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Special Issue on "Sustainable Urban Design"
Guest Editor: Ying Zhang, Yuanyi Zhang and Anrong Dang

Content

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Editorial Introduction

Special Issue on "Sustainable Urban Design"

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Urbanization is one of the great challenges of our time and unchecked haphazard urbanization is a serious threat both to the environment and social and economic balance. In order to meet global sustainability targets, rapid urban growth must be channelled into environmentally friendly, sustainable and liveable urban environments. Thus, this special issue focuses on sustainable urban design which plays a key role in creating these urban environments.

The first paper "Review on the Development of a Sustainability Indicator System in Agenda 21 for Tourism in Mexico" aimed to diagnose the current situation of tourism in Mexico through the evaluation of four major themes: environment, socioeconomic environment, tourism and urban development. The authors introduced the progress of a sustainability indicator system and the implementation of sustainable indicators then analysed the results of the application of the sustainable development indicators which were promoted by the Ministry of Tourism (SECTUR) in eighty-four destinations in the period of 2002-2007, from the length and breadth of the country. The best-positioned tourist destinations were categorized as Medium Cities. Paradoxically, coastal tourist destinations were in the middle. The worst conditions were found in tourist destinations in nature. The results show better performance indicators for urban development, while the higher pressure is in the environmental area. (Sui-Qui. et al., 2015)

Urban renewal is one important government policy which can improve the urban environment and economic growth. So, the second paper "A Study on Promotion Mechanisms and the Future of Government-led Urban Renewal Projects from the Perspective of Land Ethics" aimed to explore Taiwan's urban renewal policy development process and mechanisms of the Government-led urban renewal projects. It references Aldo Leopold's land ethic theory which can be used to explore the power relations and land health problems. The authors analysed the relationship between urban renewal rights and discussed current beliefs and disadvantages of urban renewal mechanisms. Understanding the government-led urban renewal policies is needed to improve the social, economic and ecological issues. By "regenerating" the dilapidated region, the urban area is expected to regain its energy and sustainability. (Huang. et al., 2015)

Since the 21st century, energy shortages, the greenhouse effect and global warming have always been major topics of discussion and sustainable

development has thus become an important goal of urban development policies around the world. Public Bike Systems (PBS) are a category of green transport to provide a low-carbon solution in a city, thus, the third paper "User Behaviour Analysis of the Public Bike System in Taipei" aimed to summarize the factors that affect the sustainable operation of PBS based on the development of public bicycle systems in foreign countries, and to analyse PBS user behaviour in Taipei through a questionnaire survey conducted in Taipei's metropolitan area. The authors examined the factors that influence the bike-use intentions of the bike-sharing program, and analysed user behaviour based on a survey of 557 respondents in Taipei, Taiwan. The result of this paper shows that the system cognition, environment cognition, personal perception and personal preference are four vital aspects that influence user behaviour, and the extent is varied by different travel purposes, and the location of docking stations is the most critical factor in influencing the user behaviour from each aspect. (Pai. et al., 2015)

Historic preservation, adaptive reuse, and sustainable urban design that considers the full range of social, environmental, and economic factors is an essential component of sustainable urban development, (Lewin. et al., 2013) while the mapping of historic buildings which can be archived and extracted for application, is the basic work on the protection of historic buildings and adaptive reuse. Traditional mapping methods need more time and more workers, and there are measured omissions, mistakes and other issues which go against the protection of the measured objects. 3D laser scanning technology is a new technique for quickly getting three-dimensional information, hence the fourth paper, "3D Laser Scanning-Technology-based Historic Building Mapping for Historic Preservation: A Case Study of Shang Shu Di in Fujian Province, China" introduced measurement principles of 3D laser scanning technology. The authors used Shang Shu Di, a Ming Dynasty building which is an officially protected heritage site of China in the Taining County of Fujian Province, as a case study, and studied the application of mapping historic buildings based on 3D laser scanning technology. Then, a comparison of 3D laser scanning technology using a traditional method in detailed components mapping was illustrated to indicate the advantage of 3D laser scanning technology in historic building mapping. Finally, aimed at the technical problems of the huge amount of data generated in the application process and the software defects of the Cyclone software, the authors presented two specific coping strategies which are "reasonable data collection and processing" and "construction of historic building components database". (Zhang. et al., 2015)

3D city models are important in urban planning for sustainable development. Urban planners will draw maps for efficient land use and a compact city. 3D city models based on these maps are quite effective in understanding what, if this alternative plan is realized, the image of a sustainable city will be. However, enormous time and labour has to be consumed to create these 3D models, using 3D modelling software such as 3ds Max or SketchUp.

Consequently, the final paper, "Automatic Generation of 3D Building Models for Sustainable Development", proposed a GIS and CG integrated system that automatically generates 3D building models, based on building polygons (building footprints) on a digital map, to automate the laborious steps of creating 3D building models. In either orthogonal or non-orthogonal building polygons, the authors proposed a new system for automatically generating 3D building models with general shaped roofs by straight

skeleton computation. The proposed integrated system succeeds in automatically generating alternative city plans. (Sugihara., 2015)

This special issue is one of the outputs of the biannual International Conference on Spatial Planning and Sustainable Development held on 30 August to 1 September in 2013 at Tsinghua University, Beijing, China. We would like to express our sincere gratitude to the researchers who joined the conference and submitted their works to our journal. Special thanks go to Prof. Qizhi Mao who organized this International Conference as the Chairman of SPSD2013. We would also like to express our sincere gratitude to the reviewers who gave us their most generous support on reading and commenting on the papers. We hope all our efforts would contribute to a more sustainable world.

REFERENCES

Huang K.H. and Pai J.T. (2015). "A Study on Promotion Mechanisms and the Future of Government-led Urban Renewal Projects from the Perspective of Land Ethics", International Review for Spatial Planning and Sustainable Development, 3(2), 22-38.

Lewin, S.S. and Goodman, C. (2013). "Transformative Renewal and Urban Sustainability", Journal of Green Building, 8(4), 17-38.

Pai J.T. and Pai S.Y. (2015). "User Behaviour Analysis of the Public Bike System in Taipei", International Review for Spatial Planning and Sustainable Development, 3(2), 39-56.

Sugihara, K. (2015). "Automatic Generation of 3D Building Models for Sustainable Development", International Review for Spatial Planning and Sustainable Development, 3(2), 72-82.

Sui-Qui, T.Y. and Leng, H. (2015). "Review on the Development of a Sustainability Indicator System in Agenda 21 for Tourism in Mexico", International Review for Spatial Planning and Sustainable Development, 3(2), 4-21.

Zhang, Y.Y., Zhang, Y., Shen, Z.J., Nishino, T.Y. and Chen, X.J. (2015). "3D Laser Scanning-Technology-based Historic Building Mapping for Historic Preservation", International Review for Spatial Planning and Sustainable Development, 3(2), 57-71.

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Review on the Development of a Sustainability Indicator System in Agenda 21 for Tourism in Mexico

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Key words: Sustainability; Indicators of Sustainable Development; Agenda 21; Travel Destinations; Mexico.

Abstract: Tourism in Mexico has been boosted as one of the most important economic activities, and is now trying to diversify its market by offering different types of destinations. In the context of sustainability, concern arises for authorities and society in general about the search for balance of the tourist destinations in the country. As a result of the effort and the sum of the will of three levels of government (Federal, State and Municipal), Local Agenda 21 for Tourism in Mexico was born. This instrument presents a Sustainability Indicator System to evaluate tourist destinations in Mexico. Through the evaluation of four major themes: Environment, Socioeconomic Environment, Tourism and Urban Development, the current situation of tourism in Mexico is diagnosed. This paper analyzes the results of the application of the Sustainable Development Indicators (SDIs), promoted by the Ministry of Tourism (SECTUR) in eighty-four destinations during the period of 2002-2007, from the length and breadth of the country. The best-positioned tourist destinations are categorized as Medium Cities. Paradoxically, coastal tourist destinations are in the middle. The worst condition is found in the tourist destinations of nature. The results show better performance indicators for urban development, while the higher pressure is in the environmental areas.

1. INTRODUCTION

Tourism in Mexico has been boosted as one of the most important economic activities, and is now trying to diversify its market by offering different types of destinations. In the context of sustainability, concern arises for authorities and society in general about the search for balance of the touristic destinations in the country. As a result of the effort and the sum of the will of three levels of government (Federal, State and Municipal), Local Agenda 21 for Tourism in Mexico was born. This instrument presents a Sustainability Indicator System to evaluate tourist destinations in Mexico.

Through the evaluation of four major themes: Environment, Socioeconomic Environment, Tourism and Urban Development, the current situation of tourism in Mexico is diagnosed. This paper analyzes the results of the application of the Sustainable Development Indicators (SDIs), promoted by the Ministry of Tourism (SECTUR) in eighty-four destinations during the period of 2002-2007, from the length and breadth of the country. The best-positioned tourist destinations were categorized as Medium Cities.

Paradoxically, coastal tourist destinations are in the middle. The worst condition was found in the tourist destinations of nature. The results show better performance indicators for urban development, while the higher pressure is in the environmental area.

After being raised that tourism could boost the economy and reduce the poverty in developing countries, many countries, including Mexico, have been areas with opportunities to stimulate economic growth. Currently, tourism in Mexico is wide and is strongly linked to the development policies of the country, as it is the third sector that generates income, after oil sales and foreign remittances (Ruiz, 2008).

Mexico has a great potential for development in its destinations. It thanks to cultural diversity, climate and landscape that have been diversifying the range in beach, cultural destinations, and recently, those linked to ecotourism or adventure.

Yet from this perspective, it becomes clear, for state and society in general, the need to take urgent measures to conserve natural resources and the environment that sustains them, in light of the sustainability required in order to achieve a balanced development that will lead to improving the quality of life of the population.

In Mexico a concrete effort aimed at sustainable development is the program of Agenda 21 for Tourism in Mexico. This instrument presents a methodology to assess, through a system of indicators, the sustainability of the various tourist destinations, which has been applied in eighty-four tourist destinations along the length and breadth of the country between 2002 and 2007.

The paper is organized in four sections. The work is a part of the progress of sustainable development indicators in the world. Thus, in the first part we develop three elements circumscribing the body of the subject, these are: Sustainability, Sustainable Development Indicators and Sustainable Tourism. They all have the common element of Agenda 21 for Tourism in Mexico.

In the second part we presented the methodology. In order to obtain a recent overview of the degree of sustainability of tourism in Mexico, we sought and analyzed official information generated mainly by the Ministry of Tourism (SECTUR) and the Interior Ministry. The sources that were consulted specifically to identify public policies at the national level to strengthen national sustainable development were: National Policy and Strategy for Sustainable Tourism Development, National Development Plan and Tourism Sector Program, for the period 2007 - 2012. Regarding indicators, the Indicator System SECTUR, posed through Agenda 21 for Tourism in Mexico, was revised.

The third part includes the assessment results using sustainable indicators that show a series of tables summarizing the assessments of indicators and variables in four major areas: Environment, Socioeconomic Environment, Tourism and Urban Development. Percentages are offered in priority variables, and variables with favourable assessment of the five types of tourist destination in Mexico. It then establishes the current state of sustainability of tourism destinations.

Finally, it finishes with conclusions and recommendations.

2. PROGRESS OF SUSTAINABILITY INDICATOR SYSTEM

2.1 Sustainable Development

2.1.1 Birth of the idea of Sustainability

It is pertinent to note the evolution of the idea of sustainability in order to understand the current context. The environmental problems caused by societies have existed over time, expressed through multiple forms and consequences (Hughes, 1981).

In 1987 the Brundtland report “Our Common Future” was developed, being the reference to the programs that were aimed at sustainable development. This report of the World Commission on Environment and Development was the first milestone in the international context, which analyzed the socioeconomic consequences of environmental deterioration. It was the first time when the concept of sustainable development was introduced, defined as "the set of strategies to ensure the satisfaction of current needs without compromising the ability of future generations to meet theirs" (Lanza, 1999).

This report sees sustainable development as a multidimensional process that affects the economic, ecological and social levels (Daly et al., 2005).

In order for sustainability to exist, three conditions must be met. First, integrating environmental, social and economic aspects, making more efficient use of energy, minimizing environmental impact, and maximizing social and economic benefits. Then, consider the fundamental role of the institutions in planning sustainable development policies. These policies pose a long-term vision, from good planning and sound strategies (Marbán, 2006).

The next step in the construction of sustainable development was marked by the Rio Conference "Earth Summit" in 1992, which gathered together representatives of over 179 countries in the city of Rio de Janeiro, Brazil.

2.1.2 Agenda 21: features and general principles

Agenda 21 is an action plan of the United Nations for sustainable development in the twenty-first century, adopted by 173 governments at the United Nations Conference on Environment and Development at the Rio Summit in 1992. During this summit, local communities were urged to create their own Local Agenda 21, with specific plans and actions for each location, with reference to the general guidelines of Agenda 21.

Agenda 21 attempts to identify environmental problems and their causes from environmental audits and diagnostics and to set a clear hierarchy to create action programs for environmental, economic and societal conditions (Gonzalez, 2006).

Agenda 21 introduces the concept of national strategies for sustainable development as a means of integrate economic, social and environmental issues in a focused action plan (Ruiz and Martinez, 2007).

2.2 Sustainable Development Indicators

2.2.1 International efforts on Sustainable Development Indicators

The substantive development of sustainability indicators and sustainable development began in the early 80's in Canada and some European countries, but the most important impetus came from the Earth Summit (Rio de Janeiro, Brazil). To monitor progress on Agenda 21, the United Nations Conference on Environment and Development established the Commission on Sustainable Development (CSD).

In 1995, the United Nations Commission on Sustainable Development created a work program aimed at the development of indicators of sustainable development. This work resulted in the publication in 1996 of the "Blue Book" in which appeared in four levels - economic, social, environmental and institutional - a methodological framework, the definition and meaning of a set of indicators considered sustainable development (Duran, 2012).

Of great importance is also the core set of indicators for environmental performance reviews of the OECD, a summary report by the Task Force on the State of the Environment from 1993, and it is mainly because of its methodological approach, which developed the model of Pressure-State-Response (PSR) in describing the interactions between society and the environment, which has been the basis of many of the systems developed later. But so is the variety and specificity of the collected indicators (Urbano, P, 2011).

In Latin America, the United Nations' Economic Commission for Latin America (ECLAC) prepares, through its Division for Sustainable Development and Human Settlements database, for the evaluation of sustainable development in Latin America and the Caribbean (BADELSALC) (Gallopin, 2003).

Quiroga (2001) proposes the following typology of indicators, based on experience accumulated worldwide:

1. Environmental Sustainability Indicators first generation (1980-present): They are explained as complex phenomenon from a productive sector (health, agriculture and forestry).

2. Sustainable Development Indicators or second generation (1990-present): Made since the multidimensional approach to sustainable development. Its purpose is to advance the design and implementation of SDI systems composed of environmental, social, economic and institutional indicators.

3. Sustainable Development Indicators third generation (to be developed): Designing such indicators is a major challenge, because it means to design binding indicators for understanding the complex linkages between economic, social and environmental issues, in a systemic and transversal way.

2.3 Tourism and Sustainable Development

Parallel, but linked to the sustainable development environment events, premises arise to route tourism towards sustainability, so three years after the Rio Summit, the World Tourism Organization organized the World Conference on Sustainable Tourism in the Canary Islands, Spain in 1995.

In November 2007, in Cartagena de Indias, Colombia, the WTO organized the V Sustainable Tourism Network and. as part of the panel "Current Challenges of sustainable tourism development: poverty alleviation, natural heritage management and cultural and climate change".

Mexico presents the progress of Program Agenda 21 for Tourism in Mexico (SECTUR, 2008).

2.3.1 Sustainable Tourism

In the nineties, what discussed and reflected in forums was tourism that showed the effects of rampant tourism development. The initial ideas of the critics had, as its primary focus, socially responsible tourism development that threatened the general ecologist and environmentalist approach of that time (Reyes, 2002).

The WTO defines sustainable tourism based on the following principles: a) conservation of natural and cultural resources for its continued use in the future, at the same time reporting actual benefits; b) planning and management of tourism development in a way that does not cause serious environmental or socio-cultural problems; c) maintenance and continuous improvement of environmental quality, d) maintaining a high level of visitor satisfaction and therefore strengthening the prestige and commercial potential of the destination; e) benefits perceived by populations generated from tourism's spill (Troncoso, 1999).

2.3.2 Agenda 21 for Tourism in Mexico

Agenda 21 for Tourism in Mexico has as a base of the National Policy and Strategy for Sustainable Tourism Development document.

Thus, Agenda 21 for Tourism in Mexico is the result of the commitment agreed upon and efforts to contribute to the sustainable development of the country. The work was coordinated by the Ministry of Tourism (SECTUR) and the Ministry of Environment and Natural Resources (SEMARNAP), (SECTUR, 2001).

Currently, Agenda 21 for Tourism in Mexico is part of the National Development Plan 2007-2012 and the Tourism Sector Program 2007-2012.

Agenda 21 for Tourism in Mexico proposes strategies and actions in the short, medium and long terms in order to strengthen the dynamics of the tourist regions and promote sustainable development, strengthening human welfare, respecting the environment and optimizing economic and social benefits of communities (SECTUR, 2008).

This program is designed as a proposal for the three levels of government (federal, state and municipal), tourism entrepreneurs, academia, NGOs and the local community to work in coordination in improving the tourist destinations and living conditions of communities.

In this process, the Federal Government has an important role as promoter and facilitator, and in coordination with the State Governments, tourist destinations and especially local communities, establishing objectives and goals to pursue and achieve (Martínez, 2009).

Meanwhile the Municipal Government has a leading role in implementing the program, acting as a strategic developer to meet local environmental issues and also as a driver of change processes and mediator among the groups that interact in the processes of local economic and social development locally.

The SECTUR proposes a system of sustainable development indicators (Table 1) on four major themes: Environment, Socioeconomic Environment, Tourism and Urban Development, which in turn are divided into twelve sub-themes and sets clear goals.

Table1. Sustainable Indicator System of Agenda 21 for Tourism in Mexico

Topic	***Subtopic***	***Objective***
Environment	Energy Air Water Waste Environmental Education	-Promote the sustainable use of natural resources. -Keep the functioning of ecological systems. -Protect and conserve natural resources -Evaluate the interaction between tourism and urban and natural environment of the destination (resource consumption and waste disposal).
Socio-economic Environment	Economic benefits Tourism. Social Impact	-Size the benefits generated in the destination, in order to improve the quality of life of the population. -Evaluate the impact generated by tourism in the preservation of cultural values and customs of local communities.
Tourism	Tourism demand Tourist offer	-Know the visitor profile and its relationship to sustainability. -Sizing the extent to which tourism establishments respond to sustainable development. -Promote the conservation of natural and cultural attractions.
Urban Development	Plans and Programs. Urban-Image. Urban Comprehensive Development.	-Evaluate the degree of urban development (infrastructure, equipment and housing of the population). -Identify planning processes that enable orderly spatial development of the environmental, tourism and urban issues.

3. THE IMPLEMENTATION OF SUSTAINABLE INDICATORS

For decades, internationally, the main recipients of tourism have been France, Spain, the U.S., and just recently, China. In the second level there are Italy, Great Britain, Mexico and Germany. Mexico stands out, along with China and Turkey, as a developing country that is in the list of top ten countries with the highest tourist arrivals in the world (Meixueiro, 2008).

Between 1995 and 2005 the country moved to rise and fall in the range of 20 million international visitors per year and more than 140 million domestic touristy trips (SECTUR, 2007). However, during the first few months of 2011, international visitor arrivals to the country were already at 38.2 million.

Traditionally in Mexico, the most important international sector has been from United States and Canada; however, as a result of diversification efforts and easing immigration, the number of tourists from countries like Russia (59.4%), Peru (42.6%), Brazil (45.6%), Sweden (35.4%), China (33.9%) and Colombia (31.7%), to name the major ones, has increased (SECTUR, 2011).

On the stage of the Mexican economy, tourism presents interesting figures. This sector has taken great relevance in the economy since the eighties, becoming the second largest source of revenue for the country. Revenues of Mexican tourism have presented an average increase of 6.5% over the period from 2000 to 2007 (Garcia and Carranco, 2009).

In June 2011, the National Institute of Statistics, Geography and Informatics (INEGI) presented the results of the Tourism Satellite Account in Mexico 2005-2009; this reaffirmed the importance of tourism to the economy's country, representing 8.9% of the Gross Domestic Product (GDP) in 2009. During this period, earnings from international visitors in Mexico totalled 6.179 million dollars (SECTUR, 2011).

The Ministry of Tourism (SECTUR) produced the diagnostic information that referred to the system of sustainability indicators and employs Agenda 21 for Tourism in Mexico, during five years, in six stages from December 2002 to November 2007. Also, SECTUR classified into five types the touristic destinations: Heritage's World Cities (Colonial Cities), Medium-sized Cities (Urban Centres), Magic Towns, Beaches and Nature (Adventure), and which together account 84, distributed across the national territory (see Table 2 and Figure 1).

Table 2. Implementation phases' destinations of the Sustainability Indicator System

Stage	**Colonial City**	**Medium City**	**Magic Town**	**Beach**	**Nature**	**Total**
I (Dec2002-Mar2003)			Pátzcuaro	Rosarito Huatulco Cozumel Los Cabos		5 pilot cities
II (Sept-Dec 2003)	Puebla Oaxaca Zacatecas	Mérida Tijuana	Cuetzalan San M. de Allende Taxco	Acapulco Cancún Ixtapa Mazatlán Pto. Vallarta Riviera Maya	Jalcomulco	15
III (Sept-Dec 2004)	Aguascal. Campeche Guanajuato S.L.Potosí	Chetumal Villahermosa	S. Cristobal Tepoztlán Valle Bravo	Manzanillo N. Vallarta Pto. Peñasco		12
IV (May-Nov 2005)	Morelia Querétaro Tlaxcala	Cuernavaca Durango Hermosillo	P. Fuentes Real Catorce Huesca	La Paz Veracruz Boca Río Ensenada B. de los Ángeles Loreto Tampico Madero Pto. Progreso	Creel Durango Palenque Mineral	23
V (March-July 2006)	*Oaxaca	León Tehuacán	*Acapulco *Cancún *Cozumel *Huatulco *Los Cabos *Pto. Vallarta *Riviera Maya *Playas del Rosarito B. Kino Guayabitos	*Pátzcuaro *S.M Allende Comala Mazamitla Tapalpa Tequila Uruapan	Guachochi	*10, and 11 news
VI (May-Nov 2007) ** Updated diagnostic*	*Guanajuato *Puebla	Irapuato Guadalupe N. Casas Grandes	*V. Bravo Álamos Bacalar Bernal Cosalá Caotepec Cuitzeo D. Hidalgo Izamal Papantla Santiago Tepotzotlán Tlapujahua Todos Santos	*Cozumel *Cancún *N. Vallarta *Mazatlán	Catemaco Zacatlán	*7, and 18 news

Figure 1. Tourist Destinations Assessed by SECTUR (2002-2007)

As mentioned, SECTUR proposes a system of indicators to assess the sustainability of tourism in Mexico, divided into four main areas: Environment, Socioeconomic Environment, Tourism and Urban Development. These large topics are divided into twelve sub-themes, which give rise to twenty-eight indicators to diagnose finally fifty variables (Table 4).

In this regard, it is noteworthy that the work undertaken by SECTUR becomes possible by the cooperation of various Secretaries of State in the three levels of government (Federal, State and Municipal), largely because it was them which generated the information above.

Some of the agencies that generated information for the area of Environment were the National Agricultural Council (CNA), the National Water Commission (CNA), the Secretariat of Environment and Natural Resources (SEMARNAT), the Federal Electricity Commission (CFE) and the Public Service Municipal's dependences of different touristic destinations. For the issue of Socio-economic Environment, participation was valuable from the National Institute of Statistics, Geography and Informatics (INEGI) and the National Population Council (CONAPO). For Tourism, the Ministry of Tourism (SECTUR), on which the responsibility for the subject of Tourism practically fell and finally, to the issue of Urban Development, data were obtained from the departments of Planning and Urban Development from the various states and municipalities.

To evaluate the indicators, SECTUR proposes using the *Technique of Semaphore*, which seeks to determine the Management Consideration indicators, which are patterns, evaluation ranges or variables (considered, efficient, present, existing, quantity, management...) under which one can know the status indicator. These criteria vary depending on the measure being evaluated. The Management Considerations permit identification of the values of which the indicator is, where: *Green* means that the indicator is in better shape than the parameters (under control), which is evaluated as a favourable condition; *Yellow* describes that the indicator is in good condition, but not to neglect it, requiring preventive care (in caution); and finally, *Red* shows that the indicator presents a problem (out of control) or is an opportunity area and is associated as a priority (Table 3).

Table 3. Management Considerations for Indicators

RANGE EVALUATION	CONDITION/STATUS	
Above 90% thereafter	Under control	Green
Between 60% and 89.99%	Caution	Yellow
Between 0% and 59.99%	Out of control	Red

Table 4. Outline Sustainability Indicator System

	SUBTOPIC	INDICATOR	VARIABLE
Environment	*Water*	Availability	1.Degree of pressure on water resources
		Consumption	2.Water consumption per capita
			3.Water consumption per room
		Treatment	4.Levels of water treated
			5.Quality of treated wastewater BOD5
			6.Quality of treated wastewater
			7.Receiving downloads
			8.Reuse of treated water
	Energy	Energy consumption	9.Energy consumption per capita
			10.Energy consumption per room
	Air	Air quality	11.Atmospheric concentration of sulphur dioxide
			12.Atmospheric concentration of carbon monoxide
	Waste	Waste generation	13.Generation per capita
			14.Generation by tourist
			15.Efficient collection system
			16.Landfill in accordance with standard
			17.Recycling of waste volume
			18.Hazardous waste
	Env.Education	Environmental education programs	19.Education sector
			20.Social sector
			21.Private sector
Socioeconomic	*Economic benefits of tourism.*	Unemployment	22.Unemployment rate
		Contribution to the local economy	23.Jobs in tourism
		Predial	24.Its participation of municipal resources
	Social impact.	Impact on population.	25.Welfare state level
		Population pressure.	26.Rate of population growth
		Security.	27.Perception of Security destination
		Informal trade.	28.Perception of street trading
Tourism	*Touristic demand*	Tourist satisfaction	29.Tourist satisfaction index
		Tourism benefits	30.Average daily expenditure of tourists
		Pattern	31.Seasonality
	Touristic offer	Occupation	32.Occupation percentage
		Rates	33.Rate on hotel Grand Tourism
			34.Rate in 5 star hotels
			35.Rate in 4 star hotels
			36.Rate in 3 star hotels
			37.Rate in 2 star hotels
		Certification	38.Participation in institutional programs
			39.Guides certified
		Attraction's state	40.Conservation principals attractive
		Seawater quality for recreational use	41.Enterococci
Urban	*Urban and Environment Planning.*	Plans and programs	42.Urban development plans enacted
			43.Territorial ecological ordinance enacted
	Integrated Urban Development	Urban land	44.Urban growth
		Coverage of basic services	45.Drinking water
			46.Sewerage

	SUBTOPIC	INDICATOR	VARIABLE
			47.Electric power
			48.Paving
		State housing	49.Poor housing index
	Urban image	Preservation of the architecture and landscape	50.Regulation of urban image and architecture

4. ASSESSMENT RESULTS USING SUSTAINABLE INDICATORS

Table 5, below, has divided Table 4 into four major areas that summarize the topics, subtopics, indicators and variables that evaluate the system of indicators proposed by Agenda 21 for Tourism in Mexico, to visualize and better understand the results. It shows the variables assessed by type of destination through the traffic light system.

So, for the area of Environment, which is related to the use and exploitation of resources, the indicators which should be treated as a priority in most destinations are: the collection and treatment of waste water, and excessive waste generation and its management. It finds that there are not landfills as it is indicated by the standard of sanitation and the recycling of waste is practically null. The management of hazardous waste is presented in two of the five types of destinations as a priority. These items should be included in the priority agenda of the state and municipal governments, as they are conditions that affect the health of individuals and the welfare of the urban centres.

It also becomes clear how little or limited the private sector participation is in environmental education programs, especially in Beach and Nature destinations, which depend almost entirely on the landscape and environmental conditions of the regions where they operate.

Of the indicators that are favourable in most destinations, we can cite the per capita water consumption, the efficient garbage collection system and the educational sector participation in social and environmental education programs.

Table 5. Environmental Assessment

	INDICAT.	VARIABLE	A	B	C	D	E
Environment	Availability	1.Degree of pressure on water resources					
	Consumption	2.Water consumption per capita					
		3.Water consumption per room					
	Treatment	4.Levels of water treated					
		5.Quality of treated wastewater BOD5					
		6.Quality of treated wastewater					
		7.Receiving downloads					
		8.Reuse of treated water					
	Energy consumption	9.Energy consumption per capita					
		10.Energy consumption per room					
	Air quality	11.Atmospheric concentration of sulphur dioxide					
		12.Atmospheric of carbon monoxide					
	Waste generation	13.Generation per capita					
		14.Generation by tourist					
		15.Efficient collection system					
		16.Landfill in accordance with standard					
		17.Recycling of waste volume					
		18.Hazardous waste					

	INDICAT.	VARIABLE	A	B	C	D	E
	Environmental education programs	19.Education sector					
		20.Social sector					
		21.Private sector					

A: Colonial City B: Medium City C: Magic Town D: Beach D: Nature

Table 6 shows the percentages of the evaluation and diagnosis of the variables in the Environmental issue, which are presented with prior attention and in favourable condition.

Table 6. Environment: percentage of indicators in priority and favourable condition

	ENVIRONMENT	
	PRIORITY	*FAVOURABLE CONDITION*
COLONIAL CITY	*45% destinations do not treat wastewater. *73% produces a lot of garbage. *45% have no landfill in accordance with the standard. *64% volume of solid waste recycling is low.	*91% waste collection system is efficient. *64% have programs for hazardous waste management. *91% social sector promotes environmental education programs.
MEDIUM CITY	*64% have no wastewater treatment. *91% present high garbage generation. *51% have no landfill in accordance with the standard. *91% volume of solid waste recycling is low. *54% have no hazardous waste management program.	*64% water consumption per capita is in favourable condition. *54% system garbage collection is efficient. *73% educational, social and private sector promote environmental education programs
MAGIC TOWN	*52% have no wastewater treatment. *52% discharges without treatment. *59% generates lots garbage. *79% have no sanitary landfill in accordance with the standard. *72% volume of solid waste recycling is low. *65% have no hazardous waste management program.	*72% water consumption per capita is favourable *62% the waste collection system is efficient. *81% social education promotes environmental education programs.
BEACH	*78% have high garbage generation. *63% have no landfill in accordance with the standard. *74% recycling of solid waste volume is low. *63% have no hazardous waste management program. *55% private sector has little involvement in environmental education programs.	*59% water consumption per capita is favourable. *63% water consumption per room is low. *67% waste collection system is efficient. *92% education sector promotes environmental education programs.
NATURE	*83% have no wastewater treatment. *67% discharges without treatment. *75% have no sanitary landfill in accordance with the standard. *83% private sector has little involvement in environmental education programs	*67% water consumption per capita is favourable. *50% per capita waste generation is low. *50% waste collection is efficient. *67% educational sector promotes environmental education programs.

As the results of the Socioeconomic Environment, which assess the benefits of tourism and its social impacts, it was detected as a priority, the employment variable in the tourism sector, particularly in destinations considered like Magical Towns and Nature, which are inserted in a regional or rural framework (Table 7).

In a second priority level (to intervene), it is the rate of population growth, especially in World Heritage Cities and Beach destinations. The

latter has presented itself in recent decades due to national and foreign migratory population movements, and the prior, in search of better living conditions by moving and settling in these places. The international migrants, being drawn by the rate of its currency (U.S. dollar), by relatively low land prices and weather conditions, reach Mexican lands and usually buy and build on the coast, as in the case of the peninsula of Baja California, where the two states, Baja California and Baja California Sur, compromise to accommodate a large number of Americans.

Finally, it highlights the negative perception about the informal trade in the beach destinations and colonial cities.

The variables that stand in favourable condition are: positive perception about the safety of tourist destinations in Mexico and, in the second and the third place, but closely related, the welfare of the population and the low unemployment. This is because welfare levels in tourist areas have better conditions than the rest of the country. That confirms in practice the benefits that tourism generates.

Table 7. Socioeconomic Assessment

	INDICATOR	**VARIABLE**	**A**	**B**	**C**	**D**	**E**
Socioeconomic	Unemployment	22.Unemployment rate					
	Contribution to the local economy	23.Jobs in tourism					
	Predial	24.Its participation of municipal resources					
	Impact on population	25.Welfare state level					
	Population pressure	26.Rate of population growth					
	Security	27.Perception of Security destination					
	Informal trade	28.Perception of street trading					

A: Colonial City B: Medium City C: Magic Town D: Beach D: Nature

Table 8 shows the evaluation and diagnosis of socioeconomic variables, indicating the percentages of variables in priority and favourable condition.

Table 8. Socioeconomic percentage of indicators in priority and favourable condition

	SOCIOECONOMIC	
	PRIORITY	*FAVOURABLE CONDITION*
COLONIAL CITY	*45% have high population growth. *45% have informal trade problems.	*91% has a good welfare in the population. *91% security is favourable for locals and tourists.
MEDIUM CITY	*73% has a low level of employment in the tourism sector	*82% have good welfare. *82% the security is favourable.
MAGIC TOWN	*52% has low level of employee training.	*79% has low unemployment. *93% is safe for residents and tourists.
BEACH	*70% has a high population growth. *33% presents informal trade problems.	*81% have good welfare. *74% present safe conditions.
NATURE	*67% employment in tourism is low.	*92% have low unemployment. *58% population growth is low. *92% security is favourable.

First, an aspect given priority in the area of Tourism was the certification indicator in its two variables: business participation in institutional programs and tourist guides certified in the five types of destinations. Second, it highlights the low percentage of hotel occupancy in Colonial Cities,

Medium Cities and Magic Towns. The Magic Towns and Nature destinations are affected by the activity seasonality, see Table 9.

Meanwhile beach destinations are best positioned, this may represent tourist preference for them.

Only the indicators of state and conservation of the main attractions, like water quality for recreational use, obtained favourable assessment in the five types of destinations.

Table 9. Tourism Assessment

	INDICATOR	VARIABLE	A	B	C	D	E
Tourism	Tourist satisfaction	29.Tourist satisfaction index					
	Tourism benefits	30.Average daily expenditure of tourists					
	Pattern	31.Seasonality					
	Occupation	32.Occupation percentage					
	Rates	33.Rate on hotel Grand Tourism					
		34.Rate in 5 star hotels					
		35.Rate in 4 star hotels					
		36.Rate in 3 star hotels					
		37.Rate in 2 star hotels					
	Certification	38.Participation in institutional programs					
		39.Guides certified					
	Attraction's state	40.Conservation principals attractive					
	Seawater quality for recreational use	41.Enterococci					

A: Colonial City B: Medium City C: Magic Town D: Beach D: Nature

Table 10 condenses the results of the evaluation and diagnosis of the different tourism destinations and shows the percentages of the variables that were of priority and in favourable condition.

Table 10. Tourism percentage of indicators in priority and favourable condition

	TOURISM	
	PRIORITY	*FAVOURABLE CONDITION*
COLONIAL CITY	*54% average expenditure of tourists is low. *45% occupancy rate is low. *91% companies have little participation. *64% has not certified tour guides.	*82% conservation main attractions are good. *90% are working on projects for diversification of tourism.
MEDIUM CITY	*54% occupancy rate is low. *91% tourism enterprises have little participation. *73% have no certified tour guides.	*82% conserve main attractions.
MAGIC TOWN	*62% have seasonality problems. *52% have low occupancy rate. *90% companies have little participation. *86% have no certified tour guides.	*34% destination conservation is good.
BEACH	*77% enterprises have little involvement. *52% have no certified tour guides.	*52% conserve the main attraction. *67% has clean beaches.
NATURE	*83% have seasonality problems. *75% enterprises have little participation. *83% have no certified tour guides.	*67% conservation of the main attractions is good.

The assessment of Urban Development (Table 11), in the system that integrates the sustainable development indicators of Agenda 21 for Tourism in Mexico, is the one which obtained the best results. Five of nine variables

resulted in favourable conditions, including the basic service indicators, such as potable water and electricity, are covered in the five type destinations. Sewer and paving variables of basic service indicators fall under the preventive status, that is, in order not to be neglected, in the Nature and Colonial destinations respectively.

The variable of Urban Development Plans Declared, which is referred in the indicator of Plans and Programs on the sub-theme of Urban and Environmental Planning, was evaluated as favourable condition in three destinations: Colonial Cities, Medium Cities and Beach. In addition was the result of preventive status for the Magical Town destinations and, as a priority, the Nature destinations.

Note that in the five destination types, the variable of urban growth resulted in preventive care which means it should not be neglected and should be included as a priority in state and local agendas, who should consider programs that include the construction and improvement of the existing infrastructure in urban centres, such as hospitals, schools and streets, to name a few.

For its part, the variable that considers the Ecological Land Planning emerging from the sub-theme Urban and Environmental Planning, appearing as a status of priority. It is clear for the effort that should be required in this regard, to have instruments of political and territorial planning, essential for the proper land use and resource management.

The variable on Regulations of Urban and Architectural Image is also presented in an unfavourable situation in the Colonial City and Beach destinations. These tools are essential for the conservation and protection of many colonial cities in Mexico. The absence of these brings into risk their history of richness.

The precarious housing index variable, which is from the sub-theme Urban Development Integrated, appears as a priority in two kinds of touristic destination: Magic Towns and Nature. Note that these destinations are more limited in a rural context than the others.

Table 11. Urban Development Assessment

	INDICATOR	**VARIABLE**	**A**	**B**	**C**	**D**	**E**
Urban Development	Plans and programs	42.Urban development plans enacted					
		43.Territorial ecological ordinance enacted					
	Urban land	44.Urban growth					
	Coverage of basic services	45.Drinking water					
		46.Sewerage					
		47.Electric power					
		48.Paving					
	State housing	49.Index poor housing					
	Preservation of the architectural and landscape	50.Regulation of urban image and architecture					

A: Colonial City B: Medium City C: Magic Town D: Beach D: Nature

Table 12 includes the diagnosis of the Urban Development issue, conducted through SECTUR's evaluation of tourist destinations. Shown are the percentages of the variables that were of priority and in favourable condition.

Table 12. Urban Development percentage of indicators in priority and favourable condition

	URBAN DEVELOPEMENT	
	PRIORITY	*FAVOURABLE CONDITION*

	URBAN DEVELOPEMENT	
	PRIORITY	*FAVOURABLE CONDITION*
COLONIAL CITY	*64% have no program of ecological land planning. *54% lacks urban image regulation.	*91% have declared urban development plans. *91% has covered drinking water, sewerage and electricity.
MEDIUM CITY	*82% have no program of ecological land planning.	*91% urban development plans are enacted. *82% has covered the basic water, sewerage and electricity. *82% precarious housing index is low. *73%, with regulation of urban image.
MAGIC TOWN	*72% have no ecological land-planning program. *55% poor housing index is high.	*83% has covered drinking water, sewerage and electricity. *65% has a policy of urban image.
BEACH	*74% do not have programs of ecological planning. *59% have no urban image regulation.	*78% has declared urban development plan. *70% has covered water supply, sewerage and electricity. *59% rate of poor housing is low.
NATURE	*75% have no declared urban development plans. *83% have no ecological land-planning program. *83% rate of poor housing is high.	*67% has covered drinking water and electricity.

Table 13 shows a summary of the evaluation of the destinations and the total number of variables in priority, preventive and favourable statuses.

Overall, after analyzing the results of the application of the indicator system of Agenda 21 for Tourism in Mexico, Medium-sized Cities have a greater degree of sustainability. From a total of fifty variables, ten are in a priority status, half of them on the environmental issue, then on the area of tourism mainly. Fifteen variables over fifty were evaluated in a favourable condition, most of these are included in the theme of Urban Development. Twenty-five variables were evaluated in preventive care, signally not to neglect them, but improve them.

Tourist destinations of Nature (Adventure) obtained the second best result in terms of sustainability, just after Medium Cities, following the framework proposed by SECTUR. Eleven variables of a total of fifty were in a condition to be treated as a priority. Considering those found in preventive care (twenty) and those in favourable condition (ten), that would add to thirty-nine. The issue that is most problematic is referred to in Urban Development; however, its profile is typical of features developed in rural areas of Mexico.

To be considered in middle sustainability are Magic Towns and Colonial Cities. Both exhibit practically the same results, although both present contrasts because they have the same number of variables in priority and in favourable condition (with twelve variables for each case). Priority variables are more on the subjects of Environment and Tourism (with five and four variables, respectively). The best results are in the area of Environment and Urban Development (four to five variables). There are a total of twenty-seven preventive variables, which must be addressed to improve the current condition.

Finally, on one hand, the Beach destinations, which also present contrasts. On the one hand, there are more priority variables, thirteen of

fifty. But also, it is the second kind of destination (after Medium Cities), which presents the largest number of favourable variables (fourteen of fifty). The summary table shows that the biggest challenges are related to the Environmental aspect and the best conditions are in the area of Urban Development.

Table 13. Summary: Diagnosis of Sustainability in the touristic destinations of Mexico

DESTINATION / TOPIC	COLONIAL CITY			MEDIUM CITY			MAGIC TOWN			BEACH			NATURE		
ENVIRONMENT	4	13	4	5	11	5	4	12	5	4	12	5	5	12	4
SOCIOECONOMIC	2	3	2	2	4	1	2	4	1	2	3	2	2	4	1
TOURISM	1	8	4	1	9	3	1	8	4	2	7	4	1	9	3
URB. DEVELOPT.	4	3	2	7	1	1	5	2	2	6	1	2	2	4	3
Total Variable	11	27	12	15	25	10	12	27	12	14	23	13	10	29	11

5. CONCLUSIONS AND RECOMMENDATIONS

From the Brundtland report, the world is conceived of as a global system whose parts are interrelated considering the concept of sustainable development as a multidimensional process that affects the economic, ecological and social system being a variable to be considered in policy decisions.

In recent years, one of the most troubling issues has been to really know if sustainability guidelines are followed, that is, if there are indicators that warn us about the positive or negative evolution of this process.

Environmental indicators and sustainable development indicators are an area which is still under development, where some countries have made more progress than others. In some cases, it is necessary for the progress paralleled in the development of official statistical series to feed the indicators systematically.

In the last thirty years, the environmental and sustainable development agenda has advanced significantly in the world. There are advances that comprise the conceptual and scientific development, institutionalism, design of public policies, education and citizen movements, environmental management, as well as instruments to measure progress towards sustainable development.

The central point in the discussion of sustainability is to establish the process that it needs to support, sustain or maintain over time, whether that be the process of economic development, improving the quality of life, the capacity of natural resources to produce income, ways of life of indigenous people, biodiversity or governance, to name a few. Ideally, it would be the sum of all of them.

In practice, from the perspective of public policy, the development seeks to maintain economic growth incorporating a number of environmental categories. It should be desirable that any territorial unit (country, region, state, municipality or city) simultaneously advance on the harmonious economic growth, social equity and environmental balance.

Understanding environmental dynamics, sustainable development is hard in such a highly complex field, transverse and intersectoral, so the measurement or assessment of how we approach it is quite difficult.

The efforts toward sustainability which are being carried out in Mexico are evident, a clear example is the design and implementation of the system of indicators of sustainable development posed by the Ministry of Tourism

(SECTUR), through the framework of action Agenda 21 for Tourism in Mexico.

It is important, the work of governments, but what is also fundamental is the role of municipalities in the implementation of Local Agenda 21, and it is them that is being depended on for practically building a sustainable local environment, through the integration of the three pillars: social, environmental and economic. It is within the local communities where they can negotiate decisions and guide efforts of citizens and authorities. These last have a relevant role, since they are responsible for managing the social, ecological and economic development support. Theoretically, they are who design, implement and oversee planning processes, at the same time establishing environmental policies. As actors which are nearby, they can mobilize and sensibilize the citizens towards sustainable development.

To make real and effective evaluations of tourist destinations, there should be specific proposals for each one, since conditions do not occur uniformly in all cases, which could skew the results and therefore diagnosis. Here could be incorporated more, new or other variables to have a clearer and closer idea to reality in the destination.

Mexico, like other countries, is in the first and second generations of the construction of sustainable development indicators. In recent years, the indicators have been legitimized as a useful tool in the formulation of policy, strategy evaluation, and environmental management in some states and municipalities.

In this regard, it is important to design and build actually binding indicators that can integrate more than one dimension and can interact together as a system being able to assess and, if possible, to measure the sustainability of a given space.

REFERENCES

Daly, H.E. and D. Gayo (2005). “Significado, conceptualización y procedimientos operativos del desarrollo sostenible: posibilidad de aplicación a la agricultura”, *Ministerio de Agricultura, Pesca y Alimentación. Serie de Agricultura y desarrollo sostenible.* España.

Durán, G. (2012). “Medir la sostenibilidad: indicadores económicos, ecológicos, y sociales”. VII Jornadas de Economía Crítica, Universidad de Castilla-La Mancha, Spain.

Font, N and J. Subirats (2000). *Local y sostenible: La Agenda 21 local en España*. Icaria. Barcelona.

Gallopín, G. (2003). “Sostenibilidad y desarrollo sostenible: un enfoque sistémico”, Serie Medio ambiente y desarrollo, No. 64. Ed. CEPAL, Santiago de Chile.

García Castro, B., Z. Carranco and E. Martínez (2009). “El sector turístico frente a la crisis internacional”, *El Cotidiano*, 157(3), 101-107.

González Fernández, S. (2006). “Medio ambiente urbano y desarrollo sostenible”, in: Consejería de Medio Ambiente de la Junta de Castilla y León y Revista de Estudios Locales: Medio Ambiente y Desarrollo Sostenible, Valladolid, 87-103.

Hughes, D. (1981). *La Ecología de las Civilizaciones Antiguas*, Fondo de Cultura Económica. Mexico.

Lanza, A. (1999). *Lo sviluppo sostenibile*, Il Mulino, Bologna, Italia.

Marbán Flores, R. (2006). “La Agenda 21 impulsora del desarrollo sostenible y de la protección del medio ambiente en Europa y España”, Boletín ICE Económico, 2899, 31-45.

Martinez, O.C., J.G, Ruiz and O.L., Valladares (2009). “Las particularidades de la agenda 21 para el turismo mexicano. Un análisis de la aplicación del sistema de indicadores de sustentabilidad en el municipio de Playas de Rosarito, B.C. México”, *Gestión Turística*, 12(2), 9-29.

Meixueiro Nájera, G.M. (2008). “Impacto de la actividad turística en el desarrollo local”, *Centro de Estudios Sociales y de Opinión Pública*, 48, 40.

OECD (2003). OECD Environmental Indicators: Development, Measurement and Use. Reference Paper. Ed. OECD, Paris.

Peralta Bravo, A. (2004). "Implantación de Agenda 21 Local 21 en Becerril de la Sierra". Trabajo Fin de Carrera. Facultad de Ciencias y Artes. Universidad Católica de Ávila, Madrid, 143.

Quiroga, R. (2001). Indicadores de sostenibilidad ambiental y de desarrollo sostenible: estado del arte y perspectivas, CEPAL, Serie Manuales (eds) No.16, ONU, Santiago, Chile.

Quiroga, R. (2007). Indicadores ambientales y de desarrollo sostenible: acances y perspectivas para América Latina y el Caribe, CEPAL, Serie Manuales (eds) No. 55, ONU, Santiago, Chile.

Reyes, A. (2000). *Turismo Sostenible*. Lepala. Madrid.

Ruiz Chávez, O. (2008). "Turismo: Factor de Desarrollo y Competitividad en México", *CESOP*, 46, p. 36.

Ruíz, J. and O. Martínez (2007). "Hacia una agenda 21 de la Cultura", *Espíritu Científico en Acción*, 3-6, 48-55.

Secretaría de Turismo (2001). "Plan Nacional de Turismo 2001-2007", SECTUR, México, D.F.

Secretaría de Turismo (2007). *"Programa Sectorial de Turismo 2007-2012"*, SECTUR, México, D.F.

Secretaría de Turismo (2008). *"Agenda 21 para el Turismo en México"*, SECTUR, México, D.F

Secretaría de Turismo (2011). *"Quinto Informe de Labores"*, SECTUR, México, D.F.

Secretaría de Gobernación (2007). "Plan Nacional de Desarrollo 2007-2012", SEGOB, México, D.F.

Troncoso, B. (1999). "Propuesta para una política de desarrollo turístico sostenible" in Martínez, 2009.

Urbano, P. (2011). "Sustainability indicators for transport. A structural perspective", XIII World Economy Meeting, País Vasco, Spain.

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A Study on Promotion Mechanisms and the Future of Government-led Urban Renewal Projects from the Perspective of Land Ethics

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Abstract: Urban renewal is one of the important government policies to improve the urban environment and economic growth. To further utilize public land, the Construction and Planning Agency, Ministry of Interior (CPAMI) coordinated with the related public offices to release government-owned land that contains large under-developed areas with the most business incentives for urban renewal. The policy still follows an "urban redevelopment" approach, in this case emphasizing environment improvement and construction, such as building reconstruction. The participation of communities and the ecological integrity of the natural systems in the process of urban renewal is still insufficient. The purpose of this study was to explore Taiwan's urban renewal policy development process and mechanisms of the CPAMI-led urban renewal projects. In addition, this study references Aldo Leopold's land ethic theory, using this theory to explore the power dynamics and land health problems. Understanding the government-led urban renewal policies is needed to improve the social, economic and ecological issues. By "regenerating" the dilapidated region, the urban area is expected to regain its energy and sustainability.

1. PREFACE

Urban renewal involves the government, laws and regulations, implementers and the general public. The complicating, diverse and disordered people and value judgments on the use of land has triggered people's doubts on the appropriateness of using natural land. There has also been a conflict between economical values and the ecology in the development of economy, resulting in the emergence of ethical issues. The role of urban renewal (by government, residents and builders) has been motivated by "self-interest". This often results in conflict relationships, and "zero-sum" development in environmental, economic and social aspects. This would be contrary to the goal of the sustainable development of urban environments (Liao, 2008).

As the central competent authority that took charge of Taiwan's urban planning and urban renewal projects, Construction and Planning Agency, Ministry of the Interior (CPAMI) also put forward relevant policies, including assisting non-governmental circles to autonomously promote

urban renewal projects or to serve as the authority in charge to promote urban renewal project on its own. The purpose was to improve living environments and public facilities of old urban concentrated areas, enhancing city competitiveness.

Regardless of government-led or community-driven urban renewal projects, the promotion of urban renewal projects was often time consuming due to issues such as the public's disagreements with urban renewal plans regarding their homes, the allocation and contingency approaches proposed by the authority, placement difficulties of disadvantaged households, or difficulties to reach a consensus among the public and state-owned land management agencies. The controversy of the Taipei Wenlin Yuan Renewal Project in 2012 and the interpretation of No. 709, made by the Council of Grand Justices, Judicial Yuan in April 2013 deeming that some provisions of the Urban Renewal Act are unconstitutional, indicated that urban renewal projects needed to focus more on social issues such as housing justice. Urban renewal through public participation, respect for different knowledge systems (such as local and traditional knowledge) and multi-value choice (such as land is home) are required to justify and rationalize the urban renewal of public interest (Hsu, 2012). In addition, in the 1950's, Aldo Leopold (1949) advocates the ethical relationship between man and nature to be maintained. Other species in the natural environment should also have the right to life, so when humans change the environment, we also have the responsibility of care for the welfare of biological communities. In order to explore urban renewal policy from a broader perspective, this research suggested that government-led urban renewal projects played an important role as a demonstration for the implementation of renewal projects in civil society and therefore, the central competent authority of urban renewal, such as CPAMI, should be more responsible for the land.

Therefore, this study first reviews urban renewal policies and comments on the mechanisms of CPAMI-led Urban Renewal by Leopold, Walck and Strong's land ethic. Further, it analyses the relationship among urban renewal rights of multiple groups and discusses current beliefs and disadvantages of urban renewal mechanisms.

2. LAND ETHICS

Land has multiple interpretations: Madanipour et al. (2001) argues that "the land is a complex concept, it must be understood by the dynamic and multifaceted way." Geography scholar Agnew (1987) also uses the concept of "place" to interpret the space connotation of ecology. Agnew believes the spatial policy often focuses on the economic and political structures it might neglect citizens' local identity. Land and people have a deep connection, including its full political, social and cultural implications.

The connotation of ethics in respect of land was a model of conduct. Land ethics referred to a code of ethics in handling the relationship between humans and animals as well as plants on the land. In the early years of the 20th century, the U.S. scholar Aldo Leopold (1949) explored the relationship between nature and humans from an ecological perspective. He believed that land was just a property for humans. The relationship between land and people was entirely economic in nature. The code of ethics for the use of land was solely dominated by economic individualism, containing only privileges, not obligations. As a result, human beings could unscrupulously consume resources just for their economic needs. Based on

selfishness, people determined what was valuable and what was worthless, and eliminated species that were regarded as worthless without considering the meaning that the species had in stabilizing the entire ecosystem. Through observation of historical evolution of the ecological environment, Leopold proposed his "land ethic." In his work "A Sand County Almanac", which was published in 1949 (translated by Wu Mei Chen in 1998), Leopold argued that land ethic was to turn the human's dominating role in the community into a member that equals with all other species. It introduced the idea that we should not only respect each member of the community, but also the community itself. In this argument, balancing the relationships between people and land means the code of ethics, which requires people to maintain the biological diversity and land health. Therefore, use of land should be restricted when required and should not smash up ecosystems nor deprive any species of its right to survive. Any member of the land environment should have its own ethical and moral standing.

Leopold's idea about land ethic originated from the analysis of biosocial evolution towards ethical norms. He believed that ethical norms were confinements on freedom of conduct that were developed for survival in the long term ecological evolution. Land ethic was described as the product of social evolution. Since humans depended on the land to survive, a wide range of relations has been developed with the land. Different ethnic groups, ecological environments, and regions also would develop different ethical relationships between humans and land. It was a dynamic process, constantly changed with time and the development of tools and technologies.

Since the evolution of land, the internal driving force of developing land was mainly to accumulate capital. Man's attitude towards land was to make every effort to develop and use the land. People had to continuously develop skills and techniques to accumulate wealth and improve land utilization. This model led to severe pollution problems. Environmental carrying capacity and member's extent of participation during the land use process were subject to great challenges. It was worth noting, as Leopold believed, that people should not consider the use of land as a purely economic issue. Every related problem should be taken into account from the perspective of ethics, diversity, ecology and aesthetics. In addition, the context of different regions, different historical, cultural and social backgrounds and political systems, would be considered in residents' development, internalization and continuation of behaviour patterns toward land ethics in the region.

Land ethic and power relationships would affect the sustainable use of land, as Walck and Strong (2001) stated as the three principle structure of community, cooperation and responsibility. The idea was an extension of Leopold's land ethic. An impact model of land ethic and power relation to land health (See *Figure 1*) was constructed. The model interpreted the evolution of environment by referencing Batterbury and Bebbington's dynamic perspective of history, environmental management expert Andrew King's creation of land health through proper use of land, plus the viewpoints of "power relation" and man-made "land use," which were the cross operations of the government, market, community and property. Human's interaction with land was actually affected by "land ethics", the power of social systems and the interaction of government policy, community value norms, market economy and property resources. The struggle among these factors was to determine whether land ethics could affect the use of land by maintaining land health. In the aforesaid model,

there is an interactive relationship between land health and land utilization—land use conditions would affect land health, and whether land health would infect land use depends on the cause and effect of land health and land use. It would eventually become the key to sustainable development of land policy. Therefore, this research explored the applicability of land ethics and power dynamics with land use cases of government-led urban renewal projects.

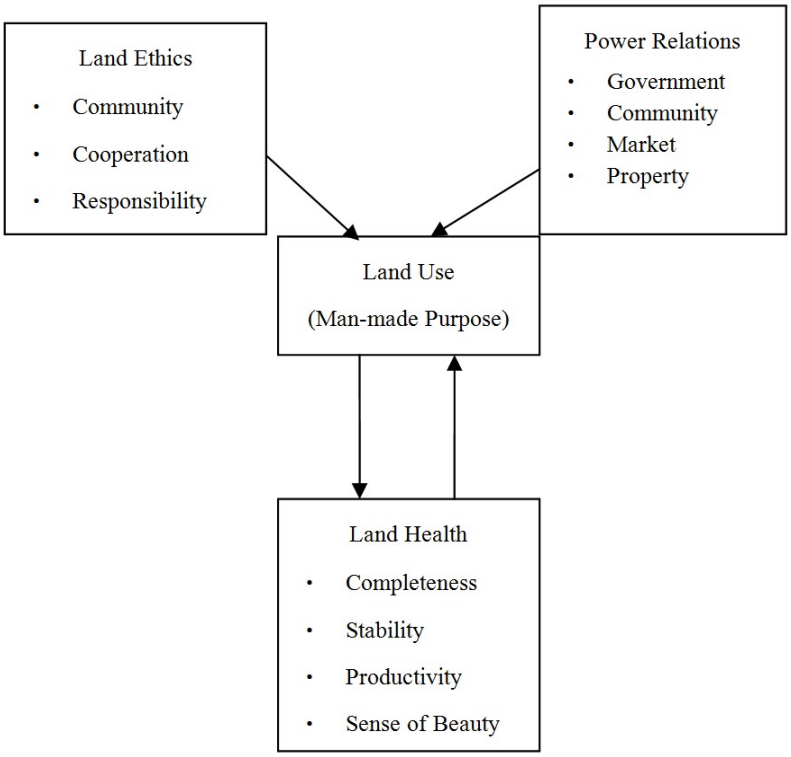

Figure 1. Impact model of land ethic and power relation on land health

In summary, land ethics is to standardize the relationship between humans and land, or the relationship between humans and other creatures on the land. As the competent authority for urban planning and urban renewal, CPAMI has the responsibility for the welfare of the land. Therefore, this research first reviews the evolution of urban renewal policy, assesses policy mechanisms of urban renewal in the current CPAMI promotion phase (through the perspective of Leopold's land ethic) and then discusses whether government agencies have institutionalized behaviour and belief. Would the government carry out long-term commitment (responsibility) to the natural community? Does the government promote urban renewal from the perspective of economy or efficiency? The mutual influence of authorities extended from land ethics is analysed in order to propose an urban renewal strategy that takes environmental resources into account and respects values of community from the perspective of land ethic norms.

3. CURRENT URBAN RENEWAL POLICY AND PROMOTION MECHANISM

3.1 Current Urban Renewal Policy

3.1.1 Phase 1- Government-led promotion

The evolution of "urban renewal" began in this phase. In order to rectify and assist city development and avoid problems arising from poor and shabby areas of a city, the government conducted the second amendments on the Urban Planning Act in 1973 and added Chapter 6 "Renewal of old urban area" which was a special chapter. It was the first time to grant legal status to urban renewal. Urban renewal in the initial phase only focused on large-scale coarse and ragged buildings, especially those on the public land. Through urban planning procedures, "compulsory collecting" or "sectional expropriation" was used to implement demolition and reconstruction for the residence. However, implementation of urban renewal was ineffective due to limited government financial sources and a lack of manpower. In order to resolve this dilemma, some local governments began developing a new system of rewarding civil circles on urban renewal in order to effectively bring in non-governmental forces. This phase primarily focused on a "joint construction agreement" for the implementation of urban renewal. Nevertheless, this mode of enforcement was short of coercive power. Acquisition of land and building was still the biggest obstacle to the implementation of urban renewal projects.

In 1996, with a purpose of boosting the economy, the Council for Economic Planning and Development convened the "Current Economic Issues" forum to discuss countermeasures against "construction industry indicator remaining in a slump". "Urban renewal" was proposed as a way to stimulate the construction industry. In addition, "urban renewal plan and economy improvement" was proposed by the Executive Yuan in February 1997 as one of the three major goals of "Improvement of National Competitiveness", which was a policy promoted by the government with full efforts. "Urban renewal project" was adopted as the guidance for related policy implementation (Wang, 2011). Since urban renewal was closely related to people's rights and obligations, incentives to meeting mandatory requirements were required and the urban renewal system itself needed to be regulated by law. As a result, the "Urban Renewal Act" was promulgated in 1998. After the promulgation, major renewal and reconstruction cases of land integration and development were implemented by private sectors.

Apart from the original objective of "old city renewal" to improve poor and shabby environments, the goal of economic development was added to make it an economic policy which fell into the perplexity of "using promotion of urban renewal work to push forward the development of construction related industry." The policy only focused on renovation of physical architecture. As for considerations on the environment, only the Environmental Impact Assessment Act, which was enforced in 1994, was used to regulate development activities. Environmental impact assessments were required only for the development of tall buildings for residence, office

and business use within a certain height limit[1]. While conducting urban renewal planning and design, many implementers deliberately reduced the intensity of development to be under the standard limit in order to avoid cumbersome environmental impact assessments. As a result, little consideration was placed on ecological environment conservation and member's participation rights during urban renewal processes.

3.1.2 Phase 2 - Encourage private investment and public-private partnership

Starting from 2000, increased bulk rewards and the concessional funds were added to urban renewal policy to encourage private investment. It means that the government began to lead the urban renewal strategy and changed policy to reward private investment. The government started to change its role from active handling to coordination and monitoring.

The government's role could be seen in related building coverage ratio and dimension incentives that were stipulated in the "Regulations of Bulk Reward for Urban Renewal." In addition, in accordance with "acceleration on urban renewal project" which was implemented by the Executive Yuan in 2006, regulations on preferential loans for urban renewal businesses were newly added to assist private fund raising and to guide private investment toward the market of renewal and renovation. Further, the Ministry of the Interior promulgated and enforced the Amendments to "Regulations of Bulk Reward for Urban Renewal" in 2008. Contents with respect to energy saving, carbon reduction, green building, intelligent building and ecological cities were added to the Amendments. It seemed that the government started to pay attention to the ecological effect of urban renewal projects and the impact on the overall environmental quality of a city, and the urban landscape was also taken into consideration. However, the final objective was still to increase profits from the bulk reward while encouraging implementers to meet the maximum limit of bulk reward as far as possible for their applications of urban renewal projects. To make it worse, to increase profits for developers, local governments could also get urban renewal funds, making both developers and governments able to receive economic benefits from urban renewal projects.

CPAMI took the lead in planning urban renewal projects in 2006 attempting to attract foreign businesses to invest in urban renewal projects in order to stimulate economic benefits. The policies included: introducing private-public partnerships, holding conferences on tender invitations one after another, investment promotions held in Hong Kong and Singapore, as well as consultation and communication with individual manufacturers. In order to actively implement investment promotions of urban renewal, foreign businesses were provided with related information on Taiwan's urban renewal projects. The foreign investors' intentions were also consulted and related opinions were conducted in coordination with the Executive Yuan's "Investment in Taiwan, global investment program", with a purpose of bringing in foreign creativity and experience and incorporating them into Taiwan's urban renewal businesses (CPAMI press release, 2010).

[1]It was the requirement of environmental impact assessments for tall buildings in accordance with Article 26 with details on standards for determining scope and development activities that environmental impact assessment should be enforced.

3.1.3 Phase 3 - Move towards urban regeneration

In 2010, the Presidential Advisory Group on Finance, the "Launching action plan for Taiwan's economic transformation," believed that urban renewal development process could drive the growth of production value of construction and related industry. After development was completed, industries, including tourism, retail and wholesale, services, catering, finance and department stores, would be attracted to the area to increase employment opportunities and expand related economic output values. Business opportunities after the development of the aforesaid industries were even greater. Therefore, "urban renewal" was regarded as one of the ten major developing projects of the service industry. CPAMI enacted the "Action Plan for Urban Renewal Industry" accordingly as the basis for the central government to promote its urban renewal policy (CPAMI, 2010:1).

The goal of the action plan explicitly set the mode of renewal to be "base redevelopment" by pushing it to "zone redevelopment" and "area regeneration." On the other hand, in order to accelerate renewal of the old and private apartments that were 30 years old or more, the government assisted households to renew their residences by themselves. Therefore, the urban renewal policy in this phase not only continued its preceding mission of giving an impetus to economic development, but also considered the needs of the public in order to attract the public to participate in the project. Moreover, the incident of Wenlin Yuan's urban renewal project that occurred on March 28, 2012 was caused by mandatory dismantling of the Wang Family's residence executed by the Taipei City Government in accordance with law, resulting in protests and conflicting public opinion. The government administration and rationality of regulations have been questioned and criticized. The Council of Grand Justices, Judicial Yuan, interpreted No. 709 on April 26, 2013 by declaring that Paragraph 1 and Paragraph 2 of Article 10 and the preceding part of paragraph 3 of Article 19 of the Urban Renewal Act were unconstitutional, and contents of the aforesaid articles should be reviewed and amended within one year. It has been determined in the interpretation that the threshold for approval of urban renewal as stated in the related outlines was too low; the renewal projects were determined not reviewed by proper organizations meaning the parties involved lost the chance to know about related information and weren't offered the opportunity to make appropriate representation. In addition, prior to submitting urban renewal and rights transformation plans for review, and after they were approved, article contents with respect to urban renewal related information were not being delivered to all owners of the renewal projects that were inappropriate, which did not comply with provisions of the Constitution for protecting people's property rights and freedom of residence, and was in violation of proper administrative procedures as required by the Constitution. Under the wave of public concern and debate among land related members and groups, CPAMI made significant revisions of the Urban Renewal Act, including a higher approval threshold on urban renewal projects and the deletion of mandatory expropriation by the competent authority on disagreement of "joint construction agreement" (CPAMI, 2012:38), hoping to carry out the protection of people's rights of abode and establishing a renewal system that complied with public interests.

3.2 Government-Led Urban Renewal Promotion Mechanism

The mode of government-led urban renewal differed from the general urban renewal projects that were handled by the private sectors. The government first operated joint survey and preliminary planning and studies, before engaging in related pre-operations, including change of urban planning, development of renewal planning and planning of investment invitation. After that, an investment invitation strategy and documents were developed. The authority in charge then coordinated related parties/ owners to draw up development guidelines on the rights and obligations of related government agencies in future development (See *Table 1*).

Table 1. Flowchart of government-led urban renewal project

Preliminary planning	Pre-operation	Announcement for investment invitation	Develop business plan and operation plan	Construction/ Operation
2-3 year	1-2 year		1-2 year	2-3 year
Government-led			Efforts from non-government circles	

The current mechanism of government-led urban renewal was adopted to implement in accordance with Article 9 of the Urban Renewal Act, where CPAMI, municipal or county (city) authority could implement urban renewal by itself, entrust it to an urban renewal business institution after going through a public evaluation and selection procedure, or accept other organizations (institutions) as implementers to undertake the business of urban renewal. In addition, as the central competent authority of urban renewal, CPAMI should submit the designation of urban renewal areas to the Urban Planning Committee, Ministry of the Interior, in accordance with Article 6 of the Urban Planning Act and Article 7 of the Urban Renewal Act in order to lend an impetus to subsequent urban renewal business.

The substantive options for development and promotion included rights transformation (including two types of processing mode: simple [2] and complex [3]), setting up superficies rights [4] and selling by tender with a provisory clause[5] (Urban Renewal Operations Manual, 2008: 4-1～4-7). The type of development was determined based on the regional characteristics and needs of management authority. For example, Keelung Railway Station, Star of Yilan City and TRA Kaohsiung Port Station were all located as important development nodes of a city with high commercial values.

[2] Rights transformation is used to implement urban renewal business. It is applicable to cases with simple housing ownership and easy to dismantle cases. Cases can be handled by the implementers themselves. The approval proportion of Article 22 is not required for the case. Other implementation procedures shall be the same as private applications for renewal business plans.

[3] Rights transformation is used to implement urban renewal business in two phases. It is applicable to cases with complex housing ownership and difficult demolition cases. The first phase shall be implemented by the competent authority to draw up business and rights transformation plans, and to integrate, in advance, owners of private land and legal buildings to establish ways of demolition and relocation prior to holding public tender invitations.

[4] Superficies rights are applicable to cases with special and strong public and urban functions, and the lands are all state-owned. Superficies rights shall be transferred to private businesses so that these businesses will participate in urban renewal projects. Private businesses also can take charge of operations of related facilities of a unit in the future.

[5] Public land of an urban renewal unit is able to be sold by tender to private businesses for the purpose of implementing an urban renewal project.

Therefore, superficies rights were adopted as the way of handling. Whereas, the region of Da-chen-yi-bao of Yonghe District, New Taipei City, was handled by rights transformation since the area was located on the riverside of Yonghe and they were primarily residential buildings. The structure of the CPAMI promotion strategy is given as follows in Figure 2.

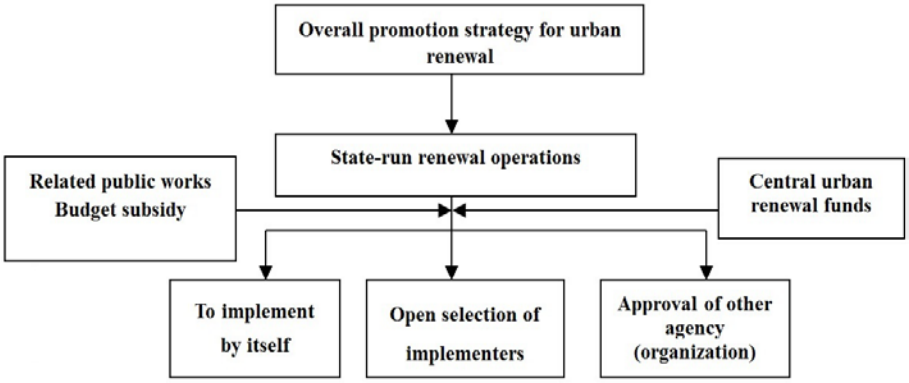

Figure 2. Structure of CPAMI's government-led urban renewal strategy

In the state-run urban renewal process, the government played the major role, followed by the developer with investment interest. There was a proxy relationship between the government and the developer, which indicated public-private partnership of the government and capital market. The government and the developer mastered more information than local community members, forming an information asymmetry. As a result, local community residents and non-government organizations often showed their distrust towards the top-down development process, leading to increased probability of collapsed negotiation during the process of urban renewal projects. According to the cooperation mode of land ethics, urban renewal development should accommodate a diverse role in participation, and the position and objectives of urban renewal development should be determined accordingly.

CPAMI developed and used land and land-based resources for the purpose of urban renewal. The land was often developed into commercial office buildings and residential units in order to facilitate market sales. Environmental impact assessments and design plans of green buildings were conducted to indicate the fulfilment of sustainable land use in the renewal process. However, the basis of sustainable use of land is land health. Land health is an essential condition to sustain life, which is affected largely by the use of land. If the land is healthy, it would promise the possibility of human's sustainable use of land, as well as the survival of biological ecosystems.

4. CASE STUDY OF LAND ETHICS AND THE ROLE OF GOVERNMENT

This research takes Leopold's three land ethic principles of community, cooperation and responsibility to analyse the current policy and mechanism of CPAMI promoting urban renewal. Details are explained in the case study of the Banqiao Fuzhou Affordable Housing Investment Construction Plan. The aforesaid three principles have imposed an impact on the acquisition of

resources, and they were equally emphasised at the level of promoting sustainable use of resources. But what are the substantive contents of these elements? Does the government have institutionalized behaviours and a belief to perform their long-term commitment (responsibility) to the natural community? Is urban renewal mainly promoted from the perspective of economy or efficiency? The abovementioned issues are the focal points to be discussed.

4.1 Banqiao Fuzhou Affordable Housing Project

In order to conduct the "Improvement of the housing market program", which was approved by the Executive Yuan on April 22, 2010, CPAMI offered an appropriate number of affordable housing units in a timely manner. The purpose was to assist middle to low income people to meet their basic living needs and, as well as balancing the demand and supply of housing market, where housing prices had been rising in the metropolitan area. Based on the policy objectives, CPAMI selected Banqiao Fuzhou region in New Taipei City near RSEA Engineering Corporation. Most of the lands were state owned and managed, or owned by state-owned enterprises. As a background, the production industry in the region was old and deserted, calling a redevelopment project to boost the economy and the environment.

By taking advantage of the public ownership of land and the government led master planning, this case was implemented by the cooperation between the government and private sectors. The government provided the land and conducted land selling by tender, whereas the private businesses contributed investment, technology and resources for construction. The housing units were offered with lower prices compared with the surrounding market prices. People could acquire affordable residences through purchase or rental. It became a housing project with a total area of 11.03 hectares. CPAMI served as the competent authority and conducted selling by tender with a provisory clause in accordance with the regulations of open tender. The housing units were expected to provide a quality ecology and follow the green building standard. Local ecology, riverside, culture and arts were blended into the project for the purpose of creating an ecological community suitable for living and wellness for children, adults and the elderly. Based on the aforementioned ideas of urban renewal, the residential area, commercial area and land for public facility were delimited. An announcement for tender invitation was made and the bid was awarded to Radium Life Tech Co., Ltd. Later the company completed an urban design review, review of green building index, traffic impact assessment and submitted an application for a construction license (See *Figure 3* for architectural plan).

Figure 3 Schematic design of architectural plan, simulation of Banqiao-Fuzhou Affordable Housing

The development project was a joint effort among the central agency (CPAMI), local agencies (New Taipei City Government and related units) and private sectors (Radium Life Tech Co., Ltd. and bank), with a total investment of NT$42.7 billion. The project stimulated the domestic demand of the construction industry market and its related service industries, promoted market liquidity and activated financial service industries. It not only brought thousands of people to live in the area, but also improved the environment and development of the surrounding areas. In addition to the reactivation and reuse of the originally old and deserted land owned by state-owned enterprises, cultural diversity and a new outlook were brought into the area as well (CPAMI, 2012:9).

It could be found in the CPAMI promoted urban renewal project that in order to achieve the purpose of social and economic benefits, the urban renewal project was planned as a top-down process. The central urban renewal fund was used mainly on public facilities. Prior to the announcement of tender invitation, business plans were drawn up in advance and then submitted and approved by the authority. In addition, state-run renewal projects did not have the threshold limit of landowner's approval as stated in Article 22 of the Urban Renewal Act, but it involved the operation of integrating landowners. As a result, the whole process was short of public participation and community consensus. The balance between development and ecological resources was also neglected.

If the government failed to guide the community cooperation towards the direction of public interests, the purpose of public-private partnerships would have been lost. The development of urban renewal was determined only based on market mechanisms. The government failed to perform its public responsibility to promote benefits of the general public. For government-led urban renewal implementation, planning in coordination with overall urban and local development should be in place. The government should make good use of public land resources and public power to implement urban renewal rather than make passive design of investment invitations to meet market demand.

5. GOVERNMENT-LED URBAN RENEWAL PROJECT BASED ON POWER DYNAMICS OF LAND ETHICS

Urban renewal involves policy efficiency, expertise, property right integration, value allocation and fund raising. It also involves interactions among essential actors of urban renewal (resident, developer and government). This relationship affects decision-making on the use of environmental resources. According to Walck and Strong's view on land ethics, it is clear that the quality of land use is based on the relations among four components: the government, the community, the market and the property. This research uses these four elements to analyse the impact of power relationships during the process of urban renewal, from acquisition of resource to use of land for current CPAMI government-led urban renewal projects. The relationship is shown in *Figure 4* .

5.1 The Government

The connotation and mode of affecting resource acquisition and guiding land use through policy implementation is the way that government implemented urban renewal through legalization of urban renewal in order to promote the establishment of an urban renewal mechanism. However, only Articles 7, 9, 27 and 28 of the Urban Renewal Act are adopted as the major references to the legalization of an urban renewal mechanism in government-led projects. Provisions of an "Act for Promotion of Private Participation in Infrastructure Projects" and a "Government Procurement Act" have been applied to the promotion procedures. As the competent authority for urban renewal projects, CPAMI adopts the same way to implement by itself, entrusting a project to an urban renewal business institution after going through a public evaluation and selection procedure, or accepting other organizations (institutions) as implementers to undertake the business of urban renewal.

With the top-down governing mode, the government conducts the delimiting of a renewal area and urban renewal businesses in advance prior to public evaluation and selection of the implementer. For example, the government assists in developing and establishing roads and bridges in the renewal area, handling illegal occupation of buildings on land and estimating values of rights transformation. Development policy needs are also taken as the public selection criteria in order to receive a royalty income for state-owned land after the renewal project is completed. Therefore, the role of government is to improve the environment of an area, increase gains of the state treasury and stimulate the economy through public power to implement urban renewal business.

5.2 The Community

Community was is an entity sharing common values, norms and objectives. Through transmission of values, projection of norms and goal setting, a community could affect the connotation and mode of land use. Urban renewal involves interactions in the urban renewal community (resident, developer and government). It has its own role and niche. In the implementation process of CPAMI-led urban renewal business, government is the important promoter of delimiting a renewal area, studying and

proposing plans as well as providing a renewal platform. On the other hand, government is also the participator of partial capital investment by deploying central urban renewal funds to invest and develop the selected renewal area, hoping to receive benefits to balance the resources after completing the renewal project. With or without a willingness to participate in the project, landowners in the renewal area passively become a part of the business process. The winning public tender company in the future would play the role of executing renewal integration, and would establish entrusted implementation and perform renewal business with the government. If that is the case, then government is also the coordination and communication platform for balancing public interests and private rights and interests.

5.3 The Market

The mechanisms of market supply and demand affect connotations and modes of land as well as the use and development of its resources due to peoples' own purposes. In the government-led promotion process, starting from delimiting renewal areas to public selection of contractor for the renewal construction, the government, the tender winning company and land related obligees respectively provide their own resources in order to achieve the objective of renewal. The resource delivery process forms the supply and demand of the market and a transaction will be made. This transaction process includes a series of communication and coordination until achieving the final goal. However, a transaction cost will be generated in the transaction process of urban renewal. As a result, market failure is caused by the uncertainty of a renewal business market, the complexity of renewal area environments and a number of participants, obligees' lack of information and the government's ambition of promoting the urban renewal project.

On the other hand, the government entrusts urban renewal business to the developer. It is important to know whether the developer's product planning complies with the market demand, and at the same time meets the policy related to government-led renewal projects. Therefore, the cognitive difference between government and developer on the characteristics of the renewal area market will be quite important in determining the renewal development standing through coordination mechanism. However, under the market mechanism of public-private partnership of urban renewal business, for community residents in those old communities that no longer have market advantages or competitiveness, they are often guided and persuaded to follow the market trend of economic efficiency in order to bring benefits to the whole nation's major constructions.

5.4 The Property

Property management is to use land, labour, capital and informative resources as the determinant of affecting land use and land quality. The implementation methods of urban renewal include joint construction agreement, rights transformation, sectional expropriation or urban land re-plotting. CPAMI-led urban renewal projects are mostly using the rights transformation method as the main development model. In this model, landowners of the renewal area provide land; building contractors provide building; other obligees provide rights. In the future, the implementer, who will be selected out of a public evaluation and selection procedure, will provide funds and the government provides multiple resources, including execution of the law, a deliberation and negotiation platform, development

of urban renewal business integration and plan prior to inviting investment, and investment of opening up related public works in the renewal area. If there is still state-owned land under the management of CPAMI in the renewal area, CPAMI will be the landowner in order to provide land resources to jointly contribute to the promotion of planned redevelopment and reuse of urban land.

In the process of restructuring property rights, through the government-led urban renewal system, government plays the leading role leadership and watches over the promotion of an urban renewal business plan and rights transformation plan, such as land acquisition, house demolition compensation and allocation, household resettlement, project planning and design, and management and maintenance, which are closely related to the residents' property interests. In addition, the existed state-run urban renewal cases do not explicitly agree on a threshold limit. Once the government defines an area to comply with construction, the area would be designated as a renewal area based on the government's own decision. The land-related obliged people will be forced to participate in the renewal plan. The only chance that these land obligees have to express their opinions is at the public hearing or during the public exhibition period. Treating land resources from the economic perspective and having an unsound system of property rights often leads to the difficult implementation of urban renewal plans withstanding the plight of continued protests.

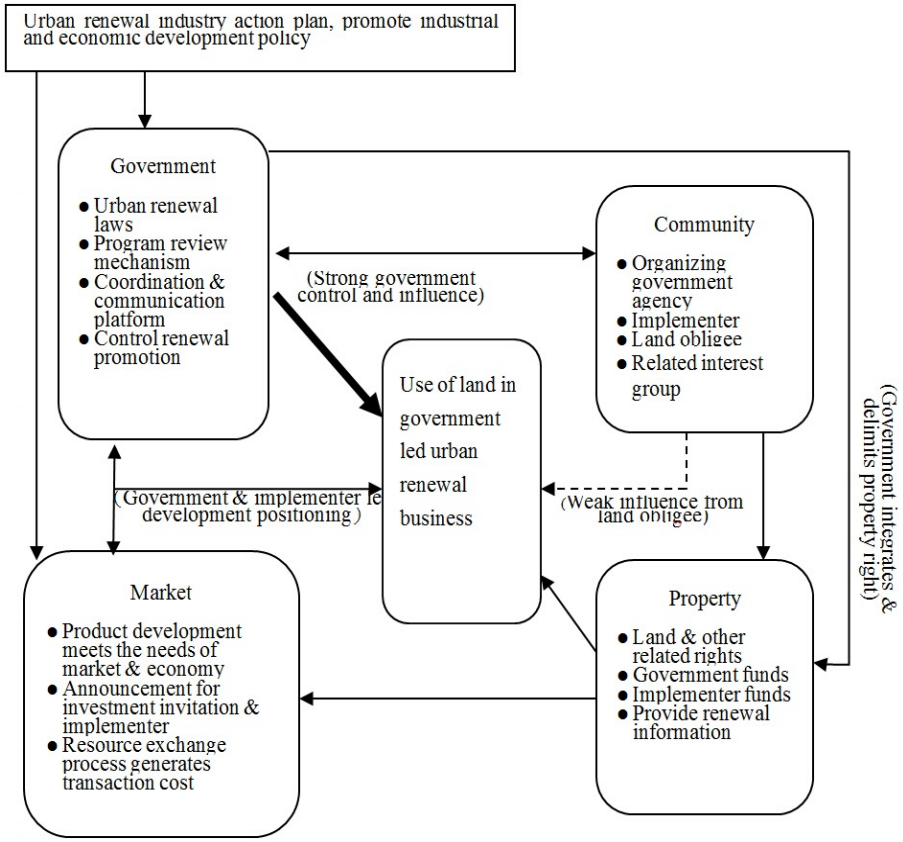

Figure 4. Power relationship of government-led urban renewal

6. CONCLUSION AND SUGGESTIONS

In recent years, CPAMI has made active use of the public land with to stimulate the economy, supplement the central urban renewal funds and coordinate with other policies. Through the cooperation between the government and non-government sectors, open investment solicitation and public selection and evaluation of urban renewal developers are conducted to develop urban renewal business in order to improve the quality of the urban living environment. However, urban renewal policies mostly focus on the "urban redevelopment" which follows the principle of "economy first." Each single renewal project puts emphasis on improvement and reconstruction of the physical environment. It does not take social and environmental resources into consideration on the basis of land ethics. In summary, based on the perspective of land ethics, this research proposes the following suggestions as a reference for a government-led urban renewal promotion strategy.

6.1 Strengthen Public Participation and Support Activation Plan

In the 1960s, the spirit of public participation was introduced to the U.S. and European urban renewal plans, and the concept of ecology was incorporated into the plan as well, including environmental cost and the idea of sustainable development. Since then, public participation has become a significant strategy for sustainable development. Unlike the general urban renewal projects, Taiwan's government-led renewal projects do allow public participation, but with certain restrictions. These renewal projects also involve integrated cooperation with private landowners. In addition to conducting routine surveys and hosting public meetings, the government should serve as a communication bridge for the project. In the initial phase, a regional work station should be established for a planning team to interact with local residents in order to understand the resources and characteristics of the area. The work station can be regarded as a place for message delivery, information exchange, communication and listening to opinions. Information regarding urban regeneration and related knowledge should be released to the general public as much as possible so that public participation would not become a formality. Residents should also be assisted in proposing a cognitive activation plan, and opinions from different groups should be reviewed and integrated by experts in order to be incorporated into tender documents so that public bidding companies could develop their plan and design based on the needs of local residents. In the end, government, developer and residents should have jointly participated in the project planning and reached a consensus to proceed with the renewal project.

6.2 Expand Urban Renewal into Urban Regeneration

The main difference between urban regeneration and the traditional urban renewal or urban redevelopment is that urban regeneration emphasizes a stimulation of economic and industrial functions, and its goal is to resolve issues of economy, industry, environment, cultural and urban conservation of the whole city. Apart from stressing the function of revitalization of the regional economy, urban regeneration also opened up

"local cultural industry" through unique construction (Yu and Kung, 2009). The emphasis of urban renewal and urban redevelopment is the improvement and reconstruction of the physical environment, such as reconstruction of public facilities and buildings (Ho, 2002).

Urban regeneration is not confined to building reconstruction, but includes having experts and the public's participation in the cooperation between government and the private community to integrate the activation of the society, economy, environment and employment. The role and attitude of the government should uphold the principles of people first, area-based and public engagement. The government should initiate the bottom-up approach in planning. With "user" as the main body and professional assistance on the side, the government should acknowledge the importance of preserving the social culture of the renewal area, give thought to the current condition of environmental resources, as well as to the expectations and needs of related obligees and residents in order to implement area activation and improve public space so as to make the area full of vitality. This would help cultivate public awareness of the community and make the area a driving force of urban sustainable development.

6.3 Public Interests of Urban Regeneration

In addition to giving consideration to both market and economic benefits, land ethics based public interest should not distort land resources and should allow for social justice and ecological environment conservation. The constraints of land ethics are able to maintain long-term and harmonious urban development. Therefore, it is suggested that while implementing urban renewal business, comprehensive assessments should be carried out on the public welfare of renewal, including factors of society, economy, culture, ecology and sustainable development. A more careful design and procedural norm should be developed to adjust and review urban renewal deliberation mechanisms, enhance channels for the public to express their views, and consider the benefits of the internal and external environments of the renewal base and the whole city, in order to help improve overall public interest. In addition, the climate has changed in recent years, and Taiwan is located in the Circum-Pacific Seismic Zone. While facing the coming of disaster, "urban disaster prevention" is the primary public interest that renewal plans should pursue. Disaster prevention and increased urban disaster-resistant abilities should be the primary concerns of government-led urban renewal projects and should be the model case for the promotion of urban regeneration.

6.4 Diverse Methods of Urban Regeneration

Property rights transformation, setting up superficies rights and selling by tender with provisory clauses are the promotional methods used in the current government-led renewal projects. These methods are of the dismantling type of renewal and are not the only ways for regeneration. While facing characteristics of diverse urban development, the renewal method of retaining original urban fabrics with low-level development through renovation or maintenance is an alternative for urban regeneration. This method not only acts to repair decayed and rotten parts or maintain current conditions, but also should include preservation of building structures, renovation of the interior part, changes in other usage, changes in space and partitions in order to preserve buildings as long as possible.

Urban regeneration is not just a face-lift of old houses and a beautification of city appearance. Local employment opportunities, the educational environment and disadvantaged groups should also be taken into account. Even future industrial transformation is one type of ongoing and continuous urban development process. Government-led urban renewal projects are not just "national affairs." Community residents also have major roles of participating in these life-changing environments. The way of promotion must have a forward-looking and effective strategy with a high degree of integration mechanisms and an elastic interface in order to have sustainable development and long-term viability. It is hoped that CPAMI would serve as the promoter of urban renewal and use the top-down approach to guide government-led urban renewal projects so that local residents could propose an activation plan using the bottom-up approach to push forward a continuous development process of area regeneration by way of "place making".

REFERENCES

Agnew, J. A. (1987). *Place and Politics: The Geographical Mediation of State and Society*, Allen & Unwin, Boston.

CPAMI. (2006). *Accelerate urban renewal program*, CPAMI, Taipei.

CPAMI. (2008). 2008*Urban renewal operations manual*, CPAMI, Taipei.

CPAMI. (2010a). *Encourage foreign investment in Taiwan urban renewal - Press Releases*, Invest in Taiwan Seminar, Singapore.

CPAMI. (2010b). *Urban renewal Industry Action Plan*, CPAMI, Taipei.

CPAMI. (2012a). *Urban Renewal Act draft amendment*, CPAMI, Taipei.

CPAMI. (2012b). *Plan simulation of Banqiao-Fuzhou Affordable Housing*, CPAMI, Taipei.

Ho, T.P. (2002). "Taiwan needs a comprehensive set of urban regeneration policy" , *National Policy Forum*, 5. http://old.npf.org.tw/PUBLICATION/SD/091/SD-C-091-044.htm.

Hsu, S.J. (2012). "The implementation of urban renewal, with the relative autonomy of the Taipei City Government", Legislative Yuan public hearing, Taipei.

Leopold, A. (1949a). *A Sand County Almanc*, Penguin/Highbridge , Taipei.

Leopold, A. (1949b). *A Sand County Almanac and Sketches Here and There.* Oxford University Press, New York.

Liao, Y.Y. (2008). *A Co-Sun Model of Urban Renewal Entities*. Chinese Culture University, Taipei.

Lin, C.Y. (2007). "Industrial Area Regeneration and Regional Development" *Industrial Zone Development Policy and Planning Workshop*, National Taiwan University , Taipei.

Madanipour, A., Hull, A., et al. (2001). *The Governance of Place: Space and Planning Processes*, Ashgate, Burlington.

Urban Renewal Authority. (2012). *The Central Oasis*, http://www.centraloasis.org.hk/chi/home.aspx.

Urban Renewal Authority. (2010). *The Central Oasis Plan Survey Report*, URA, Hong Kong

Walck. C, and Strong, K.C. (2001). "Using Aldo Leopold's land ethic to read environmental history: The case of the Keweenaw forest." *Organization & Environment, Thousand Oaks*, Vol.14(3):261-289.

Wang, Z.K. (2011). "Urban Renewal = "Services" or "domestic industry"- On the "Decade platform" proposal". http://www.wisdomshare.com.tw/msg_info.php?id=121.

Yen, A.C. (2009). *Aboriginal communities operate sustainable agriculture power relations - in Hsinchu County Atayal tribe Case*, National Chengchi University, Taipei.

Yu, C.L. and Kung, S.F. (2009). "Explore the cultural industry in Taiwan Policy Changes(1994-2007) " *The 13th Territorial Planning Conference*, National Cheng Kung University, Tainan.

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User Behaviour Analysis of the Public Bike System in Taipei

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Abstract: Public Bike System, PBS, usually named Bike-sharing System in the west, is a category of green transport to provide a low-carbon solution of the "first/last mile" problem in a city. Indeed, there were only five bike-sharing programs in 2000. Now over 400 cities in 30 different countries have PBS programs, with more than 350,000 bikes worldwide. However, the studies for bike-sharing are still limited, and it is hard to find some related research of bike-sharing programs in the East-Asia region. The factors of a successful bike-sharing system vary between different cultures, geographic limits, and models of provision. The experience in the west is not adaptable in east. Therefore, more research is necessary for a better understanding of bike-sharing systems especially in the East-Asia region. To comprehend the elements of a successful bike-sharing system, this study examined the factors that influence the bike-use intentions of bike-sharing programs, and analysed the user behaviour based on a survey of 557 respondents in Taipei, Taiwan. Results show the system cognition, environment cognition, personal perception and personal preference are four vital aspects influencing the user behaviour, and the extent is varied by different travel purposes. The location of docking stations is the most critical factor influencing user behaviour with regard to each aspect.

1. INTRODUCTION

1.1 Preface

Since the 21st century, energy shortages, the greenhouse effect and global warming have always been major topics of discussion, and sustainable development has thus become an important goal of urban development policies around the world. Research shows that carbon dioxide, a greenhouse gas, is mainly caused by transportation emissions (i.e. motor vehicles). Therefore, the development of green transportation has become a primary goal of transport agencies in major cities to mitigate the environmental impact of transportation emissions. Hence, a Public Bike System (PBS) or Bike-Sharing System (BSS) has been introduced in Europe.

PBS is a bike system in which individuals can lend and return bicycles freely at any stations located in the city. It has undergone four development stages since first launching in 1965 (Shaheen and Guzman, 2011). In fact, there were only five bicycle systems as of October 2000. However, there

were as many as 350,000 bike-sharing systems in 400 cities in more than 30 countries around the world by October 2012 (Larsen, 2013; Midgley, 2011). In Asia, Taipei also invented the first Public Bike System "YouBike" in Taiwan. It was officially launched in 2009.

1.2 Motivation and Objective

The public bike system is a new urban traffic system. There is limited academic research on the subject in Asia compared to Europe and America (Shaheen, Guzman and Zhang, 2010). There are actually many factors affecting the use of public bikes that need to be discussed. Moreover, the development experience in one city cannot be fully applied to other regions since there are cultural differences between Europe, America and Asia. Therefore, it is necessary to conduct related studies to improve the operating efficiency of public bicycles in order to help achieve sustainable development, reduce CO_2 emissions and save energy.

Based on the discussion and classification of foreign PBS cases (Bike-Share Studio, 2010; Curran, 2008; DeMaio and Gifford, 2004; Dill and Carr, 2003; JZTI and Bonnette Consulting, 2010; New York City Department of City Planning, 2009; Transport Canada, 2009), this research has summarized the factors that affect the use of public bikes and analysed PBS user behaviour in Taipei through a questionnaire survey. The research objectives are as follows:

1. To summarize the factors that affect the sustainable operation of PBS based on the development of public bicycle systems in foreign countries.
2. To analyse PBS user behaviour in Taipei through a questionnaire survey conducted in Taipei's metropolitan area.

2. LITERATURE REVIEW

2.1 Public Bike System

2.1.1 Definition

Bicycle sharing system or bike sharing, is a bike system in which individuals can lend and return bikes freely at any station in the city. Its concept is to provide free or affordable access to bicycles for short-distance trips in an urban area as an alternative to private vehicles, thereby reducing traffic congestion, noise and air pollution. It can connect users to public transit networks effectively, so it has also been cited as a way to solve the "last mile" problem (DeMaio, 2009).

In Europe and America, the system is called bicycle sharing but in Asian countries, Public Bike System is the term more commonly used. When comparing the two terms, bicycle sharing emphasizes the concept of sharing. On one hand, it suggests that sharing bicycles should solve the "last mile" problem as well as reduce air, noise and environmental pollution through green transportation. On the other hand, PBS emphasizes more on public transit network than sharing. It is a system in which individuals can lend and return bikes freely at any station in the city and serves as a means of transportation.

For short-term trips, public bikes are fast and flexible, so they are considered as a highly efficient alternative, especially compared to private

vehicles and public transportation. For long-term trips, public bikes are considered as a part of intermodality by connecting to other forms of transportation or walking trips. Indeed, most systems integrate a member's card to regional transportation user cards for an easier way to access public bikes (JZTI and Bonnette Consulting, 2010; Transport Canada, 2009).

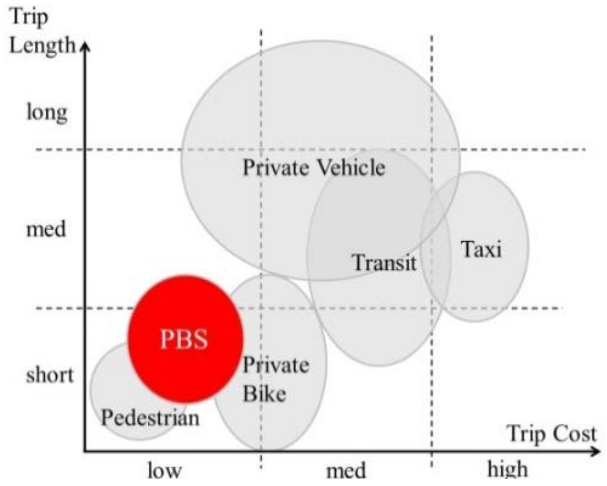

Figure 1. Position of PBS in Urban Transportation System

Data source: (Curran, 2008)

2.1.2 Components of PBS

A complete PBS is composed of different essential elements, the design and scale of which are adjusted according to the conditions in each country. These elements include specially designed bicycles, docking stations, system access and user registration systems, status information systems, maintenance programs, and bicycle redistribution mechanisms (Curran, 2008; Midgley, 2011; Transport Canada, 2009).

The elements above, including bicycles, docking stations, system access and user registration, and service systems, are developed by cities or companies independently (Midgley, 2011). Bike maintenance and management are the biggest challenges in the whole maintenance program due to excessive and frequent use of public bicycles (Curran, 2008). The rent ratio is also an important factor affecting the use of public bikes. If the rate is too high, it discourages the use of public bikes; if it is too low, it affects the fiscal balance of system operation (Midgley, 2011). Therefore, the rent ratio must be set based on many factors. It is only through adjustment can we set an optimum price. The position of the docking stations is also very important. The distance between docking stations depends on the size of the PBS and the size of the city region. For example, the distance between each docking station in both Paris and Barcelona is about 300 m (Shaheen and Guzman, 2011). In addition, given the asymmetric travel times, the PBS system must be able to prevent shortage of bikes to borrow or docking stations for returning bicycles through a dispatching system. Therefore, it can be concluded that the bicycle redistribution mechanism is the most important element in the whole system (JZTI and Bonnette Consulting, 2010).

2.2 Success factors of PBS

Bicycling is an environmentally friendly mode of transportation and important means of green transportation. There have been quite a number of studies here and abroad on the environmental benefits of bicycles. However, there is a difference between the characteristics of public bikes and ordinary bikes. Even though they share similar features, there are still some points to consider and adjust when it comes to operating PBS successfully.

This research lists four important influencing factors based on foreign and domestic literature. These are system characteristics (Youbike, 2012; Bike-Share Studio, 2010; CityRyde, 2009; Curran, 2008; Dill and Carr, 2003; JZTI and Bonnette Consulting, 2010; Midgley, 2011; Shaheen, Guzman and Zhang, 2010; University of Washington, 2009), environmental characteristics (Benson, 2009; Bike-Share Studio, 2010; Dill and Carr, 2003; Jacobsen, 2003; JZTI and Bonnette Consulting, 2010; Land Transport Safety Authority NZ, 2004; Midgley, 2011; Saneinejad, Roorda and Kennedy, 2012), existing restrictions of cities (Bike-Share Studio, 2010; DeMaio and Gifford, 2004; JZTI and Bonnette Consulting, 2010; Midgley, 2011; Saneinejad et al., 2012; Shaheen et al., 2010; Transport Canada, 2009) and PBS users' preference (JZTI and Bonnett0e Consulting, 2010) . The dimension and the influencing factors are as follows in Table 1.

Table 1. Success Factors of PBS

Dimension	Influencing Factors
System Characteristics	1. Bicycle design and quality (comfort, commonality, bicycle lock, night use) 2. Number of docking stations and bikes 3. Convenience of leasing and returning procedures (complexity, time spent) 4. Accessibility of docking stations (operating time, location) 5. Charge rate 6. Publicity and emergency preparedness and response 7. Maintenance program and bike redistribution
Environmental Characteristics	1. Bike lane quality (lane surface, roadside obstacles, gradient) 2. Related bike infrastructures 3. Slow lane design for bikes (facilities that separate them from general traffic flow) 4. Consistency and identification of bike lanes and related signs 5. Covered area for bicycles 6. Night lighting facility 7. Completeness of road network for bikes (shortest path, multiple paths, continuous path) 8. System status information systems (location, number, road condition and docking stations) 9. Quality of public transit service (transfer convenience, rate preference) 10. Different trip requirements 11. Water station, toilet and emergency equipment
Existing Urban Restrictions	1. Geographical condition 2. Urban climate 3. Social climate and culture (transportation practices, bike theft rate, safety awareness) 4. Policies (support of the whole system)
PBS Users'	1. Gender 2. Social and economic status (age, educational status, occupation, etc.)

Dimension	Influencing Factors
Preference	3. Original trip features and distribution in the city 4. Others (biking ability, credit card ownership, time limit…, etc.)

3. RESEARCH DESIGN

3.1 Questionnaire Design

This research analyses the behavioural characteristics of users of YouBike, Taipei's Bike Sharing System, through questionnaire survey. The questionnaire covers four parts and is designed based on the Success Factors of PBS presented in Table 1.

1. Use Experience of YouBike

This part covers questions that evaluate respondents' understanding and use of YouBike in Taipei, including use time, use purpose, use frequency, use hours and use area.

2. PBS System cognition, Environmental Cognition and Users Preference

This part explores people's cognition of the YouBike system and biking environment in Taipei as well as preference and demand for YouBike. The questionnaire uses the Likert Scale. The system cognition section covers the characteristics of a system's sustainable operation, including leasing and returning procedure efficiency, difficulty, rate, preference, and bicycle design of YouBike.

Cognition of Taipei's biking environment corresponds to environmental characteristics involved in the sustainable operation of PBS, including awareness of the environmental benefits of bicycles and bike lanes in Taipei, as well as the effects of supporting facilities of YouBike on use intention.

The questionnaire explores user preference and demand for YouBike. It evaluates the purpose and intention of respondents in using YouBike at different times.

3. User Perception

This part evaluates the experience and feelings of people while using the system. To simplify the questionnaire, a check list is provided on items that need improvement, such as bike borrowing method, bike returning method, the number and location of docking stations, status information systems, bicycle design, comfort, bicycle lock design, and night lighting and state of disrepair.

4. Personal data

This part covers some basic questions such as gender, age, occupation, educational status and income. Factors that may affect users' behaviour and intention are also included; these are respondents' height and weight, physical fitness, monthly commuting expense, monthly YouBike expense, possession of driving license, ownership and number of vehicles, and biking and road practices.

3.2 Sample Selection

Convenience sampling was used for this from different docking stations. In addition, an online questionnaire was distributed from Jan. 15, 2013 to

Feb. 15, 2013 to include additional users at different time intervals and non-PBS users.

3.2.1 Time Scale

The questionnaires were distributed in Jan., 2013. Since PBS user groups and use features are different during holidays and weekdays, separate questionnaires were given during both periods. However, due to the time, funding and manpower limitations, all questionnaires were distributed between 12 a.m. and 6 p.m., excluding morning and evening use.

3.2.2 Space Scale

The locations where the questionnaires were distributed are the busiest docking stations. These include MRT Taipei City Hall Station, Sun Yat-sen Memorial Hall Station, Gongguan Station, Shi-Da University Library and MRT Technology Building Station.

4. RESULTS AND ANALYSIS

4.1 Basic Information Analysis

This research collected a total of 557 valid questionnaires, among which 325 were from the online survey, which covered 158 people who had used YouBike and 167 who hadn't. The remaining 232 questionnaires were from the convenience sampling survey conducted at random; these included 211 people who had used YouBike and 21 people who hadn't. The reliability analysis was conducted using 557 valid questionnaires, and the Cronbachs α is 0.85, indicating the questionnaire's high reliability.

As shown in Figure 2, the samples in this research are people between 20 and 40 years old, almost evenly divided according to gender. In terms of occupation, students constitute the majority while service comes in second. In terms of educational background, which is influenced by the high academic qualifications in Taiwan, more than 90% of the samples have a bachelor's degree or above.

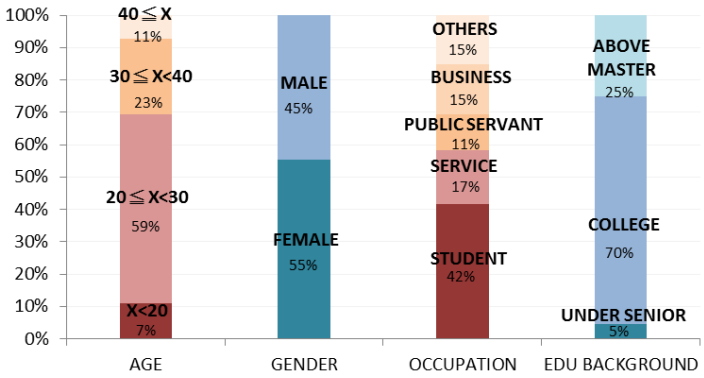

Figure 2. Basic Data Analysis of Questionnaire

Figure 3 shows the most commonly used vehicles in the samples. Almost 70% of people walk or use public transport and private bikes, and only 30% use cars or motorbikes, a non-green means of transportation. Figure 4

illustrates the use of YouBike, 98% of the total sampled know YouBike, 86% know how to use YouBike, but only 66% have actually used it.

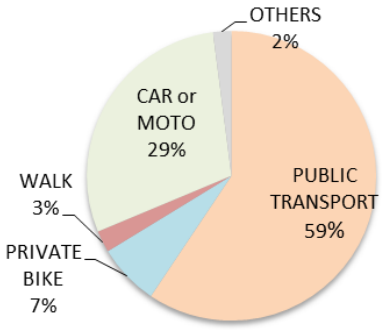

Figure 3. Percentage of Traffic Practices

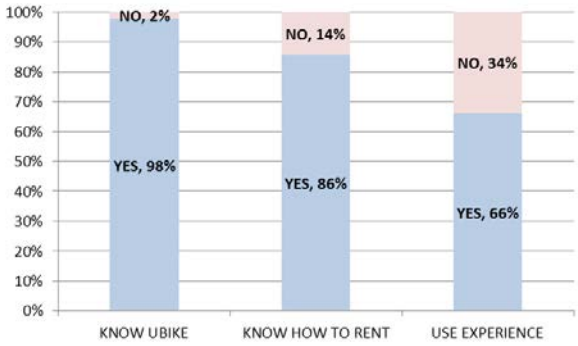

Figure 4. Use of YouBike

As shown in Figure 5, most people use bikes for short trips (i.e. within 30 minutes); 23% of people's riding time is between 30 and 60 minutes, only 6% of people's riding time exceeds 60 minutes. Figure 6 shows the use frequency, 21% ride bikes less than once a month, 42% ride bikes less than 5 times a month. The results above show that at present, most PBS users ride bikes occasionally.

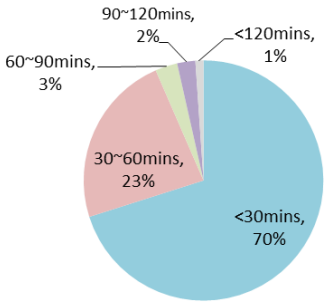

Figure 5. Average Use Time

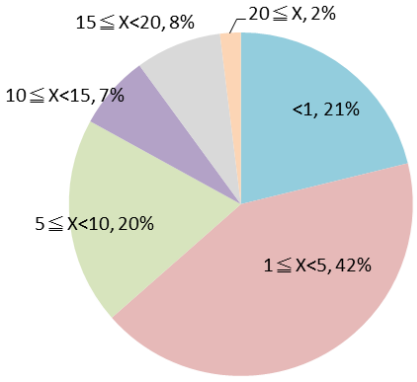

Figure 6. Use Frequency

4.2 User Behaviour Effect Factor of PBS

Based on the questionnaire, people use YouBike mainly to transit to public transport (31%) and for commuting (30%), a few people use it for recreation (28%), as shown in Figure 7. However, the result of the questionnaire survey regarding the hypothetical intention to use, as shown in Figure 8, shows that about 90% of people are willing to use YouBike as a means of recreation, while more than 80% are willing to use YouBike as a mode of transportation. This shows that people who are willing to use PBS for leisure travel are a big potential user group, which hasn't been developed in actuality.

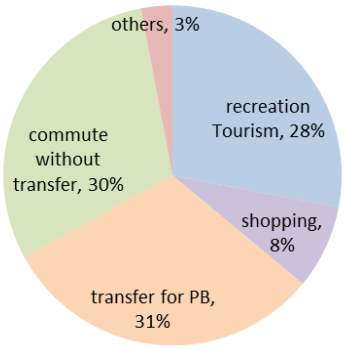

Figure 7. Travel Purpose of YouBike

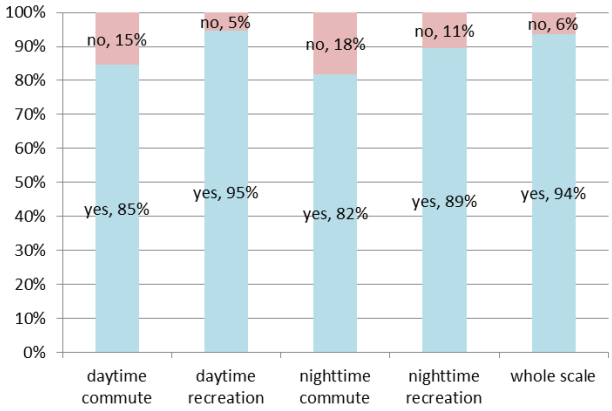

Figure 8. Use Intention in Different Purposes and Time

Figure 9 shows that among the modes of transportation which were replaced by YouBike, 93% was a replacement of public transport, walking and private bikes, which are all green transportation. and only 7% are cars or motorbikes which are non-green transportation. This means that most YouBike users are highly dependent on public transport.

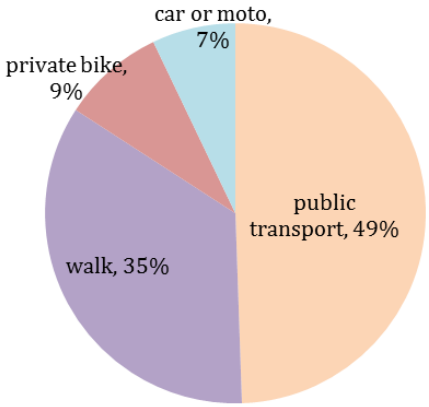

Figure 9. Means of Transportation Replaced by YouBike

In Figure 10, the most important factors that affect leisure travel are docking locations, rental ratio and safety. The factors that affect commuters are docking locations, rental ratio and rent efficiency. However, in Figure 11, based on the questionnaire, people considered the items needing to be improved are the following: location, number of docking stations, and shortage of bikes to borrow and lack of empty docks for returning bikes. At present, people believed that for YouBike, the most important factors are also those that need improvement, whether for leisure or transport.

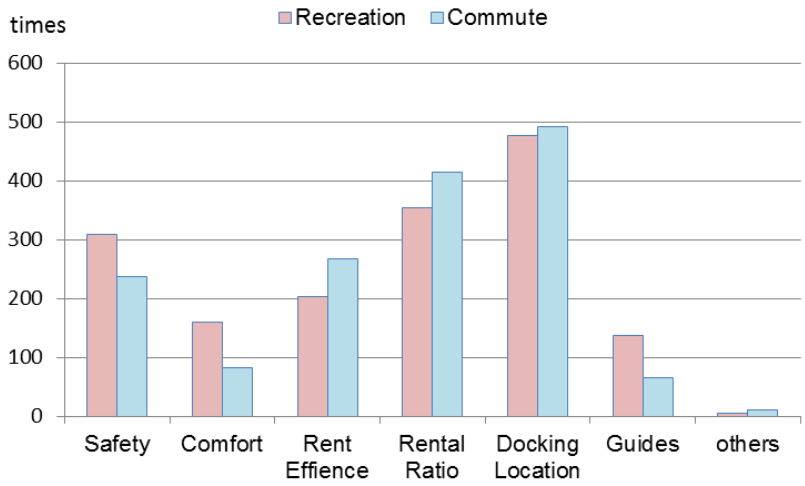

Figure 10. Factors that Affect Intention to Use for Different Purposes

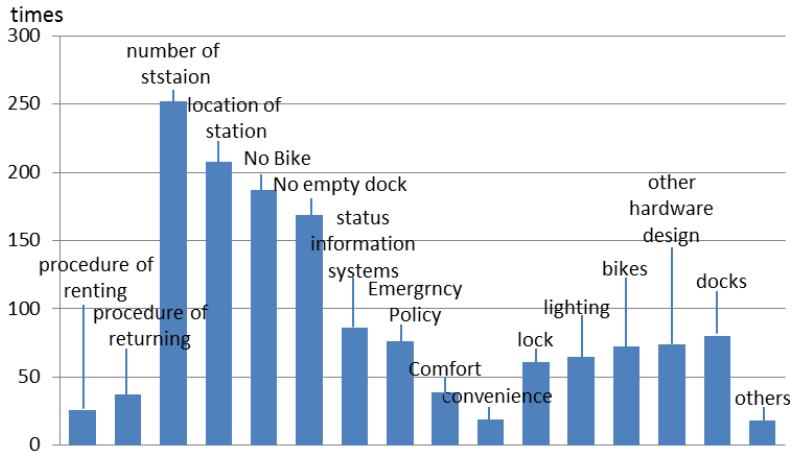

Figure 11. Factors that YouBike Needs to Improve on

To know more about factors that affect the use intention of YouBike, the research conducted a cross-over analysis of system cognition, environmental cognition and use intention. In the cross-tabulations as shown in Table 2 and Table 3, each number represents different questions in the questionnaire, which are related to different kinds of cognition. For example, in Table 2, number 1 to number 4 are four questions about the system development cognition, and number 12 to number 14 are three questions about the cognition of the YouBike appearance. Hence, we can figure if there are any relations between different sorts of cognition and use intention. The result shows that the intention of using YouBike for commuting is significantly related to both system cognition and environmental cognition. In comparison, intentions for leisure purposes are related to neither system cognition nor environmental cognition. In addition, the correlation between system cognition and the use intention is higher than environmental cognition and use intention. That is to say, use intention for commuting is correlated to both system cognition and environmental cognition, but the use intention for leisure is not. The reason for this result could be inferred. In this study, the questionnaire is designed from commuter type-related literatures, and the original purpose of a public bike system is for commuting use. Obviously, some other variables which affect leisure use intention are ignored in this study.

Table 2. Chi-Square Test Table on the Association of System Cognition and YouBike Use Intention

Preference and demand for YouBike\system cognition of YouBike	System Development Cognition				System Friendliness Cognition						Feeling Toward Appearance			
Subjects/no.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Use Intention of YouBike for commuting during the day	** .001	** .006	*** .000	*** .000		** .003	*** .000	* .014			** .009	** .002	* .024	** .005
Use Intention of YouBike for leisure during the day												** .001		
Use Intention of YouBike for commuting in the evening	** .001	*** .000	*** .000	** .002	* 015	** .001	*** .000	** .005	** .002		** .001	*** .000	** .001	* .010
Use Intention of YouBike for leisure in the evening				* .044	** .007							** .003		
Use Intention of YouBike which replace original modes of transportation within acceptable limits of time and distance		*** .000	*** .000	*** .000	* .026	*** .000	*** .000	* .011	** .004		** .005	*** .000	** .002	** .002

Table 3. Chi-Square Test Table on the Association of Environmental Cognition and YouBike Use Intention

Preference and demand for YouBike\system cognition of YouBike	Climate		Biking Environment					Biking Convenience		Overall Cognition of Environment		
Subjects/no.	1	2	3	4	5	6	7	8	9	10	11	12
Use Intention of YouBike for commuting during the day	** .004		** .001		* .027					** .001	** .001	
Use Intention of YouBike for leisure during the day							** .007					
Use Intention of YouBike for commuting in the evening	*** .000	* .015	*** .000	** .002	** .006	* .015	* .012	* .043	** .005	*** .000	** .007	* .017
Use Intention of YouBike for leisure in the evening					** .003							
Use Intention of YouBike which	***	**	*		**	**	*	*	**		**	**

replace original modes of transportation within acceptable limits of time and distance	.000	.001	.020		.006	.004	.048	.040	.003		.005	.002

4.3 Principal Component Analysis

To furthermore discuss the relation between cognition and use intentions, this research conducts a principal component analysis to simplify the questions in the questionnaire and determine the important factors that affect the intention to use. The results are shown below.

4.3.1 Principal Component Analysis of System Cognition

As Table 4 shows, in the system cognition section, three principal components - system cognition, rental ratio and rent efficiency - are considered as important factors that affect the intention to use. The Kaiser-Meyer-Olkin measure (KMO) of this part is 0.808, stating the result is good. The Bartlett Test of Sphericity is 0.000, attaining a three-star significance (p<0.001). Therefore, we can say that it is suitable to conduct a principal component analysis on this particular section.

Table 4. The Result of Principal Component Analysis of System Cognition

Principal Components Subjects	System Cognition	Rental Ratio	Rent Efficiency	Cronbachs α
It is convenient to ride public bikes in Taipei.	.629	.024	.211	
Developing PBS in Taipei is good for urban development.	.703	-.010	.197	
PBS is suitable to develop in Taipei.	.828	-.043	-.024	.776
PBS can reduce traffic congestion caused by bikes.	.694	-.002	-.117	
It is trendy to ride public bikes in Taipei.	.659	.060	-.034	
The leasing and returning procedure of PBS is easy to understand.	.019	-.006	.913	.863
The leasing and returning procedure of PBS is convenient and fast.	.006	.021	.920	
Free use for the first 30 minutes can improve the intention to use.	.131	.667	.266	.592
People will keep the bike for less than 30 minutes to avoid payment.	-.052	.947	-.127	
Kaiser-Meyer-Olkin: 0.808				
Significance evaluated by Bartlett's test of sphericity: 0.000***				

4.3.2 Principal Component Analysis of Environmental Cognition

In the environmental cognition section, environmental cognition and facility improvement are considered important factors that affect the intention to use. The KMO of this part is 0.808, stating a good result. The Bartlett Test of Sphericity result is 0.000, which attains a three-star significance. Overall, we can say that it is suitable to conduct a principal component analysis on this section.

Table 5. The Result of Principal Component Analysis of Environmental Cognition

Principal Components Subjects	Environmental Cognition	Facility Improvement	Cronbach's α
Taipei's climate is suitable for PBS development.	.535	.163	.837

It is safe to ride a bike in Taipei.	.860	-.034	
It is smooth and hassle-free to ride a bike in Taipei.	.896	-.082	
There are adequate signals, signs and marks for bikes in Taipei.	.767	-.093	
On the whole, Taipei is a bike-friendly city.	.796	.090	
Real-time information app for smart phones can improve the intention to use.	.105	.632	
Increasing green lanes on roads can improve people's intention to use PBS in Taipei.	.020	.836	.644
On the whole, improving infrastructure of bikes can improve people's intention to use PBS in Taipei.	-.107	.802	

Kaiser-Meyer-Olkin: 0.808

Significance evaluated by of Bartlett's test of sphericity: 0.000***

5. CONCLUSION AND RECOMMENDATION

5.1 Conclusion

This research analyses PBS user behaviour characteristics in Taipei's metropolitan area. The conclusions are as follows.

1. Most users use YouBike on occasion.

Based on the characteristics of YouBike users, it can be observed that most people use YouBike on occasion regardless of time or frequency. Users of YouBike have grown rapidly since YouBike expanded its service area in Aug. 2012. Their impression and experience during this period affected their decision to use YouBike in the future. In terms of user impression, it can be gathered from the survey result that the promotion of YouBike has had an effect on Taipei's metropolitan area and most people have an idea of the system.

2. People who are willing to use PBS for leisure travel are a big potential user group.

The questionnaire results show that factors that affect people's intention to use PBS for leisure and commuting purposes are different. In present, people use YouBike mostly for commuting. However, Figure 8 shows the proportion of people's intentions to use PBS for leisure is larger than for commuting. This indicates that a group of people who are willing to use PBS for leisure haven't started using YouBike yet. This is also a factor that needs to be emphasized for future operating strategies.

3. System cognition and environmental cognition are important influencing factors that affect people's intentions to use YouBike for commuting.

Based on the cross-over analysis, system cognition and environmental cognition are strongly associated with the use intention or commuting. Consequently, they are important factors that affect the intention to use.

Based on the principal component analyses, system cognition, rental ratio and rent efficiency are important factors that affect people's system cognition. Environmental cognition and facility improvement are important factors that affect people's environmental cognition. Figure 10 shows that docking locations, rental ratio, rent efficiency and safety which coincide with rate, efficiency and facility improvement, are factors that users consider

the most important based on the result of principal component analysis. This shows that for PBS development in Taipei, people's cognition of system and environment, rental ratio and rent efficiency as well as environmental safety, affect people's intentions to use PBS. System operators should pay attention to these factors to avoid people's negative impressions of PBS operation.

5.2 Recommendation

Bikes are an important means of green transportation. There have been many related studies on bike-friendly environments. Since PBS started, past research findings on bike-friendly environments have been applied to PBS planning. However, the essence and characteristics of PBS are different from those of ordinary bikes and their user characteristics are likewise different. The research results show that PBS users pay more attention to rate and efficiency rather than the environment.

PBS is a new means of transportation. Related studies have been increasing gradually in Europe and America. However, in Asia, many countries lack experience in PBS operation. Therefore, it is suggested that follow-up studies be conducted in the following areas which can serve as an important reference for the sustainable operation of PBS.

1. Comparison between PBS development experience of Asian countries, and different cities in Europe and America
2. Study of PBS evaluation mechanism from the point of supplier (government or operator)
3. Establishing evaluation indexes for docking stations of PBS
4. Establishing a redistribution system for PBS

5.3 Research Limitation

Since this research has time and manpower limitations, using an equal number of people of different ages and occupations to study their characteristics was not feasible. Interviewing PBS users at different time periods to distinguish user characteristics was not possible either. It suggests that follow-up studies should be conducted to complete the research on user's characteristics.

REFERENCES

Benson, T. (2009). "Public Use Bike Share Feasibility Study: Volume Two: Demand Analysis".

Bike-Share Studio (2010). *Seattle Bicycle Share Feasibility Study*, Department of Urban Design and Planning, College of Built Environment, University of Washington.

CityRyde (2009), *CityRyde Bike-sharing Informational Webinar*, Philadelphia.

Curran, A. (2008). *Translink public bike system feasibility study*, Quay Communications Inc., Vancouver.

DeMaio, P. (2009). "Bike-sharing: History, Impacts, Models of Provision, and Future", *Journal of Public Transportation*, 12(4), 41-56.

DeMaio, P. and Gifford, J. (2004). "Will Smart Bikes Succeed as Public Transportation in the United States?" *Journal of Public Transportation*, 7(2), 1-15.

Dill H. and Carr T. (2003). "Bicycle Commuting and Facilities in Major U.S. Cities: If You Build Them, Commuters Will Use Them", *Journal of the Transportation Research Board*, 1828, 116-123.

Jacobsen, P. L. (2003). "Safety in numbers: more walkers and bicyclists, safer walking and bicycling", *Injury Prevention*, 9, 205-209.

JZTI and Bonnette Consulting (2010). *Philadelphia Bikeshare Concept Study*.

Land Transport Safety Authority NZ (2004). *Cycle Network and Route Planning Guide*, New Zealand.

Larsen, J. (2013). "Bike-Sharing Programs Hit the Streets in Over 500 Cities Worldwide", Earth Policy Institute.

Midgley, P. (2011). *Bicycle-sharing schemes: enhancing sustainable mobility in urban areas*", Commission on Sustainable Development Nineteenth Session, New York.

New York City Department of City Planning (2009). *Bike-Share Opportunities in New York City*, PTCP08D00.G05, New York.

Saneinejad, S., Roorda, M. J. and Kennedy, C. (2012). "Modelling the impact of weather conditions on active transportation travel behaviour", *Transportation Research Part D*, (17), 129-137.

Shaheen, S. and Guzman, S. (2011). "Worldwide Bikesharing", *ACCESS*, 39:22-27.

Shaheen, S., Guzman, S., and Zhang, H. (2010). "Bikesharing in Europe, the Americas, and Asia- Past, Present, and Future", *Journal of the Transportation Research Board*, 2143, 159-167.

Transport Canada (2009). *Bike-Sharing Guide*, T22-180/2009E.

University of Washington (2009). *Climate Action Plan*.

The Bike-sharing World Map. (Accessed Oct. 18, 2012) https://maps.google.com/maps/ms?ie=UTF8&hl=en&om=1&msa=0&msid=104227318304000014160.00043d80f9456b3416ced&ll=43.580391,-42.890625&spn=143.80149,154.6875&z=1&source=embed

Website of YouBike. (Accessed Sep. 20, 2012). http://www.youbike.com.tw/

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3D Laser Scanning Technology-based Historic Building Mapping for Historic Preservation

A Case Study of Shang Shu Di in Fujian Province, China

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Abstract: Historic preservation, adaptive reuse, and sustainable urban design that considers the full range of social, environmental, and economic factors is an essential component of sustainable urban development, while the mapping of historic buildings which can be archived and extracted for application, is the basic work on the protection of historic buildings and adaptive reuse. Traditional mapping methods need more time and more workers, and there are measured omissions, mistakes and other issues which go against the protection of the measured objects. 3D laser scanning technology is a new technique for quickly getting three-dimensional information. This paper introduced a measurement principle for 3D laser scanning technology and took Shang Shu Di, a Ming Dynasty building which is an officially protected heritage site of China in Taining County of Fujian Province, as a case study, and studied the application of mapping historic buildings based on 3D laser scanning technology. Then, a comparison of 3D laser scanning technology with the traditional method of detailed components mapping has been illustrated to indicate the advantage of 3D laser scanning technology in historic building mapping. Finally, aimed at the technical problems of the huge amount of data generated in the application process and the software defects of Cyclone, this paper presented two specific coping strategies which are "reasonable data collection and processing" and "construction of historic building components database".

1. INTRODUCTION

As stated by Boquet (2014), sustainable development has become a buzzword for many sets of policies at various spatial levels. Many planning concepts such as 'new urbanism' and 'compact city' are all claiming to promote the development of sustainability (Wang, 2014). Historic preservation, adaptive reuse, and sustainable urban design that considers the full range of social, environmental, and economic factors is an essential component of sustainable urban development (Lewin et al., 2013). A growing number of developers, preservationists and design professionals are demonstrating that historic preservation and sustainable development are a natural alliance (Hammersmith Group, 2008). Mapping of historic buildings which can be archived and extracted for application is the basic work on the

preservation of historic buildings and adaptive reuse. The traditional tools for mapping the historic buildings are ruler, tape measures, benchmarks and so on. Interpretation of records is done by the human eyes and most of the measuring is of "a part taken from the whole", that is, a small component is deduced from the whole and the mapping is based on assumptions of similarity (Zang, 2006). Such mapping results in a considerable extent being dependent on personal experience and temporary judgement, which cannot accurately depict specific components, especially in shaped and complex components with detailed spatial characteristics. Such results have many problems in terms of completeness and accuracy. Compared with traditional surveying methods, laser scanning technology has particular superiority as follows (Cheng and Jin, 2006):

- is a sort of untouched measure system;
- gains the 3D coordinates, reflecting intensity etc. on object surface;
- rapidity of data acquisition, great quantity of data and high accuracy;
- works in all kinds of environments;
- extensive application.

As a new technique for quickly getting three-dimensional information, 3D laser scanning technology has been widely used in many fields; for example, Jia-Chong et al. (2007) used 3D laser scanning and a global positioning system (GPS) to acquire landslide data and to compute earthwork volume. Lin et al. (2010) used a 3D laser scanner to obtain precise measurements from experimental lithic reduction sets. Armesto-González et al. (2010) presented a methodology to combine the technology of the terrestrial laser scanner with the techniques of digital image processing to study damage on stony materials that constitute historical buildings. Kuzminsky et al. (2012) provided a simple and straightforward overview of using 3D scanning methods to preserve and document osteological material in museums, develop research ideas in the subfields of biological anthropology, and increase the potential for scholarly collaboration. Holopainen et al. (2013) used airborne (ALS), terrestrial (TLS) and mobile laser-scanning (MLS) methods in urban tree mapping and monitoring. Chen et al. (2013) proposed a method that combines SAR data with a cloud of point data (data point cloud) obtained by 3D laser scanning to improve the gradient of deformation detection. Mahdjoubi et al. (2013) established the case and rationale for the adoption of BIM and laser scanning technologies in the real-estate services sector.

This paper will take Shang Shu Di, a Ming Dynasty building which is an officially protected heritage site of China in Taining County of Fujian Province, as a case study, and study the application of mapping in historic buildings based on 3D laser scanning technology. Then the paper will verify the advantages of 3D laser scanning technology in historic building mapping through a comparison of 3D laser scanning technology with traditional methods in detailed components mapping. Finally, specific coping strategies for the huge amount of data generated in the process of the application of 3D laser scanning technology will be studied and presented.

2. MEASUREMENT PRINCIPLE OF 3D LASER SCANNING TECHNOLOGY

The 3D laser scanner targets physical objects to be scanned and the laser beam is directed over the object in a closely spaced grid of points. First, the

scanner emits a laser flight to the surface of the physical object for each measuring point $P(x, y, z)$, then the laser flight will reflect back to the scanner, so the 3D laser scanner will measure the time of laser flight, which is the time of travel of the laser from the scanner to the physical object and back to the scanner. Since the speed of light is: $c = 3 \times 10^8 m/s$, thus the scanner can calculate the distance S, which is from the surface of the physical object to the 3D laser scanner:

$$S = \frac{1}{2} \times c \times t \qquad (1)$$

Suppose α is the angle between the laser flight and the vertical direction, and β is the angle between the laser flight and the horizontal direction, as illustrated in Figure 1. Thus, the 3D spatial coordinates of $P(x, y, z)$ are:

$$x = S \times \cos\alpha \times \sin\beta \qquad (2)$$
$$y = S \times \cos\alpha \times \cos\beta \qquad (3)$$
$$z = S \times \sin\alpha \qquad (4)$$

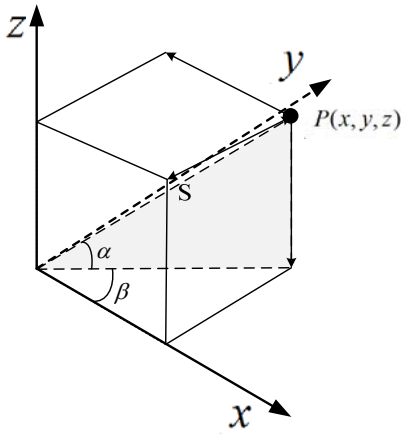

Figure 1. Coordinate calculation of measuring point $P(x, y, z)$

The result is a "cloud of points", or data point cloud, which consists of thousands of points in a 3-dimensional space that are a dimensionally accurate representation of the existing object (Arayici, 2007).

3. APPLICATION OF 3D LASER SCANNING TECHNOLOGY IN HISTORIC BUILDING MAPPING

3D laser scanning technology, which is used in the mapping of irregular and complex buildings, can effectively improve the deficiency of traditional mapping methods (Boulaassal et al., 2009; Cardaci et al., 2011; Hudson et al., 2012). In this paper, the 3D laser scanner "Scanstation C10", which was produced by Leica Company, was used in the mapping of Shang Shu Di. The scanner has many merits, such as high accuracy, works in all kinds of environments, is multidimensional, has easy operation and so on, so it has the strong superiority of being able to rapidly obtain 3D data and create a 3D model (Fan et al., 2012). The application of 3D laser scanning technology in historic building mapping is mainly composed of data collection outdoors

and data processing indoors. Figure 2, below, illustrates the flow chart of 3D laser scanning technology used in historic building mapping.

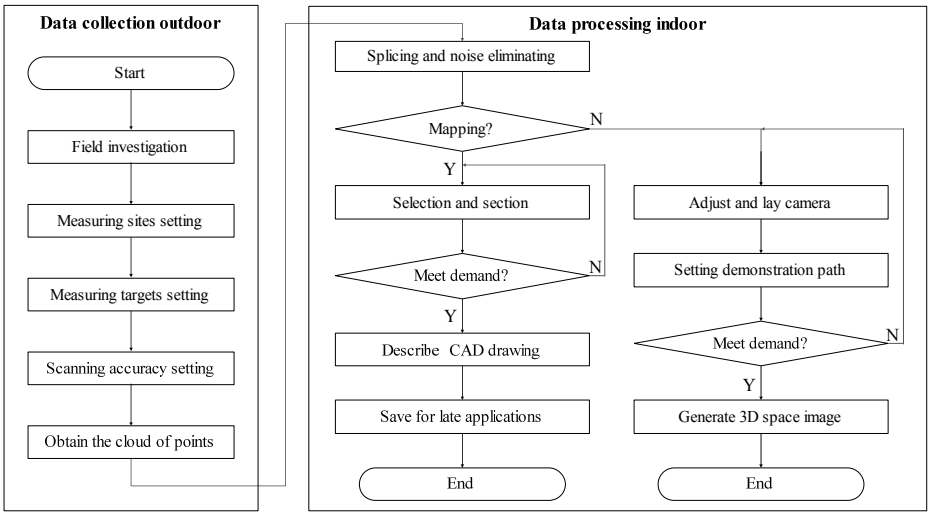

Figure 2. The flow chart of 3D laser scanning technology used in historic building mapping

3.1 Data collection outdoors

Data collection outdoors mainly includes field investigation, setting of measuring sites, targets and scanning accuracy, and obtaining the cloud of data points. For most historic buildings, they have larger and more complex angles, so to avoid excluding sections due to an excess of cloud points, it is reasonable to set multiple measuring sites and measurement targets through multi-station, multi-directional scanning.

Figure 3 illustrates 16 measuring sites and 8 measuring targets which have been set in this mapping of the historic building. In order to have multiple stations scanning different coordinates of points within the cloud together into the same coordinate system, and to obtain the complete surface information of the object shape, a reasonable target arrangement is particularly important. The basic methods or principles are: Firstly, three targets, which are not in the same straight line, should be placed between every two stations. Secondly, the position of the measurement target should follow the principle of "Service for the next station", which means setting the target in a coordinated location where it can be scanned as much as possible by multiple scanners in order to reduce the number of targets and any resulting error of points in clouds during multiple site splicing processing. Thirdly, setting up should avoid omitting set targets.

Scanning accuracy settings directly affect the final results of the mapping of historic buildings, thus for group buildings' positioning measurement, and a single-building's integral measurement, medium or low-resolution scanning is commonly used. However, for specific detail components of historic buildings, such as specific plaques, fonts or painting patterns, which require scanning of detailed components, high or ultra-high resolution scanning is used. Adjustments for degrees of exposure must be made according to the environment and weather conditions. The degree of exposure needs to be increased when the data point cloud occurs in a dark area, or decreased in a bright area.

Figure 3. The measuring sites and measuring targets

3.2 Data processing indoors

Data processing indoors mainly includes splicing and noise eliminating for the data point cloud selection and section, the generation of CAD graphics, the generation of 3D space image, data storage and extraction for use. Splicing primarily used the method of "group positioning system", to position single-buildings and the detail components into the historic building's settlement group, namely multiple stations' point clouds, were spliced into the same coordinate system in order to obtain the target entity's complete spatial data. Noise elimination is conducted to remove the invalid data points, reducing the overhead of computer data processing, and to improve the ability of computer data processing. The noise of this mapping of historic buildings is relatively obvious, so this paper used naked eye judgment to segment the cloud of points, then delete directly by a human-computer method to eliminate the noise.

Due to the impact of the scanning mode to obtain the cloud of points, and the initialization of the instrument, the cloud model that has been acquired has no accurate coordinate axis. Therefore, it is necessary to determine the coordinates using Cyclone software first, to unify the cloud of points, and to optimize the cloud model, then to put the cloud model into AutoCAD to slice the plane, vertical face and profile using the Cloudworx plugin. Finally, the plane drawing, vertical face drawing and profile drawing is described according to the section feature and cloud of points in AutoCAD. Figures 4, 5 and 6 illustrate the drawing of the section from the cloud of points.

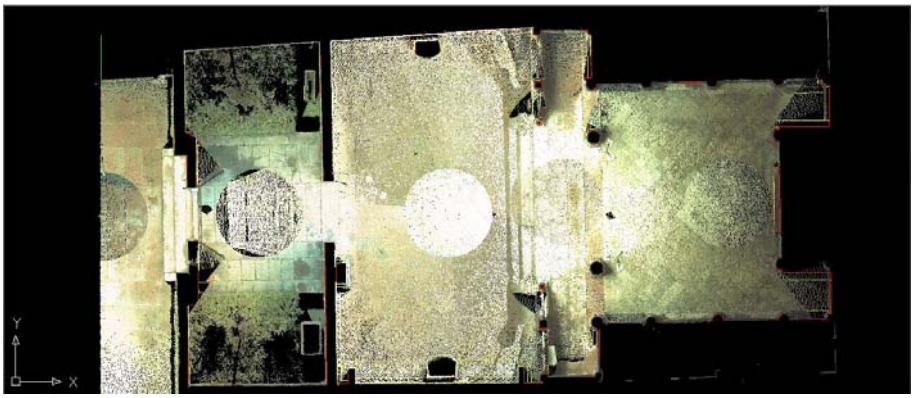

Figure 4. The drawing of the entrance plane section from the cloud of points

Figure 5. The drawing of the entrance vertical face section from the cloud of points

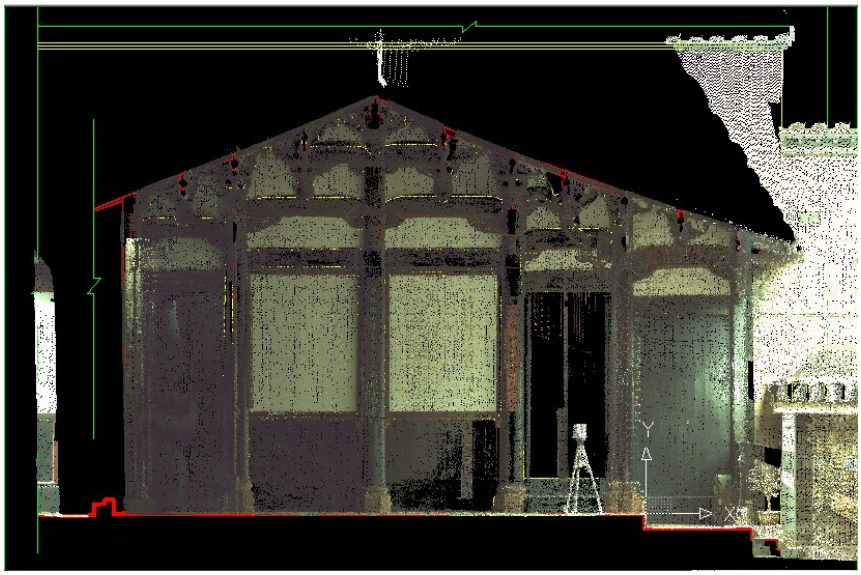

Figure 6. The drawing of the entrance profile section from the cloud of points

Figures 7, 8 and 9 illustrate the plane drawing, vertical face drawing and profile drawing of the entrance utilizing the hidden data points.

In order to express the 3D virtual reality of Shang Shu Di more intuitively, the authors constructed a 3D video to show the results of the

mapping and a live-action 3D image. This was enabled by fitting the data point cloud and the images captured from the built-in camera, and setting the demonstration path. Figure 10 illustrates the 3D space image of Shang Shu Di.

Figure 7. The plane drawing of the entrance

Figure 8. The vertical face drawing of the entrance

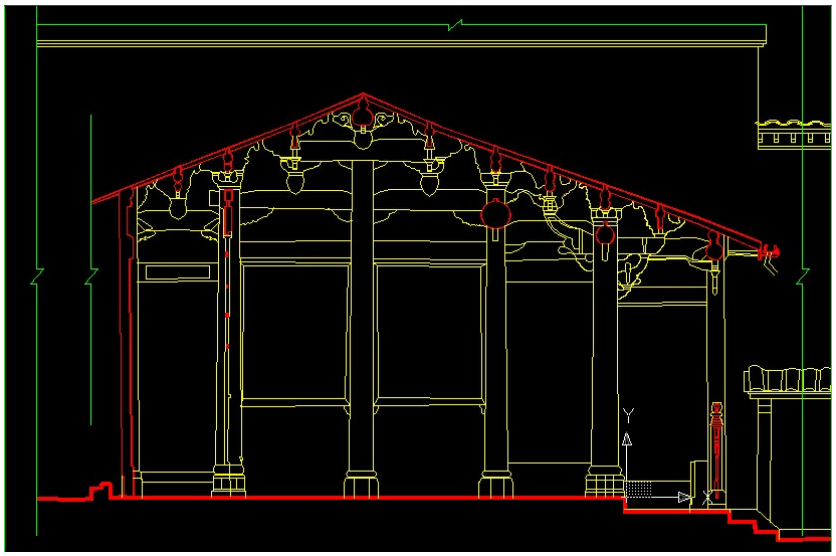

Figure 9. The profile drawing of the entrance

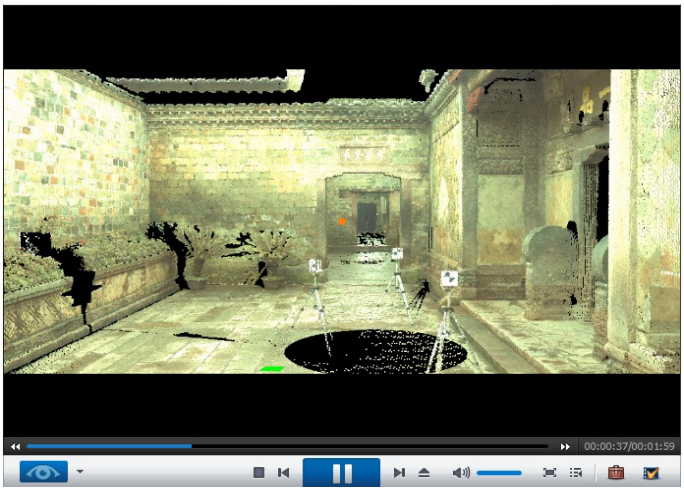

Figure 10. 3D space image of Shang Shu Di

4. COMPARISON OF 3D LASER SCANNING TECHNOLOGY WITH TRADITIONAL METHOD IN DETAILED COMPONENTS MAPPING

The detailed components of historic buildings and their decoration are important contents in historic building mapping. The traditional method is to orthographically shoot the various parts of the components and decorations of historic buildings, and to record their sizes by manually mapping them. Researchers are required to climb scaffolding, prostrate or squat, and there are measured omissions, mistakes and other issues to be taken into consideration. The application of 3D laser scanning technology can overcome these disadvantages of the traditional method.

To begin with, focus can be placed on the detailed components that need to be mapped, using an appropriate resolution to scan and collect data. In order to decrease the volume of the data point cloud, it is necessary to adjust the vision angle according to the physical objects which need mapping, then to use a "partial selection method" to extract the desired cloud of points accurately. Figure 11 illustrates the extracted data points of the Dougong beams above the Gold Pillar.

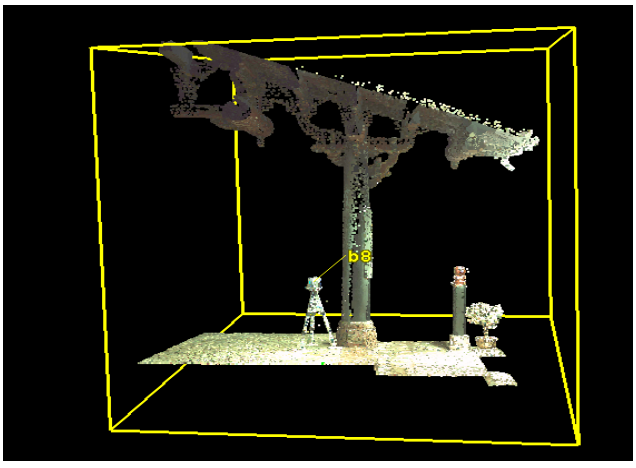

Figure 11. Extracted data points of the Dougong beams above Gold Pillar

Secondly, the data points are unified to reduce their density, then imported into AutoCAD to slice their profile using the Cloudworx plugin, the profile drawing is then described according to the section feature and data point cloud in AutoCAD. Figure 12 illustrates the drawing of the Dougong beams above the Gold Pillar using the cloud of points.

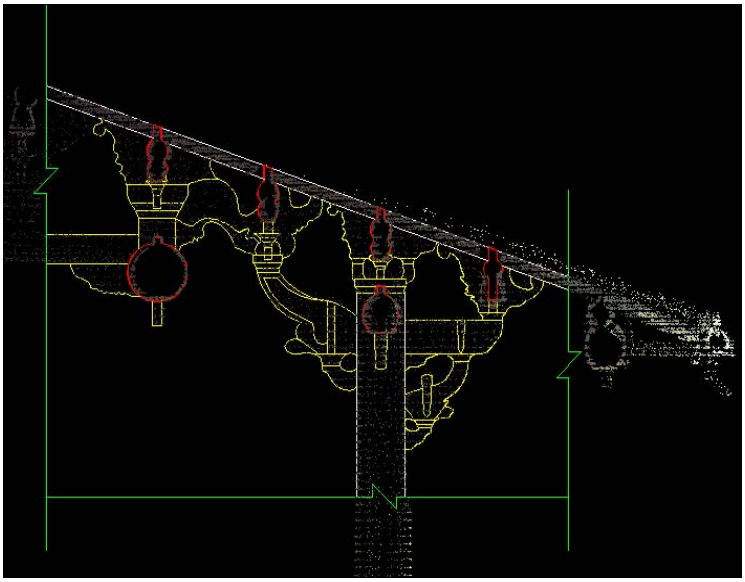

Figure 12. The drawing of the Dougong beams above the Gold Pillar using the cloud of points

Finally, the hidden data points were used to obtain the profile drawing of the Dougong beams above the Gold Pillar, as Figure 13 illustrates. The accuracy of the mapping drawing has improved significantly compared with the original manual mapping drawing. Figure 14 and Table 1 illustrate the mapping results of the 3D laser scanning technology compared with the traditional method.

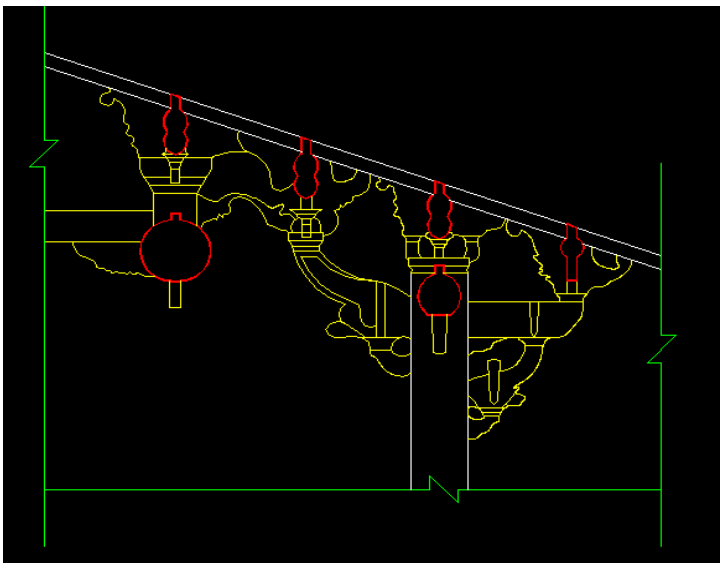

Figure 13. The profile drawing of the Dougong beams above the Gold Pillar

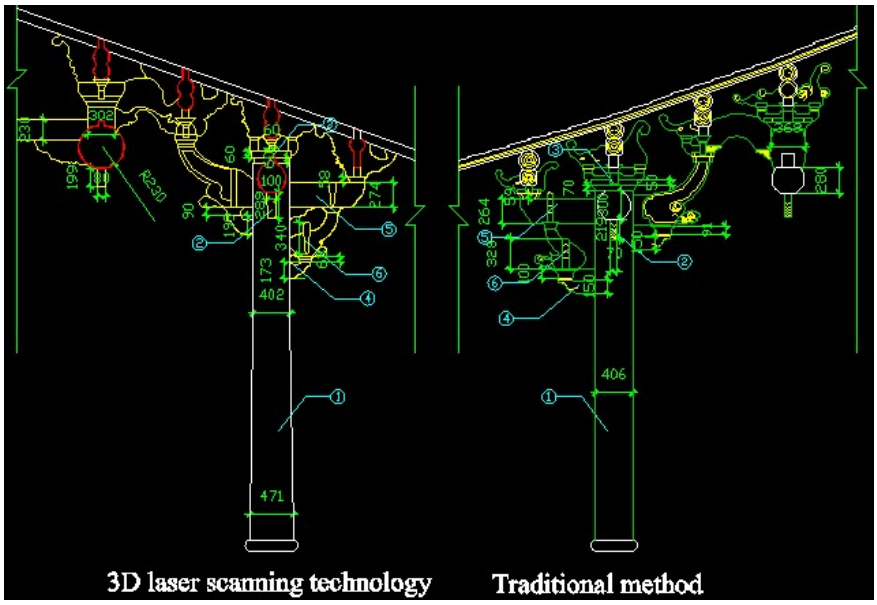

Figure 14. Comparison of mapping results of 3D laser scanning technology and traditional method using the same key points

Table 1. Comparison results of the two methods corresponding to Figure 14

Key points.	Traditional mapping method	3D laser scanning technology	The comparison results (The problems of the traditional method)
① The diameters of the Gold Pillar	The same diameters from top to bottom, 406mm	Small top and big bottom, the diameter is 471mm at 300mm, and 406mm at 2400mm from the bottom.	The traditional method often misunderstands the diameter of the Gold Pillar. So there are measurement omissions.
② The high-aspect ratio of intermediate Dougong.	Width is 70mm and height is 219mm. So the ratio is 3.13.	Width is 100mm and height is 289mm. So the ratio is 2.89.	The ratio of the traditional method is higher than the 3D laser scanning technology, so there is a measurement error.
③ Tablet Square	Absent	Present	There are measurement mistakes or omissions.
④ Trunk Gong	150mm	173mm	There is a measurement error.
⑤Er Pi Gong	264 mm	274 mm	There is a measurement error.
⑥ Hua Ya Zi	328 mm	340 mm	There is a measurement error.

5. SPECIFIC COPING STRATEGIES FOR THE HUGE AMOUNT OF DATA

Due to the sizes of historic buildings, the complexity of detailed components, the number of sites and the accuracy of scanning, a huge amount of data will be generated in the process of the application of 3D laser scanning technology. Figure 15 illustrates the spacing and data of one site's data point cloud at different scanning resolutions. When the scanning resolution is fine, ultra-high, the amount of data from panorama scanning

reaches 7.78Gigabytes. This affects not only the processing speed of the computer, but also the post-data processing, CAD graphics conversion and the efficiency of data extraction. Therefore, reasonable data collection and processing, as well as the construction of a historic building components database are two important strategies to solve problems due to there being a huge amount of data.

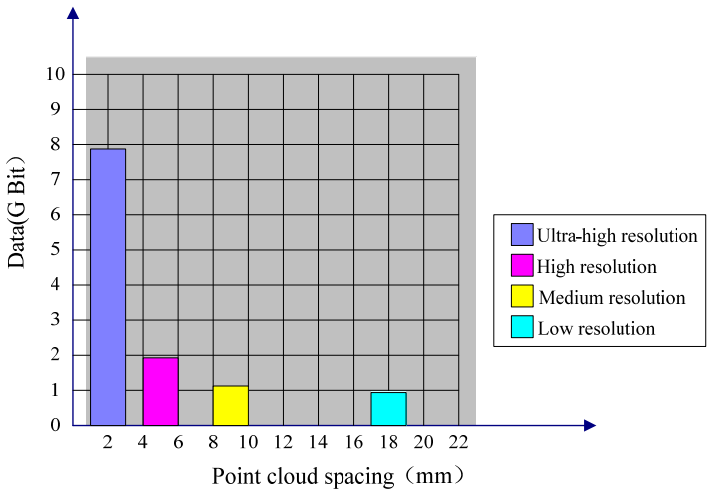

Figure 15. The spacing and data of one site's data point cloud at different scanning resolutions

5.1 Reasonable data collection and processing

Reasonable data collection and processing needs to be done in two stages: First, setting a reasonable scanning accuracy and vision angle when in the data collection stage. Second, noise elimination and saving the data as *.Ptx or *.Pts format files in the data processing stage. The scanning accuracy and vision angle should be set according to the mapping of different objects, as shown in Table 2.

Table 2. Scanning accuracy and vision angle in different mapping objects

Mapping objects	Scanning accuracy	Scanning vision angle	The distances between two clouds of points within 100 meters.	Data size
Group buildings	Low resolution	panoramic scanning	20mm	0.98GB
Single-building	Medium resolution	panoramic scanning	10mm	1.16GB
Detailed components (such as Dougong, beams, windows, doors.)	High resolution	partial scanning	5mm	1.99GB of panoramic scanning.
Graphic patterns	Ultra-high resolution	partial scanning	2mm	7.78GB of panoramic scanning.

Noise generally comes from two sources: one is the passing vehicles or pedestrians while the 3D laser scanner was in operation. Figure 16 illustrates the noise caused by the passing vehicles or pedestrians; Another is some invalid data point clouds, for example, some modern buildings appear that are adjacent to the historic buildings, or there are some debris of the historic buildings, etc. The invalid data not only affects the accuracy of mapping, but also takes up storage and system resources, as well as affecting the ability of computer data processing. Therefore, for the obvious noise, just using the "Fence Mode" marquee method is sufficient, while for complex noise, it is necessary to separate the noise area from the cloud of points, then combine with the "Fence Mode" marquee method to eliminate the noises. Figure 17 illustrates the cloud of points after noise elimination.

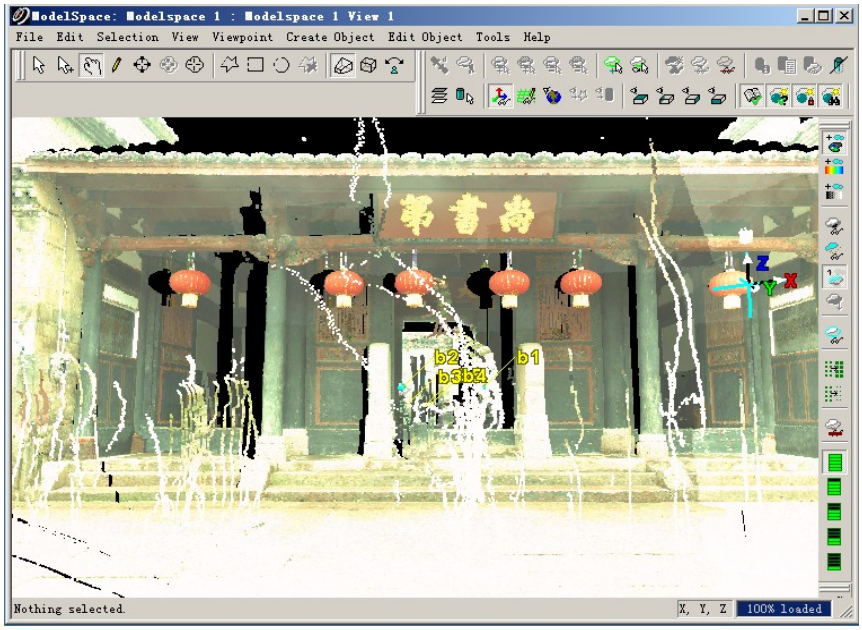

Figure 16. Noise caused by the passing vehicles or pedestrians

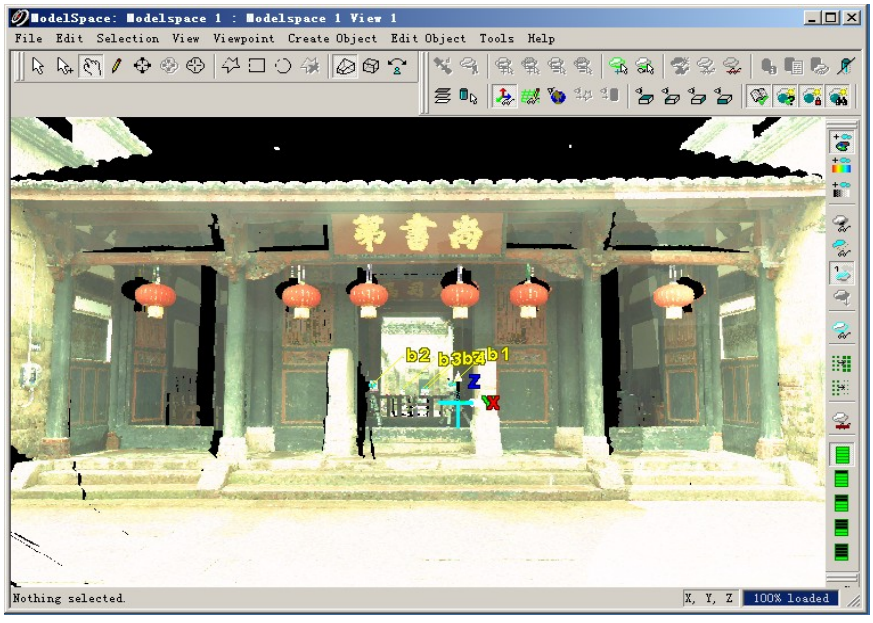

Figure 17. The cloud of points after noise elimination

The data saved for later use is very important since the data can be extracted for later use after finishing the noise elimination, so it is necessary to export the data point cloud as *.Ptx or *.Pts format files for saving as stored resources. In this project, the scanning area of Shang Shu Di was about 900m^2, there were 16 measuring sites and 8 measurement targets set, the scanning accuracy was medium resolution, and the actual volume of data generated was 18.6GB. After eliminated noises were exported and the data were saved as *.Ptx or *.Pts format files, there was only 8.72GB of data. Therefore, it greatly reduced the size of the data point cloud and saved 53.12% of storage space.

5.2 Construction of historic building components database

The data point cloud collected by a 3D laser scanner has the feature of "measurement one time, permanent use". So the establishment of a 3D data information table would assist the effective management of historic building components. Users can call and view building component parameter information and eventually establish a historic building components database.

Nowadays, noise-only elimination can be carried out after splicing in Cyclone 7.3 software. Therefore, our research team gained the experience of splicing, noise elimination, reducing data volume, and the generation of CAD graphics using AutoCAD software, and presented a specific coping strategy which is “packet processing, integrated splice” (Zhang et al., 2014). For multiple stations, it is necessary to group, firstly, one group composed of several stations, and then each group spliced and with noise eliminated, then put the data point cloud model into AutoCAD to slice and describe the CAD drawing. Finally, a 3D data information table of historic building components is established through the insert or external redeployment feature of AutoCAD. Table 3 illustrates the 3D data information table of the pillars from Shang Shu Di.

Table 3. 3D data information table of pillars

ID	Code	Type	Diameter of pillar bottom	Diameter of pillar top	Height of pillar diameter	width of pillar diameter
PFX1Y1Z1	PF	Round	471mm	406mm	No	No
PFX2Y2Z2	PF	Square	No	No	303mm	301mm
PFX3Y3Z3	PF	Round	477mm	398mm	No	No

According to the actual needs, there are many properties involved in the database, including not only the property of spatial data, such as floor area, material, location, size and social history, etc., but also attribute information, such as literature information, historical and cultural information. Table 4 illustrates the database structure for a single building. Finally, a building components database with perfect classification and easy extraction would be established through data processing indoors, which can achieve the multidimensional use of the mapped data.

Table 4. The database structure for a single building

Character	Type	Length	Name
Leb	Float	80	Length of building
Wib	Float	80	Width of building

Hed	Float	80	Height of door
Wid	Float	80	Width of door
Lay	Int	5	Layers
Buit	Datatime		Build time
Ima	Image		Image information
Rem	Text	20	Remarks

6. CONCLUSION

Historic buildings have embedded potential for sustainability. They often use comparatively low energy and durable materials, and historic neighbourhoods are often characterized by density, short distances and mixed use, which make them a relatively efficient model of sustainable development. Furthermore, demolishing or replacing these buildings would require a major reinvestment of energy and resources. Therefore, the retention, rehabilitation and reuse of historic buildings can play a pivotal role in the sustainable development of the city.

Historic building mapping is a basic work to protect, explore, organize and utilize ancient, outstanding architectural heritage. Meanwhile, it not only provides important basic data for the research of architectural history and theory and architectural history teaching, but also provides a reference for succeeding and developing traditional building culture and exploring modern architectural creation (Wang, 2006). The traditional mapping method is simple and intuitive, however, it needs more time and more workers, and there are measurement omissions, mistakes and other issues. The results cannot accurately depict specific components, especially in shaped and complex components and their detailed spatial characteristics. The application of 3D laser scanning technology can overcome the disadvantages of the traditional mapping method, such as accuracy, 3D virtual characteristics, the integrity of the data collected and so on.

In the actual application process, 3D laser scanning technology still has existed issues that need further exploration and solutions: First, as a huge amount of data came from the data point cloud and the colour images, how to fit the cloud with the colour images should be explored further to reduce the amount of data through software technology pathways. Second, more time and more workers are required to change the data point cloud into CAD graphics. Software technology capable of automatic recognition and generation needs further development and improvement. Finally, the automatic data processing techniques of noise elimination and site picture stitching need to improve.

In addition, 3D laser scanning is becoming a standard technology for the 3D modelling of complex scenes. Laser scans contain detailed geometric information, but still require interpretation of the data for making it useable for mapping purposes. With the development of integrated software development technology, 3D laser scanning technology and building information modelling (BIM) technologies will offer new possibilities for capturing, mapping and the analysis of building information in the future.

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REFERENCES

Arayici, Y. (2007). "An approach for real world data modelling with the 3D terrestrial laser scanner for built environment", *Automation in Construction*, 16(2007), 816-829.

Armesto-González, J., Riveiro-Rodríguez, B., et al. (2010). "Terrestrial laser scanning intensity data applied to damage detection for historical buildings", *Journal of Archaeological Science*, 37(2010), 3037-3047.

Boquet, Y. (2014). "Transportation and Sustainable Development in a Mid-Size French City, Dijon", *International Review for Spatial Planning and Sustainable Development*, 2(2), 52-63.

Boulaassal, H., Landes, T., et al. (2009). "Automatic extraction of planar clusters and their contours on building facades recorded by terrestrial laser scanner", *International Journal of Architectural Computing*, 7(1), 1-20.

Cardaci, A., Mirabella Roberti, G., et al. (2011). "From the continues to the discrete model: a laser scanning application to conservation projects", Proceedings of the International Archives of the Photogrammetry, *Remote Sensing and Spatial Information Sciences*, Trento, Italy, 2–4 March 2011; 38, 437-444.

Chen, B., Deng, K., et al. (2013). "Large-scale deformation monitoring in mining area by D-InSAR and 3D laser scanning technology integration", *International Journal of Mining Science and Technology*, 23(2013), 555-561.

Cheng, X.J. and Jin, W. (2006). "Study on reverse engineering of historical architecture based on 3d laser scanner", *Journal of Physics Conference Series*, 48(1), 843-849.

Fan, Y., Dong, J., et al. (2012). "Discussion on 3D laser scanning technology and the comprehensive application of related software", *Surveying and Mapping of Geology and Mineral Resources*, 28 (3), 21-23. (In Chinese)

Hammersmith Group. (2008). "Historic preservation and sustainable development", *The Hammersmith Group Research Report*.

Holopainen, M., Kankare, V., et al. (2013). "Tree mapping using airborne, terrestrial and mobile laser scanning–A case study in a heterogeneous urban forest", Urban Forestry&Urban Greening, 12(2013) 546-553.

Hudson, M. (2012). "Laser scanning enables Titanic Light Show", *Geomatics World*, July/August (2012), 20-21.

Jia-Chong, D. and Hung-Chao, T. (2007). "3D laser scanning and GPS technology for landslide earthwork volume estimation", *Automation in Construction*, 16(2007), 657-663.

Kuzminsky, S.C. and Gardiner, M.S. (2012). "Three-dimensional laser scanning: potential uses for museum conservation and scientific research", *Journal of Archaeological Science*, 39 (2012), 2744-2751.

Lewin, S.S. and Goodman, C. (2013). "Transformative renewal and urban sustainability", *Journal of Green Building*, 8(4), 17-38.

Lin, S.C.H., Douglass, M.J., et al. (2010). "The application of 3D laser scanning technology to the assessment of ordinal and mechanical cortex quantification in lithic analysis", *Journal of Archaeological Science*, 37(2010), 694-702.

Mahdjoubi, L., Moobela, C., et al. (2013). "Providing real-estate services through the integration of 3D laser scanning and building information modelling", *Computers in Industry*, 64 (2013), 1272-1281.

Wang, Q. 2006. "Historic building mapping", *China Architecture & Building Press*, Beijing. (In Chinese)

Wang Y. (2014) "The Framework of Social Sustainability for Chinese Communities: Revelation from Western Experiences", *International Review for Spatial Planning and Sustainable Development*, 2(3), 4-17.

Zang, C. (2006). "Application of the 3D laser scanning techniques to the study of cultural relics conservation", *Architectural Journal*, 24 (12), 54 -56. (In Chinese)

Zhang, Y., Zhang, Y., et al. (2014). "Research on application of 3D laser scanner in ancient architecture mapping", *Experimental Technology and Management*, 31(1), 79-82. (In Chinese)

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Automatic Generation of 3D Building Models for Sustainable Development

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Key words: 3D urban model, automatic generation, GIS (Geographic Information System), CG (Computer Graphics), 3D building model, straight skeleton.

Abstract: 3D city models are important in urban planning for sustainable development. Urban planners draw maps for efficient land use and a compact city. 3D city models based on these maps are quite effective in understanding what, if this alternative plan is realized, the image of a sustainable city will be. However, enormous time and labour has to be consumed to create these 3D models, using 3D modelling software such as 3ds Max or SketchUp. In order to automate the laborious steps, a GIS and CG integrated system that automatically generates 3D building models is proposed based on building polygons (building footprints) on a digital map. In either orthogonal or non-orthogonal building polygons, the new system is proposed for automatically generating 3D building models with general shaped roofs by straight skeleton computation.

1. INTRODUCTION

3D city models, such as what is shown in Figure 1, right, are important in urban planning for sustainable development; urban planners draw maps for efficient land use and a compact city. 3D city models based on these maps are quite effective in understanding what, if this alternative plan is realized, the image of a sustainable city will be. To facilitate public involvement for sustainable development, 3D models simulating the town in the future can be of great use. However, enormous time and labour has to be consumed to create these 3D models, using 3D modelling software such as 3ds Max or SketchUp. For example, when manually modelling a house with roofs by Constructive Solid Geometry (CSG), one must use the following laborious steps:

(1) *Generation of primitives of appropriate size, such as box, prism or polyhedron that will form parts of a house.* (2) *Boolean operations are applied to these primitives to form the shapes of parts of a house such as making holes in a building body for doors and windows.* (3) *Rotation of parts of a house.* (4) *Positioning of parts of a house.* (5) *Texture mapping onto these parts.*

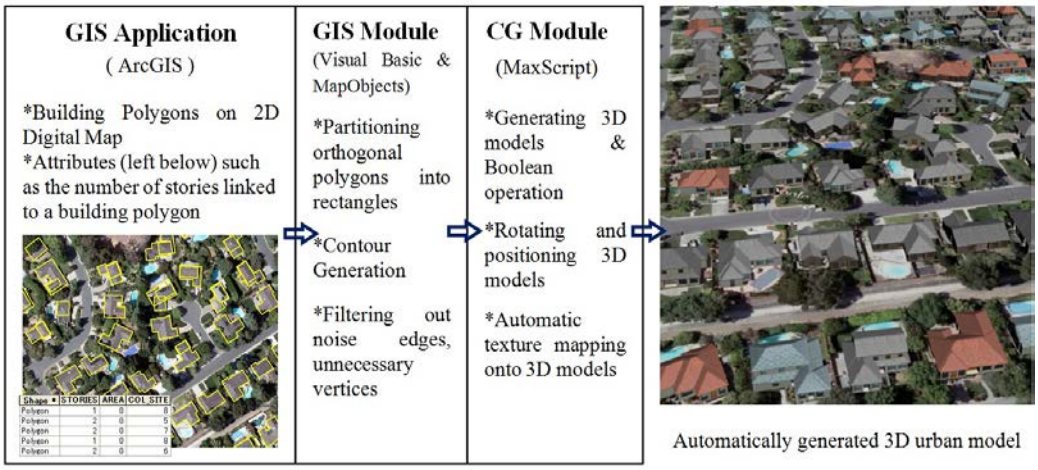


Figure 1. Pipeline of Automatic Generation for 3D Building Models

In order to automate these laborious steps, we are proposing a GIS and CG integrated system that automatically generates 3D building models (Sugihara and Kikata, 2012) based on building polygons or building footprints on a digital map shown above in Figure 1 left, which shows most building polygons' edges meet at right angles (orthogonal polygon). A complicated orthogonal polygon can be partitioned into a set of rectangles. The proposed integrated system partitions orthogonal building polygons into a set of rectangles and places rectangular roofs and box-shaped building bodies on these rectangles. In order to partition complicated orthogonal building polygons, a useful polygon expression (RL expression: edges' Right & Left turns expression) and a partitioning scheme was proposed (Sugihara, 2009) for deciding from which vertex a dividing line (DL) is drawn.

In the digital map, however, not all building polygons are orthogonal. In either orthogonal or non-orthogonal polygons, we propose the new system for automatically generating 3D building models with general shaped roofs by straight skeleton computation defined by a continuous shrinking process. We call this kind of roof 'a straight skeleton roof'. In this paper, the algorithm for shrinking a polygon and forming a straight skeleton are clarified and we propose the new methodology for constructing roof models by assuming the third event: 'simultaneous event' in addition to 'edge event' and 'split event' and, at the end of the shrinking process, some polygons are converged to 'a line of convergence'.

2. RELATED WORK

Since 3D urban models are important information infrastructure that can be utilized in several fields, the research on the creation of 3D urban models are in full swing. Various types of technology, ranging from computer vision, computer graphics, photogrammetry, and remote sensing, have been proposed and developed for creating 3D urban models.

Using photogrammetry, Gruen et al. (1998; 2002) introduced a semi-automated topology generator for 3D building models: CC-Modeler. Feature identification and measurement with aerial stereo images is implemented in manual mode. During feature measurement, measured 3D points belonging to a single object should be coded into two different types according to their functionality and structure: boundary points and interior points. After these

manual operations, the faces are defined and the related points are determined. Then the CC-Modeler fits the faces jointly to the given measurements in order to form a 3D building model.

Suveg and Vosselman (2002) presented a knowledge-based system for automatic 3D building reconstruction from aerial images. The reconstruction process starts with the partitioning of a building into simple building parts based on the building polygon provided by a 2D GIS map. If the building polygon is not a rectangle then it can be divided into rectangles. A polygon can have multiple partitioning schemes. To avoid a blind search for optimal partitioning schemes, the minimum description length principle is used. This principle provides a means of giving higher priority to the partitioning schemes with a smaller number of rectangles. Among these schemes, optimal partitioning is 'manually' selected. Then, the building primitives of CSG representation are placed on the rectangles partitioned.

These proposals and systems, using photogrammetry, will provide us with a primitive 3D building model with accurate height, length and width, but without details such as windows, eaves or doors. The research on 3D reconstruction is concentrated on reconstructing the rough shape of the buildings, neglecting details on the façades such as windows, et cetera (Zlatanova and Heuvel Van Den, 2002).

On the other hand, there are some application areas such as urban planning and game industries where the immediate creation and modification of many detailed building models is requested to present the alternative 3D urban models. Procedural modelling is an effective technique to create 3D models from sets of rules such as L-systems, fractals, and generative modelling language (Parish and Müller, 2001).

Müller et al. (2006) have created an archaeological site of Pompeii and a suburbia model of Beverly Hills by using a shape grammar that provides a computational approach to the generation of designs. They import data from a GIS database and try to classify imported mass models as basic shapes in their shape vocabulary. If this is not possible, they use a general extruded footprint together with a general roof obtained by the straight skeleton computation defined by a continuous shrinking process (Aichholzer et al., 1995). However, there is no digital map description or in-depth explanation about how the skeleton is formed and applied to create roofs in their paper.

More recently, image-based capturing and rendering techniques, together with procedural modelling approaches, have been developed that allow buildings to be quickly generated and rendered realistically at interactive rates. Bekins et al. exploit building features taken from real-world capture scenes. Their interactive system subdivides and groups the features into feature regions that can be rearranged to texture a new model in the style of the original. The redundancy found in architecture is used to derive procedural rules describing the organization of the original building, which can then be used to automate the subdivision and texturing of a new building. This redundancy can also be used to automatically fill occluded and poorly sampled areas of the image set.

Aliaga et al. extend the technique to inverse procedural modelling of buildings and they describe how to use an extracted repertoire of building grammars to facilitate the visualization and modification of architectural structures. They present an interactive system that enables both creating new buildings in the style of others and modifying existing buildings in a quick manner.

Vanega et al. interactively reconstruct 3D building models with the grammar for representing changes in building geometry that approximately

follow the Manhattan-world (MW) assumption which states there is a predominance of three mutually orthogonal directions in the scene. They say automatic approaches using laser-scans or LIDAR data, combined with aerial imagery or ground-level images, suffering from one or all of low-resolution sampling, robustness, and missing surfaces. One way to improve quality or automation is to incorporate assumptions about the buildings such as MW assumption. However, there are lots of buildings that have cylindrical or general curved surfaces, based on non-orthogonal building polygons.

By these means of interactive modelling, 3D building models with plausible detailed façades can be achieved. However, the limitation of this modelling is the large amount of user interaction involved (Nianjuan and Loong-Fah, 2009). When creating 3D urban models for urban planning or facilitating public involvement, 3D urban models should cover lots of the involved citizens' and stakeholders' buildings. This means that it will take an enormous amount of time and labour to model a 3D urban model with hundreds or thousands of buildings.

Thus, a GIS and CG integrated system that automatically generates 3D urban models immediately is proposed, and the generated 3D building models that constitute 3D urban models are approximate geometric 3D building models that citizens and stakeholders can recognize as their future residence or real-world buildings.

3. PIPELINE OF AUTOMATIC GENERATION

As the pipeline of automatic generation is shown in Figure 1, the source of a 3D urban model is a digital residential map that contains building polygons. The digital maps are stored and administrated by GIS application (ArcGIS, ESRI Inc.). The maps are then pre-processed in the GIS module, and the CG module finally generates the 3D urban model.

To streamline the building generation process, the knowledge-based system was proposed for generating 3D models by linking the building polygons to information from domain specific knowledge in GIS maps: attributes data such as the number of storeys and the type of roof.

Pre-processing in the GIS module includes the procedures as follows: (1) *Filter out an unnecessary vertex whose internal angle is almost 180 degrees*. (2) *Partition or separate orthogonal building polygons into sets of rectangles*. (3) *Generate inside contours by straight skeleton computation for placing doors, windows, fences and shop façades which are setback from the original building polygon*. (4) *Form the straight skeleton for the general shaped roof*. (5) *Rectify the shape of the polygons so that there are no gaps or overlaps between geometric primitives such as rectangles*. (6) *Export the coordinates of polygons' vertices, the length, width and height of the partitioned rectangle, and attributes of buildings*.

The attributes of buildings, shown in Figure 1, left below, consist of the number of storeys, the image code of the roof, wall and the type of roof (flat, gable roof, hipped roof, oblong gable roof, gambrel roof, mansard roof, temple roof, and so forth). The GIS module has been developed using 2D GIS software components (MapObjects, ESRI).

As shown in Figure 1, the CG module receives the pre-processed data that the GIS module exports, generating 3D building models. In the GIS module, the system measures the length and gradient of the edges of the

partitioned rectangle. The CG module generates a box of the length and width, as measured in the GIS module.

In the case of modelling a building with roofs, the CG module follows these steps: (1) *Generate primitives of appropriate size, such as boxes, prisms or polyhedra that will form the various parts of the house*. (2) *Boolean operations applied to these primitives to form the shapes of parts of the house, for example, making holes in a building body for doors and windows, making trapezoidal roof boards for a hipped roof and a temple roof*. (3) *Rotate parts of the house according to the gradient of the partitioned rectangle. The roof boards, in addition, are rotated so as to align them according to the parameter: the slopes of the roofs.* (4) *Place parts of the house, depending on the position of the rectangle partitioned*. (5) *Texture mapping onto these parts according to the attribute received*. (6) *Copy the 2nd floor to form the 3rd floor or more in case of buildings higher than 3 storeys*.

The length and width of a box as a housing body are decided by the rectangle partitioned or separated from a building polygon in the GIS module. Also, the length of a thin box as a roof board is decided by the rectangle partitioned while the width of a roof board is decided by the slope of the roof given as a parameter. The CG module has been developed using Maxscript that controls 3D CG software (3ds MAX, Autodesk Inc).

4. STRAIGHT SKELETON COMPUTATION FOR ROOF GENERATION

Aichholzer et al. (1995) introduced the straight skeleton defined as the union of the pieces of angular bisectors traced out by polygon vertices during a continuous shrinking process in which edges of the polygon move inward, parallel to themselves at a constant speed. The straight skeleton is unexpectedly applied to constructing general shaped roofs based on any simple building polygon, regardless of their being rectilinear or not.

As in the shrinking process shown in Figure 2 on the following page, each vertex of the polygon moves along the angular bisector of its incident edges. This situation continues until the boundary changes topologically. According to Aichholzer et al. (1995), there are two possible types of changes:

(1) ***Edge event***: *An edge shrinks to zero, making its neighbouring edges adjacent now.*

(2) ***Split event***: *An edge is split, i.e., a reflex vertex runs into this edge, thus splitting the whole polygon. New adjacencies occur between the split edge and each of the two edges incident to the reflex vertex.*

A reflex vertex is a vertex whose internal angle is greater than 180 degrees. All edge lengths of the polygon do not always decrease during the shrinking process. Some edge lengths of a concave polygon will increase. For example, as shown by ‘ed1’ and ‘ed2’ in Figure 2(a), the edges incident to a reflex vertex will grow in length. If the sum of the internal angles of two vertices incident to an edge is more than 360 degrees, then the length of the edge increases, otherwise the edge will be shrunk to a point (node). This shrinking procedure is uniquely determined by the distance $\mathbf{d}_{shri}$ between the two edges from before and after the shrinking procedure.

The distance $\mathbf{e\_d}_{shri}$ is the $\mathbf{d}_{shri}$ when an edge event happens in the shrinking process. $\mathbf{e\_d}_{shri}$ for the edge (ed_i) is calculated as follows:

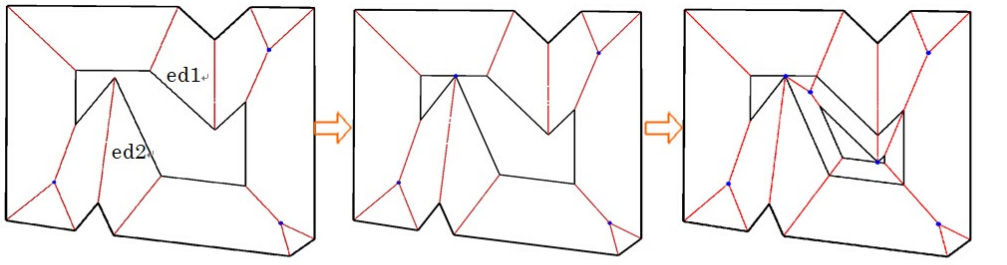
$$\mathbf{e\_d}_{\mathrm{shri}} = \frac{L_i}{(\cot(0.5 * \theta_i) + \cot(0.5 * \theta_{i+1}))}$$

where L_i is the length of ed_i, and θ_i & θ_{i+1} are the internal angles of vertices incident to ed_i.

When $0.5*\theta_i + 0.5*\theta_{i+1} < 180$ degrees, i.e., the sum of the internal angles of two vertices incident to an edge is less than 360 degrees, an edge event may happen unless the edge is intersected by an angular bisector from a reflex vertex and a split event happens.

Figure 2 from (a) to (c) shows a shrinking process for a non-orthogonal concave polygon, the polygon just before a split event, and the polygon being split into two polygons after a split event happens. Figure 2(d) shows a set of polygons shrinking at the constant interval and nodes by an edge event and a split event, and nodes by a collapse of a triangle into a point.

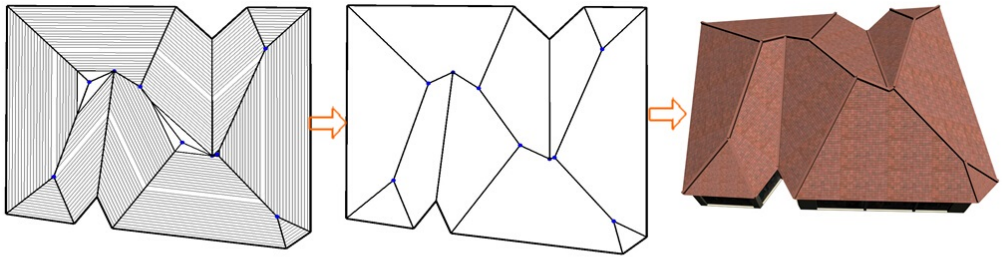
Figure 2(e) shows the straight skeleton defined as the pieces of angular bisectors traced out by polygon vertices. Figure 2(f) shows the roof model automatically generated. Since the straight skeleton partitions the interior of a polygon with *n* vertices (*n*-gon) into *n* monotone polygons, each roof board that constitutes the roof model is formed based on these partitioned 'interior monotone polygons'.



(a) Shrinking polygon just before a split event

(b) Split event happens and the polygon is split into two polygons.

(c) Split event happens again and the polygon is split into two triangles.



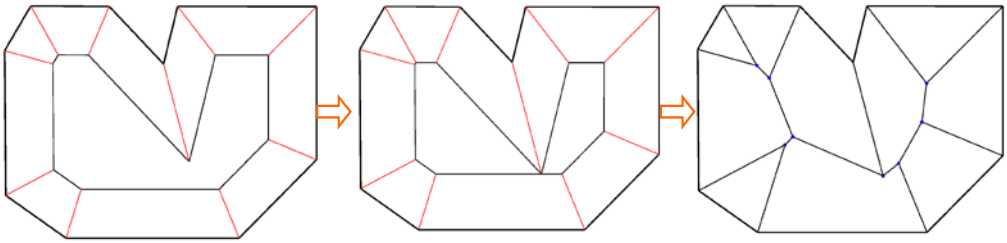
(d) Polygons shrinking at a constant interval: nodes by an edge event: nodes by a split event: nodes by a collapse of a triangle to a point.

(e) The straight skeleton defined as the union of the pieces of angular bisectors traced out by polygon vertices during the shrinking process

(f) A roof model automatically generated: each roof board is based on an 'interior monotone polygon' partitioned by straight skeleton

Figure 2. Shrinking process and a straight skeleton, a roof model automatically generated

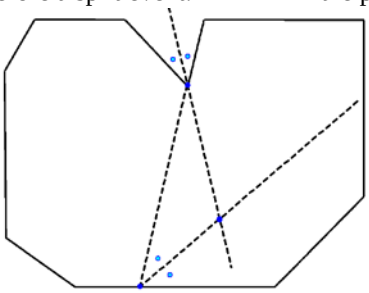
Figure 3, below, shows how a split event happens, and how the position of the node having arisen by the split event is calculated. The position of the node is given by the intersection of two angular bisectors: one from the reflex vertex and the other bisector situated between the intersected edge and one of two edges incident to the reflex vertex.



(a) Shrinking polygon just before a split event.

(b) Split event happens and the polygon is split into two.

(c) The straight skeleton formed as the union of the pieces of angular bisectors.



(d) The position of the node is given by the intersection of two angular bisectors: one from the reflex vertex and the other between the intersected edge and one of two edges incident to the reflex vertex.

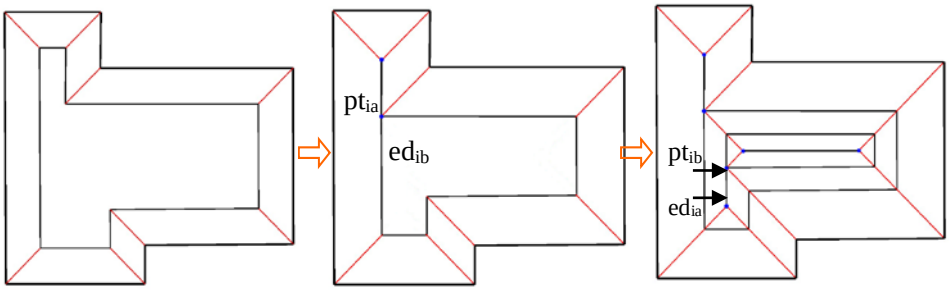
Figure 3. How a split event happens, and how the position of the node is calculated

For some polygons, such as those shown in Figure 4, the event may differ from the two events mentioned. In this research, it is proposed to add this third event, 'the simultaneous one', in which the above two events happen simultaneously. This event happens at an orthogonal part of the polygon as shown in Figure 4, in which event a reflex vertex runs into the edge, but the other split polygon is collapsed into a node since an edge event happens in the split polygon at the same time. Figure 4 shows a shrinking process of an orthogonal polygon. In the process, as shown in Figures 4(b) and (c), the system detects 'the simultaneous event' by checking if pt_{ia} (vertex) is on ed_{ib} (edge) or pt_{ib} is on ed_{ia} where pt_{ia} and pt_{ib} are the vertices next to two vertices coherent by the edge event, and ed_{ia} and ed_{ib} are the edges adjacent to these two coherent vertices.

Aichholzer et al. (1995) demonstrated three edge events let a triangle collapse to a point in the last stage of each split polygon as shown in Figure 2(d). In this paper, it is proposed to add the case in which two edge events let a rectangle collapse to a line segment ('a line of convergence') in the last stage, a rectangle whose opposite sides are the same and the shortest $\mathbf{e\_d}_{shri}$.

Since a line segment does not have an area, it is not shrunk anymore. The central area of an orthogonal polygon, shown in Figure 4(d), shows a line of convergence to which the shrinking polygon (rectangle) are converged.

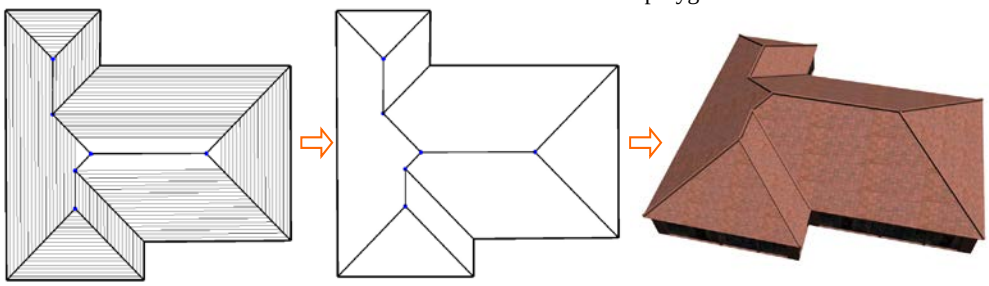
After calculating $\mathbf{e\_d}_{shri}$ for all edges and finding the shortest of them, the shrinking process may proceed until $\mathbf{d}_{shri}$ reaches the shortest $\mathbf{e\_d}_{shri}$ found. In the process, a split event may happen and the polygon will be divided. So, during shrinking to the shortest $\mathbf{e\_d}_{shri}$, our system checks if a line segment of an angular bisector from a reflex vertex intersects another edge of the polygon or not. If an edge is found intersected, the system calculates the position of the node by the split event as shown in Figure 3(d). However,



(a) Shrinking polygon just before a simultaneous event.

(b) A simultaneous event happens and the polygon is split into one node and one polygon.

(c) A simultaneous event happens again and the polygon is split into one node and one polygon.



(d) Polygons shrinking at a constant interval: nodes by an edge event and a simultaneous event: nodes by a collapse of a rectangle to a line.

(e) The straight skeleton defined as the union of the pieces of angular bisectors traced out by polygon vertices during the shrinking process.

(f) A roof model automatically generated: each roof board is based on an 'interior monotone polygon' partitioned by a straight skeleton.

Figure 4. Shrinking process and a straight skeleton for simultaneous events

one edge will be intersected by several angular bisectors from several reflex vertices. Among the several reflex vertices, the reflex vertex that gives the shortest $\mathbf{d}_{shri}$ will be selected for calculating the position.

After any type of event happens and the polygon changes topologically, we are left with one or more new polygons which are shrunk recursively if they have a non-zero area. At that moment, the system recalculates the length of each edge and internal angle of each vertex in order to find the shortest $\mathbf{d}_{shri}$ for the next events.

5. APPLICATION

Here are the examples of 3D building models automatically generated by the integrated system. Figure 5 shows the examples of 3D building models automatically generated by straight skeleton computation from non-orthogonal building polygons. To ease the discussion, Aichholzer et al. exclude degeneracies caused by special shapes of polygon, for example, a regular polygon.

In this paper, we deal with the degenerate cases in which more than three edges are shrunk to a point. Ideally, simultaneous n edge events cause a regular n-gon to collapse to a point but it is difficult to draw such a perfect regular n-gon. Accordingly, the system rectifies the shape of the regular n-gon so as to let n edge events occur at the same time. Figure 5, centre, shows the 3D dodecagon building model automatically generated based on the degeneracy of 12 edges being shrunk to only one node.

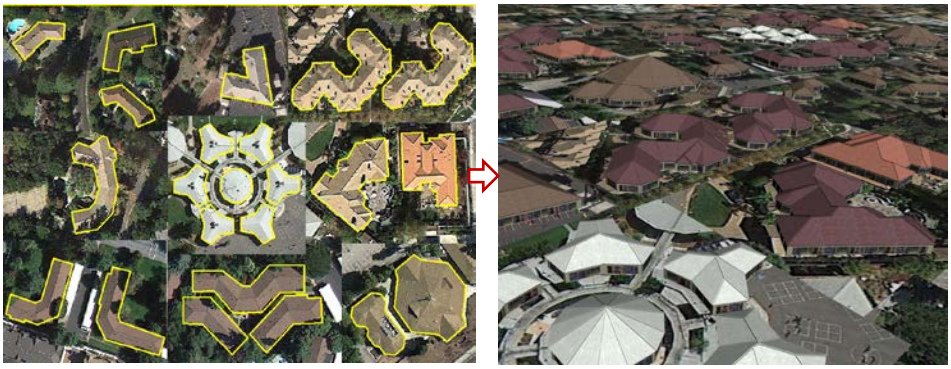


Figure 5. Non-orthogonal building footprints and 3D building models automatically generated by straight skeleton computation.

Based on digital maps, we propose the GIS and CG integrated system for automatically generating 3D building models. To generate real-world 3D urban models, the 3D shapes and material attributes of buildings and other objects need to be reconstructed. In the reconstructing process, the image data will be acquired by taking photographs of the objects in the city. But, when thinking of the future layout of the compact city and sustainable development, we cannot take photos of the future of the city and planning roads. Usually and traditionally, urban planners design the town layout for the future by drawing the maps, using GIS or CAD packages.

There may be several plans (digital maps) for urban planning. If the integrated system immediately converts these maps into 3D city models, the system surely supports the researchers and urban planners investigating the alternative idea.

Figures 6 and 7 show the digital map: the city layout proposed by an urban designer and a 3D urban model automatically generated. The area is called Meijo district in Nagoya City with a population of 2 million, the 4th largest city in Japan. This area is in almost the central area of Nagoya City and is located near Nagoya Castle. There are three- or four-storey apartment houses for government officials and citizens run by the municipal government. The area as a whole was selected as one of the areas for a city revitalization project by the Japanese government.

Figure 6 shows the alternative plan proposed by an urban designer, which is planned as low density in the middle area for condominiums with green spaces and urban facilities, and high density in both side areas for official housing and public housing. In the proposed alternative plan, as shown in Figure 7, terrace houses sharing green spaces in large courtyards are laid out for viewing Nagoya castle. The courtyards are enclosed by apartments, providing a shared park-like space for residents. Figure 7 also shows buildings are increasing in height away from the castle for each of the building's top floor residents to see Nagoya castle.

These alternative plans are created by merging generated 3D building models into three-dimensional maps (MAP CUBE) provided by Pasco Co., Ltd, an aerial survey company in Japan.

6. CONCLUSION

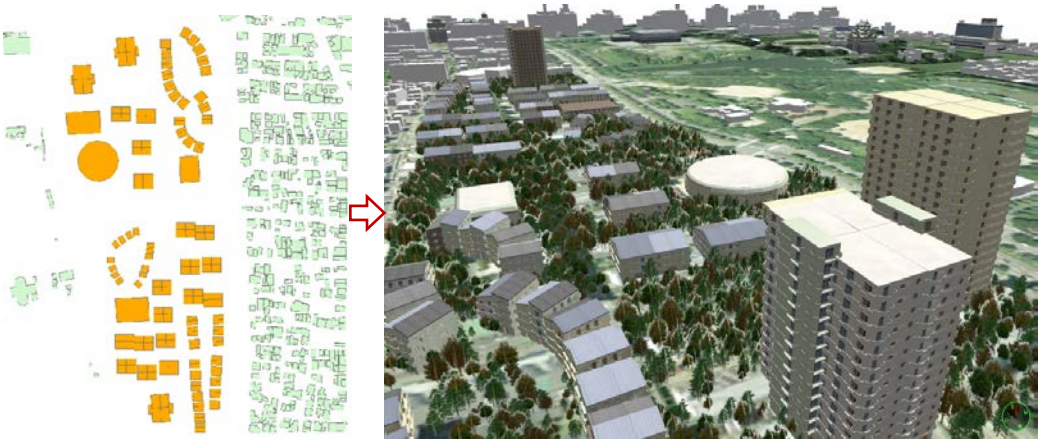


Figure 6. Proposed layout for the town and an automatically generated 3D urban model: low density in the middle area for condominiums with green spaces and urban facilities, and high density in both side areas for official housing and public housing

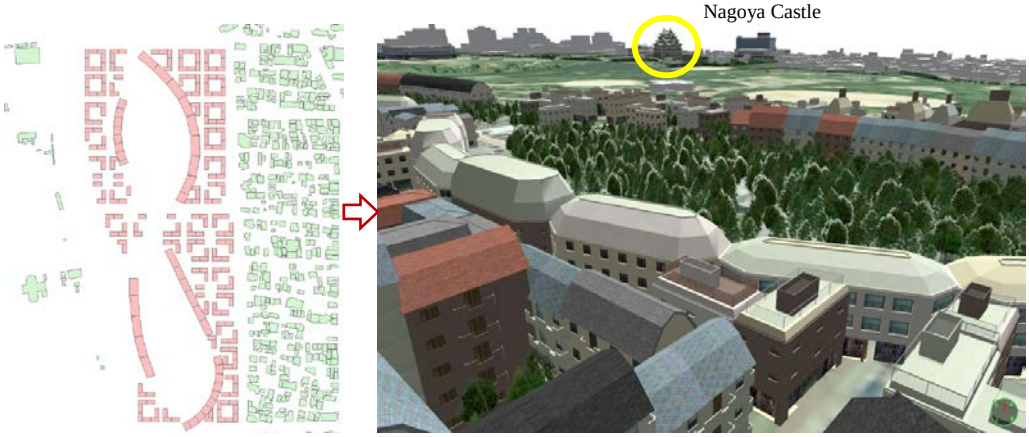


Figure 7. Proposed layout for the town and an automatically generated 3D urban model: terrace houses sharing green spaces in large courtyard, laid out for viewing Nagoya castle

For everyone, a 3D urban model is effective in understanding what, if this alternative plan is realized, the image of a sustainable city will be. Traditionally, urban planners design the city layout for the future by drawing building polygons on a digital map. This integrated system, depending on the building polygons, generates a 3D urban model so instantly that it meets the urgent demand to realize another alternative urban plan.

If given digital maps with attributes being inputted, as shown in the 'Application' section, the system automatically generates two hundred 3D building models within less than 20 minutes by a personal computer with an Intel Core i7 CPU 3.5GHz processor. In either orthogonal or non-orthogonal polygons, we propose the new system for automatically generating general shaped roof models by straight skeleton computation. In this paper, we propose the new methodology for constructing roof models by assuming the third event: simultaneous events in addition to two events and, at the end of the shrinking process, some rectangles converge into a line of convergence. Thus, the proposed integrated system succeeds in automatically generating alternative city plans.

The limitation of the system is that automatic generation is executed based only on ground plans or top views. There are some complicated shapes

of buildings whose outlines are curved or even crooked. To create these curved buildings, the system needs side views and front views for curved outline information. Future work will be directed towards the development of methods for the automatic generation algorithm to model curved buildings by using side views and front views.

REFERENCES

Aichholzer, O., Aurenhammer, F., et al. (1995). "A novel type of skeleton for polygons", *Journal of Universal Computer Science*, 1 (12), 752–761.

Carlos, V.A., Daniel, A.G., et al. (2010). "Building reconstruction using Manhattan-world grammars", *Computer Vision and Pattern Recognition* (CVPR), 2010 IEEE Conference, 358- 365.

Daniel, B.R. and Daniel, A.G. (2005). "Build-by-number: rearranging the real world to visualize novel architectural spaces", *Visualization*, 2005. VIS 05. IEEE, 143-150.

Daniel, A.G. Paul, R.A., et al. (2007). "Style Grammars for interactive Visualization of Architecture", *Visualization and Computer Graphics*, IEEE Transactions , 13, 786-797.

Gruen, A. and Wang, X. (1998). "CC-Modeler: A topology generator for 3-D city models", *ISPRS Journal of Photogrammetry & Remote Sensing*, 53(5), 286-295.

Gruen, A. et al. (2002). "Generation and visualization of 3D-city and facility models using CyberCity Modeler", *MapAsia*, 8, CD-ROM.

Müller, P., Wonka, P. et al. (2006). "Procedural modeling of buildings", *ACM Transactions on Graphics*, 25, (3), 614–623.

Nianjuan, J.P.T. and Loong-Fah, C. (2009). "Symmetric architecture modeling with a single image", *ACM Transactions on Graphics - TOG*, 28(5).

Parish, I.H.Y. and Müller, P. (2001). "Procedural modeling of cities", *Proceedings of ACM SIGGRAPH 2001*, ACM Press, E. Fiume, Ed., New York, 301-308.

Sugihara, K. (2009). "Automatic generation of 3d building models with various shapes of roofs", *ACM SIGGRAPH ASIA 2009*, Sketches DOI: 10.1145/1667146.1667181.

Sugihara, K. and Kikata, J. (2012). "Automatic Generation of 3D Building Models from Complicated Building Polygons", *Journal of Computing in Civil Engineering, ASCE* (American Society of Civil Engineers), DOI: 10.1061/(ASCE)CP.1943-5487.0000192.

Suveg, I. and Vosselman, G. (2002). "Automatic 3D Building Reconstruction", *Proceedings of SPIE*, 4661, 59-69.

Zlatanova, S. and Heuvel Van Den, F.A. (2002). "Knowledge-based automatic 3D line extraction from close range images", *International Archives of Photogrammetry and Remote Sensing*, 34, 233- 238.

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Managing "Buffer"

A Special Focus on the Itsukushima Shinto Shrine World Heritage Site, Japan

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Abstract: Itsukushima Shinto Shrine is the supreme example that represents the legacy of Japanese tradition as well as the beauty and harmony of nature, humankind and the gods. This oldest shrine, believed to be established in the 6th century, has maintained authentic religious practices by the Shinto masters and community over the centuries. The shrine was inscribed as a World Heritage Site in 1996. The shrine is observed floating above the sea during high tide and visitors have been fascinated by its beauty since the Japanese Edo period, when the Samurai rulers were allowed to issue travel permission to the population to travel to selected destinations, including Itsukushima. It was the beginning of a legacy of a prime tourist destination. Arguably, the circumstances of Itsukushima Shinto Shrine are encroached on by residential and commercial districts which accommodate over 3.5 million annual visitors, and the authorities and industrial sector giving more encouragement to the tourism industry after the site's World Heritage listing. Furthermore, the geographical setting and cosmology of Itsukushima Shinto Shrine is not limited to the island territory. There is a holy axis from the shrine that crosses the channel and reaches to the mainland where most of the hilly areas are occupied by residential, commercial and industrial land uses. Itsukushima Shinto Shrine exists peacefully, it is even said that holiness and contemporary needs have co-existed within this particular enclave. However, due to recent global warming, the sensitive geographical setting of the shrine is facing greater threats. In recent years, Itsukushima has suffered ever more serious damage by natural disasters never observed before. This paper intends to provide a broader perspective, connecting both protected property and surrounding geographical territory for future heritage site management.

1. INTRODUCTION

Preserving historic properties in contemporary society and managing the surrounding environment is one of the prime issues to enhancing historic significance as well as to meet the requirements of sustainable development. Recent arguments, especially regarding the site management of World Heritage sites, the way to maintain the surrounding buffer-zone territory is highlighted to mitigate development pressure, adjust land use, as well as create continuity within a holistic interpretation of history.

Japanese society experienced rapid economic development in the wake of WWII, yet managed to establish ways of preserving her heritage. On the

other hand, looking at the experience of these long years more closely, sometimes historic sites are considered to represent invisible socio-cultural conflicts under the social development process; tradition and modernity, conservation and development, holiness and worldliness - especially these phenomena are significant in heritage areas with spiritual or religious representation. These phenomena widely invite academic attention, for example, authors on "Historic Cities and Sacred Sites" discuss the ways to strengthen the local preservation capacity, including spiritual and material dimensions of historic sites as well as different social sectors (Serageldin, et al., 2001) Preserving "Sacred Place" as such in Itsukushima Shrine, is substantially different between historic sites and surrounding contemporary society, sometimes showing us that they stand across two different worlds. Yet it has been expected that they meld together and function as a whole, as valuable sustainable development resources to contribute to a worldly local society which consists of various business sectors, social classes, or political backgrounds. Additionally, people amongst more democratized societies have substantially increased public involvement, determining more pragmatic outcomes, for example regarding tourism development (McGregor and Thompson-Fawcett, 2011). Further integrated management and planning approaches beyond both physical and social boundaries are essential issues to ensure future sustainability of holistic, historical environments.

This paper intends to provide a perspective to connect both protected property and surrounding geographical territory, foreseeing future possible heritage site management scenarios. The intention of this paper is to provide and analyse future sustainable conservation and spatial management through the case of Itsukushima Shinto Shrine in Japan. The objective of this study is to describe the reality of site management issues in Itsukushima, including the following aspects:

(1) Describe historic connections and transformation of Itsukushima Shinto Shrine and surroundings;
(2) Analyse sustainable planning issues of surrounding environment of Itsukushima Shinto Shrine; and
(3) Discuss future sustainable planning of surrounding environment of historical environment.

In recent years, spatial management issues with respect to historic sites and their surroundings have been the focus of various fields - heritage preservation, planning, tourism, and local governance. In fact, some World Heritage sites have been observed to be threatened by development taking place in the surrounding areas. In 2006, these issues were discussed at the international symposium in Hiroshima, Japan, entitled "World Heritage Convention and the Buffer Zone," organized by ICOMOS (International Council on Monuments and Sites). During this symposium, participants discussed ways to go beyond existing academic disciplinary barriers and administrative authorities, which are sometimes observed to be disconnected from these issues, to create better historical environments.

Nishimura (1997) discussed and analysed the current situation of Japanese historic cities, and pointed out that there was a lack of preservation efforts for such historic spatial environments due to the legal planning frameworks. He proposed integrating various legal systems of planning, preservation, and urban design. Additionally, he remarked that this integration is enhanced by increased public participation.

Larkham (1996) explores the current heritage conservation issues mainly in the United Kingdom and the development process of heritage conservation discourse, as well as perceptions of the public in general. During the process of heritage conservation, he pointed out the necessity of integrating the local community into the overall process—in particular, the decision-making process and governing bodies—which are keys to the quality of conserved historic properties and the surrounding landscape.

Among the World Heritage cities, site management teams own the difficult task of making adjustments to various stakeholders and the spatial management around the historic sites. These adjustments entail various types of actors, including those only temporarily related to heritage; for one, the visitors' interpretation is always a central issue for determining the nature of the spatial management of historic sites.

Parry (2006) discussed the case of Liverpool as a World Heritage City and suggested ways for future integration of destination management. The argument is the degree to which the difference between "true heritage" and history is understood, because a poor understanding sometimes produces a disappointment for visitors. Parry analysed different factors besides those influencing historic sites, in terms of both physical and intangible aspects, and how the interplay of these different elements defines the experiences of both locals and visitors.

Buhalis, et al. (2006) considered future approaches to site management for World Heritage sites. These are an application of new spatial management approaches. Buhalis pointed out that ICT (Information and Communication Technology) will be useful for obtaining historic significance for visitors as well as for sustaining the legacy of the sites for the next generation. These holistic ICT approaches provide information to visitors before, during, and after visiting the sites. It is believed that ICT will provide more integrated information to facilitate an understanding of historic sites.

To a great extent, historic sites and their surroundings function to interpret history for people from different historic backgrounds, beliefs, social classes, ethnic groups and political stances. However, the spatial setting has been sometimes formulated by the attribution of the so-called authorized history.

Logan, et al. (2009) explore the realities of preserving history with difficult memories of the past. Not all historic sites in the world represent social glory and successful memories. Not an insignificant number of heritage sites represent pain and the shame of the past; these experiences are dealt with in different ways by diverse ethnic groups, genders, and classes. The spatial arrangement of historic sites arguably appears to represent a holistic history that often reflects the political correctness formulated by social majority groups.

Utaka (2009) examines the reality of another World Heritage site in Hiroshima, the Hiroshima Peace Memorial. Utaka traces the transformation of the spatial planning and site management aspects around Hiroshima, and points out that the historic site in Hiroshima represents past legacies of war and peace.

These memories of both local and global community are met and condensed within the small historic place, and these spatial representations raise questions about conventional preservation methodologies attributed to scientific proof of materials and age.

Tokoro (2000) pointed out that any kind of heritage conservation needs to refer to the local cultural settings, especially sacred sites that reflect

intangible value systems. Tokoro uses an example of the Ise Shrine in Japan, which regularly experiences “removal and renewal.” These heritage buildings are not given higher priority as historic sites according to conventional ways of gauging historic significance that require understanding of intangible aspects of space.

2. THE LEGACY OF ITSUKUSHIMA: FROM HOLY PLACE TO THE TOURIST DESTINATION

2.1 Early Days Itsukushima: Making Holy Land

The legacy of Itsukushima has been represented in Japanese history since ancient times. The island is situated in the central location of the Seto Inland Sea, it is recognized as an important holy place. Long discussed among historians, it is widely accepted that the Shrine was founded as early as 600AD. Immediately after the foundation period of Itsukushima, the built form that appeared at the present location was much primitive than present. A priest recorded the first constructions of the shrine pavilions in 1168. After the major construction commenced, shrine pavilions were expanded and completed by the most prominent warrior cum political leader Taira no Kiyomori. He dedicated great efforts to build the Shrine and prayed for his Taira Clan’s glory until his fall in the great battle against his competitor the Minamoto Clan. The Minamoto continued their support for prayers at Itsukushima, and no ensuing leader destroyed the Shrine until today, even though a large number of prominent places of worship in the world have been destroyed by political or religious regime changes. Itsukushima has survived socio-political changes since its foundation period; unfortunately, the Shrine is continuously destroyed by natural disasters and fires. Shrine priests and rulers made utmost efforts to reconstruct, even if at times this imposed a heavy burden, for example when the Shrine had suffered complete destruction. The Shrine continuously seeks wider support from rulers for faster recovery, and these supports provided extensions of new pavilions.

Since early history, Itsukushima Island and Mt. Misen were considered holy places - no visitor was allowed to land, even priests resided on the mainland and traveled to the Shrine only for ritual occasions. In the following years, due to the increasing necessity for regular management works, Itsukushima gradually accepted a small number of priests and carpenters. In fact, an old document remarked that a group of craftsmen stayed temporally to carry out reconstruction works for the damaged shrine in early 1700. In addition, according to the record of donators for pagodas and shrine pavilions, Itsukushima gained wider support from merchants and traders. Gradually, Itsukushima allowed selected people to reside on the island territory and, in later years, opened doors for the general public to visit.

2.2 Expansion and early tourism development in Edo period

Until the middle of the Edo Period (1603-1868), people were not allowed to travel freely or migrate. Travel was controlled, unless travel pass (*Tegata*) were obtained from relevant authorities. Along major old highways (*Kaidou*), traffic checkpoints (*Sekisho*) were built to conduct strict immigration and goods checks by authorities. The strictest checks were

carried out for ladies from, and weapons to, the capital city Edo. These controls were slowly de-regulated from the middle of the Edo period when the Japanese enjoyed their first experience of a warless age. In fact, travelers obtained their travel permission easier than previously if they declared that their destinations were shrines or temples for religious pilgrimage. Among the religious worship sites in Japan, Itsukushima has been recognized as one of the most prominent destinations for pilgrimage.

For most of the visitors, the main reason for traveling was a pilgrimage to Itsukushima. But more than that, they had another intention; pleasure and entertainment. For Japanese then, traveling abroad was usually a lifetime dream, because at that time Japan's population had difficulty even securing their daily diets. During the Edo period, Itsukushima grew as the most established pleasure town – plays, music, festivals, lotteries - it was widely observed as similar to a big city. Additionally, new migrants to the island were those involved with trade, transportation, construction, or entertainment. These growths multiplied the appeal of the site as a tourist destination, the shrine itself became a more renowned destination among Japanese which was epitomized by the recognition of the site as one of "Japan's Three Most Beautiful Sceneries (*Nihon San Kei*)" since the middle of the 1600s, when Japanese philosophers praised the beauty of Itsukushima in their written works.

Looking at the pictures portraying the scenery of a street of Itsukushima, there were already established streets fully occupied by shops and stalls. Visitors were rushing to their favorite shops and street vendors were seeking their customers – there is a lively dynamism on the high streets, representative of the growing early days of Japanese urbanism. These lifestyles were spread over from Itsukushima to more remote areas through sea routes or old highways that extended during the period of the feudal Edo government.

2.3 Rising modernist Meiji and Japanese historic sites

Eventually the Edo government ended in 1868; the succession from feudal Edo to the modern Meiji Period is one of the most significant Japanese regime changes to this day. The new Meiji government targeted carrying out national modernization, believing this to be the only way to resist the colonialist expansion, especially of her counterparts from the West. In fact, the greatest efforts of the new Meiji government were to build modern industrial facilities as well as military forces. At times, traditional faces were disregarded in the new age or even considered as obstacles to social modernization. A significant number of shrines and temples were abandoned and the surrounding towns lost their attractiveness. Interestingly enough, the Meiji government and the newly established modern administrative body of Prefectural governments enacted new legislation which designated particular locations as "parks". Fortunately, Itsukushima was selected as the "Itsukushima Park". It was observed that this had an important impact on Itsukushima's social modernization later (Sunamoto, 2007).

Subsequently, the Meiji Government enacted the "Act for the Preservation of Shrines and Temples" in 1897 and Itsukushima shrine was designated within the first batch. Under this enactment, the government carried out preservation projects at Itsukushima. Arguably, the implementation of government-led heritage conservation also contributed to encouraging and enlightening people to develop more nationalistic fervor. At that time, Japan expressed her hostility towards her Western counterparts,

especially those nations that were aggressively pursuing expansionism in the Far East. On the other hand, the government had an eye on these protected properties as resources towards further tourism development.

3. PRESERVING THE SHRINE: FROM SACRED PLACE TO WORLD HERITAGE SITE

3.1 Preservation in Itsukushima

Itsukushima has been treated as a heritage property since the early Meiji Period. After the enactment of the "*Act for the Preservation of Shrines and Temples*", historical artifacts in the shrine had been added as "National Treasures" and buildings were designated as preservation properties. In the following years, the shrine carefully carried out major preservation projects. In 1923, the island territory was designated as one "Place of Scenic Beauty" (*Meishou*) which might be understood to mean the expansion of heritage property in Itsukushima. Interestingly, these new applications of protection policies were expanded to surrounding natural heritages which were treated as sacred places, such as Mt. Misen.

These nomination and preservation projects were never interrupted during post-war periods, except for frequent natural disasters which continue to attack Itsukushima to this day. In order to carry out reconstruction projects during war periods in Japan when the society struggled with social disorder, governmental preservation policies were the essential force to conserve these historic properties which had a destiny of vulnerability. In the years after World War II, in 1952, Itsukushima Island was designated as one of the "Special Historic Sites" (*Tokubetsu shiseki).* These preservation policies were multiplied, especially for the surrounding area of the Shrine, and understood as one of the most advanced and substantial policies implemented among historic sites in Japan.

On the other hand, not only were these preservation efforts provided by governmental commitment, but also substantial efforts were paid by the Shrine's community consisting of residents, donors, management officials and carpenters engaged since establishment of the shrine. Itsukushima Shrine has its shrine carpenters - those with specially trained fine skills and respected by the public in general. This is fortunate, as the Shrine does need its own carpenters to deal with the frequent natural disasters to this day.

According to the statistics provided by authority, there were a few floods observed during the 1990s. However, since 2001 the number of floods has been rising - in 2001: 12 times, in 2002: 10, in 2003: 11, in 2004: 17 (the Ministry of Land, Infrastructure, Transport and Tourism, 2004). During high tide, sea water sometimes rises above the height of the Shrine platforms and floods practically all the Shrine pavilions which were built on the northern shoals of Itsukushima Island. One of the worst recent cases was during Typhoon No.18 in 2004, when the water level rose to 50 cm above the platform and many pavilions were seriously damaged by storm, included the famous Noh stage and pavilion. Against the typhoon attacks, Shrine priests and staff urged fixing the floors and pavilions which are sometimes drawn into the sea. Despite this, damage is becoming increasingly more serious and frequent, yet it is almost unfeasible to alter the architectural setting of the Shrine – for example, to increase the floor height - so as to keep intact the original architectural beauty of the Shrine that was designated the "Important Cultural Property." However, it is said that these floods will be worsening in

the future.

The shrine carpenters are not only trained with authentic restoration techniques, but also carry responsibilities for meeting contemporary needs for site management; adapting barrier-free needs, installation of latest fire monitoring and prevention equipment, selecting restoration materials including imported timbers, et cetera.

A researcher in Hiroshima, Nobuyuki Uemura, has analyzed barrier-free needs for visitors through intensive questioner surveys, and urges the need to carry out further barrier-free maintenance (Uemura, et al., 2005).

Recently, some experts looked into the traditional practices of Itsukushima Shrine. For example, a researcher Takuji Hamamoto pointed out that Itsukushima Shrine has traditional anti-disaster measures and practical know-how; site selection, architectural form and building details with enough attractiveness for the disaster prone Japanese society (Hamamoto, 2011).

3.2 World Heritage Listing

As mentioned above, Itsukushima is carefully treated among domestic society and is almost a representative of the "national culture" for the international community. It is argued in this paper that Itsukushima's internationalization is epitomized by the prestigious World Heritage listing in 1996, following the first batch of Japanese World Heritage listings of Himeji Castle and Religious Heritages in Kyoto and Nara in 1993. The World Heritage Committee in 1996 clearly stated the historic significance of Itsukushima and its Shrine:

Itsukushima Shinto Shrine 776 Japan C (i) (ii) (iv) (vi); The Committee decided to inscribe the nominated property on the basis of cultural criteria (i), (ii), (iv) and (vi) as the supreme example of this form of religious centre, setting traditional architecture of great artistic and technical merit against a dramatic natural background and thereby creating a work of art of incomparable physical beauty. The Delegate of Germany suggested that the authorities may consider cultural landscape criteria for a possible extension.

The criteria for the adoption of Itsukushima Shrine as a World Heritage site were provided in Operational Guidelines as follows: (i) to represent a masterpiece of human creative genius; (ii) to exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town-planning or landscape design; (iv) to be an outstanding example of a type of building, architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history; (vi) to be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance.

These stated criteria expressing the significance of the Shrine, not only within the domestic society, adopted the so-called "Outstanding Universal Value" shared internationally. Itsukushima Island and the territory obtained another emblem towards its accomplishment of being a "holy island" representing Japanese social and cultural heritage.

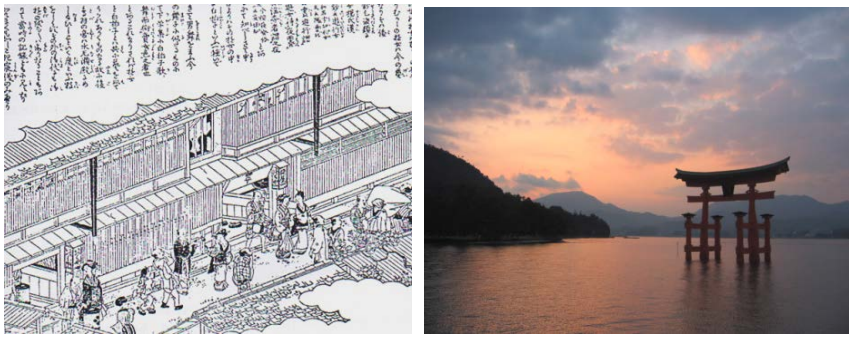


Figure 1. Images of Itsukushima Shrine
Picture right: Grand Gate of Itsukushima Shrine (Nobuyuki Uemura, 2007)
Picture left: Itsukushima during Edo Period (*Geishu Itsukushima Zue*, 1842)

4. SHRINE TOWN: FROM MARGINAL AREA TO THE SURROUNDINGS OF HISTORY

4.1 Challenges towards designation of preservation district

Previously, the surrounding shrine town had not been recognized with much significance for heritage conservation, as compared to the Shrine. The area has been designated a "*Special Historic Site*" (*tokubetsu shiseki)* for many years, which is effective for only development control without incentives for stakeholders, despite the shrine town having close relations in establishing the shrines history many years ago.

Recently, national and local authorities have carried out a series of feasibility studies towards future enactment of the preservation of districts under the legal heritage conservation system - "*Preservation Districts for Groups of Traditional Buildings.*" Among domestic heritage conservation experts, they discussed that Itsukushima can be almost the final masterpiece of the preservation district system which was enacted in the 1970s. Government selected nearly 100 districts throughout the nation. In fact, the feasibility report later revealed that there were more important historic built heritage sites than expected initially, and concluded that the area was suitable to be included among Japanese preservation districts. "*Preservation Districts for Groups of Traditional Buildings*" applied to traditional settlements consisting mainly of private properties. Once a proposed area meets with governmental "*selection*", stakeholders are required to maintain traditional housing under the regulation and obtain restoration subsidies from authority.

According to the research report "*Research Report of the Future Preservation District of Groups of Historic Buildings*" there are nearly 300 pre-war architecture units; 100 units were built before the Meiji Period, nearly another 200 units were from the Meiji to end of the war period (Hatsukaichi City Government, 2007). Generally, these architectures are given higher priority for preservation projects, and the shrine town is recognized as an important element in the historic enclave of Itsukushima. The surrounding historic enclave exists as a background to enhance the beauty of the Shrine; conversely, future insensitive development might cause problems upon the landscape.

4.2 Social diversity among shrine town community

Throughout the conduct of the intensive research project on Itsukushima, diverse architecture built forms was confirmed; town houses for a variety of social classes and businesses, and with differing construction methods. The high street in Itsukushima is occupied by relatively larger two story shop-cum-residential town houses, while smaller tenant houses are located along alleys. Social classes were clearly distinguished by differing house sizes, quality of building materials, and decorations. Additionally, recycled timber from other buildings was widely observed, especially for tenant or commercial use, as generally these buildings are required to be affordable.

Interestingly, this diversity of housing classes was observed and mixed within neighbourhoods that had never been segregated. These smaller spaces are organically connected with Itsukushima's overall history. A historic background of a tourist destination in Itsukushima was also reflected, for example, there were brothels. Hiroshi Nunokawa revealed this historic background in his study (Nunokawa, 2001). These brothels have particular decorations on the façade and plan. Generally, the grand-floor was reserved for management and guest relations. Up-stair, there were small tatami-mat guest rooms, and the floor was connected by a wide staircase with grand-floor. These brothels were closed down in later years, but their particular architecture style has remained, and some are used as residential and retail buildings. These remains are part of the holistic history of Itsukushima; however, sometimes these heritages are given lower priority for preservation and can even be neglected because they are considered as holding negative memories of the past.

4.3 Policy implementation and the challenges

Despite the detailed research results of the historical significance of these buildings demonstrated by the researchers involved in the feasibility study, a significant number of houses were torn down or abandoned. It is urged to implement a preservation policy and carry out preservation projects. However, this implementation of a preservation district is not readily possible; under the current deficit and the financial situation among local authorities, the local community withholds their towards heritage conservation.

Adding to the problem for conservationists in the Shrine town is the new enactment of a landslide prevention act. In Japan, the "*Act on Sediment Disaster Countermeasures for Sediment Disaster Prone Areas*" *(2000)* was enacted after people requested for many years for protection measures from the tragedy of landslide disasters. Hiroshima Prefecture had the unforgettable experience of a huge landslide in 1999 and the loss of livestock and infrastructure, including on Itsukushima Island. The 1999 downpour caused landslides on mountains in Miyajima, and streets and rivers were miserably covered by mud and drowned timbers, uncountable number of houses were destroyed. As a result, since the landslide prevention act has been enacted, most of the shrine town area was designated a "*landslide warning area*", a so-called Yellow Zone. Some higher hillside areas were included in the so-called Red Zone or "*landslide special warning area*" under the new enactment. Authorities take adequate measures for these areas. If property owners plan to build or alter their property, they are

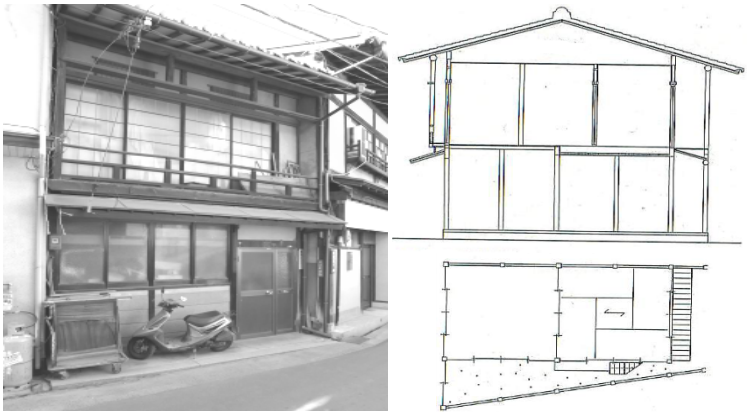
required to pass through a more strict development submission process that must pay more attention to structural resistance against landslides.

Despite these unresolved issues raised, there are other theoretical questions that have been raised. Needless to say, Itsukushima is providing a most attractive case to conduct research activities for academics; basically they are focusing on particular periods of time and phenomena.

Physical evidence revealed by architecture experts is, however, predominantly from the Edo period. There is fewer evidence from previous historic periods. This tendency is widely observed in Japanese preserved historic properties - arguably enhanced and focused on Edo's culture and history. A historian questioned why Itsukushima's shrine town's history and culture were presented from Edo perspectives through conventional heritage conservation, even though there are some physical exhibits from the pre-Edo period, and less attention is paid to younger heritage. Arguably, these queries are questioning the way to represent Itsukushima's long history within historical evidence remaining to this day.

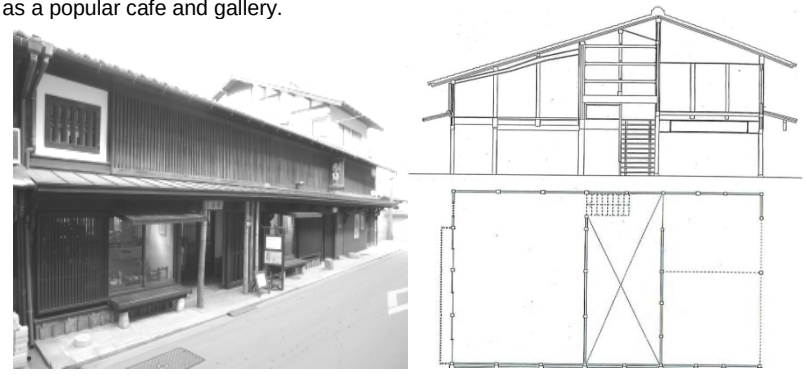
Case 1: House A (Left: façade / Right: Examined original cross section and plan)

A middle size town house in the north part of the shrine town, consisting of two floors of unique trapezoid plan to follow land shape. Decorated and carefully selected materials and walls are painted a bright blue colour that is generally found in guest rooms for entertainment. In the grand floor, there is an earth floor for the entrance and domestic use and two tatami rooms. The 1st floor has two tatami rooms with narrow veranda. Two floors are connected by steep and narrow stairs which have only a 350mm width.



Case 2: House B (Left: façade / Right: Examined original cross section and plan)

A large size town house in the centre of the shrine town consisting of two floors with a large void space and earth floor on the grand floor. There are recycled timber and remains which indicate major alternation of structures. This town house is connected to the neighbouring house, and has renovated interiors. It is now used as a popular cafe and gallery.



Case 3: House C (Left: façade / Right: Examined original cross section and plan)

A small link house is in an alley of the central shrine town. It has two tatami rooms with a small earth floor. Connected units have the same plan, altered remarkably to

accommodate more family members. Windows and doors are changed to contemporary materials, but include some remains of old recycled materials. This is a typical example existing of an old link house in the shrine town.

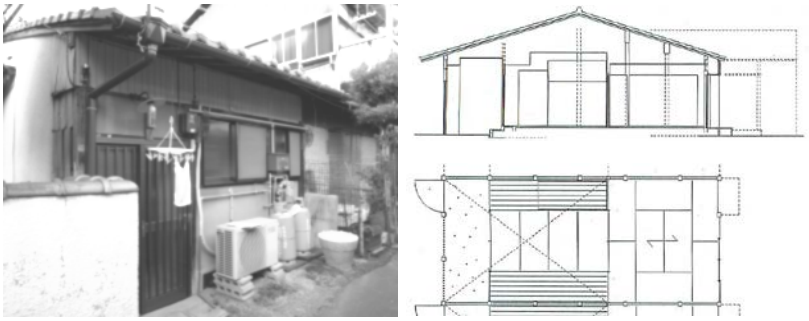


Figure 2. Varieties of House in the Shrine Town
(Survey conducted by Uemura, and Utaka, in 2004, included with the study report; National Trust Japan (2005) *Research Report of the Shrine Town of Itsukushima Shrine*, p.8, p.12, p.13.)

5. LANDSCAPE: CROSSING THE CHANNEL

5.1 Landscape beyond "core" and "buffer"

The beauty of Itsukushima is not concluded within the Shrine territory only. In fact, the surrounding scenery of the Shrine is an important background to enhance the existence of the shrine, which represents the beauty and harmony of nature, humankind and the gods.

In fact, during the nomination process of the prestigious World Heritage Listing of Itsukushima Shrine in 1996, authorities officially designated all islands and some portions of the marine water surface as the World Heritage "Buffer Zone" also designated as "Special Historic Sites" (*tokubetsu shiseki)*. Additionally, the most important "Core Zone" includes, of course, the shrine pavilions and surrounding historic properties, and some portions of mountain, Mt. Misen, which has also been defined as a place of worship since the establishment of Itsukushima. On the other hand, the shrine town area which was predominantly occupied by commercial and residential buildings is excluded from the "Core Zone" even though, as discussed in the previous chapter, not a substantial number of buildings and houses are believed to have been built during Edo period.

5.2 Perspective beyond holy land

The most expressive scenery of the Shrine is the platform to the mainland through the Grand Gate. Most visitors are fascinated and take pictures, but some express their incongruity when they find an over developed landscape in the mainland, especially housing estates scratched on hills, high-rise buildings on costal lines and massive commercial buildings nearby. These points of views have been argued continuously since the Japanese high economic growth of the 1970s when Japan experienced rapid economic development. Generally, the Hiroshima metropolitan province has a relatively small plain of land for industrial and housing development required to accommodate a population of over 1.8 million. Housing estates on the mainland, opposite Itsukushima Island, are some of the most established locations developed since the late 1970s, and these hillside estates are attractive for house seekers. They enjoy superb views of the peaceful Seto Inland Sea, Itsukushima Island and the Shrine. In the

following years, a number of companies built company-resorts for their employees along the coastal line on the mainland; at that time most Japanese companies were enjoying good business conditions. On the other hand, from time to time, these developed landscapes on the mainland were criticized by citizen interest groups who paid more sensitive attention to development in general, and said that authorities needed to implement more strict landscape controls and mitigate existing developments.

Arguably, these appeals have been slowly penetrating into the public in general since the late 1990s when Japanese society experienced the collapse of the "Bubble Economy", and has now been enduring a never-ending economic slump. Recently, "landscape" has been gradually considered as essential among populations in Japan, in fact a recent landscape versus development court case showed that judgments accorded greater importance for conserving traditional landscape than continued conventional development proposals.

It is argued in this paper that this rising awareness towards traditional landscape in Japan can be explained as people's reaction, uneasiness and crisis of confidence following the long years of economic downturn. Conversely, Japan's long-term dreams of national development since her post-war reconstruction; for example, epitomizing a post-war reconstruction experience in neighbouring Hiroshima City - have almost materialized and never been destructed.

Recently, the landscape debate about Itsukushima has been epitomized by a high-rise apartment development along the coastal area of the mainland. A developer proposed a multi-storey apartment development on the site of an abandoned amusement park. This development proposal was fully adopted and approved by authorities, however, conservationists and supporting planning experts showed their objection because of effects on the landscape (Nishi Hiroshima Times, 1998). A research group revealed the results of their own exercise for the future of the landscape. It included an idea for the establishment of a new "Secondary Buffer Zone" which has a 5 km radius from the Shrine with more strict development controls (Yomiuri News Paper, 1999). Another expert group paid attention to the connection with Zigozen Shrine which played an important role as an outer shrine accepting prayers from those previously prohibited entering the island. Conservationists are questioning the over-development of the area; there are reclaimed lands and building blocks on the "holy axis" between Zigozen and Itukushima Shrine, even though they have been almost invisible from one another for many years. Generally, their perspective was of a quality landscape extending horizontally, as existed previously. However, recently, another perspective has been included; a vertical extent - a peace group questioning the noise of jetfighters from neighbouring Iwakuni Japanese Self Defense Force and US Marine Corps airbase; questioning why these military powers are "invading" the sky of the island of holiness.

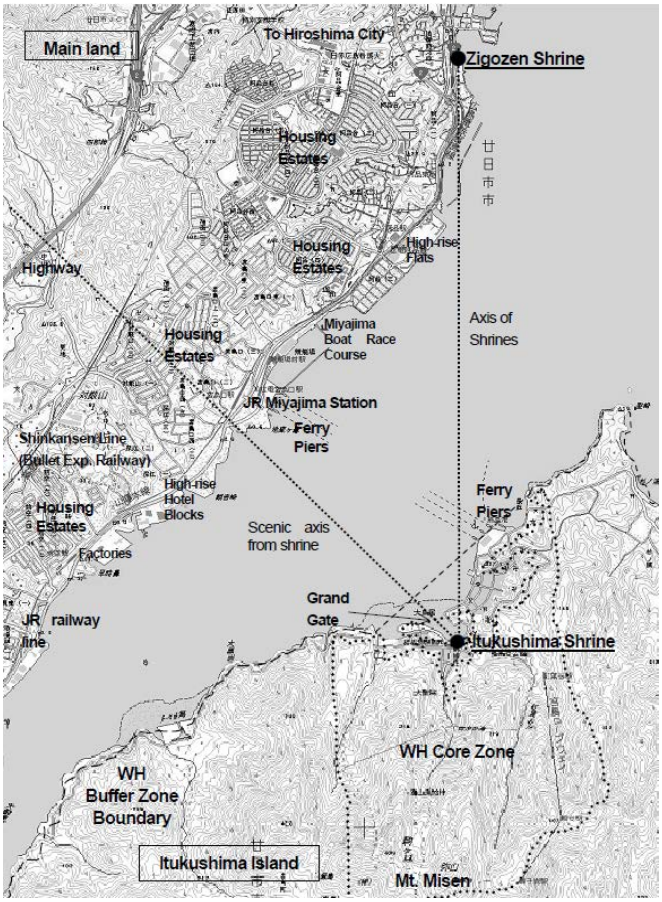


Figure 3. Lines of sight from Itsukushima Shrine.
(Base map: Geo-spatial Information Authority of Japan)

6. REAL ESTATE ASPECT ON ITSUKUSHIMA

6.1 Holy land as a living place

As a matter of fact, despite its highly evaluated historical significance, Itsukushima has been experiencing drastic circumstance changes by external development pressures. Conversely, there are internal issues too; Itsukushima is continuously decreasing in population. The population in Itsukushima peaked during in the 1970s when Japan experienced high economic growth and higher demand for the tourism industry. However, Itsukushima's population is now continuously decreasing, and the demographic pattern has also shifted to an aging society; statistics showed an elder population of over 30%.

This tendency - depopulation and aging - is not observed only in Itsukushima and the province; it is commonly observed nationwide. However, Itsukushima's demographic pattern always indicates higher and faster trends compare to the national average and most towns of her counterparts in the province. Currently, Itsukushima's population is below 2000 and has never stopped decreasing (Hatukaichi City Government, 2010). This silent change of Itsukushima's community is affecting the nature of this historical shrine town. Many "Machiya" townhouses are abandoned, or occupied by single elders. These phenomena might be observed as a substantial backlash of cultural heritage conservation in sustaining a traditional community within its physical setting.

However, the majority of landlords in the island are not positive toward selling or renting to house seekers from other towns. Among this relatively conservative community, it is said that people are always worried about negative reputations from neighbours if the buyer or occupier makes noise within the old neighbourhoods - these trends are widely observed in historic quarters in Japan.

Sue Millar investigated the nature of community on heritage sites, and pointed out that heritage management plans are required to focus the diversity of community, including layers and levels of community participation (Millar, 2006).

6.2 Utilizing historic house: reality and challenge

Furthermore, Itsukushima's real estate evaluations are still high, despite a recent Japanese real-estate down-turn. According to the local real-estate agents this reflects the nature of the island - limited land resources, relatively strict development controls, and high demand for commercial use that generally demands higher prices. In Japan, generally, real-estate is evaluated separately for lands and buildings. Commonly, only land is evaluated as a property with economic value, even though the building may be confirmed as heritage. On the contrary, historical buildings are sometimes regarded as no-value "deserted houses", even then, they are given negative evaluations due to the required demolition work cost or hidden expenditure.

Of course, there are exceptions; especially properties with potential for commercial use or advanced locations where some booming "Machiya towns", similar to renowned tourist destinations in Kyoto, are widely observed. Unfortunately, the majority of the real-estate evaluation methods for architecture do not add positive value from historic significance, due to the Japanese population's preference to occupy "new" property. According to the statistics of the Japanese housing census, Japanese houses including old houses or estate housing are demolished after 30 years on average.

Local authorities and community groups have taken action to mitigate these trends. In fact, some have directed their eyes toward heritage properties with potential. There are some renovated Machiya cases which are converted into retail or short-stay accommodation operated by private sectors. These renovation projects require an amount of investment however, and owners need to be prepared for unavoidable additional costs that generally cause the projects to adopt a wooden ramshackle traditional house feel with contemporary Japanese structural adjustments as required by the "*Building Standards Act*" and other required legal permissions. These projects operated by relatively young entrepreneurs are regarded as successful by the local community in general. It is said that further cooperation and understandings by the wider local community is essential to determine the success of their projects.

Chua Rhan See seeks a possible scenario of adequate "adaptive reuse" in historic cities in Asia. She pointed out the use and nature of heritage buildings are far more varied based on the activity in the buildings, especially buildings located in historic tourist destinations (Chua, 2011).

The tourism industry in Itsukushima town is, of course, regarded as the most vital industrial sector for future revitalization. According to the report "*Regional Tourism Development Plan Hiroshima, Miyajima, Iwakuni*" which was prepared by authorities in 2008, the number of visitors to Itsukushima is constantly increasing and indicated 3 million per year, especially foreign visitors of which there has been a sharp increase of 0.1

million, almost double the national increase, and it is believed that Itsukushima is featured prolifically by internationally renowned visitors' guides (Japan Tourism Agency, 2008).

Janet Cochrane and Richard Tapper focused on future heritage conservation which requires closer ties with tourism sectors as well as adequate revenue from them, and site managers are required to commit more to the tourism sector (Cochrane and Tapper, 2006).

However, the tourism industry in Itsukushima contains issues which are shared by authorities and experts. It is said that tourists visiting Itsukushima spend only a short period of time, due to the lack of attractiveness for contemporary consumers. In fact, visitors staying at accommodation in Itsukushima are gradually decreasing year by year (Nishihiroshima Times, 2003). Business sectors in Itsukushima show diverse reactions, especially those which have already depreciated their business properties, showing less effort to attract visitors. On the other hand, contemporary Japanese tourists to the historic cities have changed their consuming behaviour; for example, they have not paid much attention to consume conventionally sold souvenirs.

Recently, some newcomers and entrepreneurs have opened their own retail outlets occupying traditional houses on the island. This has been accepted as a positive reaction to attract contemporary consumers. However, these new trials are not shared widely among the relatively conservative local community. Additionally, some experts pointed out that these "renovations" sometimes does not meet "conservation" methodologies; have a lack of sensitivity to historic properties, and are naturally inclined towards a commercially profitable approach.

7. FUTURE ITSUKUSHIMA

In recent years, Itsukushima has accepted more foreign visitors since the Japanese government has encouraged international inbound tourists to respective destinations that represent Japanese tradition and modernity. Itsukushima is recognized as one of the most attractive destinations for them. Itsukushima has always been treated as a treasure of this world, among dauntless warriors, calmly technocrats, sensitive conservationists, residents and tourists. It is almost of miracle that the shrine has stood over a thousand years, even though many sites of precious heritage have been destructed by political disorder, natural disaster, or people's negligence of their history.

Frequent floods on Itsukushima shrine have never declined. It is said that this damage will be worse in the near future due to global warming. Local government and experts urge the establishment of practical measures, however it is still a long way to solving the problems posed by nature. Recent changes and frequent floods observed on the shrine have been silent, but are a valuable reminder for people living in the contemporary world in places of holiness. As discussed in this paper, Itsukushima is experiencing drastic or silent changes; the transforming landscape, implementation of new regulations, shrinking population, aging community, changing tourism industry, and our expectation of holiness in a contemporary sacred place. Itsukushima has been experiencing continuous changes and transition since the establishment of the shrine, however, the degree of change occurring in the near future will be beyond previously experienced.

It is argued in this paper that Itsukushima is situated on a threshold of different time and space, between holiness and worldliness, connecting different worlds. It might be accepted that Itsukushima has been conveying

to the people, through uncountable invisible or visible changes, to foresee the future. Future sustainable conservation and spatial management on Itsukushima and in the province an unavoidable necessity, sought through mitigation and a re-direction toward sustainable ways. In this case, it will be essential to enhance more invisible elements, as these are sometimes given lower priority or even neglected when compared to conventional development forces. The following are unavoidable aspects of the future of Itsukushima's sustainable development.

Integrated Policy and Control of Surroundings

- Establish landscape control and land use regulations for visible territory around Itsukushima Shrine.
- Combine existing natural and cultural conservation policies, especially of the surrounding sea surface and forest.

Quality of Preservation of Shrine Town

- Provide more effective and feasible preservation guidelines to upgrade the quality of the townscape of the shrine town.
- Create more examples of quality conversions of traditional houses meeting contemporary needs.

Interpretation and Tourism Development

- Preserve artefacts of wider social classes.
- Provide more holistic historic information for visitors, include negative memories of the past.
- Re-examine current mass tourism based development, and develop and diversify the tourist activities.

Community Involvement and Revitalization

- Encourage more inclusive approach to preservation process beyond social classes and business sectors.
- More tax deductions and financial incentives for preservation projects to invite a larger population.
- Establish a "traditional house bank" to reduce the number of unoccupied traditional houses.
- Provide stronger public facilities with disaster resistant capabilities and evacuation site, in case of emergency.

Remarks

This paper is based on the author's research activities and an official conservation research project under the auspicious of Hatsukaichi City Government and the National Trust of Japan from 2004 to 2009. However, the findings, interpretations, and conclusion expressed in this paper are entirely those of the author and should not be attributed in any manner to related bodies, organizations and projects which the author joined or was involved with prior.
This paper is the extension of the ideas and frames expressed following previous occasions;
Yushi Utaka, 2010, Conserving Japan: Challenges on the World Heritage Sites in Hiroshima, Series on the Management and Conservation of World Heritage Sites, United Nations Institute for Training and Research (UNITAR), Hiroshima. (Oral Presentation)
Yushi Utaka, 2011, Itsukushima Shinto Shrine World Heritage Site: Holiness and Contemporary Japan, International Conference 2011 on Spatial Planning and Sustainable Development, 29-31 July, 2011, Kanazawa (Conference CD)

REFERENCES

Buhalis, D. et al. (2006). "Information Communication Technology Application for World Heritage Site Management", research article presented on, Leask, A. and Fyall, A. (Eds.) Managing World Heritage Sites, Elsevier, 73.

Chua, R. S. (2011). Adaptive Reuse in World Heritage Site of Historic City Center, Ph.D. dissertation of Graduate School of Kyushu University, Japan.

Cochrane, J. and Tapper, R. (2006). “Tourism’s Contribution to World Heritage Site Management”, research article presented on, Leask, A. and Fyall, A. (Eds.) Managing World Heritage Sites, Elsevier, 98-109.

Nunokawa, H. (2001). “Red Light District in Miyajima”, research article presented on, Review of Japanese Studies, 1(57-74). (in Japanese)

Hamamoto, T. (2011). “Costal Disaster Prevention Learned from Itsukushima Shrine”, research article presented on, Journal of Architecture and Building Science, 126:48. (in Japanese)

Hatukaichi City Government. (2010). General Information of Hatsukaichi City. (in Japanese)

Japan Tourism Agency. (2008). Regional Tourism Development Plan; Hiroshima, Miyajima and Iwakuni, Japan Tourism Agency. (in Japanese)

Larkham, P.J. (1996). “Conservation and the City”, Routledge, 138-142.

McGregor, S and Thompson-Fawcett, M. (2011). “Tourism in a Small Town: Impacts on Community Solidarity”, International Journal of Sustainable Society (IJSSOC), 3(2): 174-189.

Millar, S. (2006). “Chapter 3 - Stakeholders and Community Participation”, research article presented on, Leask, A. and Fyall, A. (Eds.) Managing World Heritage Sites, Elsevier, 38.

Ministry of Land, Infrastructure, Transport and Tourism. (2004). “Damage of Typhoon 18”, article on, Assessment of Disaster Damage 2004, 24-25. Original data is provided from the Office of Itsukushima Shrine. (in Japanese)

Nishihiroshima Times, a newspaper article on, 15.5.1998. (in Japanese)

Nishihiroshima Times, a newspaper article on, 14.2. 2003. (in Japanese)

Nishimura. (1997). “Environmental Conservation and Creating Landscape: Towards Future Urban Landscape”, Kajima, 163-179. (in Japanese)

Parry, B. (2006). “Destination Management: A Holistic Approach. Liverpool - Maritime Mercantile City”, research article presented on, Leask, A. and Fyall, A. (Eds.) Managing World Heritage Sites, Elsevier, 73.

Serageldin, I. et al, (Eds.) (2001). Historic Cities and Sacred Sites: Cultural Roots for Urban Futures, The World Bank.

Sunamoto, F. (2007). “Transformation and Characteristics of Shrine Town, Itsukushima Shrine Town”, research article presented in the official report on, A Research Report of Preservation District of Group of Historic Buildings, Educational Committee Office, Hatsukaichi City Government, 34-35. (in Japanese)

Tokoro, I. (2000). “The Grand Shrine of Ise: Preservation by Removal and Renewal”, research article on, Serageldin, I. et al, (Eds.) Historic Cities and Sacred Sites: Cultural Roots for Urban Futures, The World Bank.

Uemura, N. et.al. (2005). “Evaluating Barrier Free Aspect in Tourist Destination in Costal Area of Seto Inland Sea: Case Study of Miyajima Island”, research article presented on, Review of Japanese Studies ,3(63-72). (in Japanese)

Utaka, Y. (2009). “The Hiroshima Peace Memorial: Transforming Legacy, Memories and Landscapes”, a research article on, William Logan and Keir Reeves (Eds). Places of Pain and Shame: Dealing with Difficult Heritage, Routledge, 34-49.

William Logan and Keir Reeves (Eds) (2009) Places of Pain and Shame: Dealing with Difficult Heritage, Routledge

World Heritage Committee (1996) ‘Itsukushima Shinto Shrine 776 Japan C (i)(ii)(iv)(vi)’, committee document on, World Heritage Committee, 2-7.12.1996.

Yomiuri News Paper, a newspaper article on, 17.9.1999. (in Japanese)

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