# SMART DELIVERABLE D5.5

# Multi-criteria Decision Framework to Assess Supply Chain Management

We study the barriers and drivers for market actors' contribution to the UN Sustainable Development Goals within planetary boundaries, with the aim of achieving Policy Coherence for Sustainable Development.

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# Presentation of Deliverable

## Purpose and scope

This deliverable presents technical information regarding Sustainability Assessment Framework Evaluation Process. This evaluation is based on multi-criteria decision-making methodologies, since it allows to overcome the current sustainability assessment limitations.

## Relationship to other deliverables

This Sustainability Assessment Guide is the fifth deliverable (D5.5 Multi-criteria Decision Framework to Assess Supply Chain Management) based on the work developed by WP5. This deliverable presents a set of complementary tools and processes, which enables the comprehensive assessment of corporate sustainability footprint and will be seen as a technical annex to the Sustainability Assessment Framework.

This work is connected to previous deliverables, in particular, to Deliverable D5.1 “Life Cycle Thinking: Issues to be Considered” that presents this Framework and the foundations of this deliverable; D5.2 “List of Best Practices and KPIs of the Textile Products Life Cycle” and D5.3 “List of Best Practices and KPIs of the Mobile Phone Life Cycle”, and D5.4 “Sustainability Assessment Guide”, that support the implementation of the Assessment Framework.

In addition, the results of D5.5 will flow into Deliverable 5.6 “Results of the Testing Process in the Selected Case Studies”.

## Structure of the document

The objective of this document is to provide technical information regarding the evaluation methodology based on multi-criteria decision-making methodologies. To that end, this document is structured as follows: In the first part, the fundamentals that have been used as a basis for the definition of the Sustainability footprint are presented.

After a short introduction to the footprint, in second, third and fourth parts we develop the technical steps to produce the proposed Sustainability Footprint. Finally, some transitional solutions are proposed to overcome current limitations on the use of whole evaluation process.

# Introduction to Evaluation Tool - Sustainability Footprint

The results obtained in phase 1 (footprint analysis) and 2 (hotspots analysis) of the Sustainability Assessment Tool (see deliverable 5.4 and figure 1) are considered to evaluate sustainability performance. This evaluation is based on multi-criteria decision-making methodologies, since it allows to overcome the current sustainability assessment limitations. The outcomes of this phase allow for the detection of deficiencies that cause certain scores and to establish concrete objectives for the improvement of sustainable management through the use of corrective measures.

The sustainability footprint should be elaborated considering the following key questions:

**(i)** Sustainability Assessment Framework (Figure 1) presents three processes and three steps that offer a holistic system to ensure the success of the appraisal. The main characteristics of each of the processes and steps are described below:

**Process 1: Traceability in the product's sustainable management**: Interoperability mechanisms must be defined to ensure traceability. The framework should consider the traceability of the sustainable management of products, which allows for the analysis of direct and indirect impacts of the organization, not only in environmental terms, but also in social and management terms, along their value chain. The use of sustainability clauses in the contracts of the supply chain and their communication through the entire production process, or the use of sustainable suppliers' certification programs are, among others, methods to assure this traceability.

**Process 2: Assurance**: The whole sustainability assessment process should contain enough guarantees to ensure that the information that comes out of the process is relevant, reliable and provides confidence to the different stakeholders. To this end, in this phase internal and external auditing processes should be defined.

**Process 3: Continuous improvement:** This guide also adopts a "continuous improvement approach", which implies that the organization must work towards improving its sustainability practices, processes and performance, leading to the gradual extension of the scope of the Sustainability Assessment Framework implementation over time; the gradual mitigation of negative impacts and the establishment of a more demanding sustainability objectives along time.

**Step 1: Organization sustainability framework analysis:** In this phase, the organization should 1) determine the commitment of the highest-level position in an organization, 2) connect corporate governance to sustainability, 3) know its objectives and scope, 4) position the organization within the supply chain, 5) be aware of its impacts throughout the life cycle, 6) define its supply chain map, 7) identify its stakeholders, 8) move forward in the evaluation process and, 9) plan the sustainability strategy.

**Step 2: Sustainability assessment tool:** This step comprises three phases:

**Phase 1: Footprints tools**: The framework offers footprint methodologies to identify and measure environmental, social and economic impacts. Grounded on best practices and aligning efforts with key initiatives, the Organizational Environmental Footprint from the European Commission and UNEP/SETAC methodology are used as tools to measure the environmental and social impacts to be adopted.

**Phase 2: Hotspots analysis tool**: In this phase, the critical points of the organization under evaluation are determined. These hotspots are obtained after the first evaluation of the organization and they are kept active all the time until

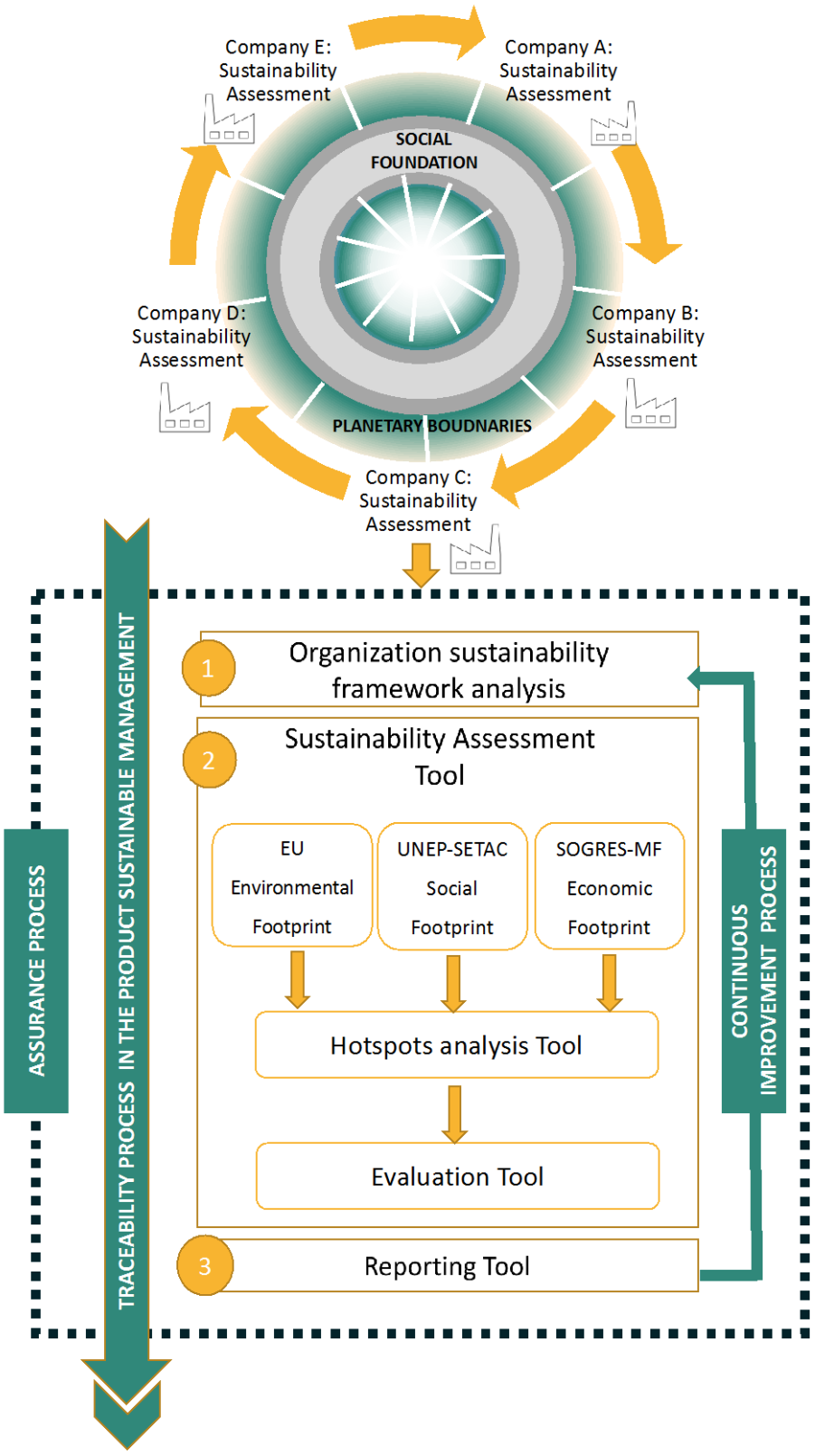
their correction or suppression. To carry out this phase, the UNEP Hotspots methodology should be considered.

**Phase 3: Evaluation Tool-Footprint methodology**: In the third phase, the results obtained in phases 1 and 2 are considered to evaluate sustainability performance. This evaluation is based on multi-criteria decision-making methodologies, which make it possible to overcome the current sustainability assessment limitations[1] , for example, that poor results in one aspect cannot be mitigated through better results in another aspect. The outcomes of this phase allow for the detection of the deficiencies that cause certain scores and the establishment of specific objectives for the improvement of sustainable management through the use of corrective measures. This phase provides organizations with the so-called sustainability footprint.

**Step 3: Reporting Tool**: In this step, organizations measure and communicate to internal and external stakeholders their environmental, social and management performance, and then set goals to manage change more effectively. Transparency about non-financial performance can help reduce reputational risks, open up dialogue with stakeholders, and demonstrate leadership, openness and accountability.

[1] Escrig-Olmedo, E., Muñoz-Torres, M. J., Fernández-Izquierdo, M. Á., Rivera-Lirio, J. M. (2014). Lights & Shadows on Sustainability Rating Scoring. Review Managerial Science, 8, 559-574.
Escrig-Olmedo, E., Muñoz-Torres, M. J., Fernández-Izquierdo, M. Á., Rivera-Lirio, J. M. (2017). Measuring corporate environmental performance: A methodology for sustainable development. Business Strategy and Environment, 26, 142-162.

**Figure 1. General outline of the sustainability assessment framework**



**(ii) Sustainability Assessment Tool Inputs:** these inputs are obtained from previous phases of the Tool, i.e. phase 1 'Footprint' and phase 2 'Hotspots':

Table 1: Sustainability Assessment Tool Inputs[2]

| SAT PHASE | WHAT? | HOW? | WHAT FOR? |
|---|---|---|---|
| Phase 1 'Footprint' | Environmental footprint. Global environmental impact indicator | Impact categories normalized, weighted and aggregated according to European OEF (EC, 2013) developments.' Values: [0,1] | To include a synthetic indicator regarding the environmental domain in the sustainability footprint following generally accepted methods. |
| | Social footprint. Global social impact indicator | Impact categories normalized, weighted and aggregated according to UNEP/SETAC S-LCA methodology (UNEP-SETAC, 2009) developments. Values: [0,1] | To include a synthetic indicator regarding the social domain in the sustainability footprint following generally accepted methods. |
| | Economic footprint. Global economic impact indicator | Impact categories normalized, weighted and aggregated according to the SOGRES-MF methodology developments. Values: [0,1] | To include a synthetic indicator regarding the economic domain in the sustainability footprint following generally accepted methods. |

[2] European Commission (2013) "2013/179/EU: Commission Recommendation of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organizations", Text with EEA relevance Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32013H0179 (Accessed on 25 February 2019

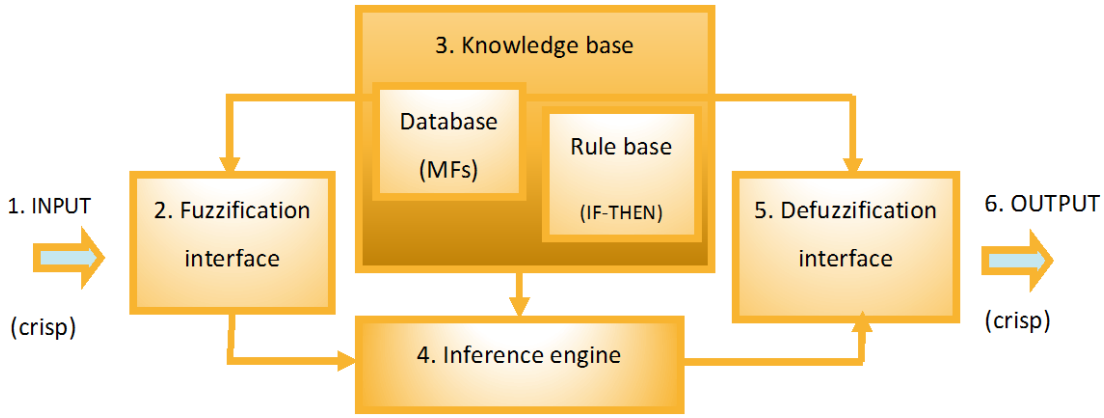
UNEP-SETAC (2009). Guidelines for Social Life Cycle Assessment of Products. Available at: http://www.unep.fr/shared/publications/pdf/dtix1164xpa-guidelines_slca.pdf (Last accessed on 28/05/2018)

United Nations Environment Programme (2017): Hotspots Analysis An overarching methodological framework and guidance for product and sector level application. Available at: https://www.lifecycleinitiative.org/new-hotspots-analysis-methodological-framework-and-guidance/ (Last accessed on 17/05/2019)

| | | | |
|---|---|---|---|
| Phase 2<br>'Hotspots' | Information regarding the most important impact categories and the life cycle phase where they take place. | Technical information validated by stakeholders and experts following UNEP (2017) methodology.<br>+<br>Normalized, weighted and aggregated information for measuring if the organization has appropriate hotspots management initiatives (Process Indicators and best practices) in order to prevent and/or correct significant potential impacts.<br><br>Values: [0,1] | Hotspots identification has implications for organizational management, but also for sustainability assessment.<br><br>Both elements (current and future hotspots management initiatives) allow for a continuous process of improvement and would be a measure of the soundness of the organizational sustainability management system. Consequently, they will be considered in the evaluation phase. |

**(iii) Method:** Fuzzy Multi-Criteria Decision-Making Method- Fuzzy Inference System[3] (Mamdani type).

Figure 2: Fuzzy Inference System




[3] Available software such as MATLAB Fuzzy Logic Toolbox can be used for running the system.

In addition, the system designed should overcome traditional sustainability assessment challenges[4]:

**(iv) Commensurability:** 'Selecting the key sustainability indicators, transforming them into commensurable units and integrating them in a single measure to generate a robust sustainability.' **(Derived from the calculation of Footprints in phase 1)**

**(v) 'Fungibility:** In a strong sustainability context, good results in some of the indicators or domains cannot hide the absence or the inadequacy of policies or processes in other areas.' **(Integrated explicitly in the rule base)**

**(vi) Stakeholders' preferences:** 'The varying assessments that different stakeholders may give to each criterion (should be) included. **(Derived from the consideration of Hotspots results phase 2)**

## 1. FROM INPUTS (1) TO FUZZIFICATION INTERFACE (2)

As seen in figure 2, SAT INPUTS, numerical values normalized between 0 and 1, are subjected to a 'fuzzification' process.

Table 2: Linguistic categorization

| From SAT INPUT Numerical [0,1] | To LINGUISTIC CATEGORIZATION |
|---|---|
| Environmental footprint | Strong (S), Medium (M), Weak (W) |
| Social footprint | Strong (S), Medium (M), Weak (W) |
| Economic footprint | Strong (S), Medium (M), Weak (W) |
| Hotspots management | Limited (L), Reactive (R), Proactive (P) |

### Environmental/ Social/Economic footprints:

These footprints are indicators regarding the environmental/social/economic domain in the sustainability footprint, synthetized following generally accepted methods, and

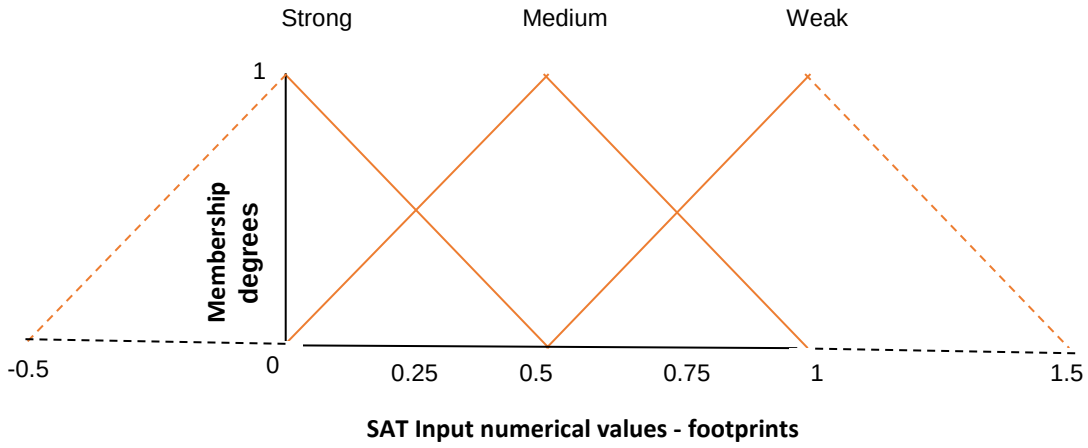
[4] Escrig-Olmedo, E., Muñoz-Torres, M. J., Fernández-Izquierdo, M. Á., Rivera-Lirio, J. M. (2017). Measuring corporate environmental performance: A methodology for sustainable development. Business Strategy and Environment, 26, 142-162.

normalized between 0 and 1 (the closer to 1, the better for environment, society and economy).

These organizational footprints obtained are translated into linguistic values (Strong, Medium, Weak) applying fuzzy maths[5], in order to define each footprint value according to their impact on sustainability (e.g. weak environmental footprint). The stronger the footprint, the worse for sustainability.

To define the relationship of numerical footprints with linguistic labels (Figure 3) it is used the so-called membership functions (triangular in this guide).

Figure 3: Footprints Triangular membership functions




Through this process, each input value is expressed in linguistic terms, where the frontier between each category becomes fuzzy. For example, there are values which clearly represent a strong, medium or weak environmental footprint (the maximum in the triangular figure); however, the rest of values belongs to other category with more or less intensity (membership degrees to each linguistic value, which also go from 0 – minimum membership- to 1-maximum membership).

[5] Zadeh, L. A. (1965). Fuzzy sets. *Information and control*, *8*(3), 338-353.

The linguistic values assigned for these inputs are Strong (S) parameters (-0.5, 0, 0.5), Medium (M) parameters (0, 0.5, 1), and Weak (W) parameters (0.5, 1, 1.5).

### Hotspots management:

The organizations should manage their sustainability hotspots within a continuous improvement approach, considering: i) company sustainability framework (SAF step 1: Organizational Sustainability Framework Analysis); ii) technical information (SAF step 2 phase 1: Footprint Tools) and iii) stakeholders' expectations and needs (SAF step 2 phase 2: Hotspots Analysis Tool).

In this context, after the identification of sustainability hotspots in SAT phase 2, organization should analyze if it has appropriate hotspots management initiatives in order to prevent and/or correct significant potential impacts.

It would be a measure of the soundness of organizational sustainability management system and they allow a continuous process improvement.

For SAF purposes is concern, hotspots management initiatives should be at least two types: i) Process Indicators (PIs) and ii) Best practices, both related to the impact categories identified as organization sustainability hotspots.

*Process Indicators (PIs):*

> 'A sustainability management system requires dynamic and adaptable tools in order to trace and control the organizational objectives for a considered period. This is the main reason for the definition of PIs. PIs are indirect quantitative measures of KPIs, focused on the measurements in a process or in a step of a process. They provide information for the control and monitoring of objectives related to KPIs and allows a continuous improvement process. Moreover, they can be used within the sustainability traceability of the product within the life cycle, as "alarm indicators" in case of risk of transgressing the established limits

of KPIs in any of the three categories and as bases for the definition of corrective measures.' (SMART Deliverable D5.2 and D5.3)

Each organization will define an effective PIs system that should fit organization's characteristics and needs. Based on SMART Deliverable D5.2 and D5.3, a suitable Process Indicator should be:

- **Measurable**. The comparison with a unit of measurement helps to ensure traceability, objectivity, consistency and accuracy of the indicator.
- **Quantifiable**. It shows the physical reality, specifies the results of the measurement and determines the level of achievement of objectives.
- **Specific.** It denotes the existence of a direct relationship between the indicator and the specific objective, which should belong to a process of continuous improvement and should be linked to KPIs.
- **Temporary.** The result of the indicator is associated with a defined period of time. Once the period has passed, the indicator must be updated to repeat the measurement according to stipulated unit of time and considering the dynamism to the information needs.
- **Relevant.** It must address the necessary and sufficient information on the factors that can have an influence on the decision-making or action planning. As a context-dependent condition, 'relevance' concept should integrate normative and technological advances under a life-cycle thinking approach.

*Best Practices:*

'The SAF not only contemplates the sustainability indicators but also integrates in the culture of the organization a continuous improvement approach. Accordingly, the organization should foster the adoption of preventive policies

and proactive practices and not only reactive ones in front of the nonconformities detected due to the evaluation process. In this regard, a useful tool is the definition of best practices. They are understood as guidelines, rules, procedures, processes, actions, policies, programs, methods and innovative ideas that could implement a company to improve sustainability performance, which are integrated in the management system with the aim to be consistent with the continuous improvement process.' (SMART Deliverable D5.2 and D5.3)

Based on SMART Deliverable D5.2 and D5.3, the best practices defined should take into account the following considerations:

- The best practices defined should include information related with the specific PIs, justification, description, expected results, responsible team, operational structure and tools, and protocol of revision and improvement.
- The best practices defined should allow all the members of the organization to know their role in the sustainability management, responsibilities, means to achieve the objectives and the importance of their individual effort.
- The best practices defined must incorporate a consistent training strategy aligned with sustainability and life-cycle thinking.
- A necessary condition for the implementation of best practices defined is the high-level commitment of the organization in order to ensure the consistency of the SAF implementation with the SMART Sustainable Governance Model.

The definition of the best practices could be made explicit by means of a best practices handbook specifically developed by the organization. In this case, a best practices handbook could be the way to inform, share knowledge, and communicate actions under development between organizations belonging to the same the life cycle, contributing to an effective assurance and information traceability process.

Hotspots management evaluation should consist in a two-step process: 1) *self-evaluation* process and 2) *critical review* by experts and stakeholders following UNEP Hotspots methodology.

Consequently, during the hotspots management evaluation process, the organization initiatives are scored as follows: never (0), sometimes (0.25), frequently (0.75), always (1), in relation to the frequency with which the organization covers the following issues:

Table 3: Hotspots management scoring

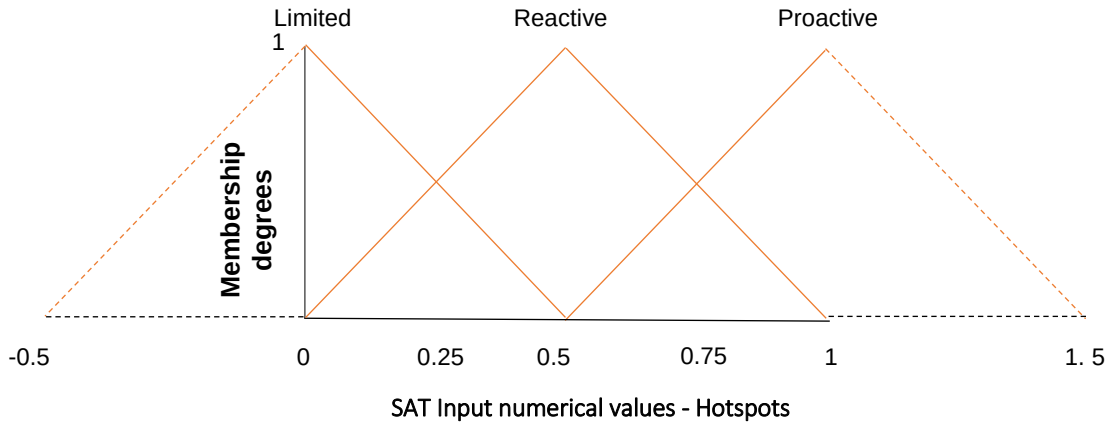
| Issue | Never | Sometimes | Frequently | Always |
|---|---|---|---|---|
| 1. The organization defined **PIs** associated with its hotspots in order to measure and control them. | 0 | 0.25 | 0.75 | 1 |
| 2. The organization defines objectives linked to **PIs** associated with its hotspots. | 0 | 0.25 | 0.75 | 1 |
| 3. **PIs** defined allows sustainability hotspots management along the supply chain. | 0 | 0.25 | 0.75 | 1 |
| 4. **PIs** defined are consistent with main organization stakeholders. | 0 | 0.25 | 0.75 | 1 |
| 5. **PIs** defined are consistent with organization sustainability policy. | 0 | 0.25 | 0.75 | 1 |
| 6. The organization defines **best practices** associated with its hotspots. | 0 | 0.25 | 0.75 | 1 |
| 7. The organization defines these **best practices** including information related with the specific PIs, justification, description, expected results, responsible team, operational structure and tools, and protocol of revision and improvement. | 0 | 0.25 | 0.75 | 1 |
| 8. The organization makes specific actions in order to assure that all the members of the organization must know their role in the sustainability hotspots management, responsibilities, means to | 0 | 0.25 | 0.75 | 1 |

| | | | | |
|---|---|---|---|---|
| achieve the objectives and the importance of their individual effort. | | | | |
| 9. The organization defines a consistent training strategy for these **best practices** development, aligned with sustainability and life-cycle thinking. | 0 | 0.25 | 0.75 | 1 |
| 10. The organization ensures SAF implementation, specifically to be consistent with the Corporate Governance Management for Sustainability, defined in Step 1 of SAF. | 0 | 0.25 | 0.75 | 1 |

The score is obtained following a sequential and cumulative scoring process which will be rescaled in order to obtain a score which ranges from 0 to 1 (the closer to 1, the best for hotspots management).

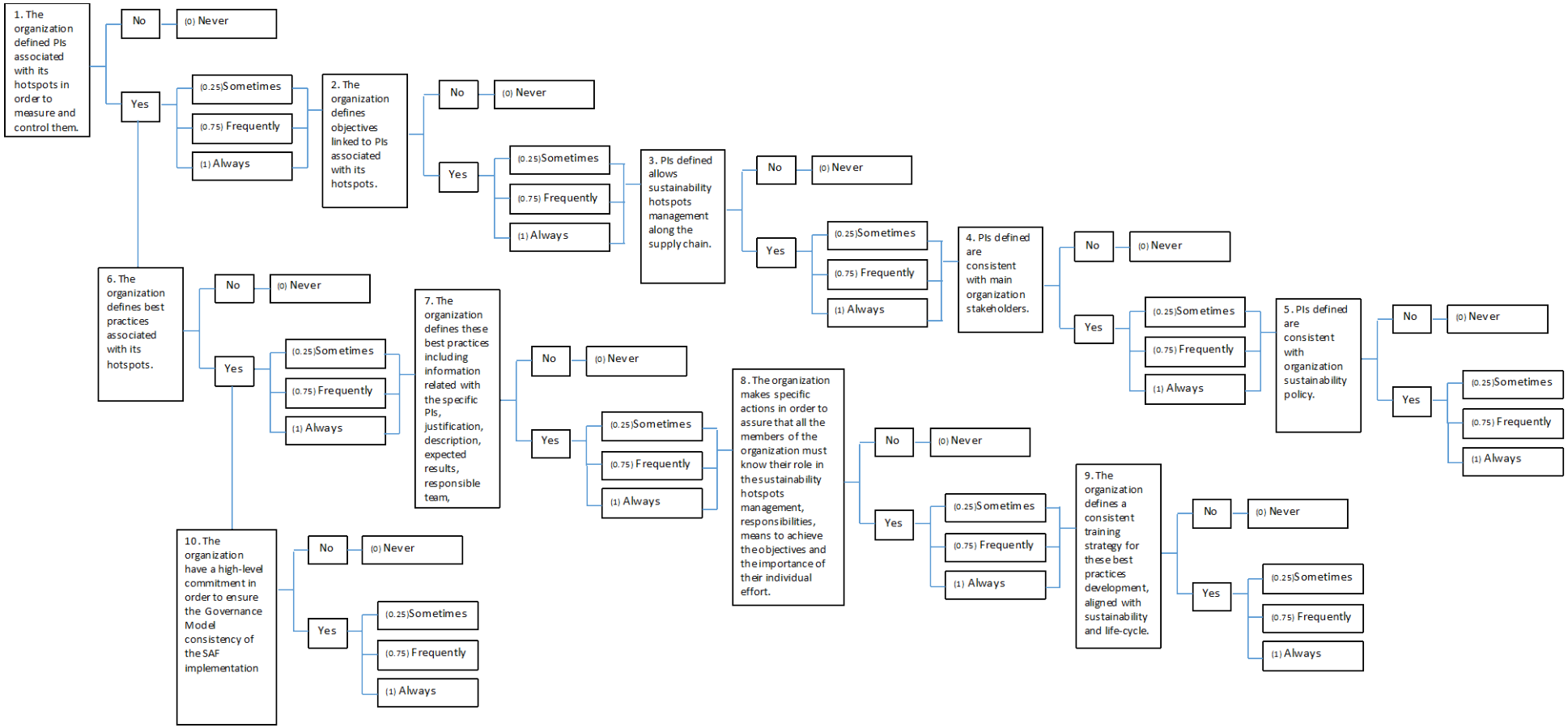
To define the relationship of numerical hotspots management with linguistic labels it is used triangular membership functions.

Figure 4: Hotspots Management Triangular membership functions




In this case, the linguistic values assigned for hotspots management inputs are Limited (L) parameters, (-0.5, 0, 0.5), Reactive (R) parameters, (0, 0.5, 1), and Proactive (P) parameters, (0.5, 1, 1.5).

Figure 5: Cumulative scoring process-Hotspots management



## 2. OUTPUTS AND IF-THEN RULES DEFINITION (3)

In this step, it is necessary to define the organization sustainability footprint (output) and the set of rules that will allow to obtain information about this sustainability footprint, depending on the values presented by the environmental, social and economic footprint, jointly considered with hotpots management score (inputs).

Table 4: Output linguistic categorization

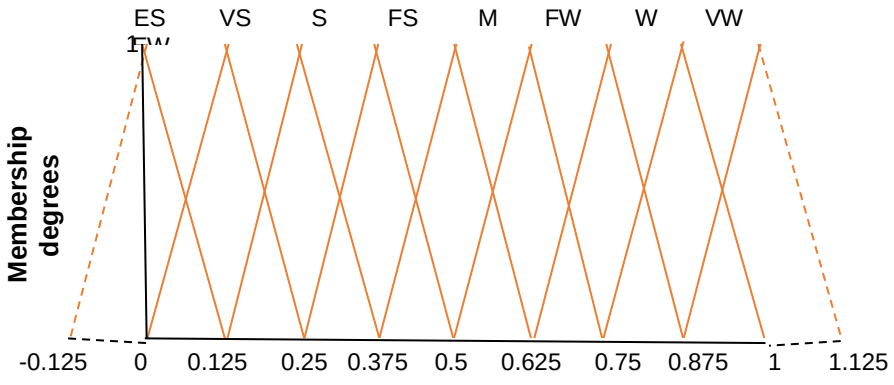
| From INPUT | | To OUTPUT |
|---|---|---|
| *Environmental footprint (EvF)* | Strong (S), Medium (M), Weak (W) | *Sustainability footprint (SuF)*<br><br>Extremely Strong (ES), Very Strong (VS), Strong (S), Fairly Strong (FS), Medium (M), Fairly Weak (W), Weak (W), Very Weak (VW), Extremely Weak (EW) |
| *Social footprint (SoF)* | Strong (S), Medium (M), Weak (W) | |
| *Economic footprint (EcF)* | Strong (S), Medium (M), Weak (W) | |
| *Hotspots management (HoM)* | Limited (L), Reactive (R), Proactive (P) | |

**IF-THEN Rules**

### Sustainability footprint:

The linguistic labels used for categorizing the sustainability footprint are defined using triangular membership functions.

Figure 6: Sustainability Footprint membership functions



In this case, the linguistic values assigned for sustainability footprint (output) are: Extremely Strong (ES) parameters (-0.125, 0, 0.125), Very Strong (VS) parameters, (0, 0.125, 0.25), Strong (S) parameters (0.125, 0.25, 0.375), Fairly Strong (FS) parameters 0.25, 0.375, 0.5), Medium (M) parameters (0.375, 0.5, 0.625), Fairly Weak (W) parameters (0.5, 0.625, 0.75), Weak (W) parameters (0.625, 0.75, 0.875), Very Weak (VW) parameters (0.75, 0.875, 1), Extremely Weak (EW) parameters (0.875, 1, 1.125).

### IF-THEN Rules:

Following Kouikoglou and Phillis (2011)[6] and Escrig et al. (2017)[7] method, among others, the set of inference rules has been defined as follows:

Table 5: Fuzzy Inference Rules

| ***If Env/Soc/Ec footprints are…*** | ***and Hotspots management is…*** | ***Then, Sustainability Footprint is…*** |
|---|---|---|
| All of them 'Strong' | 'Limited' | 'Extremely strong' |
| All of them 'Strong' | 'Reactive' | 'Very strong' |
| All of them 'Strong' | 'Proactive' | 'Strong' |
| Two of them 'Strong', one 'Medium' | 'Limited' | 'Very strong' |
| Two of them 'Strong', one 'Medium' | 'Reactive' | 'Strong' |
| Two of them 'Strong', one 'Medium' | 'Proactive' | 'Fairly Strong' |
| Two of them 'Strong', one 'Weak' | 'Limited' | 'Strong' |
| Two of them 'Strong', one 'Weak' | 'Reactive' | 'Fairly Strong' |
| Two of them 'Strong', one 'Weak' | 'Proactive' | 'Medium' |
| One of them 'Strong', one 'Medium', one 'Weak' | 'Limited' | 'Fairly Strong' |
| One of them 'Strong', one 'Medium', one 'Weak' | 'Reactive' | 'Medium' |
| One of them 'Strong', one 'Medium', one 'Weak' | 'Proactive' | 'Fairly Weak' |
| All of them 'Medium' | 'Limited' | 'Fairly Strong' |
| All of them 'Medium' | 'Reactive' | 'Medium' |
| All of them 'Medium' | 'Proactive' | 'Fairly Weak' |
| Two of them 'Medium', one 'Strong' | 'Limited' | 'Strong' |
| Two of them 'Medium', one 'Strong' | 'Reactive' | 'Fairly Strong' |

[6] Kouikoglou, V. S., & Phillis, Y. A. (2011). Application of a fuzzy hierarchical model to the assessment of corporate social and environmental sustainability. Corporate Social Responsibility and Environmental Management, 18(4), 209-219

[7] Op. Cit.

| | | |
|---|---|---|
| Two of them 'Medium', one 'Strong' | 'Proactive' | 'Medium' |
| Two of them 'Medium', one 'Weak' | 'Limited' | 'Medium' |
| Two of them 'Medium', one 'Weak' | 'Reactive' | 'Fairly Weak' |
| Two of them 'Medium', one 'Weak' | 'Proactive' | 'Weak' |
| Two of them 'Weak', one 'Strong' | 'Limited' | 'Medium' |
| Two of them 'Weak', one 'Strong' | 'Reactive' | 'Fairly Weak' |
| Two of them 'Weak', one 'Strong' | 'Proactive' | 'Weak' |
| Two of them 'Weak', one 'Medium' | 'Limited' | 'Fairly Weak' |
| Two of them 'Weak', one 'Medium' | 'Reactive' | 'Weak' |
| Two of them 'Weak', one 'Medium' | 'Proactive' | 'Very weak' |
| All of them 'Weak' | 'Limited' | 'Weak' |
| All of them 'Weak' | 'Reactive' | 'Very Weak' |
| All of them 'Weak' | 'Proactive' | 'Extremely Weak' |

As a consequence, the set of inference rules gives the same importance to the three sustainability dimensions and their management, and reflects the fact that whenever an input indicator is improved, the overall sustainability footprint is also improved (the sustainability footprint becomes weaker). In addition, if one of the environmental, social or economic footprints is strong, or the hotspots management is limited, the sustainability footprint cannot be very weak nor extremely weak.

## 3. APPLICATION OF IF-THEN RULES THROUGH (4) INFERENCE ENGINE AND TRANSLATION OF LINGUISTIC OUTPUT (5) TO A NUMERICAL VALUE (6)

After the definition of the inference rules, it is necessary to define the **implication method** that would allow to operationalize them, and to generate the corresponding consequent (strong, very weak, medium, etc. sustainability footprint), giving the results in SAT inputs obtained by the organization.

In addition, since the application of the inference engine implies the activation of various if-then rules, it is also necessary to apply an **aggregation method**.

In this case, Following Kouikoglou and Phillis (2011)[8], SAT uses a product-sum fuzzy inference:

- Implication method: "AND" is expressed by the product of membership grades of the rule antecedents.
- Aggregation method: the overall output is a linguistic measure of the sustainability footprint, obtained after the sum of membership grades of the individual rules.

### Numerical output:

The linguistic output of the Fuzzy Inference System is translated into numerical terms [0, 1] by means of the so-called 'defuzzification' method. In SAT framework, it is used the centroid (Escrig et al., 2017)[9].

This step finishes the process of commensurability of a sustainability footprint, where the closer to 1, the best for sustainability.

## 4. TRANSITIONAL SOLUTIONS

The normalization, ponderation and aggregation of impact categories are optional phases still in progress both in the environmental footprint (European OEF) and in the social footprint (UNEP/SETAC S-LCA) methodologies. The objective in the Sustainability Assessment Framework is to apply these methodologies when fully established. Meanwhile, the Assessment Tool proposes an evaluation method that joins technical results with expert knowledge and which allow to work with qualitative and quantitative data. In this case, the Sustainability Footprint would be defined in linguistic categories according to the following process:

[8] Op. Cit.
[9] Op. Cit.

### INPUT:

Environmental/ Social/Economic footprints: a committee of experts and stakeholders assess the Environmental, Social and Economic Footprints of the organization considering the technical analysis previously developed in the Tool. As a consequence, they will classify the Environmental, Social and Economic footprints as Strong (S), Medium (M) or Weak (W) footprint. The stronger the footprint, the worse for sustainability.

Hotspots management evaluation should consist in a two-step process: 1) self-evaluation process and 2) critical review by experts and stakeholders following UNEP Hotspots methodology. Following a cumulative scoring process, the hotspots management implemented by organizations will be classified as Limited (L), Reactive (R) or Proactive (P).

### OUTPUT:

The sustainability footprint of the organization will be classified as Extremely Strong (ES), Very Strong (VS), Strong (S), Fairly Strong (FS), Medium (M), Fairly Weak (W), Weak (W), Very Weak (VW) or Extremely Weak (EW); depending on: i) the values presented by the environmental, social and economic footprint, jointly considered with hotpots management score (inputs); and ii) the set of IF-THEN rules defined.

### RULE-BASE:

The set of inference rules (see Table 5) shall give the same importance to the three sustainability dimensions and their management, and shall reflect the fact that whenever an input indicator is improved, the overall sustainability footprint is also improved (the sustainability footprint becomes weaker). In addition, if one of the environmental, social or economic footprints is strong, or the hotspots management is limited, the sustainability footprint cannot be very weak nor extremely weak.

The sustainability footprint has been defined in linguistic categories. However, future developments of both the European OEF and the UNEP/SETAC S-LCA methodology regarding normalization, ponderation and aggregation of impact categories, will allow to obtain a final score by means of the transition to a Fuzzy Inference System as shown in figure 2.