

Sustainability planning, implementation, and assessment in cities: how can productivity enhance these processes?

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Abstract

In this “urban century”, planetary realities and increased environmental and social awareness have led to significant international agreements and the recognition that local communities play a crucial role in successfully implementing long-term sustainability goals. Through two case studies in British Columbia, Canada, this research focused on how the concept, principles, and practices of holistic urban productivity can help address urban sustainability planning, implementation, and assessment processes. The research findings showed a range of challenges in urban sustainability such as the persistence on utilitarian approaches to resource management and community planning, the prioritization of short-term policies, a general resistance to systemic thinking, and various shortfalls in municipal capacity. These obstacles reflected the reality and complexity of urban sustainability processes and highlighted the need to redesign current decision-making. Addressing issues that transcend humanmade borders requires new configurations, non-hierarchical decision-making processes, and using local knowledge as a key guiding tool. Our recommendation is that cities embrace systems thinking in sustainability planning and implementation by focusing more on holistic evaluation of policy impact and finding synergies among policies and stakeholders in all sectors.

Keywords Urban sustainability · Sustainable cities · Systems thinking · Sustainability assessment · Sustainability frameworks · Sustainable communities

1 Introduction

The impact of human activity on Earth in the Anthropocene ranges from extreme climate phenomena and inequality to ecosystem services decline and species extinction, and threatens human and ecological well-being locally, regionally, and globally [1, 2]. The Brundtland Commission was among the first to describe the connection between human activities and increasing environmental degradation [3]. The Commissions also voiced the need for sustainable development (SD) which today is generally conceived as the integration of environmental, economic, and social considerations in decision-making processes for the benefit of current and future generations [4].

In this “urban century”, planetary realities and increased environmental and social awareness have led to significant international agreements such as the United Nations Sustainable Development Goals (SDGs), the UN Habitat New Urban Agenda, and the Paris Climate Agreement [5]. While these are signed and ratified by national governments, local governments and their citizens play a crucial role in successfully implementing sustainability and resilience [6]. For example, although the SDGs contain a goal for inclusive, safe, resilient, and sustainable cities, all SDGs are locally relevant [7, 8].

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Urban areas today use more than two thirds of global resources, generate most global waste, and are projected to host more than two thirds of the global population by 2050 [9–11]. Yet they have huge economic, social, and ecological productivity potential and can offer innovative opportunities and long-term solutions for socio-ecological systemic issues [6, 12]. In this research, we focus on SD at the local community level (thus, sustainable community development or SCD) and particularly urban areas. We look at how the concept, principles, and practices of urban productivity can help address urban sustainability planning, implementation, and assessment (as major steps in the policy process) and thus advance theory and practice of SCD. This research contributes to SCD theory and practice not only by substantiating existing literature but also by proposing a framework grounded in case study findings and with principles and goals promoting systemic, long-term thinking.

The paper begins with a brief overview of urban sustainability literature and practice, a presentation of the urban productivity concept and a brief discussion of its potential to address urban sustainability processes and outcomes. It then presents two case studies in the Metro Vancouver¹ region of British Columbia, Canada, and the research findings on perceptions and challenges in urban sustainability planning, implementation, and assessment. These findings, grouped here in five major themes, helped refine the holistic Urban Productivity Framework through an iterative process. The final section discusses implications of the research findings and offers corresponding recommendations for integrated and effective urban sustainability through application of the urban productivity principles and practices.

2 Conceptual background

2.1 Planning, implementing, and assessing urban sustainability

Sustainability as a body of knowledge originates in 18–19th-century discourses on environmental and social justice but contemporary SD theory and practice have been shaped by seminal works of the 1970–1980s such as Rachel Carson's *Silent Spring*, the Club of Rome report on limits to economic growth, and the Brundtland Commission report [4]. SD is a normative concept that encourages comprehensive analysis of economic, social, and environmental dimensions of a system [13]. SD and SCD gained popularity particularly after the universal agreement on the UN SDGs that promote systemic thinking, i.e., a holistic, non-linear approach that addresses the complexity of systems by integrating the above dimensions in all stages of decision-making [14].

Early applications of SD and SCD were informed by weak sustainability theory that assumes indefinite economic growth with efficiencies and innovation compensating for ecological damage [4, 15]. Strong sustainability, on the contrary, acknowledges the limits to growth and the need for holistic, long-term approaches to achieve resilience and well-being of socio-ecological systems (SES) [1, 14, 16, 17]. The literature on weak and strong sustainability reflects a decades-long debate on economic growth and whether resources should be managed with technology (weak sustainability) or by limiting demand (strong sustainability) [4].

Although the influence of eco-efficiency still exists in local sustainability policies and projects, these are nowadays gradually shifting toward stronger sustainability. Guided by stronger sustainability approaches and global movements for equity, socio-ecological considerations are increasingly included in local decision-making through community-led action, social economy, community economic development, and participatory processes [18, 19]. Nevertheless, cities still widely perceive SCD as an environmental and resource management framework; this has led to fragmented and siloed planning and implementation of goals that governments and citizens often consider conflicting [12, 13, 20, 21].

While many urban agendas, e.g. sustainable city, ecocity, smart city, resilient city, low-carbon city, green city, compact city, eco-urbanism, and “climate urbanism” operationalize SCD, in practice most do not seem to adopt a systemic perspective [22]. Some prioritize climate action, such as emissions reduction or green infrastructure, or economic growth over social equity and justice and others are executed within mainstream municipal operations or without adequate resources, equitable planning, and political will [4, 13, 23–25]. Additional obstacles include ineffective collaborative processes, persistence of a greenwashing mentality, limited local government financing or mandate, and absence of regular and reliable data [26, 27].

¹ For an overview of the Metro Vancouver federation of 21 municipalities, one Electoral Area and one Treaty First Nation, please see: <http://www.metrovancouver.org/about/Pages/default.aspx>.

Despite limitations that hinder disruption of current extractive paths, cities often adopt one or more agendas and one or more sustainability frameworks or tools [8, 23, 28]. Sustainability frameworks can be broadly defined as “the rationale and the structure for the integration of concepts, methodologies, methods, and tools” [29, 30]. Designed by various organizations, most such frameworks emerged since 2000 and usually comprise principles, goals, and metrics to guide a community through some or all stages of the policy cycle: from agenda setting and policy formulation to implementation, monitoring, and evaluation or assessment [23, 31].

Comprehensive tools are needed to guide the city toward balanced goal achievement and to increase stakeholder involvement in transparent processes throughout the entire policy cycle. One such tool is the Community Capital Framework (CCF); the CCF and the Community Capital Tool (CCT) that operationalizes it are versatile, scalable, and designed to support holistic decision-making at all stages with comprehensive graphics and citizen input [29]. The CCT, a valuable tool in the two case studies and inspiration for the Urban Productivity Framework below, is composed of the Scan (evaluating impact of municipal policies) and the Balance Sheet (monitoring and reporting progress) [32].

Apart from the CCT, for this research we consulted sustainability frameworks such as the SDGs, LEED v4.1 Cities and Communities, Global Resilient Cities Network (City Resilience Index), ISO37120 Sustainable cities and communities, EU Reference Framework for Sustainable Cities, International Eco-City Standards, Community Foundations of Canada Vital Signs, One Planet Communities, Eco2Cities, and The Natural Step. Many tools and frameworks, however, do not analyze urban sustainability with a whole-systems, full-process, equitable, and future-oriented approach to ensure success in achieving sustainability goals [23, 33, 34].

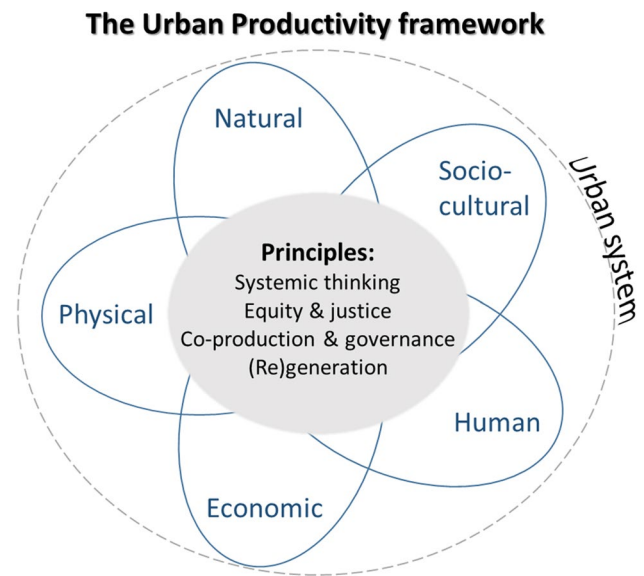
2.2 Urban productivity: a concept and a framework

Urban sustainability requires integrated decision-making to support a transformation from the currently dominant individualistic approach of impact reduction to the systemic logic of urban systems restoration and inclusive co-production [14]. The emerging SCD concept of holistic urban productivity can help cities address constraints and create fundamental changes in urban processes to achieve optimization and regeneration of tangible and intangible assets.

Although productivity is historically associated with economic and labor resources, holistic urban productivity is interdisciplinary, multi-dimensional, and grounded in strong sustainability principles (for a detailed examination of the concept's and the framework's theoretical background, development, and components, we encourage the reader to consult the cited article) [32]. Conceptually, it has been informed by numerous theoretical traditions and approaches:

- The neoclassical definition of economic and labor productivity as the ratio of given output per given input and the Total Factor Productivity theory that added natural resources, knowledge, and policies to this ratio;
- Resource productivity and circularity that starts with urban metabolism (flows) analysis and encourages product redesign, resource regeneration, resilient infrastructure, and overall closing of technical and biological cycles in production and consumption;
- Ecological productivity that pursues the restoration of urban ecological processes and a healthy relationship between humans and the natural environment through biophilic design principles;
- Regenerative design which is rooted in living systems theory and indigenous ecological wisdom and promotes urban fabric optimization, ecological spaces restoration, and reduced energy and materials consumption and ecological footprint;
- Regenerative development that seeks alignment and synergies with the natural environment and regenerative sustainability that advocates for strong and healthy socio-ecological systems through holistic design and collaborative planning;
- Socio-cultural and human productivity that encompasses equity, inclusion, institutional and social trust, justice, connection, education, happiness, health, and well-being, and aims to increase collective and individual resilience and capacity for sustainability transformations;
- Future visions that entail reclaiming, co-producing, and co-managing the urban commons (i.e., the right to the city) through inclusive processes and partnerships with all stakeholders, sharing of assets and spaces, creativity, plurality, and redundancy;
- Doughnut economics that urges to not only stay within planetary ecosystem boundaries but also ensure that everybody meets their basic needs (referred to as social boundaries);

Fig. 1 The holistic urban productivity framework [32]



- Whole systems thinking that converges the above concepts and approaches into a foundational requirement for urban productivity to create healthy communities and long-term well-being across all community components [5, 8, 9, 28, 33, 35–50].

Operationally, urban productivity has manifested in the form of context-specific or sector-specific projects. Initiatives such as restorative justice programs, reclaimed and regenerated spaces, free community-run libraries, innovation districts with green space and transit hubs, social innovation and sharing economy, and inclusive training for young entrepreneurs, can be found worldwide, from Vancouver, Canada, and Kigali, Rwanda, to Copenhagen, Denmark, and Medellín, Colombia [32].

Informed by the above, the holistic Urban Productivity Framework aspires to help improve currently ineffective sustainability practices such as siloed, inequitable, or fragmented planning, implementation, and assessment (Fig. 1). Unlike other frameworks, it is not meant to solely measure municipal service performance or climate action progress. Rather, it is designed to holistically evaluate policy impact while identifying systemic synergies to support transformative action toward cities that decouple well-being from economic growth and live within planetary boundaries [32].

The niche of this holistic framework lies at the intersection of its four principles:

- Systemic and long-term thinking (strategic, synergistic, integrating social productivity approaches, and future-oriented through backcasting i.e., following sustainability paths toward pre-determined long-term goals);
- Equity and justice (solidarity, food security, sharing, equitable resilience, social connection, equitable opportunities, and well-being);
- Urban co-production and governance (inclusive and value-driven decision-making, citizens co-produce and co-manage the urban commons as important change agents);
- (Re)generation (living systems perspective, circular flows of tangible and intangible urban assets, adaptive processes, living within the Earth's carrying capacity).

Context-specific analyses and inclusive planning processes are paramount to reveal synergies among these goals in an urban system. The framework can help guide a city throughout the various stages of the policy cycle, including progress assessment. To this end, we accompany it with a set of generic goals for each component of urban productivity and sample quantitative and qualitative indicators [32]. The indicators have been primarily informed by the theory and practice of the concepts and approaches the framework converges and builds upon. They have also been further shaped and refined following discussions with subject matter expert staff in the two case studies who offered valuable feedback on the definitions and units of measurement of each indicator.

Overall these indicators are geared toward the productive, regenerative, and socio-cultural aspects of the community and are designed to be used additionally to the more mainstream sustainability indicators. Holistic urban productivity

indicators include for example: growing space per dwelling unit, land use mix, net-positive buildings, local innovation, positive health practices, life satisfaction, confidence in local government, and cultural access and participation [14]. Data can be collected both from common data sources, such as archival provincial, regional, and federal records, and through surveys and engagement methods that the city can conduct in collaboration with community stakeholders.

3 Research methods

This research started with a review of the literature on sustainable community development, urban sustainability and holistic urban productivity and related concepts and initiatives. We then engaged a mixed-methods, information-oriented case study approach, integrating a participatory process with qualitative and quantitative data collection and analysis [51–53]. We conducted two in-depth case studies with municipalities in British Columbia, Canada, established opportunities to embed holistic urban productivity in sustainability processes, and formed recommendations for research and practice.

The research design was a flexible and comprehensive, three-stage roadmap for conducting the case studies and collecting a wealth of data. In the first stage, two municipalities were identified as the units of analysis and data collection instruments and protocols were prepared. In selecting cities factors of funding and local focus and archival data demonstrating the potential of were considered. Both cities had also expressed interest in this research and in receiving tangible recommendations for their sustainability processes.

In the second stage, data on each case study were collected. The majority of data stemmed from the study of strategic policy documents, 30 interviews with city appointed and elected officials, 36 expert municipal staff consultations, 16 City Council meeting observations, and engagement in workshops with more than 40 residents who were members of the local community foundations or other established groups (these community members provided context on the community's needs and expressed aspirations for their community's sustainability). Some quantitative data were also obtained through a short survey component in the interviews and an overview of contextual information retrieved from archival sources such as Statistics Canada and municipal records.

The concept and principles of holistic urban productivity were discussed in the case studies without explicitly mentioning the term “productivity” to ensure that participants would not immediately associate it with economic and labor resources only (as is commonly the case) and that we would receive responses on all aspects of urban productivity. During the case studies, the urban productivity framework was still in the draft stage of its development and thus was only indirectly explored in the interviews or in other conversations with participants either through the use of holistic productivity language and concepts or through discussions on holistic productivity goals and metrics; the approximation with the CCF's six capitals was used. It is worth noting that the conceptual framework for holistic urban productivity was developed through an iterative process informed both by the related literature, as presented above, and the findings of the two case studies.

The third research stage consisted of data analysis and further conceptual discussion. Microsoft Excel and Tableau were used for quantitative data entry, cleaning, aggregation, interpretation, and visualization, while QSR NVivo was used for a combined inductive and deductive analysis of qualitative information which formed the bulk of research data collected. Finally, we'd like to note that most of the findings stem from data that have been aggregated in one dataset for two reasons: firstly, to ensure confidentiality and anonymity, as the number of participants in each case study was limited and potential identification of elected or appointed officials with the findings should be avoided per research ethics, and; secondly, because initial comparative analysis clearly showed that on most occasions the answers and opinions of participants from the two case studies completely converged (unless mentioned otherwise below).

3.1 The case studies

The units of analysis were the District of North Vancouver² (DNV) and the City of Maple Ridge³ (CMR). As described in their respective Official Community Plans (strategic planning and community development documents): CMR is a family-oriented community east of Vancouver and has a vibrant local economy and affordable industrial land and real

² Details on the District of North Vancouver can be found in the District's website: <https://www.dnv.org/>.

³ Details on the City of Maple Ridge can be found in the City's website: <https://www.mapleridge.ca/>.

estate (CMR has a Sustainability Plan which was studied as part of this research); DNV, one of three municipalities on Metro Vancouver's North Shore, shares key infrastructure and partners in the delivery of some services (DNV does not have a Sustainability Plan); and both are fast growing communities and work toward becoming prosperous, inclusive, supportive, and respectful of their diverse populations and natural environment [54, 55].

The two cities present similarities in total population, surrounding natural environment, and suburban character, and differences in household income and educational level (both are higher in DNV) [56–58]. Contextual research revealed three types of shared challenges: social (housing stock inadequacy and unaffordability and homelessness), infrastructural (wastewater management and transportation infrastructure), and economic (shortage of work opportunities and of local economic activity).

Many participants described their city as a “bedroom community” for Vancouver and a “creature of the province”. The latter statement is directly connected to the legislative context of local government in Canada. While federal and provincial governments share powers and responsibilities under the Constitution Act of 1982, local governments do not have constitutional status [59]. Provinces delegate powers to local authorities and, along with the federal government, they influence local matters directly through funding and strategies for immigration policy, infrastructure, housing, and transportation.

4 Research findings

Case study data analysis revealed topics or challenges that can be grouped into four major sustainability-related themes (and some miscellaneous findings): perceptions on sustainability and urban sustainability; issues and perceptions related to systemic and long-term thinking; barriers linked to local government powers and responsibilities; and issues in progress measurement and sustainability evaluation.

4.1 Sustainability perceptions

When asked how they perceive sustainable development, sustainability, and sustainable community, one third of all 30 interviewees viewed SD as a commitment to future generations and the continuation of current plans into the future. About 25% considered it as directly related to infrastructure whereas, interestingly, a different 25% linked SD to the need to reduce impact on the environment or at least consider environmental impact in decision-making. Lastly, about 20% of interviewees directly or indirectly referred to social and/or cultural aspects of sustainability.

Similar perceptions of weak, one-dimensional sustainability were also noticeable in Council and staff meetings we attended. Sustainability was referred to as the ability to financially maintain municipal assets that included only human-made infrastructure which was sometimes discussed as an acceptable way to replace natural processes interrupted by urban sprawl. It is worth noting that, at the time of this research, DNV participated in the provincial initiative Asset Management for Sustainable Service Delivery, while CMR was considering participating in the national Municipal Natural Assets Initiative to integrate natural assets into the city's core asset management processes [60, 61].

Following our request to describe a sustainable community, about one third of interviewees responded with examples in lieu of a definition and another third equaled a sustainable community with good land use planning and reduced environmental impact. The most frequently used keywords here were: balanced, complete, infrastructure, environment, energy, future, employment, people, and education. Words such as social, green, and management were also frequently used in examples about housing, smart growth, asset management, and environmental mapping and management.

Also, one participant incidentally alluded to the regeneration principle and goals of the Urban Productivity Framework: “If the sustainable city existed... I might have difficulty wrapping my head around how that would actually look like, but the concept of probably [be] mostly a net-zero cycle where your energy inputs and outputs are almost balanced.”

Regarding their city, most interviewees acknowledged that it could not objectively be considered a sustainable city. While many viewed their city as advanced or leading in environmental preservation and heritage protection, they believed that economic and infrastructure issues still kept the community far from their acceptable level of resilience or sustainability. Finally, a few explicitly associated their city's low level of sustainability with high levels of material consumption and waste and GHG generation.

For the last question on sustainability perceptions we showed participants the CCF's six capitals and asked them to rate each capital by importance for their city's decision-making on a scale from 1 (least important) to 5 (most important). The overwhelming majority agreed that the most important capitals were the physical and natural, closely followed by

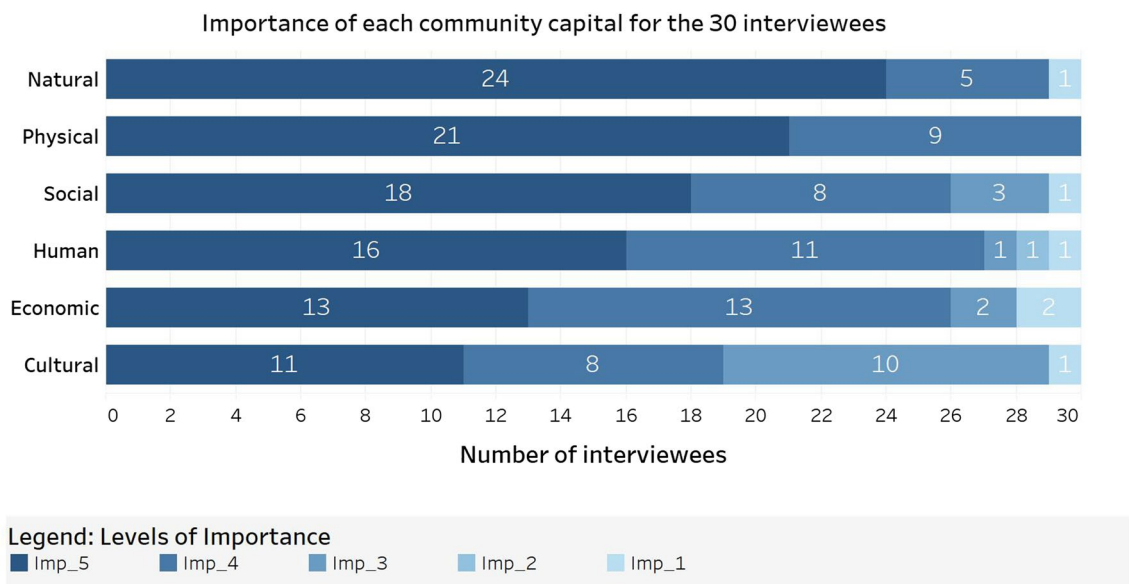


Fig. 2 Importance of each of the six capitals of the Community Capital Framework for the case studies’ 30 interviewees. Note that the scale is from 1 (least important—light blue) to 5 (most important—darkest blue)

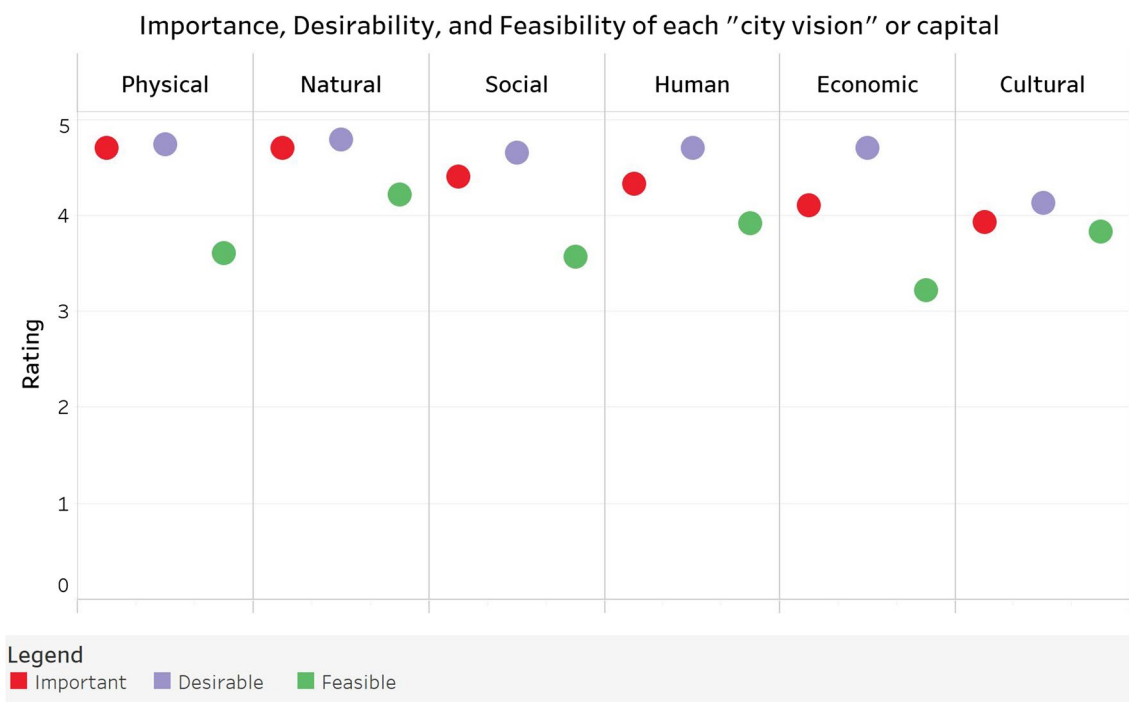


Fig. 3 Interviewees’ ratings for importance, desirability, and feasibility of six “city vision” elements (or CCF capitals)

the human, social, and economic capitals (Fig. 2). While these five capitals were rated almost identically in both cities, there was a difference in the cultural capital which was rated as highly important (= 5) by 50% of CMR participants but only by 21% of DNV participants; although the population in DNV is slightly more ethnically diverse than in CMR, this rating could be related to potential uncertainties due to the partnership with the City of North Vancouver in cultural programming and culture venues.

Seeking to gauge the potential of urban productivity, we asked a question that included productivity principles and goals in disguise, with language such as diversified employment, restored natural environment, circular economy, and healthy and connected community. Interviewees rated six “city vision” elements for desirability and feasibility (from

1 = not feasible/desirable at all, to 5 = fully feasible/desirable); the six elements correspond to the CCF's six capitals for comparability (Fig. 3).

All interviewees considered most elements as important and highly desirable but not necessarily feasible (Fig. 3). They rated the physical and natural capitals as the most important now and most desirable into the future. They linked the physical capital to their city's effort to maintain infrastructure and achieve energy efficiency goals, and the natural capital to their city's positive record of protecting surrounding nature. The economic aspect was also considered highly desirable which perhaps reflects municipal priorities for increased local economic development. Also, while both cities gave all capitals very similar ratings for importance and desirability, DNV interviewees rated each capital for feasibility slightly higher than CMR interviewees did. This may be related to median income levels and annual municipal revenue; as mentioned above the main revenue source is property taxes which are higher in DNV due to higher market values.

Comments on employment and housing in particular hid some pessimism that interviewees linked to the absence of related municipal power and the reality of being "bedroom communities". Some participants also repeatedly spoke about the lack of available land for industry and manufacturing in their city which for them constitutes a major economic drawback and reduces municipal revenue that could be used for improved infrastructure and other services.

In commenting on social, human and cultural capital ratings, many interviewees again alluded to the lack of municipal mandate for education and cultural protection. Some pointed to the changing demographics as both a shortcoming and an asset: the city may struggle to engage with and integrate a highly diverse community but socio-cultural opportunities may also increase thanks to citizen-led groups. Despite the above, participants eventually expressed a rather optimistic perspective for the future because they believed that their city's OCP already included objectives for all "city visions".

4.2 Systemic and long-term thinking

Systemic, long-term thinking is fundamental for sustainability in highly complex systems like cities. "Running a city is a massive job, it's like running 25 businesses really" (participant). Systemic thinking was not explicitly mentioned but sparsely implied in our data: several interviewees alluded to the interactions among policies, the potential consequences from heavily focusing on one aspect, and the need to adopt policies that promote balanced community development. A few interviewees connected these concerns to complexities inherent in local policy-making and community systems.

Many interviewees noted that decision-makers usually do not connect the dots among issues nor with the larger picture, i.e., the Official Community Plan or national and international goals. One person for instance wondered: "But how do things connect? And how good are we in connecting all these elements together?". Such responses revealed discrepancies between policy and practice; for example while DNV's Transportation Plan prioritized place-making "for people, not cars" with low-impact choices such as walking or cycling, our research data showed that in practice the city prioritized investment in additional road network.

Several interviewees discussed the need for long-term planning and informed decision-making through more or comprehensive information. They explained that in reality this did not occur often and provided examples such as one-off rezoning decisions or piecemeal OCP amendments. Similarly, Council meeting observations contained only a few occasions of systemic thinking when a Councillor inquired about the broader impact of a policy. Perhaps unavoidably though, any agenda topic would eventually be connected to other issues or the municipality's concerns at that time, e.g. economy or housing debates would at some point be linked to infrastructure, transit, or education.

Systemic thinking was also sporadically present in responses about the roles of Council and staff in municipal operations and sustainability decision-making. More than half of the interviewees agreed that Council's role was "higher up" and to provide direction, while city staff were viewed as subject-matter experts, knowledgeable about best practices, and required to provide relevant and professional information and implement the OCP based on Council directions. Overall, most interviewees implicitly acknowledged the systemic interconnections among City Council, municipal staff, and vision development and implementation.

A recurrent theme was about municipal departments often operating in silos, guided by their own specific priorities and path dependencies, without necessarily considering the impact of their work on other policies or coordinating with other departments. Only a few participants discussed this explicitly; for example: "there's a lot of different things I need to do that are going to compete with my sustainability goals. [...] I don't see everything through the lens of sustainability, [...] I have it really compartmentalized right now" (participant). This is supported by our review of documents such as CMR's Environmental Management Strategy and Strategic Transportation Plan: both briefly mention sustainability but propose policies of smart growth and additional infrastructure. Also during

the DNV case study we did not encounter the cross-departmental sustainability team reported to have been established in 2007 for a partnership with The Natural Step [62].

Another common thread was the perception of citizens as customers which has resulted in a separation of the city into two components: local government and community. This disconnect emerged repeatedly as participants affirmed the role of local government as simply delivering service to citizens. One interviewee explained that for Council the three-legged stool consisted of performance in sustainability, fiscal, and customer service, but in most cases “customer service and fiscal won over the sustainability” (participant). The example of waste management came up several times in the interviews: if citizens want weekly garbage pick-up and are willing to pay more, the city must deliver accordingly – even if this means increased volumes of garbage and CO₂ emissions.

Systemic thinking for sustainability also requires long-term planning, although this may be overlooked in practice: “our planning tends to be short term or catches up” (participant). Many interviewees believed that, without long-term goals, decision-making and prioritizing were reactive and fragmented, resulting in insufficient citizen involvement and decisions detached from set strategies. They acknowledged short-termism, i.e., what people want at a given moment and in the near future, as a multi-faceted barrier: politicians may not be re-elected if they aim for longer term goals and citizens may perceive their impact during one election cycle as negligible and thus focus on shorter-term benefits. Some interviewees also noted that the community is constantly in election mode and that only citizens opposing or directly interested in a policy are vocal. More than one third stated that Council should think in horizons that are much wider than electoral cycles and “plan for the future” (participant) by helping develop the community’s long-term shared vision and working with staff to ensure implementation.

4.3 Local government power

A significant obstacle to successful sustainability planning and implementation is related to the perceived inability to influence decision-making. Several interviewees expressed concerns that they couldn’t make a difference or resolve issues in aspects such as the energy mix or socio-economic opportunities and equality. Their influence was perceived as low or not meaningful, leading to fragmented action or even inaction. Land use was the most frequently mentioned policy area that local governments have absolute control over; a few interviewees also stated that any development (such as sustainable development) starts with planning land uses.

Energy is another example reiterated in half of the interviews and during several Council meetings, either in the context of waste (waste management or waste-to-energy) or regarding building and transportation energy efficiency and greenhouse gas (GHG) emissions. Energy decisions, particularly those seeking to reduce energy consumption and building emissions, are not entirely within the local government’s purview. Although both cities have GHG emission reduction targets, they can control such policies for municipal facilities only. However, as many participants observed (some with concern), the city can “at the end of the day [...] communicate as stewards and lobby higher levels of government” (participant) to influence other energy-related policies.

This perception of low ability to influence policy-making also came up about intangible community aspects related to social, cultural, human capitals. Several interviewees explained that, in combination with the anticipated lack of influence, they would not pursue a policy if tangible, measurable, or immediate results could not be expected: what matters in city management is what can be measured (example quote from a participant: “nothing is fixed unless it’s measured”).

What is measured however is directly influenced by local government power and capacity. In our case studies, we repeatedly heard that sustainability processes can be hindered by a limited service delivery mandate which regulates municipal resources and capacity levels accordingly. Some interviewees compared their cities to European cities whose sustainability action benefits from broader powers and support from national governments, the European Union, and active citizens.

The most prevalent obstacle mentioned as directly linked to the complicated governmental system is the availability and allocation of funds. Municipalities in B.C. expect provincial or federal funding to act on issues that they do not have mandate for. The provincial and federal governments were frequently mentioned in both case studies regarding the need to advocate or apply for funding or when discussing sectors over which the provincial government has clear authority. Interviewees mentioned repercussions such as policy-making inflexibility and a slow-moving governmental system.

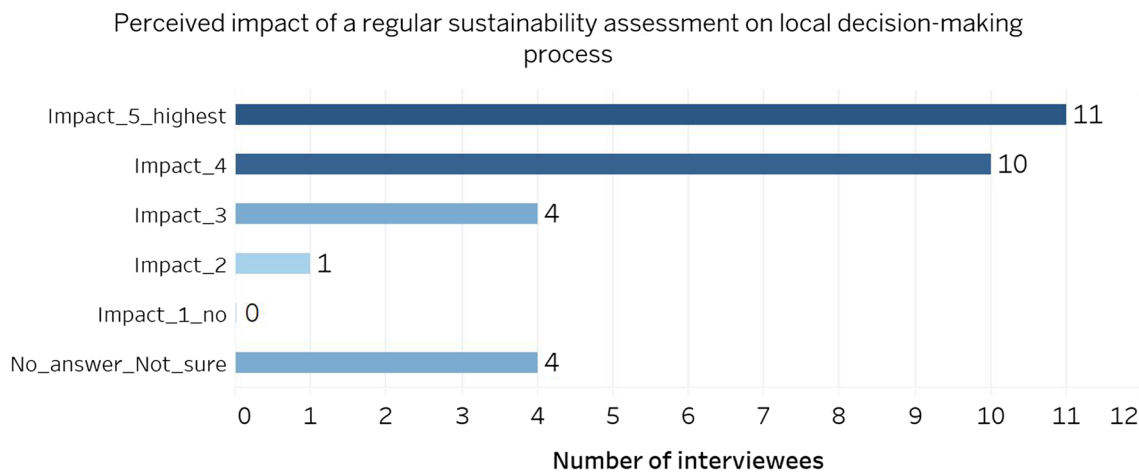


Fig. 4 Responses to the forced-choice question: “On a scale from 1 = no impact to 5 = highest impact, how would you rate the impact of a regular sustainability assessment on a city’s decision-making processes?”

4.4 Assessing urban sustainability

When asked whether a sustainability assessment tool would be useful in their city, most interviewees responded that it would provide value if used to evaluate strategic documents such as the OCP and area plans, as it might become onerous if applied, for instance, to every development application. They attached however some conditions: the tool should be accurate, populated with timely and valid data, well structured, clear enough to prevent contradictory interpretations, and adaptive to align with forward-looking goals so that citizens contribute to, accept, and support it.

Most respondents also believed that a regular sustainability assessment would greatly affect decision-making (Fig. 4), by revealing broader impacts of a policy, supporting policy continuity, helping decision-makers prioritize, and enabling comparisons over time and adjustments. Also, if the process is transparent, “in a lot of ways it can also educate the community” (participant). Lastly, while most interviewees would welcome a full city-wide sustainability evaluation annually or biannually, some would also like to see sustainability impact assessment entrenched in daily operations, perhaps as a regular section in reports to Council.

We then asked participants to choose their preferred way of benchmarking among these options that stood out as the most common ways of benchmarking in our review of sustainability assessment literature and sustainability frameworks or indicators systems: (a) measuring progress toward set policy goals and targets, (b) measuring progress against scientifically based sustainability targets, (c) comparing to a baseline assessment of the city’s sustainability, or (d) comparing to other municipalities in the region, in Canada, or abroad. Almost all interviewees expressed difficulty in choosing only one option. Most favored a combination of options (a), (b), and (c), but eventually more than one third chose (a) and one fifth chose (c) (Fig. 5).

Several interviewees explained their choices as context-dependent (“make it work for your specific location” – participant), reiterating that each community is different and that transparency and accountability about assessment is more important than adopting standards for the sake of comparability (per the assumption behind option d). Overall, most agreed that a baseline assessment and science-informed goals and targets would make data collection meaningful and would help identify progress or barriers; a few also noted that local governments have to measure and report on progress anyway.

Building on the previous questions, participants selected their preferred attributes of a sustainability assessment framework they would recommend for use in their city. We offered some options but encouraged additions. The most preferred attributes were user-friendliness, communicability, and resonance with the community (Fig. 6). Other important factors were user time investment, outputs that enhance decision-making, scalability, and cost, with the latter deemed as less important if the tool provided high value and long-term benefit. Participants reiterated that they wanted an intuitive tool, easy to embed in municipal operations, and independent from electoral cycles. They described an ideal tool as self-explanatory, visual and interactive, transparent, in lay language, consistent with community values, and flexible enough to “grow with the community” (participant).

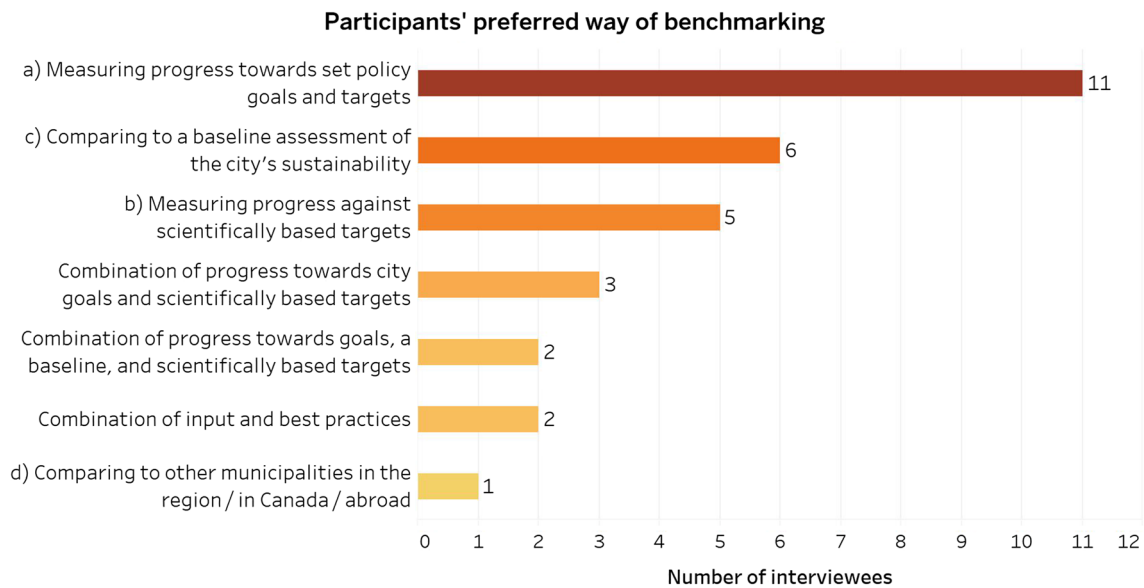


Fig. 5 Responses to the forced-choice question: “What would you say is the best way of benchmarking for your city?”

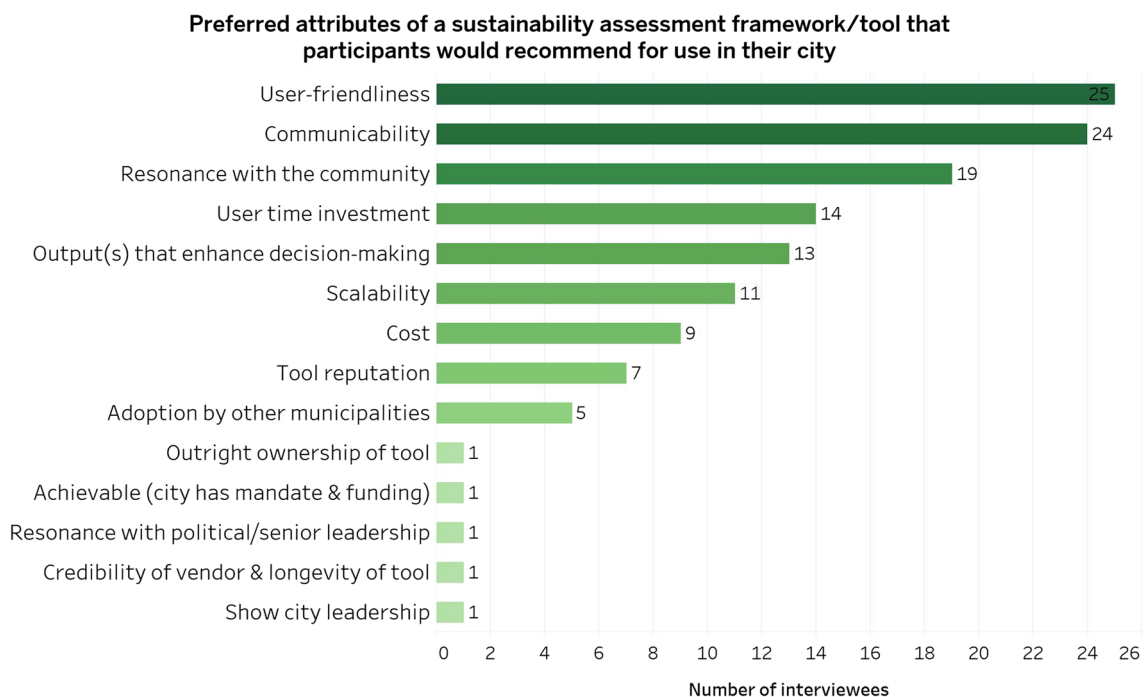


Fig. 6 Responses to the select-all-that-apply question: “What characteristics would you want a sustainability assessment framework to have in order for you to recommend it for use in your city?”

Collection and management of data for sustainability assessment and progress evaluation was not only discussed in interviews but was also the main topic of many meetings with staff in both cities. We extensively consulted with subject-matter expert staff about the potential use of several holistic urban productivity indicators in their city; we discussed relevance of indicators, suggested targets, direction, and units, data availability and sources, etc. We particularly proposed indicators related to socio-cultural and human productivity and some indicators on natural, physical, and economic aspects to be measured in addition to mainstream sustainability indicators. These suggestions

were initially informed by the academic and practitioner literature on concepts and approaches that the holistic Urban Productivity Framework converges and builds on.

The initial reactions to the proposed indicators were generally positive as staff supported the expansion of the city's metrics database to measure more dimensions and in more depth so as to have better picture of the city's sustainability state and progress. These reactions may in part be attributed to the two cities measuring limited ecological, economic, and social indicators that for the most part did not correspond to sustainability-related goals or policies. They were used because of convenience or simplicity in data collection (e.g. another governmental or non-governmental body is responsible) but they mostly assessed staff performance, plan completion (not plan implementation), or population demographics, or measured a negative side of policy impact (e.g., numbers of crimes or offences but not perceptions of safety and cohesion).

Although data such as those currently collected enhance understanding of the community and contribute to informed decision-making, we noticed a lack of community assessment indicators that would measure various resource flows within the community and the impact of policies on all aspects and assets. Both cities seemed to focus on measuring assets or aspects that could easily or readily be quantified but had barely any indicators for intangible community assets.

Many of our holistic productivity indicators pertained to the socio-cultural and human productivity but in most cases staff raised objections to adopting them in practice. They attributed this to the lack of: timely and reliable data; adequate human resources for data collection; and/or financial resources for new databases and portals. Specifically the difficulty to obtain reliable, adequate, frequent, and locally useful data and the extensive reliance on data from external sources (e.g. national census, regional surveys, etc.) stood out in most discussions. Additionally, whole-community surveys were conducted infrequently and would lead to unreliable data due to the low number of responses; project-based consultations with citizens were more frequent but limited in scope. Nevertheless, expert staff offered valuable feedback and helped us refine the list of indicators.

After recognizing the significance of abundant and good quality data for decision-making, senior staff in particular appeared reluctant to assign their teams additional, data-related work, emphasizing that staff had reached capacity for the mandated service delivery. They generally advised against assigning data tasks to one person per department and suggested instead to have one data coordinator for the entire municipality. On a similar note, some interviewees implied that their city would need to reconnect data collection and reporting with strategic goals such as those in the OCP.

Finally, some participants added that all local government work must be justified in terms of value created for the community and therefore the cost-effectiveness of data collection must be visible to citizens. This is another reason why most of the socio-cultural and human productivity indicators we suggested were not embraced in the two cities; they would measure intangible and subjective urban assets and, according to staff, this would not align with Council's (and constituents') priorities at the time. Perhaps the above also partly explains why one of the case municipalities had established a citizen group tasked, *inter alia*, to review the OCP monitoring processes.

In a nutshell, as several participants mentioned, limited mandate, short-termism, and overall municipal capacity are the main constraints that can obstruct sustainability data collection and management. Almost all participants agreed that this process should require minimal effort, with streamlined and efficient measurement processes, and a few in fact favored municipal investment in technology for connected databases and related training. In any case, the need for more data (in volume but above all in comprehensiveness) to better inform decision-making was repeatedly expressed both in meetings with staff and in the interviews as analysis showed.

5 Discussion

Working closely with municipalities provided us with valuable insights regarding urban sustainability application and the factors that determine or at least influence both action and lack thereof. Below we discuss the factors that seem to hinder and those that seem to help local sustainability planning, implementation, and assessment; either way, these findings helped shape the Urban Productivity Framework and recommendations for future research and practice.

5.1 Obstacles

Throughout the interviews and Council meetings, we identified weak sustainability perspectives indicating that local governments may tend toward a rather utilitarian (eco-efficiency) approach of resource and community management, with municipal assets signifying humanmade infrastructure only. Responses on defining sustainability and on the importance

of the physical and natural capitals were anthropocentric in focus, consistent with our observations of Council meetings: issues pertaining to local infrastructure, protection of the surrounding environment, and economic development dominated Council discussions in both cities.

Participants' descriptions of urban sustainability as mostly linked to land use, infrastructure, and impact reduction align with the literature on understandings and applications of urban sustainability [4, 12, 13]. For example, the constant concern about funding to develop housing and maintain infrastructure for these still sprawling suburban municipalities explains to some extent the increasing uptake of urban agendas such as smart cities and compact cities [12, 63].

Interestingly, while many interviewees defined a sustainable community as a "complete community", borrowing language from Metro Vancouver's Regional Growth Strategy, their descriptions typically included only one sustainability dimension [64]. Sassen has however explained that "a real city is complex and incomplete" because it is more than buildings, technology, and smart networks; it includes those who live in and visit it, its natural assets, its diversity and human innovation [65]. Metro Vancouver's current process of updating its Strategy is a promising sign in this regard, as it seeks to clarify that "complete" communities promote walkability, transit-oriented and mixed uses, inclusiveness, holistic health, and economic and socio-cultural equality [64].

The generally limited number of references to social sustainability in our data was noticeable: for instance, although Council and interviewees frequently discussed housing and education, these were commonly connected to the physical and economic capitals (stock/infrastructure and municipal finances). In both municipalities, trade-offs and conflicting interests often led to prioritizing shorter-term economic—and to some extent ecological—sustainability policies over social topics such as gender equality, governance, safety and well-being, institutional trust, culture and heritage, etc. Such findings are congruent with related literature about SD still viewed as a framework mainly for environmental management [13, 20].

Urban issues though are interconnected and cannot be tackled without systemic (broad and deep) analyses and iterative policy-making [59]. Several interviewees, for instance, hesitated to discuss local policies on health and education because of lack of jurisdiction, but almost all policy areas can impact the social and ecological determinants of healthy communities and ecosystems [29, 66]. Systemic analysis for effective decision-making also requires comprehensive and reliable data but issues in data availability, collection, and management and related municipal capacity are a reality.

The strong focus on efficiencies and the traces of path dependency we noticed may constitute another indication of insufficient systemic and forward thinking. Some participants for instance expressed concern about their municipality's continuing devotion to an OCP they considered outdated. Others firmly defended the current clearly distinguished roles of Council, staff, and citizens in decision-making processes and the potentially detached departmental operations. Such dichotomy between policy-makers and administration can be problematic though; urban systems are complex and require procedural and institutional flexibility [59, 67].

This ostensible resistance to systemic thinking could be attributed to other limiting factors we identified such as short-termism and the view of citizens as customers. Despite their separate responsibilities, both staff and Council appear to be influenced by the short electoral cycle. Similarly the singular focus on service delivery promotes a perception of disconnect between local government and citizens. Local government effectiveness appears contingent on resident willingness to pay and municipal performance assessment outweighs the holistic assessment of a policy's impact [59].

To achieve long-term sustainability thinking in local government, as an interviewee said, they "would need a department, people to drive the messaging, the mandate, and innovate and create ideas for the city" (participant). In growing cities like the case municipalities, the range of backgrounds, values, and needs of the constantly changing demographics cannot be easily reflected in one vision statement. If consultation processes do not meaningfully or adequately involve all citizens in vision development and implementation, this may lead to top-down place-making and the decreased sense of community that some participants alluded to. Such processes can undermine systemic analyses and, by extent, inclusive decision-making and governance [68, 69].

Lastly, the above obstacles need to be considered within the structural context in which Canadian local governments operate; municipalities are "creatures of the province" and receive "delegated authority" by the provinces [59]. Not only are local governments endowed with limited mandate but their revenue sources are limited to property taxes and economic activity fees (both can be quite low in "bedroom communities"). Municipal operations' dependence on federal and provincial funding can reduce local resilience and capacity to analyze urban and other connected systems and identify synergies for large-scale, transformative change [5].

Participant perceptions reflect the reality and complexity of urban sustainability decision-making processes in Canada and elsewhere, as described in the literature [21, 59, 67]. The disparities in interviewee responses about municipal capacity, sustainability interpretation, and progress assessment suggest that integrated decisions on principles, vision, and

priorities need to precede decisions on implementation and assessment. Perhaps now is the time to secure municipalities' place in the constitutional order by legally recognizing them and by clearly articulating their powers in the federal or provincial acts while respecting provincial autonomy [70].

5.2 Opportunities and recommendations

While the above limiting perceptions and obstacles overall support existing literature, the case studies also provided insights that enhanced the Urban Productivity Framework and the recommendations for municipalities in Canada and beyond. Some findings encouragingly point to participants' openness to embrace well articulated, long-term goals developed with inclusive citizen engagement and supporting both the local vision and the international agreements. Aligning local goals with the national context and the country's international commitments is an important opportunity for urban sustainability. Policy coherence among various levels of government and with global goals can help boost municipal influence over sustainability aspects that cities now do not have direct control over (in Canada at least) [59].

The intent of global outlook, of course, is far from local policies simply copying best practices from around the world. Several interviewees for example expressed the need to attend to local context during several stages of the policy cycle, including assessment through locally relevant tools and indicators. Unlike urban developments branded as "eco", "sustainable", or "smart" but in practice offering luxury housing and becoming resource-consuming and socio-culturally disconnected, embracing holistic urban productivity will enable cities to connect past, present, and future [71–73]. Cities are thus urged to identify sustainability practices and metrics that fit their community values and can be adapted to their context: local nature, history, needs, culture, nature, ways of being, the thousands-of-years relationship of Indigenous people with the land, key patterns of success, core identity, etc. [74].

Cities also need to redesign current decision-making that perceives citizens as customers, through application of urban productivity principles of co-production, governance, equity, and justice. The holistic Urban Productivity Framework can help local governments to move beyond participation models and New Public Management approaches (i.e., seeing the city as a corporation that delivers service) toward inclusive, cross-sector, comprehensive, and multi-level partnerships that promote social justice [8, 24, 49, 59]. The development of a shared vision requires broad community involvement and agreement. Manifesting shared values and priorities through visioning and storytelling can strengthen socio-cultural aspects and policy evaluation [29, 75].

By employing, for instance, the future-oriented backcasting method in their sustainability planning, cities could not only motivate citizens to engage but they will also be able to collectively identify the necessary steps toward their goals [42]. Complementarily, community-based initiatives can empower citizens through direct involvement in urban place-making, progress indicator selection, and data collection (particularly subjective, qualitative data) while benefiting from local, traditional, and cultural knowledge [36, 76].

Whole-systems training for planners, engineers, and other city professionals is recommended to overcome short-termism and siloed thinking. Recent research on the roles and competences of sustainability managers in cities corroborates this statement: strategic and systemic thinking, change management, and multi-disciplinary collaboration are some of the most important skills and qualities for senior staff in such positions [77].

Local governments need to embrace holistic thinking in sustainability planning and implementation by focusing more on systemic evaluation of policy impact, finding synergies among policies and stakeholders in all sectors, and incorporating ecosystems in their asset management policies [4, 60]. Acting toward long-term goals and upon priorities that have potential for greater impact in most community aspects can also help combat obstacles of limited power and short cycles while transforming institutional structures and social practice [26].

Local governments could use the Urban Productivity Framework as a compass to help pursue balanced and synergistic optimization of community elements (economic, physical, ecological, socio-cultural, and human) (Fig. 7). Holistic urban productivity principles such as systemic analysis and regeneration can help cities set goals beyond impact reduction and environmental protection. Integrated resource regeneration and circularity, species and habitat restoration, and regenerative and inclusive urban food systems would then become entrenched in urban processes, while also building up individual and collective skills, fulfillment, and resilience.

Our overarching recommendation is that cities should build on the signs of systemic thinking we spotted in the data, through continuing education and adoption of tools such as the Urban Productivity Framework that fosters whole-systems processes. Sustainability assessments are a snapshot of a dynamic system in time and must be connected to local and global goals set through long-term outlook. We would recommend regular assessments (annually

Urban sustainability – Research findings	Case studies: major themes in findings	Holistic urban productivity – A systemic lens
<ul style="list-style-type: none"> • Environmental impact reduction • Financially maintain infrastructure • Good land use planning • Energy efficiency 	Sustainability perceptions	<ul style="list-style-type: none"> • Ecological restoration • Resource regeneration and circularity • Energy and material consumption reduction • Net-zero built environment
<ul style="list-style-type: none"> • Dependence on electoral cycle • Reactive action • Siloed operations • Disconnect between local government and citizens 	Systemic and long-term thinking	<ul style="list-style-type: none"> • Whole-system, synergistic, and long-term planning and impact evaluation • Inclusive, multi-level, cross-sector partnerships throughout the policy process; equity
<ul style="list-style-type: none"> • Inability to influence decision-making • Limited power and mandate • Municipal resource constraints • “Bedroom communities” 	Local government power	<ul style="list-style-type: none"> • Truly complete communities with local opportunities • Community-based initiatives; Indigenous, traditional knowledge • Formal Constitutional status for Canadian local governments
<ul style="list-style-type: none"> • Data: not adequate, timely, and reliable • Insufficient human resources • Disconnected monitoring programs from goals/vision • Reluctance to assign data-related work to staff 	Assessing urban sustainability	<ul style="list-style-type: none"> • Long-term outlook for goal setting linked to progress assessment • Regular, inclusive, community-wide assessments • Holistic urban productivity indicators (in addition to mainstream indicators)
<ul style="list-style-type: none"> • Low awareness of non-local matters • Focus on short-term, local ones 	Localising the SDGs	<ul style="list-style-type: none"> • Long-term, multi-level outlook • Education and awareness for all stakeholders and decision-makers

Fig. 7 This figure links the principles and generic goals of the holistic urban productivity concept and the proposed framework with the urban sustainability shortcomings as identified in the research findings to suggest a direction for the future development of cities

if possible) that could be gradually streamlined and embedded as iterative processes that highlight synergies and potentially necessary adjustments.

In our reports to the case study municipalities, we advocated for frequent citizen surveys to help measure intangible aspects of the community (particularly socio-cultural and human). We also proposed a set of indicators influenced and informed by the urban productivity literature, language, and framework. They would be used in addition to more mainstream sustainability indicators but, while some were immediately embraced, most were listed for future consideration depending on available resources.

Future research in collaboration with more cities worldwide will further refine the Urban Productivity Framework and its suggested generic goals while enhancing its applicability at different scales and local contexts. It will also allow researchers and practitioners to test and adjust the proposed urban productivity indicators. This framework's suggested goals and metrics can be transformed into questionnaires and other specific tools to help uncover community values and needs and develop a shared vision through multi-stakeholder engagement and collaboration.

The particularity of conducting only two, albeit in depth, case studies and in a Global North country limits drawing definitive generalized conclusions. Therefore further research in Global South cities is required so as to explore the flexibility and adjustability of the concept and framework of holistic urban productivity. Expansion with case studies globally can help promote the concept's systemic viewpoint and establish the transition toward urban space

co-production and co-management with effective and inclusive decision-making processes that can help cities live within the Earth's carrying capacity.

6 Conclusion

Current global calls for climate action coupled with social justice and equity offer a window of opportunity in the journey toward the productive and sustainable city. Youth activist leaders such as Autumn Peltier and Greta Thunberg and equity movements led by Black, Indigenous, and People of Color, and LGBTQIA2S + create change by increasing awareness and mobilizing citizens while ultimately bringing these issues into the political agendas worldwide.

This research identified a range of challenges and obstacles to urban sustainability that the concept and framework of holistic urban productivity can help address. This emerging concept (with its principles and practices) offers a multi-disciplinary approach that acknowledges the interdependence of systemic components and enables individual and community well-being. The case study findings helped enhance this framework and the development of recommendations for municipalities in Canada and beyond and for further research.

Holistic productivity principles and practices can help cities operationalize SCD with systemic and adaptive objectives and metrics to transform ineffective processes and tackle issues of fragmented thinking and implementation and short-termism. Politicians and professionals will also benefit from training on design thinking, resilience and adaptive socio-ecological systems, systems thinking, and long-term planning. These, combined with recognition and reconciliation, can help release human potential for sustainable development.

As shown in the discussion about opportunities and recommendations, holistic urban productivity components such as whole-systems thinking, co-production, and regeneration have the potential to respond to current issues, enhance local sustainability processes, and optimise stocks and flows of tangible and intangible assets. By reaching holistic urban productivity goals, cities can become not only well-functioning systems but also sustainable, both in a literal sense and in terms of intergenerational and intragenerational well-being within the Earth's carrying capacity.

A pathway such as the one proposed in this paper embodies a living systems perspective, with holistic and long-term thinking, and respect the limits of local and global resources acknowledging that humanity is embedded within the nature and not external to it [78]. In addition, to overcome data issues in their sustainability decision-making, cities are encouraged to use non-traditional data sources, e.g. satellite data, citizen-generated data, and anonymized data from the private and the non-profit sectors; a solution endorsed by the United Nations as well [79].

Grounded in this research we posit that cities would make more robust decisions if they welcomed visioning, networking, learning, connection and relationship building, and compassion tools that reflect the non-quantifiable part of the sustainability picture. Cities can achieve sustainable urbanization by promoting the right to the city and the design of nature-based urban environment without compromising collective and individual health and well-being [14, 80]. Addressing twenty-first century issues that transcend municipal borders requires new configurations, non-hierarchical decision-making processes, and using local knowledge as a key guiding tool [59]. As Sassen and others posit, a city should embrace diversity, transdisciplinarity, and uncertainty and thrive by being flexible, creative, and inclusive [26, 65]. "The sustainability revolution is nothing less than a rethinking and remaking of our role in the natural world" (David Orr, in Edwards, [81]).

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Data availability For this study, qualitative and quantitative data sets generated and analysed were anonymized according to research ethics and are not publicly available due to the number of participants but are available from the corresponding author on reasonable request.

Code availability Not applicable.

Declarations

Ethics approval and consent to participate Ethics approvals according to Simon Fraser University's standards and policies were obtained prior to conducting the case studies and all participants provided informed consent.

Competing interests Not applicable.

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