UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

FINANCE CENTER FOR
SOUTH-SOUTH COOPERATION
南南合作金融中心

BRIDGE FOR CITIES | Belt & Road Initiative: Developing Green Economies for Cities

ISSUE PAPER NO. 2

Sustainable City Indexing: Towards the Creation of an Assessment Framework for Inclusive and Sustainable Urban-Industrial Development

INCLUSIVE AND SUSTAINABLE INDUSTRIAL DEVELOPMENT

Acknowledgements

The authors of this publication would like to take this opportunity to acknowledge the kind support of Mr. Kanishka Raj Rathore, who provided inputs for the case study on light industries in cities and offered substantial inputs on the document's contents in its later stages of refinement, and Ms. Victoria J. Haykin, who reviewed and edited the final version of the document prior to publication.

The contents of this document were further reviewed and enriched by the remarkable advice and feedback received from external experts Prof. Aron Perenyi (Swinburne University of Technology), Prof. Gerhard O. Braun (Free University of Berlin), and Prof. Chaolin Gu (Qinghua University). The authors thank them not only for their valuable contributions to this report, but also for their insightful suggestions on indicator selection and city-assessment methodology.

Sustainable City Indexing:
Towards the Creation of an Assessment Framework for Inclusive and Sustainable Urban-Industrial Development

Weixi GONG
Hui LYU

August 2017

CONTENTS

Figures

Tables

Boxes

1. INTRODUCTION

1.1 Background

Urbanization has been on the rise since 2009, when the percentage of the global population living in urban areas reached 50% (United Nations, 2014). Cities are often viewed as drivers of economic growth and innovation, attracting large shares of investment into research and development and innovative service sectors. On the other hand, rapid urban growth can cause significant environmental and societal problems, which pose longer-term challenges.

The United Nations Industrial Development Organization (UNIDO) has been exemplary in promoting and implementing industrial development projects globally since its inception as a specialized agency of the United Nations in 1966. In response to the global issue of ensuring sustainable industrial development, UNIDO's landmark Lima Declaration, adopted by Member States on 2 December 2013, first put forward the concept of inclusive and sustainable industrial development (ISID).

Within this framework and under the umbrella of South-South and triangular industrial cooperation, UNIDO organized the first "BRIDGES for Cities – Belt and Road Initiative: Developing Green Economies for Cities" event in October 2016.[1] The event highlighted the importance of the interlinkages between ISID and urban development in several key areas, including eco-industrial parks, brownfield redevelopment and urban regeneration, eco-efficiency, and green industry (UNIDO, 2016). During the event, the necessity of building a robust measurement tool to assess city development was raised. It was widely agreed that a city assessment process would be required in order to identify the demand and supply for urban-industrial development so as to better analyze and match cities for the facilitation of technical-cooperation projects.

The 2030 Agenda for Sustainable Development was adopted by the 194 Member States of the United Nations in September 2015 with the aim of realizing the human rights of all. Within the 2030 Agenda are encompassed 17 Sustainable Development Goals (SDGs). Each SDG is accompanied by 169 targets that set out objectives to be achieved by the year 2030. The targets are applicable globally, and they take into account the capacities and development levels of different nations (United Nations, 2014). Cities are included in these goals and should play a key role in achieving the SDG targets through their actions and practices.

In 2016, the New Urban Agenda (UN, 2016) was adopted at the United Nations Conference on Housing and Sustainable Urban Development (HABITAT III). The New Urban Agenda defines a new global consensus on sustainable urban development. Within the Agenda, political leaders have made commitments on several key points, including:

(1) Ensuring access to basic services for all citizens;
(2) Providing equal opportunities and eradicating discrimination;
(3) Promoting cleaner cities;
(4) Strengthening cities to reduce the risk and impact of disasters;
(5) Addressing climate change;
(6) Respecting the rights of refugees and migrants;
(7) Enhancing connectivity and supporting innovative and green initiatives; and
(8) Safeguarding the quality of public spaces.

These commitments should be addressed in all future urban development plans and initiatives, and should also be emphasized in the city-benchmarking process.

1 The event has recently been re-branded but was originally referred to as the "One-Belt-One-Road Inclusive and Sustainable City Exhibition and Dialogue".

1.2 Objectives

The objective of this report is to develop a framework of indices that can provide an overview of trends on inclusive and sustainable urban-industrial development. Using these indices, cities could be assessed and compared to reveal their comparative advantages and disadvantages, in order to better establish their respective development trajectories for the promotion of smart, sustainable and inclusive urban and regional growth.

Figure 1: *Sustainable Development Goals*
(Source: United Nations, 2016)

More specifically, the aim of this research is to develop a robust and comprehensive framework of multi-layered city indices, which can be used to measure a city's performance and sector-specific challenges in line with the SDGs (in particular SDGs 9, 11, 13 and 17), and to identify key categories of inclusive and sustainable urban-industrial development as first-level indices with sub-factors elaborated under each category. This will assist in the assessment of demand from cities and will better facilitate matchmaking along the lines of UNIDO's thematic competencies.

Urban demand is a driver of urban and industrial development, and there is significant potential for cities to catalyze industrial development. Combining both quantitative and qualitative indicators, the indices ought to be designed to meet the following objectives:

(1) To assess the city's current development situation;
(2) To monitor urban and industrial development trends;
(3) To identify urban risks and hazards;
(4) To identify focus areas for further development.

Based on the indices, a guideline for inclusive and sustainable urban-industrial development will be developed, which could provide guidance on strategy, policy and technology for urban development.

2. CITY BENCHMARKING: CASES IN URBAN DEVELOPMENT

There are many indices already in existence, which can be used to measure, benchmark and assess industrial and urban development. It is worth examining a selection of the most widely used urban indices to gain greater insight into the following:

(1) The main urban-development focus issues (based on the differing objectives of each indexing system);
(2) The methods used to construct an applied indexing system;
(3) Those indicators currently in use, as well as the reasons behind their selection.

Based on these targets, eight global indexing sets have been chosen for review below.

2.1 Urban Development Indicators

2.2.1 European Green Capital Award

Today, more than two thirds of Europeans live in urban areas. Most cities face a common set of core environmental problems, such as poor air quality, high noise levels, greenhouse gas emissions, water scarcity, contaminated sites, brownfields and challenges in resource efficiency. The European Green Capital Award[2] (European Union, 2016) is therefore awarded to a European city based on its environmental record. The award was launched in 2008 and first awarded to Stockholm for the year 2010.

The objectives of the European Green Capital Award are (European Union, 2016):

(1) To reward cities that have a consistent record of maintaining high environmental standards;
(2) To encourage cities to commit to ongoing and ambitious goals for further environmental improvement and sustainable development;
(3) To provide a role model to inspire other cities and to promote best practice and experience-sharing in all other European cities.

The selection of a city awarded with the title of European Green Capital is assessed based on a series of indicators, which has a relatively stable structure but changes slightly at the indicator level every year according to the sustainable development situation. In the 2016 application for the 2019 European Green Capital Award, twelve indicator categories are listed:

(1) Climate change: mitigation and adaptation;
(2) Local transport;
(3) Green urban areas incorporating sustainable land use;
(4) Nature and biodiversity;
(5) Ambient air quality;
(6) Quality of the acoustic environment;
(7) Waste production and management;
(8) Water management;
(9) Wastewater treatment;
(10) Eco-innovation and sustainable employment;
(11) Energy performance;
(12) Integrated environmental management.

In accordance with the adjudication process, a panel of internationally acknowledged experts assesses the information supplied by each city. This includes qualitative evaluations and a peer review of each application

2 For more information, please refer to: http://ec.europa.eu/environment/europeangreencapital/index_en.htm.

based on the 12 indicators above. A shortlist of cities is then selected by the expert panel. Shortlisted cities are invited to present their action plans and communication strategies to the jury. Following these presentations, the jury deliberates, and the new European Green Capital is announced.

2.2.2 China Urban Sustainability Index

The China Urban Sustainability Index (CSI)[3] is funded by the Urban China Initiative. It is an investigation into the sustainability of nearly 200 Chinese cities. The latest set of indicators was released in 2013 and was developed using the 2011 China Sustainability Index, as well as the China Urbanization Index, using an indicator framework set out in the 2011 CSI. In this index, emphasis is placed on societal and environmental indicators via a weighting system. The strength of the CSI indicator set is that it acts as a means of quantifying urban growth and development, rather than a static benchmarking tool (Urban China Initiative, 2014).

Bold = indicator not in USI 2011

Category (weight = 100%)		Components (weight within category = 100%)	Indicators
Society (33%)	Social welfare (33%)	**Employment (25%)**	**Urban employment rate (%)**
		Doctor resource (25%)	**Number of doctors per capita (per thousand persons)**
		Education (25%)	**Middle school students in young population (%)**
		Pension (13%)	**Pension security coverage (%)**
		Healthcare (13%)	**Health care security coverage (%)**
Environment (33%)	Cleanliness (17%)	Air pollution (11%)	Concentration of SO2, NO2, PM10 (mg per cubic meter)
		Industrial pollution (11%)	Industrial SO2 discharged per unit GDP (tons per bn RMB)
		Air qualified days (11%)	**Days of air qualified equal or above level II[1](%)**
		Waste water treatment (11%)	Wastewater treatment rate (%)
		Household waste management (5%)	Domestic waste treated (%)
	Built environment (17%)	Urban density (11%)	Persons per square kilometer of urban area
		Mass transit usage (11%)	Passengers using public transit (per capita)
		Public green space (11%)	Area of public green space (%)
		Public water supply (5%)	**Public water supply coverage (%)**
		Internet access (11%)	**Household access to Internet (%)**
Economy (17%)	Economic development (17%)	**Income level (33%)**	**Disposable income per capita**
		Reliance on heavy industry (33%)	GDP from service industry (%)
		Capacity investment (33%)	Government investment in R&D (per capita)
Resources (17%)	Resource utilization (17%)	Energy consumption (33%)	Total energy consumption (SCE per unit GDP)
		Power efficiency (33%)	Residential power consumption (kwh per capita)
		Water efficiency[2] (33%)	**Total water consumption (liters per unit GDP)**

Figure 2: *China Urban Sustainability Indices*
(Source: Urban China Initiative, 2014)

The Urban Sustainability Index of 2013 deploys 23 metrics, which cover four categories: (i) economy; (ii) society; (iii) resources; and (iv) environment. The report of 2013 ranked 185 cities of varying sizes and at different stages of development. In this report, 23 indicators are included in four categories, with particular emphasis placed on society and the environment.

2.2.3 Medium-Sized Smart Cities Ranking

The term "smart city" is relatively new and refers to the deployment of Information and Communications Technology (ICT) to support the sustainable development of cities. This Smart Cities Ranking[4] (SRF, 2007) project deals with medium-sized cities and their perspectives for development. It considers the challenges of medium-sized cities, which can be rather different and remain unexplored to a certain degree. Cities in Europe face the challenge of simultaneously addressing their competitiveness and sustainable urban development.

3 For more information, please refer to: http://www.urbanchinainitiative.org/en/research/usi.html.

4 For more information, please refer to: http://www.smart-cities.eu/download/smart_cities_final_report.pdf.

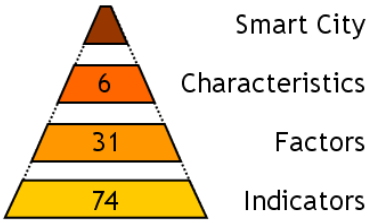


Figure 3: *Structure of the smart city indexing system (Source: SRF, 2007)*

In the hierarchic structure above, the term "smart city" is defined by six characteristics, wherein each level is described by the results of the level below. The six characteristics are: (i) smart economy; (ii) smart people; (iii) smart governance; (iv) smart mobility; (v) smart environment; and (vi) smart living. Each of these characteristics contains several factors, which respectively represent a number of indicators. These characteristics and factors form the framework for the indicators and the subsequent assessment of a city's performance as a smart city.

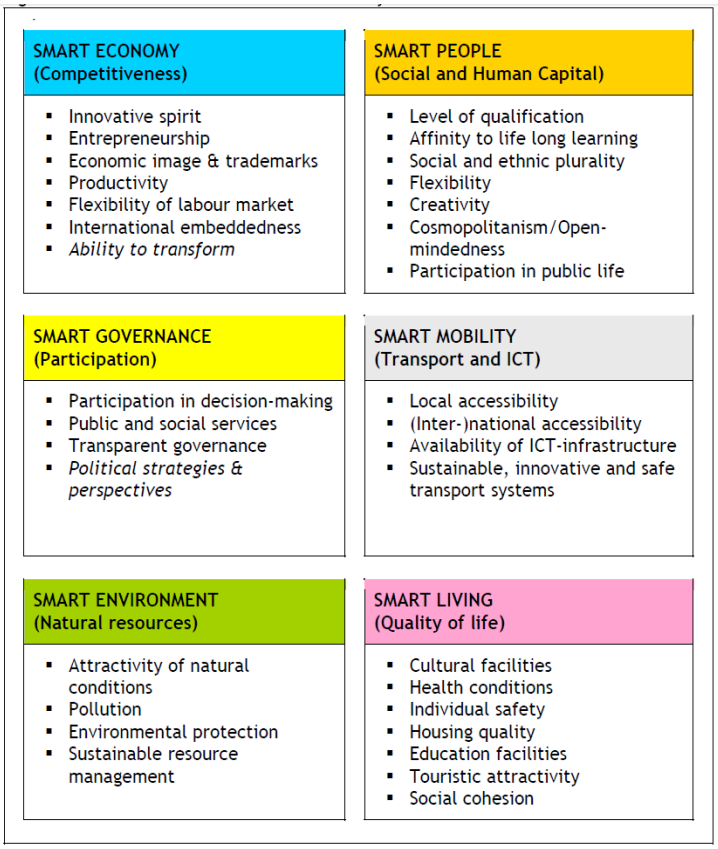


Figure 4: *Characteristics and factors of a smart city index (Source: SRF, 2007)*

2.2.4 The Green City Index

The Green City Index[5] project was launched in 2008. The Green City Index methodology was developed by the Economist Intelligence Unit (EIU) in cooperation with Siemens. First, there is the European Green City Index, which is an evaluation of the environmental sustainability of 30 European cities ranging in size from less than 1 million to more than 3 million people. Following the development of the indexing system, EIU and Siemens worked together to conceptualize and develop a series of city rankings called the Green City Index, which began with a focus on Europe's major cities and has since come to include cities across Asia, Africa and the Americas.

5 For more information, please refer to: https://www.siemens.com/entry/cc/features/greencityindex_ international/all/en/pdf/gci_report_summary.pdf.

The Green City Index series measures cities according to approximately 30 indicators across eight to nine categories, depending on the region. It covers CO_2 emissions, energy, buildings, land use, transport, water and sanitation, waste management, air quality, and environmental governance. About half of the indicators in each index are quantitative – usually using data from official public sources, for example, CO_2 emissions per capita, water consumption per capita, recycling rates and air pollutant concentrations. The remainder are qualitative assessments of the city's environmental policies, for example, the city's commitment to sourcing renewable-energy technologies, as well as implementing traffic- and congestion-reduction policies and air-quality codes. Measuring quantitative and qualitative indicators together implies that the indices are based on current environmental performance, as well as the city's intentions to improve.

The set of indicators comprehensively covers all major areas of urban environmental sustainability, which the index defines as green, but pays less attention to the measures of health, happiness and quality of life in cities. The indicators are divided into quantitative indicators, which measure the cities' current performance, and qualitative indicators, which cover the aspirations and commitments of a city to sustainable practices.

The indicator set is designed to use publically available data (with the notable exception of CO_2 emissions, which are not well-reported in many European cities), and each indicator is normalized to allow for comparison between cities. In these series of indices, the European Green City Index evaluates 16 quantitative and 14 qualitative indicators. The methodology for Europe has also been adapted for use on a regional level.

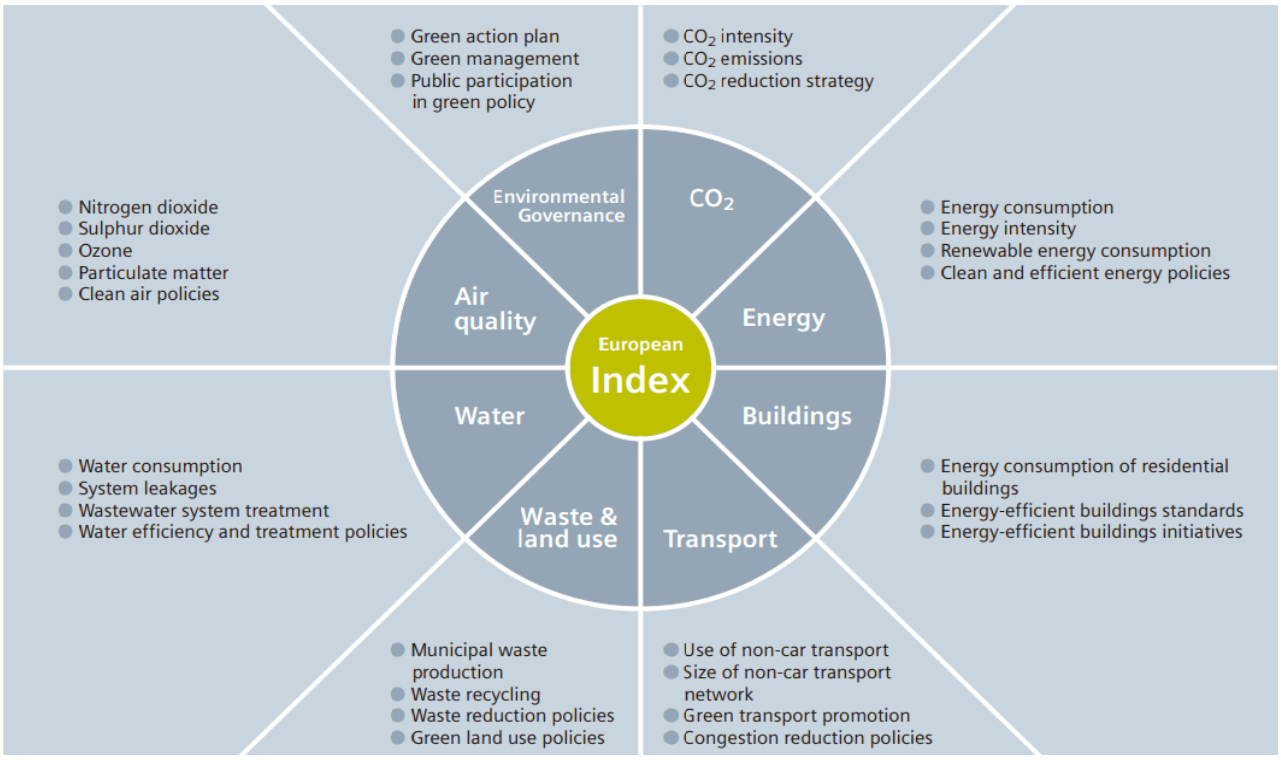


Figure 5: *The European Green City Index (Source: EIU, 2012)*

2.2.5 CITYkeys Indices

CITYkeys[6] (CITYkeys, 2017) is a recently developed research project that aims to create a city performance framework. It takes a specifically European and holistic approach to smart-city objectives and smart-city projects. The mission of CITYkeys is to develop and validate a holistic performance measurement framework for the harmonized and transparent monitoring and comparison of European cities' activities during the implementation of smart-city solutions.

6 For more information, please refer to: http://citykeys-project.eu/.

The CITYkeys framework supports smart cities in strengthening their strategic planning processes and measuring their progress. The indicators are thus primarily performance oriented. An important feature of this framework is that it focuses on the city, as well as the project level.

The aims of the project are to:

(1) Develop and validate a transparent performance evaluation framework;
(2) Develop recommendations for the integration of the performance system into the cities' decision-making processes, as well as recommendations for the development of new businesses;
(3) Engage stakeholders in identifying and exploiting opportunities for synergy and replicability;
(4) Establish a collaborative platform for European cities.

The project defines the term "smart city" as a city that is: (i) improving the quality of life of its inhabitants (people); (ii) significantly reducing its resource consumption (planet); (iii) building an innovation-driven and green economy (prosperity); and (iv) fostering a well-developed local democracy (governance). In line with the CITYkeys project's definition of a "smart city", success is determined by the entire ecological footprint of the urban area, in that it must simultaneously promote economic prosperity, social aims, and resilience to climate change and other external disturbances. The indicators are arranged in an extended triple-bottom-line sustainability framework. These include five main themes: (i) people; (ii) planet; (iii) prosperity; (iv) governance; and (v) propagation.

Table 1: Classification of CITYkeys' indicators (CITYkeys, 2017)

People	Planet	Prosperity	Governance	Propagation
• Health • Safety • Access to (other) services • Education • Diversity and social cohesion • Quality of housing and environment	• Energy and mitigation • Materials, water and land • Climate resilience • Pollution and waste • Ecosystems	• Employment • Equity • Green economy • Economic performance • Innovation • Attractiveness and competitiveness	• Organization • Community involvement • Multi-level governance	• Scalability • Replicability

99 project indicators and 76 city indicators have been selected under the framework above. There are two different pools of indicators designed for different uses:

(1) The indicators for assessing smart-city projects serve to assess or evaluate single projects. They indicate the difference the project has made by comparing the baseline scenario to the situation after the implementation of the project. As such, they can also serve to benchmark projects against one other.
(2) The indicators for smart cities focus on monitoring the evolution of a city to facilitate its transition into an even smarter city. The city indicators may be used to show to what extent overall policy goals have been reached or are within reach.

2.2.6 A.T. Kearney Global Cities

The A.T. Kearney Global Cities Index[7] is a portfolio of city-level indicators measuring progress. It consists of two key indices: (i) the Global Cities Index; and (ii) the Global Cities Outlook. The Index (consisting of 27 indicators) focuses on current conditions, while the outlook (consisting of 13 indicators) addresses future

7 For more information, please refer to: https://www.atkearney.com/research-studies/global-cities-index.

progress. Table 2 provides a summary of the key indicators and their groupings. The information used to calculate these indices is obtained from publicly available sources. The report today encompasses 128 cities and six world regions, and information has been collected since 2008 (A.T. Kearney, 2017).

Table 2: A.T. Kearney Global Cities Index and Outlook measures (A.T. Kearney, 2017)

		WEIGHT	MEASURES	INFORMATION SOURCES
GLOBAL CITIES INDEX	**Business activity**	30%	Capital flow, market dynamics and major companies present	Fortune 500; top global services firms; capital markets; air freight; sea freight; conferences
	Human capital	30%	Education levels	Foreign-born population; top universities; population with tertiary degrees; international student population; number of international schools
	Information exchange	15%	Access to information through internet and other media sources	Access to TV news; news agency bureaus; broadband subscribers; freedom of expression; online presence
	Cultural experience	15%	Access to major sporting events, museums and other expos	Museums; visual and performing arts; sporting events; international travelers; culinary offerings; sister cities
	Political engagement	10%	Political events, think tanks and embassies	Embassies and consulates; think tanks; international organizations; political conferences; local institutions with global reach
GLOBAL CITIES OUTLOOK	**Personal wellbeing**	25%	Safety, healthcare, inequality and environmental performance	Infrastructure; GDP per capita; foreign direct investment inflow
	Economics	25%	Long-term investments and GDP	Stability and security; healthcare evolution; Gini coefficient index; environmental performance
	Innovation	25%	Entrepreneurship through patents, private investments and incubators	Patents per capita; private investments; university-sponsored incubators
	Governance	25%	Proxy for long-term stability through transparency, quality of bureaucracy and ease of doing business	Quality of bureaucracy; ease of doing business; transparency

The unique character of these sets of indicators is that they encompass both the static and dynamic dimensions of urban development. Therefore, in addition to the evaluation of strengths and weaknesses, the indices can also be used to assess opportunities and threats. Within the indexing system, three dimensions from the Global Cities Index and two dimensions from the Global Cities Outlook have been chosen to define “smart cities”, namely: (i) information exchange; (ii) human capital; (iii) business activity; (iv) governance; and (v) personal wellbeing.

2.2.7 International Standard ISO 37120

The international standard ISO 37120 is designed to track and monitor progress on city performance. In order to achieve sustainable development, the international standard takes the needs of the entire city system into consideration (ISO, 2014). The idea is that current consumption patterns and efficiency must be taken into consideration when planning for the future (ISO, 2014). The set of city indicators is selected to steer and measure delivery of city services and quality of life.

As described in the foreword of ISO 37120, the indicators have been developed in order to:

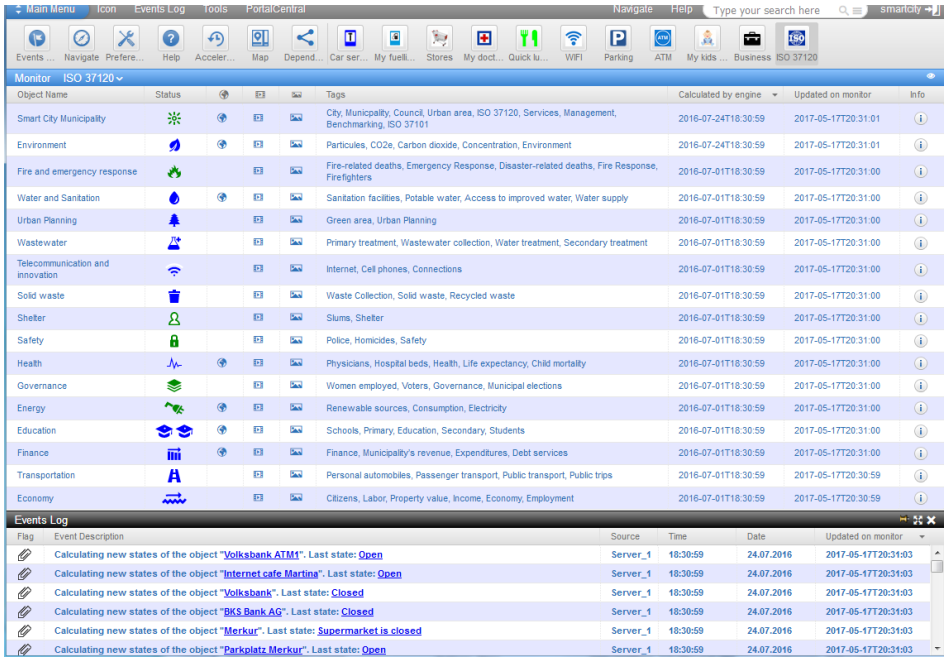
(1) "Measure performance management of city services and quality of life over time;
(2) Learn from one another by allowing comparison across a wide range of performance measures; and
(3) Share best practices" (ISO, 2014).

There are 17 categories and 100 indicators, including 46 core indicators that cities must report on and another 54 supporting indicators. Each category has 3 to 10 indicators. The categories of indicators are: (i) economy; (ii) education; (iii) energy; (iv) environment; (v) finance; (vi) fire and emergency response; (vii) governance; (viii) health; (ix) recreation; (x) safety; (xi) shelter; (xii) solid waste; (xiii) telecommunication and innovation; (xiv) transportation; (xv) urban planning; (xvi) wastewater; and (xvii) water and sanitation.

The city will be required to renew certification every year to remain ISO 37120 certified based on the recommendation of an independent third-party verifier who reviews the city's data. Depending on the data provided, a city could be certified as platinum, gold, silver, bronze or aspirational.

Box 1: PHAROS Smart City Monitor System

PHAROS Smart City Monitor system is an ICT tool that has been developed to produce an integrated vision of the smart city for smart governance. It builds a specific model for each city based on a rich set of data-driven information from big-data streams.[8] The system is community centred, with one of its key sources of indicators being ISO 37120.[9]



Screenshot of the Demo Pharos Smart City Monitoring system interface (Source: https://win2biz.com/)

The PHAROS Smart City Monitoring system provides information services for citizens, businesses, administrators and tourists, by transforming big-data streams into rich datasets. The main objective is to control and identify city problems, make decisions and take action in real time.

The system can provide digital urban models for each city. Through the system, it is possible to improve financing opportunities for smart-city projects and to provide better services for municipalities, stakeholders and citizens.

2.2.8 Commission on Sustainable Development Indicators of Sustainable Development and United Nations SDG Indicators

In 1992, the United Nations Conference on Environment and Development recognized the important role that indicators could play in helping countries make informed decisions concerning sustainable development. At the international level, the Commission on Sustainable Development (CSD) approved its "Work Programme on Indicators of Sustainable Development" in 1995 (United Nations, 2007).

From the perspective of the United Nations, the indicators of sustainable development act not only at the city level but are also applicable at the national, regional and global levels. The United Nations has released a series of research papers and published three sets of sustainable-development indicators in 1996, 2001 and 2007. In the latest version of the CSD's "Indicators of Sustainable Development", the structure is organized according to three layers: (i) theme; (ii) sub-theme; and (iii) indicator. The 14 themes are:

8 For more information, please refer to: https://smartcity.win2biz.com/static/content/en/676/Introduction.html.

9 For more information, please refer to: https://www.iso.org/obp/ui/#iso:std:iso:37120:ed-1:v1:en.

(1) Poverty;
(2) Governance;
(3) Health;
(4) Education;
(5) Demographics;
(6) Natural hazards;
(7) Atmosphere;
(8) Land;
(9) Oceans, seas and coasts;
(10) Freshwater;
(11) Biodiversity;
(12) Economic development;
(13) Global economic partnership;
(14) Consumption and production patterns.

The CSD indicators have been widely tested over the last decades. During preparations for the HABITAT III conference, held in Quito, Ecuador in October 2016, the development of an SDG-based indicator set was initiated. The process of development is, as yet, still ongoing. In June 2016, a report released by the Inter-agency and Expert Group on Sustainable Development Goal Indicators included a list of 230 indicators under each of the 17 SDG categories (United Nations, 2016).

2.2 A Short Review: Learning from Indices

In order to gain greater insight into the diverse methods, objectives and results of different urban measurement indices, several international examples above are described and compared, as shown in Table 3 below.

Table 3: A list of analyzed urban indices

No.	Title	Initiating Organization/Government	Latest Version	Spatial Scope
1	European Green Capital Award	European Union	2016	Europe
2	The China Urban Sustainability Index	Urban China Initiative	2013	China
3	European Medium-sized Smart Cities Ranking	Centre of Regional Science (SRF), Vienna University of Technology	2007	European medium-sized cities
4	The Green City Index	EIU and Siemens	2012	Worldwide
5	CITYkeys indices	CITYkeys Project group	2017	Europe
6	Global Cities Index & Outlook	A.T. Kearney	2016	Worldwide
7	International standard ISO 37120: 2014	International Organization for Standardization	2014	Worldwide
8	CSD Indicators of Sustainable Development	United Nations	2007	Worldwide
9	SDG Indicators	United Nations	2017	Worldwide

From the case studies above, several recurring aspects should be noted:

(1) Indicators follow the objective of measurement;
(2) The methodology and structure should be clear;
(3) The implementation of results is based on set targets;
(4) Smart-city related attributes are highlighted in recent indices.

Bearing these aspects in mind, one can begin to develop a set of indicators intended to measure inclusive and sustainable urban-industrial development.

3. AN ASSESSMENT FRAMEWORK FOR INCLUSIVE AND SUSTAINABLE URBAN-INDUSTRIAL DEVELOPMENT

3.1 Defining Sustainable Urban-industrial Development

The SDGs offer wide-ranging insight into sustainable development at the global level, while UNIDO's ISID mandate, as also mirrored in SDG 9, addresses infrastructure development, innovation, and the efficient and sustainable use of resources, as well as other priorities related to sustainable development. In advancing both the 2030 Agenda and UNIDO's mandate in ISID, cities can play a crucial role as their nation's most populous and industrialized areas.

Although the concept of sustainable urban and industrial development has not yet been widely applied in other research or indexing methodologies, it is still possible to identify several key aspects. These are the so-called "hard factors", which encompass the physical features of this approach, such as infrastructure, industry and the environment, and also the "soft factors", which are the supportive and social features of sustainable urban and industrial development, such as governance, human resources and social equity. Based on these characteristics, an analysis of sustainable urban and industrial development can be undertaken.

3.2 The Basic Structure of Inclusive and Sustainable Urban-Industrial Development Indices

UNIDO's mandate in ISID plays an integral role in the long-term sustainable development agenda. Industries can act as the primary source of income generation, simultaneously allowing for rapid and sustained increases in living standards for all people, and providing technological solutions to environmental development challenges. From the perspective of UNIDO, ISID means that:

(1) Every country achieves a higher level of industrialization in their economies and benefits from the globalization of markets for industrial goods and services;
(2) No one is left behind in benefiting from industrial growth, and prosperity is shared among women and men in all countries;
(3) Broader economic and social growth is supported within an environmentally sustainable framework;
(4) The unique knowledge and resources of all relevant development actors are combined to maximize the development impact of ISID (UNIDO, 2015).

To measure and promote ISID at the city level, first there is a need for consensus on ISID's impact on urban development. Four key principles can be drawn from ISID:

(1) The urbanization-industrialization nexus;
(2) Sustainable economy and social growth;
(3) Shared prosperity;
(4) Resource efficiency and environmental sustainability.

Based on previous research and the principles drawn from the concept of ISID, the key domains of an inclusive and sustainable city should be: (i) infrastructure; (ii) industry and innovation; (iii) environment; (iv) governance; (v) citizen development; and (vi) social equity. To describe an inclusive and sustainable city with six domains, it is necessary to develop a multi-layered hierarchic structure, wherein each level is described by the results of the level below. Each domain is therefore defined by several factors, and each factor is described by several core indicators and supplementary indicators.

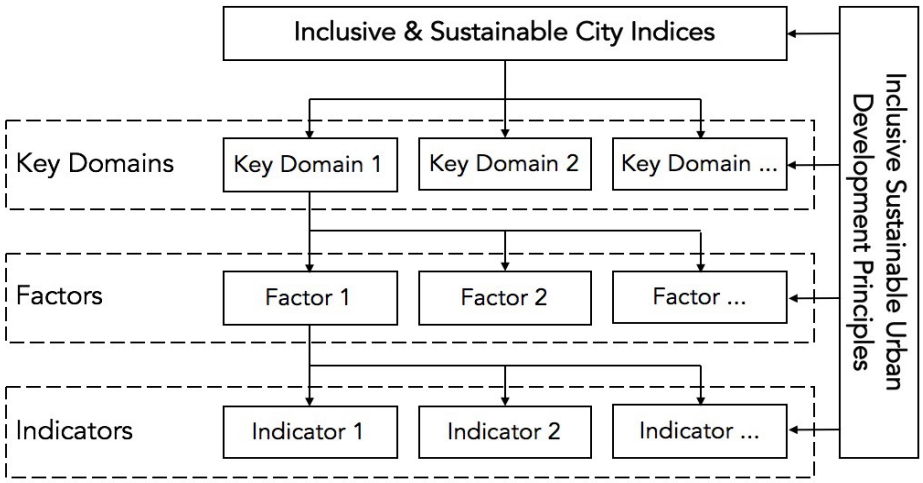


Figure 6: *A three-layer structure: Key domains, factors and indicators*

Sustainable urban and industrial development focuses not only on the tangible aspects of traditional urban and industrial development, but also on the social dimensions. Infrastructure and industry are the physical basis for growth and development, while a healthy urban environment ensures sustainable growth in the long term. From a social standpoint, strong urban governance is integral to providing the proper institutional framework for development. The ultimate goal of urban and industrial development is the eradication of poverty among city residents. Hence, human-resource development is a key factor in measuring the progress of urban development.

3.3 Constructing Inclusive and Sustainable Urban-Industrial Development Indices

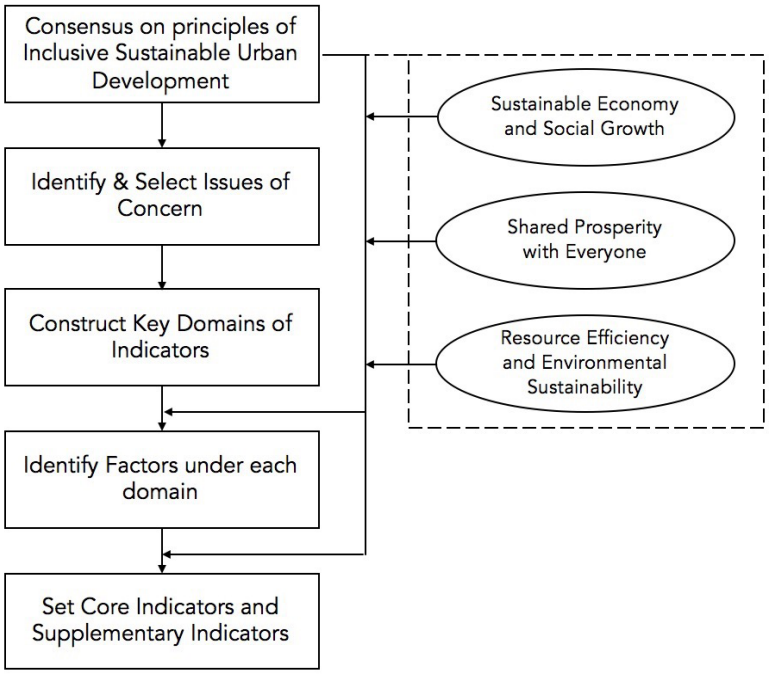


Figure 7: *Method and process of constructing inclusive and sustainable urban-industrial development indices*

The process of constructing the indexing system is illustrated in Figure 7. Essentially, it includes five steps:

(1) The principles of the indices will be concluded by consensus;
(2) Based on the guiding principles, several issues of concern will be identified;
(3) These issues will be selected and integrated to become key domains;
(4) Under each domain, factors reflecting practical fields within that domain will be elaborated;
(5) Finally, two circles of indicators, the core and supplementary indicators, will be selected.

Workshops with specialists from different domains should be organized to identify different levels of indicators.

3.4 An Analytic Framework for the Development of Inclusive and Sustainable Urban-Industrial Development Indices

Based on previous study, a framework of indices, such as those set out in Table 4, could be used as a working structure with which to identify detailed indicators. There are six key domains and 22 factors. Each domain comprises three to four factors that need to be further defined by the total 72 indicators and their data.

The key domains of a city are interlinked with one another in the urban and industrial development process. For example, industries are a key economic driver but are likewise linked to the environment, employment and energy efficiency (See Box 1 below). These connections need to be considered in an integrated way when selecting factors and indicators.

Table 4: A framework of inclusive and sustainable urban-industrial development indices

KEY DOMAINS	FACTORS
Infrastructure	Mobility
	Water treatment
	Waste management
	ICT infrastructure
Industry and innovation	Green economy
	Innovation
	Competitiveness
	Industrial clusters
Environment	Energy efficiency
	Pollution control
	Nature condition
Governance	Public participation
	Urban strategy and planning
	Multi-level involvement and cooperation
	Political transparency
Citizen development	Safety and health
	Education
	Human capital
	Culture development
Social equity	Employment
	Housing
	Social cohesion

There are two main sources from which to build a first version of indicators. One is the SDG indicators list (United Nations, 2017), which includes 232 indicators. The list of SDG indicators is comprehensive, but only certain indicators are relevant to city-level development. The other source is the ISO 37120 indicators list, which has 100 core and supportive indicators, in addition to several others. By combining these different sources, a proper indicator pool for city assessment may be created.

For all indicators selected, the data should be provided by the city authority involved in the assessment. In addition, big data analytics will be used for verification purposes. All data is to be assembled for analysis and will result in the preparation of a city profile. Experts will be invited to offer an overall analysis of the data, to set standard scores for all indicators and to provide further contextual analysis.

All cities are closely connected to neighbouring cities within a broader regional context. Consequently, the indicators need to be considered within a wider spatial and temporal context. The key domains and factors can therefore remain relatively stable, but indicators could be accorded greater flexibility depending on the local situation and the availability of data. Two sets of indictors based on the same framework will be generated, one will be used for city assessment and the other will be used for investors, business-sector entities and other solution providers to judge and monitor urban development.

Box 2: Light industries and cities

Heavy industry, in contrast with light industry:

- "Relies more on labor and less on heavy machinery;
- Produces finished products from partially processed materials;
- Produces smaller products with higher value per unit weight;
- Requires less raw materials, square footage, and power;
- Has less environmental impact" (US Legal, 2017).

Light industry is an integral part of a city's economy and contributes majorly to a city's export industries. Some key examples of light industry in urban areas include textile and garment industries, shoes, leather goods, jewelry and pottery. Cities all over the world, including Beijing in China, London in the United Kingdom, São Paulo in Brazil and Dhaka in Bangladesh, have integrated small manufacturing industries into the central areas of the city, where they can contribute directly to their city's economic and social structure and employ a large part of the urban population. Due to their central location, these industries benefit from high visibility and proximity to the urban customer. Inside Dharavi, the central slum of the city of Mumbai in India, there are more than 20,000 mini-factories and a skilled workforce engaged in the light manufacturing industry, including leather works, clothing, pottery and furniture (Assainar, 2014).

A glimpse into the Dharavi garment industry in Mumbai, India
(Photograph: Suraj Uchil. Source: Assainar, 2014)

Light industrial businesses are for the most part located centrally in mixed land-use areas of a city. The most suitable businesses are therefore the ones that contribute to a vibrant street life, while meeting the environmental and quality standards of the city. Due to the organic growth of such industries, in particular in the inner areas of the city, along with the lack of a proper evaluation and monitoring system, light industries can cause potential threats and nuisance (i.e. vibration, noise, fumes, etc.).

Moreover, basic infrastructural facilities and proper waste-management systems are commonly missing from such industries in urban areas, in particular in developing countries. Consequently, there is a need for the development of rehabilitation policies and the proper relocation of those light industrial businesses that are in non-compliance with the current standards of the city's land-use plan or urban-development policy. The relocation of such industries will have a significant impact on the lives of local citizens and business owners. Factors, such as transit time to the workplace, standard of living, willingness to relocate, cost of accommodation and so on, should therefore be taken into consideration during the policy-reformulation process.

In addition, since light industries consume a significant amount of a city's energy, being one of the most energy-intensive sectors, benchmarking surveys for energy efficiency and city indices needs to be extended. Surveys and indices should aim to better cover important processes in light industries and small-scale clusters. As noted in UNIDO's report on *Global Industrial Energy Efficiency Benchmarking* (UNIDO, 2010), consideration of the energy use of light industries is very important since they have relatively large improvement potentials in percentage terms for energy efficiency. Indices measuring inclusive and sustainable urban-industrial development should therefore also include these industrial sectors, which can contribute significantly to citizens' wellbeing, as well as the urban economy.

The closely connected six key domains constitute an entire urban system under the principles reflected in ISID, as illustrated in Figure 8:

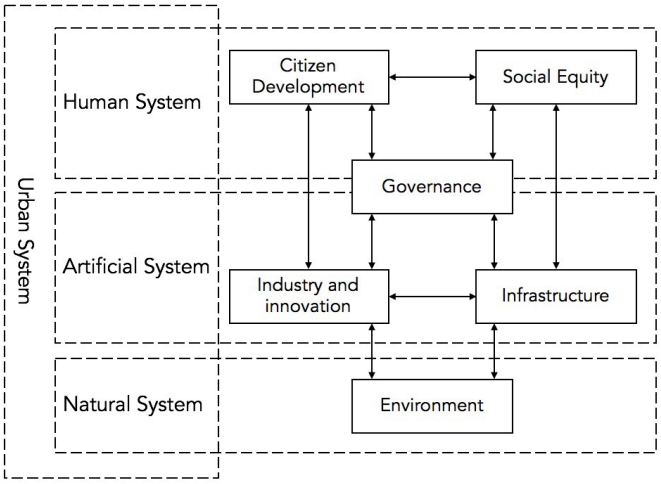


Figure 8: *Relationship of the six key domains in an urban system*

The next step should be to identify indicators and data sources. Some modification and optimization of the indices will need to be done, bearing in mind data availability and local specificity, during construction of the indicators. The basic structure of the indices should be kept stable, which means that key domains and factors should be relatively fixed for easy comparison between different stages of city development or between different cities, but the indicators can be varied slightly in accordance with local data availability and other conditions. In addition, the data should be standardized to allow for comparison across cities of different backgrounds. Last but not least, a visualization of the assessments needs to be outputted for use by stakeholders located both within and outside of the city (i.e. municipal governments and potential investors, respectively).

3.5 The Assessment Method and Process

The assessment methodology requires a mix of quantitative and qualitative processes. This integrated approach seeks both the accuracy of quantitative assessment and the comprehensiveness of results obtained through qualitative analysis. It is likewise important to consider indicator data in the broader context and in relation to other indicators during data analysis or interpretation. Different sources of data should be considered during assessment to ensure that the entirety of a city's image is described as best as possible. Big data analytics will be undertaken on city statistics and related documents can be used to develop an integrated city profile.

An expert group should be organized to produce a profile of each assessed city. Based on the data provided, a qualitative assessment of each domain will be undertaken by experts. It is also recommended that indicators should be further analyzed bearing in mind their contextual relevance. The experts are responsible for the interpretation of data and scoring of each domain. Considering that data may not be available for all indicators, the impact of indicators on the score of each key domain should be discussed according to each city's specific situation. The city profile is then produced primarily based upon the contextual analysis of the index. The profile should focus not only on the static state of urban and industrial development, but also on recommendations for future areas of urban and industrial development, as well as suggestions within specific domains and indicators.

4. INCLUSIVE AND SUSTAINABLE URBAN-INDUSTRIAL DEVELOPMENT INDICES AND ASSESSMENT

4.1 Putting the Framework into Action

The indexing framework forms the basis of the promotion of ISID and SDG 9 within urban areas. Measurement with indices is just the beginning. Once the results of the benchmarking procedure have been obtained, further actions should be introduced. First, benchmarking outputs can support decision-making for urban strategies and projects. Second, they can inform citizens of what is going on in their city and can promote the improvement of urban governance and service delivery. Third, they can help to build up the city's image locally and internationally and to attract investors or tourists.

The indexing framework can offer international organizations a framework within which to assemble guidelines and manuals for the promotion of inclusive and sustainable urban-industrial development, with a special focus on the roles of industry and infrastructure, and to provide advice and guidance to city governments and other municipal actors. City assessment can also help facilitate the development of projects and partnerships between cities and international organizations, such as UNIDO, the World Bank and others.

4.2 Benchmarking, Comparison and Cooperation

The framework, along with a detailed study of the indicators, could be used by all relevant stakeholders. Further research into indicator selection should be undertaken in relation to specific targets. With indicators established, the indices will be used to promote inclusive and sustainable urban-industrial development through a three-step process:

(1) First, the selected cities will be assessed using benchmarks.

(2) Second, the comparison will be carried out along two dimensions: (i) a horizontal comparison with other cities' measurement results; and (ii) a vertical comparison with previous years' results to assess development progress. For example, Africa has similar urbanization rates but lower income in comparison with Asia. In other words, the cities have grown but citizens remain poorer (UNECA, 2017). This comparison can offer a relatively full-bodied understanding of a city's position within a system of cities over a specific time period.

(3) Third, focus areas and potential cooperation projects could be proposed based on previous assessments and city-to-city comparisons.

On the one hand, the framework can be used to measure urban development and to compare development with other cities in order to locate any restricting elements and developmental imbalances by citizens, enterprises and those working in city government. On the other hand, potential investors and neighbouring cities can use the assessment results as a guide for cooperation by ascertaining any city's needs directly from the results. Benchmarking and city comparison can help each city elaborate a city profile that can clearly indicate its development advantages and disadvantages. Furthermore, with guidelines developed based on these indices, cities could be matched as potential cooperation partners, if complementarities exist, and could thereafter support each other in locating inclusive and sustainable pathways for development.

REFERENCES

Assainar, R. (2014, November 25). At the heart of Dharavi are 20,000 mini-factories. Retrieved from The Guardian: https://www.theguardian.com/cities/2014/nov/25/dharavi-mumbai-mini-factories-slum.

A.T. Kearney. (2017). Global Cities 2017: Leaders in a World of Disruptive Innovation.

Centre of Regional Science (SRF), Vienna UT. (2007). Smart cities: Ranking of European medium-sized cities. Vienna, Austria.

CITYkeys. (2017). CITYkeys: City handbook to performance measurement.

EIU. (2012). The Green City Index: A summary of the Green City Index research series. Munich, Germany.

European Union. (2016). Good Practice Report: European Green Capital 2018.

ISO. (2014). ISO 37120: Sustainable development of communities: Indicators for city services and quality of life. Geneva, Switzerland.

United Nations. (2007). Indicators of Sustainable Development: Guidelines and Methodologies.

———. (2014). Department of Economic and Social Affairs, Population Division. (The 2014 Revision, Highlights ed.).

———. (2014). Sustainable Cities & Human Settlements in the SDGs. New York City, United States of America.

———. (2016). Report of the Inter-Agency and Expert Group on Sustainable Development Goal Indicators.

———. (2017). Report of the Inter-Agency and Expert Group on Sustainable Development Goal indicators (E/CN.3/2017/2).

UNECA. (2017). Urbanization and Industrialization: Economic Report on Africa 2017. Addis Ababa, Ethiopia.

UNIDO. (2010). Global Industrial Energy Efficiency Benchmarking: An Energy Policy Tool. Vienna, Austria.

———. (2015). Introduction to UNIDO - Inclusive and Sustainable Industrial Development. Vienna, Austria.

———. (2016). Cities at Crossroads: Unlocking the potential of industries in sustainable urban development. Vienna, Austria.

Urban China Initiative. (2014). The China Urban Sustainability Index 2013 Report.

US Legal. (2017). Light Industry. Retrieved from US Legal: https://definitions.uslegal.com/l/light-industry/.

BIOGRAPHIES

Mr. Weixi GONG has worked at the United Nations Industrial Development Organization (UNIDO) since 1997. Since 2011, he has held the position of Senior Coordinator for South-South and Triangular Industrial Cooperation. In this role, he has overseen the development and implementation of several projects on inclusive and sustainable urban and industrial development and has been actively engaged in research into the interlinkages between cities and industries since 2012. Mr. Gong began his career at Shenyang Aircraft Design and Research Institute at the Aviation Industry Corporation of China. He later worked for various international companies, including Siemens and Pfizer Group.

Mr. Hui LYU is an urban development specialist with expertise in sustainable urban development and smart-city planning. Currently, he is working at UNIDO as an international consultant while completing his PhD on the topic of smart cities as a social-technical process in urban and regional development at the Vienna University of Technology.

Mr. Lyu holds a Bachelor of Engineering from Tongji University in Shanghai, a Master of Science from Bauhaus-Universität Weimar and a Master of Engineering from Tongji University.

Academic Contributors

Mr. Áron Perényi is Assistant Professor in International Business at the Swinburne University of Technology in Melbourne, Australia and a member of the Group of Energy Efficiency Researchers Australia. In recent years, his research has focused on international management and economics, encompassing international competitiveness, small- and medium-sized enterprise management and life cycle, economic development, leadership and ethics, energy efficiency, and specialized areas of consumer behaviour.

Mr. Perényi holds a Master of Science in Engineering from the Budapest University of Technology, a Master of Science in Economics from Corvinus University Budpest and a PhD from the Faculty of Business and Enterprise at the Swinburne University of Technology.

Mr. Gerhard O. Braun graduated from the University of Würzburg with a degree in Geography, Mathematics and Psychology. After five years as Assistant Professor, Mr. Braun was hired by the University of Frankfurt in 1974, and in 1975, by the Free University Berlin as Professor for Urban Studies, Geographic Information Science and Statistics. In 2009, he founded the Institute for International Urban Studies at the International Academy Berlin. For some twenty years, he has been invited as a guest professor at Wilfrid Laurier University in Waterloo, Canada.

Mr. Braun's main fields of research include inter- and intra-urban systems studies within the subfields of social segregation, migration, housing and employment studies, urban economics, planning, governance, modeling, scenario analyses and theory building at all spatial and contextual scales based on sustainable balance concepts. Mr. Braun's recent research has concentrated on planning concepts such as smart growth, transportation, sustainable urban development and new spatial patterns as the result of global economic restructuring.

Mr. Chaolin GU is a Professor at the School of Architecture at Tsinghua University, Vice President of the Chinese Futurology Association and Councilman of the China Society for Urban Sciences. In addition, he is a member of the Science and Technology Committee at the Ministry of Housing and Construction. Mr. Gu was a visiting scholar in the Department of Geography and Planning at the University of Toronto in the academic year 1992 to 1993 and in the Centre of Urban Planning and Environmental Management at the University of Hong Kong in 1994 and 1995. He has also been a Visiting Professor at the Institute of Social and Economic Geography at the University of Leuven.

Mr. Gu is engaged mainly in research into urban and regional planning, as well as regional economics and urban geography in China. Since 1986, he has published twenty-six monographs and more than 380 papers. He has successfully led many major research and planning projects and won several prestigious prizes. Mr. Gu holds a bachelor's, master's and PhD degree from the School of Geographic and Oceanographic Sciences at Nanjing University.

NOTES

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION

Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Telephone: (+43-1) 26026-0, Fax: (+43-1) 26926-69
E-mail: unido@unido.org, Internet: www.unido.org

FINANCE CENTER FOR
SOUTH-SOUTH COOPERATION
南南合作金融中心

FCSSC

Finance Center for South-South Cooperation, 1102-1106, 11/F,
Two Pacific Place 88 Queensway, Admiralty, Hong Kong, China
Telephone: +852 3758-2366, Fax: +852 3758-2879
Email: general@fc-ssc.org, Internet: www.fc-ssc.org