Towards the Sustainability Assessment: A Case Study of International Indicators and the Trial Assessments of Kashiwa-no-ha Plans in Japan

Masaru Miyawaki

Department of Urban Environment Systems, Faculty of Engineering, Chiba University, Chiba, Japan, miyawaki@tu.chiba-u.ac.jp

Soujanya Tenkayala

Takusho-Kaihatsu Co., Ltd, Chiba, Japan – soujanya13@gmail.com

Abstract

Sustainability indicators and their assessment are increasingly recognized as a useful tool for planning and communication of progress in fields such as environment, economy and society in the world. However in Japan, sustainability assessment is neither applied nor mandatory in the planning process. In order to easily evaluate sustainability of the various types of plans, effective indicators must be established. After the comparison of international indicators of 'Sustainable development', 'Eco City' and 'Smart City' in the global context, the integrated indicators are proposed in this paper. The proposed indicators are applied to the trial of the sustainability assessment for the recent urban development of Kashiwa-no-ha, which is a well-known Smart City Project in Japan. Even though the lack of some viewpoints is evident from the sustainability indicators, the sustainability assessment is a useful tool to check and develop plans for Kashiwa-no-ha in the future.

1. Introduction

The impact of human activity on the environment has been long recognized. In recent years, environment friendly urban development has been well debated and seen a surge of activity especially with growing concern towards issues such as global climate change and urbanization. Such various projects are labeled often by self-declared terminologies such as sustainable, eco, smart, intelligent etc., which have a wide range of interpretations. The compounded result of lack of clarity regarding various environment friendly urban development terminologies and lack of universally accepted regulations or assessment frameworks for these terminologies has been labeled as 'Fuzzy planning' (Gert de Roo and Geoff Porter 2007).

Clear and comprehensive environment friendly development terminology and identification of their salient features will disperse fuzziness and aid in selection process of appropriate urban areas for comparative studies.

1-1. Research Objective

This paper examines current trends of indicators seen internationally in sustainability, and attempts to explain these trends through a comparative study between the different terminologies in the international level. The objective of this study is to provide clarity to such terminologies and to try to integrate sustainability indicators and to evaluate some model plans in Japan.

1-2. Research Methodology

A comprehensive study of indicators was conducted to identify origin, widely accepted definition of current terms and their salient features. Similar terms were grouped together based on related themes and sub-themes. The frameworks of each are compared and analyzed to validate their conformance with the identified definition and their indicators. An international comparative analysis of three main frameworks; *'Sustainable development'*, *'Eco City'* and *'Smart City'*, and the integration of their indicators are the unique point of this study and it was conducted to identify their characteristics.

Two case studies were analyzed based on this comparative table to demonstrate the applicability of the study. The indicators of three frameworks were used to assess two plans of the well-known Kashiwa-no-ha project in Chiba Prefecture which is the recent urban development selected as the case study of the applicability in Japan.

1-3. Role and Importance of Indicators

Indicators should be used for the Environmental Assessment or the Sustainability Assessment in the formal procedure but they are yet to be established in every country until now. Indicators are very useful for everyone to quickly check the integral sustainability, and are able to widely ensure

conformance to project plan and introduce the progress of the project. They help to assess strategies and policies enforced, and are used to communicate success of environment friendly developments. Hence, indicators should be continued to research from worldwide comparative studies, required for knowledge sharing purposes.

2. Classification of Terminology

The term sustainability is used in this paper to commonly refer to all projects, which aim to reduce their impact on the environment. Based on the literature study, this paper groups terms with overlapping concepts together and identifies three main types of urban developments in practice today- *sustainable*, *eco* and *smart*. Classification of various terms under the three main types is given in Table 1. The three main terms types of projects are defined as follows.

Ecocity builders and associates. It is a United Nations accredited non-profit organization. Richard Register, the head of this organization is credited with coining of the term 'Eco City'. It is yet to see an internationally accepted framework and indicators list. Ecocity builders and associates work closely with the United Nations. The International Eco City Framework and Standards (IEFS), currently under development by the organization, Ecocity builders, has been taken as the base framework for studying the Eco City developments in this comparative study.

2-3. Smart City

Smart City is the latest term and the fuzziest concept. Unlike the previous terms, there are a large number of governments and private businesses involved in various Smart City projects worldwide. Hence consensus in this case is most difficult. Various definitions were identified as closest to the concept indicated by the term 'Smart City'. From these definitions, 'Smart City' can be summarized as a strategic device to encompass

Table 1 – Classification of Terminologies and Definitions.

Urban Development Types	Sustainable development	Eco city	Smart city
Year	1980's -	1980's -	2000's -
Related terms	Green city, Low carbon, Zero carbon	Bio-Region, Ecological Metropolis, Compact city, Neighbourhood	Digital city, Intelligent city, Innovative city, Smart growth, Smart industry, E-Governance, E-Democracy
Definitions	The most quoted definition is from Our Common Future, also known as the Brundtland Report (United Nations 1987): **"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs**. It contains within it two key concepts: The concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and The idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs."	"an urban environmental system in which input (of resources) and output (of waste) are minimized" (Register 2002). Ecocity Builders and associates' definition of "ecocity" is conditional upon a healthy relationship of the city's parts and functions, similar to the relationship of organs in living complex organism.	A Smart City is a city well performing in six characteristics- smart economy, smart mobility, smart environment, smart people, smart living, smart governance, built on the 'smart' combination of endowments and activities of self-decisive, independent and aware citizens. (Centre of Regional Science, Vienna University of Technology 2007)

2-1. Sustainable Development

Sustainable Development is defined, as 'Development that meets needs of the present without compromising ability of future generations to meet their own needs[2]', by United Nations. Sustainable Development is the most developed term with an internationally accepted UN framework. The 3rd edition of this framework (2007) has been used for this comparative study.

2-2. Eco City

Eco City is defined as 'an urban environmental system in which input (of resource) and output (of waste) are minimized', by

and highlight the growing importance of Information and Communication Technologies in profiling the competitiveness of cities. Additionally it relates to wise management of natural resources through participatory governance. European Union in particular has devoted constant efforts towards growth in the 'Smart Sense', through initiatives such as the 7th Research and Development Framework Program and the Competitiveness and Innovation Program (CIP). The base framework for smart cities which is proposed by the Centre of Regional Science of Vienna University of Technology has been adopted from a European research paper on ranking of European cities. No other indicators list has appeared with more official credibility. Hence their indicators of 'Smart City' are adapted in this paper.

3. Comparative Analysis of the indicators

3-1. Frameworks: An overview

Assessment frameworks form the skeletal grid over which the progress of the environmental friendly urban development takes place. It gives the important areas of focus, referred in this paper as themes and sub-themes, and forms the baseline for achieving the concept objectives. The assessment framework forms the basis for evaluating the measures and plotting the progress achieved towards environment friendliness. It shows where the urban area stands with regards to its performance level under each theme. It also helps pinpoint themes, which need immediate attention and those where good progress has been achieved. It forms a medium to propagate and collaborate with other such efforts.

3-2. Indicators: An overview

Performance of the urban development under each theme for the assessment framework is measured through indicators. Indicators are defined as 'A quantitative or a qualitative measure derived from a series of observed facts, that help determine relative the position (e.g. Urban development) in a given focus area.' Indicators guide and play an important role in making informed decision towards achievement of environment friendliness by:

▪ Translating technical knowledge into manageable units of information to give a solid basis for decision-making. This aids the process of setting policy priorities and benchmarking or monitoring performance.

▪ Help measure and plot progress towards goals. When evaluated over a period of time at regular intervals, an indicator can show the direction of change over a period of time.

▪ Indicators are useful in identifying trends and drawing attention to particular problem areas. They can provide a warning to help reassess areas, which require immediate attention and also to alert in cases of measures not taking there expected course and remedying the situation.

Indicators play an important role in communicating the progress and status of development, which is an important requirement for collaborated efforts towards advanced research for the sustainability of development and the realization.

3-3. Objective of the comparison

The assessment frameworks and indicator systems for each of the three types of environment friendly urban developments are compared to understand the differences between the three approaches with respect to the indicators adopted. Table 2, shows comparative study of frameworks of

the three main terminologies. This helps us determine:

▪ The actual point of focus within each theme of focus (theme). Area of focus may be broad but comparing the sub-themes and the characteristics used helps decipher actual level coverage and gives the difference between the frameworks.

▪ The validity of the observations made in the previous sections.

▪ This comparison is also intended to formulate an evaluating methodology to observe and understand existing urban developments, with respect to the suitability of adopted concept terminology.

3-4. Analysis Methodology

The framework for 'Sustainable Development' has been taken as base and placed in its original format, as it is the oldest, well defined and the most widely accepted framework currently in use today. The Eco City framework, which is next in line in terms of evolution, is placed next and the Smart City framework, the latest framework is placed last. The Sustainable Development framework, as it was taken as base, was placed in its original format. The 'Eco City' framework and the 'Smart City' framework have been shifted around to match the related themes and sub-themes on the base framework. Each framework uses slightly different wording to describe related theme. Hence, to make the table easy to read, the themes have been color-coded based on three traditional themes namely- 'social - blue', 'environmental - green' and 'economic - orange'. Two additional groups 'ecological' and 'technological' have been suggested for features unique to eco and smart respectively. These help identify the areas of focus central to each concept.

During the comparison, it was observed that, in the frameworks used to assess the urban developments though same themes were answered, the amount of importance given to themes varied. This was observed in the number of indicators under each theme. This is indicative of importance of a certain theme in the framework and directly corresponds to center of focus of the concept and terminology used to name it.

3-5. Analysis in the table 2

Comparing the three frameworks, gives us a clear understanding of the characteristics and themes central to each framework. From the comparison in table 2, the following observations were made.

Sustainable Development framework is most well defined in terms of the areas of focus and indicators used. Sustainable Development through continued efforts by the United Nations has a good degree of coverage in the three traditional areas - social, economic and environmental. It deals with the basic

minimum standards required for an urban area. It addresses basic issues such as poverty, sanitation, living conditions, climate change, income levels etc. along with themes such as research development. Sustainable Development, the oldest framework has the least number of areas of focus.

The comparison shows the conference of Eco City framework with the Sustainable Development framework. While the basic social, economic and environmental factors are covered, the indicators move on to a more sophisticated level. It overlooks certain subthemes seen in Sustainable Development and can be said to be suited for the measure of the state of a developed urban area. Eco City covers newer areas than Sustainable Development. Ecological factors receive special emphasis in the Eco City framework. These newer areas of focus, introduced from Eco City framework onwards have been labeled as ecological and shaded with purple color. It is also clear that Eco City refers to not just the ecological aspects of the urban area but is concerned with its functioning as an ecosystem. The importance of community building is also seen from the degree of coverage for those particular areas.

However, it is Smart City, which offers the maximum coverage. Existing themes from the Sustainable Development and Eco City are covered and additional themes introduced. Smart City framework shows development in the technological aspect, a necessary essential in this technology intense age. The smart use of resources and knowledge is also clear from the framework and indicators set. A similar transition as seen from Sustainable Development to Eco City framework, can be seen in the indicators in the Smart City framework. Certain older themes have lost their place in the Smart City framework. It places emphasis on taking the urban area to an innovative new level; with increased emphasis on the latest cutting edge research and technology as the means for this step. The new areas of focus, introduced from Smart City framework onwards, have been labeled as technological factors and shaded with grey color.

All three frameworks of Sustainable Development, Eco City and Smart City sufficiently cover the three traditional themes-social, economic and environmental themes. However, certain themes grouped here as ecological and technological are answered only in the newer frameworks. An evolution of environment friendly development trends can be seen in the time line of the frameworks. This evolution pattern is explored with respect to usability as a base framework for evaluating urban developments pursuing environment friendly concept. The Sustainable Development being stage 1, Eco City stage 2 and Smart City stage 3.

After the analyses of three frameworks, their integrated indicators of the Sustainability Assessment are proposed in this paper (Table 2). Evaluation of the case study in Japan was done to understand with the integrated indicators. This also helps in demonstrating the usability of the model for study of environment friendly urban developments.

4. Case Study – Kashiwa-no-ha International Campus Town, Chiba Prefecture, Japan

4-1. Current Situation of Environment Friendly Planning in Japan

Rapid economic growth in the 1960's led to massive waste disposal and pollution related issues. These issues led to awareness and inclination towards, planning of environment friendly urban developments. As early as the 1970's, cities such as Kitakyushu started adopting innovative methods to reverse the negative effects of industrialization. These efforts were mostly localized approaches aimed at immediate mitigation of pressing concerns of the effects of industrialization. A more nationalized effort was seen in 1993, with the eco town project by the central government. Stringent recycling laws by the government also diverted focus into recycling and reuse strategies and led to the development of cutting edge technologies, leading to technology advancement in this area.

Declining population, increase in the aging population, environmental issues, health, crime prevention, disaster prevention and need for economic growth revitalization are some of the problems ailing Japan today. Along with these, due to the diversification in the lifestyle of the people there has been a change in the needs of the residents and users of the urban environment. Recent trends have seen large-scale development of urban developments by private agencies with cutting edge technologies especially in the energy and waste management sectors. With the 2011 March Tohoku earthquake and resulting energy issues, disaster prevention and environment friendly rebuilding of Japanese urban areas has received more focus. The future city initiative, the government's new growth strategy, which was proposed in 2010, received a boost and decisions to quicken the pace towards environment friendly urban development are being made. Most of these strategies were based on the Sustainable Development principles. The Sustainable Development framework stipulated by Architectural Institute of Japan exists, but Eco City and Smart City related projects are yet to see a framework. Currently both are evaluated against the Japanese adaptation of the UN-CSD framework. As is clear in the study so far, Sustainable Development, Eco City and Smart City are concepts with independent areas and unless these are understood and planned accordingly, cannot give the complete picture. Hence, we can say that 'Fuzziness' in sustainability is evident in Japanese urban planning.
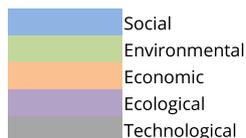
4-2. Selection of the Case Study

Operational examples of Smart City in Japan are few and of these, Kashiwa-no-ha was selected for this study following a literature study for the following reasons:

▪ Long period of application and development of environment friendly initiatives.

▪ Public – Private – Academic model. Advanced research being conducted in the universities for development in this area.

▪ A new development, which was conceived as a model city for knowledge transfer and to utilize know-how for local economic benefit and world environment benefit.

▪ Unique initiatives and maximum areas covered.

Kashiwa-no-ha International campus town is a new town located just 30 km from the capital, Tokyo. It is well connected

Table 2 – Comparison of the international indicators and their integration into the indicators of sustainability assessment in this paper.

Legend:
- Social
- Environmental
- Economic
- Ecological
- Technological

SUSTAINABLE DEVELOPMENT			ECOCITY			SMART CITY			Indicators of the Sustainability Assessment in this paper	
Source: UNITED NATIONS COMMISSION FOR SUSTAINABLE DEVELOPMENT (UN-CSD) - Indicators of sustainable development -3rd edition- © United Nations 2009			**Source:** International Ecocity Frameworks and Standards(IEFS) - © 2011 Ecocity Builders -United nation accredited non-profit organisation			**Source:** Smart Cities- Ranking of European Medium-Sized Cities Vienna, Austria: © Centre of Regional Science, Vienna University of Technology, October 2007				
http://www.un.org/esa/sustdev/natlinfo/indicators/guidelines.pdf			http://www.ecocitybuilders.org/what-we-do/ecocity-standards/			http://www.smart-cities.eu/press-ressources.html				
Theme	**Sub-theme**	**Characteristics**	**Themes**	**Sub-Theme**	**Characteristics**	**Theme**	**Sub-Theme**	**Characteristics**	**Theme**	**Characteristics**
Poverty	Income poverty	Poverty line	Socio Cultural features	Wellbeing	Employment	Smart Living	Social cohesion	Poverty	**Poverty**	Poverty
	Income inequality	Difference in income levels				Smart People	Flexibility	Acquiring new job		Employment
	Sanitation	sanitation facilies			Living standards	Smart Living	housing quality	Living standards		Living standards
	Drinking water	Improved water source	Bio-Geo-Physical conditions	Water	Clean and safe water	Smart Environment	Sustainable resource management	Resource use		Improved water source
	Access to energy	Electricity and modern energy sources		Energy	Clean and renewable energy					Electricity and modern energy sources
	Living conditions	Slum dwellers	Socio Cultural features	Wellbeing	Living standards	Smart Living	housing quality	Living standards		Slum dwellers
			Socio Cultural features	Culture	Cultural activities to facilitate eco literacy and social learning	Smart People	Cosmopolitanism/Open-mindedness	Knowledge about regional affairs		Cultural activities to facilitate eco literacy and social learning
						Smart People	Cosmopolitanism/Open-mindedness	Immigration friendly		Immigration friendly
Governance	Corruption	Bribes paid	Socio Cultural features	Wellbeing	Good governance	Smart Governance	Transparent governance	Corruption and bureacracy	**Governance**	Transparent governance
	Crime	Homicide cases			Safety	Smart Living	Individual safety	Crime		Safety
					Social belonging	Smart People	Participation in public life	Voluantary work, voter turnout		Voluantary work
			Socio Cultural features	Community Capacity and Participation	Community participation in decision making process	Smart Governance	Participation in decision-making	Political activity of inhabitants		Community participation in decision making process
					Organisational support		Public and social services	Day care, quality of schools and other social service facilities		Day care, quality of schools and other social service facilities
Health	Morality	Life expectancy	Socio Cultural features	Wellbeing	Physical and mental health	Smart Living	Health conditions	Life expectancy	**Health**	Life expectancy
	Health care delivery	health care facilities		Community Capacity and Participation	Organisational support : Resources			Health care facilitites, health care personel, quality		health care facilities
	Nutritional status	nutritional status of children	Bio-Geo-Physical conditions	Food	Healthy and accessible					nutritional status of children
	Health status and risks	Tobacco use, Death due to major diseases, suicide	Socio Cultural features	Wellbeing	Physical and mental health	Smart Living	Health conditions	health system		Physical and mental health

Education	Education level	primary education access	Socio Cultural features	Education	Formal and informal education	Smart People	Level of qualification	Qualification levels, language skills	Education	primary education access
		life long learning			Lifelong access to education		Affinity to life long learning	Participation percentage		Lifelong access to education
	Literacy	Literacy rate			Formal and informal education		Level of qualification	Qualification levels, language skills		Literacy rate
			Socio Cultural features	Education	Access to information		Level of qualification	Knowledge center, books accessed		Access to information
					Vocational training and social institutions	Smart Living	Education facilities	Access, quality		Vocational training and social institutions
Demo-graphics	Population	Growth rate	Ecological Imperatives	Carrying Capacity	Demographics	Smart People	Social and ethnic plurality	Foreigners, nationals born abroad	Demo-graphics	Foreigners, nationals born abroad
	Tourism	Ratio of local residents to tourists	Socio Cultural features	Wellbeing	Time Use: Work, Recreation and leisure time	Smart Living	Touristic attractivity	Leisure time use		Leisure time use
Natural hazards	Vulnerability to natural hazards	population in hazard prone area	Socio Cultural features	Wellbeing	Safety	Smart Living	Individual safety	Personal safety	Natural hazards	Personal safety
	Disaster preparedness and response	Human and economic loss								Disaster preparedness and response
						Smart Living	housing quality	Minimal standards		housing strength
Atmosphere	Climate change	Emissions	Bio-Geo-Physical conditions	Air	Condusive to the atmosphere	Smart Environment	Pollution	Pollution rate and effects	Atmosphere	Emissions
	Ozone layer depletion	Ozone depleting substances								Ozone depleting substances
	Air quality	Air pollutants			Healthy air for good health					Air pollutants
Land	Land use and status	Land use	Ecological Imperatives	Carrying Capacity	Demand of the settlement on the local ecosystem	Smart Environment	Environmental protection	Nature protection	Land	Land use
		Land degradation	Bio-Geo-Physical conditions	Soil	Soil fertility					Land degradation
	Desertification	land affected by desertification			Functions and operations meet their ranges of healthy ecosystem					land affected by desertification
	Agriculture	Fertilizer Use			Fertilizer Use		Attractivity of natural conditions	Green Space share		Fertilizer use
		Organic farming			Organic farming					Organic farming
			Bio-Geo-Physical conditions	Food	Healthy and accessible					Healthy and accessible
Land	Forests	extent and sustainable management	Ecological Imperatives	Ecological integrity	Habitat areas and ecological corridors	Smart Environment	Environmental protection	Nature protection		Ecological integrity
Oceans, seas and coasts	Coastal zone	demand by local settlement and water quality	Bio-Geo-Physical conditions	Water	Healthy water bodies	Smart Environment	Environmental protection	Nature protection	Oceans, seas and coasts	demand by local settlement and water quality
	Fisheries	Fish stock			Impact to the local ecosystem					Fish stock
	Marine environment	marine ecosystem protection								marine ecosystem protection
Freshwater	Water quantity	Extent of water resource use	Bio-Geo-Physical conditions	Water	Ratio of water use to recharge rate	Smart Environment	Attractivity of natural conditions	Green Space share	Freshwater	Extent of water resource use
	Water quality	quality, pollution, waste treatment			Healthy water bodies		Pollution	Pollution rate and effects		Water quality, pollution, waste treatment
			Bio-Geo-Physical conditions	Water	Local sourcing of water					Local sourcing of water
Bio-diversity	Ecosystem	protected ecosystems and their management	Ecological Imperatives	Ecological integrity	Habitat areas and ecological corridors	Smart Environment	Environmental protection	Nature protection	Biodiversity	Habitat areas and ecological corridors
	Species	threat status								
				Biodiversity	Sustains healthy biodiversity of the ecosystems		Attractivity of natural conditions	Green Space share		Green Space share
			Ecological Imperatives	Carrying Capacity	Support ecological integrity					Support ecological integrity

Economic development	Macro-economic performance	Gross domestic product (GDP), Gross Savings, Investment share, Inflation	Socio Cultural features	Economy	Healthy and equitable environment	Smart Economy	Productivity	GDP	**Economic development**	GDP
	Sustainable public finance	Debt Vs Gross National Income (GNI)			credit unions					Sustainable public finance
	Employment	Vulnerability, Labour productivity and costs		Wellbeing	Employment	Smart Economy	Flexibility of labour market	Part timers, rate of unemployment		Employment, Part timers, rate of unemployment
	Information and communication technologies	Internet users								Research and development expenditure, Employment in knowledge intensive sectors, patents held
	Research and development	Research and development expenditure	Socio Cultural features	Economy	Healthy and equitable environment	Smart Economy	Innovative spirit	Research and development expenditure, Employment in knowledge intensive sectors, patents held		
	Tourism	Contribution to GDP			Eco-tourism	Smart Living	Touristic attractivity	Importance of location		Touristic attractivity
			Socio Cultural features	Economy	Green (local) employment	Smart Economy	Enterpreneur-ship	Self-employment rate and new buisnesses		Self-employment rate and new buisnesses
						Smart Economy	International embedded-ness	International passenger and frieght intensity		International passenger and frieght intensity
Global economic partnership	Trade	Export	Socio Cultural features	Economy	Fair trade programs				**Global economic partnership**	Fair trade programs
	External financing	Official development assistance, Foreign Direct Investment (FDI)			Community development corporations					Official development assistance, Foreign Direct Investment (FDI)
						Smart Economy	Economic image & trademarks	Importance as decision making center		Economic image & trademarks, decision making center
Consump-tion and production patterns	Material consumption	Material use	Bio-Geo-Physical conditions	Material Resources	Responsible source/use/recycling	Smart Environment	Sustainable resource management	Resource use	**Consumption and production patterns**	Responsible source/use/recycling
	Energy use	Renewable energy		Energy	Clean and renewable energy					Renewable energy
	Waste generation and management	Hazardous waste		Material Resources	Responsible source/use/recycling		Pollution	Pollution rate and effects		Waste generation and management
	Transportation	Energy use, Passenger and freight	Primary urban design feature	Access by proximity	Transit access	Smart Mobility	Local accessibility	Public transport access and connectivity	**Smart Mobility**	Public transport access and connectivity
			Primary urban design feature	Access by proximity	walkability			Quality		walkability
						Smart Mobility	Availabilty of ICT-infrastructure	Computers and broadband access		Computers and broadband access
							(Inter-)national accessbilty	International connectivity		International connectivity
							Sustainable, innovative and safe transport systems	Green mobility, traffic safety, economical cars		Green mobility, traffic safety, economical cars

by train and superhighway to Tokyo. Many universities and academic research centers also located around this area. As a result, the Kashiwa-no-ha campus town was developed with a strategy to adopt environment friendly policies through ties with universities and other institutions. The development plans were studied from the 90's. The new Kashiwa-no-ha plans were prepared with the cooperation of Chiba Prefecture, City of Kashiwa, the Developer of Mitsui Fudosan Co., Ltd and two Universities of Tokyo and Chiba. The author was a member of these planning process for the environment friendly urban development. The analysis of this paper, with respect to the international indicators integrated from the three methodologies, was conducted for two of main Kashiwa-no-ha plans, as seen in Table 3.

Case Study 1: Kashiwa-no-ha International Campus Town Initiative (2008, modified in 2014).

Case Study 2: Kashiwa-no-ha Smart City project (2011).

4-3. Analysis of Case Study 1: Kashiwa-no-ha International Campus Town Initiative (2008, modified in 2014)

A joint development effort by public–private–academic sectors drafted in 2007 and implemented the Kashiwa-no-ha International Campus Town Initiative from early 2008. In this case study, we see all factors of Sustainable Development answered. Most factors under Eco and Smart methodologies

The objective 2: 'Creative and Industrial Spaces' aims to provide for global level industries through the development of an incubation center near the new railway of Tsukuba Express. For the example the 'Plant Factory' of Chiba University is a closed growing system, in which throughout the year a constant production of high quality vegetables can be achieved.

The objectives from 3 to 8 aim to attain their challenges for education, mobility, healthy, area management, urban design, and innovation through the partnerships between public, private and academic sectors.

In this case study, we see most factors of sustainability answered (Table 4). Kashiwa-no-ha has wide walkways for the safe movement of pedestrian traffic and can be hence be argued as a walkable city. Among the unanswered themes- characteristics of immigration friendly is the international theme of poverty. But immigration is very limited as it is highly regulated and controlled by law as a whole in Japan, so the indicator of 'immigration friendly' may be not be applicable in the sustainability of this local plan. Each country is differentunique in its characteristics and in this case, immigration being a subject of national policy, it is difficult to use this parameter to measure the sustainability.

Another unanswered theme is the characteristics of 'support ecological integrity' under the theme of biodiversity. Generally

Table 3 – Eight objectives of Kashiwa-no-ha International Campus Town Initiative (2008, modified in 2014).

Objective 1 : Sustainable Garden City
Objective 2 : Creative and Industrial Spaces
Objective 3 : International Spaces for Academic Community and Culture
Objective 4 : Sustainable Mobility System
Objective 5 : Healthy and Kashiwa-no-ha Life Style
Objective 6 : Area Management by the Partnership between Public, Private and Academic Sectors
Objective 7 : High Quality Urban Design
Objective 8 : Innovation Field

are also met. After the five years of the execution of the plan, their objectives and the contents were modified and more detailed issues were incorporated for the realization of the plan in 2014.

The objectives of Kashiwa-no-ha International Campus Town Initiative are composed of eight ambitious themes (Table 3). The objective 1: 'Sustainable Garden City' leads to environmental projects and certain standards. For the example the existing green fields and their networks will be preserved in the total 40% of the planning area. The developers would be obligated to maintain more than 25% of the green part of their building lots. The aim of reductioning more than 35% of CO_2 by 2030 (which is based on the Kyoto protocol of 2010) is being promoted in all area of City of Kashiwa.

there is a lack of sensitivity for the ecological support in the urban development plan in Japan. Although the plan incorporates green corridors spiteunderof strong pressure of economic activities, there is not indicated any support for the ecological activities. This point would be added in the environmental theme and the educational theme.

The last unanswered themes are characteristics of 'global economic partnership'. The plan is respected for the academic internationality but that is not oriented for the economic one. We don't have any data about the international trade and we should research more about the real relationships between the products of Kashiwa-no-ha and the global market in the next planning phase.

Table 4 – Assessment of the Case Study of Kashiwa-no-ha Plans – Answerability with respect to indicators of the three themes of Sustainability.

Theme		Answerability		Plans	
	Social	+	Answered	A	Kashiwanoha International Campus Town Initiative (2008, modified in 2014)
	Environmental	-	Unanswered	B	Kashiwanoha Smart City Project (2011)
	Economic	NA	Not Applicable		

Indicators of the Sustainability Assessment (Social Theme)

Theme	Characteristics	A Answerbility	B Answerbility
Poverty	Poverty	+	+
	Employment	+	+
	Living standards	+	+
	Improved water source	+	+
	Electricity and modern energy sources	+	+
	Slum dwellers	+	+
	Cultural activities to facilitate eco literacy and social learning	+	+
	Immigration friendly	-	-
Governance	Transparent governance	+	+
	Safety	+	+
	Voluantary work	+	+
	Community participation in decision making process	+	+
	Day care, quality of schools and other social service facilities	+	+
Health	Life expectancy	+	+
	Health care facilities	+	+
	Nutritional status of children	NA	NA
	Physical and mental health	+	+
Education	Primary education access	+	+
	Lifelong access to education	+	+
	Literacy rate	+	+
	Access to information	+	+
	Vocational training and social institutions	+	-
Demographics	Foreigners, nationals born abroad	+	+
	Leisure time use	+	+
Natural hazards	Personal safety	+	+
	Disaster preparedness and response	+	+
	Housing strength	+	+

Indicators of the Sustainability Assessment (Environmental Theme)

Theme	Characteristics	A Answerbility	B Answerbility
Atmosphere	Emissions	+	+
	Ozone depleting substances	NA	NA
	Air pollutants	+	+
Land	Land use	+	+
	Land degradation	+	+
	land affected by desertification	+	+
	Organic farming	+	+
	Fertilizer use	+	+
	Healthy and accessible	+	+
	Ecological integrity	+	-
Oceans, seas and coasts	Demand by local settlement and water quality	NA	NA
	Fish stock	NA	NA
	Marine ecosystem protection	NA	NA
Freshwater	Extent of water resource use	+	+
	Water quality, pollution, waste treatment	+	+
	Local sourcing of water	+	+
Bio-diversity	Habitat areas and ecological corridors	+	-
	Green Space share	+	+
	Support ecological integrity	-	-

Indicators of the Sustainability Assessment (Economic Theme)

Theme	Characteristics	A Answerbility	B Answerbility
Economic development	GDP	NA	NA
	Sustainable public finance	+	+
	Employment, Part timers, rate of unemployment	+	+
	Research and development expenditure, Employment in knowledge intensive sectors, patents held	+	+
	Touristic attractivity	+	+
	Self-employment rate and new buisnesses	+	+
	International passenger and frieght intensity	+	+
Global economic partnership	Fair trade programs	-	-
	Official development assistance, Foreign Direct Investment (FDI)	-	-
	Economic image & trademarks	-	-
Consumption and production patterns	Responsible source/use/ recycling	+	+
	Renewable energy	+	+
	Waste generation and management	+	+
Smart Mobility	Public transport access and connectivity	+	+
	Walkability	+	+
	Computers and broadband access	+	+
	International connectivity	+	+
	Green mobility, traffic safety, economical cars	+	+

4-4. Analysis of Case Study 2: Kashiwa-no-ha Smart City project (2011)

Implemented from 2011, it is a joint venture of world leading private companies who have come under the Smart City planning Inc. to build a next generation environmental city. It aims to take advantage of advanced technologies and know-how of these companies, to provide optimal solutions at source. The Kashiwa-no-ha Smart City is being developed as a flagship project to create a model to showcase cities of the future (Figure 2, Figure 3) Especially the Smart City project leads the efficient energy use based on the Area Energy Management System (AEMS, Figure 4). Sustainable building design rich with innovative ideas and technologies will be produced in this area (Figure 5).

This case study project meets most factors of the social theme without the 'immigration friendly' and 'vocational training'. Answerability of the economic theme is same as in the previous case. Many factors of smart technologies have introduced in Kashiwa-no-ha, but there are no points about global market partnerships. Also the characteristics of ecological integrity, ecological corridors and the support of ecological integrity are not fulfilled. The answerability of these points is lesser than the previous case (Table 4). One reason for this lack of answerability can be attributed to the fact that, private companies drive this project. The companies excel in research and technological edge in their respective fields and the project is a showcase of such cutting edge technologies. However, the absence of governing bodies to look at the overall planning such as in the previous case of the International Campus Town Initiative may have led to the decreased answerability in this project.
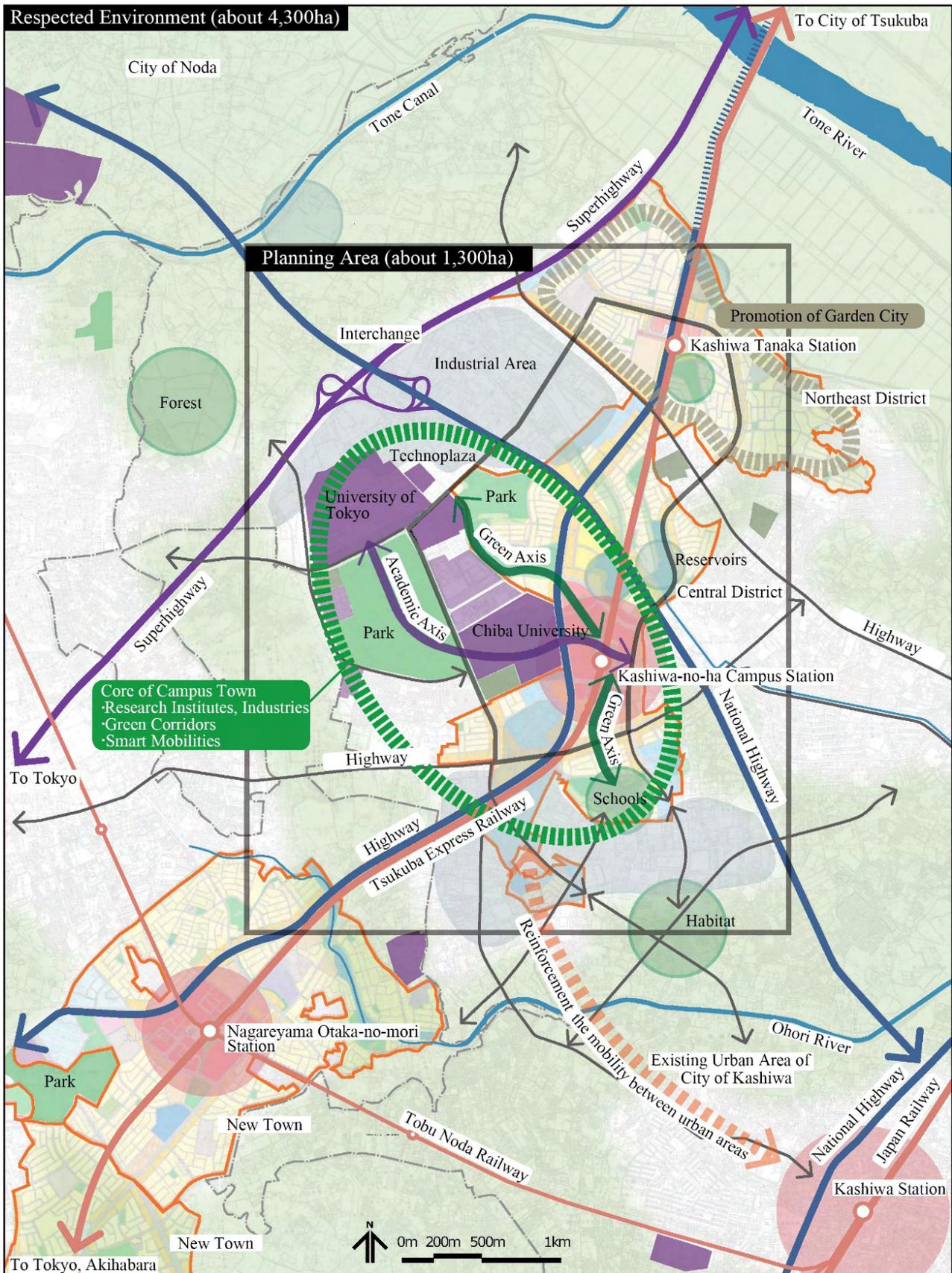
Respected Environment (about 4,300ha)

City of Noda

To City of Tsukuba

Tone Canal

Tone River

Planning Area (about 1,300ha)

Interchange

Industrial Area

Promotion of Garden City

Kashiwa Tanaka Station

Northeast District

Forest

Technoplaza

Park

University of Tokyo

Green Axis

Academic Axis

Park

Chiba University

Reservoirs

Central District

Highway

Core of Campus Town
·Research Institutes, Industries
·Green Corridors
·Smart Mobilities

Green Axis

Kashiwa-no-ha Campus Station

National Highway

To Tokyo

Highway

Schools

Highway

Tsukuba Express Railway

Habitat

Reinforcement the mobility between urban areas

Nagareyama Otaka-no-mori Station

Ohori River

Existing Urban Area of City of Kashiwa

Park

New Town

Tobu Noda Railway

National Highway

Japan Railway

Kashiwa Station

New Town

N

0m 200m 500m   1km

To Tokyo, Akihabara

Figure 1 – The planning area of Kashiwa-no-ha International Campus Town Initiative (2008, modified in 2014). The main target of this plan is about 1,300ha of the City of Kashiwa in the respected environment of the intercity surroundings (4,300ha). Credit: Committee of International Campus Town Initiative (Chiba Prefecture, City of Kashiwa, Chiba University, the University of Tokyo, Urban Renaissance Agency, Mitsui Fudosan Co., Ltd).

The project area of the Smart City is now limited in some building lots but it may be spread to surrounding lots including natural preservation area and reservoirs.

Figure 2 – Project Area of the Kashiwa-no-ha Smart City Project (2011). Credit: Mitsui Fudosan Co., Ltd.

Fig. 3 Perspective of the Kashiwa-no-ha Smart City Project (2011). Credit: Mitsui Fudosan Co., Ltd.
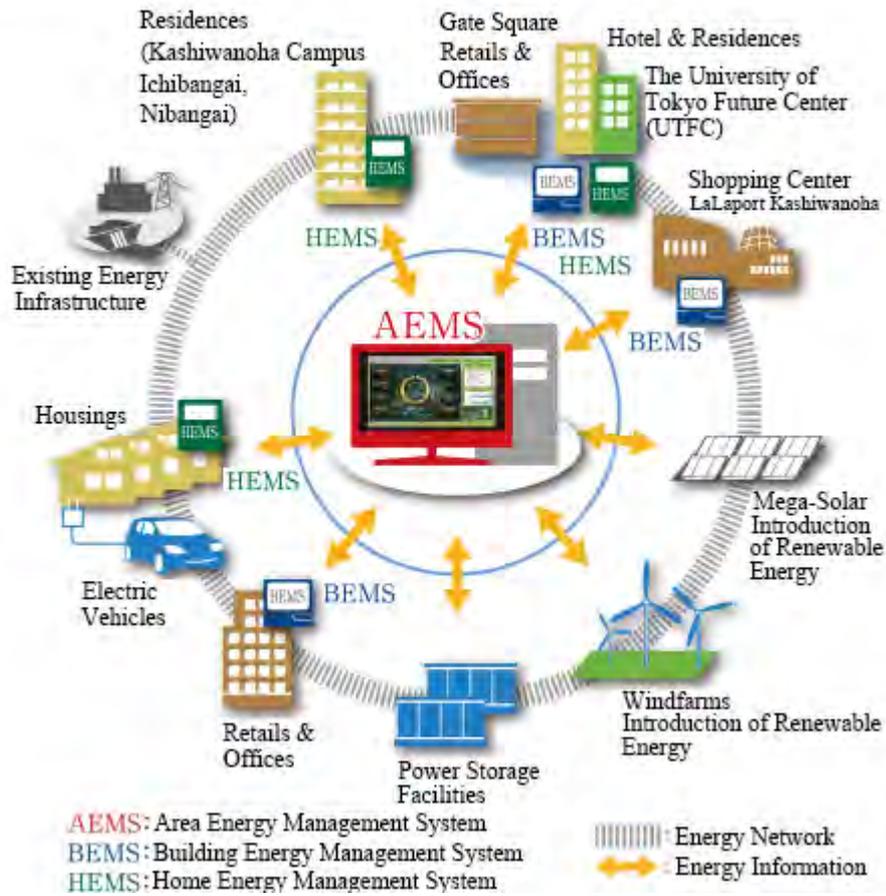
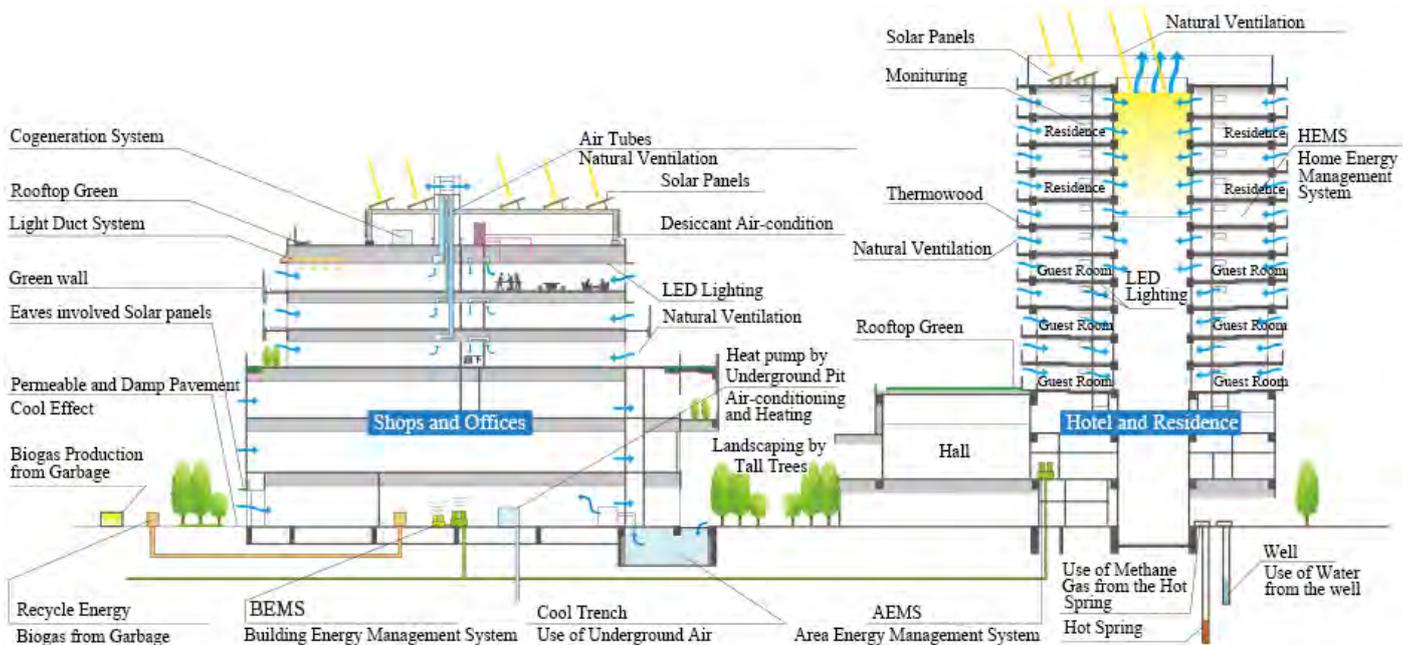Fig. 4 Concept of Area Energy Management System in Kashiwa-no-ha. Credit: Mitsui Fudosan Co., Ltd.

Fig. 5 Sustainable building design in Kashiwa-no-ha (District no.148). Credit: Mitsui Fudosan Co., Ltd.

4-5. Comparison of the Two Case Studies

The comparison of the two case studies was based on the comparison table of the three themes of Sustainability (Table 4). The table was adapted to check answerability of both projects. Based on the results of the answerability evaluation, the areas where the projects cover and the areas they lack have been identified.

From the analysis it is evident that both plans of Kashiwa-no-ha are at Sustainable Development stage with the current development plans. This shows insufficient application of environment friendly urban development terminology as identified in the study. For the next step, the insufficient themes of both plans must be studied.

Between the two plans, most of the urban development themes are covered and this can be said to be to the overall benefit of the development. Overall Kashiwa-no-ha International Campus Town Initiative (2008, modified in 2014) is more comprehensive than the Smart City project (2011). When replicating the Smart City project, care must be taken to ensure the operation by adopting from the comprehensive plan as possible as overall themes.

5. Conclusions

This paper concludes the following five points.

1) Differences between terminologies of Sustainable Development, Eco City and Smart City have been analyzed from their indicators (themes and sub-themes). The basic minimum themes to be covered, so as to be benchmarked under each of the three main methodologies is evident from the analysis (table 2).

2) United Nations, International organization and Vienna University of Technology being responsible for 'Sustainable Development', 'Eco City' and 'Smart City', has resulted in a well-defined framework, which has the potential to be used worldwide. It is clear that, usage of indicators of 'Sustainable Development', 'Eco City' and 'Smart City', along with involvement of government regulatory bodies leads to overall comprehensive plans. It can be concluded that, involvement of government regulatory bodies leads to overall comprehensive plans if the integrated indicators of 'Sustainable Development', 'Eco City' and 'Smart City' would be used for the sustainability assessment before or during the planning.

3) All of the themes in 'Sustainability' are answered in the 'Eco City Framework'. 'Eco City' methodology covers certain new areas previous not seen in the older 'Sustainable Development'. 'Eco City' can therefore be concluded as an evolved form of Sustainable Development. One reason for the 'Eco City Framework' and 'Sustainable Development

Framework' overlap could be the close association of the organization at the forefront of development of the two terminologies.

'Smart City' covers new areas previously not seen in either 'Sustainable Development' or 'Eco City', however, it doesn't cover some of the themes found in both 'Sustainable Development' and 'Eco City'. The reason for this may be the independent development of the 'Smart City' concept as against the collaborative efforts seen in 'Sustainable Development' and 'Eco City'.

Recognizing the differences between their terminologies, we tried to integrate their indicators under all themes in 'Sustainability' in this paper.

4) In the case studies at Kashiwa-no-ha, the integrated indicators clearly verify characteristics of the plans. At Kashiwa-no-ha, even though the newer 'International Campus Town Initiative' (2008, modified in 2014) and 'Smart City Project (2011)', fails to cover all themes, it is clear that especially the themes of 'biodiversity' and the characteristics of 'ecological integrity' in the theme of 'land' should be paid more attention while planning. The characteristic of 'immigration friendly' in the theme of 'poverty' maybe not be concerned with the local plans, because it depends on the national policy. The theme of 'global economic partnership' was also unanswered. The themes of globalization should be studied in more detail during the next planning modification.

All indicators of the sustainability assessment of this paper are meaningful and the result could be useful for the future development of planning methodologies at Kashiwa-no-ha.

5) In the current scenario of multiple frameworks, this study proposes to sort the existing scenario, rather than to propose another new framework. This study proposes that the integration of three types of themes (social, environmental and economic themes) can be considered as three stages in the development of environment friendly urban developments. Considering the development time line and convergence of themes in the analysis of frameworks of the three terminologies, the following stages have been proposed – Stage1- Sustainable Development, Stage 2- Eco City and Stage 3 - Smart City. This study proposes that the overlap of the concepts and the integration of their indicators can be taken advantage of to develop overall comprehensive plans. The comparison table of the frameworks is useful as a base framework for evaluating urban developments pursuing environment friendly concepts.

Though, development of frameworks has many variable factors such as; location, culture, local issues, etc., from the frameworks of Sustainable Development, Eco City, Smart City and the case studies at Kashiwa-no-ha Campus Town, we can conclude that mutual co-operation in development of frameworks, at least at regional level, along with government

involvement will ensure proper coverage of all critical themes, consensus and uniform applicability of terminology and their inherent concepts. This study demonstrates a methodology to analyze, evaluate urban development projects, and attain clarity to terminology usage or their corresponding framework. It facilitates comparative studies between differently termed developments, which are critical for identifying successful projects and for the adaptation of these in future projects thus aiding the growth of future environment friendly urban developments.

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