

Article

Sustainability Assessment: Exploring the Frontiers and Paradigms of Indicator Approaches

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Abstract: Sustainability assessment approaches could support all levels of decision-making and policy processes (including strategies, policies, plans, programs, projects, and activities/operations), thus improving the management of natural and human systems. Sustainability Indicators (SIs) have been extensively used to assess and communicate the progress toward sustainable development. However, despite all the SI initiatives and the well-known advantages and popularity, several risks have been pointed out, so there is a need to rethink the current state of SIs and build visions that could reshape the indicator reality. The main goal of this research is to develop a constructive debate around the possible futures and paths of SIs, by conducting a critical analysis of a set of challenges and opportunities identified by the literature. This was explored through a critical perspective and viewpoint article that discusses what could be some of the new frontiers and paradigms in SIs. Exploratory research supported by a combination of methods was conducted, consisting of a search of the literature and qualitative document analysis, followed by an assessment procedure based upon an evaluation ranking scale. The classification scale integrated three main criteria of valuation: Relevancy, feasibility, and societal impacts. The findings showed that most of the challenges and opportunities analyzed are old and mainly technically oriented, with a low potential impact on society, including end-users and practitioners. The majority of the challenges have low-to-medium feasibility, showing that there would be difficulty in implementing them, and so they should be improved or redesigned. A set of key questions on SIs' futures is proposed, aiming to represent a critical view of the relevant challenges and opportunities analyzed, but underpinned and observed from a crosscutting angle, represented by the societal role. The SI research community should be ready to adapt ways of thinking and doing, responding to new global and local paradigms and using transdisciplinary collaborative scientific development and innovation as the foundations for the change process, wherein communities and the individual have central roles to play.

Keywords: sustainable development; indicators; stakeholders; goals; challenges; opportunities; societal impact

1. Introduction

In the monitoring, assessment, and reporting of sustainability, one of the main ends is to support decision-making and policy processes, thus improving the management of socio-ecological systems and achieving more sustainable outcomes with fewer negative effects, as discussed by several authors [1–3]. In addition, to support policy development and management strategies, sustainability evaluation, reporting, and governance initiatives should integrate and reflect the uncertainty and complexities of human and natural system interactions, and face global challenges toward sustainable development [4]. Despite the existence of several non-consensual definitions, interpretations, and methods [5], the term “sustainability assessment” is often used to refer to ex post and forward-looking ex ante approaches [6],

aiming to characterize the sustainability state (covering the environmental, social, economic, and institutional/governance dimensions) of a current implemented situation or to predict the potential effects of an activity prior to its implementation, respectively. Sustainability assessments can support decision-making processes, playing a role in the strategic and operational levels of planning and project processes, including policies, plans, programs, projects, and activities or operations that address sustainable development goals and targets, independently of their specific context and mission.

There is a significant diversity of methods and tools to assess and report sustainable development (SD). However, indicators are one of the approaches most used, playing a central role in the sustainability assessment of every decision-making process, as noted by Sala [7] and Pope [5], in particular to communicate sustainability performance to stakeholders [8]. Nevertheless, at the same time, sustainability assessment theoretical approaches and practice are currently in a relative initial phase of development [9], where early practice is being adapted to fit new situations and new contexts. Practice has not yet reached a situation where particular methods or approaches are proven to work well.

Despite the current importance and popularity of indicators at an international level [10,11], their development and use is not very recent, since some of the first important references date from the 1970s, for instance, [12–14] mainly focusing on the environmental aspects. In the last decades, there has been a proliferation of sustainability indicator initiatives worldwide (e.g., [15–17]), often labelled and criticized as an “indicator factory” that produces countless initiatives, which mainly serve the individuals or organisations closely involved in designing, producing, and disseminating indicators, as discussed by Rinne et al. [18]. They range from global to local and citizen levels, including transnational, national (countries), regional (e.g., states, regions, provinces), local (e.g., municipalities, cities, localities), organizational (e.g., companies, public agencies, universities, non-governmental organizations), economic sectors (e.g., energy, transports, agriculture), households, communities/families, and individuals, as well as ecosystems.

The massive literature and the uncoordinated and independent practice on sustainability indicators (SIs) have brought no consensus around methodologies—not even agreements on conceptual frameworks, or clarifications of the different terms. As noted by Bell and Morse [19], numerous books, articles and reports have been written, attesting to the popularity and relevance of the field, and yet very few resources exist that tell the full story of the SI phenomenon. Several authors insist that the way forward for SIs should be stronger harmonization at different territorial/organization levels and functions (e.g., [20,21]). Others argue that sustainability indicators must incorporate sufficient flexibility, yet still be culturally and universally appropriate, emphasizing the need to develop tailor-made approaches [22]. There is a will to channel diversity and at the same time standardize some concepts and methods. SIs have also been criticized for trying to assess sustainability complexities through quantitative and restricted indicator approaches, but mostly for being ineffective in changing decision-making processes and outcomes [23].

Related to the specific challenges, threats, and opportunities of the past, current and future roles for SIs are the use of different definitions of the terms sustainable development (SD), sustainability, and indicators, which have been explored over the past decades. As discussed by Bolis et al. [24], the conceptual complexity is significant when dealing with sustainability, since this concept means many things to different people, and this diversity of meaning tends to increase over time. The concept of SD is charged with uncertainties and complexities, as it involves and balances several different dimensions. As stressed by Hussey et al. [25] and Lozano [26], SD-related terms have been considered subjective, complex, controversial, and open-ended, and the indicator terminology is still rather confusing and not well established [27]. Since the indicator movement and boom that started in the early 1990s [24], the term “indicator” has been used rather loosely to include almost any sort of quantitative information or statistic [28].

SIs reflect the issues and paradigms that have been most studied in practice. However, as highlighted by Ramos [17] and Viegas et al. [29], sustainability frontiers should also be built upon

non-traditional aspects of sustainability, including immaterial values of sustainability, such as ethics, culture, esthetics, justice, compassion, mutual help, moderation, and solidarity. Sustainability indicator research and practical approaches have to be transdisciplinary and flexible in order to include emerging issues and deal with aspects that have been overlooked in previous research. As explored by Lang et al. [30], to deal with real-world problems, as well as with the goals of sustainability science as a transformational scientific field, approaches like transdisciplinary, community-based, interactive, or participatory research are often suggested as appropriate means.

Conventional SIs and related tools have long been used to assess sustainability, and much progress has been achieved. However, it has become necessary to start rethinking their roles and applicability. The approval of the 2030 Agenda for Sustainable Development at the United Nations (UN) with 17 Sustainable Development Goals (SDGs), 169 targets, and 232 indicators [31] represents a paramount opportunity for transitions to new paradigms and ways of thinking in assessing sustainability. Despite their weaknesses and limitations (see, e.g., Spangenberg [32]), SDGs create visibility for SIs, where indicator-based assessments are presented as key evidence-based approaches to support SDG implementation and benchmarking [33], giving room for research, innovation, and change.

As noted by Bell and Morse [19] (pp. 1), “we have never been so much in need of indicators to assess, in an impartial and confirmable manner, the outlines of our changing, developing, resilient, and threatened world,” in a growing “post-truth reality.” There is a decline in official data and information credibility, where objective facts are less influential in shaping public views. Therefore, desires and opinions appeal to emotion and personal beliefs, calling for a sustainability assessment change of paradigm. The official truth provided by raw data, statistics, and indicators should be able to integrate and weight non-official inputs, such as societal values, aspirations, desires, perceptions, opinions, and ultimately data collected by stakeholders, as explored by Coutinho et al. [34] and Domingues et al. [35], in a balanced and trustworthy approach. Social or multi-stakeholder collaborative networks, as presented in Kelly and Moles [36], could play an important role in these processes.

In the last 40 years, various studies have identified and discussed the strengths and weaknesses of SIs, addressing the most relevant challenges. Some of those major challenges are related to the use of indicators [3,37], with the need to define clear, simple, and robust frameworks for presenting the indicators, and supported by the engagement of those who are involved in the indicator process, including the potential users. Recent works repeated these attempts and systematized a vast array of challenges and opportunities for SIs, e.g., [38]. However, when analyzing those lists, and despite the value of several of the identified items noted by the international literature analyzed in the work of Verma and Raghubanshi [38], several of them are too general, outdated, redundant, and somewhat blurred. This is also true for the discussion around the specific challenge of SI selection criteria, where most related indicator studies keep using and recommending a substantial number of criteria. As demonstrated by several authors, e.g., [39–42], the vast number of SI selection criteria causes significant complexity and ineffectiveness, and is often associated with subjectivity, redundancy, and alienation from the reality of indicator practice. Therefore, it has been increasingly assumed that indicator development and selection criteria should be tested and evaluated, through assessment by the end-users and other stakeholders [41,43], for example to ascertain their importance to select SIs, confronting their theoretical grounds and the potential relevance versus their practical effectiveness and usefulness.

The main goal of this research was to develop a constructive debate around the possible futures and paths of SIs, conducting a critical analysis of a set of challenges and opportunities identified by the literature. This was explored through a critical perspective and viewpoint article that discusses what could be some of the new frontiers and paradigms in SIs.

This paper is organized as follows: After the introduction, which presents an overview of and international context for the research, the research gap is presented, including the fundamentals to discuss indicator challenges and opportunities. Then the main research goal is detailed. In Section 2, the methods used to develop the research are outlined, followed by Section 3, with the main findings

and discussion of new SIs frontiers and paradigms. In Section 4, final remarks are presented, and the contribution to knowledge and the paper's implications are highlighted.

2. Methodological Approach

Inductive-exploratory research was conducted through a combination of methods, consisting of a search of the literature and qualitative document analysis, followed by an assessment procedure supported by an evaluation ranking scale, as discussed by Saunders et al. [44].

The document analysis focused mainly on the scientific literature on approaches, concepts, methods, and frameworks, or case study applications that deal with assessing and reporting sustainability through indicator initiatives. This analysis was essentially comparative of the main SI challenges and opportunities identified. It was explored whether and how they overcome the major drawbacks and limitations of SIs, looking at differences, highlights, and novelties between documents. Although the search procedure mainly followed a subjective approach, rather than systematic, it took into consideration a minimum level of regularity in the analyzed literature that covered SIs' challenges and opportunities. Issues that are seldom pointed out, not clearly presented, or not well grounded were not included in the analysis. To identify and review the selected documents, the keywords *challenges, limitations, drawbacks, opportunities, strengths, weaknesses, threats, sustainability indicators, and sustainable development indicators* were particularly considered to support this exploratory analysis.

A critical evaluation of a set of challenges and opportunities was then conducted. The criteria used to support the analysis were Relevancy, covering technical and scientific importance, Feasibility, covering the possibility of implementation and operability, as explored by Ramos et al. [27], and Societal Impacts, related to the usefulness to society in terms of SD desires, aspirations, values, and needs. Therefore, elements such as potential community added value, contribution to public policies, and initiatives and contribution to community sustainable development objectives, as identified in Bornmann (2012) [45], were included in the analysis of this third criterion. A ranking scale of Poor, Moderate, and High, varying from low to high values of Relevancy, Feasibility, and Societal Impacts, was used to evaluate each challenge and opportunity. The evaluation process was mainly supported by the insights collected in the document analysis and weighted through qualitative expert knowledge.

There are limitations associated with exploratory qualitative research design and the inherent flexibility and adaptability. Validity, reliability, and generalizability [44,46] are limitations of this type of approach, and were weighed up in the qualitative assessment and discussion of the results, and when drawing the conclusions.

3. Findings and Discussion of New Frontiers and Paradigms





3.1. Evaluation of the Indicator Challenges and Opportunities

Findings make clear that the analyzed set of SI challenges and opportunities have high relevancy (Table 1), and are considered a significant priority for action in the literature, e.g., [38] and [47], as demonstrated by the rationale that supported this evaluation (see the Appendix A for more details).

In all, few of the identified challenges and related opportunities simultaneously received a classification of high relevancy, feasibility, and societal impact. Most of the current challenges and opportunities are old and repeated by the literature (see, for example, the limitations and questions raised in the 1970s by the work of Ott [14]).

Table 1. Evaluation of the selected sustainability indicator (SI) challenges and opportunities, according to the three main criteria (Relevancy, Feasibility, and Societal Impacts), ranked in the following categories.

Selected Challenges and Opportunities	Relevancy	Feasibility	Societal Impacts
#1. Richer selection of case studies	M	H	H
#2. Specific cultural context	H	M	H
#3. Adequate level of standardization	H	M	H
#4. Meta-evaluation	H	L	L
#5. Alternatives to move beyond GDP	H	L	H
#6. Data limitations and provision problems	H	L	L
#7. Integrated and systemic and holistic perspective	H	M	L
#8. <i>Optimum</i> level of indicator aggregation	M	L	H
#9. Better mechanisms for indicator use in practice	H	L	H
#10. Integration or non-traditional aspects of sustainability	H	L	H
#11. Use of information tools and systems	H	L	H
#12. Find the best selection criteria	H	M	H
#13. Institutionalisation process and governance models	H	M	L
#14. Satellite remote sensing and other observing technologies	H	M	L
#15. Intergenerational equity information transfer	H	L	L
#16. The lack of an endogenous indicator's theory	H	L	L


 High  ; Moderate  ; Low  .

Overall, they are technically oriented, and are meaningless or too complex for end-users' understanding, even for practitioners who are non-indicator experts, following the same pattern identified for SIs themselves and the surrounding discourse, which is often developed by scientists and expressed in abstruse language [43,48], and mainly useful for the people who designed them. Almost half of the analyzed challenges have a potential low impact on society, since their opacity or technicality move them away from users' perceptions and interests. Therefore, a central topic to deal with low social understanding and usefulness could be the promotion of societal collaborative networks, involving decision makers, researchers, practitioners, communities, and individuals, as also explored by Domingues et al. [35] and Kelly and Moles [36]. These networks could provide mutual support and learning, and mitigate the low social impact.

Overall, despite the high relevancy, they have low-to-medium feasibility, showing that there will be great difficulty in implementing them, often due to their inherent complexity and operability, or the resources needed. The current state shows that it has become necessary to rethink SI priorities to overcome old and new barriers, and to make future steps toward the Sustainable Development Goals, as established by the United Nations [31]. Several of the analyzed challenges and opportunities

remain unanswered or are still in the early stages of development, and are not yet covered by sufficient theoretical and empirical knowledge and evidence.

Two of the challenges (“#1. A richer selection of case studies” and “#8. Optimum level of indicator aggregation”) were classified with medium relevancy mainly because, despite their relative importance, they represent aspects that are already well covered by the existing literature and practice, or their importance is not confirmed (see Table A1 in the Appendix A).

3.2. Exploring New Frontiers and Paradigms

Despite important progress and the existing vast amount of literature, SIs are still an underexplored field of study. The analyzed set of indicator challenges and opportunities call for a critical analysis of some specific challenges. Exploring new frontiers and paradigms of SIs leads to unanswered epistemological questions, such as “How was the original development of SIs conceived?” and “Why do serious-minded communities of decision makers and theorists still believe sustainability can be measured in an objective sense?” [49] (pp. 205).

A crosscutting challenge for SIs is that the lack of an endogenous indicator’s theory hinders the development of the indicator’s research into an autonomous scientific field and limits indicators to the ecological, social, or economic fields [50], meaning that researchers can only conduct the study of indicators within their subjects of expertise. Therefore, SI evolution is often stuck in sectoral frontiers (ecological, sociocultural, economic, institutional) and facing different barriers, depending on the angle from which they are viewed. They are often not grounded in effective integrated and interdisciplinary sustainability studies, which are not just a sum of different parts, and usually do not include the time dimension and intergenerational equity evaluation, which is a fundamental SD pillar [51,52].

Another central issue to consider in this discussion is related to indicator data, where SIs have a key part to play in the crisis of truth: “We are in a fight, and we recognize the reality that interests will always make selective and distorted use of indicators. That is the price we pay for being in the indicator business” [47] (pp. 553). SIs need to deal with reality, where the value of official data is in question. Furthermore, some other related drawbacks from the existing indicator approaches are that oftentimes, and in spite of the investment put into the compilation of SIs and respective data, stakeholders feel that either the information is not easily accessible or usable, or it is incomplete or sometimes obsolete by the time it reaches the user [53], and therefore not useful.

SIs should be ready to rethink the “old” and “new” world challenges, and deal with the complexity, scale, and unpredictability of many of the current SD questions: A multifaceted mix of post-truth reality, scientific developments, global changes, globalization, social crises (e.g., environment, poverty, and war refugees), economic growth pressures versus de-growth thinking, and new technological opportunities and risks. SIs should also be able to respond to non-traditional aspects of sustainability [17,29], also referred to as a less tangible “fourth pillar” or “missing dimension” of sustainability [29,54], particularly those involving sustainability ethics, culture, esthetics, justice, compassion, mutual help, moderation, solidarity, and general non-material values, as well as goal and target uncertainty, new and old limits of natural-human systems, or the blurred distinction between peacetime and wartime, collaborative learning, voluntary monitoring, and crowd sourcing.

Besides a community perspective, where each community has to develop its individual set of indicators [55] and be an actor in a multi-stakeholder collaborative network [36], each individual should play a central role in sustainability assessment [56], being more ambitious than “simply” measuring and reporting. Each one should be a pivotal asset, using and assessing their own selection of SIs and applying them at any desired and feasible scale, from households to ecosystems, following a stakeholder-driven approach for sustainability assessment [34,35] as previously stressed. This diversity of concepts, approaches, methods, and frameworks for SIs is usually presented as the root of the increased difficulty in providing reliable and robust comparisons among different situations. This should be used as an opportunity to face SD complexities and singularities, improving and developing the use of tailor-made approaches conducted by citizen volunteers.

In this context, academia has a paramount role to play [17], including as an example for the rest of society through its scientific knowledge, independence, transparency, and proactive and facilitating behavior. Higher education institutions could help stakeholders deal with the new opportunities and risks of sustainability [57], including teaching and educating for observing, listening, understanding, and following up the progress toward SD.

The evolutionary stages of adherence between future indicator paths and reality will guide initiatives in several major areas, as identified in the previous section (see also Table A1 and the Appendix A). Regardless of the importance of all those topics identified and evaluated, it is proposed here that indicator progress should particularly address the angles that will impact society, as already emphasized by other works, e.g., [48,56], and assuming the individual as a central dimension for future developments in SIs (e.g., using a technological device to collect, upload, and report SIs, tagging and interacting in real-time word situations, such as noise level, water quality data, urban degradation, or street poverty and crime). This will be underpinned by an unpredictable changing world of new technologies and platforms of gathering, sharing, and spreading data and information [53,58,59].

In the context of the current critical perspective and viewpoint paper, and supported by the evaluation conducted previously, a set of key questions on SIs' futures are proposed (Figure 1). These questions aim to represent an integrated view of the relevant challenges and opportunities analyzed, but are underpinned and observed from a crosscutting angle, represented by the societal role.



Figure 1. Cont.



Figure 1. Key questions to be addressed by SIs in a societal-oriented approach.

To respond to these questions, significant further work should be conducted based upon theoretical and empirical research approaches. The SIs community should work on the qualitative values and societal dimensions of sustainability, trying to minimize the time delay to start dealing with these challenges and contribute to the truth value of the SIs in place. Transdisciplinary, community-based, interactive, or participatory research approaches [30] should be major options to conduct the necessary review of the current sustainability monitoring, assessing, and reporting systems, and reach the next level of SIs. Also, major indicator guidelines, such as the Bellagio Principles, now reviewed and renamed the Bellagio STAMP (Sustainability Assessment and Measurement Principles) [60], in particular, should be considered.

Empowerment approaches in sustainability assessment should be further studied, including the type of stakeholders to integrate in different SI initiatives [35], which indicators are more suitable, and what practices could guide the use of SIs. This step can result in a new level of effectiveness and active engagement, and increase the inclusiveness, transparency, and accountability of SIs.

4. Final Remarks

In the near future, SI researchers and practitioners should be ready to adapt their ways of thinking and doing. Sustainability assessments must respond to new global and local paradigms, and use collaborative scientific development and innovation as the foundations for change. Indicators should evaluate what really matters to track progress toward a sustainable society, and be able to deal with new information traps, post-truth reality, and volatile contradictory societal values. The term

“sustainability” and its related topics are wrapped up in a blurred web of contrary meanings, despite several important events and initiatives, including the 2030 Agenda for Sustainable Development of the United Nations as a major SD roadmap at the global level.

The critical review and qualitative evaluation conducted in this research allowed us to trace the pragmatic profile of the analysed SIs’ challenges and benefits, where the majority of them are still not implemented or answered, and a significant amount will probably have a low impact on society if operationalized. Therefore, the need for new developments on SIs to effectively assess and report SD in a robust and, at the same time, collaborative and open way, has never been so great.

There are limitations associated with this kind of critical review and qualitative evaluation, and those limitations should be weighed up in the use of the obtained findings, and when drawing conclusions. However, since a critical perspective and viewpoint paper is clearly assumed as a particular view on a specific topic of research, where views differ, this should not be considered a major constraint. The objective was to promote constructive debate around SIs’ possible futures and paths.

As proposed in this research, the individual should have a central role to play in all the SIs’ challenges, in particular the ones related with societal impact dimension. Individual citizens should be leading actors, collecting, analyzing, evaluating, and communicating sustainability data and related SI information, from households and daily activities to “upper scales,” including rural and urban ecosystems. A crowdsourcing mindset for SIs will be a central piece in this process, associated with tailor-made approaches conducted by volunteer individuals.

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Appendix A

Table A1. Identification of the set of challenges and opportunities and remarks that supported the value given to each criterion: Relevancy, Feasibility, and Societal Impacts.

Selected Challenges and Opportunities	Summary of Rationale		
	Relevancy	Feasibility	Societal Impacts
#1. Richer selection of case studies: Call for a richer selection of case studies to help create practical and more useful guidance regarding sustainability assessment [60]. Allow the identification of patterns of what works best and the understanding and designing of context-specific approaches.	A significant amount of the existing SI work is related to case study-based approaches.	Despite their being resource-intensive, there are several SI systems being implemented, at national, regional, local and organisational levels, that can be used as case studies.	Proximity and visibility to stakeholders.
#2. Specific cultural context: Indicators should be placed in a specific cultural context with a clear understanding of previous interventions; if indicators are used without understanding the processes and people they are relevant to, they may be easily misused (even if an indicator is good itself) [61]. SIs should not be “context-free.”	The need to understand the context that will tailor the SIs (e.g., the type of decision-making assessed, the institutional system, the context of professional practice and capacity, the territorial context and their specific natural and human-cultural aspects).	Requires additional resources to adopt this approach. Local context data, including cultural/social, should be collected and integrated.	Increased sense of ownership and commitment from everyone involved.
#3. Adequate level of standardization: Identify the adequate level of standardization for indicator sets versus context-specific sets [21]. Related to this aspect is the need to consider the vertical integration between SIs at different spatial scales (national, regional, local/organizational), and to examine the common sets of indicators between scales [62,63].	Facilitate comparability and benchmarking between different cases and scales, and optimize the resources to conduct a sustainability assessment.	The operational process is not consensual, and the approaches are still under discussion. Further methodological development and practical evaluations are required.	Improve the communication with stakeholders, and the governance of different SIs.

Table A1. Cont.

Selected Challenges and Opportunities	Summary of Rationale		
	Relevancy	Feasibility	Societal Impacts
#4. Meta-evaluation: The evaluation of an evaluation and analysis of SI experiences [64,65]. Allows us to do a critical assessment of the strengths and weaknesses of the SIs, and draw conclusions about the overall utility, accuracy, validity, feasibility and propriety.	Several research initiatives that show how to accomplish this task and demonstrate the need and benefits of adopting meta-evaluation and reviewing approaches, with practical and theoretical implications.	The implementation of a formal meta-evaluation process could be technically complex, where the approaches are still not well established. Practical difficulties can arise in their implementation due to the complexity of prioritizing the implementation of the “key good-practice factors” and developing “meta-evaluation indicators” can also be a hard task [65].	Too technical to be understood by most of the stakeholders, in particular the general public.
#5. Alternatives to move beyond GDP: Development of alternative indicators, to move beyond GDP [66,67], to obtain clear and robust sustainability measures and “achieve measures of what we really want” [67].	To provide a global SD shared vision, using new ways of measuring progress towards new goals.	Despite several attempts to propose GDP substitutes with the same popularity and impact, this is still ongoing work, and there is no consensus among the existing proposals.	Global communication implications and significant visibility to citizens.
#6. Data limitations and provision problems: Overcome the data limitations and provision problems to better support decision-making processes, as well as reporting and communication initiatives, e.g., [68,69].	Access to reliable data or justifiable proxies for the relevant themes is a paramount step, as well as providing open access to data.	In some cases, this could be difficult to overcome in a short term, in particular in territories/institutions that are less developed. It is a resource-intensive and complex task, with moving targets.	In an era of “post-truth” where the value of data and information is very volatile, data accuracy and reliability could be not perceived or valued by stakeholders.
#7. Integrated and systemic and holistic perspective: Develop a more integrated and systemic/holistic perspective for SI, considering linkages, synergies, and antagonisms between SI, goals and targets [70]. SI integrated sets should include integrated or interlinkage indicators that cover different sustainability dimensions, i.e., one single indicator includes several dimensions, in particular environmental, economic, social, cultural and institutional/governance [51,65,71].	Analyse, understand and report the integrated/systemic sustainability views and perspectives, and avoid a fragmented assessment, in particular for indicators that cover more than one thematic area and dimension (environmental, economic, social).	The implementation process is technically complex, where the approaches are still not well established. According to some authors (e.g., [50]), the interdisciplinary hypostasis of sustainability that traverses environmental, economic and societal issues may be an operational drawback instead of an advantage. This holistic approach, which encompasses more aspects than necessary, orients the use of indicators to vast collections of statistics that rarely influence policy-making.	Despite it being too technical to be perceived by stakeholders, the indirect effects of using integrated sustainability measures could be significant for communication and awareness purposes.
#8. Optimum level of indicator aggregation: Raise the optimum level of indicator aggregation, as discussed in Singh [8]. Help present complex information in a synthetic way and at the same time avoid manipulation and “fake news,” with distorted indicators.	Several authors, e.g. [50], stress that instead of focusing on the construction of composite indicators that cover different areas of knowledge, we should try to summarise a complex situation in a single number (difficult to be attained in the absence of an appropriate indicator theoretical framework); “research should be focused on the identification of key indicators that can be linked together through verbal, statistical, or mathematical relationships and equations, contributing to a better understanding of the linkages among the different areas of knowledge that compose the aforementioned fields . . . ” [50] (pp. 426).	Despite several attempts to propose the adequate level of indicator aggregation, this is still an ongoing work, and there is a lack of consensus among the existing approaches.	Improve communication standards, with significant visibility to stakeholders. Support the main indicator goals of synthesizing complex phenomena and transmit them in an easy and understandable way to stakeholders, and support decision-making processes.
#9. Better mechanisms for indicator use in practice: Explore the mechanisms for indicator use in practice, e.g., [48,56,72], and understanding by different actors, creating opportunities for use and reporting indicator information. Approaches and methods need further development to understand the most effective ways to influence processes at different levels, including policy making and organisational strategies and operations, likewise citizens’ behaviours and attitudes towards sustainable goals.	As emphasized by Ronseström [73], good indicators are of little influence and importance if they are not used in any way. Information can feed back into the development and presentation of SIs.	Despite the existence of several works that explore technical issues of indicators and how they could support decision-making processes, few of them address the how, if, when, and who questions about indicators. The work of Morse [48] shows the emergence of this topic.	The most significant impact for stakeholders is when they use the tool that was developed for them.
#10. Integration or non-traditional aspects of sustainability: SIs should cover general non-material values or non-traditional aspects of sustainability, such as ethics, culture and arts, aesthetics, effectiveness of governance, legislation and norms, spirituality, solidarity, compassion, mutual help [17,29,54,71], which represent less tangible dimensions of human society.	Until we have appropriate indicators to assess these intangible but fundamental aspects of SD, they will be invisible for assessment purposes [71].	It may be very difficult to use direct indicators to evaluate these non-tangible aspects. Qualitative survey approaches are most likely to support these indicators, and therefore difficult to operate in a continuous way.	Increased sense of ownership, commitment and communication from everyone involved.

Table A1. Cont.

Selected Challenges and Opportunities	Summary of Rationale		
	Relevancy	Feasibility	Societal Impacts
#11. Use of Information tools and systems: Use of information tools and systems that condense the huge flows of information to report SIs, e.g., [74]. SI systems should respond to the growing access to information provided by modern information technologies and ensure rapid assessment.	New technologies, including geographic information systems and the Internet, are enabling web-based platforms for information sharing and gathering [53,58,59], enabling the desired stakeholders' input.	The implementation process could be technically complex, and the approaches are still not well established. These more demanding information and communication technologies still face pending challenges that need further research. Examples of such limitations comprise data quality, use and sharing policies and expertise.	Increased sense of ownership, commitment and improved communication with stakeholders and access/use to data and indicators. Information systems designed to use/report sustainability data and indicators provide tools that could have significant positive impacts at individual/community levels.
#12. Find the best selection criteria: What indicator selection criteria should be used without compromising credibly and accuracy and at the same time avoiding redundancy and complexity. Indicator selection is usually made by experts and/or through participatory approaches, in combination with literature reviews of existing indicator sets, and often little is known about the robustness of the selection stage [43].	It is fundamental to evaluate the indicator selection process, regarding their utility, accuracy, validity and feasibility, e.g., [41,75]. The selection stage will impact the ability of the indicator system to be institutionalised and therefore used and maintained [76].	Despite various works discussing these aspects, the implementation process is technically complex, and the approaches are still not well established.	When stakeholders are effectively involved, it could increase the sense of ownership, commitment and improve the evaluation and communication stages.
#13. Institutionalisation process and governance models: SI governance models should be improved and clarified. Also, SIs need to become institutionalised in certain governmental processes to provide stability and credibility [17].	The management model and institutional cooperation is a fundamental component of SIs; identifying the institution(s) and their roles and the leadership structures is essential to an understanding of the feasibility and societal influence of the indicator system [65].	Despite no significant additional resources being required to implement this component, an institutional/political commitment of the involved decision-makers is a fundamental step, and in many cases is difficult to achieve.	Low visibility and usually not being perceived as a very important aspect by the general public and practitioners – “somebody is certainly in charge” but few people really care who is and what they do.
#14. Satellite remote sensing and other observing technologies: New approaches to indicators using satellite remote sensing and other observing technologies to evaluate sustainability goals, as explored by [77].	SIs supported by satellite data could be an important solution to mitigate data limitations and provision, in particular for certain scales of analysis.	Despite various related works that explore this field, the use of remote sensing data for SIs is still relatively underexplored, e.g., [77].	The value of data and information is very volatile, and data availability, accuracy and reliability could be not perceived or valued by stakeholders, probably even more so in the case of remote sensing data.
#15. Intergenerational equity information transfer: Indicators that capture the effectiveness with which intergenerational equity information transfer is taking place and how are pushing social and cultural evolution. However, several questions arise: How do we know what future generations will value? In that respect, how can one define what is a “fair,” ethical and “sustainable” thing to do? [61])	One of the SD dimensions should be “time” [52], when assessing progress towards sustainability goals, so consider time preservation or intergenerational equity. As noted by ([51]), the time dimension should be taken into account where long-term changes towards sustainability are evaluated, like global warming, ecological disruption and social equity issues	Despite the existence of several attempts to explore this topic, it is still an open and complex question, needing further theoretical and practical scientific work.	Low visibility and too technical to be perceived by stakeholders.
#16. The lack of an endogenous indicator's theory The inexistence of an endogenous indicator's theory is an important barrier to the enhancement of indicator research into an autonomous scientific field and relegates indicators to the ecological, social or economic field [50]	An integrated SI theory could be a fundamental step to respond to several of the most important needs and related challenges, weakness and limitations, and reach the next stage of indicator evolution.	Despite some works that explore this topic, there is a significant lack of progress and consensus on how to approach this complexity.	Low visibility and too technical to be perceived by stakeholders.

References

1. Bond, A.; Morrison-Saunders, A.; Howitt, R. *Sustainability Assessment: Pluralism, Practice and Progress*; Routledge: New York, NY, USA, 2013; ISBN 9780203112625.
2. Gibson, R.B.; Hassan, S.; Holtz, S.; Tansey, J.; Whitelaw, G. *Sustainability Assessment: Criteria and Processes*; Routledge: New York, NY, USA, 2013; ISBN 9781849772716.
3. Gibson, R.B. Why Sustainability Assessment? In *Sustainability Assessment: Pluralism, Practice and Progress*; Routledge: New York, NY, USA, 2013; pp. 3–17.
4. Ramos, T.B.; Wallis, A.; Track, B. Sustainability Assessment and Indicators. In Proceedings of the 25th Annual International Sustainable Development Research Society Conference, Nanjing, China, 26–28 June 2019.

5. Pope, J.; Bond, A.; Hugé, J.; Morrison-Saunders, A. Reconceptualising sustainability assessment. *Environ. Impact Assess. Rev.* **2017**, *62*, 205–215. [[CrossRef](#)]
6. Pope, J.; Annandale, D.; Morrison-Saunders, A. Conceptualising sustainability assessment. *Environ. Impact Assess. Rev.* **2004**, *24*, 595–616. [[CrossRef](#)]
7. Sala, S.; Ciuffo, B.; Nijkamp, P. A systemic framework for sustainability assessment. *Ecol. Econ.* **2015**, *119*, 314–325. [[CrossRef](#)]
8. Singh, R.K.; Murty, H.R.; Gupta, S.K.; Dikshit, A.K. An overview of sustainability assessment methodologies. *Ecol. Indic.* **2012**, *15*, 281–299. [[CrossRef](#)]
9. Bond, A.; Morrison-Saunders, A.; Pope, J. Sustainability assessment: The state of the art. *Impact Assess. Proj. Apprais.* **2012**, *30*, 53–62. [[CrossRef](#)]
10. Agol, D.; Latawiec, A.E.; Strassburg, B.B.N. Evaluating impacts of development and conservation projects using sustainability indicators: Opportunities and challenges. *Environ. Impact Assess. Rev.* **2014**, *48*, 1–9. [[CrossRef](#)]
11. Holman, N. Incorporating local sustainability indicators into structures of local governance: A review of the literature. *Local Environ.* **2009**, *14*, 365–375. [[CrossRef](#)]
12. Thomas, W.A. (Ed.) *Indicators of Environmental Quality*; Plenum Press: New York, NY, USA, 1972.
13. Inhaber, H. *Environmental Indices*; John Wiley and Sons: New York, NY, USA, 1976.
14. Ott, W.R. *Environmental Indices—Theory and Practice*; Ann Harbor Science: Ann Arbor, MI, USA, 1978.
15. Hezri, A.A.; Hasan, M.N. Management framework for sustainable development indicators in the State of Selangor, Malaysia. *Ecol. Indic.* **2004**, *4*, 287–304. [[CrossRef](#)]
16. Wilson, J.; Tyedmers, P.; Pelot, R. Contrasting and comparing sustainable development indicator metrics. *Ecol. Indic.* **2007**, *7*, 299–314. [[CrossRef](#)]
17. Ramos, T.B. Development of regional sustainability indicators and the role of academia in this process: The Portuguese practice. *J. Clean. Prod.* **2009**, *17*, 1101–1115. [[CrossRef](#)]
18. Rinne, J.; Lyytimäki, J.; Kautto, P. Beyond the “indicator industry”: Use and potential influences of sustainable development indicators in Finland and the EU. *Prog. Ind. Ecol. Int. J.* **2012**, *7*, 271. [[CrossRef](#)]
19. Bell, S.; Morse, S. Introduction: Indicators and Post Truth. In *Routledge Handbook of Sustainability Indicators*; Bell, S., Morse, S., Eds.; Routledge: New York, NY, USA, 2018; pp. 1–17.
20. Tasaki, T.; Kameyama, Y. Sustainability Indicators: Are We Measuring What We Ought to Measure? *Glob. Environ. Res.* **2015**, *19*, 147–154.
21. Moreno Pires, S.; Fidélis, T.; Ramos, T.B. Measuring and comparing local sustainable development through common indicators: Constraints and achievements in practice. *Cities* **2014**, *39*, 1–9. [[CrossRef](#)]
22. Mickwitz, P.; Melanen, M.; Rosenstro, U.; Seppa, J. Regional eco-efficiency indicators e a participatory approach. *J. Clean. Prod.* **2006**, *14*, 1603–1611. [[CrossRef](#)]
23. Holden, M. Sustainability indicator systems within urban governance: Usability analysis of sustainability indicator systems as boundary objects. *Ecol. Indic.* **2013**, *32*, 89–96. [[CrossRef](#)]
24. Bolis, I.; Morioka, S.N.; Sznclwar, L.I. When sustainable development risks losing its meaning. Delimiting the concept with a comprehensive literature review and a conceptual model. *J. Clean. Prod.* **2014**, *83*, 7–20. [[CrossRef](#)]
25. Hussey, D.M.; Kirsop, P.L.; Meissen, R.E. Global Reporting Initiative Guidelines: An Evaluation of Sustainable Development Metrics for Industry. *Environ. Qual. Manag.* **2001**, *11*, 1–20. [[CrossRef](#)]
26. Lozano, R. Envisioning sustainability three-dimensionally. *J. Clean. Prod.* **2008**, *16*, 1838–1846. [[CrossRef](#)]
27. Ramos, T.B.; Caeiro, S.; de Melo, J.J. Environmental indicator frameworks to design and assess environmental monitoring programs. *Impact Assess. Proj. Apprais.* **2004**, *22*, 47–62. [[CrossRef](#)]
28. RIVM (National Institute of Public Health and the Environment). *A General Strategy for Integrated Environmental Assessment at the European Environment Agency*; RIVM: Bilthoven, The Netherlands, 1995.
29. Viegas, O.; Caeiro, S.; Ramos, T.B. Conceptual Model for the integration of Non-Material components in Sustainability Assessment. *Rev. Ambient. Soc.* **2018**, *21*.
30. Lang, D.J.; Wiek, A.; Bergmann, M.; Stauffacher, M.; Martens, P.; Moll, P.; Swilling, M.; Thomas, C.J. Transdisciplinary research in sustainability science: Practice, principles, and challenges. *Sustain. Sci.* **2012**, *7*, 25–43. [[CrossRef](#)]
31. United Nations. Sustainable Development Goals—Knowledge Platform. Available online: <https://sustainabledevelopment.un.org/sdgs> (accessed on 13 January 2019).

32. Spangenberg, J.H. Hot Air or Comprehensive Progress? A Critical Assessment of the SDGs. *Sustain. Dev.* **2017**, *25*, 311–321. [[CrossRef](#)]
33. Allen, C.; Metternicht, G.; Wiedmann, T. Initial progress in implementing the Sustainable Development Goals (SDGs): A review of evidence from countries. *Sustain. Sci.* **2018**, *13*, 1453–1467. [[CrossRef](#)]
34. Coutinho, V.; Domingues, A.R.; Caeiro, S.; Painho, M.; Antunes, P.; Santos, R.; Videira, N.; Walker, R.M.; Huisingh, D.; Ramos, T.B. Employee-Driven Sustainability Performance Assessment in Public Organisations. *Corp. Soc. Responsib. Environ. Manag.* **2017**, *25*, 29–46. [[CrossRef](#)]
35. Domingues, A.R.; Lozano, R.; Ramos, T.B. Stakeholder-driven initiatives using sustainability indicators. In *Routledge Handbook of Sustainability Indicators*; Bell, S., Morse, S., Eds.; Routledge: London, UK, 2018; pp. 379–391.
36. Kelly, R.; Moles, R. The Development of local Agenda 21 in the mid-west region of Ireland: a case study in interactive research and indicator development. *J. Environ. Plan. Manage.* **2002**, *45*, 889–912. [[CrossRef](#)]
37. Bell, S.; Morse, S. *Measuring Sustainability: Learning by Doing*; Routledge: London, UK, 2013; ISBN 9781849771962.
38. Verma, P.; Raghubanshi, A.S. Urban sustainability indicators: Challenges and opportunities. *Ecol. Indic.* **2018**, *93*, 282–291. [[CrossRef](#)]
39. Hardi, P.; Zdan, T. *Assessing Sustainable Development: Principles in Practice*; International Institute for Sustainable Development: Winnipeg, MB, Canada, 1997; ISBN 1895536073.
40. Kurtz, J.C.; Jackson, L.E.; Fisher, W.S. Strategies for evaluating indicators based on guidelines from the Environmental Protection Agency's Office of Research and Development. *Ecol. Indic.* **2001**, *1*, 49–60. [[CrossRef](#)]
41. Cloquell-Ballester, V.-A.; Cloquell-Ballester, V.-A.; Monterde-Díaz, R.; Santamarina-Siurana, M.-C. Indicators validation for the improvement of environmental and social impact quantitative assessment. *Environ. Impact Assess. Rev.* **2006**, *26*, 79–105. [[CrossRef](#)]
42. Donnelly, A.; Jones, M.; O'Mahony, T.; Byrne, G. Selecting environmental indicator for use in strategic environmental assessment. *Environ. Impact Assess. Rev.* **2007**, *27*, 161–175. [[CrossRef](#)]
43. Mascarenhas, A.; Nunes, L.M.; Ramos, T.B. Selection of sustainability indicators for planning: Combining stakeholders' participation and data reduction techniques. *J. Clean. Prod.* **2015**, *92*, 295–307. [[CrossRef](#)]
44. Saunders, M.N.K.; Thornhill, A.; Lewis, P. *Research Methods for Business Students.*, 6th ed.; Pearson Education Limited: Harlow, Essex, England, 2012; ISBN 9780273750758.
45. Bornmann, L. What Is Societal Impact of Research and How Can It Be Assessed? A Literature Survey. *J. Am. Soc. Inf. Sci. Technol.* **2013**, *64*, 217–233. [[CrossRef](#)]
46. Bryman, A. *Social Research Methods* Bryman; Oxford University Press: Oxford, UK, 2012; ISBN 9788578110796.
47. Bell, S.; Morse, S. Whats Next? In *Routledge Handbook of Sustainability Indicators*; Bell, S., Morse, S., Eds.; Routledge: New York, NY, USA, 2018; pp. 453–555.
48. Morse, S. Measuring the Success of Sustainable Development Indices in Terms of Reporting by the Global Press. *Soc. Indic. Res.* **2016**, *125*, 359–375. [[CrossRef](#)]
49. Bell, S.; Morse, S. *Sustainability Indicators: Measuring the Immeasurable?* 2nd ed.; Routledge: New York, NY, USA, 2008; ISBN 9781849772723.
50. Pissourios, I.A. An interdisciplinary study on indicators: A comparative review of quality-of-life, macroeconomic, environmental, welfare and sustainability indicators. *Ecol. Indic.* **2013**, *34*, 420–427. [[CrossRef](#)]
51. Lozano, R.; Huisingh, D. Inter-linking issues and dimensions in sustainability reporting. *J. Clean. Prod.* **2011**, *19*, 99–107. [[CrossRef](#)]
52. Seghezze, L. The five dimensions of sustainability. *Environ. Polit.* **2009**, *18*, 539–556. [[CrossRef](#)]
53. Ramos, T.B.; Martins, I.P.; Martinho, A.P.; Douglas, C.H.; Painho, M.; Caeiro, S. An open participatory conceptual framework to support State of the Environment and Sustainability Reports. *J. Clean. Prod.* **2014**, *64*, 158–172. [[CrossRef](#)]
54. Burford, G.; Hoover, E.; Velasco, I.; Janoušková, S.; Jimenez, A.; Piggot, G.; Podger, D.; Harder, M.K. Bringing the “Missing Pillar” into sustainable development goals: Towards intersubjective values-based indicators. *Sustainable* **2013**, *5*, 3035–3059. [[CrossRef](#)]
55. Valentin, A.; Spangenberg, J.H. A guide to community sustainability indicators. *Environ. Impact Assess. Rev.* **2000**, *20*, 381–392. [[CrossRef](#)]

56. Dahl, A.L. Achievements and gaps in indicators for sustainability. *Ecol. Indic.* **2012**, *17*, 14–19. [[CrossRef](#)]
57. Disterheft, A.; Caeiro, S.S.; Leal, W.; Azeiteiro, U.M. The INDICARE-model—measuring and caring about participation in higher education’s sustainability assessment. *Ecol. Indic.* **2016**, *63*, 172–186. [[CrossRef](#)]
58. Jankowski, P. Towards participatory geographic information systems for community-based environmental decision making. *J. Environ. Manag.* **2009**, *90*, 1966–1971. [[CrossRef](#)]
59. Green, D.R. The role of Public Participatory Geographical Information Systems (PPGIS) in coastal decision-making processes: An example from Scotland, UK. *Ocean Coast. Manag.* **2010**, *53*, 816–821. [[CrossRef](#)]
60. Pintér, L.; Hardi, P.; Martinuzzi, A.; Hall, J. Bellagio Stamp. In *Routledge Handbook of Sustainability Indicators*; Bell, S., Morse, S., Eds.; Routledge: London, UK, 2018; pp. 21–41.
61. Latawiec, A.E.; Agol, D. 13 Conclusions-Sustainability Indicators In Practice: Lessons Learned From The Past, Directions For The Future. *Sustain. Indic. Pract.* **2016**, 16–18. [[CrossRef](#)]
62. Mascarenhas, A.; Coelho, P.; Subtil, E.; Ramos, T.B. The role of common local indicators in regional sustainability assessment. *Ecol. Indic.* **2010**, *10*, 646–656. [[CrossRef](#)]
63. Coelho, P.; Mascarenhas, A.; Vaz, P.; Dores, A.; Ramos, T.B. A framework for regional sustainability assessment: Developing indicators for a Portuguese region. *Sustain. Dev.* **2010**, *18*, 211–219. [[CrossRef](#)]
64. Ramos, T.B.; Alves, I.; Subtil, R.; Joanaz de Melo, J. Environmental performance policy indicators for the public sector: The case of the defence sector. *J. Environ. Manag.* **2007**, *82*, 410–432. [[CrossRef](#)]
65. Ramos, T.B.; Caeiro, S. Meta-performance evaluation of sustainability indicators. *Ecol. Indic.* **2010**, *10*, 157–166. [[CrossRef](#)]
66. Dahl, A. Contributions to the Evolving Theory and Practice of Indicators of Sustainability. In *Routledge Handbook of Sustainability Indicators*; Bell, S., Morse, S., Eds.; Routledge: London, UK, 2018; pp. 42–58.
67. Costanza, R.; Hart, M.; Kubiszewski, I.; Posner, S.; Talberth, J. Lessons from the History of GDP in the Effort to Create Better Indicators of Prosperity, Well-being, and Happiness. In *Routledge Handbook of Sustainability Indicators*; Bell, S., Morse, S., Eds.; Routledge: London, UK, 2018; pp. 117–123.
68. Hildén, M.; Rosenström, U. The use of indicators for sustainable development. *Sustain. Dev.* **2008**, *16*, 237–240. [[CrossRef](#)]
69. Mascarenhas, A.; Nunes, L.M.; Ramos, T.B. Exploring the self-assessment of sustainability indicators by different stakeholders. *Ecol. Indic.* **2014**, *39*, 75–83. [[CrossRef](#)]
70. Gallopin, G. The socio-ecological system (SES) approach to sustainable development Indicators. In *Routledge Handbook of Sustainability Indicators*; Bell, S., Morse, S., Eds.; Routledge: London, UK, 2018; pp. 329–346.
71. Dahl, A.L. Integrated Assessment and Indicators. In *Sustainability Indicators*; Tomás, H., Moldan, B., Dahl, A.L., Eds.; Island Press: Washington, DC, USA, 2007; pp. 163–176.
72. Gudmundsson, H. The Policy Use of Environmental Indicators-Learning from Evaluation Research. *Environ. Stud.* **2003**, *2*, 1–12.
73. Ronseström, U. Sustainable Development Indicators, Finland: Going from Large Descriptive Sets to Target-Oriented Actively Used Indicators. In *Routledge Handbook of Sustainability Indicators*; Bell, S., Morse, S., Eds.; Routledge: London, UK, 2018; pp. 321–328.
74. Myhre, O.; Fjellheim, K.; Ringnes, H.; Reistad, T.; Longva, K.S.; Ramos, T.B. Development of environmental performance indicators supported by an environmental information system: Application to the Norwegian defence sector. *Ecol. Indic.* **2013**, *29*, 293–306. [[CrossRef](#)]
75. Van Zeijl-rozema, A.; Ferraguto, L.; Caratti, P. Comparing region-specific sustainability assessments through indicator systems: Feasible or not? *Ecol. Econ.* **2010**, *70*, 475–486. [[CrossRef](#)]
76. Moreno Pires, S.; Fidélis, T. Local sustainability indicators in Portugal: Assessing implementation and use in governance contexts. *J. Clean. Prod.* **2015**, *86*, 289–300. [[CrossRef](#)]
77. Andries, A.; Morse, S.; Murphy, R.; Lynch, J.; Woolliams, E.; Fonweban, J. Translation of Earth observation data into sustainable development indicators: An analytical framework. *Sustain. Dev.* **2018**, 1–11. [[CrossRef](#)]

