Initial Experiences of the First Version of Slovene Sustainable Building Indicators That Are Based on Level(s)

Sabina Jordan, Miha Tomšič, Friderik Knez, Marjana Šijanec Zavrl

Abstract**—**To determine the possibilities for the implementation of sustainable building indicators in Slovenia, testing of the first version of the indicators, developed in the CARE4CLIMATE project and based on the EU Level(s) framework, was carried out in 2022. Invited and interested stakeholders of the construction process were provided with video content and instructions on the Slovenian e-platform of sustainable building indicators. In addition, workshops and lectures with individual subjects were also performed. The final phase of the training and testing procedure included a questionnaire, which was used to obtain information about the participants' opinions regarding the indicators. The analysis of the results of the testing, which was focused on level 2, confirmed the key preliminary finding of the development group, namely that currently, due to the lack of certain knowledge, data, and tools, all indicators for this level are not yet feasible in practice. The research also highlighted the greater need for training and specialization of experts in this field. At the same time, it showed that the testing of the first version itself was a big challenge: only 30 experts fully participated and filled out the online questionnaire. This number seems alarmingly low at first glance, but compared to level(s) testing in the EU member states, it is much more than 50 times higher. However, for the further execution of the indicators in Slovenia, it will therefore be necessary to invest a lot of effort and engagement. It is likely that state support will also be needed, for example, in the form of financial mechanisms or incentives and/or legislative background.

Keywords**—**Sustainability, building indicator, project CARE4CLIMATE, alpha version SLO kTG, Level(s), sustainable construction stakeholders.

I. Introduction

SUSTAINABLE buildings are the foundation of each sustainable society. However, to define a building as sustainable, assessment with specific procedures, indicators and criteria is needed, combined in an appropriate methodology. Slovenia started the development in this area in the LIFE IP CARE4CLIMATE project, in action C4.4. Doing so, it relied entirely on the EU Level(s) framework. At the end of 2021, the Alpha version of the Slovenian sustainable building indicators for the evaluation of buildings (hereinafter SLO kTG) was created and was available for testing. The version includes indicators for use at Level 2, as given by the European framework Level(s), version 1.1, January 2021 [1]. From the testing of the Alpha version SLO kTG, the first experiences were gained and the basis for the development of the improved version of the SLO kTG was obtained.

By preparing common framework Level(s), the EC offered support to EU members in implementing the sustainable evaluation of buildings. And not only that, with Level(s) the EC took a step towards European harmonization in this area. Using Level(s) one »can start by implementing standard data as an entry point, and later working with more specific data items that even better represent their building project, as familiarity with the framework increases« [2]. Level(s) framework, organised into three levels, aims to encourage the whole life cycle thinking for building. It provides a set of indicators and common metrics for measuring the sustainability performance of buildings along their life cycle, addressing the following aspects: environmental performance, health and comfort, life cycle cost and value and potential risks to future performance [3], [4].

Level(s) is still in the development phase; for the testing of Beta version at the EU level that lasted for two years 136 building projects and 21 countries were registered [5]. To complement the results of Level(s) performance evaluation and to gather feedback from the participants, a specially created survey was distributed. 82 full responses were submitted, which represents a 60% response rate, based on registered stakeholders [6]. Among others, the results of the survey contributed to the important content reformulation of the three levels in the new version of Level(s) [7]. From the answers it was highlighted that the added value in sustainable evaluation can be achieved by fully integrating Level(s) into construction project workflow management [1]. For this, specific actions will have to be taken, such as assigning roles and responsibilities, conducting training, providing certain information and data, and setting requirements and deadlines. One of the issues raised by participants was increasing importance of the digitalisation in construction sector, therefore Level(s) should support this new way of working and sharing information [7]. The well-known certification schemes BREEAM (UK), DGNB (Germany), HPI (Ireland), HQE (France) and Verde (Spain) support the development of Level(s); actually, all of which intend to align with it as much as possible [8]. If we compare indicators of different kind of current most known building certification schemes with Level(s), DGNB seems to be most aligned with the EU

Sabina Jordan and Friderik Knez are with Slovenian National Building and Civil Engineering Institute, Dimičeva ulica 12, 1000 Ljubljana (e-mail: sabina.jordan@zag.si).

Marjana Šijanec Zavrl and Miha Tomšič are with Building and Civil Engineering Institute ZRMK, Dimičeva ulica 12, 1000 Ljubljana.

framework Level(s) [9]. Both deal with specific or similar indicators, with DGNB being much more complex. Level(s) and its indicators appear in many comparative studies, but most of them focus only on LCA [10]- [13]. De Wolf listed, analysed and discussed LCA software tools and databases for the analysis of building projects in EU countries in the context of LCA indicator as described in Level(s) [10]. Kanafani checked the Danish LCA calculation tool, LCAbyg, for its suitability for use for Level(s)-compliant assessment and emphasized that more transparent data functions and program-specific guidelines may need to be considered [11]. The comparison between Level(s) indicator 1.2 GWP calculated according to EN 15978 and Norvay standard NS 3720 showed some important differences between the methods, which means that buildings assessed with these two methods cannot be directly compared [12]. The evaluation of the Level(s) alignment with the existing Swedish tools focusing on LCA showed that due to large flexibility (e.g. in boundary settings) the Level(s) LCA result are not comparable and cannot be used for comparative assertion; the study provides recommendations for the upgrade of the current Level(s) pilot guidance, with taking the digitalisation into account [13].

Testing the versions of the methodology and obtaining feedback on experiences is extremely important, as it helps to get the basis for improvement of the proposed procedure. That is why it was used both in the development of Level(s) and SLO kTG. For example, testers of Level(s) mentioned that feedback on their performance assessment and on the sustainability of their building would increase their motivation for participation, so, there is a need for benchmarking [14].

This paper aims to present the findings of the survey analysis which was carried out during testing of the Alpha version SLO kTG in Slovenia. The purpose of the online survey, in which the experts involved in the testing participated, was not only to gain a comprehensive insight into the applicability of the procedures defined by SLO kTG, but also a broader insight and understanding of the various challenges of implementation of sustainable evaluation of buildings. The gathered results will help in further development of the SLO kTG. They may also assist and give some guidance to other countries in the preparation of national methodologies based on Level(s).

II. Methodology

The Alpha version SLO kTG for testing consisted of eleven sustainability indicators to assess the building that were prepared to be used at Level 2. The Level 2 was coordinated with the phase of detailed building project planning and construction and foresees the quantitative determination of indicator values. These eleven indicators are named the same as in the latest version and old version of Level(s) - 1.1 Use stage energy performance, 1.2 Life cycle Global Warming Potential, 2.1 Bill of quantities, materials, and lifespans, 2.2 Construction and demolition waste and materials, 2.3 Design for adaptability and renovation, 2.4 Design for deconstruction, reuse and recycling, 3.1 Use stage water consumption, 4.1 Indoor air quality, 4.2 Time outside the thermal comfort range. 5.1 Protection of occupier health and thermal comfort and 6.1 Life Cycle Costs [3], [4] except that they are translated into Slovenian. Manuals for Slovene indicators (in Slovenian) are available to stakeholders as e-documents at e-platform of SLO kTG “Kazalniki trajnostne gradnje” (https://kazalnikitrajnostnegradnje.si/) [15].

The sustainability building indicators were designed as a tool to support the planning process and help investors, designers and other professionals at decisions during the building planning and construction process. Therefore, the methodology has the character of an iterative process for the optimization of elements and systems, with which it is possible to influence the reduction of the use of resources and raw materials, the impact on the environment and the quality of living environment. At the end of the planning phase, the indicators can also be used as a criterion to demonstrate the sustainability of the building according to the defined aspects.

The testing of the Alpha version SLO kTG took place in the period from November 2021 to June 2022. The mandatory part of the testing included a review and study of the e-documents of the Alpha version SLO kTG on the e-platform with the presentation of indicators and steps to determine their value for Level 2. However, the concrete use of one or more indicators on a hypothetical or concrete example of a building was optional. As the project did not provide funds to finance the work of the stakeholders, the testing of the Alpha version SLO kTG was based on the voluntary participation of stakeholders. Also, specific prior knowledge of the test subjects and/or their involvement in the concrete project were not a condition.

The testing purpose was to obtain feedback on the feasibility of evaluating individual indicators in the national context and to check the suitability of the indicators for the Slovenian environment and their compatibility with the established phases of the construction process. The purpose was also to encourage professional discussion among test users of SLO kTG, as well as dialogue within individual segments of sustainable construction stakeholders.

E-documents, multi-lesson courses and gamification elements were available for each indicator in the online learning environment. To facilitate understanding of the materials, supporting video materials with introductory information on the indicators, videos of workshops with content related to one or more indicators, as well as important external links and some examples of the use of indicators in Slovenia were also accessible. All interested professionals in the field of building sector were invited to participate in the testing of the alpha version SLO kTG (Fig. 1).

The concept of testing the alpha version SLO kTG consisted of two steps. The 1st step, which was called the "umbrella approach", included the initial training of the experts on the SLO kTG contents. The experts had the opportunity to complete it via a basic online workshop or via an introductory video training on the e-platform. In the 2nd step, called the "detailed approach", the experts applied the selected indicators from the SLO kTG to any building example. Experts could have chosen indicators that were more familiar to them or were more manageable for them (Fig. 1) [16].

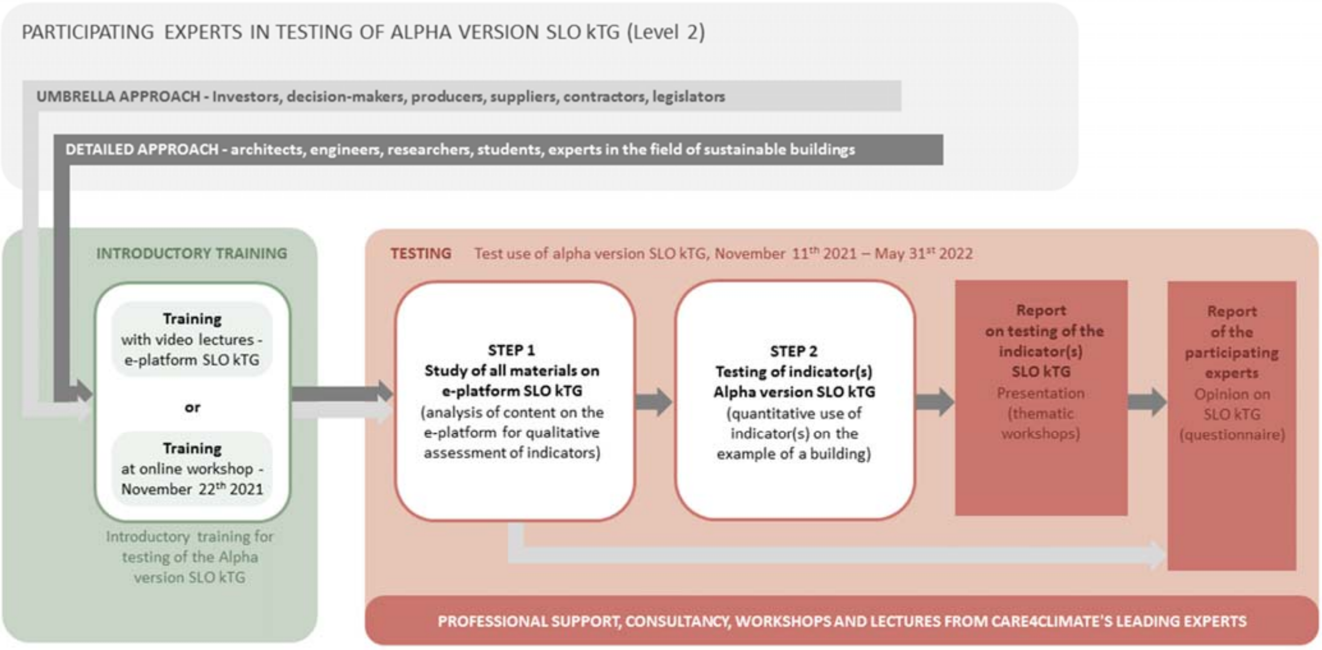

Fig. 1 Testing protocol of the Alpha version SLO kTG [16]

At the end of the testing, an online survey was sent to all participating experts, regardless of whether they used the umbrella approach (step 1 only) or both approaches (step 1 and 2). The final phase of the testing was the analysis of data from the survey responses of the experts involved in the testing of the Alpha version SLO kTG.

The goal of the testing was to assess the experience of users in the field of sustainable evaluation of buildings and their current competence in analysing the sustainable aspects of buildings. Furthermore, the goal was to identify methodological gaps and obstacles and to obtain an opinion on the completeness of the proposed set of indicators. The objective was also to find out what is the usefulness, the importance, and the role of indicators in practice, as well as the content quality of training materials.

III. Results

The testing of the first version SLO kTG was a big challenge since a lot of effort needed to be put into involving the stakeholders into cooperation. Finally, 64 of them registered on the e-platform SLO kTG, of which 30 answered the survey questions, which is almost 47%. Attracting 30 experts to participate in a country of 2 million people (i.e., Slovenia) should be considered as a great success, especially compared to the 82 experts who participated in the Level(s) testing from across the EU. The majority of SLO kTG test participants, 41.7%, had between 1 and 5 years of general experience in the field of sustainable building construction, 16.7% of participants had between 5 and 10 years of experience, and 20.8% had more than 10 years of experience. Only 20.8% of respondents had less than 1 year of general experience in the field of sustainable construction [16].

Regarding the education of the respondents, it was found that university education or master's degree is dominant, as they reach 54.2%. 16.7% of the respondents had a Master of Science Education and 12.5% a doctorate. The respondents came from a variety of disciplines, with civil engineering dominating at 45.8%, followed by architecture at 20.8% and mechanical engineering at 16.7%. Other sciences were represented to a very small extent. The analysis of the answers also showed that most of the respondents were designers, 33.3%, and experts in the field of creating construction knowledge, 33.3%. Respondents working as technical advisors, 8.3%, and supervisors, 12.5%, also participated. Other roles were mentioned only individually [16].

One third of the respondents, 33.3%, stated that they have "extensive experience" with the evaluation of sustainable buildings, i.e., they have already used indicators from certification schemes or used evaluation methods to assess the sustainable aspects of the building. Another third of the respondents, 33.3%, indicated "average experience" with sustainable construction indicators, and 29.2% indicated "limited experience"; the rest of them had "no experience" (Fig. 2) [16].

Fig. 2 Respondents' experiences in the field of sustainable buildings in testing phase of Alpha version SLO kTG [16]

The content comprehensibility of e-documents on the e-platform was rated as "excellent" by 29.2% of respondents. For

54.2% of them it was "very good", while for 16.7% of respondents it was "average". Also, 12.5% of the respondents were of the opinion that the electronic learning materials on the e-platform "significantly helped" their understanding of various areas within the framework of sustainable buildings, 41.7% of them believed that the materials "helped" them to a large extent, a further 37.5% of them indicated that the materials only "moderately contributed" to their understanding of the sustainability [16].

The level of the knowledge of the indicators, as assessed by the surveyed participants for themselves, was an average of 3.2 for all indicators. This score on a scale from 0 to 6 means "theoretical knowledge of the indicators, but not sufficient for practical use". As expected, the highest level of knowledge was shown at indicator 1.2 Energy use in the use phase (level 3.9) and indicator 4.1 Indoor air quality (level 3.5). The remaining indicators, especially 2.3 Planning for adaptability and renovation (level 2.8), 2.4 Planning for decommissioning, reuse and recycling (level 2.6) and 4.2 Time outside the thermal comfort zone (level 2.9) were rated by respondents as less known (**Error! Not a valid bookmark self-reference.**) [16].

TABLE I
RESPONDENTS' ASSESSMENT REGARDING THEIR LEVELS OF KNOWLEDGE FOR THE INDICATORS IN TESTING PHASE OF ALPHA VERSION SLO KTG [16]

	Level of knowledge for each Indicator SLO kTG (Scale 0 – 6)										
Indicator	1.1	1.2	2.1	2.2	2.3	2.4	3.1	4.1	4.2	5.1	6.1
Average	3.9	3.1	3.3	3.2	2.8	2.6	3.2	3.5	2.9	3.2	3.1
Median	4	3	3	3.5	2.5	2.5	3.5	4	3	3	3

Legend: 0 - I don't know it at all; 3 - I know it theoretically, but not enough for practical use; 6 - I know it well and know how to use it.

In the 2nd step of testing, in the detailed approach, which included the use of the prescribed procedure of evaluation of the indicator on a selected example of a building, 14 experts participated with their 18 examples of the use of indicators. These experts were dominated by researchers and postgraduate students, but also included representatives of the construction industry, designers and BIM experts, and undergraduate students. The recorded testing of SLO kTG indicators with a detailed approach included (a) quantitative use of indicators of the Alpha version of SLO kTG on 15 examples of buildings and (b) quantitative use of indicators of comparable methodologies (e.g., beta Level(s), DGNB, Active House) on 3 examples of buildings [16].

Regardless of whether the respondents chose an overall or detailed testing approach in their engagement, they all had the opportunity to assess the suitability of the tested indicators for use in practical cases. Most respondents, 54.2%, considered the suitability of the indicators to be "very good", a further 37.5% rated the suitability as "average" and 8.3% of the respondents rated the indicators as "excellent". The rating "bad" was not selected (Fig. 3) [16].

When testing the Alpha version SLO kTG, the respondents identified some potential or actual problems and challenges, such as (multiple answers were possible): "additional training would be necessary", 45.8%, "incomprehensible or incomplete instructions", 12.5%, "input data is not available or is payable", 37.5%, "tools and necessary support materials are not available or are payable", 29.2%, "time-consuming process", 29%, "complicated process" 25% [16].

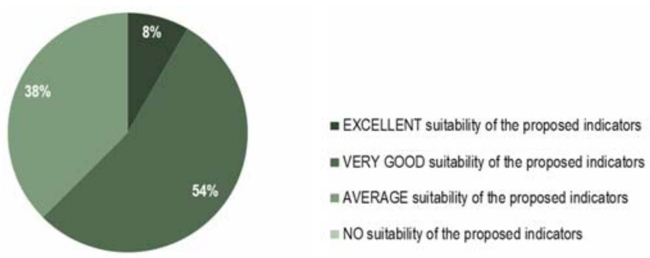

Fig. 3 Respondents' assessment of the suitability of the indicators for use in practical cases in testing phase of Alpha version SLO kTG [16]

The main obstacles for the use of indicators in the process of designing and constructing buildings, as recognized by the respondents, were (multiple answers were possible): "lack of specific knowledge", 83.3%, "additional design costs", 58.3%, "extended design time", 50%, "general mastery of calculation operations", 29.5%. In addition, the participants stated that there is no demand for sustainable buildings among investors and residents, i.e., insufficient awareness of sustainable buildings is also an obstacle [16].

For the area of application where the indicators would be particularly useful (multiple answers were possible), 62.5% of respondents indicated "green public procurement", then "formulation of criteria in project orders for design and construction", 62.5%, "formulation of criteria in subsidy schemes and construction crediting", 50%, "assessing the impacts of construction and renovation of buildings", in 75%, and "creating criteria for architectural competitions", 29.2%. Also, as a proposal for the area, they added "creating instructions for residents to use the nZEB" [16].

Regarding the assessment of the importance of the indicators in achieving national strategic goals in the field of sustainable construction, decarbonization of the building stock and mitigating climate change, 37% of respondents answered that they recognize the influence of the indicators as "very large", 29.2% as "large" and a further 20.8% as "moderate", while no one marked the impact as "negligible". 12.5% of respondents did not express their opinion about this issue [16].

Furthermore, 54.2% of the respondents answered that indicators are of "great" importance in encouraging and supporting investors in their decisions. 20.8% of them even indicated that the influence of indicators on investors' decisions can be "very large" and only 16.7% stated that the influence of indicators on investors' decisions is "moderate". Assuming that this view reflects the situation in practice, the indicators can be recognized as an important tool to promote sustainable decisions in the early stages of building design, where the effects are greatest and the tools to evaluate the decisions are rather modest (Fig. 4) [16].

At the end of the survey, the respondents also gave suggestions for improvements that would increase the usefulness of the proposed set of indicators. They suggested e.g., simplification of the system, guided use of indicators, accessible software tools and free access to the necessary data, comparative values of individual sustainability aspects (classes, scale), examples of the use of indicators in practice, demonstration examples of the use of indicators, upgrading of indicators to the official certification system and/or use of a commercial system such as DGNB. The necessity of training personnel through educational programs at faculties and the legal basis for the mandatory use of SLO kTG was highlighted. The need to raise awareness among investors and building users in the field of sustainable building construction was also emphasized [16].

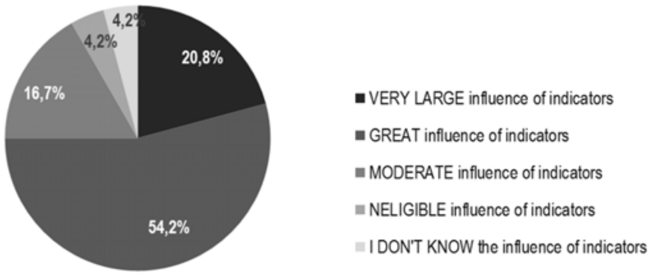

Fig. 4 Respondents' assessment of the importance of indicators on investors' decisions in testing phase of Alpha version SLO kTG [16]

IV. Discussion

Throughout the project work and during the test use of SLO kTG indicators, it was repeatedly pointed out that BIM design and the digitization of all processes represent a great potential for faster and easier use of indicators. Development in the field of software for BIM design is taking place very quickly: e.g., software solutions are available that support the most familiar indicators (energy consumption, carbon footprint). Despite this, the implementation of BIM in Slovenia is still very low, it is taking place slowly and not at an adequate level.

Gaps in input data (e.g., data from environmental product declarations, data on costs, on product lifetime, on the possibilities of decomposition, reuse, recycling) for the evaluation of indicators represent a major obstacle. Default values or temporary use of generic data should be considered, which allows the use of indicators at least as a tool for planning and optimising sustainable buildings. This can also ensure the transparency of the quantitative analysis.

For relatively undemanding indicators, it is necessary to prepare data analyses and bases for their national adaptation. For example, the existing list of inventories in the construction documentation of projects in Slovenia does not provide comprehensive information. As such it is not useful for direct use as an indicator and a standardized format should be developed as envisaged in the Bill of Quantities and Materials (BoQ and BoM).

The issue may also be the appropriate use of professional software tools for the purposes of calculating the value of indicators, e.g., tools for energy modelling, for modelling indoor air quality, thermal comfort, overheating, etc. These tools require specialized knowledge and a lot of experience, both to use and to interpret the results, but they cannot be acquired in a quick and easy way. So, this can also be one of the challenges for the implementation of SLO kTG.

V. Conclusion

In accordance with the CARE4CLIMATE project task, "The development of the SLO kTG", the testing of the first version of indicators for the evaluation of sustainability of buildings was carried out between November 2021 and June 2022. The testing turned out to be extremely important and useful, as the survey among the testing participants which included various stakeholders in construction process, obtained a lot of valuable feedback and suggestions for the further development of SLO kTG.

First, it was found out that based on the respondents' profile, the relevance of the provided feedback is high. In addition, it was also found that, according to the analysis of the results, some indicators can be implemented immediately. These are indicators 1.1, 2.1, 2.2, 3.1, 4.1, 5.1 and 6.1. Indicators 1.2, 2.3, 2.4 were assessed to be conditionally feasible, as they still have some open processing issues. The findings are meaningfully related to the responses from the survey, where the respondents indicate their knowledge of the indicators and ranked indicators 2.3, 2.4 and 4.2 as less familiar. The latter proved to be completely feasible in recorded practical use by specialized experts.

The results of the survey confirmed that the development of the indicators is on the right track. On the other hand, the testing revealed that for some indicators there are many obstacles, and that in order to implement the sustainability evaluation of buildings, they will have to be dealt with very radically. It also showed that there is potential for improvements and refinements - which is already foreseen for the Beta version SLO kTG.

Furthermore, it was established that for several indicators, theoretical knowledge prevails, but practical knowledge is lacking. The need for training and specialization of experts in sustainable construction was highlighted, which is also expected to be done in the further stages of the development of SLO kTG. It would also be useful to support the implementation of the SLO kTG in practice with an appropriate legal basis and/or financial mechanisms or incentives.

And finally, a very important conclusion of the testing was that for the design of the survey and the analysis of the results, it is crucial to understand the close connection of the indicators with the existing construction legislation, with the available calculation methods and software tools, and with the established construction procedures.

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