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Including local actors' perspective in neighborhood sustainability assessment: evidence from Dubai's sustainable city

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Abstract

Purpose – Existing Neighborhood Sustainability Assessment (NSA) tools such as "Leadership for Energy and Environmental Design - Neighborhood Development" (LEED-ND) and "Building Research Establishment Environmental Assessment Method" (BREEAM Communities) are widely criticized for a lack of transparency in the selection of indicators and an unbalanced focus on specific sustainability dimensions.

Design/methodology/approach – This paper asks how the expectations and use values of the professionals and residents involved in developing, designing, managing and living in a sustainable neighborhood can shape sustainability indicators that affect progress towards project goals. Taking as its focus The Sustainable City (TSC), a neighborhood in Dubai, United Arab Emirates (UAE), the paper develops data from in-depth, go-along interviews with 46 different actors.

Findings – Findings indicate that when given the opportunity to express their opinion, many actors will prioritize metrics different than the metrics dictated to the by sustainability experts and international rating systems. The findings suggest that NSA tools should place greater emphasis on local factors, public engagement and operational concerns.

Practical implications – The paper provides a method that any community can replicate to better understand the different use values of local actors and establish its own NSA tool. This can help experts learn how design, management and operational decisions interact to impact different dimensions of performance.

Originality/value – This paper recognizes sustainable neighborhoods as spaces with multiple identities. Hence, the indicators used to evaluate these neighborhoods need to be based on the expectations and use values of different actors. This paper proposes using the priorities of different local actors to reshape how these neighborhoods are assessed.

Keywords Sustainable, Neighborhoods, Participatory, Indicators, Local, Operational, Metrics

Paper type Research paper

1. Introduction

The continuously increasing worldwide interest in developing planned sustainable neighborhoods has been coupled with an expansion in sustainability accreditation systems and certificates. However, validating the success of these developments is difficult in part because existing frameworks such as LEED for Neighborhood Development (LEED-ND) have no procedure for incorporating the perspective of residents and other stakeholders into the

selection of metrics for evaluation. This paper asks how the expectations and use values of the professionals and residents involved in developing, designing, managing and living in a sustainable neighborhood can be better incorporated into indicators that measure progress towards project goals. We use The Sustainable City (TSC) in Dubai as a case study and compare the indicators seen as important by different groups of actors in the community (Plates 1 and 2).

"Planned sustainable neighborhoods" are custom-built master-planned mixed-use developments with publicly stated goals of sustainability. Examples of such neighborhoods are Bo01 in Malmo Sweden, Fujisawa Smart Sustainable Town in Japan and Dockside Green in British Columbia, Canada.

Developers typically label such communities "sustainable" based on design intentions rather than actual performance since it is much easier to claim sustainability than to demonstrate it (Whitfield, 2017). The widespread use of Neighborhood Sustainability Assessment (NSA) tools such as LEED-ND and BREEAM Communities is a step towards

Plate 1.
Geographical location
of TSC in Dubai

Source(s): Authors and https://satellites.pro/

Plate 2.
Aerial view of TSC
in Dubai

Source(s): Permission from and Courtesy of The Sustainable City (TSC)

guaranteeing the sustainability intentions of such projects; however, these tools are based on design specifications rather than actual performance of projects (Al Khalifa, 2019; Westerhoff, 2015). Modeling and then tracking the performance of a complex system such as a neighborhood is challenging and proves easier in theory than in application, resulting in what is called a "performance gap" (Boarin et al., 2018; Francis and Thomas, 2023). Studies have shown that plenty of sustainable neighborhoods worldwide do not end up reporting their performance. Barriers related to measuring and reporting performance range from lack of financial and human resources, fear of accountability and a general dissatisfaction with current indicators that are not usually an indication of success in the eyes of the local community (Asaad et al., 2023; Whitfield, 2017; Wiedmann et al., 2019).

The challenge is not only to get such projects to measure their performance, but also to determine which indicators are most valuable on the scale of a neighborhood. Different studies have pointed out a conflict between ways that building managers, architects, system assessors, government officials, academics and developers prioritize sustainability indicators (AlWaer et al., 2008; Gan et al., 2017). For example the importance given to the use of wind energy in one project varied drastically between a BREEAM assessor and an architect (AlWaer et al., 2008; Gan et al., 2017; Sandanayake et al., 2023; Settembre Blundo et al., 2019). The actors involved in the process of designing and planning for sustainable neighborhoods significantly influence the choice of NSA tools (Oliver and Pearl, 2018). Recent research has identified a need to understand the multifaceted interests and alignments of sustainable neighborhoods' actors (Hamdan et al., 2021).

This paper proposes using the priorities of different local actors to reshape how certain elements of these neighborhoods are assessed. Instead of using a universal sustainable community evaluation framework such as LEED-ND or BREEAM Communities, it may be preferable to ask sustainable in doing what, for whom and under which worldview. Potentially local concerns might be added to or take the place of global templates.

2. Background

2.1 Limitations of mainstream sustainability indicators

Interest in validating the sustainability of neighborhoods has led to the development of many NSA tools that look at this scale. The pros and cons of NSA tools are widely known and covered in the literature (Sharifi and Murayama, 2013, 2015; Szibbo, 2015; Boarin et al., 2018; Oliver and Pearl, 2018). NSA tools such as LEED-ND and BREEAM Communities are valued for being easily understood, offering a guide to minimizing impact and maximizing efficiency and incentivizing more sustainable development practices (Berardi, 2013; Sullivan et al., 2014). Although widely used, they are criticized as insufficient due to the absence of long term performance measurement and their focus on energy and transportation needs rather than the social experience of the neighborhood (Szibbo, 2015).

While examining the use of LEED-ND, Garde (2009) concluded that a certification alone cannot guarantee a sustainable neighborhood development and that the costs of the certification can outweigh its benefits. The Living Community Challenge is another neighborhood-scale sustainability system that focuses on the actual performance rather than the design. However, it is criticized for being idealistic and hard to achieve (Boarin et al., 2018). NSA tools are seen as static without much flexibility towards a diversity of local contexts, development types and phases (Komeily and Srinivasan, 2015). Such tools are also criticized for claiming international status while being unresponsive to local conditions (Rogmans and Ghunaim, 2016). For example, out of a maximum 110 points that a project can earn in LEED-ND, only 4 points are assigned to regional priorities.

In general, moving beyond the building scale makes it harder to control some performance dimensions and to measure performance on all claimed goals. Despite the existence of so

many NSA tools, Whitfield (2017) found that out of 27 sustainable communities worldwide only six reported that they monitor one or more sustainability indicators. Projects have often been criticized for focusing on some aspects of sustainability while ignoring others (Barton, 1998, 2000). There is also a call for expanding what is meant by performance when looking at sustainable neighborhoods. For example, a successful performance is not just a minimization of environmental impacts, but also success in creating livable and social spaces (Boarin *et al.*, 2018). In general, these new neighborhood projects, although ambitious, face many challenges including lack of monitoring due to complexity of goals, fear of accountability and number of stakeholders (Barton, 2000; Whitfield, 2017).

2.2 From occupants to actors

One consistent theme in evaluations of housing projects, especially ones with a sustainability agenda, is the need for focus on users' perceptions, behaviors and needs. This movement goes back to the 1970s. For example, when Boudon and Onn (1972) looked at Pessac – a housing project designed by Le Corbusier in the 1920s – he highlighted the conflict between the designer's conception and the users' reactions. They introduced the residents as active and creative agents and emphasized the importance of assessing projects throughout their lifetime. Cooper (1975) did the same in her review of a social housing project in Richmond, California. She emphasized discrepancies between the architect's intentions and users' needs, especially related to privacy, layout and safety.

There have also been many recent discussions about how important it is to account for the occupants' behavior and perceptions when evaluating the sustainability of projects and specifically residential projects (Janda, 2011; Berry *et al.*, 2014; Westerhoff, 2015). There is now more understanding that investing in technology and design alone rarely leads to a successful project. Aspects such as leadership, collaboration, setting goals, whole systems technical expertise and engagement of homeowners are proving to be vital for the success of sustainable neighborhoods (Fraker, 2013).

Beyond the focus on the residents, understanding the needs and roles that other actors play in such sustainability projects is vital. Actors in the development process have different expectations of how the project should look and function. The role and influence of these actors in shaping the projects can vary based on the type of project and the context. In addition, the values and roles of the actors and their relationship with each other can often change through time (Weiss, 1987).

The development of NSA tools rarely incorporates a diverse array of stakeholders. In an evaluation of 5 NSA tools, Komeily and Srinivasan (2015) found that none included a comprehensive set of stakeholders in their initial development. All of them excluded the involvement of citizens initially and were mostly expert led. Sharifi and Murayama also criticized lack of resident involvement in NSA tools and recommended that residents should be involved in three stages: defining the core criteria; weighting of different criteria and developing feedback loops to regularly update the system (Sharifi and Murayama, 2013).

Recent research has attempted to identify and categorize the range of stakeholders involved in the development of sustainable neighborhoods across time (Al Khalifa, 2019; Asaad *et al.*, 2023). The primary stakeholders identified in different case studies of housing projects are mostly residents, developers, architects and property managers (Czischke, 2018). Hamdan *et al.* (2021) listed a range of stakeholders that get involved in different stages of sustainable neighborhood projects from conceptualization to closure. These stakeholders included central governments; local authorities; nonprofit housing developers; philanthropic organizations; R&D institutions; private housing developers; consulting companies; design companies; construction companies; material suppliers and financial institutions. However, this list omits residents and stakeholders involved in operation.

What is needed is to go beyond the acknowledgment of actors and to focus on analysis of their common interests, differences, overlaps and contradictions (Evans, 2002). In other words, an analysis of stakeholder alignments and multifaceted interests related to neighborhood sustainability is a highly desired research avenue (Hamdan *et al.*, 2021). This study recognizes sustainable neighborhoods as spaces with multiple identities and actor interrelations. They are spaces produced through various overlapping stories (Logan and Molotch, 1987; Massey, 2005; Batalhão *et al.*, 2019). Hence the assessment and indicators used to evaluate these neighborhoods need to be based on the expectations and use values of different actors.

3. Methodology

To elaborate on how such an actor-based participatory assessment can be applied, we present the process of developing participatory indicators for a single planned sustainable neighborhood. The paper then discusses what can be learned from this case study. We focus on the TSC, a privately developed master-planned community in Dubai, UAE (Plate 3). The neighborhood has 590 residential units, a school and a commercial area with services such as a rehabilitation center, an innovation center and an equestrian club. The first resident moved in during 2015 and the development was fully occupied in 2020 with a population of 3,000 residents. As its name implies, TSC is promoted as a sustainability showcase, with 10 megawatts of on-site solar production, urban farming, on-site water recycling, waste sorting and pedestrianized car-free streets (Plate 4).

We conducted 46 in-depth semi-structured go-along interviews with different actors in The Sustainable City (Figure 1). The interviews were undertaken between January and March 2020. The actors interviewed included residents, local business owners, project developers, architects, landscape architects, town planners, sustainability officers, community managers, sales representatives and members of the operation team. To recruit the interviewees, we sent a general email to the resident listserv and posted on the community Facebook page. All
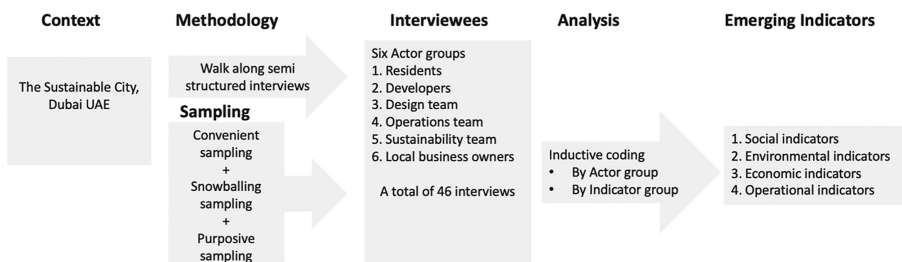

Source(s): Authors

Source(s): Authors

residents, professionals and business owners who showed interest were interviewed. We used a snowball technique with the initial interviewees suggesting a wider pool of actors. Those who self-identified as professionals that worked on the project or are still working on it were individually approached.

The interviewees were asked to give the interviewer a tour of the neighborhood. During the tour, they were asked questions with regards to how they use and evaluate the

neighborhood. They were specifically asked *"As a (... role of actor ...), what kind of indicators do you think should be considered in the evaluation of the performance of TSC?* A typical interview time spanned between 20 and 90 min. This go-along technique, also referred to as walking interview, was selected due to its ability to nudge the environmental memory of the interviewee, resulting in a discussion that is highly informed by the built environment (Evans and Jones, 2011). This method has been used in several previous studies rooted in urban and landscape disciplines to answer questions related to environmental perception and evaluation (Kusenbach, 2003; Bergeron *et al.*, 2014). This interview style is also a useful tool to balance the power dynamics between the researcher and the community by allowing the interviewees to lead the walk (Evans and Jones, 2011; Bergeron *et al.*, 2014).

This method provides an initial window into the use values and indicators that matter the most to the key actors of the community; however, it has some limitations. First there might be biases in the sample. Individuals who volunteer may be either overly excited about the project or negatively opinionated; focusing analysis on them may leave out an unopinionated majority. Conducting the interviews while walking may exclude potentially interested participants with mobility limitations. Also, the weather can sometimes make it hard to have an outdoor interview. To make the method more inclusive for participants, an alternative indoor location inside the neighborhood was offered for those who preferred a seated interview.

In a community with a population of over 3,000, the small pool of interviewees (46) might not be representative enough to reflect the use values of all members. However, it does provide an indication of values that matter the most to many key actors. Of the 46 interviews conducted, 3 were with lead members in the design team, 5 were with members of the sustainability team, 5 with members of the operation team, 2 were with the original project developers, 4 were with local business owners and the rest were with residents. Although the number of interviews with different groups were not equal, [1] they provide early indication of the interests of each group. Since the method and approach were crafted to be context-specific, they might not be repeatable in other contexts. However, they are flexible enough to be crafted in different ways depending on context and needs.

We transcribed and then inductively coded the interviews by indicator themes while keeping track of different actor identities. We developed a matrix from the coding which highlights all the indicators mentioned in the interviews and separates the actors by type (see Table 1). The actors were grouped into six types: residents, local business owners, design team, sustainability team, operations team and developers. To avoid vagueness whenever an actor mentioned an indicator, they were encouraged to give an example of a question that can help in operationalizing such an indicator. Examples of the questions actors provided are presented in Table 2.

4. Findings

Overall, the fieldwork highlighted indicators and performance dimensions that might not be present in mainstream sustainability assessment systems. Although interviewees suggested diverse socially, economically and environmentally oriented indicators to evaluate TSC's sustainability, they also emphasized the need for a fourth group of indicators which we have termed operational indicators. Such a group reflects indicators that can mostly be validated through the successful operation and management of the community in the long run. Operational indicators include factors such as frequency of maintenance, resident retention and occupancy rate.

Different actors deemed 30 indicators important for the context of TSC (see Table 1). The three that were mentioned with the highest frequency among all stakeholder groups were sense of community, energy consumption and production and occupancy rate. The first and last of these are not commonly mentioned in mainstream NSA systems.

Legend:
- (gray) An indicator is mentioned by more than 4 actor groups.
- (light green) An indicator mentioned by the actor group.
- (dark green) A highly stressed indicator was mentioned by more than 50% of the actor group interviewed.

Key: ● = highly stressed (dark green); ○ = mentioned (light green); blank = not mentioned.

Category	Indicator	Residents	Local Business owners	Design team	Sustainability team	Operation team	Developers
Social Indicators	Sense of community	●		●	●	●	○
	Sense of ownership	○			○	●	○
	Sense of safety	●				○	○
	Walkability	○		○	○		
	Wellness	●	○		○		
	Inclusion and diversity	○			●		
Environmental Indicators	Energy production and consumption	●		○	●	○	○
	Water consumption	●		○	○		○
	Waste production and diversion	●		○	○		
	Food production						
	Air quality	○					
	Materials choice and lifecycle	○		○			
	Carbon footprint	○		○	○		○
	Impact on ecosystem	○		○			
	Environmental attitudes	○	○		○		
	Vegetation	○		●			
Economic Indicators	Savings in living expenses	●		○			
	Affordability	○					
	Commercial viability	○		○		○	○
	Local job opportunities	●			○		
	Occupancy rate		○	○	●	○	●
	Local business support		●		○	○	○
Operational indicators	Resident satisfaction	●		○	●	●	●
	On-site amenities and services	○					
	Recognition and media attention			●		○	
	Local benchmarking				○	●	
	Community maintenance	○		○			
	Resident longevity	●	○			●	
	Good governance	●					
	Continued Technical advancement	○				○	

Note(s): These six groups agreed on very few indicators of sustainability
Source(s): Table was created by the authors

Environmental indicators
- Energy production and consumption
  - Energy utilization index
  - Energy produced by the community
  - Energy consumed by the community
- Water consumption
  - Water consumption per person and household
- Waste production and diversion
  - Waste produce per household
  - Rate of waste diversion from landfill
- Food production
  - Amount of food produced on-site
- Air quality
  - The quality of air on-site vs off-site
  - Number respiratory problems within the community
- Materials choice and lifecycle
  - The use of local building material
  - The toxicity of building material
  - The lifecycle of building material
- Carbon footprint
  - Annual and embedded carbon footprint of the community
- Impact on ecosystem
  - The biodiversity on site
  - Percentage of native plants
- Environmental attitudes
  - Changes in the resident's environmental awareness
  - Number of awareness events in the community
  - The number of people adopting pro-environmental habits after moving in
- Vegetation
  - Vegetation ratio
  - Amount of water used for irrigation
  - Amount of fertilizers and chemicals used

Economic indicators
- Savings in living expenses
  - Savings in utility bills
  - Savings due to benefiting from local amenities
- Affordability
  - Unit price compared to similar communities
- Commercial viability
  - Changes in property value
  - Return on investment
  - Perceived value for money
- Local job opportunities
  - Number of local business owners
  - Number of on-site jobs created
- Occupancy rate
  - The rate of occupied residential units through the project lifetime
- Local business support
  - Percentage of residents using local shops
  - Number of management incentives to support local businesses

Social indicators
- Sense of community
  - Number of social events initiated by the management
  - Number of community groups and communication platforms
  - Rate and distribution of social spaces that allow interaction
- Sense of ownership
  - Are community members proud to be part of the community?
  - The number of events and activities initiated by the residents
  - Are residents committed to shared community goals and vision?
- Sense of safety
  - Willingness to let kids play outside alone
- Walkability
  - Number of steps per day
  - Time spent walking outdoors
  - Ability to access basic services on foot
- Wellness
  - Number of health and wellness facilities
  - Number of health and wellness facility visitors
- Inclusion and diversity
  - Number of different nationalities in the community
  - Number of outside visitors using community facilities

(continued)

Table 2.
Sample metrics
provided by the
interviewees for each
indicator category

Operational indicators

- Resident Satisfaction	- The resident continued satisfaction from management
	- Resident prolonged comfort in the community
- On-site amenities and services	- Number of trips made to outside services
	- Time spent commuting to outside services
- Recognition and media attention	- Number of awards
	- Number of media features
- Local benchmarking	- Overall metrics compared to neighboring communities
- Community maintenance	- The ease and efficiency of requesting maintenance services
	- The frequency of maintenance work to upkeep the community
- Resident longevity	- The rate of resident turnover
- Good governance	- Management transparency
	- Open communication channels
	- Community participation in decisions
- Continued technical advancement	- Rate of optimization experiments
	- Rate of new innovations coming out of community

Table 2.

Source(s): Table created by authors

In terms of social indicators, a sense of community and ownership was important to the majority of actor groups, but for different reasons. For the residents, this meant knowing your neighbors, interacting with them and depending on them. A sense of community was also presented as an indicator of reduced consumption. One resident explained, *"It is about maximizing the opportunity of a shared society ... For two villas to be friends and buy one lawnmower and share it, that would be helpful."* Actors from the design team stressed that a strong sense of community can attract people to a better lifestyle. *"It draws people to a lifestyle; it is a positive spiral. To create a community that is sustainable is one thing, but to create a community where its members have a sense of pride. This is what makes it different."* Actors from the operation team explained that a sense of community nurtures a sense of ownership which benefits the whole community through mobilizing social responsibility.

The most frequently mentioned environmental indicators were those associated with resource consumption: energy consumption, water consumption and carbon footprint. The sustainability team proposed Energy Use Intensity (EUI) as an indicator but agreed with residents that gross energy use and direct on-site photovoltaic production would also be good energy indicators. Interviewees focused on the importance of measuring water consumption on an individual basis along with measuring the greywater output of the community as a whole. Operational and embodied carbon footprint were also seen as important metrics by different actor groups. Many actors saw vegetation as an indicator of sustainability. In contrast, food production was only seen as an important sustainability metric by members of the sustainability team.

The single economic indicator that the majority of actors agreed on was the occupancy rate. While residents were more concerned with indicators that economically benefit them like savings in living costs, all other actors stressed the importance of occupancy rate as an indicator. One of the developers explains, *"The occupancy rate is the most important key performance indicator for any developer."* Members of the sustainability team also agree on this, *"we can be great on sustainability but if we don't have people here it's useless."*

An operational Indicator that seemed to matter to the majority of actors is resident satisfaction. One resident explained, *"Satisfaction can be how comfortable people are ... do they feel more or less at home when they are around a community?"* In contrast, good governance as an indicator was only mentioned by residents. For residents, good governance meant management transparency and feeling heard. One resident explained, *"perhaps taking*

a more civic stand, maybe having a community town hall, listening to the community members rather than dictating [to] them. Transparency appeared important in two respects: decision making and community performance data.

Although some of the indicators mentioned in the interviews are already present in NSA tools, others such as resident longevity, environmental attitudes and sense of ownership are rarely mentioned. By comparing the list of indicators that emerged from the interviews to indicators used by LEED-ND and The Living Community Challenge it was evident that almost 50% of the indicators proposed by the actors of TSC are not present in these NSA toolsets. The findings indicate that when given the opportunity, users and diverse local actors will prioritize different metrics than expert-based models.

5. Discussion

5.1 Context-based indicators

The preceding findings highlight how mainstream neighborhood sustainability indicators may not fit local contexts and that engagement of local actors may be necessary to produce the best overall set of sustainability indicators for a given project. A successful project should fulfill the use values and needs of various actors involved as well as more universal needs such as for carbon-neutral development. Therefore, the process of producing indicators should be rooted in local contexts and different actor's use values as well as global concerns.

The specific context of Dubai likely influenced several proposed indicators. First, a sense of community is important to all different actors in Dubai because it speaks to Dubai's expatriate population base. When asked how a sense of community can be measured one resident explained, *"I think it has a lot to do with the social activities. How many activities do you have in this property compared to other properties?"* Another resident added, *"I would look at the way people interact here and the opportunities for interaction compared to other places I lived in."* This reflects how a sense of community is increasingly an add-on amenity that needs to be carefully planned into the design of communities in Dubai and probably many other places. For the management a sense of community also enhances the sense of ownership. The community manager explains, *"We wanted people to build a sense of community, . . . Now we got a good foundation . . . a committee of the residents [can] take care of the social events."* This is an important indicator because it reflects how much residents are involved in planning for social events, making the management of the community easier.

Vegetation as an indicator of sustainability in Dubai might be controversial considering the hot climate and lack of fresh water. Residents are mostly western expats and appreciated the "lush" feeling that "makes the community more livable" as one explained. However, some were concerned with the water consumption of vegetation: *"Let's ask what the water usage is. Yes, you can grow a garden but how much water does it use in a place where water is not available?"* The design and operation team were more concerned with the needs, impacts and costs of vegetation, saying for example that *"We have a lot of biennials, so we need to always replace them. It is a lot of labor, waste and carbon footprint going and coming."* Although all of the above actors mentioned vegetation as an indicator, it was evident that it had different implications for different groups.

The harsh climate in Dubai can explain why food production was not seen as an important indicator, by many groups, even though this was an initial priority of the developers. TSC diversifies its food outputs by hosting community gardens for residents along with biodomes and container farms for startups. Although residents appreciated such initiatives, they did not think that measuring food output is critical. For some residents it was more of social activity, *"Farming is helping people socialize."* According to one of the residents, *"this place can't exist if there is no massive import of food and water."* Having food production as an

indicator is common in many NSA rating systems, yet its application in harsh climates can be more of an esthetic add-on than a sign of sustainability or a real contribution to food self-sufficiency.

The competitive housing market in Dubai can explain why many actors deemed occupancy rate the most important economic indicator. This was always raised in reference to neighboring communities. In the words of one of the developers, *"for you to be able to tangibly quantify the success of what you have developed, it is how it is occupied in comparison with your neighbors."* Residents viewed occupancy rate as important in that it helped them build community with neighbors in surrounding occupied units. For local business owners, occupancy rate matters because it provides a customer base. As an indicator, occupancy rate appears to be a simple but vital indicator for many actors.

Indicators like resident retention or longevity are important for TSC due to its location in an expatriate-dominated country. These would also apply to many projects in other global cities. Turnover is perceived as something that affects sense of the community. The community manager explains, *"I think the amount of people that move in and move out is not sustainable."* For the residents, resident retention is important because it's about maintaining their connections, *"When we first arrived here, we made friends, but [it is] Dubai's nature, people leave and then you suddenly left to start from scratch again."* For the business owners, resident retention is about maintaining their customers. The owner of a local coffee shop explains, *"In December, a lot of people left ... It affected me ... New tenants will take time to make us their habit."* While the occupancy rate can stay stable, a high rate of resident turnover can be an indication that time, energy and resources are being wasted in reestablishing new community norms, new local business customers and new neighbor friends. Resident longevity might not be an indicator that comes to mind when discussing sustainability, but for the case of TSC, it does impact all the pillars of sustainability – the economic, social and environmental performance.

5.2 Operational based indicators

Findings highlight a dominance of operational indicators across different actors. This reveals that actors have developed an experience-based awareness of the importance of managerial decisions post-operation and how such decisions can be critical to sustainable performance. Such operational indicators may not be common in mainstream NSA tools because these cannot be validated except after operation and are hard to measure. Moreover, operational indicators are highly affected by different management models.

One operational indicator that can be linked with the specific management model of the case study is good governance. This was widely mentioned by the residents as a key indicator for a sustainable community. The most important aspect of good governance for residents was transparency. One resident clarified, *"I would like to see some data about our consumption telling us what we use. Sharing of information: to know how much we are doing and how much more can be done."* Another resident added, *"Maybe there should be more transparency around decisions ... We don't necessarily know why the changes were made."* Good governance seemed to be rather vital for most of the residents as a determinant of resident retention, "If people are unhappy and they feel unheard then they won't stay." Good governance might be a theme of global sustainability practices, but it is rarely highlighted as an indicator of success in NSA frameworks.

Satisfaction as an operational indicator was stressed heavily during the interviews, yet it can be very subjective. For TSC, some residents presented much more fully developed explanations of what satisfaction means to them than others. One resident explains, *"it is important to see if people are happy, comfortable, enjoy homes, enjoy the actual community spirit, and [are] happy with the management."* Few residents doubted the importance of

satisfaction as an indicator due to its subjectivity, *"[Universal] resident satisfaction is never going to happen. There [are] always going to be people that grumble. They are the ones that you can hear the most."* This indicates that different management and governance models of sustainable neighborhoods require different indicators. When neighborhood development is corporate-driven, the residents might situate themselves as the customers of the management who demand customer satisfaction.

Comparing environmental performance with local benchmarks—rather than abstract international norms—was a common theme across interviews. One resident explained, *"you would want to take a look at consumption . . . compare it to different communities in Dubai and establish a metric or scoring system from it."* A member of the sales team explains the significance of local benchmarking as follows, *"There are lots of things that you can measure, but it becomes more significant in what you are measuring it against."* This highlights a need to rethink how regional points work in global indicator systems through offering regularly updated local benchmarks.

Resident behavior can greatly affect the performance of many sustainable neighborhoods. As one resident puts it, *"The infrastructure is sustainable, but it is really behavioral dependent."* Behavior is difficult to measure in terms of metrics, and it is hard to know which behaviors were elicited by the neighborhood design and which were the result of resident self-selection. Yet behavioral variables such as per capita energy and water consumption are clearly important to sustainability. As one of the sustainability officers' comments, *"Let us look at the impact of knowledge sharing on energy and water demands . . . We started out with certain targets based on the design, and those targets continued to improve because of demand management due to awareness from the residents' side."*

Overall, our study suggests that the success of sustainable neighborhoods should not be determined except after occupancy. Most of the already established sustainability rating systems provide a robust base for designing sustainable communities. However, locally relevant operational and behavioral indicators such as those mentioned above should be incorporated, preferably through an actor survey such as in our example. Inputs from various local actors could shape a post-occupancy NSA tool. Assessing neighborhood sustainability post-operation will help experts learn how initial design decisions and ongoing management and operations interact to impact different actors and dimensions of performance.

Creating sustainable neighborhoods and communities is a complex and challenging mission. One way of untangling such a mission is to stop looking at the built environment as the final deliverable of the mission. Assessing the built environment throughout its lifetime performance is what is needed to verify the success of the mission (Boudon and Onn, 1972). In many cases, when developers embrace a sustainability accreditation system, they become driven by the numbers not by the output behind it. One of the developers interviewed justified his lack of interest in the accreditation system saying *"We don't believe in gold and platinum market ranking indicators. They assess features that may be useless in our context."* As humans, we optimize for what we measure, which can lead to adding design elements that prove useless after operation in certain contexts just because of the points gain. The well-known Goodhart's law summarized this problem perfectly by declaring, *"When a measure becomes a target, it ceases to be a good measure."* (Strathern, 1997).

6. Conclusion

This research revealed three important findings. First is the need to establish benchmarks for sustainability performance that reflect the experiences of local actors. In the case of TSC, measuring and comparing aspects such as consumption, a sense of community and resident turnover seem vital to validate performance. For many of the NSA tools, this is applied through offering local credits or weighting criteria. This example shows that existing efforts

to localize global NSA tools are not enough. Global NSA tools can omit many indicators that are vital in local contexts such as longevity, while highlighting others that are unimportant in some contexts such as local food production. For each neighborhood, there need to be solid local benchmarks for indicators to be meaningful.

Second, the analysis revealed that there are surprisingly few common indicators that almost all actors are keen on measuring. This may mean that it's important to include a broad variety of indicators to meet everyone's concern and that it's important to have educational and community processes through which actors can learn about the concerns of other stakeholders. Also, even when actors agree on the importance of one indicator, they may still be driven by different motives. These dynamics are important to consider within community processes to develop indicators that matter for as many stakeholders as possible.

Third, it was clear that within each project there will be indicators that only matter to one set of actors but still can have a huge impact on the community as a whole–such as good governance in the case of TSC. Giving special attention to all voices of the community and having discussions of why such indicators can impact the performance of the community as a whole can help unite different worldviews around common goals. Using global sustainability goals such as the United Nations SDGs as a reference can help community members understand the importance of certain indicators, even if they were not originally endorsed by all actors.

There is a need to rethink some of the standard indicators that come to mind when discussing sustainable neighborhoods worldwide. Although something like local food production is often promoted when planning for sustainable neighborhoods, the interviews showed that metrics associated with it might be more about socialization, esthetics and resource consumption than the quantity of food. In other instances, the residents might be more interested in metrics such as good governance that might not be considered by design and sustainability professionals. This highlights the need to localize indicators and include diverse actors when discussing indicators of success.

Many of the indicators discussed in the paper are outcome- and operation-focused rather than design-focused. In comparison, many global NSA tools provide design guidelines and focus on pre-occupancy accreditation. Hence, the indicators presented in this paper are not a comparison with or a replacement of established NSA tools because the intent is different. For example, adding public and green spaces is important for accreditation pre-construction, but what matters at the end is whether the people are using such spaces and whether they are contributing to a sense of community or not. For the case of TSC, future assessments should focus on energy production and consumption, a sense of community, occupancy rates and resident satisfaction since these indicators were agreed upon by various actors.

This study shows a need for more attention to localization, participation and implementation when it comes to indicators of sustainable neighborhoods. In contrast, sustainability accreditation systems emerged as the product of an expert-dominated field with a global ambition. We recommend that developers and managers of neighborhoods aiming at sustainability hold focused conversations with diverse local actors pre- and post-operation to determine context-specific indicators. Initiating an open conversation led by the community managers about shared community indicators that matter to different actors will assist in aligning expectations and improving progress goals and indicators. This process can be costly and should have a preassigned budget from the early start to assure its feasibility in the long run. It might also be pre-required by global NSA systems.

Through a participatory approach, additional evaluation priorities can emerge from those undergoing the experience of developing, designing, operating and living in a sustainable community. Including more voices can add a range of indicators rarely considered by experts. The indicators that emerged from this case study might not work for others. Yet, the methodology can be replicated by other communities to better understand the different use-values of diverse local actors and establish context-specific indicator systems.

Note

1. The number of residents in any project will of course outnumber the number of developers or designers behind the community.

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