CIB W101 Meeting Report in Helsinki 2011
Assessment Tools on Urban Sustainability

1. Introduction

CIB W101, Working Commission on Spatial Planning and Infrastructure Development, held annual meeting on October 20th 2011 in Helsinki in conjunction with SB11 Conference. Seven people including CIB Secretary General Dr. Bakens were attended in the meeting, and it was chaired by Dr. Akashi as coordinator of the commission. Members were from Japan, US and Finland.

The main subject of the meeting was “Assessment Tools on Urban Sustainability”, which was voluntarily selected by attended commission members as one of the most competitively progressing technological field with diversity among research groups internationally in relation to the subject of urban planning and sustainability. In the meeting, three specific tools were taken up for comparative study and discussion, which are HEKO, CASBEE-City and NILIM tool. The three are in fairly different characteristics with each other under different purposes. Here is the outline of the three tools.

2. HEKO

HEKO (Helsinki Eco-efficiency Tool for Urban Development) was developed by VTT (Technical Research Center of Finland) as a fast, comprehensive and user-friendly eco-efficiency estimation method for urban development. Its prominent characteristics are clear focusing on to be practical in planning process of urban development, as well as to fit to locality of Finnish harsh climate and low density urban design culture.

On selection of indicators, HEKO tool approaches eco-efficiency from six viewpoints or criteria: flows of materials and energy, share of renewable energy sources, flows of emissions and waste and impact on the ecosystem. Eco-efficiency in the built environment is calculated with 21 "indicators" (Table 1) that are divided into 5 groups: land use, water usage, energy use, traffic and services, and carbon and material cycles. The tool produces one single aggregated average value of 21 independently calculated indicators.

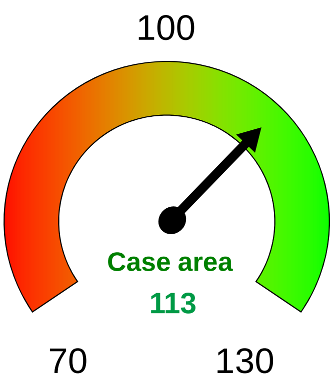
The results are presented also graphically. The overall average is called “total eco-efficiency”. This result can be used to label the studied area. Labeling resembles familiar European Union energy labels with colors. The tool also delivers real time indicator "speedometer" for planners (Figure 1) and designers to follow improvement of the eco-efficiency during their design process, and a spider web figure (Figure 2) that shows results of 21 indicators in the case area compared to maximum, minimum and average eco-efficiency.

Definition of eco-efficiency of the HEKO tool is somewhat unique and practical. It is defined as

$$\textit{Eco efficiency} = \frac{Total\ floor\ area\ or\ sum\ of\ inhabitants\ and\ jobs}{Use\ of\ natural\ resources\ harm\ to\ the\ environment}$$

This reduced definition covers now the so-called hard-core of eco-efficiency. Total floor area or sum of inhabitants and jobs represent here the products and services provided by the built environment. Use of natural resources consists of the use of materials and energy, with a specific focus on nonrenewable fuels and materials. Harm to the environment consists of emissions (especially greenhouse gases), production of waste and ecosystem damage. It is based on a definition of eco efficiency applied specially for the built environment. In this definition, eco-efficiency can be expressed in a mathematical form with sufficiently unambiguous contents.

The tool was tested in three case areas in the City of Helsinki as well as in Koukkuranta district in the City of Tampere. Urban planners and designers participating in the project were quite satisfied with the outcome. Average time spent to use the tool for a quick estimation was only approximately two hours.



ECO-EFFICIENCY POINTS (total eco-efficiency)		
points	value category	CLASSIFICATION
110 or more	top value	A+
105...109,9	excellent	A
95...104,9	good	B
86...94,9	normal	C
75...85,9	sufficient	D
below 75	weak	E

Figure 1: Eco-efficiency Speed meter of HEKO

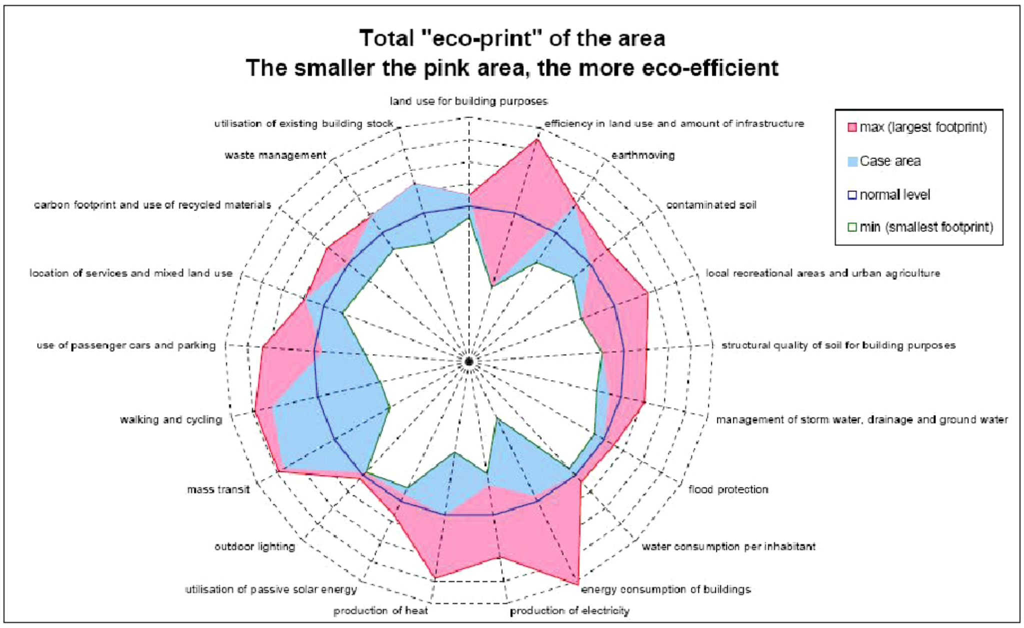


Figure 2: Spider web Diagram on 21 Indicators of HEKO

Table 1: List of HEKO Indicators

Indicator group	#	Indicator	Score		Weight	
			Min	Max		
LAND	1	land use for building purposes	95	105	+	1%
	2	efficiency in land use and amount of infrastructure	65	135	++++	10%
	3	earthmoving	84	116	++	5%
	4	contaminated soil	90	110	++	3%
	5	local recreational areas and urban agriculture	84	116	++	5%
	6	structural quality of soil for building purposes	90	110	++	3%
WATER	7	management of storm water, drainage and ground water	89	111	++	3%
	8	flood protection	95	105	+	1%
	9	water consumption per inhabitant	96	104	+	1%
ENERGY	10	energy consumption of buildings	58	142	+++++	13%
	11	production of electricity	81	119	+++	6%
	12	production of heat	71	129	++++	9%
	13	utilisation of passive solar energy	93	107	+	2%
	14	outdoor lighting	98	102	+	1%
TRANSPORT AND SERVICES	15	mass transit	71	129	++++	9%
	16	walking and cycling	71	129	++++	9%
	17	use of passenger cars and parking	77	123	+++	7%
	18	location of services and mixed land use	91	109	++	3%
CARBON AND MATERIAL CYCLES	19	carbon footprint and use of recycled materials	88	112	++	4%
	20	waste management	91	109	++	3%
	21	utilisation of existing building stock	86	114	++	4%

3. CASBEE-City

CASBEE-City is developed by JSBC (Japan Sustainable Building Consortium) with the cooperation of the PCLCC (Promotion Council of Low Carbon Cities) as a comprehensive assessment tool on built environmental efficiency for city-wide scale that allows users to identify the performance of their city. As with other tools in the CASBEE family, CASBEE-City is also measured by BEE (Built Environment Efficiency) value, which defined as Q/L（score for Quality/score for Load）.

Technically, CASBEE-City set a hypothetical boundary around the area of a city in order to estimate the value of L and Q. L is measured as negative environmental impact to outside the hypothetical boundary by activities inside the city, while Q is measured as improvement of quality of life within the target area (Figure 3).

Score for L is based on greenhouse gas (GHG) emissions. By calculating the score for L from GHG emissions, industrial cities tend to receive lower scores. However, we must not forget that the entire nation benefits from the industrial activities in these cities. Therefore CASBEE-City provides two different assessment methods for L; "emitter-pays principle," which allocates all GHG emissions to producing areas, and "beneficiary-pays principle," which reallocates GHG emissions to consuming areas.

Score for Q is based on a triple bottom line approach which takes into account of environmental, social and economic conditions. It is a measure of improvements in the activities of citizens, and quality of life, which is a crucial factor in developing a sustainable society.

CASBEE-City consists of more than 40 assessment items which makes this tool as comprehensive assessment tool. These items were carefully selected and reviewed for many times by experts in city planning and by administrative officers in local governments in terms of practical use (Table 2).

The performance of a target city is calculated as BEE value, which is described in BEE chart (Figure 4). Before industrialization, score of L of a city was small but score of Q was also small. In recent cities, score of L becomes large but score of Q has been much larger. Hopefully score of L would be smaller as well as score of Q would be larger than current position, and that is the direction which urban policy should take to.

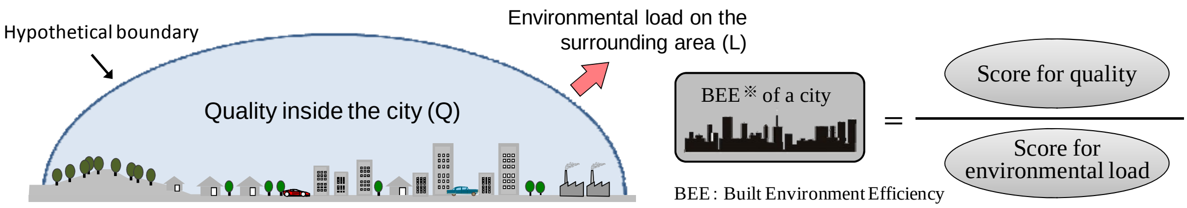


Figure 3: Hypothetical Boundary Implemented in CASEBEE-City & Definition of BEE

Table 2: Assessment Items of CASEBEE-City

(1) Assessment items for Environmental Load (L)

Major category	Middle category	Subcategory
L1. GHG emissions	L1.1 CO_2 from energy sources	L1.1.1 Industrial sector*
		L1.1.2 Building (residential) sector
		L1.1.3 Building (commercial) sector
		L1.1.4 Transportation sector
		L1.1.5 Energy conversion sector*
	L1.2 Industrial processes*	
	L1.3 Waste disposal sector	
	L1.4 Agriculture sector*	
	L1.5 Three gases (HFCs, PFCs and SF6)	
L2. Environmental load reduction and CO_2 absorption	L2.1 Low-carbon energy sources	
	L2.2 CO_2 sinks	
L3. Support to other regions for reducing CO_2 emissions	L3.1 Domestic trade, etc.	

Note: There are two calculation methods for assessing environmental load: "emitter-pays principle" and "beneficiary-pays principle." The latter method is applied to items marked with an asterisk; GHG emissions from the producing area are deducted and reallocated evenly to consuming areas across the country.

(2) Assessment items for Environmental Quality and Activities (Q)

Major category	Middle category	Subcategory
Q1. Environment	Q1.1 Nature conservation	Q1.1.1 Ratio of natural and agricultural land use
	Q1.2 Local environmental Quality	Q1.2.1 Air
		Q1.2.2 Water
		Q1.2.3 Noise
		Q1.2.4 Chemicals
	Q1.3 Resource recycling	Q1.3.1 Recycling rate of general waste
	Q1.4 Environmental measures	Q1.4.1 Efforts and policies to improve the environment and biodiversity
Q2. Society	Q2.1 Living environment	Q2.1.1 Adequate quality of housing
		Q2.1.2 Adequate provision of parks and open spaces
		Q2.1.3 Adequate sewage systems
		Q2.1.4 Traffic safety
		Q2.1.5 Crime prevention
		Q2.1.6 Preparedness for natural disaster
	Q2.2 Social services	Q2.2.1 Adequacy of education services
		Q2.2.2 Adequacy of cultural services
		Q2.2.3 Adequacy of medical services
		Q2.2.4 Adequacy of child-care services
		Q2.2.5 Adequacy of services for the disabled
		Q2.2.6 Adequacy of services for the elderly
	Q2.3 Social vitality	Q2.3.1 Rate of population change due to births & deaths
		Q2.3.2 Rate of population change due to migration
		Q2.3.3 Progress toward an information society
		Q2.3.4 Efforts and policies for vitalizing society
Q3. Economy	Q3.1 Industrial vitality	Q3.1.1 Amount equivalent to gross regional-products per capita
		Q3.1.2 Ratio of change in the number of employees
	Q3.2 Economic exchanges	Q3.2.1 Index equivalent to the number of people visiting the city
		Q3.2.2 Efficiency of public transportation
	Q3.3 Financial viability	Q3.3.1 Tax revenues
		Q3.3.2 Outstanding local bonds

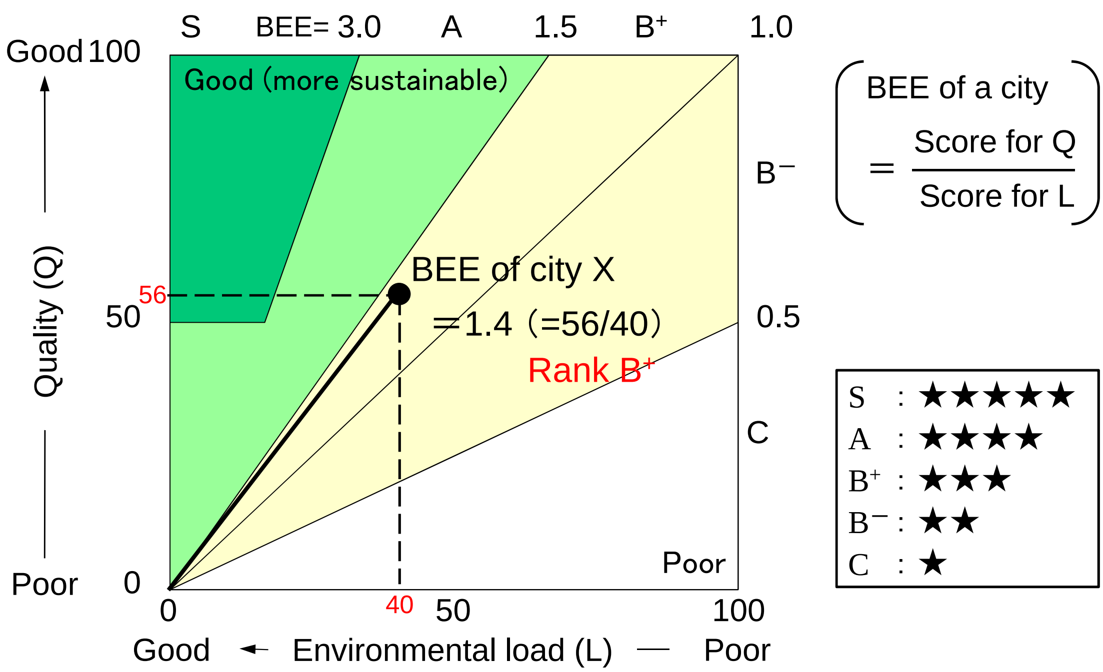


Figure 4: BEE Chart & an Example Assessment Result

4. NILIM tool

NILIM tool is an assessment tool on spatial planning policy selection in terms of sustainable urban development and/or smart shrinking. It focuses on performance measurement of urban structure, which mainly consists of land use, facility allocation and infrastructure network including public transportation services. It particularly emphasize on future public expenditure in terms of operational cost of public services and maintenance cost of infrastructures in relation to spatial allocations in the city area, which is the most uniqueness of the tool.

The tool consists of two part; perspective setting part of future urban structure, and evaluating part of future urban structure (Figure 5). Principle way in forecasting expected future urban structure is to use simulation model of which core part is a type of land use transportation model. In this case, the input factors are mostly implementation of planning policy such as rezoning, relocation of public facilities, development or redevelopment of city center district, introducing or abolishing public transportation system, and so forth. Some alternative cases should be provided including business as usual (BAU).

In evaluation part, performance of future urban structure is measured by specific indices that categorized in five large items which is Quality of Life, Safety, Environment, Vitality and Public Expenditure (Table 4). The alternative future urban structures should be compared with each other by each item.

NILIM tool intends to approach the decision making process on spatial planning and infrastructure development including public participation process. Thus, potential users are assumed to be local planning authorities. The tool is not yet finalized, but it has already been applied in two local city regions as case studies until 2011.

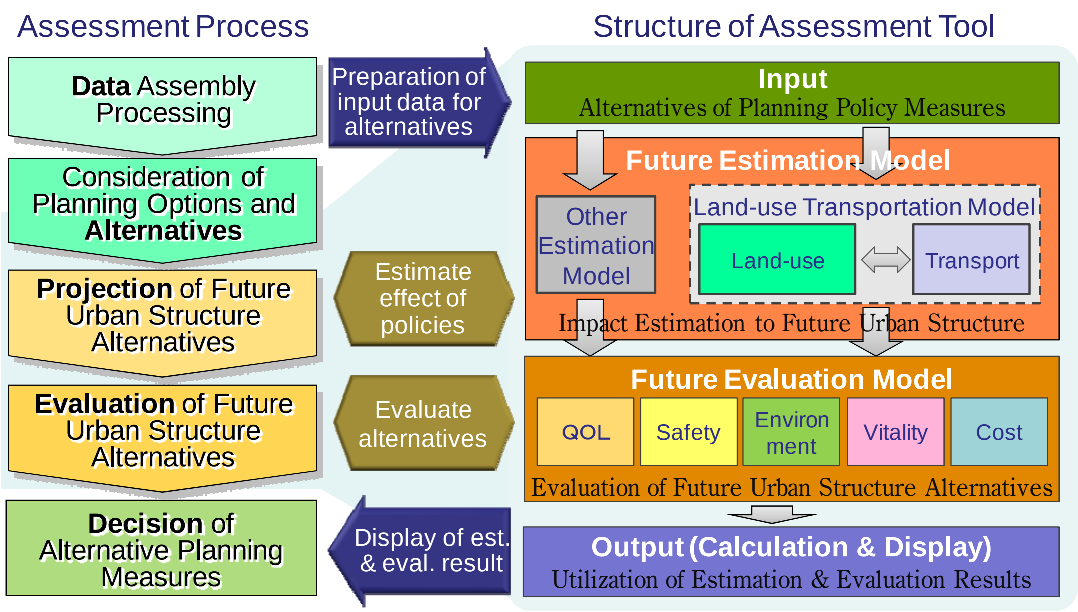


Figure 5: Structure of NILIM Tool

Table 4: Indices for Evaluation of NILIM Tool

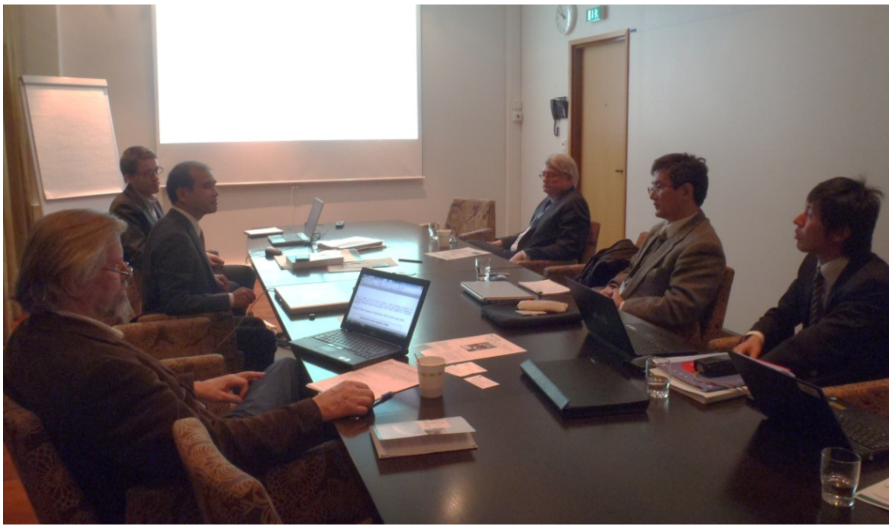
Field	Categories		Indicator	Declare	Forecast
Quality of Life	Housing	Habitation	No. of Inhabitants by Type (e.g. in 1km Radius City Centre)	●	○
		Quality	Floor Area per capita	–	●
		Cost	Cost of Housing	–	●
	Transport	Features	Required Time (by modes etc.)	–	●
			Mode Split	–	●
		Public Transport	No. of Public Transport Passengers	–	○
			Access to Transportation Facilities	●	○
		Clog	Congestion rate	–	◎
		Accidents	No. of Traffic Accident Victims	–	◎
		Accessibility	Accessibility to City Cores	–	●
	Infrastructure	Water & Sewerage	Sewage Serving Population Percentage	●	□
		Parks & Green	Parks & Green Area per Capita, Green Coverage	●	□
	Communication	Community	Population Composition Balance	–	●
Safety	Crime	Crime Prevention	No. of Crime, Crime Rate	–	–
	Disaster Mitigation	Disaster Mitigation	No. of People with Hardship in Home-returning in Case of Disaster	–	◎
			Difficult Areas of Fire-fighting	–	◎
			Wide Street Density	●	□
			No. of Houses in Hazardous Area	●	◎
			Quakeproof Building Rate	–	△
	Medical Care	Medical Care	Population of Accessible Area to Medical Facilities	–	◎
Environment	Global Env.	Global Warming	CO2 Emissions (by sector)	–	◎
			Amount of Fixed CO2 by Green	●	□
	Air Pollution	Emission	NOX Emissions	–	◎
	Nature	Green Coverage	Green & Agricultural Land Coverage	●	□
	Energy Resources	Fuel	Fuel Consumption	–	◎
	Waste	Waste Emission	Waste Emission Amount per Capita	–	△
Vitality	Activity Distribution	Industry	No. of Employee	–	●
	Industrial Activities	Distribution Costs	Time Reduction & Punctuality	–	◎
		Commerce	Commercial Sales Total	–	△
		Tourism	Accessibility between Tourist Spots	–	◎
	Economic Growth	GDP, GRP	GDP & GDP per Capita	–	△
	Economic Impact	Land Price	Land Price, Land Rent, Volatility	–	●
Cost	Road		Road Maintenance Cost	–	◎
	Welfare		Operation Cost for Visiting Care for Elderly	–	◎
	Public Transport		Operation Cost for Bus Route	–	◎
	Education		Operating Cost for Primary and Junior High School	–	◎

5. Discussions

- Assessment tools on sustainability of cities and urban development are already in the stage of practical use rather than theoretical studies. It is sure that urban related activities include so many various factors, however, we should know it is necessary to select and reduce the number of indicators to use the tool in real cases rather than useless pursuit of comprehensiveness.

- User friendly shall be the most important key word in developing practical tools. Different approach is needed for different purpose of assessment in different role of users. For this reason, study and development of the tools has still large possibility to explore.

- Characteristics of built environment in terms of urban context are quite diverse according to difference of climate, design culture and so forth from country to country. We should pay more attention to the fact that parameters, indicators as well as methodology itself are not necessarily being common and single between various regions in the world.



6. References

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(Above 2 articles are in Conference USB Book of SB11 Helsinki, World Sustainable Building Conference)

3) Shuzo Murakami, Shun Kawakubo, Yasushi Asami, Toshiharu Ikaga, Nobuhaya Yamaguchi, Shinichi Kaburagi, "Development of a comprehensive city assessment tool: CASBEE-City", Building Research & Information, 39: 3, 195 - 210 2011

(The responsibility for the wording of this article lies with Dr Tatsuo Akashi)