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Key Considerations When Designing Certification Systems for Urban Sustainability and Implications for The Swedish Post-Construction System Citylab

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Abstract: Addressing sustainability in urban planning has led to an increasing number of certification systems to support such processes. Nevertheless, there is no commonly recognised framework listing what is important to consider when developing such systems. Citylab is a certification system that is used in several Swedish urban development projects. Today, Citylab certifies the planning process of urban areas but it will be extended with a post-construction part. This paper presents a three steps analysis of the design of such a post-construction certification system. First, a literature review was performed, which allowed for identifying three principles and 11 sub-principles that make up a generic framework for the design of similar certification systems. Second, 13 semi-structured interviews were conducted in Sweden with key urban development stakeholders to better specify the scope of a post-construction extension of Citylab. As a result, four alternatives emerge for the role and function of this system. Third, crossing the results of both previous steps allowed for an understanding of important considerations and implications for the Citylab post-construction certification system design. The paper concludes on the relevance of such a reflexive procedure for the design of certification systems in general, in which the use of the framework is a key to ensure transparency and enable deliberate choices and priorities.

Keywords: sustainability; indicators; certification system; urban areas; urban development

1. Introduction

The increasing global concentration of both population and resource use [1] to urban areas implies that urban sustainability is essential to sustainable development at large; there cannot be any global sustainability without urban sustainability [2,3]. Urban development is often also conceptualised as a driver of sustainable development per se, providing more resource-efficient ways to organise society and everyday life and providing access to jobs, education and healthcare [4,5]. The recognised importance of sustainable urban development can be seen in the establishment of a specific Sustainable Development Goal (SDG) for "Sustainable cities and communities" [6] and, as a continuation of that, the creation of the New Urban Agenda [7]. It should be noted however that both the SDG and the New Urban Agenda focuses primarily on the 'internal' and social sustainability of urban areas, i.e., how well these function as inclusive and healthy living environments for different groups of people. The 'external' sustainability, i.e., how the urban areas impact "the natural world or the living conditions of other people, now or in the future" [2] (p.13), is addressed to a much more limited extent.

The growing recognition of how urban development can contribute to sustainability has led to a variety of initiatives aimed at promoting and supporting urban actors (municipalities, developers, contractors, real estate companies etc.) in their work on sustainable development. One specific type of initiatives is the development of certification systems for buildings and urban areas, including e.g., BREEAM in the UK, LEED in the US, CASBEE in Japan and Green Star in Australia. Through establishing indicators, criteria and weighting procedures, such systems provide a definition of, and support for, sustainable urban development in practice. The design, development and use of such systems have been the subject of a growing body of literature, ranging from evaluating the content of certification systems such as LEED for Neighbourhood Development and BREEAM Communities [8,9] to the process of developing local indicator sets for monitoring sustainability in cities such as "Sustainable Seattle" [10]. This literature has pointed out a number of different drawbacks of the systems studied, e.g., they are biased towards ecological sustainability by not including enough of the other dimensions of the concept [9], they focus on internal sustainability by not including enough of how the urban area affect sustainability elsewhere [8,11], they lack enough mandatory parts which opens to neglect important issues [12] and they lack indicators to assess urban areas post-construction [8]. Despite existing reviews and categorisations of this literature [13,14], there is no commonly recognised and broadly used framework listing what is important to consider when developing a certification system, including careful choice of indicators.

Several urban development projects over the world have been promoted as having ambitious goals for sustainability. Examples from Sweden include Hammarby Sjöstad and Stockholm Royal Seaport, both in Stockholm, Västra Hamnen in Malmö, and Norra Älvstranden in Gothenburg. However, several of these projects have been questioned regarding whether they actually fulfil the promoted ambitions of being sustainable [15,16]. Several studies suggest that failure to meet sustainability targets are to be found in the governance of urban development projects [17,18], indicating a need to rethink both the organisation and the planning process of such projects. To handle this challenge, the Sweden Green Building Council (SGBC) facilitated a discussion within the urban development sector in Sweden 2011–2015, focusing on exploring the need and interest for adapting an international certification system for a Swedish context [19–22]. Particularly BREEAM Communities was found promising, and was thoroughly investigated through 22 urban development projects trying out the system in 2014 [19]. This exercise resulted in the conclusion that the Swedish planning context was too different from where existing certification systems had been developed. In Sweden, urban planning takes place at the level of municipalities, and in contrast to many other countries, Swedish municipalities have comparatively large power over the urban planning process. One reason for this is the municipal 'planning monopoly', which means that municipalities are the only ones who can initiate a new development. Another reason is that municipalities often own land which they can sell or assign to developers using competitions, e.g., on environmental performance, low rents, or, simply, highest bidder. This often results in public-private negotiations which a certification system needs to support and make use of for sustainability to be integrated into the process [19]. Thus, instead of adapting an international certification system to a Swedish context, SGBC decided to develop a new certification system, called Citylab. Following the perceived needs of the Swedish urban development sector, Citylab focuses less on promoting specific features in the urban environment (than BREEAM Communities and LEED ND), but instead emphasise target-oriented and collaborative planning processes, including more engaging public participation [19]. Today, Citylab comprises a Guide and a certification system for the planning phase of urban areas which has been used by more than 25 urban development projects in Sweden.

However, in the development work pursued by SGBC so far, the need for post-construction follow-up activities has been increasingly outspoken. The exact role of such a post-construction part of Citylab has however remained ambiguous [19–21]. One reason is a lack of clarity in regard to the role and function of a post-construction system.

Thus, with no commonly used framework for how to develop these kinds of certification systems and a need of understanding potential alternatives for Citylab post-construction the aim of this paper is to: identify and categorise key considerations for designing certification systems for sustainable urban areas and to investigate how such considerations relate to different potential designs of similar certification systems. In doing so, the development of the Swedish Citylab certification for urban areas post-construction is used as a case. With this approach, the paper both provides insights of interest for the development of certification tools and indicator sets for urban areas more in general, and more specifically for such tools and indicator sets to be used to improve sustainability in urban areas post-construction.

To address this dual aim the structure of the rest of the article is as follows. Section 2 presents the methods used: a literature review, through which key considerations are identified, and semi-structured interviews, through which further understanding on the expectations on Citylab post-construction is gained. In Section 3 the results from the literature review are presented, and Section 4 presents the result of the interviews. Section 5 analyses and integrates the findings from the literature review and the interviews, to discuss concerns to be reflexive about in similar design processes of certification tools. Finally, the article is concluded in Section 6 with a summary of the most important considerations, both regarding the development of post-construction systems, such as Citylab, but also for the development of certification systems in general.

2. Methods

The two connected studies reported on in this paper form part of the on-going design and development process of the Citylab post-construction certification system. Therefore, the methodological umbrella approach for these studies is the field of constructive design research which means that the theoretical development also builds on the actual practice of the design process [23]. As Koskinen et al. [23] (p. 2) phrase it: "When researchers actually construct something, they find problems and discover things that would otherwise go unnoticed."

To fulfil the dual aim of the paper in addressing both the general and the specific (Citylab) perspective, two different, complementary methods were used. The first comprised a review of relevant literature on important considerations when developing certification systems and indicator sets in general and for urban areas in particular. The second method comprised semi-structured interviews with urban development practitioners, to obtain their views on a future certification system to be used post-construction.

2.1. Review of Relevant Literature

2.1.1. Identifying Literature

Literature reviews come in many shapes [24]. For this article, literature on addressing sustainability indicators and certification systems was reviewed with the aim to identify important considerations for when developing certification systems for sustainable urban development. Thus, the aim of the review was not to make an exhaustive coverage of this literature, but was a much more targeted exploration of the literature. Validity was thus obtained qualitatively, through the principle of saturation [25].

Relevant literature was identified through a combination of targeted searches in SCOPUS (using search terms like "sustainability indicators," "certification system" and "urban areas") and snowballing, based on the reference list of relevant publications. Three different, but interrelated, sets of literature were examined: (1) studies scrutinising the content of existing certification systems for urban development, such as LEED for Neighbourhood Development and BREEAM Communities (e.g., [8] and [9]), in order to identify the major criticisms and arguments for the content and structure of those systems; (2) studies focusing on the development of different local indicator sets to evaluate sustainability in a specific city (e.g., [10]) or community (e.g., [26]); and (3) publications on sustainability indicators in a broader context (e.g., [14,27]), including the work on indicators for UN's 'Sustainable

Development Goals' [28] which is of more non-academic nature. A list and additional information on the literature used for this part of the paper is presented in Appendix A.

2.1.2. Analysing Literature

The literature reviewed included publications which clearly listed important considerations as bullet-points or in tables (e.g., [9,14]) and publications in which considerations were extracted from the body text (e.g., [13,29]). Due to differences in terminology, it was not feasible to categorise the findings by the use of specific words, especially for what we call principles and sub-principles (presented later in Section 3). Instead, the principles had to be categorised by their meaning, according to our interpretation. The categories were developed iteratively, using a draft set of categories as the starting point. As more literature was read and analysed, the categorisation evolved until it reached a point of saturation, i.e., reviewing more literature did not lead to new categories, but rather contributed to additional synonyms, concretisations or arguments for the same categories. The categorisation resulted in what we call a 'Framework of important considerations when designing a certification system for urban areas. This framework is further described in Section 3.

2.2. Interviews

Interviews were conducted to gain an understanding of how Swedish urban development practitioners view the role of Citylab as a certification system for sustainable urban areas post-construction. As the questions posed circulated around a hypothetical future certification system, none had an objective answer, but rather individual thoughts on what role or function such a certification system should have. Thus, the interviews were conducted as what Gustavsson [30] describes as "conversations" [samtal]. According to Gustavsson [30], interviews can be categorised as conversations when the intention is to get the respondents to share their personal thoughts and opinions about an issue, rather than obtaining specific objective facts.

The interviews were semi-structured, with the most central questions formulated beforehand and complementary questions asked to identify the reasoning behind the answers. The interviews started with questions about the respondents' previous experience of post-construction follow-up activities regarding sustainability in urban development projects. The interviews then continued with reflections on what the respondents thought should be included in a post-construction follow-up. Thereafter, the questions focused on what the respondents believed a third-party certification system should review and assess in relation to the follow-up, and why. Thus, the questions made a clear distinction between the follow-up conducted by the actor/s seeking certification and the review and assessment (of that follow-up) conducted by the third-party certification organisation. To maintain this distinction, these two terms are used throughout the present paper. The interviews lasted about one hour and took place at the office of the respondents. All interviews were recorded and listened to again while making detailed notes of arguments and critical statements.

2.2.1. Selection of Respondents

The respondents included in the study were selected through a convenience sample, guided by the following criteria:

1. Respondents should have previous experience of working in urban development projects with ambitious sustainability objectives. This was fulfilled by interviewing people engaged in projects already working with Citylab in the planning phase. As a result of that, the respondents were also able to relate their ideas about a future post-construction certification to how Citylab is functioning today regarding the planning phase.
2. Respondents should be diverse in terms of type of stakeholder and geographical context, and have experience of both new developments and re-development.

3. Respondents should be generalists, rather than experts in a certain subject. This was to keep the interviews on a comprehensive level.

The number of interviews was decided beforehand, with the option of doing more if needed. As the last couple of interviews did not give anything more than nuances to the results and the respondents argued in a similar manner to previous interviewees, it was concluded that more interviews were not needed.

This resulted in respondents working both strategically and operationally with sustainability at the main types of stakeholders (municipalities, real estate owners, developers and consultants) who are active in sustainable urban development projects going on in Sweden (see Table 1). The urban development projects the respondents represent are situated within or just outside some of the larger cities in Sweden (Stockholm, Gothenburg, Uppsala and Norrköping) as that is where the larger developments are located. The respondents also cover a diverse set of project types such as brownfield development, refurbishment of existing housing areas (combined with infill measures) and more long-term maintenance of existing areas.

Table 1. Summary of practitioners who were interviewed.

Respondent	Title	Stakeholder	Type of Urban Development	Geographical Context	Main Competence
Person 1	Senior advisor	Real estate owner	Both new and existing areas	Large city	Environmental
Person 2	Senior consultant, sustainable urban development	Consultant	New areas	Large city	Environmental
Person 3	Project developer	Developer	New areas	Suburbs of large city	Environmental
Person 4	Head of sustainability	Real estate owner	Existing areas	Suburbs of large city	Environmental
Person 5	Strategist environment	Municipality	Mostly existing areas	Medium-sized city	Social/economic sustainability
Person 6	Project manager	Municipality	Existing areas	Large city	Social/economic sustainability
Person 7	Sustainability consultant	Consultant	Both new and existing areas	A mix of cities	Environmental
Person 8	Project manager, environment and sustainability	Municipal development project	New areas	Small city	Environmental and social/economic
Persons 9 and 10	Process leaders	Municipality owned development company	New areas	Large city	Social/economic
Persons 11 and 12	Specialists, sustainability and project developer	Developer	New areas	Large city	Environmental
Person 13	Strategist, urban development	Strategic planning at municipality	New and existing areas	Medium-sized municipality	Environmental and social/economic

2.2.2. Analysing the Interviews

With their different experiences and opinions on follow-up activities done by contractors and municipalities today, the respondents also had different ideas of what the certification system should review and assess in relation to such follow-up activities. There were some distinct differences on what should be reviewed, which made it possible to categorise these ideas as four different alternatives for the certification system. Interestingly, some respondents adhered rather closely to one of the alternatives, while others argued for the advantages of different alternatives and found difficulty in deciding which was best. The alternatives and the underlying reasoning are presented in Section 4.

2.2.3. Analysing and Validating the Typology

The four alternatives for the certification system and its assessment were then presented and discussed in a workshop with a group of seven other urban development practitioners, including representatives from municipalities, developers, consultants and real estate owners. The discussion focused on the arguments raised in the previous interviews for each alternative. This was done to validate the alternatives and the way they were formulated. The participants in the workshop agreed with the analysis presented, including the advantages of the different alternatives.

3. Identifying and Categorising Considerations from Other Studies

The results of the literature review are presented here as a framework of important considerations when developing a certification system for sustainable urban areas (see Table 2). The framework starts out by defining three benefits a certification system should provide to be attractive to use. Three principles with associated sub-principles then clarify what needs to be fulfilled by the certification system to provide the benefits. Lastly, an overarching requirement for compliance with the (sub-) principles is formulated.

Table 2. Framework of important considerations when designing a certification system for urban areas, based on the review of relevant literature presented in this paper.

Benefits to be Provided	**Principles to Guide the Development**		**Overarching Requirement for Compliance with the Principles**
	Principles	**Sub-Principles**	
Beneficial for the organisation Beneficial for practitioners Beneficial for the urban area	Scientifically credible	Comprehensive	Stakeholder and public participation
		Integrative	
		Valid	
		Reliable	
	Practical	Intelligible	
		Simple	
		Influenceable	
	Driving change	Determining what is good enough	
		Guiding a discussion among relevant stakeholders	
		Including different kinds of indicators	
		Presenting the results in a way that enables action	

3.1. Benefits a Certification System Should Provide

As pointed out by Lynch and Mosbah [31] and Wangel et al. [8], certification systems are used to enable benchmarking and comparison across urban areas. This can be done as part of market communication with the public or other stakeholders [32] and to attract new taxpayers to move to the municipality [22]. In this way, the certification system is beneficial for the organisation seeking certification. Another benefit of using a certification system is that practitioners get help in structuring their sustainability work [22]. Sustainability is a complex term and, as Håkansson [33] emphasises, many civil servants struggle to implement it into everyday work. A certification system facilitates cooperation between different stakeholders and thus also makes it easier to get sustainability measures implemented [22,32]. A third and last benefit of a certification system concerns those living in and

using the urban area, since the quality of the urban environment can be improved through use of such a system [22,32].

3.2. Scientifically Credible

The first main principle of the framework is scientific credibility, which is important to ensure that the urban area has the intended benefit of being more sustainable. Lack of scientific credibility may also lead to accusations of 'green wash' if an unsustainable urban area is described as sustainable, which would mean less benefits for the organisation using certification for marketing purposes. The term scientific credibility is taken from Niemeijer and Groot [14] and their compilation of principles for selecting indicators. Niemeijer and Groot [14] also discuss "analytical soundness," while Malmqvist and Glaumann [34] use the term "theoretical considerations" and Innes and Booher [35] use "methodologically sound," all with similar meaning. The scientific credibility principle includes four sub-principles (comprehensive, integrative, valid, reliable) that further define what scientifically credible means in practice (see Table 2).

3.2.1. Comprehensive

Being comprehensive in this context means that a certification system includes all important sustainability issues. Thus, the certification system, through its indicators, needs to be based on a clear definition of sustainable development [8,9,13,27,36], which should include all (economic, social and environmental) dimensions of sustainability [8,9,36]. Regarding the latter, Tanguay et al. [36], AtKisson [10] and Bell and Morse [27] emphasise the need for a balance between the dimensions and the overlaps between these. This is in line with both Zhou [11], who argue that certification systems for urban development often overlook important sustainability issues, and also the 'Bellagio principles', which emphasise long-time impacts, long-distance impacts and equity as important aspects which should not be forgotten [27]. The equity aspect is also highlighted by SDSN [28].

To ensure that important sustainability issues are included, Atkisson [10], Niemeijer and Groot [14], Gibson [29] and SDSN [28] cite a need to use agreed targets for sustainability at regional, national and global level. This includes e.g., the UN's Sustainable Development Goals or similar target initiatives on different scales [28]. Others claim that, rather than being a result of top-down processes, sustainability indicators should be defined through bottom-up, local processes, focusing on local issues of sustainability relevant for that specific context [26,27,31,36]. However, according to Atkisson [10], Gibson [29] and SDSN [28], there is no real conflict between the top-down and bottom-up way of constructing indicators and both perspectives need to be included.

3.2.2. Integrative

Several studies argue that sustainability indicators need to recognise the integrative nature of sustainability, i.e., that issues such as ecosystem degradation, climate impact and human health are related to each other [14,27–29]. Otherwise, it is claimed that the indicators will be reductionistic and oversimplify the concept of sustainability [27]. Thus, as explained by Gibson [29], it is important to use indicators that capture integration of the different dimensions of sustainability (ecological, social and economic). This requires a system approach and complexity awareness, i.e., not measuring all parts of the system but still having an understanding of 'the whole' [27]. As an example of this perspective, SDSN [28] acknowledges that the indicators related to the UN's Sustainable Development Goals will not measure each goal independently, as the goals are interrelated.

3.2.3. Valid

The importance of validity is raised by Innes and Booher [35], Wangel et al. [8] and Malmqvist and Glaumann [34]. Malmqvist and Glaumann [34] argue that validity in the context of designing certification systems means that one should choose indicators as close to the end problem as possible. Drawing on Wallhagen et al. [37], this is further developed by Wangel et al. [8], who make a distinction

between "procedure indicators" (focusing on the processes of an urban development project, such as making a flood risk assessment), "feature indicators" (focusing on the features in the urban area, such as distance to transport hubs or green areas) and "performance indicators" (focusing on the sustainability performance of the urban area, such as energy use or noise level). Wangel et al. [8] argue that certification systems for urban areas have too few performance indicators, essentially meaning that these systems do not address the actual sustainability of the area per se, resulting in lower validity.

In relation to this, Niemeijer and Groot [14] argue that indicators need to be anticipatory, meaning that they should allow changes in the system they seek to measure to be detected and rectified. Thus, validity as a sub-principle incorporates indicators measuring changes close to the end problem, by being performance indicators, and also having good sensitivity to changes in the system.

3.2.4. Reliable

Each indicator also needs to have high reliability. Thus, an indicator should produce nearly identical (or very similar) results in repeated measurements, given that there are no changes in what is being studied. Even though the term reliability is not used by all sources, several mention related terms. For example, Niemeijer and Groot [14] write about robustness, which according to them means that the indicator is insensitive to interference outside what one wants to measure. Another term used by Niemeijer and Groot [14] is portability, which means that the indicator can be used in other contexts and is still repeatable and has high reliability. Malmqvist and Glaumann [34] list repeatability but also accuracy as important principles, both of which are related to high reliability. Accuracy, specificity and measurable are terms with similar meaning used by Lynch and Mosbah [31], Niemeijer and Groot [14] and Tanguay et al. [36].

3.3. Practical

The second main principle concerns the need for a certification system, and its indicators, to be "practical" in different ways. The term practical is taken from Malmqvist and Glaumann [34] and is elaborated upon by Wangel et al. [8], who divide it into intelligibility, simplicity and influence. This principle is important to make the certification beneficial to the practitioners using the system and the organisations using it for marketing purposes. Without being practical, the costs of the certification system will exceed the benefits. The practical principle includes three sub-principles (intelligible, simple, influenceable) (see Table 2).

3.3.1. Intelligible

Even though the specific term intelligible is not used by all the sources examined, several refer to similar properties that indicators should possess. In short, the indicators used should not be too complicated. As SDSN [28] and Niemeijer and Groot [14] emphasise, indicators will have to be communicated and thus need to be understood by the target audience. As the target audience may be quite broad, Innes and Booher [35] and Bell and Morse [27] point out that indicators need to be understood, acceptable and recognised by experts, technocrats, local people and other stakeholders. Turcu [26] uses the terms "visible" and "perceptible" with similar meaning.

3.3.2. Simple

The sub-principle of simplicity means that using a certification system should not be too costly [14,27,34], too complicated [34] nor demand too much (specialist) competence [14]. A way of fulfilling this principle is to avoid including too many indicators [27,28] and to formulate indicators which make use of existing data [10,14,28] or at least use readily accessible data [27].

3.3.3. Influenceable

The sub-principle of influence means that certification systems and indicators should be sensitive to changes in policy [14,26,27]. Lynch and Mosbah [31] go further and argue that indicators should be action-based and measure what is done, rather than state-based and measure the effects of implemented actions. The reason is that action-based indicators create more incentives to action [31]. Niemeijer and Groot [14], Lynch and Mosbah [31] and Tanguay et al. [36] also discuss influence from the perspective of achievability, i.e., that any levels or targets set in relation to the indicators are possible to fulfil given available resources and time.

3.4. Driving Change

The third main principle states that certification systems and their indicators should drive and facilitate urban development practices to improve the sustainability of the area or area-to-be. This is of course important for providing benefits for the urban area (see Table 2), but is also beneficial to practitioners as the certification system can facilitate their work [22]. The driving change principle includes four sub-principles (determining what is good enough, guiding a discussion among relevant stakeholders, including different kinds of indicators, presenting the results in a way which enables action) (Table 2).

3.4.1. Determining What is Good Enough

One way of driving change is for the certification system and its indicators to clarify what is good (i.e., sustainable or sustainable enough) or bad (unsustainable). In the literature, this is raised in rather different ways. One of the principles presented by Niemeijer and Groot [14] (p. 18) states that an indicator needs a "threshold that can be used to determine when to take action." In existing certification systems, these thresholds are typically designed as targets which, when met, lead to credits being awarded. In this context, Wangel et al. [8] argue that both targets and related credits need to be set on a level that is ambitious enough, defining a level that is sustainable. In analyses of existing certification systems for urban development, Wangel et al. [8], Haapio [12] and Sharifi and Murayama [9] argue that these need to incorporate enough mandatory achievements so that projects do not aim solely at the 'cheap' credits. On a different note, Lynch and Mosbah [31] and Tanguay et al. [36] highlight that targets for sustainability need to have a time limit, specifying the time frame for reaching the threshold.

Several of the sources reviewed argue that indicators with historical records should be chosen, in order to compare data [14], track changes over time and, not least, identify trends [27]. Thus, indicators could be used not only to assess the level of achievement in relation to a pre-defined threshold, but also to determine what is happening in the area. However, in contrast, Atkisson [10] and Niemeijer and Groot [14] argue that indicators should be selected for sustainability issues on which there is high uncertainty about performance level, in order to expand overall understanding of the sustainability of the target area.

3.4.2. Guiding a Discussion among Relevant Stakeholders

Since urban development projects typically involve a variety of stakeholders who need to collaborate, certification systems and indicators should seek to facilitate discussion and knowledge exchange between stakeholders [13,31,35,38]. Cohen [13] (p. 11) states that "sustainability indicators should not just be applied as a measurement tool, but rather they can be utilized to identify problems, set goals, and establish management strategies as well." Holman [38] argues that while scientific credibility is important, it is even more important that indicators are used to track progress and facilitate a conversation among key stakeholders about what to do in the area. Others claim that indicators which measure sustainability aspects with a wider geographical scope need to be agreed upon within that geographical area, for example along a river, in order to also agree upon what actions to take and when [14].

3.4.3. Including Different Kinds of Indicators

Some researchers also emphasise the need for using different kinds of indicators. Bell and Morse [27] discuss this in terms of the need to measure both the state of an area (from a sustainability perspective) and the causes of that state, including internal and external causes. Innes and Booher [35] make another distinction, categorising indicators into three types: system performance indicators (to measure how the system performs in relation to sustainability), policy and programme indicators (to diagnose causes of problems) and rapid feedback indicators (to support individuals, agencies and businesses to make right choices in their everyday life to promote sustainability in the area). The idea is that there is a need for a combination of these types of indicators in order to drive change. Niemeijer and Groot [14] discuss this in a similar way, with their main argument being that the choice of indicators needs to be based on a framework which enables both causes and effects to be analysed. They suggest doing so by creating a causal network based on DPSIR (Driving force, Pressure, State, Impact, Response) which includes indicators to monitor the different parts of this network [14].

3.4.4. Presenting the Results in a Way Which Enables Action

The last sub-principle within driving change is how to present the results of a certification process. Haapio [12], Innes and Booher [35] and Sharifi and Murayama [9] argue that the aggregation of sustainability aspects, which is typically done in certification systems, is problematic. SDSN [28] also mentions that aggregation of indicators to an index or indices should be avoided. However, as Tanguay et al. [36] note, different audiences want different degrees of aggregation and simplification of information, ranging from having a single index to knowing the results of each individual indicator. Thus, being aware of the target audience and their needs and interests is important. Bell and Morse [27] also see this as vital and therefore suggest using a radar diagram to present the results in a visual product which can be easily compared with older versions over time, giving enough information to enable action.

3.5. Stakeholder and Public Participation

In order to develop a certification system that fulfils the principles stated above, a number of studies emphasise the importance of participation when choosing and formulating indicators [14,26,27,29,31,35,36]. For example, it is difficult for an expert group with an outside perspective to know what is relevant for a specific place [27], but participation is also important in order to create a sense of ownership of the questions and promote discussions about the sustainability of an area [26]. A lack of participation from local actors might create opposition to a development or re-development project [31]. However, participation is not only about involving the residents of an area, but also all relevant stakeholders and perspectives, e.g., experts whose perspectives are important in relation to the scientific credibility of the indicators [35].

4. Swedish Practitioners' View on the Role and Function of a Post-Construction Certification System

This results section is structured according to the three overarching questions posed in the interviews. Note that the first two questions (Section 4.1 and 4.2) focus on the follow-up activities of urban development projects and the last question (Section 4.3) focuses on the review and assessment of that follow-up to be done by a third-party certification organisation.

4.1. What is Followed up Post-Construction Today?

Altogether, five of the 10 respondents interviewed (respondents 1, 2, 4, 9 and 10) had previous experience of post-construction follow-up of urban development projects, albeit with differences in focus and on different scales. Respondents 1 and 4, who both worked for real estate companies, described how their respective company is working on monitoring sustainability aspects such as

energy use and travel habits of tenants. However, this is done mainly to monitor existing buildings, rather than as a follow-up of completed urban development projects. Respondents 2, 9 and 10, on the other hand, had experiences of follow-up being done at the scale of neighbourhoods and post-construction. Respondent 2 referred to the development of Stockholm Royal Seaport in which he had been personally involved. As in other Swedish urban development projects, the municipality sold land to the developers on the condition that certain sustainability measures would be implemented. This was all specified in contracts between the parties as a part of the public-private negotiation explained in the introduction to the article. To ensure that the developer followed the agreement, the municipality monitored whether planned measures were implemented in accordance with agreed contracts. Respondents 9 and 10 also provided an example of a follow-up being done of an urban development project in which the planning process was put under scrutiny, with the aim of evaluating how the urban development process could be improved. This follow-up process included interviews with the planners involved and other civil servants.

4.2. What Should be Followed up Post-Construction?

The respondents had some different ideas on what an urban development project should follow up post-construction in order to evaluate the sustainability. First, respondents 5–13 said that the follow-up should focus on the effects of implemented measures on the sustainability performance of the urban area, which they claim is not happening today. According to respondent 7, this type of follow-up could contribute with knowledge on whether the right and enough measures had been implemented. Respondent 6, who works with an urban area with social challenges, said that it would be interesting to evaluate whether the urban area is addressing its identified problems regarding sustainability, i.e., evaluate whether "there are no differences anymore in the feeling of safety between this area and the rest of the city, as well as employment rate and other social differences we see today." Respondent 3 had similar thoughts, but an interest in other details, e.g., whether the storage rooms for bicycles were used as intended and how much storage space for bicycles will be needed in the next project.

A second thought, provided by respondents 2 and 4, was that the follow-up should focus on whether planned measures have been implemented or not, since this would reflect the agency of the stakeholders engaged in the development project. It would also be relevant as part of the follow-up on potential legal agreements between the stakeholders involved regarding what would be built, which municipalities struggle to monitor.

Respondents 1 and 8 had a third perspective, arguing that the focus in a post-construction phase should be on future management and maintenance. They believed that it is important to ensure that management and maintenance aim at realising the sustainability ambitions from the earlier urban development project, in a process of continuous improvement. For example, the maintenance of green space is vital, as it takes years for trees to grow and provide the intended ecosystem services.

4.3. What should the Post-Construction Certification System Review and Assess in Relation to the Follow-Up?

As the respondents had different ideas on what urban development projects should follow up post-construction, the ideas on what a certification system should review and assess in relation to this follow-up also differed. The latter are categorised here into four alternatives for the development of the certification system. It should be emphasised that some respondents adhered rather closely to one of the alternatives, while others discussed pros and cons of different alternatives. All four alternatives are explained below and summarised in Table 3.

Table 3. Summary of the four alternatives for a post-construction certification system identified in interviews with practitioners.

	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**
What is assessed in the certification system?	The level of sustainability in the urban area	The organisational learning and use of this in future projects	What measures have been implemented	The organisational learning and use of this for operation and maintenance.
What would be the main type of indicator in the certification system?	Performance	Process	Feature	Process
Central stakeholders for application of the certification system	Municipality, property owners	Municipality, developers	Municipality, developers	Municipality, property owners

4.3.1. Alternative 1 – Certifying the Sustainability Performance of The Urban Area

The first alternative is distinguished by the idea that follow-up of an urban development project should focus on effects the implemented measures have had. In relation to such a follow-up, the certification system would be used to assess the sustainability performance of the urban area and decide whether it is good enough (respondents 6, 7, 9, 10 and 13). A certification system without such demands on the performance of sustainability was argued to be "toothless" (respondent 13), while respondent 7 emphasised that it is "important to create such targets in order to know what the project is to strive for." At the same time, some respondents thought it was unclear who the main stakeholder of such certification would be, since no single stakeholder has such comprehensive responsibility for an urban area (respondents 6, 9 and 10).

4.3.2. Alternative 2 – Certifying That the Follow-up Process Leads to Learning Outcomes

Alternative 2 is similar to Alternative 1 in that it too involves the follow-up focusing on examining what effects planned measures have had. However, respondents 3, 5 and 9–12 argued that the stakeholders involved cannot be held to account for the sustainability performance of the urban area because there are too many external factors involved. For example, respondents 11 and 12 said that for them as developers, it is important to be able to decide beforehand what they will deliver in relation to the certification system. Since they cannot decide how future residents will behave or how external factors will affect the area, a certification system in line with Alternative 1 is not relevant to them. Instead of focusing the certification system on the sustainability performance, respondents 3, 5 and 9–12 suggested a focus on what can be learnt for future projects. In other words, the role of the certification system should be to review and assess how well the stakeholders make use of the follow-up, in order to improve how they work with sustainability in coming projects. According to respondent 3, such a certification system would potentially be more relevant, as it can focus on the most important sustainability issues for that specific place and project, e.g., if public squares or storage rooms for bicycles are used as intended, while still producing important learning outcomes. In addition to this, respondents 5, 9 and 10 emphasised that it is important to follow up and learn from the development process and how that could have been done differently, e.g., evaluate the collaboration between involved stakeholders.

4.3.3. Alternative 3 – Certifying That Promised Measures Were Taken

In contrast to the other alternatives, Alternative 3 is premised on the idea that the follow-up of urban development projects should focus on whether planned measures have been implemented or not. Respondents 2, 4 and 5 argued that since it is only the implementation of measures that is within the agency of urban development stakeholders, this is also what they should be held to account for in certification. Thus respondent 5 argued that, while it would be interesting to do a follow-up of the effects of measures, it would not be relevant to have a certification system review and assess

that. Respondent 2 also argued that Alternative 3 would support the process of following up whether agreements between the municipality and developers are fulfilled.

4.3.4. Alternative 4 – Certifying Operation and Maintenance

In Alternative 4, the role of the certification system is to review and assess how operation and maintenance are organised to secure sustainable development in the urban area over time. According to respondent 8, this includes whether there has been a structured handover from the urban development project to the operation and maintenance agent regarding the intentions with the urban design in relation to the sustainability targets. According to respondent 1, the certification system could also include a follow-up on the effects of implemented measures, as in Alternatives 1 and 2, but the assessment would focus on whether operation and maintenance improve the sustainability of the area. It could also specify how operation and maintenance should be organised, including collaborative activities between the different stakeholders in the area (respondent 1). This alternative was argued to be useful for a wider diversity of urban areas, as it focuses on whether sustainability is handled as a continuous process, regardless of what the urban area looks like and how it functions today (respondents 1, 4 and 8). Thus, the role of the certification system in this alternative can be compared to certification systems aiming at reviewing environment management systems, such as ISO 14001.

5. Analysis of the Framework and How the Alternatives Relate to It

To be able to use the framework and alternatives presented in this paper we have analysed them in several steps. First, we analyse how the principles within the framework connect to each other, then how those more general findings relate to the more specific case of the alternatives for Citylab post-construction. To assist the reader, in this section all components of the framework in Table 2, i.e., principles and sub-principles, are written in *italics*.

5.1. Connections within the Framework

Even if the main focus of the framework is on the principles, it is important to keep in mind what benefits these principles should provide. If the certification system is not *scientifically credible*, there is a risk of it not contributing to the benefit of improving sustainability and thus the organisation seeking certification may be accused of 'green washing'. Without being *practical*, the system will not support the working process. Without *driving change*, the sustainability in the urban area will not be improved and, again, the organisation seeking certification may be accused of 'green washing'.

Each sub-principle to these main principles has so far been addressed separately. However, looking more closely at how different sub-principles relate to one another makes it clear there are several examples of both synergies and conflicts.

The first sub-principle of being *comprehensible* could lead to use of many indicators as many sustainability issues are included, which may affect the *simplicity* of the system. That conflict could be mitigated by being *integrative*, as that might lead to fewer indicators being required if a few cross-cutting indicators can capture several sustainability issues in a satisfactory way. However, how this can be done in a balanced way is not evident.

For the sub-principle *validity*, several interesting connections with other sub-principles appear, e.g., between *validity* and *influence*. Using an extreme but illustrating example, the indicator PPM of CO_2 in the atmosphere can have very high *validity* as it measures close to the end-point problem, but on the other hand suffers from low *influence* when used in an urban development project. At the same time, selecting indicators based on high *influence* would in many cases lead to feature or process indicators, which often have low *validity*. Hence, it seems that *influence* and *validity* are in conflict with each other, especially concerning sustainability issues on global scale which one urban area cannot influence, but also local issues that are not exclusively about urban planning, e.g., health issues. One way of handling this could be to follow the principle that the certification system should *consist of different kinds of indicators*, i.e., both indicators with high *validity* to measure the effects and

indicators with high *influence*. This may also support the sub-principle of *guiding a discussion among relevant stakeholders*, as it would map measures taken and the effects those have had. However, this might also lead to a large number of indicators and thus lower *simplicity*.

The sub-principle of *defining what is good enough* seems to have synergies with high *validity*. For example, it may be easier to *define a good-enough* level of performance, like noise level, rather than defining the urban design that should be implemented to support a good noise environment. However, when including local sustainability issues, as part of being *comprehensive*, it may be difficult to define what is good enough, as it may be difficult or irrelevant to compare it to other urban areas.

The last category of consideration in the framework is the overarching requirement to include stakeholder and public participation. This seems to connect to all the principles, as e.g., experts can help in making indicators *valid* and *reliable*, practitioners can help in making them *simple* and *influenceable* and the public is crucial regarding the local perspective of being *comprehensive*.

5.2. Handling the Principles as a Design Space

Based on the above discussion, it is clear that even when the framework is established, there are a number of decisions, prioritisations and balancing acts left to do. While it might seem 'unscientific' to present a framework that requires interpretations and negotiations, this is very much in line with the literature on certification systems and indicators. For example, Bell and Morse [27] and Turcu [26] argue that the development of sustainability indicators is always an activity of social negotiation. No matter what indicators are chosen, there are always several other possible indicators that are rejected. Thus, as Bell and Morse [27] (p. 145) emphasise, indicators may function as a "presentation and not a representation of reality." In addition to this, as stated by SDSN [28] (p. 19) "A single indicator cannot measure every aspect of a complex issue" but can be a "proxy" of the development of an issue.

Hence, we suggest that the principles be viewed as coordinates in a design space for the development of certification systems and the selection of indicators. This design space allows for a variety of outcomes, depending on the principle/s prioritised. This should allow the framework to be sensitive to, and thus useful for, developing certification systems for many different contexts.

5.3. Use the Alternatives to Navigate in the Design Space

With the identified framework and an understanding of using its principles as an open design space, we can now discuss the design implications of this in the particular case of the development of Citylab post-construction. This is done using the four alternatives summarised in Table 3, since these represent four qualitatively different 'end products' of a certification post-construction for the Swedish context. By analysing the relationships between the four alternatives and the principles, we illustrate how the specific case of Citylab post-construction can be positioned in the design space, as each alternative supports the fulfilment of different principles (see summary in Table 4).

With its aim of assessing the sustainability performance of the urban area, Alternative 1 would clearly prioritise performance indicators, which is beneficial to achieving high *validity*. However, as discussed in Section 5.1, high *validity* risks leading to lower *influence*. The developers interviewed even argued that such low influence would make it uninteresting to use the certification system, since they would not be in control of whether they could meet the requirements or not. However, another respondent argued that "one needs to dare to take at least one step out of the influence" (respondent 7), to make sure that an urban area has achieved a certain level of sustainability.

Alternative 2 instead emphasises *influence* at the expense of *validity*, as the certification system reviews the learning outcomes and not the sustainability performance. Thus, a clearly unsustainable urban area would be possible to certify as long as the actors involved could draw important learnings from it. This alternative would mean that the follow-up done by the urban authority would use *different kinds of indicators* to map cause and effect chains, but the review done by the certification system would use only process indicators to assess the organisational learning. As discussed in Section 5.1 such approach may in turn lead to many indicators and thus difficulties in developing a *practical* certification

system. The focus on organisational learning provides strong potential to *guide a discussion among stakeholders* in urban development projects.

Table 4. Summary of how the different alternatives (Table 3) lead to different possibilities to fulfil the sub-principles in the framework (Table 2), both regarding the certification system at large and the kind of indicators that each alternative results in. Light grey = the alternative supports fulfilment of the sub-principle; dark grey = fulfilment of the sub-principle seems difficult in the alternative; white = two-fold relationship (see comments in cells) or the alternative seems not to affect the possibility to fulfil the sub-principle (no comments).

Principle	Sub-Principle	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Scientific-ally credible	Comprehensive				
	Integrative				
	Valid	Indicators focus on the effects, which means measuring closer to the end problem	Indicators measure effects but are not the focus for the review	Indicators do not focus on effects	Indicators may measure effects, but are not the focus for certification
	Reliability				
Practical	Intelligibility				
	Simplicity				
	Influence	Indicators focus on effects, which may mean low influence due to behaviour of citizens and external factors	Focus on learning outcomes through process indicators means high influence	Focus on implemented measures means high influence	Focus on the process of operation and maintenance means high influence
Support change	Defining good enough	The level of sustainability can be compared between different areas	Does not focus on what is sustainable in the urban area	Can be difficult to decide due to unclear causality	Can be difficult to decide due to unclear causality
	Guide a discussion		Not in the context of the certification process but in coming urban development projects as learning outcomes are implemented		Not for the planning phase, where there might be more possibilities for transformative change, but surely for operation and maintenance.
	Different kinds of indicators	Focus on performance indicators	Follow-up can include different indicators, but certification would focus on process	Focus on design features implemented, and not their effects	Follow-up can include different indicators, but certification would focus on process.
	Present results in a way supporting action				

In Alternative 3, the sub-principle of having *influence* is prioritised over *validity*, as in Alternative 2, and the focus of the certification system is on the implementation of design features in the urban environment. This alternative is similar to existing certification systems (such as BREEAM Communities) which have been argued to *guide discussion among stakeholders* and to be beneficial for the area and the organisations, etc. [22], even if the discussions among stakeholders probably would focus on how to fulfil a certain urban design rather than how to reach high sustainability performance. As discussed in Section 5.1, a focus on features rather than performance may be problematic when *defining a good enough level*.

In Alternative 4, there is also an opening for *different kinds of indicators*, as the follow-up of the urban area could focus on sustainability performance and then the certification system would review the plans and processes of operation and maintenance. As with Alternatives 2 and 3, it might lead to low *validity* and difficulties in determining what is *good enough*. However, it would probably *guide a discussion among stakeholders* in the operation and maintenance phase, but not in the planning phase, which contains the main window of opportunity for making a difference.

Even though the alternatives in Table 3 are presented as four separate ideas for the certification system, it is important to highlight that they are not isolated from each other. On the contrary, they may be combined in different ways and should therefore be seen as different extremes within the design

space, with many possible combinations. In addition, there are probably other alternatives too, creating other possibilities within the design space.

6. Conclusions

Based on a literature review, this article presents a framework of important considerations when developing indicators and certification systems for sustainable urban areas (see Table 2). The considerations are categorised into principles and sub-principles which, through the analysis in this article, in some parts are found contradictory. For example, to accomplish *comprehensibility* at the same time as *simplicity* offers a difficult challenge. Therefore, it is important to handle these conflicts in a systematic and thoughtful way when developing a certification system, and even with the framework defined, there are a number of decisions, prioritisations and balancing acts to do. Hence, we suggest that the principles and sub-principles are viewed as coordinates in a design space, highlighting issues that the designer of a certification system needs to be aware of and be transparent about in the development process.

In the specific development process used as a case in this paper, the development of Citylab post-construction, interviews were performed to identify potential alternative approaches for such a system. These alternatives were then used for reflecting on the implications for the design space for each alternative, that is; the relationship between the framework and the four alternatives. The analysis highlights that the choice of alternative has a significant impact on the subprinciples to be prioritised (see Table 4). Therefore, the identification of similar alternatives seems to be a good way to orientate in the design space and to understand the design implications the framework has on the development of a certification system, in this case Citylab post-construction. One key consideration brought up in the analysis is the conflict between *validity* and *influence*. For none of the identified four alternatives it is obvious how to handle this conflict as Alternative 1 focuses on sustainability performance which prioritises higher *validity*, which at the same time implies lower *influence*, while the other alternatives lead to the reverse priority. Thus, choosing alternative for the Citylab post-construction system is also a choice of whether to prioritise validity or influence. In the same manner the choice of alternative is also about including *different kinds of indicators* or not, as Alternative 2 and 4 can aim to reveal cause and effect chains while the others do not have such ambition. There are also differences regarding if, and how, the alternatives support *defining a good enough level*, as this is easier to do in Alternative 1 with its focus on performance. One last consideration is how the different alternatives *guide a discussion* between stakeholders since that would be done quite differently in the different alternatives (see Table 4).

What alternative/s to choose and thus what (sub-) principles to prioritise in the specific development of Citylab post-construction is not evident. The respondents have different opinions on what alternative is the most promising, and some are even having a hard time deciding as they see strengths and weaknesses with all the alternatives. However, the framework and the alternatives both highlight important considerations which will be vital for the future development of Citylab post-construction, not because they necessarily made the choices easier but much clearer. The work presented in this article thus enables making informed and transparent decisions in similar development processes.

As a final point, this article has shown that there are lots of choices to be made when developing a certification system and, without any framework or an understanding of the available alternatives, the certification system will not be thoughtfully designed. By using the framework presented in this paper it is possible to be transparent about the choices made. This can in turn generate a common discussion regarding how different certification systems are being developed and thus what principles to prioritise in different situations, or in other words how to best design certification systems.

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Appendix A Publications Included in the Review of Relevant Literature.

Author(s)	Year	Review?	Title	Journal (If Article)
AtKisson, A. [10]	1996		Developing indicators of sustainable community: Lessons from sustainable Seattle.	*Environmental Impact Assessment Review*
Bell, S. & Morse, S. [27]	2000		Sustainability Indicators - Measuring the Immeasurable.	
Cohen, M. [13]	2017	Yes	A systematic review of urban sustainability assessment literature.	*Sustainability*
Gibson, R. B. [29]	2006	Yes	Beyond the pillars: Sustainability assessment as a framework for effective integration of social, economic and ecological considerations in significant decision-making.	*Journal of Environmental Assessment Policy and Management*
Haapio, A. [12]	2012		Towards sustainable urban communities.	*Environmental Impact Assessment Review*
Holman, N. [38]	2009	Yes	Incorporating local sustainability indicators into structures of local goverance: A review of the literature.	*Local Environment*
Innes, J. E. & Booher, D. E. [35]	2000		Indicators for sustainable communities: A strategy building on complexity theory and distributed intelligence.	*Planning Theory & Practice*
Lynch, A. J. & Mosbah, S. M. [31]	2017		Improving local measures of sustainability: A study of built-environment indicators in the United States.	*Cities*
Niemeijer, D. & Groot, R. S. d. [14]	2008	Yes	A conceptual framework for selecting environmental indicator sets.	*Ecological indicators*
Leadership Council of the Sustainable Development Solutions Network (SDSN). [28]	2015		Indicators and a Monitoring Framework for the Sustainable Development Goals - Launching a Data Revolution for the SDGs	
Sharifi, A. & Murayama, A. [9]	2013		A critical review of seven selected neighborhood sustainability assessment tools	*Environmental Impact Assessment Review*
Tanguay, G. A., Rajaonson, J., Lefebvre, J.-F. & Lanoie, P. [36]	2010		Measuring the sustainability of cities: An analysis of the use of local indicators.	*Ecological Indicators*
Turcu, C. [26]	2012		Re-thinking sustainability indicators: Local perspectives of urban sustainability.	*Journal of Environmental Planning and management.*
Wallhagen, M., Glaumann, M., Eriksson, O. & Westerberg, U. [37]	2013		Framework for Detailed Comparison of Building Environmental Assessment Tools.	*Buildings*
Wangel, J., Wallhagen, M., Malmqvist, T. & Finnveden, G. [8]	2016		Certification systems for sustainable neighbourhoods: What do they really certify?	*Environmental Impact Assessment Review*
Zhou, C., Dai, X., Wang, R. & Huang, J. [11]	2011		Indicators for evaluating sustainable communities: A review.	*Shengtai Xuebao/ Acta Ecologica Sinica*

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