the phases:

i) ex-ante to support decision-making processes at the urban/neighborhood scale, providing indications on which areas of the city need appropriate interventions;

ii) ex-ante (planners/students) to guide the process of defining urban transformation projects. In this sense, the IBTool takes the form of a checklist, verifying the correspondence of project elements with the requirements in terms of SDG11 conveyed by specific indicators;

[1] IBTool is currently in the development and testing phase and therefore suffers from some major limitations. The main ones are: i) it can only implement the set of indicators identified within the GLOSSA project. This feature will remain until the end of the GLOSSA project in October 2025; ii) different users cannot use different sets of indicators; iii) users with limited permission levels can only fill in the questionnaire; iv) given a potentially infinite set of indicators, those that can be considered as KPIs are maximum 9; v) the software's graphics have not yet been refined and some parts may be difficult to understand for non-expert users; vi) the software is in Italian since it was developed and financed within the framework of a national project and is primarily intended for PAs. By April 2025 it will be available in English language; vii) the numbering of indicators is not definitive. In fact, it now follows a logic that is functional for programming but difficult for the end user to interpret.

iii) ex-ante (PA) to select and fund projects that best match the SDG11 targets conveyed by the appropriate indicators;

iv) ex-post (PA) to monitor funded projects through a consistent set of impact indicators with a view to quantifying and certifying performance.

The IBTool is a flexible tool consisting of three main modules:

i) Indicators' database: here, users with editing permissions can enter and describe the indicators under study. This is a delicate module since the entire analysis depends on it and can therefore only be used by experts' users;

ii) Questionnaire: all stakeholders interested in the transformation under investigation can look at the indicators, evaluate them from the point of view of relevance and calculability of the data, report possible problems in data retrieval as well as specific feedback in text form. The questionnaire is designed to be used asynchronously: each stakeholder is asked to fill in the questionnaire in his or her own sphere of autonomy. The software will then collect all the answers and provide a clustering of the indicators by grouping them in terms of relevance and calculability through the methodology of 'fuzzy numbers' (Wang et al., 2008). This asynchronous operation is crucial to avoid cognitive bias in workshops and focus groups;

iii) Multicriteria analysis: it is on the contrary designed to be implemented within workshops and/or focus groups. Under the guidance of an administrator/evaluator, during the focus group stakeholders are asked to discuss the importance of the indicators by selecting up to a maximum of 9 KPIs, sorting them in terms of priority and weighing them in a normalised manner. The multi-methodology of multicriteria analysis implemented in the IBTool consists of the Best-Worst Method (Rezaei 2015, 2020) and the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS, Hwang and Yoon 1981).

Due to the complexity of some of the steps implemented by the IBTool, it is designed to be used by 2 types of users:

i) Administrators/evaluators: users who have full access to the functionality of the software and therefore need to be trained before proceeding with its use. These users can enter the indicators[2], view the results in real time in terms of indicator clustering, manage and conduct the multicriteria analysis, use the aggregation system and extract the final rank in conjunction with the evaluation of projects or areas to be transformed;

ii) Users: who have restricted access to the software limited to filling in the questionnaire and viewing the final results[3]. The users are, in fact, the stakeholders, who have no expertise or interest in the aggregation processes implemented by the software but are extremely interested in providing information with respect to the indicators.

The IBTool will be available for the download in the GLOSSA website (glossaknowledge.com) thanks to login. The username and password will be provided by the research team who will also set the user type (Administrator/evaluator or User) as required (Figure 2).

[2] It is important to stress that the set of indicators implemented in the IBTool is the GLOSSA set developed in O1. It is currently not possible to use other indicators.

[3] It is important to specify that since the software is under development, such users can currently only fill in the questionnaire.

The following sections provide a brief illustrated description of the IBTool considering the access level as Administrator/evaluator. This allows the functionality of the software to be explained in detail.

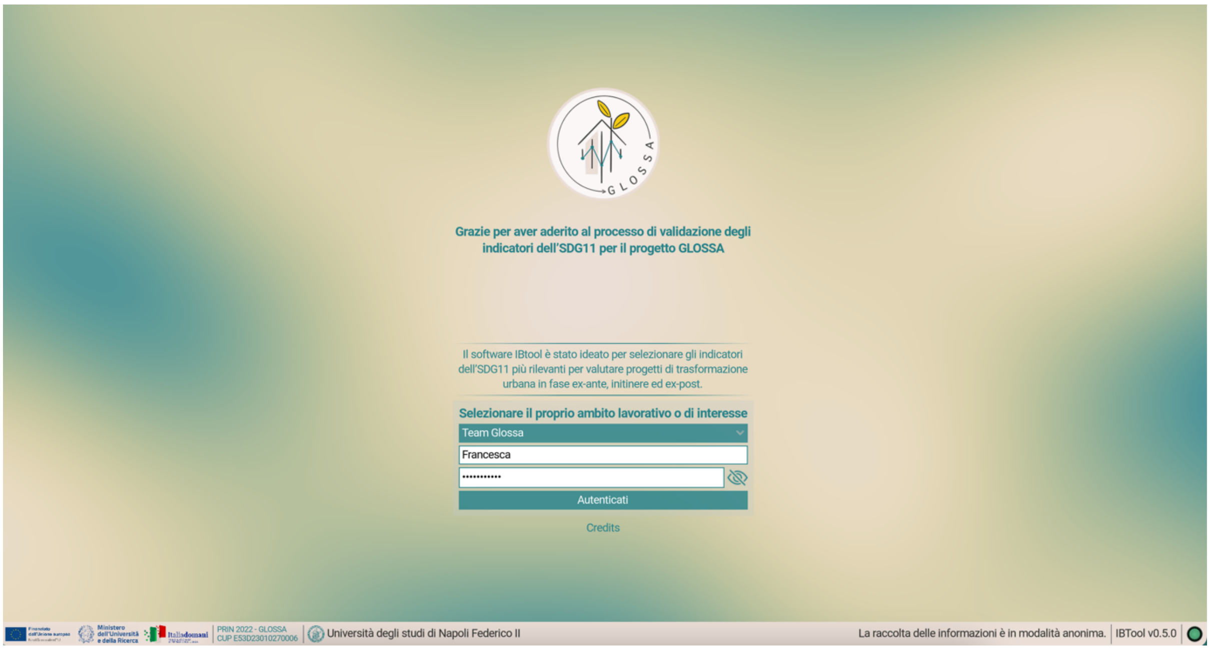

Figure 2: IBTool login page

ii. Module 1: Indicators ’ database

Once logged in, Administrator/evaluator users can enter the list of indicators under study. The IBTool allows an asynchronous working mode: all users with the appropriate permission level can, on the same project, work simultaneously. Indicators are in fact entered in ‘local’ (on the left of Figure 3) and transferred to the ‘cloud’ (on the right of Figure 3) available to all. To avoid problems in the working mode, the most recent indicators are marked in green, while those in red represent outdated indicators. In Figure 3, for example, the indicator 11.1.1 in the cloud is more recent than the one in the local area.

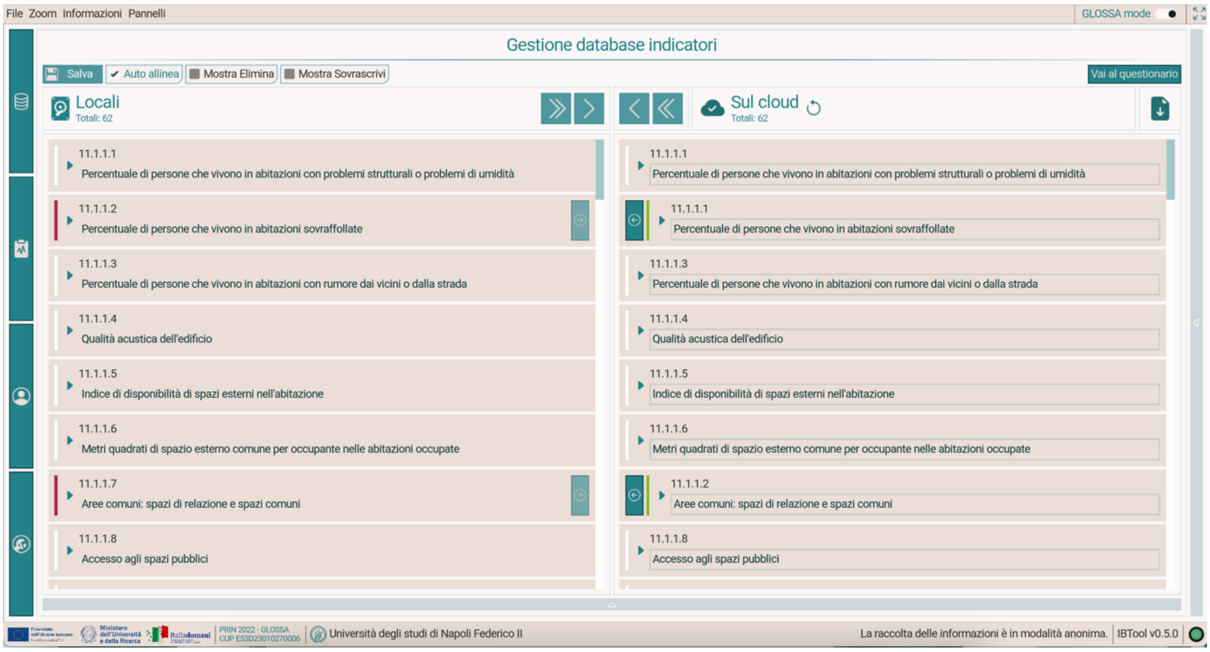

Figure 3: Indicators' database

Each indicator can be described according to different fields such as: topic, unit of measurement, method of calculation, scale of analysis, phase of use (Monitoring - related to the selection of areas or monitoring of implemented projects - and/or Evaluation - related to the definition of projects), source of data retrieval, links to useful documents.

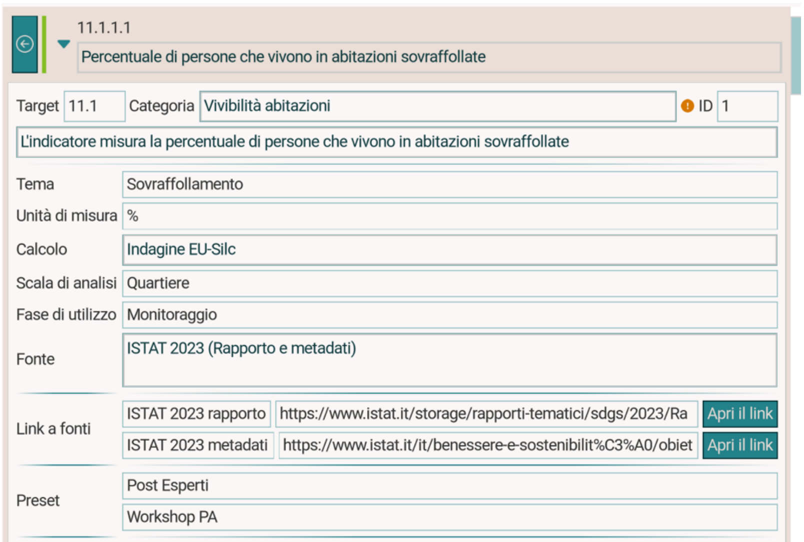

Figure 4: Indicators' database. Description of an indicator

Once the complete set of indicators has been set up, the IBTool allows the creation of a "preset" on which to perform a questionnaire validation in the following steps. In this sense, as shown in Figure 5, it is possible to assign each indicator to a predefined preset. In the case of a very large set of indicators, it might be necessary to observe and evaluate only some of them according to the panel of stakeholders (i.e. if the panel of stakeholders in a first stage of the work were environmental engineers, it might be necessary to limit the analysis to only indicators with environmental value).

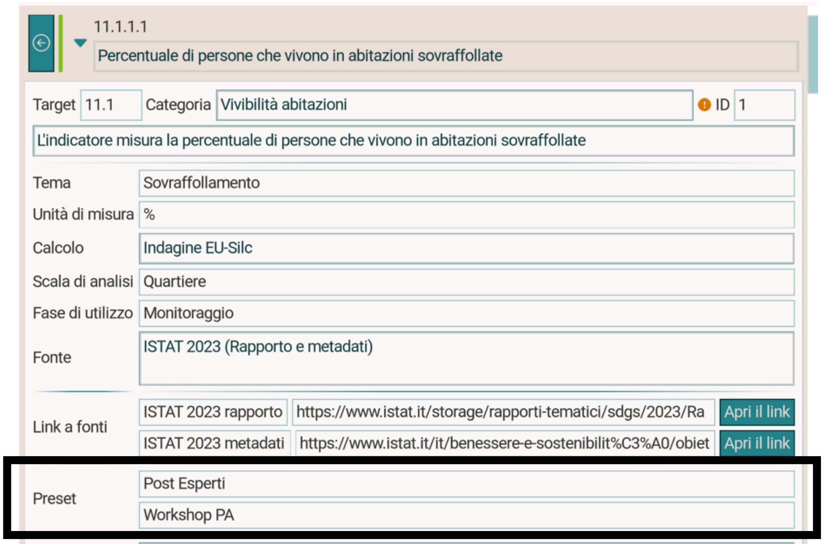

Figure 5: Indicators' database. Preset

iii. Module 2: Questionnaires

Once the entire set of indicators has been defined and the indicators have been assigned to the preset of interest, it is possible to proceed filling-in of the questionnaire by stakeholders. This step is the only one that can be used by 'User'. Any stakeholder who has downloaded the software and logged in will be faced with a page similar to the one in Figure 6 showing a quick tutorial.

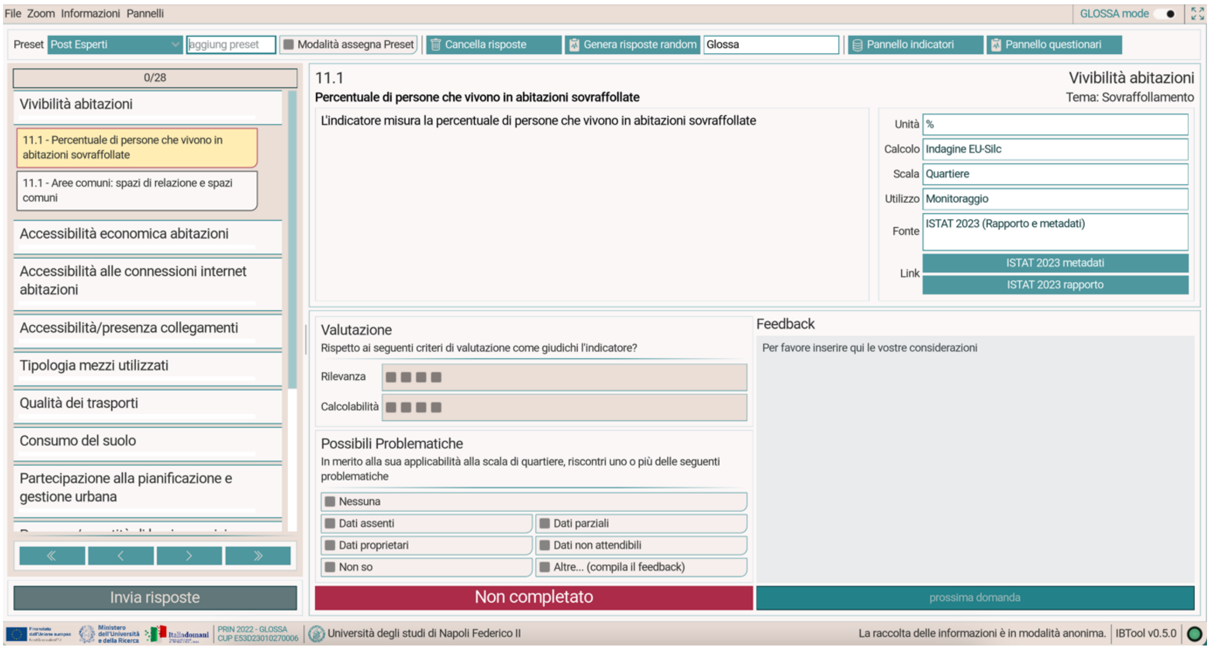

Figure 6: Questionnare mode

The left side of the page contains the list of indicators under study divided into categories related to different subject areas (Figure 7).

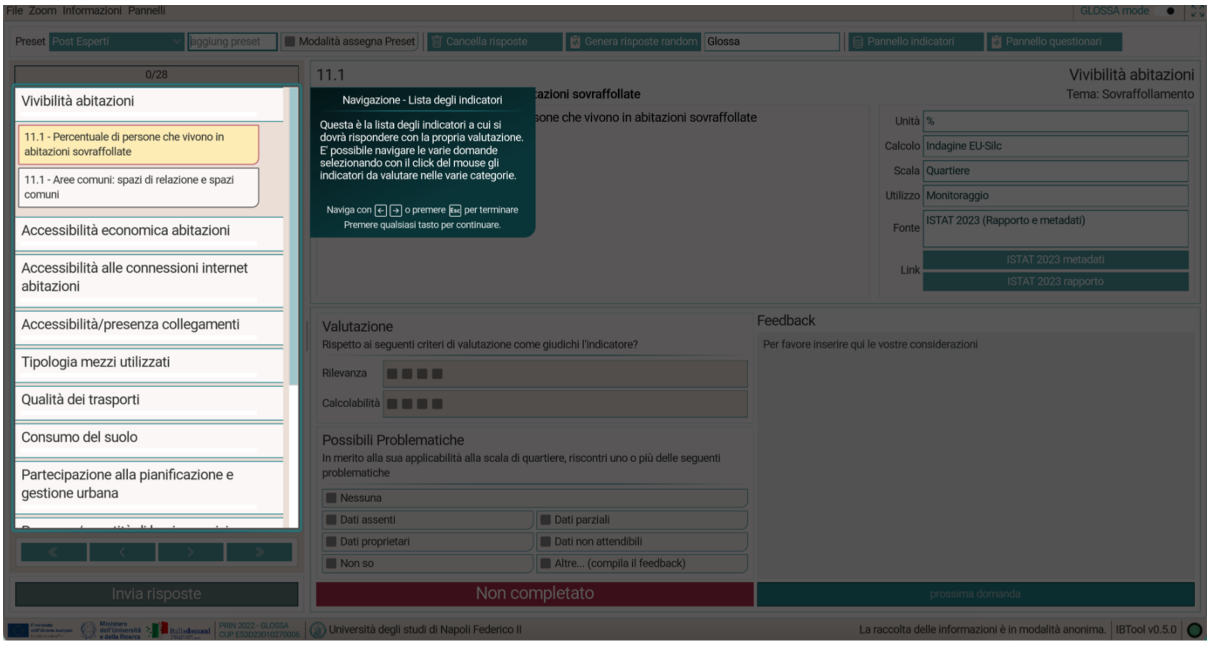

Figure 7: Tutorial. Navigation information

On the right side for each indicator (Figure 8) is the specific description and links to useful documents.

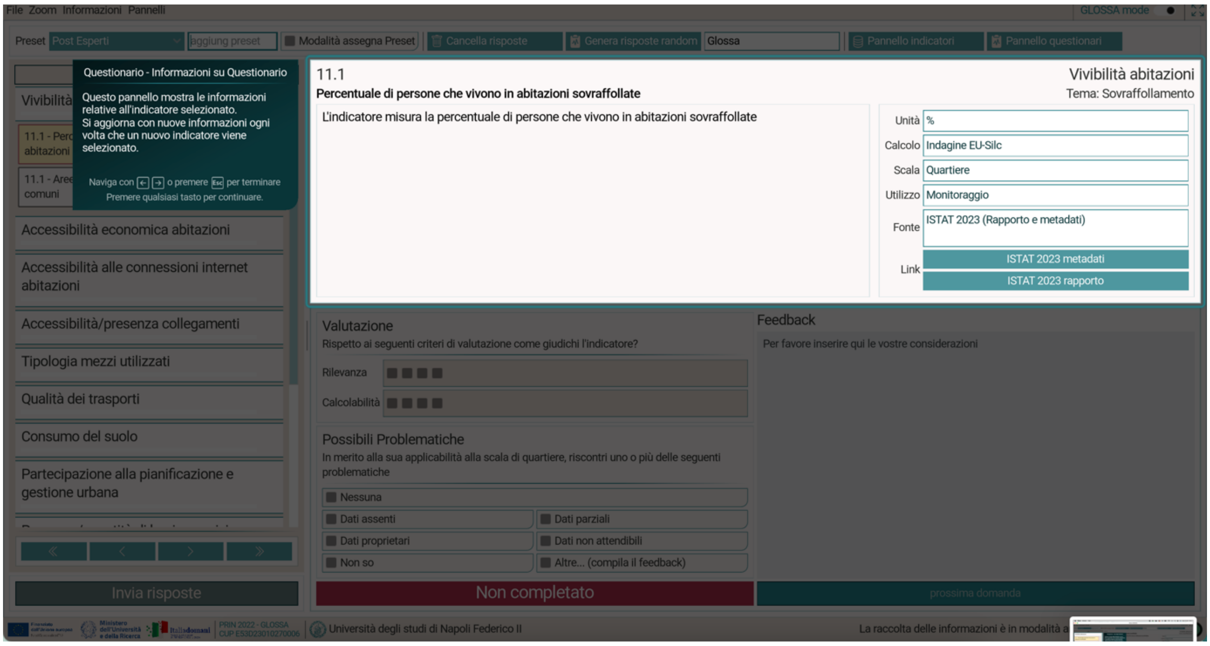

Figure 8: Tutorial. Indicators' information

At the bottom is the evaluation panel where each stakeholder can indicate the level of relevance and calculability on a 4-point scale for each indicator (Figure 9). In this section it is also possible to highlight possible problems in terms of absent, proprietary, partial or unreliable data (for the territory in exam) or indicate specific problems in the Feedback box (Figure 9). Completion of the evaluation section is mandatory in order to submit the questionnaire.

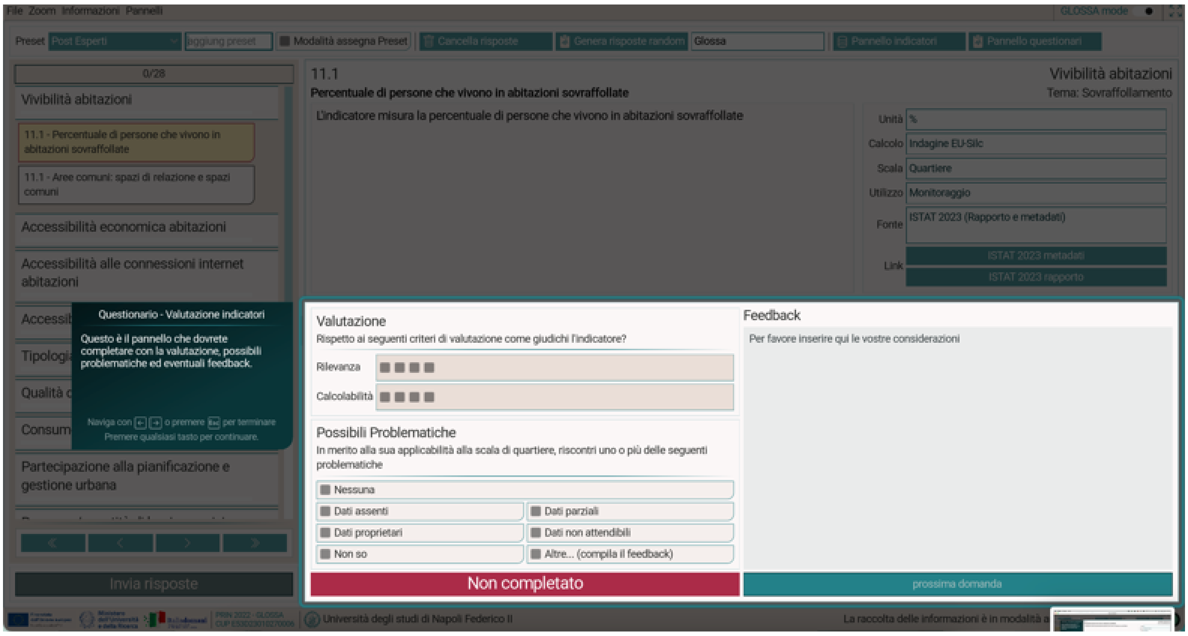

Figure 9: Tutorial. Indicators' assessment

The progress of the completion of the questionnaire is indicated by a number of elements: the presence of a red 'not completed' field indicates that the questionnaire has not yet been completed (Figure 10), while the progressive number above the list of indicators indicates how many indicators have been assessed out of the total number of indicators present in the analysis (Figure 11).

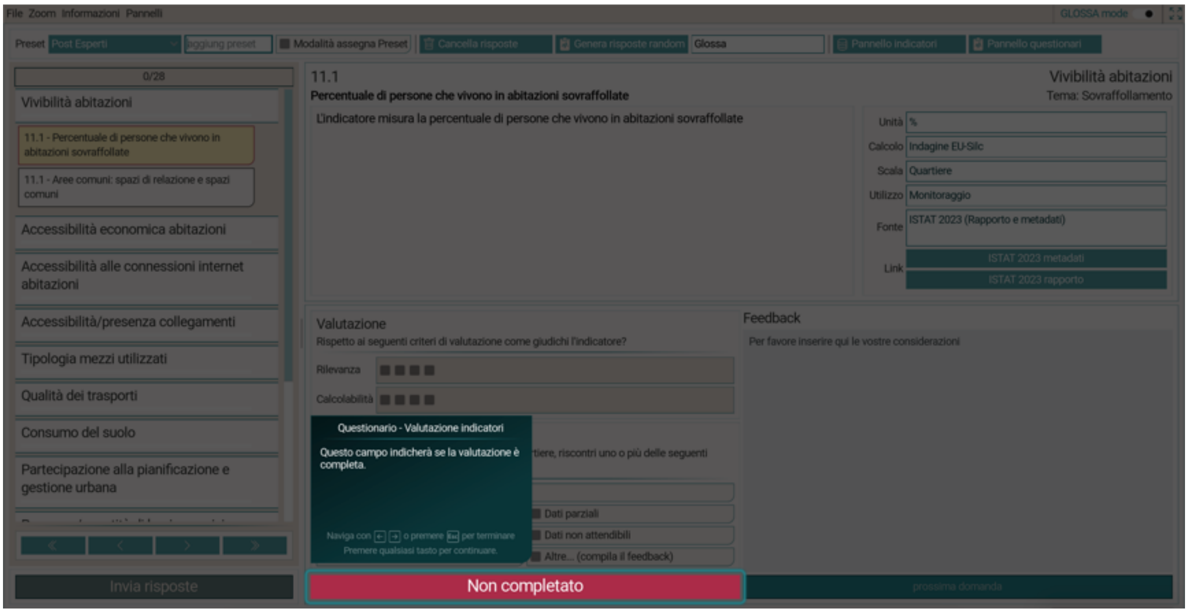

Figure 10: Tutorial. Indicators' assessment completion

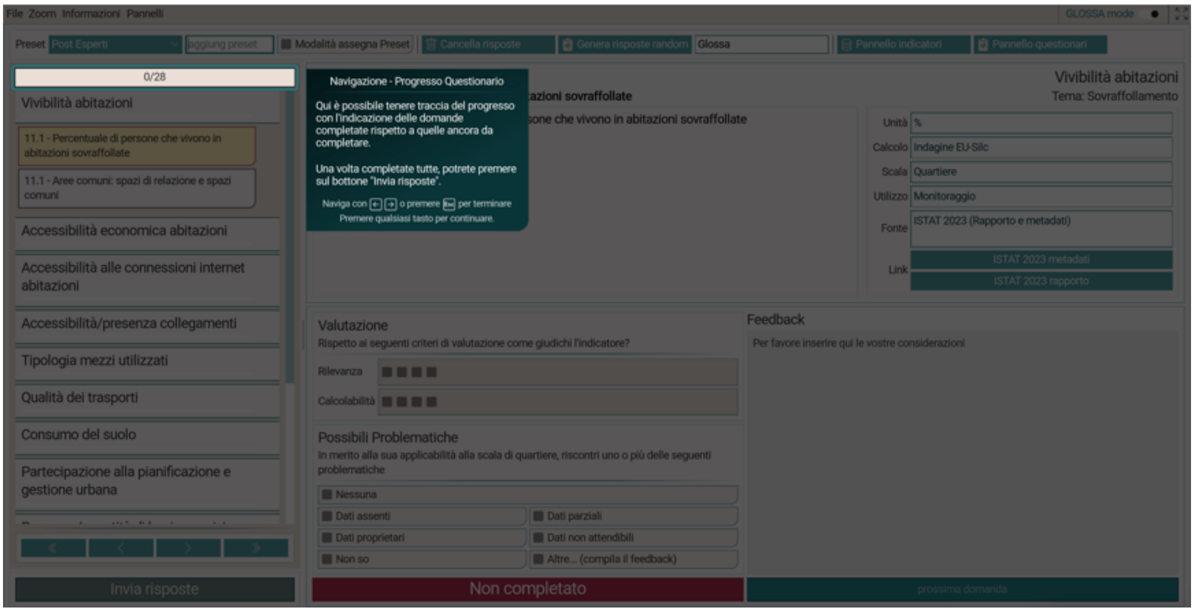

Figure 11: Tutorial. Questionnaire progress

Once the questionnaire is completed, it is possible to send it via the ‘Send answers’ button.

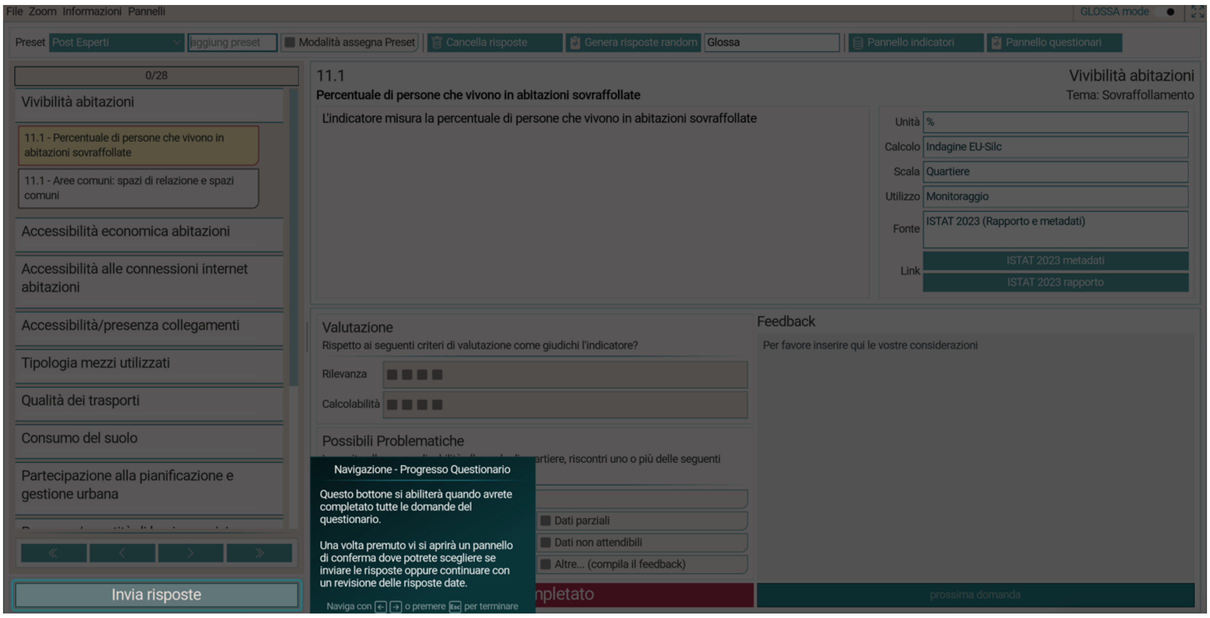

Figure 12: Tutorial. Send answers

Having collected all responses from all stakeholders, the IBTool is able to process and synthesize them into clusters of relevance and calculability through the fuzzy numbers methodology (Wang et al., 2008). Indicators that are considered relevant and calculable are shown in green, those that are averagely relevant and/or calculable in orange and those that are not relevant and/or not calculable in red (Figure 13, left). A further indication is provided in terms of issues highlighted by stakeholders (Figure 13, right). This is crucial for selecting the indicators that will become part of Module 3 of the IBTool (Multicriteria Analysis) in a maximum number of 9 indicators. Although the IBTool automatically considers relevant and calculable indicators (in green) as suitable, the Administrator/evaluator may need an overview of the issues related to these indicators to decide whether to keep or exclude them from the final set. In the same way, the Administrator/evaluator might decide to include indicators that are not relevant or calculable according to the questionnaire filled in by the stakeholders according to specific needs related to the case study.

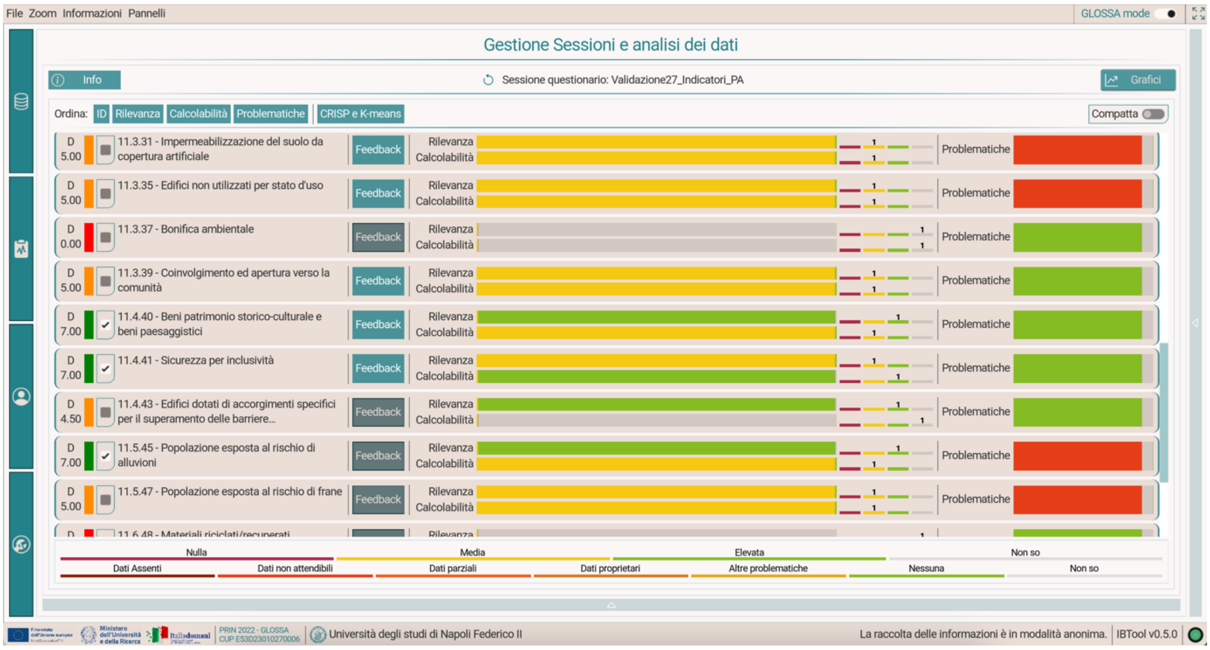

Figure 13: Data analysis

Finally, the IBTool returns the results in the form of a graph (Figure 14).

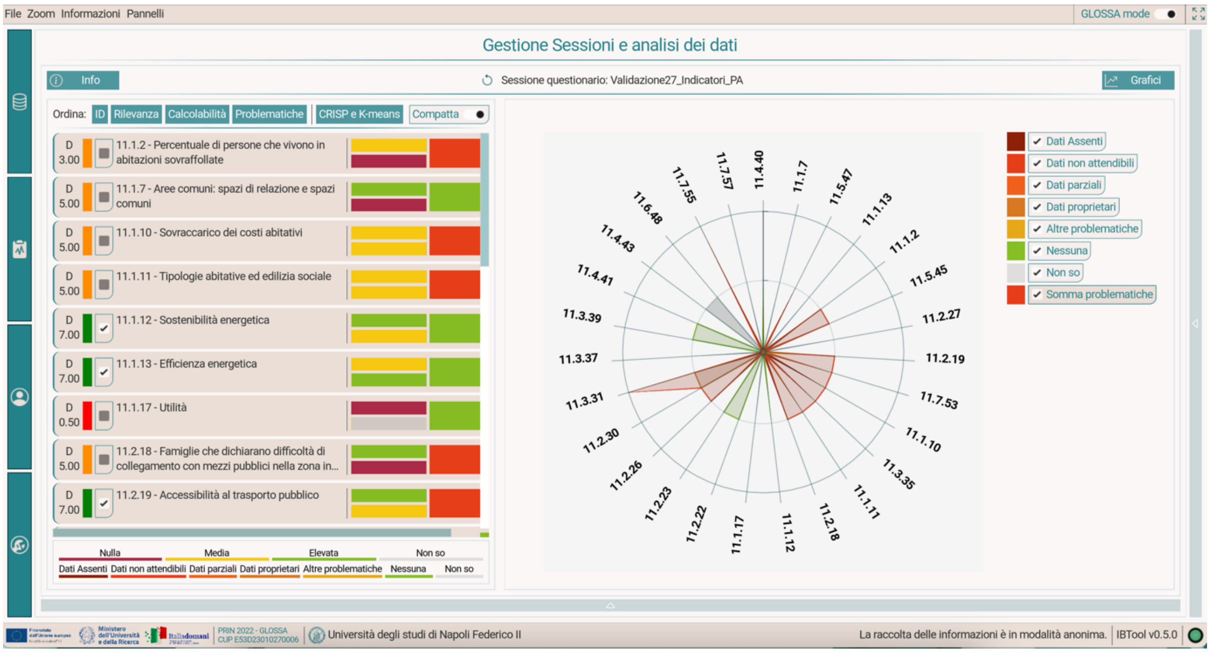

Figure 14: Data analysis graph

iv. Module 3: Multicriteria Analysis [4]

The third module on defining the level of importance of indicators is designed to be applied by an administrator/evaluator, in the role of moderator, during a workshop or focus group with interested stakeholders (online or in-person). These are called upon to discuss the indicators identified in module 2 with the aim of reaching agreement on the importance of the individual indicators within the set.

The first multicriteria analysis method implemented in the IBTool is the Best Worst Method, a multi-criteria methodology based on pairwise comparison that offers a structured way to make the comparisons using the 1-9 judgement scale developed by Saaty.

First, stakeholders are asked to identify the best and worst indicator of the set (in the example in Figure 15, the best indicator is 11.2.11 while the worst is 11.1.6).

[4] This module is currently under development and therefore cannot be described in operational detail as it may change in some of its elements according to the needs of the GLOSSA project.

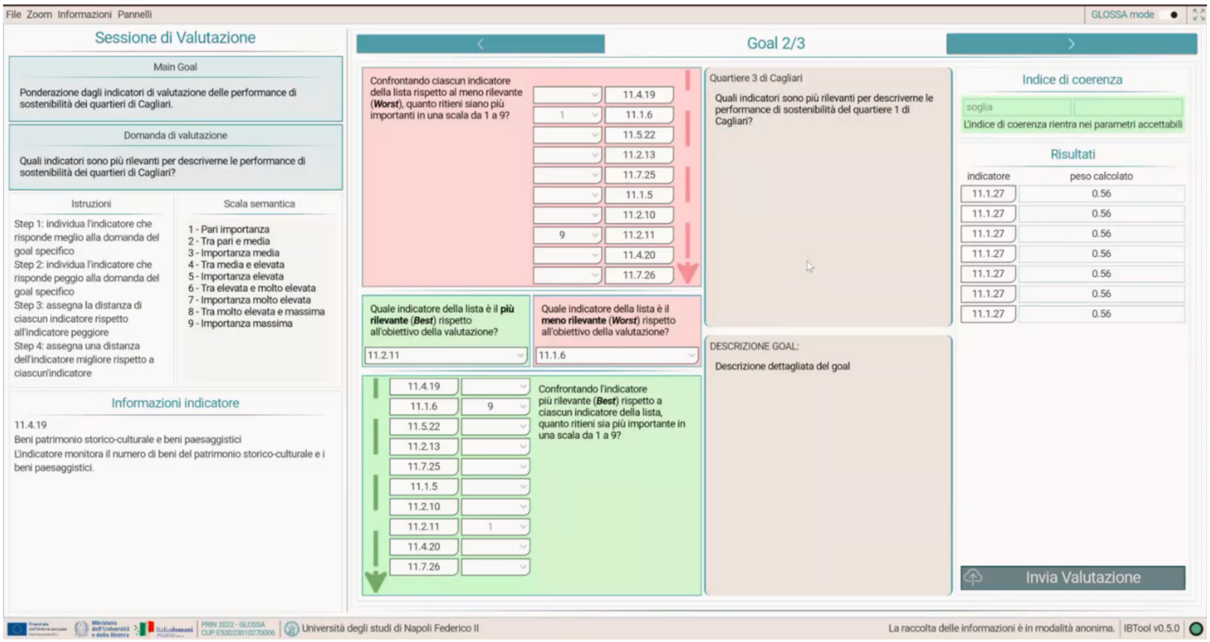

Figure 15: Evaluation of the importance of indicators using the Best and Worst method

Finally, the red and green boxes are filled in (Figure 15). In the red box, the indicators are rated against the worst using Saaty's scale and answering the question ‘by how many times is the indicator under consideration better than the worst indicator?’. In the example, indicator 11.2.11 is shown as extremely better than indicator 11.1.6 with a score of 9.

In the green box, on the other hand, the indicators are rated against the best indicator using Saaty's scale and answering the question ‘by how many times is the indicator under consideration worse than the best indicator?’. In the example, indicator 11.1.6 is indicated as being extremely worse than indicator 11.2.11 with a score of 9.

Having done this for each indicator in the set, the IBTool returns a ranking of indicator preference according to the normalised weight.

Finally, the last step of the IBTool will allow the weights of the indicators to be combined with the performance of the project under examination with respect to each indicator, thus defining a synthetic sustainability index of the project under examination. Each project examined will show objective performance with respect to each indicator, which will be independent of the weight of the indicator itself and will have to be entered as input data of the IBTool.

For example, considering project X, this will have a performance of the indicator ‘percentage of people living in overcrowded dwellings’ equal to y%, independent of the level of importance, and therefore the weight, that this indicator assumes in the set considered.

Therefore, in order to arrive at a synthetic project index capable of simultaneously considering the weights of the indicators and the performance of the project under consideration, the IBTool will implement the TOPSIS methodology (Hwang and Yoon 1981) which uses a partially compensatory linear logic by defining the distance from the positive and negative ideal[5].

[5] Currently, it is not possible to provide more information than the creation of the ranking and the synthetic index.

3.2. Case studies

In order to build a transversal and inter-scalar knowledge-system and design an operational IBTool, the GLOSSA project envisages the involvement of multiple stakeholders. First, representatives of numerous PAs are included to intervene in the project as specific connoisseurs of the territories. Second, GLOSSA involves experts in various fields (economic assessment, environment, society, urban planning and architecture) who possess detailed knowledge not only about territorial realities but also of the methods and techniques being studied. In this sense they can provide important feedback and help in the development of an operational but scientifically robust tool. Third, citizens are involved as end users of the territory and subjects on whom the choices made at a political level fall. Finally, The GLOSSA project engages master's degree students in architecture as "key" stakeholders. These students, specializing in architecture and planning, represent the future decision-makers and practitioners responsible for shaping tomorrow's interventions.
The GLOSSA project ensures significant involvement through the participation of various research units, including the City of Turin (Northern Italy), the Autonomous Region of Sardinia (Island), and the City of Naples (Southern Italy). These units represent diverse territorial realities within Italy, with the goal of developing a knowledge-system capable of addressing the unique characteristics of different regions.

The relevance of the IBTool and GLOSSA across the various project phases is ensured through the use of case studies, adopting a case study research perspective (Yin, 1984). 3 separate tests are planned to evaluate the effectiveness and efficiency of the IBTool during the selection, design and monitoring phases.

Test 1: Assessment of 3 neighborhoods in the city of Cagliari (Sardinia) to evaluate their current level of sustainable development. This initial test involves citizens and local PAs to verify the IBTool's capacity to determine which urban interventions should be prioritized and to support decision-making processes for urban renewal. Additionally, citizen participation will help identify any discrepancies between residents' perceptions of their neighborhoods' current state and the results produced by the IBTool. This test is currently in progress.

Test 2: Design of an urban area using the GLOSSA indicator set and the IBTool to guide sustainable design choices. This test will take place in the City of Turin and will involve master's degree students. The urban transformation projects developed by the students will be evaluated by PAs and the research units using the IBTool. This test has 3 objectives:

i) to verify the usefulness of the IBTool in defining urban transformation projects; ii) to assess the effectiveness of the IBTool during the design and selection phases of urban areas and projects; iii) to refine the methodological elements of the IBTool.

Test 3: monitoring of specific urban transformation projects in the Municipality of Bacoli (Campania region). The objectives of this test are twofold: i) to verify the usefulness of the IBTool in monitoring the performance of urban transformation projects; ii) to refine the methodological elements of the IBTool.

These three tests represent very different spatial applications. The first test covers an entire city, considering its broader size and urban dynamics. The second test focuses on a specific urban area in Turin, which is privately owned but publicly accessible and slated for major redevelopment in the coming years. Finally, the third test concerns a small/ medium-sized municipality, Bacoli (approximately 25.000 inhabitants), which has received around €31 million from the NRP to fund 76 projects divided into 8 thematic areas. In this case, the IBTool will assess the effectiveness of these interventions by providing key performance indicators to measure their impact on territorial sustainability and to guide future policies.

The structure of the GLOSSA project thus enables the development of a transversal and versatile knowledge-system, of which the IBTool is a core component, capable of being applied to various types of urban projects.

4. Assignments

The teaching module can be tailored for various student groups, including master's and PhD students pursuing fields such as architecture, environmental engineering, urban planning, and design. The **IBTool module** is designed for diverse groups of students, fostering a broader understanding of urban dynamics, enhancing design skills, and encouraging meaningful participation and interaction. While there is no specific recommended number of students, participants are expected to have prior knowledge related to urban transformation, sustainability, and city dynamics.

The module follows a **problem-based learning approach**, combining theoretical lectures, design activities, practical application of the IBTool, and collective discussions.

The module begins with a series of theoretical lessons aimed at building a common foundation of knowledge among all participants. These lectures introduce key concepts such as urban sustainability and the **2030 Agenda**, decision-making processes, the theory and application of multicriteria analysis, and topics related to architectural and urban design (approximately 6 hours).

Following the theoretical phase, students engage in practical application through a **significant case study** of urban transformation, defined in collaboration with the relevant PAs and stakeholders. Students are tasked with envisioning design solutions that integrate functional, symbolic, economic, and structural requirements, contributing their own architectural and urban proposals derived from the IBTool.

This phase offers flexibility in duration, ranging from 6 hours (workshop format) to an entire semester, depending on specific course requirements.

Students participating in the module address the complexities of urban transformation processes, engaging in analysis, reflection, and problem-solving. They also acquire cognitive and practical tools concerning urban and territorial systems. The module extends beyond the physical transformation of spaces, encouraging students to consider cultural heritage valorization, economic activation processes, and the broader sustainability of urban and territorial interventions.

The foundations of **GLOSSA** are integrated into this approach, emphasizing the interplay between potentially diverse or even divergent perspectives. Here, design and evaluation serve as complementary tools for envisioning and developing project scenarios.

Each student group is required to analyze, design, and/or evaluate a designated area, depending on the course theme and design stage. Deliverables include **design boards**

in A1 format, accompanied by a **4.000 word report** detailing the conducted work and outcomes.

5. Summary of Learning

The expected learning outcomes of the module are:

- Understand the role of indicators and multicriteria analysis as tools for design and assessment;
- Recognize the value and methodology of case study research as a design approach;
- Develop the ability to design effectively using indicators and data-driven approaches;
- Grasp the importance of decision-making and the design process across the selection, planning, and monitoring phases;
- Internalize the role of various public and private stakeholders and learn how to identify and address their specific needs;
- Analyze and critically assess transformation contexts through the diverse perspectives of disciplines and actors involved in the process;
- Understand and deepen knowledge of sustainability and the principles of the 2030 Agenda paradigm;
- Learn to interpret and describe territorial contexts with unexplored, recognizable, and arguable insights, offering critical positions;
- Define optimized project alternatives and strategies to achieve better performance outcomes;
- Evaluate scenarios and project alternatives using qualitative-quantitative models and multiple criteria-based frameworks.

Quiz

Q1: What a multicriteria analysis is?

A: Multicriteria analysis consists of a set of techniques used to compare alternatives on the basis of different decision criteria, taking explicit account of the relative importance attached to each of them.

Q2: What is meant by Neighborhood Sustainability Assessment Tools (NSATs)?

A: Tool aimed at supporting decision and policy makers to decide which actions/project should or should not be taken in an attempt to make urban territories more sustainable in a holistic perspective

Q3: The IBTool is structured into different modules that allows to identify, assess and weight indicators, supporting workshops and focus groups discussions. True or False?

A: True

Q4: Which of the following statements is correct: 1) the IBTool allows PAs to make decisions about urban areas to be transformed urgently; 2) the IBTool does not allow planners to understand priority indicators; 3) the IBTool is designed to estimate the running costs of alternative projects; 4) the IBTool assesses the energy performance of existing buildings.

A: 1

Q5: Sustainability assessment is: 1) a linear evaluation method designed to support corporate business models in an economic/financial context; 2) a multi-criteria analysis methodology capable of aggregating the different indicator weights into a single synthetic index considering multiple stakeholder perspectives; 3) a complex evaluation method conducted to support decision-making and policy-making in a broad environmental, economic and social context and which transcends a purely technical-scientific evaluation; 4) a complex aggregation method that compares a set of alternatives, normalizing scores for each criterion and calculating the geometric distance between each alternative and the ideal alternative, which is the best score in each criterion

A: 3

Q6: The IBTool is designed for diverse groups of users, fostering a broader understanding of urban dynamics, enhancing design skills, and encouraging meaningful participation and interaction among stakeholders with different backgrounds. True or False?

A: True

Q7: The indicator: 1) does not necessarily measure a phenomenon, but rather an element of it representing a significant dimension; 2) measures a holistic phenomenon; 3) measures a non-significant element of a global phenomenon; 4) does not necessarily measure a phenomenon, but an element of it representing a non-significant dimension.

A: 1

Q8: The Best-Worst Method (BWM) is a multicriteria methodology BWM based on pairwise comparison that offers a structured way to make the comparisons. True or False?

A:- True

Q9: The Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS) is: 1) a non-compensatory method of aggregation; 2) is a method of compensatory aggregation; 3) a multicriteria analysis; 4) is strictly related to the indicator’s concept

A: 2

Q10: The IBTool is a software consisting of 2 modules providing 3 users' type: administrator, decision-makers and students. True or False?

A: False

Q11: One of the objectives of GLOSSA is to: 1) support PAs in the identification of urban areas to be transformed; 2) support students in estimating transformation costs; 3) support PAs in the construction phase of urban transformation projects to be presented; 4) support teachers in the choice of case studies

A:1

Q12: A fuzzy number is a generalization of a normal real number. However, it does not refer to a single value but to a set of possible values with weights between 0 and 1. True or False?

A: True

Q13: The questionnaire module of the IBTool is designed to be used asynchronously: each stakeholder is asked to fill in the questionnaire in his or her own sphere of autonomy. True or False?

A: True

Q14: The set of indicators developed within the GLOSSA project is suitable for use at different stages of the project process such as: 1) selection, design, monitoring; 2) cost and revenue estimation; 3) environmental impact assessment and strategic evaluation; 4) estimation of the social return on investment

A: 1

6. Bibliography

Abastante, F., Lami, I. M., & Mecca, B. (2020). How Covid-19 influences the 2030 Agenda: do the practices of achieving the Sustainable Development Goal 11 need rethinking and adjustment?. *Valori e Valutazioni*, (26).

Abastante, F., Lami, I. M., & Gaballo, M. (2021). Pursuing the SDG11 targets: The role of the sustainability protocols. *Sustainability*, *13*(7), 3858.

Boggia, A., & Cortina, C. (2010). Measuring sustainable development using a multi-criteria model: A case study. *Journal of environmental management*, *91*(11), 2301-2306.

Bond, A., Morrison-Saunders, A., & Pope, J. (2012). Sustainability assessment: the state of the art. *Impact Assessment and Project Appraisal*, *30*(1), 53-62.

Cerreta, M., Giovene di Girasole, E., Poli, G., & Regalbuto, S. (2020). Operationalizing the circular city model for naples' city-port: A hybrid development strategy. *Sustainability*, *12*(7), 2927.

Ernesto, S. M. (2020). Implementing the OECD Recommendation on Policy Coherence for Sustainable Development.

Hiremath, R. B., Balachandra, P., Kumar, B., Bansode, S. S., & Murali, J. (2013). Indicator-based urban sustainability–A review. *Energy for sustainable development*, *17*(6), 555-563.

Hwang, C. L., & Yoon, K. (1981). Multiple attribute decision making. In Methods and applications: A state-of-the-art survey. Springer-Verlag.

Rezaei, J. (2020). A concentration ratio for nonlinear best worst method. *International Journal of Information Technology & Decision Making*, *19*(03), 891-907.

Rezaei, J. (2015). Best-worst multi-criteria decision-making method. *Omega*, *53*, 49-57.

Sala, S., Ciuffo, B., & Nijkamp, P. (2015). A systemic framework for sustainability assessment. *Ecological economics*, *119*, 314-325.

Yin, R. K. (2009). *Case study research: Design and methods*(Vol. 5). Sage.

7. Glossary

Best Worst Method: a multicriteria decision-making technique used to evaluate and prioritize options based on a set of criteria. In this method, decision-makers are asked to identify the best and worst options or criteria, relative to each other, within the set being evaluated. After identifying the best and worst, the decision-maker assigns scores to the other criteria based on their preference compared to the best and worst. The method then calculates a set of weights for the criteria, which can be used to rank or assess the alternatives.

Case Study Research: an in-depth research approach that focuses on the analysis of one or more specific cases within a real context, with the aim of understanding their dynamics, processes and outcomes. It is particularly useful in complex and interdisciplinary fields, where the variables at stake cannot be easily isolated.

Indicator: a quantitative summary measure, coinciding with a variable or composed of several variables, capable of providing a representation of a phenomenon and summarizing its development. The indicator does not necessarily measure a phenomenon, but rather an element of it capable of representing a significant dimension of it. In this sense, the use of a quantitative instrument does not prevent the highlighting of qualitative aspects of the phenomenon analyzed.

Indicators's Based Tool: a multicriteria evaluation tool composed by multiple modules. It is able to manage sets of indicators and to outline their level of importance and priority considering different territorial realities. The IBTool provide a ranking of key indicators (KPIs) weighted from a site-based perspective, contributing to the evaluation of projects or urban areas according to the performance and weighting of the indicators

Multicriteria Analysis: a decision-making methodology used to evaluate and compare multiple options or scenarios based on a set of criteria, which may include both qualitative and quantitative factors. It allows for the systematic consideration of conflicting objectives, assigning weight to each criterion to reflect its relative importance in the decision-making process. MCA is particularly useful in complex situations where decisions involve diverse stakeholders, multiple perspectives, and competing priorities.

Neighborhood Sustainability Assessment Tools: a framework or instrument designed to evaluate the sustainability of a specific neighborhood or urban area. It typically measures various environmental, social, and economic factors that contribute to the overall sustainability of the area. These tools assess key aspects such as energy efficiency, waste management, green space availability, transportation systems, housing quality, social equity, and local economic opportunities.

Problem-Based Learning: an instructional approach that uses real-world problems as the starting point for learning. In PBL, students are presented with a complex, open-ended problem, and they must work collaboratively to solve it. This method encourages critical thinking, problem-solving skills, and self-directed learning, as students actively seek out the necessary information and resources to understand and address the problem at hand.

Ranking: the process of arranging items, individuals, or alternatives in a specific order based on certain criteria or attributes. This order is typically determined by evaluating the relative performance, quality, or preference of each item in comparison to the others.

Triangular Fuzzy Number: A fuzzy number is a generalization of a normal real number. However, it does not refer to a single value but to a set of possible values with weights between 0 and 1.

TOPSIS: a multicriteria decision-making method used to rank and select the best alternative from a set of options based on multiple criteria. The method operates on the principle that the chosen alternative should be the one that is closest to the ideal solution and farthest from the negative ideal solution.