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A taxonomy for indicators related to the Sustainable Development Goals

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Preface

In this document we present a *taxonomy* for classification of any indicator relevant for the UN Sustainable Development Goals (SDGs). The taxonomy was developed on commission by KS, the Norwegian Association of Local and Regional Authorities, with the purpose of sorting, evaluating and comparing different SDG indicators and indicator sets. As part of the commission, other suggested taxonomies for classification of SDG indicators have been reviewed and evaluated.

Statistics Norway, 2. mars 2021

Arvid Olav Lysø

Abstract

In this document we present a *taxonomy* for classification of indicators related to the Sustainable Development Goals (SDG), commissioned by KS.

Our point of departure has been to identify the central properties and characteristics of an indicator or an indicator set that we regard as necessary to establish for the various uses relevant to the SDGs. In the proposed taxonomy they are organised under three *dimensions*:

- *Goal,* which tells us *what* an indicator is about, i.e., which SDG goals and targets, and which TBL (Triple Bottom Line) it may be related to.
- *Perspective,* which clarifies *why* or in which context the indicator is used (the user's perspective).
- *Quality,* which measures *how useful* the indicator is, i.e., if it is fit-for-purpose.

These three overarching dimensions give the taxonomy a clear and logical structure. They cover all the relevant elements in other classification systems, which we have come across in the literature. Changes in future user needs, which most likely will take place, can be accommodated by adjusting certain elements of the relevant part of the taxonomy, without the need to alter the basic structure.

Applying the same taxonomy to all indicators helps to clarify and compare both their uses and their usability, for users who work in different sectors or at different geographical levels. It can also make it easier to reuse the indicators that have been classified and evaluated by other users.

We have developed the taxonomy in close collaboration with KS, with the emphasis of developing a tool that is practical and helpful at the regional or local level. Meanwhile, the taxonomy is designed generically, in a way that makes it equally well suited for users at a national or global level.

This document is organised in four Sections. Section 1 provides a general introduction to this work. Section 2 presents the taxonomy, along with explanations and discussions and a selection of Questions and Answers that may be helpful to the reader. Section 3 contains a review of the literature, where the reader will also find further details on several issues underlying the proposed taxonomy. Finally, in Section 4, we illustrate the practical considerations a user may need to take when applying the taxonomy, by employing four examples related to public transport, sewage, wind power and school, respectively.

Contents

1. Introduction

1.1. Background

There is considerable interest in indicators that are applicable for the United Nations Sustainable Development Goals (SDG). We present here a *taxonomy* for SDG indicators developed by Statistics Norway (see also Zhang et al. 2021, in Norwegian), commissioned by KS, the Norwegian Association of Local and Regional Authorities. KS is the organization for all municipalities and county councils in Norway and is the largest public employer organization in the country.

The proposed taxonomy is a classification system, which can be used to *classify* and *assess* either a given indicator or a set of indicators. Applying a common standard taxonomy to all SDG indicators helps to clarify their *use* and *usability*, either each on its own or in comparison to others.

The UN global SDG framework consists of 17 goals and 169 targets. KS is particularly concerned with tools that can be useful for connecting these global sustainability goals to activities and projects at regional and local levels. As the central statistical bureau and coordinator of the national statistical system in Norway, Statistics Norway is a natural partner and shares KS's interest in developing a taxonomy for SDG indicators for this purpose. As part of this work, other proposals of classification systems are reviewed and assessed with respect to the needs of KS, with the aim to supplement the proposed taxonomy with additional necessary elements, which may be missing in the existing proposals in the literature.

Thus, the taxonomy has been developed with an emphasis to accommodate the relevant sub-national perspectives. At the same time, the taxonomy is generically and logically designed, in a way that makes it equally well suited for users at the national and international levels.

1.2. Organisation of the document

The rest of the document is organized in three Sections. Section 2 starts with a presentation of the taxonomy. Next, we systematically explain and discuss the concepts and different elements of the taxonomy, including the necessary choices we make when defining the taxonomy and some possibilities on how certain elements of the taxonomy can be adjusted, depending on the user needs in applications and future developments of the conceptual frameworks surrounding SDG. Some selected questions and answers are included towards the end of Section 2, which hopefully may be helpful to the prospective readers.

In Section 3, the relevant literature is reviewed and discussed, including all the classification systems and *taxonomies* that KS has found to be potentially useful. Here, the reader can also find further details and considerations underlying the proposed taxonomy.

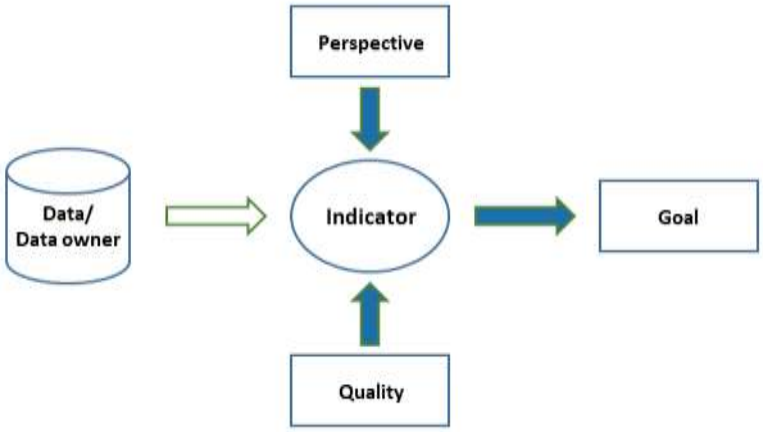
Finally, in Section 4 we discuss four examples of indicators related to public transport, sewage, wind power and school, respectively. The purpose is to provide cases which illustrate the relevant considerations to a user, who would like to apply the taxonomy to classify and evaluate SDG indicators.

2. A Taxonomy for SDG indicators

2.1. The conceptual model

Figure 2.1 presents the conceptual model of a taxonomy for SDG indicators, where the central characteristics or properties necessary to clarify their *use* and *usability* are identified and placed in relation to each other.

Figure 2.1 Conceptual model for the taxonomy



Source: Statistics Norway 2021

Generally, an *indicator* can be understood as a summary representation of a phenomenon or theme area, based on data for a specific time, place and other relevant characteristics. Whereas a *statistical indicator* is a measurable variable, sometimes also called data point or element, which is a quantitative summary based on numerical data. Sometimes, several data points may be defined to constitute a single indicator. In such cases, one can classify each data point on its own, or one can classify the indicator as a whole, provided its constituent data points are sufficiently homogeneous such that it makes sense to do so.

Data/data owner denotes the factual basis of an indicator including the owner(s) of the relevant data. *Goal* refers to *what* the indicator is about, i.e., which sustainable development goals it is directly related to. *Perspective* is about *why* the indicator is of interest in a given context, i.e., it specifies the underlying reason or user perspective, such as evaluation of a policy or assigning the responsibility for governance. Finally, *Quality* is about *how useful* the indicator is, i.e., it contains an assessment of whether an indicator is actually useable at all or to which extent it is fit-for-purpose, such as whether it is comparable at the municipality level.

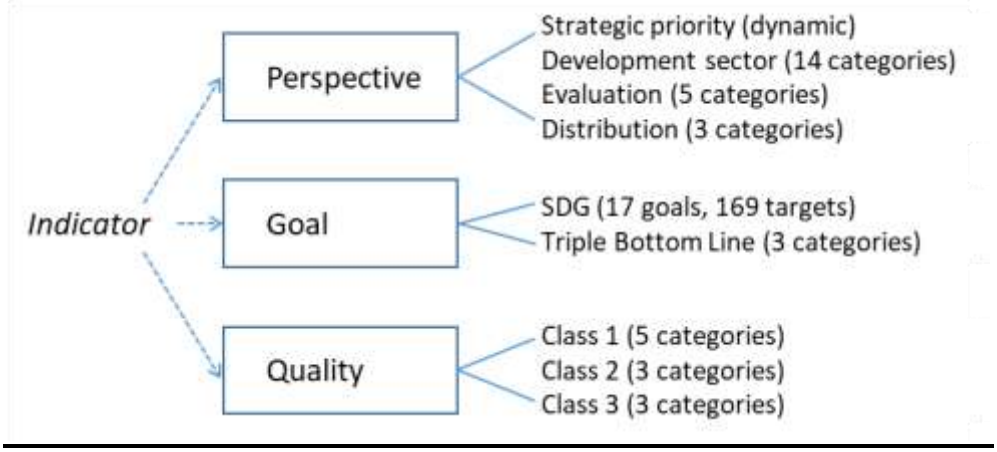
Goal, *Perspective* and *Quality* are defined as the three *dimensions* of the proposed taxonomy. Together, they cover the central properties of any SDG indicator, with respect to its target, use and usability. It should be possible to relate each relevant SDG indicator to one or more sustainable development *targets*; place it under one or several user *perspectives*; and assess its usability with respect to a specific well-established *quality* framework.

Meanwhile, *Data* does not constitute a separate dimension, mainly because the relevant aspects are distributed across the three dimensions. For instance, data access or scarcity is clearly an important issue when it comes to *Quality*.

2.2. The Taxonomy

Figure 2.2 presents the classifications under each of the three dimensions of the taxonomy.

Figure 2.2 Taxonomy for SDG indicators



Source: Statistics Norway 2021

Goal

In addition to the SDGs, triple bottom line (TBL) is a central reference framework for sustainable development.

- The SDGs is divided hierarchically in two levels with 17 goals and 169 targets, respectively.
- TBL consists of *People*, *Planet* and *Prosperity*.

One must be able to classify any SDG indicator with respect to the goals and targets. One can expect to be able to classify an SDG indicator with respect to the TBL most of the times, in which case the indicator may possibly be relevant for more than one bottom line. For instance, "employment rate" measures both the social and economic conditions. As will be discussed later, the TBL is sometimes felt to be not all-covering; however, any eventual modifications of the TBL are outside of the scope of this work, hence we include the TBL as-is.

Perspective

We define four *types* of *Perspectives* to the uses of SDG indicators. For an indicator to be relevant to the user, one must be able to place it under at least one type of perspective. The four types are as given below.

- *Strategic priority*, e.g., on four of these themes that are important to many.
  - Effective energy use
  - Responsible finance
  - Social cohesion
  - Digitalisation

  The categories are defined as *dynamic* in the proposed taxonomy, i.e., they can vary from one application to another. More on this in Section 2.3.
- *Development sector*, with 14 categories below.
  - Natural environment
  - Built environment
  - Water and waste
  - Transport
  - Energy
  - Economy
  - Industry
  - Work/employment

    - Childhood and education
    - Culture
    - Health, social services and welfare
    - Safety and preparedness
    - Governance and citizen engagement
    - Digitalisation
- *Evaluation* (of policy, change, etc.), with five categories below.
    - Input
    - Process
    - Output
    - Outcome
    - Impact
- *Distribution* (in one or more aspects), with three categories below.
    - Time interval
    - Lowest level of geography
    - Socio-economic groups

Quality

We define three *classe*s of *Quality*. An indicator belongs to one and only one class at a given moment of its development. The classification differs for different classes.

- *Class 1*, if the (statistical) indicator can be assessed with respect to the standard quality framework of ESS[1], the *principles* of which are shown below.
    - Relevance
    - Accuracy
    - Timeliness
    - Coherence and comparability
    - Availability and clarity
- *Class 2*, if the indicator neither belongs to class 1 nor class 3. Any indicator in class 2 can further take one of the three *states* below,
    - Under development (expected time to completion of development)
    - Under planning for development (expected time to completion of planning)
    - Undecided (expected time to decision)
- *Class 3*, if the indicator is unavailable, because one or several of the following features are missing,
    - Data
    - Method
    - Measurable concept

2.3. Explanation and discussion

The proposed taxonomy is more comprehensive than the other classification systems we have come across in the literature, such as UN "Global indicator framework", Huovila et al. (2019) and U4SSC (2020); see also the literature review in Section 3.

The taxonomy has a clear structure in terms of the three fundamental dimensions. The classification under each dimension is either logically constructed, as in the case of *Quality*, or builds on a sufficiently rich typology, as in the case of *Perspective*. Evolvement of user needs, which naturally will occur in the future, can be accommodated by appropriate adjustments of certain elements of the taxonomy, without the need to alter its basic structure. In this sense, the taxonomy can hopefully provide a sustainable classification system over time.

[1] https://ec.europa.eu/eurostat/documents/64157/4392716/ESS-QAF-V1-2final.pdf/bbf5970c-1adf-46c8-afc3-58ce177a0646

Central to the understanding is the distinction that we have introduced between *Goal* and *Perspective*. The actual uses of a given SDG indicator can rarely be determined by the goals and targets for which it may be relevant. It is therefore necessary to take into consideration the specific user context, i.e., *Perspective*, in order to be able to examine it appropriately. The four types of perspectives proposed are able to cover the entire relevant context that can be detected during our consultation with prospective users and from the literature studied.

Below we go through the taxonomy in the order of *Goal*, *Perspective* and *Quality*, to explain the underlying ideas, necessary choices and possible adaptions in applications.

Goal

This document does not require elaborating the SDG targets any further. However, some comments regarding the TBL are in order.

Firstly, possible extensions of the TBL framework are discussed in the literature.

- Hara et al. (2016) introduce "satisfaction" as a fourth element, under which only one indicator "willingness to pay" is given.
- Institution or institutional relationship has been mentioned as a possible supplement (e.g. OECD, 2020), when good public administration is central.
- The EU-project TRUST (Alegre et al., 2012) includes "assets" and "governance" as two supporting bottom lines when developing an indicator framework for sustainability evaluation of city water supply and waste systems.
- Angelakoglou et al. (2018) complement the TBL with "technical", "ICT" and "legal" perspectives.
- Sharifi (2019) lists "Governance", "Living", "Mobility" and "Data" as additional themes to "Economy", "People" and "Environment".

Another approach is to introduce a finer resolution of the TBL at a more detailed level. While the SDG targets are hierarchically nested in the goals, the concerns of the TBL are often overlapping. For instance, as mentioned before, employment and unemployment are both used as measures of the social and economic conditions. Refining each bottom line into a set of categories could further complicate the overlap. It is also a fact that an internationally accepted standard is missing, whenever these more refined categories are mentioned, proposed or discussed.

Thus, for either approach to the extension of the TBL framework, there is currently no accepted international standard or sufficiently balanced proposals. For these reasons, we have decided to incorporate the TBL as-is in the proposed taxonomy, while pointing out the possible extensions. In case an acknowledged extension does take place in the future, it would of course enrich the TBL as *Goal* in the taxonomy.

Perspective*: Strategic priority*

The *strategic priority* type of Perspective can be formulated dynamically according to the user needs. It is important to notice that strategic priority should not be confused as targets that overlap with *Goal*, but rather as the means for steering sustainable developments in the most desirable directions. It is equally important to emphasise that in practice a good strategic priority requires concrete expressions and a sharp focus.

Let us consider some examples. Take first the example of strategic priority given in Section 2.2.

- *Effective energy use* is only one of the topics under sustainable environment. But it can provide an overriding purpose for a developed country to deal with the climate challenge, which is also considered as one of the most important actions of climate control on a global level (IPCC, 2014).
- Although *Responsible finance* is only one aspect of a healthy economy, it may be the preoccupation of many in a given context, such as when "financial sustainability" at the local level is stressed in VLR (Voluntary Local Review) from Espoo, Finland (2020).
- There are obviously many important topics for *People* in the TBL. However, given the heightened tension many places around the world due to political, religious or ethnical conflicts, social cohesion can be a priority for many countries and societies.
- *Digitalisation* is nowadays a key driver for technological and economic developments. Meanwhile, increasing attention is being given to the many undesirable trends associated with the digitalised way of life, such as the so-called "surveillance capitalism".

We emphasise that further clarifications will be necessary, in order to form the priorities in these four directions, although we do not go into the details here.

GSDR (2019) identifies the following six "Entry points" to transformation, to ensure "focused and collaborative action by various stakeholders to accelerate progress towards the goals", i.e., as means for steering actions in the most desirable directions:

- Human well-being and capabilities
- Sustainable and just economies
- Food systems and nutrition patterns
- Energy decarbonization and universal access
- Urban and peri-urban development
- Global environmental commons

These points can serve as *strategic priorities*, after they are given concrete expressions.

OECD (2020, Figure 1.2) lists 5 "megatrends" which can be developed into *strategic priorities*:

- Climate change
- Urbanisation
- Demography
- Digitalisation
- Geography of discontent

One can easily detect similarities to the priority directions mentioned in Section 2.2.

VLR New York (2018) puts forward four visions for the city:

- Growing, thriving
- Just and equitable
- Sustainable
- Resilient

In particular, *Resilient* can be related to the "Build It Back program" in the aftermath of hurricane Sandy, or preparedness against natural disasters. It can be regarded as a concrete expression of one's *strategic priority* regarding climate change or sustainable environment.

VNR Israel (2019) highlights the following "strategic issues":

- Digital Israel
- Human capital development and utilization
- Regional economic development
- Financing infrastructure
- Productivity and competitiveness
- Strategy in the housing field
- Preparing for population aging

The attention on housing reflects a national challenge in Israel.

Finally, as an example for local governments, the Norwegian municipalities may find inspiration in the policy document "Mange bekker små" adopted in 2020 (in Norwegian):

- "God oppvekst og godt liv" (Good upbringing and a good life)
- «Klima- og miljøvennlig utvikling» (Climate- and environmental-friendly development)
- "Omstillingsdyktig næringsliv" (Adaptable business community)
- "Attraktive steder og byer" (Attractive/popular villages and cities)
- "Mangfold og inkludering" (Diversity and inclusion)
- "Deltakende innbyggere" (Participating citizens)

As an example of the need for being concrete and sharp, kindergarten availability can easily be a priority for "Good upbringing and a good life" ("God oppvekst og godt liv") in a municipality that has experienced shortages in the past, but not necessarily otherwise. Whereas, without a sharp focus, both kindergarten and retirement homes (and many others) would all belong to "Good upbringing and a good life" everywhere.

Perspective: *Development sector*

This type of Perspective seems most relevant, when it comes to assigning the responsibility for development, management or reporting, which in practice is often divided among the government departments or according to other administration/management structures, such as in the case of the preparation of VNR Norway (2016) and VNR Handbook (2020).

The proposed 14-category structure in the proposed taxonomy arises from "Los" (Digitaliseringsdirektoratet, Norway),[2] which is a common glossary for categorising and describing public services and resources. They contain some adjustments of the similar classification of city sectors that was earlier proposed by Ahvenniemi et al. (2017), as given below:

- Natural environment
- Built environment
- Water & waste
- Transport
- Energy
- Economy
- Education, culture, innovation & science
- Health, well-being & safety
- Governance & citizen engagement
- ICT

This classification of city sectors by Ahvenniemi et al. (2017) has been adopted for Key Performance Indicators of the initiative United 4 Smart Sustainable Cities (U4SSC). We have proposed some adjustments in order to suit a wider range of

[2] https://doc.difi.no/los/ (in Norwegian).

users and to bring a greater balance among the different sectors, e.g., the city sector "health, well-being & safety" is divided in two separate *development sectors* in the proposed 14-category structure.

Perspective*: Evaluation*
The 5-category typology originates from the well-known input-output model in econometrics, which is highly popular in the context of evaluation and monitoring, drawing on the analogy to *production* as a process of transformation from raw materials to final products.

Sometimes, it can be difficult to distinguish the different categories in practice, as e.g. commented by Bruvoll and Pedersen (2019) for the indicators measuring the recent local government reform. Instead, these authors adopt the 4 categories below:

- Input
- Product/service
- User effects
- Society effects

Of course, in the extreme case, one can simply include 2 categories:

- Input
- Results

Such modifications can be considered in any given application of the taxonomy.

Perspective*: Distribution*
This type of Perspective is always relevant when the same indicator is needed more than once, either over time, across geographical areas/administrative divisions, or subpopulations. Common to all these settings, one can then speak of the corresponding *Distribution*.

A distribution over time can be used to describe short-term changes or long-term trends. Yearly production is probably the most typical for SDG indicators. If one only needs the indicator evenly spaced over time, then it suffices to specify its frequency. However, since it is generally possible that an indicator may be required on an uneven basis, we have chosen the term 'time interval', for which the user would specify a starting time point and a subsequent series of time points accordingly.

A distribution over geographical areas can be relevant e.g. when one is concerned with the differences across the country. It is almost always the case that one is also interested in the country as a whole at the same time. Generally, one can therefore envisage a hierarchy of geographical areas, such as country, region and municipality, where the indicators at the lowest level can be aggregated to yield that at the top level. Hence, one only needs to specify the lowest level of geography, at which an indicator is required. Notice that it becomes a question of *Quality*, whether the indicator can be produced at the required level, or whether it is reliable enough for one to study the differences across the areas.

A distribution over socio-economic groups is naturally important when the focus is diversity or "Leave no one behind" (VNR Handbook, 2020). Breaking down a statistical indicator by gender, age, ethnicity or other characteristics is common in Official Statistics. It seems reasonable to let the categories be dynamic in the taxonomy, so as to allow the users to define them according to their specific needs in applications.

Quality

We consider as our starting point the "Tier classification" of the SDG indicators (IAEG-SDGs, 2019b, 2020) where the three tiers are specified as follows:

- "Tier 1: Indicator is conceptually clear, has an internationally established methodology and standards are available, and data are regularly produced by countries for at least 50 per cent of countries and of the population in every region where the indicator is relevant.
- Tier 2: Indicator is conceptually clear, has an internationally established methodology and standards are available, but data are not regularly produced by countries.
- Tier 3: No internationally established methodology or standards are yet available for the indicator, but methodology/standards are being (or will be) developed or tested".[3]

We notice that per July 2020, there are 123 indicators in Tier-I and 106 in Tier-II. In addition, there are 2 indicators, whose components belong to different Tiers.

We have chosen to adopt a set of more stringent criteria. All the indicators are divided into 3 classes. Basically, an indicator belongs to class 1 if it is at all useable, in the sense that one is able to assess it according to some well-established quality framework. It seems natural to expect a large overlap between the class 1 and Tier-1 classifications. The rest of the indicators that cannot be used in practice are divided into two classes, where class 3 contains those which are considered impossible to produce at the moment, regardless if it is due to the lack of measurable concept, accepted method or available data, or any combinations of the three. It follows that a number of the aforementioned 106 Tier-II indicators will be classified as class 3 according to the proposed typology for the dimension Quality.

The literature is extensive when it comes to frameworks and methods for quality assessment in Official Statistics. Here we provide only some highlights of the 5 principles for class 1 indicators in the ESS Quality Framework.

- **Relevance**: Statistics should correspond to user needs. Mechanisms for user consultation should be in place to monitor this, such that the statistics can be improved continuously over time.
- **Accuracy**: Statistics should reflect the reality. Data sources should be assessed regularly. The uncertainty associated with the statistics should be measured in accordance with the relevant standard.
- **Timeliness**: Statistics should be disseminated timely and punctually. It is good practice that the calendar for dissemination should be announced in advance.
- **Coherence and comparability**: Related statistics should provide a mutually compatible description of the reality. It should be possible to combine their respective underlying data. Statistics on the same population but of different frequencies should be consistent with each other over time. Statistics over different regions or countries should be comparable with each other.
- **Availability and clarity**: Statistics should be presented clearly and understandably. Statistics should be easily available, with sufficient metadata and user guide.

2.4. Questions and answers

Below is a selected set of questions and answers, which may be helpful to the prospective readers. The literature study and illustrations that follows contain many other discussions and details.

[3] "As of the 51st session of the UN Statistical Commission, the global indicator framework does not contain any Tier III indicators" (https://unstats.un.org/sdgs/iaeg-sdgs/tier-classification/).

Q
- Would it be possible to include priority categories under Perspective, such as (Very important, Quite important, Less important, Not important)?
A
As strategic priority is defined to have a dynamic classification, the choice is very much up to the user. For instance, a user who is interested in using the taxonomy to identify the best indicators for her/his priorities can simply choose to disregard any indicators that are less or not important. Whereas a researcher who wishes to systematically study or develop SDG indicators will most likely adopt a more refined and informative typology.

Q
- Shouldn't time or geography belong to the dimension Quality instead of Perspective, since they seem to say something about the properties of an indicator rather than its uses?
A
Specifying the time and/or geography under Perspective clarifies what the user needs from an indicator. Whereas the temporal or spatial properties of the indicator that one actually obtains do belong to Quality, e.g., in terms of coherence and comparability.

Q
- How about introducing short-term vs. long-term perspective for changes or developments?
A
One would need to specify the time interval under Perspective in any case.

Q
- Should it be made clear how many municipalities an indicator may be available for?
A
One can specify municipality as the lowest level of geography under Perspective distribution. How many municipalities an indicator is available for would then become a matter of Quality, which e.g. can affect the comparability of the indicator.

Q
- Should something be said about the data sources in the taxonomy, such as whether there exist open sources, or where the data are collected from?
A
Data sources can often be crucial to the choice of method. The issue is indeed relevant to all the 5 principles for class 1 indicators under Quality.

Q
- Should one distinguish whether an indicator can be adjusted or modified, or must be regarded as fixed?
A
The matter seems to be more concerned with the circumstances rather than the indicators.

Q
- What about the status of work related to the SDGs, such as (achieved, not achieved but progress exists, no progress, no available indicator)?
A
Such characterisations of the SDG work are examples of what one might be able to conclude on the basis of the relevant indicators, or why one cannot conclude due to

the lack of any relevant indicator. But they are not classifications of any given indicator itself.

Q
- *What about composite indicators, e.g. used to measure multidimensional poverty?*
A
As mentioned in Section 2.1, an indicator may consist of several data points. All the data points may be said to be homogeneous, if they share the same classifications. Otherwise, one should classify each data points on its own. However, in case the data points are explicitly weighted together to yield a single statistical indicator, then it would become possible to classify it according to the proposed taxonomy.

3. Review of the literature

In what follows the review of the literature includes the following elements:

- Other classification systems
- VNR (Voluntary National Review)
- VSR (Voluntary Sub-national Review), VLR (Voluntary Local Review)
- U4SSC (United 4 Smart Sustainable Cities)
- Stand-alone articles or reports

3.1. Other classification systems

1) The UN "Global indicator framework" contains 231 indicators per July 2020 (A/RES/71/313, 2020) distributed onto 169 SDG targets. Our taxonomy has under *Goal* incorporated the SDG goals and targets.

The IAEG-SDGs uses a "Tier" classification of the indicators (IAEG-SDGs, 2019b, 2020). Under the *Quality* dimension of the taxonomy, we have introduced a more extensive typology where *classes* replace Tiers. (cf. Section 2.2 and 2.3). As an example, some of the 106 Tier-II indicators can be moved to class 3 in case they are considered impossible to construct at the moment, due to lack of available data.

In addition, we have sharpened the quality criterions by adopting the standard of the European Statistical System (ESS) for the indicators of class 1. We hope that this eventually can lead to significant quality improvements of SDG indicators. The importance and scope of the SDGs demand the best possible quality of the indicators, to ensure development and goal achievement in a satisfactory manner. Improvement of SDG indicators is difficult without stringent quality criteria being placed on them.

2) Huovila et al. (2019, Figure 1, shown below as Figure 3.1 here) suggests a classification model, which has received much attention within the U4SSC work.

The model explicitly touches on two of the dimensions of the proposed taxonomy, i.e., *Goal* and *Perspective*.

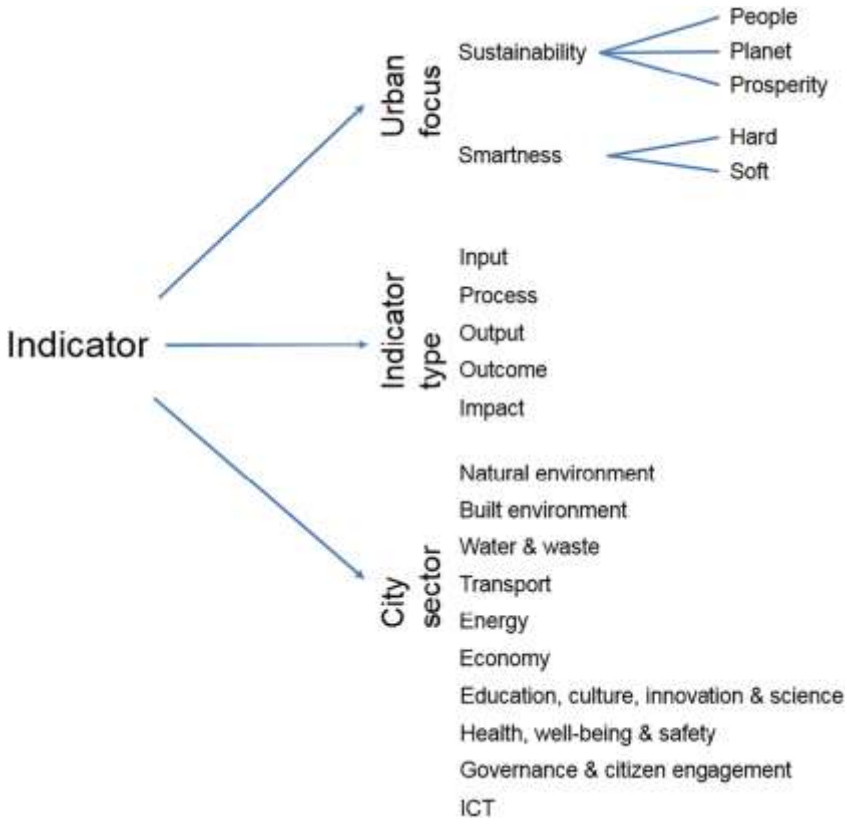
- "Urban focus" contains smartness (2 categories) and sustainability (TBL)".
- "Indicator Type" corresponds to the 5-category perspective *evaluation*".
- "City sector" corresponds to the perspective *Development sector*, with a different typology (Ahvenniemi et al., 2017), as mentioned in Section 2.3".

We have made the following adjustments to the model.

- We have removed smartness from G*oal*, but included the SDG goals and targets.
- We have pointed at the possibilities of adjustments for the 5-category typology under the perspective *Evaluation*.
- We have replaced the 10-category city sector with the 14-category perspective *Development sector*.

The model of Huovila et al. does not define a quality dimension, although quality is discussed several times in the article. Neither does the model cover the strategic priority perspective or addresses some of its specific elements such as "Leave no one behind". Our proposed taxonomy (**Feil! Fant ikke referansekilden.**) represents thus an extension of the model (Houvila et al., 2019).

Figure 3.1 Classification model of Huovila et al. (2019)



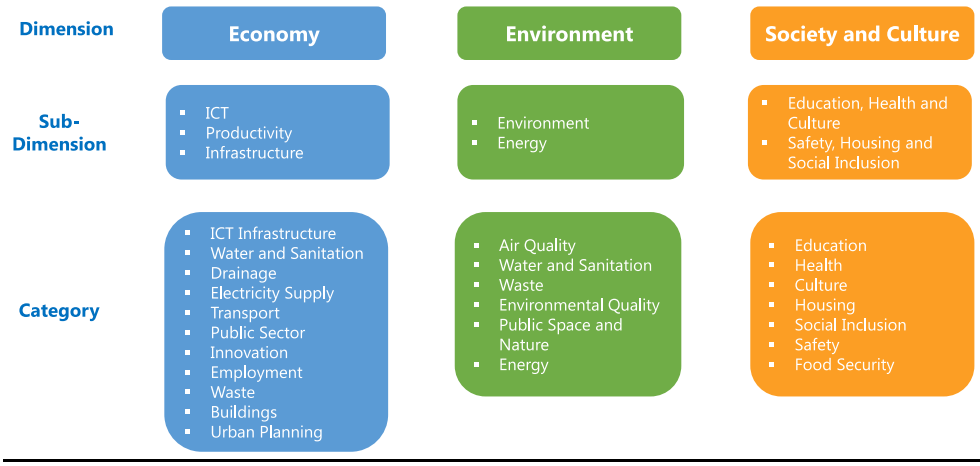
Source: Huovila et al. (2019, Figure 1)

3) For methodological development of KPI (Key Performance Indicators), a hierarchical system for indexing indicators is used in U4SSC (2020, Section 2), containing the following levels:

- Dimensjon
- Sub-dimension
- Category

An overview of the hierarchy is given in Figure 3.2. At the highest level, each dimension corresponds to one of the triple bottom lines. At the next levels, the elements within "Sub-dimension" and "category" have similarities with those of our *Development sector*.

Figure 3.2 Hierarchy for indexing indicators for U4SSC KPI



Source: Smiciklas 2019

As we have discussed in Section 2, it is both useful and necessary to distinguish between *Goal* and *Perspective*: what an indicator is about (goal) does not explain why it is being considered by a user (perspective). Thus, we believe that the taxonomy has an improved 'nomos' compared to the model of U4SSC (2020).

Moreover, it is not necessary to adopt a *hierarchical* approach with mutually exclusive categories at lower levels, to the classification under TBL, as we have discussed in Section 2.3.

Finally, the quality dimension is also absent in the model of U4SSC (2020).

3.2. Other indicator characteristics in the literature

Many other characteristics of the SDG indicators are mentioned and discussed in the literature. Below we will review them by groups.

Group 1: Voluntary National Review

VNR Handbook (2020)

VNR Handbook (2020) addresses the preparation and implementation of the Voluntary National Review (VNR) and which principles one should follow during this process.

The handbook emphasises the need for alignment of national frameworks and programmes with the SDGs, where critical gaps should be identified. Further, the handbook advocates that "Countries should be specific about the main challenges and difficulties they face in implementing the SDGs…" (*ibid.*, page 18). Formulating policies to address such challenges can be accommodated by the *Strategic priority* perspective in the taxonomy.

As an important building block of the alignment is the assessment of synergy, trade-off or potential conflict between the SDGs and TBL (*ibid.*, page 24), or national priorities (*ibid*., page 26). The clarification of such connections is useful for effective coordination and good cooperation among different responsible institutions. The distinction between the *Goal* and *Perspective* dimensions can help in this respect. As an example, an unconditional distribution of cash to girls with the aim of social protection, can be relevant from s*trategic priority* perspective but can also be connected to the SDGs related to poverty reduction, education, health as well as gender equality.

"Leaving no one behind" is mentioned as an important principle in the handbook. The focus on groups in-need or below-the-average can be accommodated under the perspective *Distribution*, where the relevant indicators by socio-economic groups can be the factual basis for identifying the measures to be implemented.

The handbook stresses that monitoring of the implementation requires adequate data for the relevant indicators. This motivates *Quality* as a separate dimension in the taxonomy.

VNR Norway (2016)

In preparation of the first VNR in Norway (VNR Norway, 2016), a responsible institution was appointed for each of the 17 SDGs (*ibid.*, page 3). In practice, the responsible institution was the coordinating governmental department in charge of the national follow-up. The idea was to improve the coordination, reporting and assessment of the SDG work through the established political mechanisms of the budget process (*ibid.*, page 7). This is an example of the usefulness of the perspective *Development sector*, and further that the proposed 14-category

classification may be more reasonable than the 10-category city sector for KPI (U4SSC).

Moreover, we cite the text (VNR Norway, 2016, page 1) here as a good example of being concrete when formulating strategic priorities:
"The Government has identified a number of targets that pose particular challenges for domestic follow-up in Norway. These challenges relate to several of the SDGs and all three dimensions of sustainable development – social, economic, and environmental. Among the targets that are likely to remain the focus of political attention and policy development are those relating to sustainable consumption and production, health and education, equality, employment, and migration. The Government is giving priority to ensuring quality education and employment, especially for young people and those at risk of marginalisation. This is an important contribution to realising the 2030 Agenda vision of leaving no one behind. Challenges that have been identified at the national level include:

- Reducing non-communicable diseases and promoting mental health.
- Increasing high-school completion rates.
- Eliminating all forms of violence against women and girls.
- Reducing the proportion of young people not in employment, education or training.
- Ensuring sustainable infrastructure.
- Sustaining income growth of the bottom 40% of the population at a rate higher than the national average.
- Improving urban air quality.
- Halving food waste and reducing waste generation.
- Reducing the impact of invasive alien species.
- Reducing all forms of violence and related death rates and combating organised crime.

As for the crucial area of climate change, national follow-up of the Paris Agreement will constitute the main basis for action to fulfil SDG 13. Norway is committed to reducing emissions by at least 40 % by 2030, compared with the 1990 level. Norway is engaged in a dialogue on joint fulfilment of its 2030 commitment together with the EU".

Nørgaard et al. (2018)

Nørgaard et al. (2018, in Norwegian) report the work carried out by Statistics Norway in 2018, to map the global SDG indicators to the body of Norwegian Official Statistics.

Table 3.1 Results of mapping of global indicators at Statistics Norway in 2018

	Ansvarlig internasjonal organisasjon	Forslag til nasjonal statistikk-ansvarlig	Data for Norge i FNs SDG indikator-database per juli 2017	Indikator kan lages nasjonalt
2.1.1 Prevalence of undernourishment / Tier I	FAO	Ikke avklart / SSB	Ja	Nei
2.1.2 Prevalence of moderate or severe food insecurity in the population, based on the Food Insecurity Experience Scale (FIES) / Tier II	FAO	SSB	Nei	Nei
2.2.1 Prevalence of stunting (height for age <-2 standard deviation from the median of the World Health Organization (WHO) Child Growth Standards) among children under 5 years of age / Tier I	UNICEF	Uavklart	Nei	Ukjent
2.2.2 Prevalence of malnutrition (weight for height >+2 or <-2 standard deviation from the median of the WHO Child Growth Standards) among children under 5 years of age, by type (wasting and overweight) / Tier I	UNICEF	Uavklart	Nei	Ukjent

Source: Excerpts of Table 2.1 in Nørgaard et al. (2018)

The Tier-classification of the 232 UN indicators from 2018 is noted in the documentation report. At the same time, it is pointed out that some Tier-I indicators cannot readily be calculated in Norway, some examples of which are included here in Table 3.1, to illustrate the necessity of tightening the quality criteria, as we have done in the taxonomy by adopting the ESS-standard.

Nørgaard et al. (2018) describe and assess the existing data sources for the SDG indicators. They specify disaggregation by sex, age, income, region and country of origin where this is relevant and possible, which reveals that disaggregation by disability would typically be impossible without methodological development.

2030-panel (2020)

The Danish report *Vores Mål* (2030-panelet, 2020, in Danish) outlines 197 indicators. No particular taxonomy is used, but the indicators are described in a structured way that is relevant for several elements of our taxonomy. The indicators are presented using classification by the SDG or TBL (cf. the goal dimension). Further, the indicators are disaggregated by geography, sex, age, place of birth, disability etc. Development of indicators over time is also provided. This underlines the importance of the perspective *Distribution.*

In the discussion on availability and method, the report notices that the proposed Danish indicators satisfy the main requirements of good statistics, with respect to the standards of Statistics Denmark, Eurostat and the UN. Six methodological principles are presented for the indicators:

- Relevance
- Measurability
- Data availability
- Reliability
- Accept
- Resources

The Danish report also presents several additional indicators where data are not available, but the indicators can be very useful in a future perspective. Such indicators can either be classified as *class 2* or *class 3*, under the quality dimension of our taxonomy, depending on the phase of the indicator's development.

VNR Israel (2019)

VNR Israel (2019) emphasises the relation between the SDG and Israel's strategic goals, as shown in
Table 3.2 here and discussed previously. This is another example of the usefulness of distinguishing between the SDG as *goal* and *Strategic priority* as *Perspective*.

Table 3.2 Connections between the SDGs and Israel's strategic goals

Strategic issues for Israel	Relevant SDG goals
Digital Israel	
Human capital development and utilization	
Regional economic development	
Financing infrastructure	
Productivity and competitiveness	
Strategy in the housing field	
Preparing for population aging	

Source: VNR Israel (2019, Table 1.1)

Group 2: VSR and VLR

In this section, we consider the work on sub-national (VSR) and local (VLR) voluntary reviews.

Messias (2019)

Messias (2019) addresses the sub-national contribution in achieving sustainable goals: "It is now largely acknowledged that regional governments have a crucial role to play in the implementation of the SDGs. Considering their unique and shared competences on planning, legislation and policy-making, governments at the subnational level are directly responsible for actions required for achieving the SDGs...". Further, it is highlighted that the monitoring of the SDGs requires disaggregated data, which is accommodated by the perspective *Distribution.*

Global Taskforce of LRG (Global Taskforce of local and regional governments, 2020)

Global Taskforce of LRG (2020) underlines how VSR and VLR can contribute to sustainable development. The recommendations for future development include using localised indicators, establishing national localisation strategies, as well as Governmental involvement at all levels (Global Taskforce, 2020, p. 120-121). Using our taxonomy, the recommendations above can be addressed by combining the *Distribution* and *Development sector* perspectives when assessing the indicators.

Global Taskforce of LRG (2020, Section 4) divides the examples of development by local and regional authorities into the following groups, which may be considered as a means to formulating possible strategic priorities:

- The exceptional circumstances created by the COVID-19 crisis.
- Urban and peri-urban development.
- Advancing human wellbeing and ending hunger.
- Protecting the planet and building resilience; and ensuring access to sustainable energy.
- Sharing economic benefits.

Global Taskforce of LRG, 2019

"The purpose of the GOLD V Report is to propose how these ambitious Global Goals and objectives can be met through policies, actions and initiatives designed and put in place by the territories and communities that make up cities, towns and regions" (Global Taskforce of LRG, 2019). It is investigated how local and regional authorities can contribute to the achievement of the SDGs with respect to the five global trends "urbanization, demographic change, climate change, protracted crises and frontier technologies" (UNECE, 2019). These are the "megatrends" that we have discussed earlier under the *Strategic priority* perspective. Recommended actions on local and regional level includes:

- Galvanize forces for the localization of the 2030 Agenda in our cities and territories.
- Protect the commons, human rights and culture as foundations of peace.
- Put human rights and the 'Right to the City' at the core of the local agendas – strengthen inclusive local policies to 'leave no one behind'.
- Harness the co-creation of cities and territories through sustainable participative urban and land planning.
- Improve access to sustainable and inclusive public services in cities and territories.
- Focus on the future of jobs and local economic development (LED).

These recommended actions can be considered as an attempt to specify the strategic priority.

Policy coherence is emphasised (Global Taskforce of LRG, 2019, page 23) as "An approach to sustainable development that calls for the integration of economic, social, environmental and governance dimensions in the policy-making process, acknowledging the critical interlinkages that exist between the SDGs. It aims to foster synergies, promote partnerships and balance transboundary and intergenerational policy impacts in order to identify and manage the relationships between the SDGs in a way that limits and overcomes any potential negative impact resulting from their implementation". This discussion has similarities to our TBL discussion in Section 2.3.

Global Taskforce of LRG (2016)
Global Taskforce of LRG (2016) addresses how to locate the monitoring of the SDG indicators. The report points at the importance of disaggregated data (perspective *Distribution*) and comparability between territories, which in our taxonomy is covered by the *Quality* dimension for the *class 1* indicators.

Siragusa et al. (2020)
The European handbook of VLR (Siragusa et al., 2020) is a guide for European cities in the preparation of VLRs. Several recommendations for the choice of indicators (*ibid.*, page18) relate to concerns different dimensions in our taxonomy. Among the criteria devised in the handbook for selecting indicators, are "Alignment with the UN Global Indicator Framework" and balance with respect to TBL. Both these criteria are covered by the *Goal* dimension in our taxonomy.

The following recommendations in the European handbook can be attributed to different types of *Perspective* in our taxonomy:

- "Relevance to the European context", for comparison between the countries and tracking of the trend over time.
- "Relevance at local scale", concerning the perspective *Distribution* (over regions).
- "Covering areas of competence of local governments", concerning the area of perspective *Development*.

Some of the handbook recommendations are related to our *Quality* dimension:

- "Number of cities and availability in different countries", concerning comparability.
- "Timeliness, time coverage and comparability over time".
- "Affordability of data collection and production over time", indicating whether the indicator should belong to *class 1*.

All the aforementioned recommendations have been given a clear structure in our taxonomy.

The handbook classifies the indicators into four types (*ibid.*, page 19):

- "Official indicators, harmonised at the European Level".
- "Experimental indicators harmonised and available for a significant number of European cities".
- "Official indicators, not harmonised, collected by countries or local entities".
- "Experimental local indicators",

where the difference between the two types of experimental indicators is that the former is created by recognised scientific institutions that are relevant and available to large parts of Europe.

All the four types of indicators aim at producing *class 1* indicators of good quality, but differ mainly by origin and to a certain extent availability.

We have omitted "origin" from our taxonomy, since the quality information added by origin is covered by the current ESS quality standard which is included in our taxonomy. However, a user who collects indicators of various origins, may well choose to add origin as a part of the indicator metadata even when origin is not included as a quality criterion or principle.

Just as with the 2030-panel (2020), the handbook presents the indicators in a structured way with the following metadata:

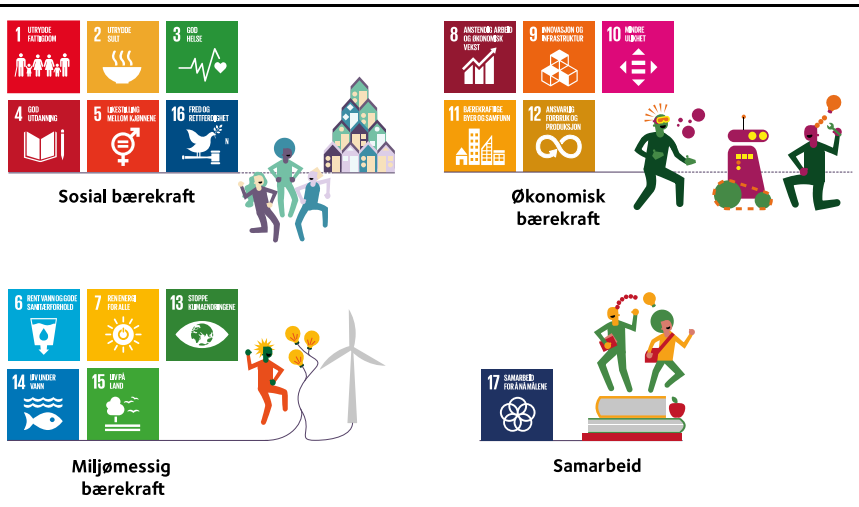
- The SDGs
- Alignment (with other indicator frameworks)
- Coverage (of EU countries)
- Aggregation level and Available geographical coverage
- Source (from where the indicator has emerged)
- Measurement unit (being a part of the definition of every statistical indicator)
- Time coverage and frequency

Notice that time and space is here concerned with the existing indicators and thus belong to the quality dimension. Using our taxonomy, we can clearly separate these aspects of *quality* from the desired distribution over time and space which belongs to the perspective *Distribution*.

Viken (2019)

The *Viken report* (Viken, 2019, in Norwegian) is a knowledge base for regional strategic planning, where the region *Viken* creates goals and strategies for its development. The Viken report is organised by the 17 SDGs which are grouped into four categories: social sustainability, environmental sustainability, economic sustainability, and cooperation (Figure 3.3). Cooperation can be regarded as an extension of TBL here. On its page 244-245, the Viken report contains an interesting appendix that compares the findings from many recent studies, regarding the dependences between these categories.

Figure 3.3 Grouping of SDGs in VLR (Viken, 2019)



Source: Viken (2019, Figure 0.0)

As we have discussed earlier, adjustments of TBL may be possible and relevant to many users. By defining TBL as goals *next to* the SDGs, one can avoid (or postpone) a discussion of the suitability of the TBL framework or its exact relations to the SDGs, when applying our taxonomy to classify indicators.

OECD (2020)

The *OECD-report* (OECD, 2020) presents the results of pilot studies from nine cities and regions. The angle of approach is influenced by VSR/VLR: "The Organisation for Economic Co-operation and Development (OECD) is an international organisation that works to build better policies for better lives. Our goal is to shape policies that foster prosperity, equality, opportunity and well-being for all". The report focuses on identifying "…place-based priorities, reorient existing strategies and plans or shape new ones towards sustainable development" (OECD, 2020, page 19). The OECD-report further emphasises the importance of promoting better political cooperation between different authorities as well as improving coordination between local and regional authorities.

In Córdoba, Argentina, the distinction "People, Planet, Prosperity, Partnership and Place" is used as an alternative to TBL (*ibid.*, page 49), which is another input to the discussion of TBL.

The OECD-report contains several examples of strategic priorities, which can benefit from further specification. One example is the above mentioned "global megatrends". The report describes *Vision 2050* by Flanders, Belgium where the strategic frame is directed at addressing the transition to:

- Circular Economy
- Smart living
- Industry 4.0
- Lifelong learning and a dynamic professional career
- Healthcare and welfare
- Transport and mobility
- Energy

Another example is the 2020-2023 strategies for regional development of the region of Southern Denmark:

- Mobility for all
- Green transition
- Climate and resources
- Clean water and soil
- Skills for future
- Healthy living conditions
- An attractive region, rich in experiences

A third example is the Helsinki 2017-2021 strategy focusing on the three topics (ibid., side 58)

- Sustainable growth
- Developing service offerings
- Responsible financial management

A fourth example is when the OECD-report refers to Sachs et al. (2019), where "*six transformations* provide an integrated and holistic framework for action that reduces the complexity, yet encompasses the 17 SDGs, their 169 targets and the Paris Agreement", containing:

- Education, gender and inequality
- Health, well-being and demography
- Energy decarbonisation and sustainable industry
- Sustainable food, land, water and oceans
- Sustainable cities and communities
- Digital revolution for sustainable development

VLR Espoo (2020)

VLR Espoo (2020) describes their projects and actions on the SDGs. Their indicators can be adequately characterised using our taxonomy, where TBL is adapted to *social*, *cultural*, *economic* and *ecological* sustainability.

VLR New York (2018)

As discussed in Section 2, VLR New York (2018) contains four visions for the city (Figure 3.4), which in the terminology of our taxonomy can be presented as *Strategic priorities*.

Figure 3.4 New York's visions.

Source: VLR New York (2018, page 22)

The connection between the visions and the SDGs is investigated in VLR New York (2018), as shown in Figure 3.5 for the SDG 11. The SDGs 6, 7, 11, 12 and 15 are singled out for rapid implementation in accordance with the city's own visions (or *Strategic priorities* in the terminology of our taxonomy).

Figure 3.5 Illustration of connections between New York's visions and the SDG 11.

Source: VLR New York (2018, page 22)

More than 1000 indicators are presented by VLR New York (2018). The indicators are used by New York city and have been developed as a part of a monitoring system since the 1970s. The indicators are grouped by the 17 SDGs, and the relevant data sources are included. In our taxonomy, *data source* belongs to the *Quality* dimension.

Group 3: U4SSC

This group of *U4SSC* literature concerns the work related to smart sustainable cities: "A smart sustainable city is an innovative city that uses information and communication technologies (ICTs) and other means to improve quality of life, efficiency of urban operation and services, and competitiveness, while ensuring that it meets the needs of present and future generations with respect to economic, social, environmental as well as cultural aspects" (International Telecommunication Union, 2016).

D'Alpaos og Andreolli (2020)

D'Alpaos og Andreolli (2020) aim at identifying the most frequently discussed topics on *ecological indicators* for Urban Quality Assessment in the City of the Future, based on 1024 articles in the SCOPUS database, identified by the key

words “urban quality assessment” and “future city”. The analysis was carried out using criteria coinciding with TBL:

- Economic criteria: refer to business environment, economic growth, costs and productivity, employment, connectivity and wealth.
- Environmental criteria: relate to natural resources and account for their use and maintenance over time. They capture “green” factors such as energy, pollution, emissions, etc.
- Social criteria: refer to social performances, including quality of life for human beings and communities.

The topics are in D’Alpaos og Andreolli (2020) grouped into the following categories after an analysis of the most cited key words in the 1024 articles:

- Air
- Water
- Waste
- Land Use
- Greenspace
- Built environment
- Infrastructure

Most of the categories are related to environmental aspects. The categories are either created for clarifying responsibility or prioritising policy. These needs are accommodated by *Development sector* or *Strategic priority* in our taxonomy.

Angelakoglou et al. (2019)

Angelakoglou et al. (2019) introduce a Methodological Framework for the Selection of Key Performance Indicators to Assess Smart City Solutions. A basic approach of the framework is the definition of KPI dimensions:

- technical
- environmental
- economic
- social
- ICT
- legal,

with the following comments: “The current proposed dimension categorization is not the only one that can be adopted. There are other relevant frameworks, either close to the one presented (e.g., SCIS), or quite different (e.g., CITYKeys). We propose the one presented as a more holistic option in studies for systems operation characterized by a medium to high TRL (Technology Readiness Level, Editors note). The legal dimension is a new aspect that is presented in this study and many stakeholders demand it nowadays, given the condition that the current EU legislative framework is not uniform, but fragmented across the various EU countries.”

The suggested KPI-dimensions seem to be an example of TBL extension, although it is maybe limited by the scope of sustainable cities.

In the paper, the authors point out that “A filtering procedure according to predefined criteria is necessary to narrow down the vast number of potential indicators that can be included in the repository”. The CIVITAS framework is then used for filtering, leading to characterising KPI by:

- Relevance
- Completeness
- Availability
- Measurability
- Reliability

- Familiarity
- Non-redundancy
- Independence

These characteristics can be interpreted as quality criteria. The *Quality* dimension of our taxonomy is both more structured and comprehensive.

Wahab et al. (2020)
Wahab et al. (2020) identify 11 dimensions contributing to the development of smart cities, based on 28 selected documents in the Scopus as well as the Science Direct databases:

- smart economy
- smart governance
- smart people
- smart environment
- smart infrastructure
- smart technology
- smart living
- smart mobility
- smart water and waste
- smart security
- smart agriculture

These dimensions can be restructured and accommodated by the *Goal* and *Perspective* dimensions of our taxonomy.

Sharifi (2020)
Sharifi (2020) presents a "typology of smart city assessment tools and indicator sets". The indicators are labelled by theme and factor, where "Themes are broad categories that denote major dimensions related to the objectives of smart city development. Each theme may include several factors that provide further details to the themes and outline more specific targets that cities should strive to meet".

Table 3.3 Themes and factors in Sharifi (2020).

Clustering component	Most commonly used items
Theme	Economy, environment, governance, mobility, living, people, data (adapted from (Sharifi, 2019))
Factor	Education, infrastructure, health, services, innovation, culture, transportation, environment, inclusion, safety, governance, energy, business, pollution, planning, entrepreneurship, sustainability, security, accessibility, water, resources, technology, building, participation, social, efficiency, productivity, economy, connectivity, traffic, employment, housing

Source: Sharifi (2020, Table 3)

The themes and factors are given in Table 3.3. One may interpret the themes as an TBL extension, where the factors represent a 2nd level of finer categories. It is also possible to use the themes and factors as keywords when specifying the strategic priorities. We have thus chosen not to include them directly in the taxonomy.

Group 4: Other reports or articles

Zhang et al. (2021) review several Norwegian references that may be primarily of interest to the Norwegian readers, which are therefore omitted here.

MacFeely (2020)
MacFeely (2020) discusses the challenges in constructing and using SDG indicators. The complexity of the task is stressed. An example is the detailed distribution required of some indicators developed by the IAEG-SDGs (2019a): "For Target 10.2 (By 2030, empower and promote the social, economic and political inclusion of all, irrespective of age, sex, disability, race, ethnicity, origin, religion or economic or other status) the "minimum required disaggregation dimension" is: sex; age; disability status; race; ethnicity; origin; religion; and other economic or social status".

Moreover, the harmonisation of data at different geographical levels is discussed, and the need that "no one gets left behind", which is the same as the perspective *Distribution* of our taxonomy.

Two challenges mentioned in the article is the lack of priority ("Another challenge is the lack of priority within complex and sometimes rather muddled targets") as well as universality ("Although the scope of the 2030 Agenda is universal and applies to all countries, clearly not all targets are relevant to every country"). Such needs can be highlighted using the *Strategic priority* perspective of our taxonomy.

Finally, the article is concerned with data problems: "Problems with data could mean anything from errors or inaccuracies, non-adherence to international standards, incompleteness or data gaps, inconsistencies over time, or imbalances". This statement shows again the importance of *Quality* as a dimension in the taxonomy.

4. Examples of using the taxonomy

In this Section, we use four examples to illustrate the application of the taxonomy, and in particular, how it may vary given the same indicator but in different situations. It will become clear that, while the different considerations may have little to do with the *Goal* dimension, the *Perspective* dimension often depends critically on the *user context*, hence also affecting the *Quality* dimension, since quality generally means *fit for purpose* when it comes to SDG indicators.

Terminology:

- *User* is to be understood as the agent/administration in a municipality who is going to use the indicator.
- *Citizen* refers to the public who use the municipal services or are affected by the relevant policy.

4.1 Example 1: Public transport

Indicator: ”11.2.1 Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities”. This is SDG-indicator 11.2.1 cf. IAEG-SDGs (2020, page 18).

Goal:

- *SDG*: The indicator belongs to (and is suggested) as Goal 11 (“Make cities and human settlements inclusive, safe, resilient and sustainable.”), Target 11.2: “By 2030, provide access to safe, affordable, accessible and sustainable transport systems for all, improving road safety, notably by expanding public transport, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons”.
- *TBL*:
  - Bottom line *planet*: The indicator is related to the bottom line *planet* since an increased public transport coverage is a prerequisite for reducing car use among the citizens. However, a high indicator value does not directly imply better environment, other factors are needed in addition.
  - Bottom line *people*: The indicator is associated to the bottom line *people* since public transport increases freedom of movement in the lack of access to a car or a driving licence, and this can reduce inequality in the society.
  - Bottom line *prosperity*: The indicator has an unclear relationship to the bottom line *prosperity* since a poorly developed public transport system is not necessarily a sign of less prosperity. For instance, it is not obvious that Los Angeles has less prosperity that Washington DC despite the differences in their public transport availability.

User context:

a. The municipality would like to know how it compares to other municipalities with respect to public transport.
b. The municipality would like to evaluate the new system of bus routes.
c. The municipality would like to increase the mobility of the citizens having no access to a car or are unable to drive a car.
d. The municipality would like to reduce private car traffic.

Below, we will discuss how the user context influences the classification of the same indicator under the dimension *Perspective* and *Quality*.

User (a)

The user (a), i.e., given user context (a), could in this case have a statistical interest, where the indicator can be considered as a *performance indicator* of the system,

without the presence of any specific policy intervention or changes. The most relevant and probably the only perspective is then distribution. Here, the finest geographical level should not be higher than municipality, a yearly frequency probably suffices, and no division by socio-economic groups may be needed.

Concerning *Quality*, comparability is an important aspect for the user, i.e. whether an observed difference to another municipality is reliable or not. To decide this, the data source and the method must be studied further, i.e., the accuracy of the indicator. Notice that high accuracy and comparability are more difficult if additional socioeconomic grouping is needed for the *distribution.*

User (b)
Contrary to (a), the interest of user (b) stems directly from the reorganisation of the bus routes. *Evaluation* then becomes an obvious *perspective*. Whether the indicator measures output, outcome or impact may vary from one user to another, depending on the adopted logical framework of evaluation.

For instance, one user may consider the public transport coverage as *output* of the new bus route system, the number of bus passengers as *outcome*, and less queues and air pollution as *impact*. Another user may consider the new bus route system as *output*, the number of bus passengers as *outcome*, and the public transport coverage as *impact*.

Next, the logical framework of evaluation can affect the quality assessment. As *impact* is usually considered the most important in evaluation studies, the criteria for the indicator to be of good quality could be more stringent when public transport coverage is considered as *impact* instead of *output.* For instance, it could be discussed whether a survey among the citizens should be performed to measure the citizens' satisfaction with the public transport, instead of simply using the calculations provided by the responsible technical department, as the latter may potentially be considered to lack relevance.

User (c)
Let us consider the municipality's administration as user (c), who aims to increase the mobility of the citizens having little access to cars, given a specific budget for the purpose over the next three years. But who has the responsibility of planning and implementing the actions, as well as reporting the results? The *Development sector* seems now the most natural perspective for the user (c), who may decide that the local authorities for *Transport* and *Health, social services and welfare* must cooperate on this endeavour.

In addition to *Development sector*, it may be reasonable to include the *Distribution* perspective with a focus on *socio-economic groups*, since the public transport coverage is especially important for the target group consisting of citizens with little or no access to cars.

Given the need for distribution, the data source and the method can become a central question. It is possible to perform a survey among the target group, which will be rather expensive in order to achieve sufficient accuracy. Alternatively, smart technologies for passenger registration could be implemented. Although it will also cost, the accuracy can be better than by carrying out the survey; moreover, the solution can be re-used over time, and it can be useful in other user contexts. However, would privacy concerns make such a solution infeasible?

User (d)
A user (d) who would like to reduce private car traffic may typically consider this as means towards a greener environment. Thus, *Strategic priority* is a possible *Perspective* here. However, although higher public transport coverage can contribute to reduced car use, other factors are needed. Such considerations can quite possibly lead the user (d) to disregard this indicator and look for other indicators that measure car traffic directly instead.

Or, if the user (d) decides to use the indicator, it may well be concluded that the indicator has limited *relevance* with respect to the *Quality* dimension, since it is not directly measuring the car traffic.

4.2 Example 2: Sewage

Indicator:
"6.3.1 Proportion of the population connected to a municipal sewage service". This is Statistics Norway alternative to the UN "Proportion of domestic and industrial wastewater flows safely treated" (IAEG-SDGs, 2020, page 12).

Goal:
- *SDG:* The indicator is connected to Goal 6, "Ensure availability and sustainable management of water and sanitation for all", Target 6.3, "By 2030, improve water quality by reducing pollution, eliminating dumping and minimizing release of hazardous chemicals and materials, halving the proportion of untreated wastewater and substantially increasing recycling and safe reuse globally".
- *TBL*:
  - Bottom line *planet:* The indicator is related to bottom line *planet* since municipal sewage contributes unnecessary pollution, e.g. through leakage.
  - Bottom line *people:* The indicator is related to the bottom line *people* since municipal sewage service by and large contributes to better well-being and improves living conditions.
  - Bottom line *prosperity*: The indicator is related to *prosperity* since a safe sewage system can be viewed as a sign of prosperity.

***User context*:**
The municipality would like to reduce pollution but has a tight budget.

We shall assume that being connected to the municipal sewage system is a better solution for reducing pollution and leakage compared to private solutions. Given the tight budget, consider two different situations: (a) deciding whether to extend the municipal sewage system/network, (b) implementing the extension.

For situation (a), *Strategic priority* is the most relevant perspective, as the user considers whether to extend the sewage system over one or several budgetary years, or to adopt other measures. A potentially important priority could be the diversity of species for a better environment. Another possible strategic priority could be to improve the citizens' well-being and living conditions. The one concern may be stronger than the other, but both need to be aligned with the municipality's other strategic priorities in the presence of a tight budget.

The *Distribution* perspective can be relevant in this context, both for studying the historic development in the municipality and for comparing with other municipalities. Specification of the time interval and the lowest geographical level

is unproblematic here, provided the municipality have the details over the municipal sewage system and its coverage.

Concerning situation (b), the *Development sector* is perhaps the most relevant perspective when it comes to extending the system, and the *Water and waste* authority should naturally assume the responsibility. Nevertheless, it may be discussed whether a tender competition is necessary, and how to control the quality of the construction work once it has been carried out.

The perspective *Distribution* can be relevant with respect to the different parts of the municipality, or for identifying areas close to rivers or lakes. Again, the specification is unproblematic, provided the municipality has a detailed overview of the municipal sewage network.

Irrespective of the user's perspective, we have assumed that the *Quality* dimension poses no difficulties, when it comes to relevance, accuracy, timeliness, comparability, accessibility and clarity, and that the indicator can be calculated readily and accurately for any desired distribution.

4.3 Example 3. Wind energy

Indicator: "The wind energy production (kWh) in the municipality".

This is a type of local indicator that we have chosen to explore at the request of KS, and because it illustrates the issue of conflicting goals.

Goal:

- *SDG*: The indicator is related to Goal 7: "Ensure access to affordable, reliable, sustainable and modern energy for all". The indicator has similarities to UN's indicator 7.2.1 "Renewable energy share in the total final energy consumption" that is aiming at Target 7.2: "By 2030, increase substantially the share of renewable energy in the global energy mix".
- *TBL*:
  - Bottom line *planet*: The indicator is related to bottom line *planet* since wind energy is renewable. However, the indicator is also related to *planet* in a negative way: an increase in wind energy production facility reduces the area of "untouched" nature and impacts wildlife negatively.
  - Bottom line *people*: The indicator is related to bottom line *people* since windmills from experiences can create polarised debates in local communities, as well as between the citizens living nearby or regularly visiting the affected areas and the citizens not using these areas.
  - Bottom line *prosperity:* Windmills generates income for the municipality, either as the recipient of taxes or as the owner of the windmills, which can contribute to prosperity. Further, increased total energy production in the country may lead to lower energy prices and contribute to prosperity.

User context:
The municipality is considering applying for government subsidies given to selected windmill construction projects.

The user will probably need to weigh the different consequences against each other, i.e., the *Strategic priority* perspective. On the one hand, the windmills have the environmental advantage of producing renewable energy, apart from the environmental footprint of the construction work and the infrastructure. On the other hand, the windmills can have negative consequences both for the wildlife diversity and for the citizens' experiences of nature. A public debate on new

windmills can also negatively affect the social cohesion. That is, an increased value of the indicator has both positive and negative consequences for the bottom line *planet*, and possibly negative consequences for the bottom line *people.* Finally, an increased value of the indicator can be expected to have a positive effect on prosperity, where the subsidy further decreases the financial risks of the project compared to the situation without subsidies.

The perspective *Distribution* could be relevant as well. By comparing to similar municipalities, the user can assess the potential for increased energy production in the user's own municipality, and thereby estimate the related income. The indicator needs to be comparable for municipalities with similar wind climate at the spots where the windmills are to be constructed. In other words, the user may need the indicator to be calculated at a very fine geographic level.

Thus, if the indicator is not available at the desired geographical level, *Quality* could be an issue either in the form of lack of relevance or of comparability.

4.4 Example 4. Dropout from senior high school

Indicator: "Proportion of the senior high school pupils completing within five years after starting this education programme".

This is also an indicator that we have chosen at the request of KS.

Goal:

- *SDG*: The indicator is related to two of the goals on ensuring a good life for all citizens, avoiding differences between the citizens:
  - "Goal 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all". Here, the indicator is related to several Targets, e.g. Target 4.1 "By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes", Target 4.4 "By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship" and Target 4.5 "By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations".
  - "Goal 8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all", Target 8.6 "By 2020, substantially reduce the proportion of youth not in employment, education or training".
- *TBL*:
  - Bottom line *planet*: The indicator has no direct relation to bottom line *planet*.
  - Bottom line *people*: The indicator is related to bottom line *people* in several ways. As an example, the completion of senior high school prevents social exclusion, in the sense of "falling out of the community". Being part of the school environment can also reduce the risk of radicalisation.
  - Bottom line *prosperity:* The indicator is associated with *prosperity* since dropout from school tends to lead to a lower likelihood of future employment. The experiences show also that there is an increased risk of larger municipal expenses for supporting these persons, ultimately slowing the prosperity development for the average citizen.

User context:

a. The municipality would like to reduce social exclusion.
b. The municipality would like to reduce future welfare expenses.
c. The county (responsible for high schools) would like to measure the effect of the education reform carried out during the recent years.

User (a)

For a user (a), the indicator can be relevant to the *Strategic priority* of reducing social exclusion. It is also possible that this user has a focus on the *Development sector* "Childhood and education", when social exclusion is not an explicit strategic priority for the municipality.

No matter which perspective is adopted, it is natural for this user (a) that the local authorities for Childhood and Education share the responsibility to increase the proportion completing senior high school. The Education authority would work to improve the teaching and the school environment, whereas the Childhood authority would work for safe and healthy home situations. It is also possible for user (a) to include other development sectors than Childhood and Education, such as "Health, social services and welfare" as mental health among children is a contributing factor to school dropouts.

Distribution by socioeconomic groups could be relevant since e.g. the family economy and the education level of the parents are statistically related to the completion of school.

Concerning *Quality*, the user will probably find the indicator to be relevant regardless of the adopted perspective, insofar as dropout from senior high school is regarded as a form of social exclusion in itself.

The comparability between municipalities is good for the indicator as such: However, depending on the perspective, it may be insufficient without an appropriate distribution by socioeconomic groups, or other relevant statistics on what happens to the dropouts. For instance, an identical dropout rate in two municipalities could have rather different causes/consequences, if in one of the municipalities there are many job opportunities requiring no more than junior high school, whereas this is not the case in the other municipality. In the former municipality, a dropout from school may be caused by eagerness to be employed and become financially independent, whereas a dropout is a genuine sign of social exclusion in the other municipality.

User (b)

The user (b) who would like to avoid preventable future welfare expenses, may have focus on the *Development sector*. As an alternative, suppose that user (b) has a focus on finance, in a situation with tight municipal budgets, and chooses low dropout from senior high school as a *Strategic priority*.

Distribution by socioeconomic group is as desirable for user (b) as for user (a), no matter which perspective the user (b) otherwise has.

Concerning *Quality*, the assessment of the indicator's relevance can vary depending on the user's perspective. As for user (a), the indicator is relevant if user (b) has *Development sector* as perspective. However, in contrast to user (a), the indicator is less relevant to user (b) if the focus is on future welfare expenses since many other problems can cause larger future expenses than dropout from school.

The considerations on comparability may be similar for user (b) and user (a).

User (c)
The user (c) who is interested in studying the effect of the education reform, needs to evaluate *output*, *outcome* and *impact*. Most likely, the indicator can be viewed as either *outcome* or *impact*, depending on the logical framework of evaluation. Whereas *exam results* are examples of other relevant indicators.

In addition to evaluation, the perspective of *Distribution* by socioeconomic groups, is likely to be of interest to the user (c).

Quality evaluation poses no additional challenges for the user (c), beyond the concerns for the users (a) and (b).

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