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Defining strategies to adopt Level(s) for bringing buildings into the circular economy. A case study of Spain

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Abstract:	Level(s) is a common European Union framework of core sustainability indicators for measuring the performance of buildings along their life cycle, enabling emissions reductions and circular resource flows. A fundamental tool for the development of European policies to boost the market for sustainable, resilient and climate change adapted buildings. The objective of this study is to contribute to the existing body of knowledge in the field of sustainable building research, through the definition of strategies to adopt Level(s) for bringing buildings into the Circular Economy. For this reason, a triple SWOT-Analytical Hierarchy Process (AHP)-TOWS analysis was applied. The strengths, weaknesses, opportunities and threats (SWOT) of the Level(s) have been identified in relation to the availability of resources, product quality, internal and market structure, consumer perception, among others. The results obtained are conclusive in terms of the experts' positive assessment of the tool; highlighting factors such as its response to the need to adapt buildings to climate change, its a standard reference language, and its use in multiple situations. However, several barriers have also been identified, which may affect its development, including its complexity of use, its lack of self-sufficiency, and its dependence the criteria used in each evaluation. Finally, the key strategies to be carried out for the implementation of the Levels have been established.

Dear Editor,

We appreciate the helpful feedback from the two Reviewers of our submittal, "**Defining strategies to adopt Level(s) for bringing buildings into the circular economy. A case study of Spain"** (JCLEPRO-D-20-11086). Authors have carefully considered the comments of the reviewers, responding as follows:

REVIEWER #1:
Reviewer's comment 1
My comments have been addressed and the authors' response is satisfactory. The paper is suitable for publication.
Author's Response 1
Thank you very much for your review and contribution to this work. After exhaustively considering the recommendations by the reviewers, we have detected an error in the local priority indexes of the factors that affect their order, which has been corrected. However, this error does not affect the methodology, the foundation, or the development of the work. However, we ask that we accept our apologies for the inconvenience that this error may have caused.

REVIEWER #2:
Reviewer's comment 1
1. The building sector is multi-agent and has complicated interactions. Literature often in the management sector discussed extensively in the past more environmentally friendly organizational practices for better buildings. This paper aligns with this literature and stress the continuity of the topics and the connections of different players for better and more sustainable practices. The original and worthy contributions of the study to the current body of knowledge is better outlined. 1. The description of the methodology is (still) too qualitative and probably a detailed description would be recommended, but overall this paper is otherwise ready to be accepted.
Author's Response 1
Thank you very much for your review and contribution to this work. After exhaustively considering the recommendations by the reviewers, we have detected an error in the local priority indexes of the factors that affect their order, which has been corrected. However, this error does not affect the methodology, the foundation, or the development of the work. However, we ask that we accept our apologies for the inconvenience that this error may have caused.

1. Also, once the reviewer' comments have been analyzed, the authors consider that the AHP methodology is widely used, in addition to being widely contrasted. In this work, an application of it is made, so it is understood that it is not necessary to create a more detailed description of it, although the reference in which this methodology is explained extensively, as well as its justification, is cited and mathematical formulation. There are similar works that only address the analysis of the results obtained, without including an extensive rationale for the formulation of this methodology, for example:

T. Brudermann et al. / Energy Policy 76 (2015) 107–1. Agricultural biogas plants–A systematic analysis of strengths, weaknesses, opportunities and threats

T. Brudermann, T. Sangkakool / Urban Forestry & Urban Greening 21 (2017) 224–234. Green roofs in temperate climate cities in Europe – An analysis of key decision factors

Defining strategies to adopt Level(s) for bringing buildings into the circular economy. A case study of Spain

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Abstract

Level(s) is a common European Union framework of core sustainability indicators for measuring the performance of buildings along their life cycle, enabling emissions reductions and circular resource flows. A fundamental tool for the development of European policies to boost the market for sustainable, resilient and climate change adapted buildings. The objective of this study is to contribute to the existing body of knowledge in the field of sustainable building research, through the definition of strategies to adopt Level(s) for bringing buildings into the Circular Economy. For this reason, a triple SWOT-Analytical Hierarchy Process (AHP)-TOWS analysis was applied. The strengths, weaknesses, opportunities and threats (SWOT) of the Level(s) have been identified in relation to the availability of resources, product quality, internal and market structure, consumer perception, among others. The results obtained are conclusive in terms of the experts' positive assessment of the tool; highlighting factors such as its response to the need to adapt buildings to climate change, its a standard reference language, and its use in multiple situations. However, several barriers have also been identified, which may affect its development, including its complexity of use, its lack of self-sufficiency, and its dependence the criteria used in each evaluation. Finally, the key strategies to be carried out for the implementation of the Levels have been established.

Keywords

Level(s); SWOT analysis; Analytic hierarchy process; Delphi method; TOWS matrix; sustainable building

Highlights

- Level(s) is a common European Union framework of core sustainability indicators.
- The triple SWOT-AHP-TOWS analysis is used in defining strategies to adopt Level(s).
- The strengths and opportunities of Level(s) outweigh their weaknesses and threats.
- The economic and fiscal incentives is determined as the most offensive strategy.

1. Introduction

Architecture and city building constitute a complex organisational system that contributes to the social and economic development of a country (Alawneh et al., 2019). However, it has also sometimes caused environmental degradation, habitat destruction, and alterations in ecosystems that threaten people's well-being (Foster, 2020). In this sense, the main interest of this sector should be to generate, through research and technological development, systematic knowledge that contributes to solving the problems of our society. This is where the concept of sustainable construction, introduced by Charles Kibert in 1994 (Kibert, 1994), is defined as the *'creation and responsible management of a healthy building environment, considering ecological principles and the efficient use of resources'.*

The concept of 'circular economy' (CE) in the building industry is based on the principles of sustainable construction. This notion allows both the reduction of negative impact on the environmental and increases the healthiness of indoor environments. It calls for the reduction of the material's environmental footprint, the extension of its useful life, and the consumption of sustainable resources – all of which are crucial for the development of climate change mitigation (Wen et al., 2020) and adaptation strategies that reduce global emissions and waste (Arora et al., 2019; Hertwich et al., 2019; Olivetti and Cullen, 2018). These requirements have multiple benefits that extend beyond the project itself, contributing to the economic and social development to the surrounding area. A transition to sustainability of the construction sector corresponds to new relationships between firms in the construction organization; to realize sustainable buildings, a higher level of integration between the general contractor and suppliers is required; it is fundamental a new organization of construction processes for green residential building(Albino and Berardi, 2012). However, (EC) remains a relatively new issue (Leising et al., 2018); a lack of knowledge and tools makes it difficult to implement in the construction sector (Kibert, 1994). The high uncertainty and the lack of information and communication among stakeholders often increase the reluctance for the adoption of energy-saving technologies (Berardi, 2013).

In this context, public authorities and society have generally shown a particular interest in more sustainable, efficient, and environmentally friendly buildings and construction technologies (Araújo et al., 2013) within the framework of the CE and adaptation to climate change. The interest of the local government in adopting energy-saving technologies is limited, it mainly focus on legal and administrative aspects. The disconnection between national and local governments merits particular attention in future policies (Berardi, 2013). However, due to the variety and extent of challenges posed by sustainable construction, the assessment of buildings and construction methods can be very complicated. Indeed, since the emergence of the concept of sustainable construction, more than 600 Sustainable Building Assessment Methods (SBAM) (Doan et al., 2017), have been developed, including the Building Research Establishment Environment Assessment Methodology (BREEAM) ("BREEAM: the world's leading sustainability assessment method for masterplanning projects, infrastructure and buildings - BREEAM," n.d.), Haute Qualité Environnementale (HQE™Method) ("Alliance HQE-GBC – Alliance des professionnels pour un cadre de vie durable," n.d.), Verde ("GBCe | Green building council españa," n.d.), Protocollo ITACA ("Itaca," n.d.), PromisE ("Sustainable Building - VTT Materials and Construction," n.d.), Nordic Swan ("Nordic Ecolabel | Nordic Ecolabel," n.d.), SBTool PT ("SBTool | International Initiative for a Sustainable Built Environment," n.d.), Green Globes ("Green Building Initiative : Green Globes Certification," n.d.), etc. SBAMs are tools that seek to balance the three aspects contained in the concept of sustainable building: social, economic and environmental. To this end, they qualify and certify the sustainability of the building in all phases of the life cycle (Díaz López et al., 2019), based on a series of quantitative and qualitative indicators that measure different environmental, economic, social and usability aspects (Díaz-López et al., 2019).

The SBAMs have gradually been adapted to the concept of sustainable construction (Wen et al., 2020); this has allowed them to play a significant role in the development of sustainable buildings by raising awareness of the main actors involved in recent years (notwithstanding that their objectives, application areas, and structures are very different (Díaz López et al., 2019). However, implementation of the SBAMs has encountered some obstacles, notably their voluntary nature (Haapio and Viitaniemi, 2008), resulting in low implementation rates. On the other hand, the absence of unified sustainability criteria to be considered in sustainability assessments across different countries has been noted (Banani et al., 2013; Warren et al., 2009).

Level(s) is a common framework proposed by the European Union (EU) and developed by the Joint Research Centre (JRC) for sustainable buildings, based on a comprehensive research effort involving both industry and the public sector. The tool aims to unite the entire value chain of the sector round a common European language for better building performance. To do this, it examines the complete life cycle of buildings. This enables it to address their vast emission-reduction potential and circular resource flows, thus supporting the health and well-being of those for whom they are intended. All this is presented within the concept of EC and adaptation to climate change, moving away from the linear economic model of 'take, do and waste' (Dodd et al., 2017a). Additionally, the establishment of unified indicators makes it easier to compare sustainable buildings within the EU. Consistent with this objective, the objectives set by Level(s) were as follows (Dodd et al., 2017b, 2017c; "Sustainable buildings - Green growth and circular economy - Environment - European Commission," n.d.):

- Raise awareness among the public, developers, and public procurement services of the need to have sustainable buildings and increase demand for them.
- Increase knowledge regarding the efficient use of resources within the built environment to foster better decision-making processes by designers, architects,

developers, construction companies, construction product manufacturers, investors, and property owners.

- Provide a common EU approach to assessing the sustainability of buildings and the built environment. The flexible indicator can also be incorporated into new and existing evaluation systems.

Since Level(s) is based on the full range of existing tools (Díaz López et al., 2019), it is essential to analyse its potential as a critical tool for the development of a sustainable building within the framework of the CE and adapted to climate change in Europe. Understanding this novel indicator framework and its political, economic, administrative, and social environment impact – as well as that of its implementation – is vital to determining the need to apply this common language in various circumstances.

To meet all the above, the main objective of this study was to contribute to the existing body of knowledge in the field of sustainable building research, through the definition of strategies to adopt Level(s) for bringing buildings into the Circular Economy. Therefore, the strengths, weaknesses, opportunities and threats of Level(s) regarding the availability of resources, product quality, internal and market structure, consumer perception, among others, have been identified. This knowledge has made it possible to correct weaknesses, address threats, maintain strengths and exploit Level(s) opportunities for their correct implementation.

2. Material and Method

The evaluation of Level(s) was carried out through the analysis Strengths, Weaknesses, Opportunities and Threats (SWOT), a tool that emerged in the field of economic analysis for the evaluation of management procedures in companies, projects and plans (Samolada and Zabaniotou, 2014), but whose use has been increasingly extended and applied in the context of environmental and sustainability research. SWOT facilitates the identification of factors that affect the use of Level(s), establishing the Weaknesses, Threats, Strengths, and Opportunities related to its implementation, facilitating future decision-making (Samejima et al., 2006) and informing decision-making, planning, and building strategies.

The main advantage of SWOT analysis is its simplicity (Liao and Chern, 2015; Zhou et al., 2019), which has led to its continued use in both leading companies and academic communities since its development in the 1960s (Ghazinoory et al., 2011). However, there are shortcomings in the traditional SWOT approach: (i) it produces a superficial and imprecise list of factors, based on the subjective perception of the selection of factors and (ii) it lacks prioritisation of factors regarding the importance of each SWOT factor. The first of the problems can be solved by selecting a panel of experts to reduce subjectivity in the identification of factors. The second, the absence of a prioritisation of these factors, has been solved with the proposal by several researchers based on the integration of SWOT with other quantitative methods – among which is the Analytical Hierarchy Process (AHP)-SWOT (Kangas et al., 2001; Kurttila et al., 2000). This approach was developed by Thomas L. Saaty (1980) (Saaty, 1987) and it is designed to solve complex problems of multiple criteria through the analysis of quantitative data relating to decision alternatives.

To achieve the main objective of this study, a triple SWOT-AHP-TOWS analysis was applied, an additional combination of analysis tools to further improve the decision-making process and also to develop policies based on the results of SWOT and AHP . It is one of the few models that allows the integration of analysis, identifying individual factor variables and appropriate policies (Gottfried et al., 2018). Hybrid SWOT–TOWS with AHP model are simple, efficient and the abilities to combine qualitative and quantitative criteria. Thus, AHP can manage the decision making in situation of uncertainty (Chanthawong and Dhakal, 2016).

Various fields of research have used such a three-phase analysis: tourism (Monavari et al., 2013), infrastructure projects (Behzad Malekpour Asl et al., n.d.), biorefinery (Brunnhofer et al., 2020), forest planning (Kurttila et al., n.d.), water resources (Gao et al., 2017), transport management (Dimić et al., 2016), textile industry (Dimić et al., 2016), among others. The SWOT method is based on expert judgement and is designed to identify the Weaknesses, Threats, Strengths, and Opportunities (SWOT) in order, subsequently, to prioritise factors identified through the AHP. Based on this information, the TOWS matrix has finally been used to generate strategies (Weihrich, 1982) to achieve to implementation of Level(s). Therefore, this three-phase analysis is suitable for this study since it allows the identification, through qualitative and quantitative methods, of the main strategies for the implementation of policies that promote improved construction within the framework of the circular economy.

The territory of Spain has been selected for this study, for its representation as a Mediterranean country, for its low percentage of sustainable construction development, as well as its high percentage of the urban population, among which the whole EU is the largest (Herczeg David McKinnon Leonidas Milios and Klaassens Katarina Svatikova Oscar Widerberg Rotterdam, 2014). 90% of the housing stock in Spain was built before the Technical Building Code, approved in 2006, came into force. Moreover, 60% of the properties were built without sustainability criteria, as no regulations existed at the time. For this reason, efforts to improve must be extreme.

The working methodology described above, therefore, includes three distinct phases, as shown in Figure 1: (i) application of the SWOT analysis and (ii) application of the AHP method, both supported by the Delphi method. The final phase is (iii) establishment of strategies base on TOWS matrix. These phases are described below, as well as the Delphi method on which they are based.

2.1. Implementation of the SWOT analysis.

Application of the SWOT analysis, in aggregate, is based on both internal and external analyses. Internal analysis facilitates the identification of Strengths and Weaknesses, controllable factors that support and hinder the implementation of Level(s), respectively; external analysis identifies Opportunities and Threats, uncontrollable factors that allow and incapacitate the achievement of the objectives set out in Level(s)(Dyson, 2004).

Initially, and based on the technical manuals provided by the developers of Level(s) (Dodd et al., 2017b, 2017c; “Sustainable buildings - Green growth and circular economy - Environment - European Commission,” n.d.), a set of potential factors was selected. Subsequently, those who will be included in the SWOT matrix will be selected based on the opinion of the experts, and those who will be called relevant factors. To gather the opinion of the experts, a survey was designed in which these persons were asked to rate, from '1' to '10', the degree of importance of each of the possible factors selected, considering '1' as minor and '10' as very important.

2.2. Application of the *AHP* method.

Once the SWOT matrix was defined, it was prioritised using the quantitative AHP method, allowing the SWOT factors to be ranked according to their relative importance. AHP is based on the own value method (Kilinç et al., 2018; Lyu et al., 2020; Moussaoui et al., 2018), and as a result of the calculations, each of the SWOT factors has been associated with a local priority level or index p ($0 < p < 1$, $\sum_{i=1}^{n} p_i = 1$) within a group of n relevant factors that integrate each of the categories Weaknesses, Threats, Strengths and Opportunities, as well as a total priority index q ($0 < q < 1$, $\sum_{j=1}^{4n} q_j = 1$) in the group of 4n factors that integrate the entire SWOT matrix. To this end, a new survey was designed which was then sent to the experts involved and in which a peer comparison was requested between the factors included in the SWOT matrix, for each of the categories, as well as between categories, according to the scale of comparisons recommended by Saaty (1987)(Saaty, 1987) and presented in Figure 2. It shows that, for the paired comparison, the scale was limited to odd numbers and varied from 9:1 (the F1 factor is much more critical than the F2 factor), at 1:9 (the factor F2 is much more important than the factor F1); for 1:1 the factors are equally important (Wang and Chen, 2014).

To calculate the local priority index (p_j), firstly four factors were selected for each of the category; as result four original square matrices *A*, with dimension 4 × 4 (a_{ij} is the element that takes up row *i* and column *j*, for *i* = 1, ..., 4, and *j* = 1, ..., 4), were obtained with the average value of the experts' opinions, according to the Equation 1. In a second step the matrices of paired comparisons $\hat{A}$ in which $\hat{a}_{ij}$ is the measure of the preference of the alternative in row *i* when it is compared to the alternative of column *j* (Equation 2). Finally, each element of each matrix $\hat{A}$ was normalized to obtain the normalised paired comparison matrix $\hat{A}_n$; to do that each element has been divided by the addition of its column; the obtained value v_j (Equation 3) turned out to be the local priority of factors (p_j), in each category.

$$A = \left(a_{ij}\right)_{i,i=1,\dots4} = \begin{pmatrix} a_{11} & a_{12} & a_{13} & a_{14} \\ a_{21} & a_{22} & a_{23} & a_{24} \\ a_{31} & a_{32} & a_{33} & a_{34} \\ a_{41} & a_{42} & a_{43} & a_{44} \end{pmatrix} \quad (1)$$

$$\hat{A} = \left(\hat{a}_{ij}\right)_{i,j=1,\dots,4} = \begin{pmatrix} \hat{a}_{11} & \hat{a}_{12} & \hat{a}_{13} & \hat{a}_{14} \\ \hat{a}_{21} & \hat{a}_{22} & \hat{a}_{23} & \hat{a}_{24} \\ \hat{a}_{31} & \hat{a}_{32} & \hat{a}_{33} & \hat{a}_{34} \\ \hat{a}_{41} & \hat{a}_{42} & \hat{a}_{43} & \hat{a}_{44} \end{pmatrix} \text{where } \hat{a}_{ij} = \begin{cases} 1, \ i = j \\ a_{ij}, \ i < j \\ 1/a_{ij}, \ i > j \end{cases} \quad (2)$$

$$v_j = \frac{1}{4} \times \sum_{i=1}^{4} \frac{\hat{a}_{ji}}{c_i} \quad (3)$$

The total priority index for each factor (P_j) has been calculated taking into account Equations 4, where W_G is the weight corresponding to the category of the factor, and v_j is the value of its local priority, with *j* = 1, ..., 4. The weight of each category (W_S, W_W, W_T, W_O) was determined as the weighted average of the experts' opinions.

$$P_j = W_G \times v_j \quad (4)$$

Finally, an important consideration in terms of the quality of the final decision concerns the consistency of that judgement, as displayed by the decision-maker during the series of paired comparisons. It should be kept in mind that perfect consistency is tough to achieve and that some inconsistency is expected in almost any set of paired comparisons, as they are judgements derived by people. The AHP offers a method for measuring the degree of consistency between the paired options provided by the decision-maker. If the degree of consistency is acceptable, the decision-making process can be continued. If it is unacceptable, the decision-maker must reconsider and possibly modify his/her judgement on paired comparisons before continuing with the analysis. This was done using the Consistency Ratio (CR), designed so that values exceeding 0.1 were a sign of inconsistent judgement and calculated according to the methodology established by Saaty (Saaty, 1987). The CR of a matrix was calculated by applying Equation 5, where CI is the consistency index of the matrix, RCI is the random consistency index of the matrix, n is the number of factors (n=4), and n_{max} is determined as the sum of the elements of the local priority vector v_j.

$$CR = \frac{CI}{RCI} = \frac{\frac{n_{max}-n}{n-1}}{\frac{1.98\times(n-2)}{n}} \quad (5)$$

2.3. Determination of Strategies.

The most straightforward approach to generating these strategies, having developed the SWOT-AHP analysis, is the TOWS matrix (Turcksin et al., 2011). Weihrich (1982) (Ikeda et al., 2017) developed TOWS as the next step of SWOT analysis. This tool analyses the key actions that will need to be taken to Correct Weaknesses, Address Threats, Maintain Strengths, and Exploit Opportunities. Four types of strategies have been considered:

- Offensive Strategies. These are obtained by relating Strengths + Opportunities (SO). They are growth strategies that seek to link internal and external strengths to improve the situation. These are known as maxi-maxi strategies as they have the highest potential. These strategies use strengths to take advantage of opportunities.

- Defensive Strategies. These are obtained by relating Strengths + Threats (ST). They are reactive strategies that link internal strengths to counter external threats. These are known as maxi-mini strategies.
- Adaptive Strategies. These are obtained by relating Weaknesses + Opportunities (WO). There are reorientation strategies where some element of weaknesses is changed to take advantage of opportunities. These are known as mini-maxi strategies.
- Survival Strategies. These are obtained by relating Weaknesses + Threats (WT). These are known as mini-mini strategies as they have the least potential. These strategies minimize weaknesses to avoid threats.

2.4. Delphi method.

Both the determination of the SWOT matrix and the application of the AHP methodology are based on the Delphi method. Delphi is a forecasting technique involving the compilation of knowledge from a selected group of experts (Dalkey and Helmer, 1963), enabling solutions to interdisciplinary research problems where the opinions of the experts are heterogeneous (Stern et al., 2012; Sutterlüty et al., 2017). It consists of a strong consensus through a process of repetitive evaluation with controlled feedback of opinion (Landeta, 2006). This method is used mainly in cases where critical information is indispensable (Rowe et al., 1991). Its main characteristics are anonymity, iteration, and controlled feedback (i.e., the response of the group in statistical form and heterogeneity). In this study, the Delphi technique has been applied in the following four phases:

I. **Definition of objectives.** This presents a formulation of the problem, the objective of the study and the spatial frame of reference.

II. **Formation of the panel.** There is no defined guide to determine the number of participants or their level(s) of experience (Rikkonen and Tapio, 2009). However, choosing the right participants to serve as experts is fundamental to Delphi's research: the quality of the experts is directly related to the quality of the results. For this reason, a highly selective process has been used to identify panellists. This phase presents a qualitative dimension, where respondents were selected based on the predetermined objectives and because of experience criteria; and a quantitative dimension, where the choice of sample size varied depending on the resources and time available. To reduce the risk of illusory experience and to systematise the process for identifying experts, in this work the selection of experts was based on those defined by Delbecq et al. (Atherton, 1976) and its Knowledge Resource Nomination Worksheet (KRNW), which enabled the establishment of the following four steps:

- In a first step, different categories of experts were proposed for this study: universities, students, and research centres; builders and developers; governmental agencies (local, autonomous, state and international); professional associations and institutes of construction and organisations for sustainability; technical professionals of the building; consultants and advisors in sustainability and environment; manufacturers; environmental and ecological associations; manufacturers; and business associations. Delbecq *et al.* (Atherton, 1976) emphasised that it is essential not to write down the specific names of the experts at this stage.

- In a second phase, the categories were supplemented with the names of experts based on their research in that area and in-field experience.
- The classification of experts by qualifications was then carried out, for which the ratings of the first roster of experts (second step) were compared and ranked by priority for the invitation to the study. First, many sublists as categories were created; the experts were then classified by those sublists according to their qualifications. Each member of the research team then classified each subcontractor independently, according to the person's qualification. Based on the classifications, a panel was created for each of the 10 categories, resulting in a total of 190 experts (Table 1).
- Finally, the experts were invited to participate in the study. This was done through e-mail, which included a brief explanation of the background, objectives, and expected results of the study.

III. **Preparation and launching of questionnaires.** The questionnaires were designed to facilitate responses by respondents. The questions were based on the objectives of the work and followed a clear, concise and robust approach. The design of the questionnaires aimed to capture the diversity of opinions, achieve a high degree of reliability, allow the involvement of the experts, avoid the prominence of one or more experts over others, guaranteeing equal participation and find the formation of a criterion with a high level of objectivity.

In this study, a three-round Delphi survey (Table 1 and Figure 1) was conducted; each round involved a written survey of participants followed by statistical feedback for each survey question. After seeing the results of the previous round, participants were asked to reconsider their views. Using this method, there typically is a convergence of opinions after three or four rounds, from which a stable group opinion emerges (Tavana et al., 2012). In the First Round, a two-pronged approach (involving both qualitative and quantitative methods) was applied. For this purpose, an online questionnaire containing various types of questions was developed. The tool allowed evaluating, on the one hand, the quality of the experts and, on the other, qualitatively selecting the relevant factors from among the potential factors. In the second round, peer comparison of relevant SWOT factors and an AHP were applied to quantify and weight Level(s) factors. Finally, in the third round, the questionnaire incorporated a peer comparison of the four SWOT groups.

IV. **Exploitation of results.** The aim of the successive questionnaires was to reduce dispersion and clarify the average consensus opinion. In the second dispatch of the questionnaire, the experts were informed of the results of the first consultation and had to provide a new response, which allowed the reasons for the differences to be identified and evaluated. Iterations of the process continue until it is perceived that an absolute consensus and/or an acceptable level of stability in responses has been reached. The outcome of the last round can be considered the final response of the expert group.

The level of consensus reached after each round determines whether there is a need to start an additional round in the research process. The coefficient of variation (Voc), calculated by the quotient between the standard deviation (SD) and the average of the responses, has been considered for its determination. If the Voc is less than 0.5, the internal agreement is considered reasonable (Zinn et al., 2001).

3. Results and discussion

Following the established methodology (Figure 1), the results obtained are presented below. The SWOT analysis will be presented first, followed by the AHP methodology, followed by the results concerning the quality of the opinion process established by a Delphi methodology. Finally, based on the analyses carried out, the strategies generated to facilitate the implementation of Level(s) have been presented.

3.1. Implementation of the SWOT analysis.

The SWOT matrix, which provides a qualitative analysis of the application of Level(s), has been obtained in two phases (Figure 1). The first of these (internal and external analysis) has made it possible to obtain a list of potential factors for each of the categories involved in the SWOT matrix. In a second phase and thanks to the support of experts, the most relevant factors will be selected from these factors, which will form the SWOT matrix. The results obtained in this phase, which are presented and analysed below, are presented in Tables 2 and 3, as well as in Figure 3.

3.1.1. Internal and External Analysis. Potential Factors.

To determine the potential factors for each of the four categories involved in the SWOT matrix, the technical manuals provided by the Level(s) developers have been used (Dodd et al., 2017b, 2017c; “Sustainable buildings - Green growth and circular economy - Environment - European Commission,” n.d.). From these, a total of 16 potential internal factors related to Level(s) were selected, which are controllable and cannot be modified in the short term. Half were identified with internal aspects that facilitate the development and implementation of Level(s) (Strengths) and half were aspects that make its effectuation difficult (Weaknesses). In the same way, a total of 16 external and uncontrollable potential factors were selected, eight of which will facilitate the development of Level(s) (Opportunities), and another eight that will impede such progress (Threats). On the other hand, the potentially external factors were considered aspects that were not yet concrete, representing opportunities or threats for the development of Level(s) in Spain.

Tables 3 and 4 show the selected factors. It may be noted as being driven and supported by a critical common public body such as the EU, which strengthens commitment and collaboration between academic research, business, industry professionals and government institutions; this is a subjective aspect that facilitates its development and implementation. Similarly, the fact that there is a growing demand for and awareness of sustainable development throughout society in Europe supports and legitimises the incorporation of Level(s) into concrete policies and regulations. This is an external aspect, which facilitates its development and implementation. On the contrary, the dependence on other tools to obtain the data is considered a weakness that cannot be modified in the short term. This fact may condition its ease of use, which, together with the complexity of the guides, may result in a handicap that further enhances the uncertainty in the data needed to carry out the analysis.

3.1.2. Determination of the SWOT Matrix. Relevant Factors.

Having identified the 32 potential factors in the previous section, a qualitative approach was adopted to construct the SWOT matrix, based on input from the panel of experts. To this end, in a first round of the Delphi method (Table 1), respondents were asked to attach importance in each category (Strengths, Weaknesses, Opportunities, and Threats), between '1' and '10', to the potential factors identified in the previous stage and listed in Tables 2 and 3. This allowed selection of the 16 most important factors, i.e., eight internal relevant factors (four Strengths and four Weaknesses) and eight external relevant factors (four Opportunities and four Threats) that were denominated, respectively, as S_i, W_i, O_i, and T_i, for i={1, 2, 3, 4}. These factors appear shaded in Tables 2 and 3.

The relevant factors allowed obtaining the SWOT matrix (which compiles all the aspects mentioned by the interested parties, as shown in Figure 3). This framework yielded interesting initial information on Level(s). Thus, they were highlighted as positive aspects (not contemplated in the rest of the current SBAM) (Díaz López et al., 2019); their character as a common framework, the support of the European Commission (EC); and evaluation of the adaptation of buildings to climate change within the concept of the CE. On the other hand, the complexity of the user guides; difficulty in developing a comprehensible, practical and useful implementation for the end-user; and dependence on other databases are negative aspects compared to other SBAMs applications such as VERDE or LEED.

3.2. Application of the AHP method

The SWOT matrix thereby obtained enabled a global and qualitative analysis of strengths and weaknesses, but not their quantification. Therefore, application of the AHP in this study has been aimed at the quantitative evaluation of the factors comprising the SWOT matrix. This made it possible to prioritise them both locally and globally. The results obtained, displayed in Table 4 and Figures 4 and 5, are analysed and discussed below.

3.2.1 Determination of local priority index

As shown in Table 4, for each of the factor categories in the SWOT matrix, the local priority index has been determined. This allowed us to know and quantify the greater or lesser weight the experts have given to the relevant factors. In the following section, the results for each category are analysed and discussed.

STRENGTHS (+)

Figure 4a shows very similar values in the local priority indices obtained for the four strengths included in the SWOT matrix. However, the prioritisation of factors is situated in the first place the S_2 strengths $(p_{S_2} = 0{,}2920)$. This indicates that Level(s) is a standard reference language for the whole of Europe that allows us to compare progress in sustainable building.

On the other hand, the factor S_4 – It is based on the three current critical aspects of sustainability policies – is the factor that has obtained the lowest value $(p_{S_4} = 0{,}1884)$. The SBAMs used so far have shown that each of them separately does not assess all aspects of a sustainable building. Many assess energy and the quality of the interior environment; few assess more recent social and economic aspects [18]. In fact, the very concept of sustainable building has evolved. It should be noted that the emerging theme, social aspects, has been the last to be incorporated (Díaz-López et al., 2019).

It is worth highlighting the S3 strength $p_{S_2} = 0{,}2791$. Interest in including the most significant number of phases in a building's life cycle is reflected in the evolution of methodologies. Consequently, although until its appearance Level(s) was the only tool that included all of them, methodologies such as the ATHENA™ Tool or LEED covered all except one: its use and demolition, respectively (Díaz López et al., 2019). This is why it is justified that this factor shows a slightly lower value than the first.

WEAKNESSES (–)

Figure 4b also shows, in this case, very similar values with respect to barriers that can affect the excellent development of Level(s) (although it stands out, with a $p_{W_4} = 0{,}3278$, the factor W_4). Which identifies the difficulty of developing an understandable, practical, and useful implementation for the end-user. This weakness is followed by W_3, with a local index $p_{W_3} = 0.2293$. It identifies the condition that this is an insufficiently self-sufficient methodology, dependent on other procedures or databases that require the use of external measurement tools of varying technical utility to obtain some data needed for analysis. which identifies the difficulty of developing an understandable, practical, and useful implementation for the end-user.

Finally, the weakness that least worries the experts has been the W_2, with a local index $p_{W_2} = 0{,}2113$. In this case, the experts question the comparative capacity of Level(s) which, in the absence of benchmarks against which to compare the data, makes it difficult to draw direct conclusions. Consequently, the comparison is only valid with other buildings whose criteria of the evaluator and characteristics of the building are similar.

OPPORTUNITIES (+)

Figure 4c and Table 4 show a local priority index for the opportunities assessed by the experts, with a significantly higher value for O_3 with a $p_{O_3} = 0{,}3174$. This factor refers to the need for adaptation of buildings to climate change and alignment with sustainable and CE initiatives and policies. These factors show that the benefits generated in the environment are related to its positive contribution to policies in the CE, being a pioneering project and ambitious in terms of scope and impact, which is a benchmark for sustainability and circular economy policies in general.

It is worth highlighting the opportunity O_1 ($p_{O_1} = 0{,}2030$), the possibility offered by Level(s) to be included in certification and regulatory tools at different scales across Europe. This characteristic will contribute to the drive of its development since it can be assumed as its own in the current methodologies. Finally, with a local priority index $p_{O_2} = 0{,}1912$, there is the opportunity O_2, related to its capacity to act as a spearhead and reference point for sustainable initiatives. Being a pioneering and ambitious project in terms of scope and impact, Level(s) can be a benchmark for sustainability and circular economy policies. This character can encourage its initial impulse and development and, as well, its settlement as an example of a methodology of action. Society's awareness of sustainable development supports and legitimises the incorporation of Level(s) in concrete policies and regulations.

THREATS (–)

Figure 4d shows, in this case, somewhat different values when quantifying the threats to the development and implementation of Level(s), if not able to address them. The first and second are factors T_1, T_4 and T_3 ($p_{T_1} = 0{,}2924$, $p_{T_4} = 0{,}2769$, $p_{T_3} = 0{,}2347$)

referring to the need to reach a consensus on the part of all countries of EC, either for their normative implementation or for the establishment of standard criteria for analysis. This outcome highlights concerns about the adoption of directives that may affect practices aimed at the development of climate change adapted sustainable building, within the context of the CE. It may, therefore, be necessary to devise appropriate implementation strategies (although abrupt legislative changes, without any transitional rule, lead to confusion and discouragement of investment). It is also possible that the ability to attract investment in a sector that brings together so many disciplines will be hugely resented. As an example, consider the energy sector, where many policy decisions require years of maturation and implementation: major changes in policy orientation lead to inefficiencies that raise costs and harm competitiveness (Burke and Stephens, 2018; Xingang et al., 2011).

The threat that has reached a lower local priority index has been related to uncertainty in the data needed to carry out the analysis (T_2) ($p_{T_2} = 0{,}1960$). This highlights the impetuous need for strategies aimed at creating large databases at European level; these may even be useful for different fields of research, thus creating multiple synergies and feedback.

3.2.2 Determination of total priority indices

In order to determine the priority of the global factor in the first place, the weighting for each of the factors (strengths, weaknesses, opportunities and threats), W_S, W_W, W_O and W_T were calculated (based on the assessment obtained by the factors in the different categories). This was again done through the panel of experts, who was asked in the third round for a peer comparison of the four SWOT groups. This made it possible to obtain the weighting coefficients shown in Table 4. From the local priority indices and the weighting coefficients determined, the overall priority index was calculated for each of the relevant factors (q_i), obtaining the values given in Table 4 and Figure 5.

Figure 5 clearly shows how, according to expert opinion, the positive aspects of Level(s) (Strengths and Opportunities) prevail over the negative ones (Weaknesses and Threats). In Table 4, one can see, the first eight places in the order of hierarchy (as obtained from the global priority index) are occupied by Strengths and Opportunities; the factors that identify Weaknesses and Threats occupy the final eight positions of the list.

If the global priority indices corresponding to the different relevant factors are explicitly analysed, it is observed that the relevant factors with the highest overall value are the opportunity O_3, and the strengths S_2 and S_3, with values in the indices very similar ($P_{O_3} =$ 0,1181, $P_{S_2} =$ 0,1135, $P_{S_3} =$ 0,1085). On the contrary, the least-valued aspects by the experts, globally, have been the weakness W_2 and W_3 with values of the overall priority index of 0,0230 and 0,0249 respectively. These factors refer to experts' concern about the inability to reach a consensus among all European countries on the criteria and factors of the Level(s) analysis, as well as the possible difficulty of its implementation by relying on databases that must also be common and duly verified. This implies the need for a systemic change in the sector approach, based on the CE so that all parts of the process are dependent on each other. This entails a change in the way we work, moving from modern individualism to a multidisciplinary approach (which can provoke resistance and lead to simplistic interpretations that limit, reduce, or nullify the tool's potential.

3.3. SWOT-AHP results. Sample quality

Finally, two procedures have been used to analyse the quality of the data obtained. On the one hand, the consistency of the judgements obtained from the series of paired comparisons was determined; on the other, the level of consensus, as determined by the CoV, was calculated in order to know the quality of the answers of the Delphi method.

As described, each phase of the study involved a different number of experts on the panel. Thus, the online survey conducted during the first phase successfully gathered the perspectives of 112 experts and a VoC=0.13. A reasonable degree of consensus was thus determined (without the need for an additional round). Interviews during the second phase were conducted with 88 experts, who were distributed more equitably among the groups that gave a VoC=0.24. Finally, during the third phase, a selection of the panel of experts of the second phase was contacted, and responses were obtained from 26 experts, with a VoC=0.27 being determined, as in the second phase, a reasonable degree of consensus, without the need for an additional round.

As can be seen in Figure 6ab, in the first round 13% and 4% of the respondents are experts in sustainable building and have worked with Level(s) respectively; given the heterogeneous nature of the panel, it is understood that these data are representative of the sample. In the second round, and after a selection process, 19% and 8% of respondents are experts in sustainable building or have worked with Level(s), respectively. Finally, in the last round, of the 26 experts surveyed, 57% and 21% of the respondents were experts in sustainable building or worked with Level(s) respectively; this value is considered high, given the novelty of this framework of indicators.

In order to determine the consistency of the judgments of paired comparisons, the values of the Consistency Ratio (CR) have been calculated, obtaining, CR= 0,001621896 for factors in the Strengths category; CR= 0,000100945 for Factors in the Weaknesses category; CR= 0,002252346 for Factors in Opportunity category; and CR= 0,005434977 for Factors in Threat category. In all cases, CR ≤ 0.10 these results thus ensured that the decision-making process was adequate.

3.4. Identification of strategies

The results obtained from the Level(s) SWOT+AHP analysis show that failure to adopt short-term strategies could lead to loss of potential, uncertainty in results, and an inability to achieve a common framework of indicators. The identification of the strengths and weaknesses of this tool allows proposing four sets of specific measures, once all the strengths, weaknesses, opportunities and threats are known. Strategies, therefore, have been put in place to indicate the general objectives that Level(s) must achieve in the short and medium-term (Figure 7). Finally, Figure 8 shows the main outcomes obtained.

3.4.1. Offensive Strategies.

It is obtained by relating Strength$_3$ + Opportunity$_1$ (SO_a). Promotion of sustainable construction through economic and fiscal incentives. Driving through fiscal incentives (taxes or fees) or economic incentives (funding or aid) public bodies can promote sustainability criteria in building at different stages of the building's life cycle.

It is obtained by relating Strength$_4$ + Opportunity$_3$ (SO_b). Establishment of regulations at a local level for the implementation of minimum requirements for sustainability and adaptation to climate change in buildings. Employing local regulations and standards the different public bodies can demand a minimum of sustainability and adaptation to climate change in the building.

3.4.2. Defensive Strategies.

It is obtained by relating Strength$_1$ + Threat$_1$ (ST$_a$). Establishment of implementing regulations at European Level. Launch by the European Commission of regulations on the application and regularisation of sustainability criteria.

It is obtained by relating Strength$_2$ + Threat$_3$ (ST$_b$). Adaptation of sustainability criteria to the context of each country. Being a common reference language for all Europe, a consensus can be reached among all European countries, allowing each country to adopt the criteria to its constructive and socio-economic conditions, without losing the character of a common language.

3.4.3. Adaptive Strategies.

It is obtained by relating Weakness$_3$ + Opportunity$_4$ (WO$_a$). Create of synergies between Level (s) and other methodologies to promote green policies. Through synergies between Level (s) and other methodologies, already established, initiatives and policies of the circular economy and sustainable can be promoted.

It is obtained by relating Weakness$_4$ + Opportunity$_2$ (WO$_b$). Awareness of the benefits of having environmentally friendly buildings. Raise awareness of all actors involved in the construction sector of the need for environmentally friendly buildings.

3.4.4. Survival Strategies.

It is obtained by relating $Weakness_4$ + $Threat_4$ (WT_a). Provide technical support for the use of Level(s). Provide courses, workshops and all the necessary material for the correct management of the Level(s) by the competent administration.

It is obtained by relating $Weakness_2$ + $Threat_2$ (WT_b). Create a common database. Create a common database to facilitate the homogeneity of criteria in all countries of the European Union.

4. CONCLUSIONS

Level(s) aims to unite the whole sector value chain around a common European language for better building performance. It looks at the full lifecycle of buildings to address their huge potential for emissions reductions, efficient and circular resource flows, and supporting the health and wellbeing of those they are built to serve.

The implementation of the combination of the SWOT+AHP analysis has made it possible to identify and quantify strengths and weaknesses that facilitate the development of Level(s) in Spain and, further, the establishment of strategies to facilitate their implementation. The methodology used in this study, as well as the results obtained, can be extrapolated to countries in the EU with a similar development in terms of sustainable construction, especially those in the Mediterranean arc.

The analysis of the values of the global priority indices clearly shows how the factors relating to the strengths and opportunities of Level(s) outweigh their weaknesses and threats. The results obtained, therefore, are conclusive in terms of the experts' positive assessment of the tool.

From its design, the most valued aspects of the tool have been (i) It responds to the need to adapt buildings to climate change and (ii) the fact that Level(s) is a common and reference language for the whole of Europe, that allows us to compare progress in sustainable building. However, several barriers have also been identified which may affect its smooth development. These include its complexity of use and its lack of self-sufficiency (and hence the dependence on other procedures/databases, with the different assessment criteria this may imply).

On the other hand, the experts think that the use of Level(s) will generate a set of benefits in the environment related to its positive contribution to CE-related policies, given its pioneering and ambitious nature in terms of scope and impact. This makes it a benchmark for sustainability and circular economy policies in general. Similarly, its ability to be included in certification and regulatory tools at different scales across Europe will contribute to the drive of its development, as it can be taken up on its own. However, the vast potential of Level(s) may be compromised if it is not implemented in regulations, as there is a risk of losing the tool's benefits if it is extended as a frame of reference.

The European Commission must, therefore, develop a set of measures to publicise Level(s) and inform its implementation. It also must progressively promote the implementation of their indicators in existing tools within regulations that ensure their application. This is the only way to achieve handy levels of sustainability in building and adapting to climate change.

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Credit author statement

Carmen Díaz-López: Conceptualization, methodology, writing, review and editing. original draft, validation (equal). **Manuel Carpio**: writing –formal analysis (equal). **María Martín-Morales**: writing – review and editing (equal). **Montserrat Zamorano Toro**: Conceptualization, Writing – original draft, Writing – review and editing, validation (lead).

Declaration of interests

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests:

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14st September, 2020

Dear Editor:

Please find enclosed the revised research paper titled **Defining strategies to adopt Level(s) for bringing buildings into the circular economy. A case study of Spain**, by *Díaz-López, C., Carpio, M., Martín-Morales, M., Zamorano, M.*

After exhaustively considering the recommendations by the reviewers, we have detected an error in the local priority indexes of the factors that affect their order, which has been corrected. However, this error does not affect the methodology, the foundation, or the development of the work. However, we ask that accept our apologies for the inconvenience that this error may have caused. I would like this manuscript to be reviewed by the Journal of Cleaner Production.

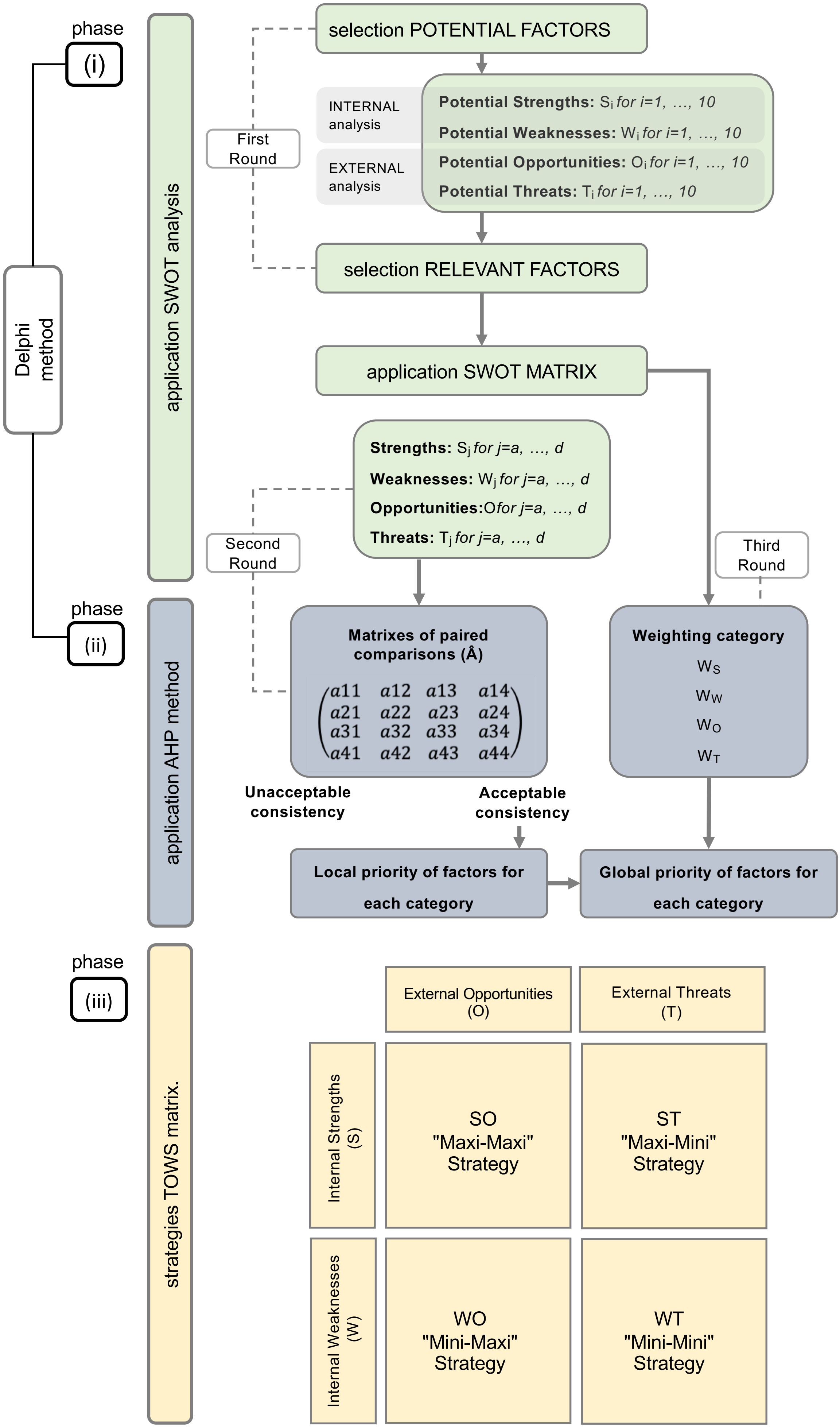
Should you need to contact me, please use the above address or call me at 34-58-249458. You may also contact me by fax at 34-58-246138 or via email at zamorano@ugr.es.

Sincerely,
Montserrat Zamorano Toro

Highlights

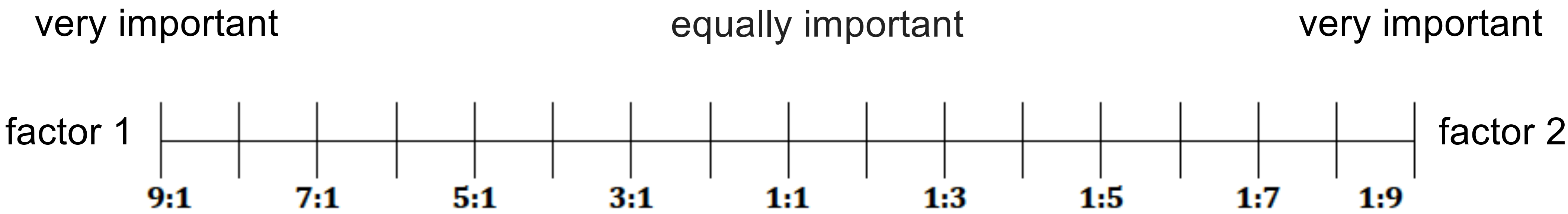
- Level(s) is a common European Union framework of core sustainability indicators.
- The triple SWOT-AHP-TOWS analysis is used in defining strategies to adopt Level(s).
- The strengths and opportunities of Level(s) outweigh their weaknesses and threats.
- The economic and fiscal incentives is determined as the most offensive strategy.

Figure

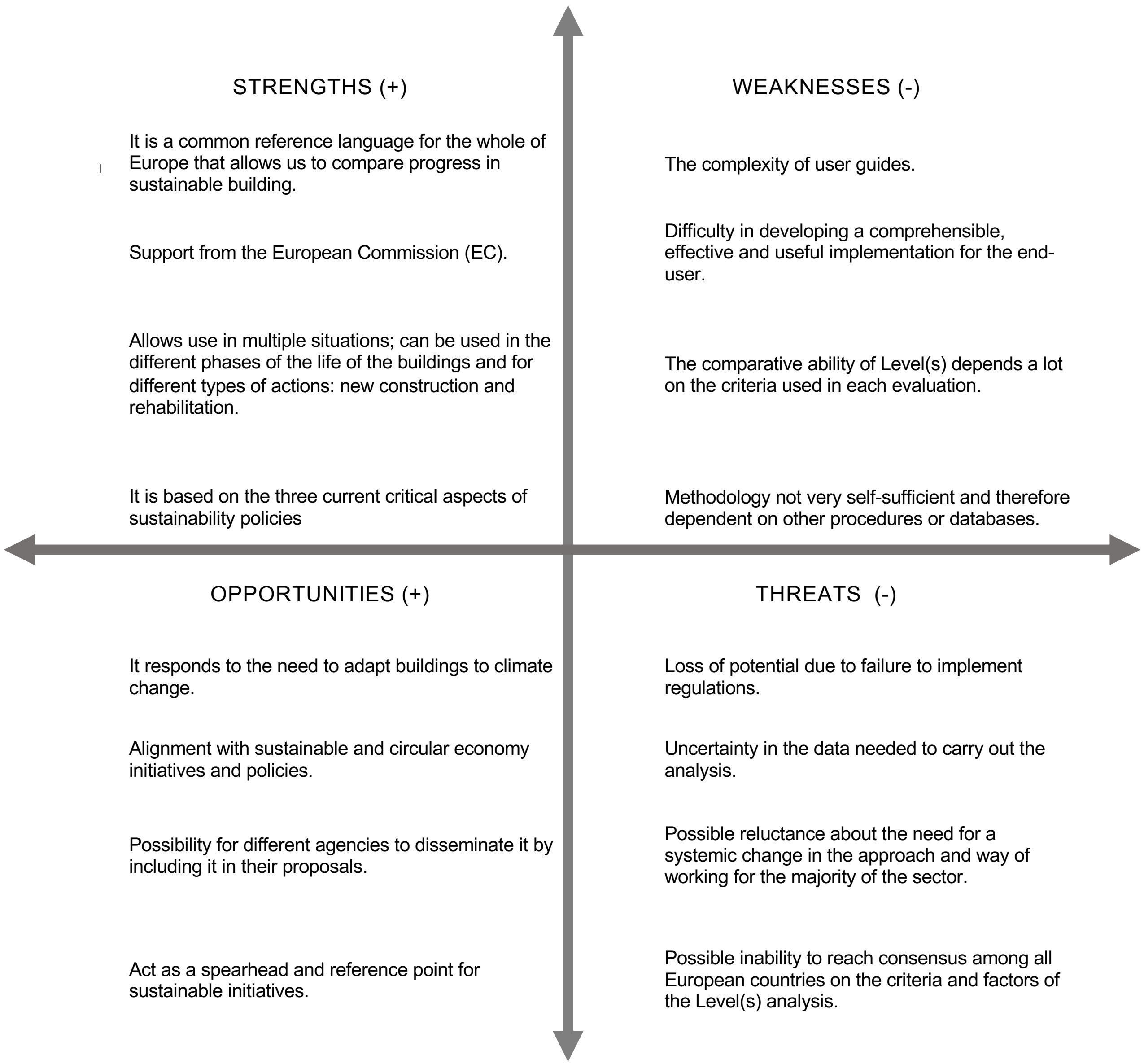


phase
(i)
phase
(ii)
phase
(iii)
Delphi method
application SWOT analysis
application AHP method
strategies TOWS matrix.
selection POTENTIAL FACTORS
INTERNAL analysis
EXTERNAL analysis
Potential Strengths: Si for i=1, …, 10
Potential Weaknesses: Wi for i=1, …, 10
Potential Opportunities: Oi for i=1, …, 10
Potential Threats: Ti for i=1, …, 10
First Round
selection RELEVANT FACTORS
application SWOT MATRIX
Strengths: Sj for j=a, …, d
Weaknesses: Wj for j=a, …, d
Opportunities:Ofor j=a, …, d
Threats: Tj for j=a, …, d
Second Round
Third Round
Matrixes of paired comparisons (Â)
a11 a12 a13 a14
a21 a22 a23 a24
a31 a32 a33 a34
a41 a42 a43 a44
Weighting category
WS
WW
WO
WT
Unacceptable consistency
Acceptable consistency
Local priority of factors for each category
Global priority of factors for each category
External Opportunities (O)
External Threats (T)
Internal Strengths (S)
Internal Weaknesses (W)
SO "Maxi-Maxi" Strategy
ST "Maxi-Mini" Strategy
WO "Mini-Maxi" Strategy
WT "Mini-Mini" Strategy

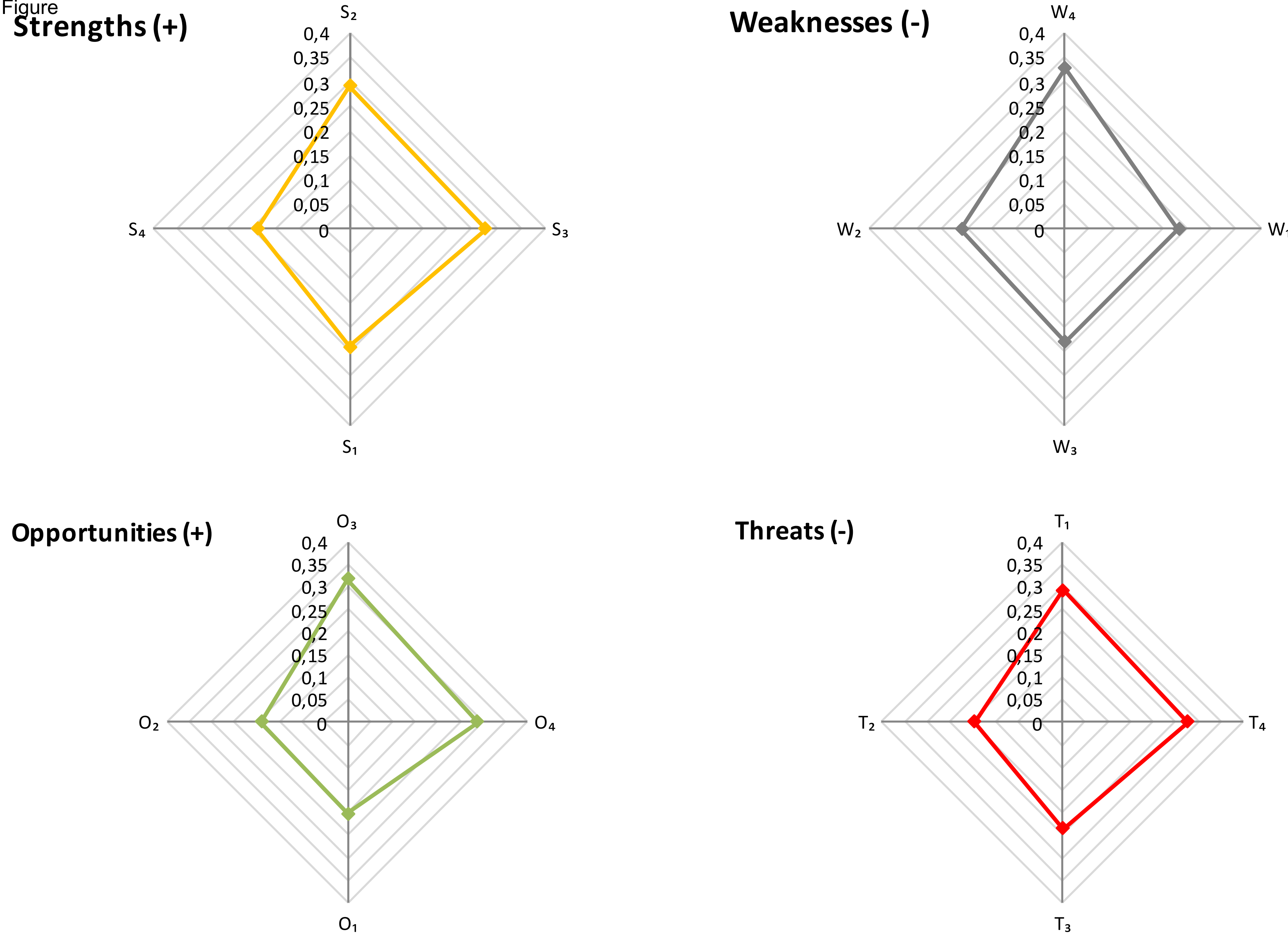
Figure


very important
equally important
very important
factor 1
factor 2
9:1
7:1
5:1
3:1
1:1
1:3
1:5
1:7
1:9

Figure


STRENGTHS (+)
It is a common reference language for the whole of Europe that allows us to compare progress in sustainable building.
Support from the European Commission (EC).
Allows use in multiple situations; can be used in the different phases of the life of the buildings and for different types of actions: new construction and rehabilitation.
It is based on the three current critical aspects of sustainability policies
WEAKNESSES (-)
The complexity of user guides.
Difficulty in developing a comprehensible, effective and useful implementation for the end-user.
The comparative ability of Level(s) depends a lot on the criteria used in each evaluation.
Methodology not very self-sufficient and therefore dependent on other procedures or databases.
OPPORTUNITIES (+)
It responds to the need to adapt buildings to climate change.
Alignment with sustainable and circular economy initiatives and policies.
Possibility for different agencies to disseminate it by including it in their proposals.
Act as a spearhead and reference point for sustainable initiatives.
THREATS (-)
Loss of potential due to failure to implement regulations.
Uncertainty in the data needed to carry out the analysis.
Possible reluctance about the need for a systemic change in the approach and way of working for the majority of the sector.
Possible inability to reach consensus among all European countries on the criteria and factors of the Level(s) analysis.

Figure

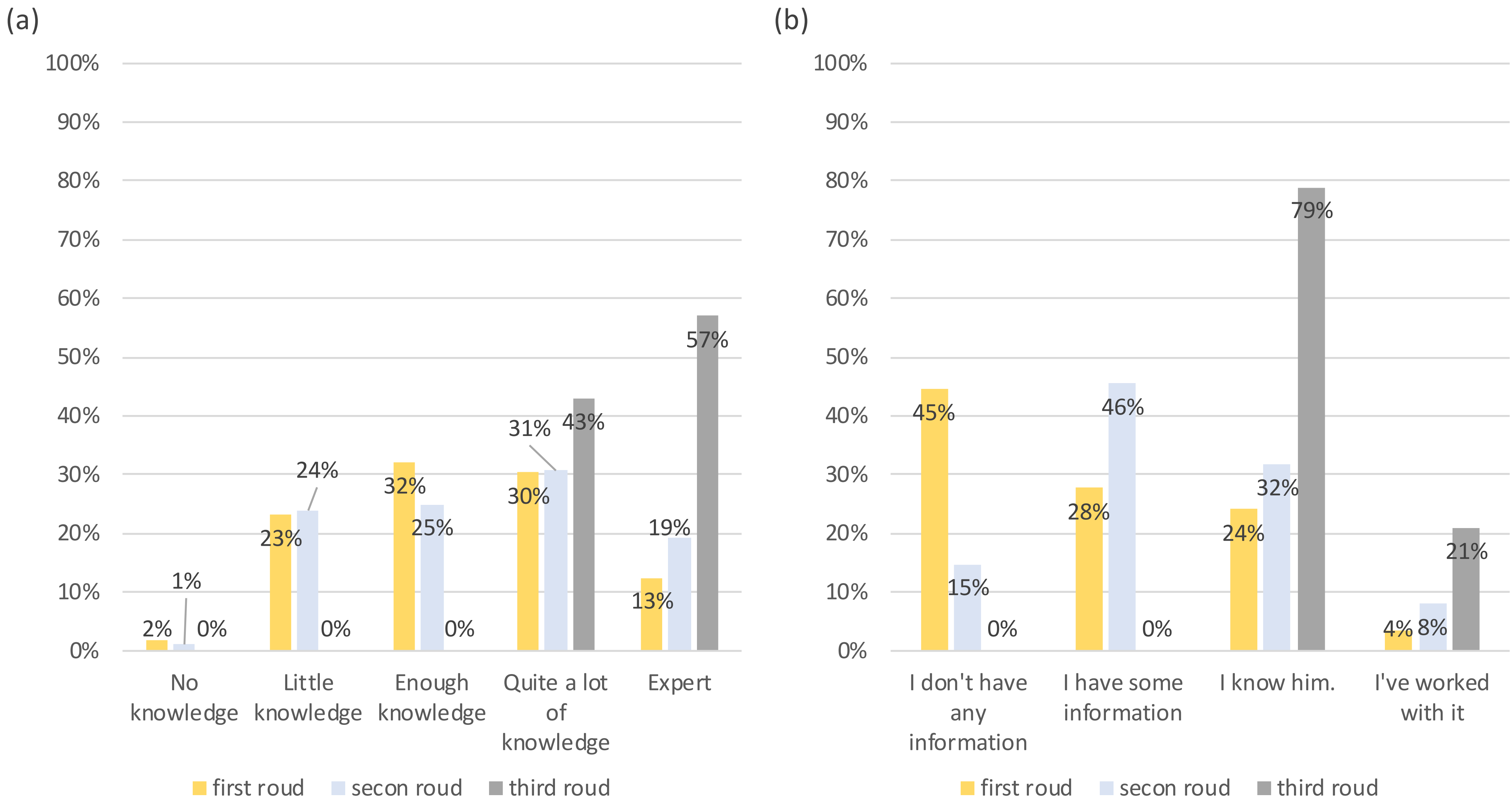


Strengths (+)
S2
S3
S1
S4
0,4
0,35
0,3
0,25
0,2
0,15
0,1
0,05
0
Weaknesses (-)
W4
W1
W3
W2
Opportunities (+)
O3
O4
O1
O2
Threats (-)
T1
T4
T3
T2

Figure


Opportunities (+)
Strengths (+)
Threats (-)
Weaknesses (-)
0,15
0,12
0,09
0,06
0,03
0,00
-0,03
-0,06
-0,09
-0,12
-0,15
-0,15
-0,10
-0,05
0,00
0,05
0,10
0,15

Figure


(a)
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
2%
1%
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23%
24%
0%
32%
25%
0%
30%
31%
43%
13%
19%
57%
No knowledge
Little knowledge
Enough knowledge
Quite a lot of knowledge
Expert
first roud
secon roud
third roud
(b)
100%
90%
80%
70%
60%
50%
40%
30%
20%
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15%
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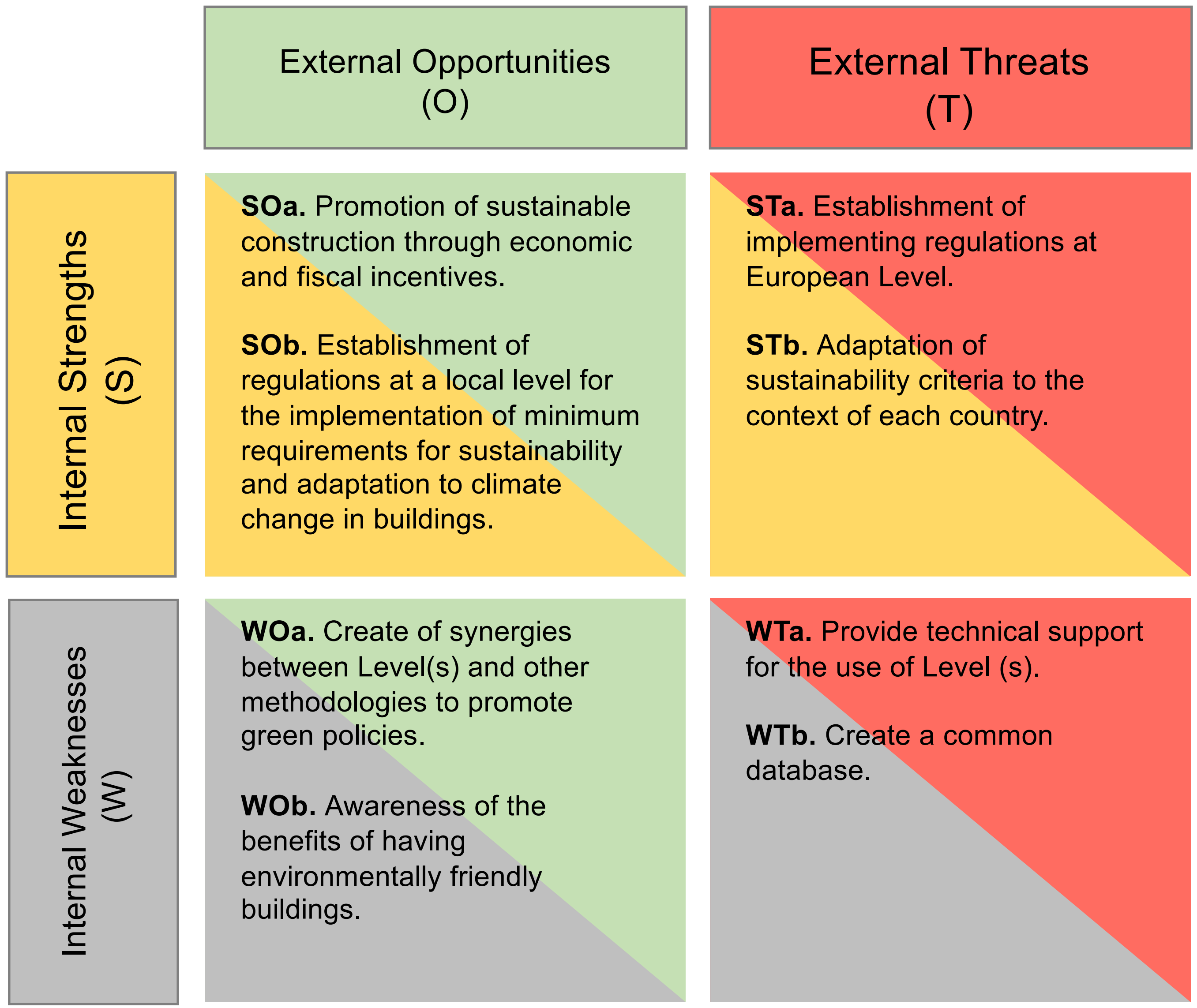
28%
46%
0%
24%
32%
79%
4%
8%
21%
I don't have any information
I have some information
I know him.
I've worked with it
first roud
secon roud
third roud

Figure


External Opportunities (O)
External Threats (T)
Internal Strengths (S)
Internal Weaknesses (W)
SOa. Promotion of sustainable construction through economic and fiscal incentives.
SOb. Establishment of regulations at a local level for the implementation of minimum requirements for sustainability and adaptation to climate change in buildings.
STa. Establishment of implementing regulations at European Level.
STb. Adaptation of sustainability criteria to the context of each country.
WOa. Create of synergies between Level(s) and other methodologies to promote green policies.
WOb. Awareness of the benefits of having environmentally friendly buildings.
WTa. Provide technical support for the use of Level (s).
WTb. Create a common database.

Figure

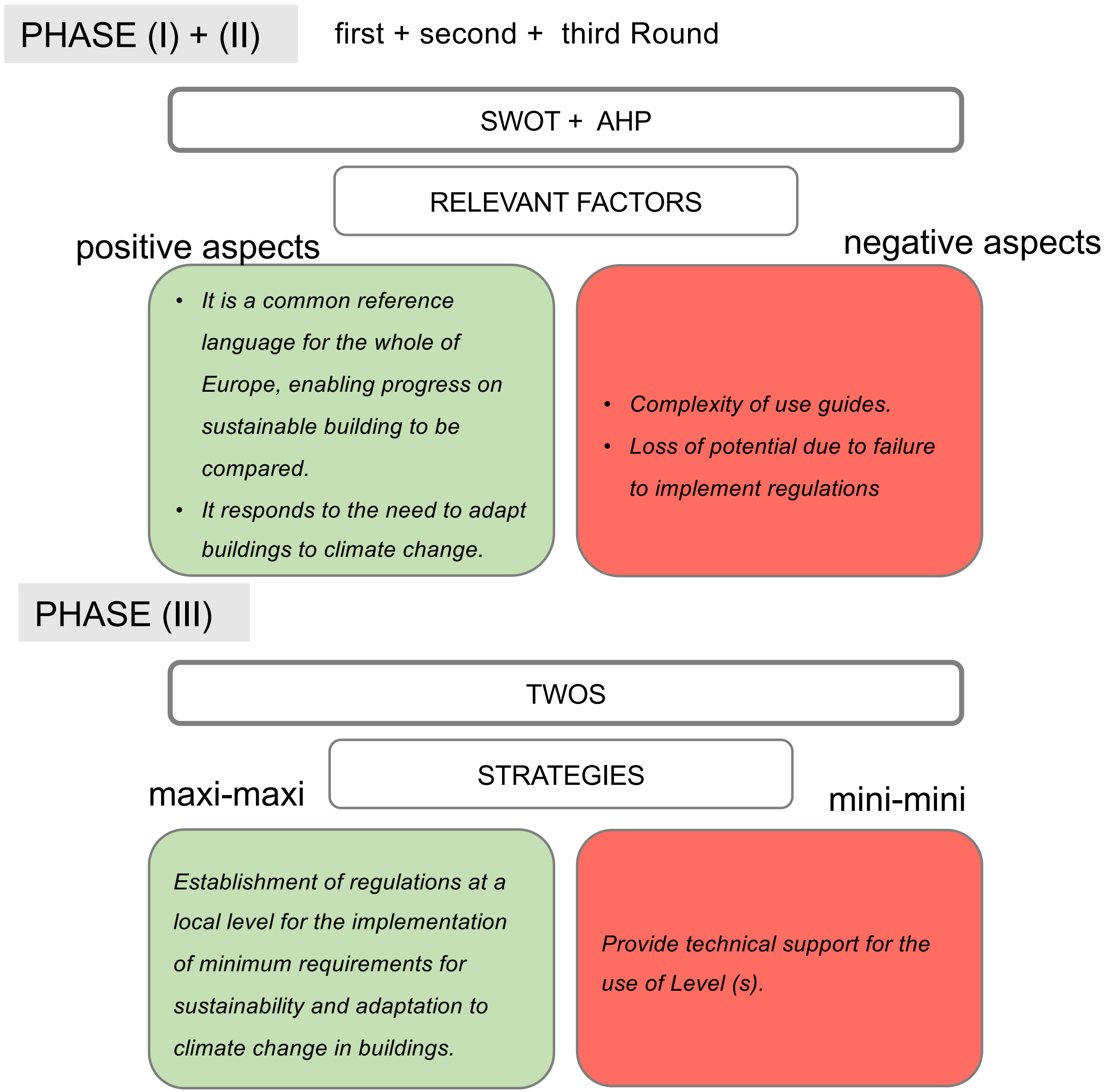

PHASE (I) + (II)
first + second + third Round
SWOT + AHP
RELEVANT FACTORS
positive aspects
negative aspects
It is a common reference language for the whole of Europe, enabling progress on sustainable building to be compared.
It responds to the need to adapt buildings to climate change.
Complexity of use guides.
Loss of potential due to failure to implement regulations
PHASE (III)
TWOS
STRATEGIES
maxi-maxi
mini-mini
Establishment of regulations at a local level for the implementation of minimum requirements for sustainability and adaptation to climate change in buildings.
Provide technical support for the use of Level (s).

Table 1

Table 1. Detailed composition of the panel of experts.

Category	Number of experts					
	First phase		Second phase		Third phase	
	Sent	Answers	Sent	Answers	Sent	Answers
Universities, students and research centres	50	23	23	21	6	6
Builders and promoters	20	11	11	9	3	3
Administration						
Local	15	11	11	9	3	3
Autonomous	10	6	6	4	2	2
State	10	7	7	3	1	1
International	5	1	1	-	-	-
Professional associations and institutes of construction and organisations for sustainability	10	7	7	6	2	2
Technical professionals of the building	30	22	22	18	2	2
Sustainability consultants	10	9	9	8	3	3
Manufacturers	15	9	9	7	3	3
Environmental associations	5	2	2	1	1	1
Administration of the real estate	5	2	2	1	1	-
Business partnership	5	2	2	1	1	-
Total	190	112	112	88	28	26

Table 2

Table 2. Assessment of potential factors from expert surveys. Internal analysis: Identification of Strengths and Weaknesses

Category	Potential factor		Description	Average valuation	Position by category
STRENGTHS	S_a	Support from the European Commission (EC).	It is driven and supported by an important common public body such as the EC.	8.482	2nd
	S_b	Support from different associations at European level.	There are a number of influential actors with a strong interest in its development, such as GBC, professional associations, companies and national governments.	7.748	8th
	S_c	Its design is oriented to cover a broad spectrum of actors, with capacity, experience, activity, objectives or diverse interests	The breadth of potential users increases their ability to expand. Potential actors would be: property owners, development agents and investors, design teams (among others, architects and engineers), construction and demolition management personnel, property agents and appraisers, asset and facility managers, public and private organizations using the evaluated buildings, etc.	8.098	5th

	S_d	It is a common reference language for the whole of Europe, enabling progress on sustainable building to be compared.	Being able to access a European framework with a language and methodology common to all countries about sustainable construction, allows the creation of European and other national policies along the same lines, joining forces in its dissemination.	8.652	1st
	S_o	Allows use in multiple situations; can be used in the different phases of the life of the buildings and for different types of actions: new construction and rehabilitation.	Level(s) has been designed to be used in the different phases of the life of a building, allowing the transition from simple to more complex and complete calculations, identifying key steps to improve to reduce the environmental impact, which multiplies its use opportunities.	8.321	3rd
	S_f	It is based on the three current key aspects of sustainability policies.	Level(s) covers the three keys of sustainability: environmental (through life cycle analysis), economic (with emphasis on circular economy), and social (health analysis), so it aligns perfectly with the upcoming European initiatives,	8.223	4th

			demonstrating its relevance for implementation.		
	S_g	Level(s) would allow progressive implementation of the objectives.	The structure of the tool would allow, if necessary to facilitate implementation, the possibility of implementation in several phases of the different objectives, starting for example with the most urgent, developed or extended -as carbon footprint or healthy spaces-, and add the rest later.	7.902	6th
	S_h	It allows a partial or total implementation of double character: obligatory or voluntary.	In this way the most important indicators could be made regulatory, while those who might present more difficulties could be established on a temporary basis as volunteers to facilitate the preparation of the sector for their management.	7.518	7th
WEAKNESSES	W_a	Complexity of use guides.	For now, Level(s) guides are complex and not very didactic. It makes it difficult to understand them and ultimately to use them by the wide range of agents to which they are addressed (designers, developers,	8.126	1st

		builders, manufacturers, users, etc.)especially for those whose professional work does not involve direct experience with the concepts handled in the analyses.		
W_b	Difficulty in agreeing on the Level(s) approach to actors in professional contexts from different countries.	As it is a framework for the whole of Europe, it is necessary to find consensus for its acceptance by actors from a wide range of professional and cultural, and even environmental and climate contexts.	7.649	5th
W_c	Reliance on other tools to obtain data.	The need to rely on external measuring tools of varying technical utility to obtain some data needed for analysis may condition its ease of use.	7.468	6th
W_d	The comparative ability of Level(s) depends a lot on the criteria used in each evaluation.	Without reference values to compare the data, it is difficult to draw direct conclusions and the comparison is only effective with other buildings with similar evaluator criteria and building characteristics.	7.928	3rd

W_e	Mainly quantitative nature of the analysis.	The analytical approach based mainly on quantifiable data may discourage their use intentional professionals by not helping them to develop or demonstrate the validity of those sustainable strategies, architectural design, of a more qualitative character, but of great efficiency to obtain positive results.	7.045	7th
W_f	Methodology not very self-sufficient and therefore dependent on other procedures or databases.	In order to achieve some objectives set out in Level(s), it is necessary that there be prior systemic changes in some commercial activities involved in building, such as the provision of environmental product declarations for the correct assessment of LCA (life cycle analysis) and LCC (life cycle costs).	7.712	4th
W_g	Sample results with data only.	The way in which results are displayed exclusively through technical data, difficult to assimilate by some non-expert agents such as building users, can produce disinterest and	7.036	8th

		drive away these types of actors who are key in the success of the tool's welcome.		
W_h	Difficulty in developing a comprehensible, effective and useful implementation for the end user.	There is a risk that users and/or promoters will see that evaluation with Level(s) is just a process that increases cost and effort without contributing anything in return, for example, in some cases with the energy performance certificate.	8.063	2nd

Table 3

Table 3. Assessment of potential factors from expert surveys. External Analysis: Identification of Opportunities and Threats. In shading the selected factors as relevant

Category	Potential factor		Description	Average valuation	Position by category
OPPORTUNITIES	O_a	Relationship between environmental awareness and the use of Level(s).	The use of Level(s) generates more excellent knowledge of the professionals of the sector and its clients, on the impact of construction on the environment, resulting in a positive feedback cycle whereby higher environmental sensitivity drives knowledge about Level(s), and the use of this, in turn, promotes such sensitivity.	7.730	8th
	O_b	Possibility for different agencies to disseminate it by including it in their proposals.	By being included in certification and regulatory tools at different scales across Europe, the bodies associated with these tools and regulations will drive their development by taking ownership of them.	7.847	3rd

O_c	Act as a spearhead and reference point for sustainable initiatives.	Being a pioneering and ambitious project in terms of scope and impact, it can be a reference action for sustainability and circular economy policies in general, encouraging its initial impetus and development, and their settlement as an example of methodology.	7.784	4th
O_d	The growing ecological awareness of the citizens encourages their conversion into political initiatives.	That in Europe, there is a growing demand for and awareness of sustainable development throughout society, supports and legitimizes the incorporation of Level(s) in concrete policies and regulations.	7.764	7th
O_e	It will facilitate and disseminate the standardization of desirable comfort standards by users, which will increase the demand for Level(s) buildings.	Buildings designed under the criteria determined by Level(s) will offer standards of comfort that will be of tangible benefit to society as a whole, and which, once extended, will be difficult to renounce, making the reception of the tool extensive and practically definitive and	7.782	5th

		irreversible, as is already the case with some improvements introduced by the changes in the technical codes of the building.		
O_f	It responds to the need to adapt buildings to climate change.	The changing climatic conditions will make any measure to adapt to them essential and Level(s) can represent the most effective and feasible way to face them from the building field.	8.136	1st
O_g	Build on the experience of existing sustainability certification tools.	Voluntary sustainability certification tools, already operational in all European countries, are an example of the feasibility of building construction by assessing most of the indicators provided by Level(s), and with ambitious compliance requirements. They provide a precise reference that removes uncertainties about what it means to implement sustainability analysis in the building process.	7.771	6th

	O_h	Alignment with sustainable and circular economy initiatives and policies.	The Level(s) approach, fully integrated into the circular economy idea, makes the activities involved and the products developed in the processes that have used Level(s) can justify their sustainability and circularity to obtain tax advantages and other benefits that are emerging to drive change.	8.064	2nd
THREATS	T_a	Loss of potential due to failure to implement regulations.	If it does not become a European directive or if it does not reach regulations and regulations in the various Member States, and remains a purely voluntary framework, it risks losing its full potential to extend itself as a frame of reference.	8,495	1st
	T_b	If it is not implemented quickly enough to meet the objectives and deadlines of the Paris Agreement, its effectiveness as a tool for change	Moreover, with it, the work and resources invested in a project of that size.	7.636	5th

	could be called into question.			
T_c	Possible rejection, due to the inertia of the market and its difficulty to adapt to changes.	The difficulty of a large part of the construction and building market, in general, to adapt to a sustainable model can provoke rejection of its implementation and therefore, opposition or lack of support from that sector.	7.559	7th
T_d	There is a danger that to obtain a better reception of the project from specific sectors, extreme flexibility in criteria will lead to a loss of potential as a tool.	Trying to satisfy those actors involved with the most significant resistance to the change of model can lead to a weak framework, without the capacity to achieve sustainable development goals and therefore to question their usefulness and expansion.	7.505	8th
T_e	Uncertainty in the data needed to carry out the analysis.	In some cases, these data do not exist (2030-50 climate files), or are incomplete (manufacturers' environmental product declarations), or are unreliable (material databases).	7.883	2nd

T_f	Possibility of a complementary relationship with existing certification tools.	Poor alignment between Level(s) and current voluntary certification tools could lead to the perception of Level(s) implementation as a duplication of work without duplicating benefits, or even as competition for such tools.	7.582	6th
T_g	Possible inability to reach consensus among all European countries on the criteria and factors of the Level(s) analysis.	Climate change and resource scarcity will affect the different Member States in a variety of ways, so the needs and priorities for assessment will also be different, and disagreement along these lines could affect an adequate standard reception.	7.802	4th
T_h	Possible reluctance about the need for a systemic change in the approach and way of working for the majority of the sector.	Sustainable building implies a new way of understanding and making buildings for the whole sector, based on the circular economy so that all parts of the process are dependent on each other. The change for many professionals	7.820	3rd

		from working isolated to the need to consider multiple parts and factors involved in the process, can cause resistance or even lead to simplistic and appealing interpretations that limit, reduce or nullify the potential of the tool.

Table 4

Table 4. Local and global priority indexes and position for each factor

Category and weight		Relevant factor	~~Index of local priority~~Local priority index		~~Index of overall priority~~Total priority index	
			Value (p_i ~~pi~~)	Position	Value (P_{ij} ~~Pe~~)	Position
STRENGTHS ($W_{S=0.3887}$)	S_2~~S_1~~	It is a standard reference language for the whole of Europe that allows us to compare progress in sustainable building.	0,2920~~0.2522~~	1st~~3rd~~	0,1135~~0.0980~~	~~3rd~~2nd
	S_3~~S_2~~	~~Support from the European Commission (EC).~~Allows use in multiple situations; can be used in the different phases of the life of the buildings and for different types of actions: new construction and rehabilitation.	0,2791 ~~0.2525~~	2nd	0,1085~~0.0981~~	~~3rd~~2nd
	~~S_3~~S_1	Support from the European Commission (EC).~~Allows use in multiple situations; can be used in the different phases of the life of the~~	0,2406 ~~0.2422~~	~~4th~~3rd	0,0935~~0.0941~~	5th

		~~buildings and for different types of actions: new construction and rehabilitation.~~				
	~~S_4~~S_4	It is based on the three current critical aspects of sustainability policies.	0,1884~~0.2531~~	~~1st~~4th	0,0732~~0.0984~~	~~1st~~7th
WEAKNESSES ($W_{W=0.1088}$)	~~W_1~~W_4	Difficulty in developing a comprehensible, practical and useful implementation for the end-user.~~The complexity of user guides.~~	0,3278~~0.2422~~	~~3rd~~1st	0,0357~~0.0270~~	11~~3~~th
	~~W_2~~W_1	The complexity of user guides ~~Difficulty in developing a comprehensible, practical and useful implementation for the end-user.~~	0,2317~~0.2393~~	~~4th~~2nd	0,0252~~0.0260~~	14th
	W_3~~3~~	Methodology not very self-sufficient and therefore dependent on other procedures or databases ~~The comparative ability of Level(s) depends a lot on the criteria used in each evaluation.~~	0,2293 ~~0.2485~~	~~2nd~~3rd	0,0249 ~~0.0270~~	15~~2~~th
	W_2~~4~~	~~Methodology not very self-sufficient and therefore dependent on other procedures or databases.~~The comparative ability of Level(s)	0,2113 ~~0.2640~~	~~1st~~4th	0,0230~~0.0287~~	16~~1~~th

		depends a lot on the criteria used in each evaluation.				
OPPORTUNITIES ($W_{O=0.3720}$)	O_{3}~~1~~	It responds to the need to adapt buildings to climate change.	0,3174 ~~0.2480~~	1st~~2nd 3rd~~	0,1181~~0.0923~~	~~6th~~1st
	O_{4}~~2~~	Alignment with sustainable and circular economy initiatives and policies.	0,2884 ~~0.2480~~	2nd ~~3rd~~	0,1073~~0.0923~~	~~7th~~4th
	O_{1}~~3~~	Possibility for different agencies to disseminate it by including it in their proposals.	0,2030 ~~0.2446~~	~~4th~~3rd	0,0755~~0.0910~~	~~8th~~6th
	O_{2}~~4~~	Act as a spearhead and reference point for sustainable initiatives.	0,1912 ~~0.2594~~	~~1st~~4th	0,0711~~0.0965~~	~~4th~~8th
THREATS ($W_{T=0.1305}$)	T_{1}~~1~~	Loss of potential due to failure to implement regulations.	0,2924 ~~0.3144~~	1st	0,0382~~0.0410~~	9th
	T_{4}~~2~~	Possible reluctance about the need for a systemic change in the approach and way of working for the majority of the sector.~~Uncertainty in the data needed to carry out the analysis.~~	0,2769 ~~0.1994~~	~~3rd~~2nd	0,0361~~0.0260~~	~~15th~~10th
	T_{3}~~3~~	Possible inability to reach consensus among all European countries on the criteria and	0,2347~~0.1890~~	~~4th~~3rd	0,0306~~0.0388~~	~~10th~~12th

	factors of the Level(s) analysis.~~Possible reluctance about the need for a systemic change in the approach and way of working for the majority of the sector.~~				
T24	Uncertainty in the data needed to carry out the analysis.~~Possible inability to reach consensus among all European countries on the criteria and factors of the Level(s) analysis.~~	0,1960~~0.2972~~	~~2nd~~4th	0,0256~~0.0247~~	13~~6~~th

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Abstract

Level(s) is a common European Union framework of core sustainability indicators for measuring the performance of buildings along their life cycle, enabling emissions reductions and circular resource flows. A fundamental tool for the development of European policies to boost the market for sustainable, resilient and climate change adapted buildings. The objective of this study is to contribute to the existing body of knowledge in the field of sustainable building research, through the definition of strategies to adopt Level(s) for bringing buildings into the Circular Economy. For this reason, a triple SWOT-Analytical Hierarchy Process (AHP)-TOWS analysis was applied. The strengths, weaknesses, opportunities and threats (SWOT) of the Level(s) have been identified in relation to the availability of resources, product quality, internal and market structure, consumer perception, among others. The results obtained are conclusive in terms of the experts' positive assessment of the tool; highlighting factors such as its response to the need to adapt buildings to climate change~~the inclusion of the three keys of sustainability~~, its a standard reference language, and its use in multiple situations. ~~its common language for the whole of Europe, the support of the European Commission, and its ability to be included in certification tools and regulations at different scales.~~ However, several barriers have also been identified, which may affect its development, including its complexity of use, ~~and~~ its lack of self-sufficiency, and its dependence the criteria used in each evaluation. Finally, the key strategies to be carried out for the implementation of the Levels have been established.

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