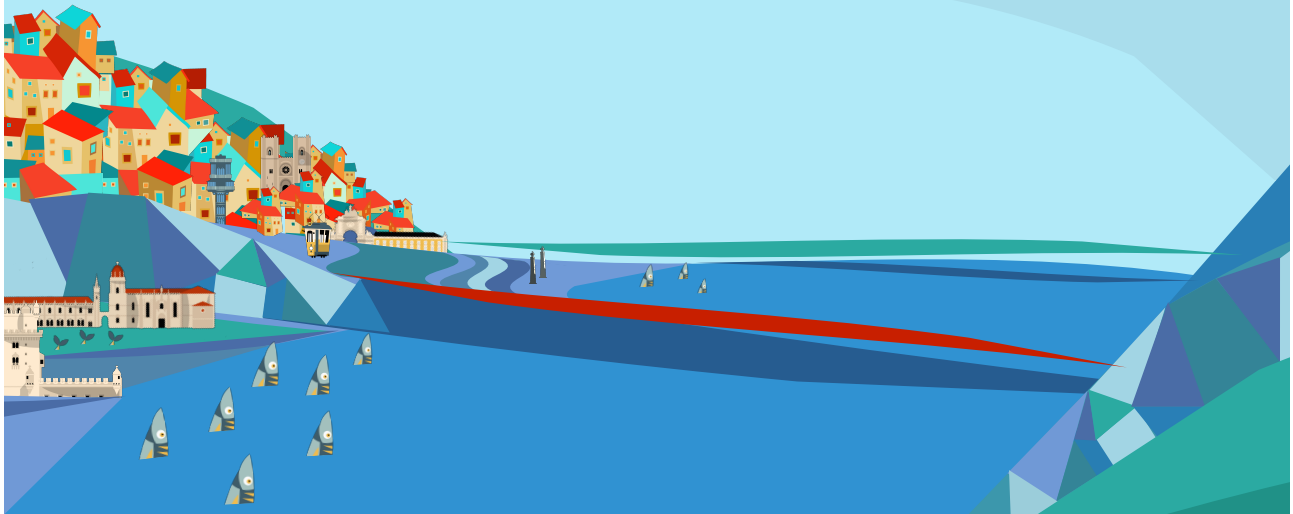
22nd Annual
International Sustainable Development Research Society Conference

Lisbon, Portugal, 13-15 July 2016

Universidade Nova de Lisboa
Campus de Campolide



Proceedings
Volume 2 of 3

Edited by:
João Joanaz de Melo, Antje Disterheft,
Sandra Caeiro, Rui F. Santos and Tomás B. Ramos

FACULDADE DE CIÊNCIAS E TECNOLOGIA
UNIVERSIDADE NOVA DE LISBOA
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ISDR Society

Proceedings of the
22nd International Sustainable Development Research Society Conference

ISDRS 2016

Rethinking Sustainability Models and Practices: Challenges for the New and Old World Contexts

Volume 2 of 3

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July 2016

ISRDR 2016 was organized and hosted on behalf of ISDRS
by the Center for Environmental and Sustainability Research,
School of Science and Technology, Universidade Nova de Lisboa

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Title: Proceedings of the 22nd Annual International Sustainable Development Research Society Conference

Subtitle: Rethinking Sustainability Models and Practices: Challenges for the New and Old World Contexts

Volume 2 of 3

Published by the International Sustainable Development Research Society and the Center for Environmental and Sustainability Research, School of Science and Technology, Universidade Nova de Lisboa

Digital edition only

Lisbon, July 2016

ISBN: 978-972-674-791-8

Cover design: Nuno Videira

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International Sustainable Development Research Society
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Proceedings organization

The ISDRS 2016 Proceedings are divided into three volumes, organized according to the Conference theme special tracks and the core ISDRS themes and tracks. Papers associated to posters are presented at the end of each theme chapter. At the end of each volume there is a complete authors´ index.

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General conference information

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- Track A. Adaptive Sustainability Policies and Models in Changing Contexts
- Track B. Oceans and Marine Sustainability: Innovation and Management
- Track C. Sustainability Knowledge Sharing: From Individuals to Countries
- Track D. African Perspectives on the Old and New World Challenges for Sustainable Development

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Track 4a. Sustainable Land Use Policy/Planning to Manage Land Competition

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Mapping the Lisbon potential foodshed in Ribatejo and Oeste: A suitability model for assessing the potential for localised food production

Andreia Cardoso, Tiago Domingos, Manuela Magalhães, José De Melo- abreu, Miguel Carmo, and Jorge Palma

Abstract

Research on food planning has been recently supported in North-American and European planning for accounting how cities might change their food provisioning to respond to the rising demands for a more sustainable, ethical and fair food system. This paper presents a method for mapping potential foodsheds – land areas that could potentially feed an urban centre. It is evaluated the potential for the local food system to reduce the distance food travels while assessing the ecological basis of food security for the Lisbon city-region. A preliminary assessment of the current foodshed is made on which the existing land resources are evaluated regarding the land requirements of an estimated diet for the regional population. The potential regional production is determined by using agro-climatic and agro-edaphic agricultural suitability models. Regarding other factors, the production is allocated to meet food needs and considers the maximization of economic land use value. The first scenario is meat-based and provides food from eight groups: meat, dairy, eggs, fruit, vegetables, grains, tubers, vegetable oils and pulses. Large differences between land requirements for food groups were observed. Especially the consumption of meat, dairy and eggs have large effects on total land requirements. Therefore, two possible alternative dietary scenarios (plant-based and vegan) were considered for assessing the required land use change and the impacts on regional self-reliance. The nitrogen cycling in the agroecosystem serves as a land cost proxy for the different scenarios. Results presented in this study show the opportunity for food system relocalisation while assuring the sustainable use of the ecological basis of food security. However, a dietary transition must take place if total food system relocalisation is envisioned.

Keywords: food planning, food system resilience, relocalisation, foodshed, landscape planning

Making sense of sustainable land use policy: Reconnecting land and people

Mariaelena Huambachano, Lauren Cooper

Abstract

Land acts as a backdrop to human sustenance by forming the foundation on which ecosystems thrive. In the midst of climate change, economic and energy crisis scenarios, efforts to undertake Sustainable Land Management (SLM) are under enormous pressure. Particularly, attention to complex adaptive systems (of both nature and people) has grown significantly. Despite increasing demands for land-scape scale knowledge and data, the value and role of traditional knowledge remains unclear. This has led to a set of research questions to learn: (a) who makes broad land-based policy decisions; (b) and how traditional knowledge does, or does not, inform those policies. The Quechua and Amazon peoples of Peru are referred to as a case in point, highlighting that there is a lacuna of traditional wisdom informing SLM, specifically the constraints on scaling up of knowledge sharing pathways between land users and consumers. The aim of this paper is to investigate from an Indigenous perspective how the principles of reciprocity, well-being, and guardianship of the environment contribute to SLM. Also, we examine the knowledge-sharing between those that work directly in the land (i.e. traditional local and indigenous communities) with decision-makers and consumers of land-based products in order to understand how these relationships might promote a holistic sustainable approach to the issue of land degradation. The study utilises a Participatory Action Research (PAR) approach based on focus groups, workshops, and in-depth semi-structure interviews to draw empirical data from four indigenous Quechua and Amazon communities in Peru. Using a Traditional Ecological Knowledge (TEK) lens, we examine and analyse how two overlapping sets of cultural values shape access to, and management of, the land, including both the legal and customary tenure systems that function alongside their holistic approach for natural resource management. Finally, a literature review of current western science and alternative TEK methods not only complements the findings but it also ascertains a common ground approach for TEK inclusion in SLM. Preliminary research findings indicate similarities between Amazon and Quechua peoples in exhibiting land management systems that enable community resilience. Moreover, findings indicate that Indigenous' cultural values linked to land, food production, and natural resource management do not align with current Western approach. A disconnect exists between policies at the national and regional level and on-the-ground local impacts. Lack of TEK in the policy-making and program planning process represents an under-utilized resource. The paper concludes that a paradigm shift to connect decision-makers and consumers with the land-based TEK will allow for more intuitive and beneficial land management, one that values ecologic stability, climate resilience, and a wide range of human values. It then offers some suggestions to foster respect and to create a more robust understanding of the wide-ranging benefits of SLM. These include incorporating Indigenous cultural values and ecological observations into scientific studies, business plans, and development programs and projects.

Keywords: Sustainable land management, Indigenous peoples, traditional knowledge, Amazon, Quechua, resilience

Peri-urban food production - increasing urban resilience and linking urban and rural regions

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Abstract

In the Anthropocene era most people globally live in cities and urban areas which rises vast challenges for handling resources and navigating towards sustainable urban development. The sustainable city is a frequently used vision but in the discussion on sustainable systems for housing, energy, waste, communication and security etc., the food security issue is most often absent. The food system in the industrial world is totally integrated in a global food system directly linked to the globalized economic market. The efficient functioning of a such system assumes reliable access to land, natural resources, energy, efficient and undisturbed transportation along routes in land, water, cyber space and absence of political and military conflicts. To the uncertainty of all those factors the environmental uncertainty, e.g. climate warming, must be added, and thus making food security endangered. The strong current interest in urban agriculture in many cities is partly a response to this situation although the food produced here cannot satisfy the need of the urban population. In contrast, the peri-urban regions have a large potential for food production but the land here is under severe pressure for a number of different and contradicting uses. Such pressures include 1) Land for built up activities and infrastructure; 2) Natural and cultural values and protected areas; 3) Recreation (golf courses, horse activities etc); 4) Food production. The challenge for urban planning of resilient livelihoods is to find a balance between the four competing dimensions since they all include needs for human wellbeing. *The aim of this paper is to address the peri-urban land use changes in relation to food production, and to discuss the potential of increasing resilience for urban-rural regions by enhancing food production as part of multifunctional land use in those areas.* A case study addressing this aim is performed in peri-urban Gation of considerable peri-urban land owned by the municipality and strong engagement and political will among officials and local residents to preserve the peri-urban agricultural land and to increase the local food production; Food production activities can produce multiple values available for citizens in the urban and peri-urban regions; Multifunctionality in protected areas that are part of the agricultural landscape; Local food production creating new job opportunities; Food production activities as arena for knowledge sharing and cultural integration; Combining the urban and peri-urban food production and including adjoining rural municipalities can revitalize the region; Food production activities increasing social and environmental sustainability have a potentiothenburg, Sweden. This is a coastal city with considerable cultural diversity, segregation problems and challenges for social sustainability. Methods applied are interviews of different groups of stakeholders including planners and mapping of historical, statistical, land use data and land use plans. Among the preliminary findings are: unique situation in Gothenburg with a combinal for increasing resilience of urban-rural regions. Issues of power, local participation and influence on the food system are crucial and the study is an illustration to political ecology.

Keywords: peri-urban food production, urban food security, urban-rural resilience, political ecology

Contemporary cities — global overview, trends and challenges

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Abstract

Paper integrates a research focused on sustainable urban growth strategies based on place identity and resources management. The goal of this work is to provide a broader overview of contemporary cities context, presenting emergent urban needs in order to point ways to their sustainable solutions. Currently, 54% of the world's population lives in urban areas and in 2050 it is expected that 66% of the world's population to be urban. In 2014, 18 countries accommodated 28 megacities – i.e. urban agglomerations with 10 million inhabitants or more – and it is expected by 2030 that the world has a total of 41 mega-cites. In this urbanized planet, projections point that by 2050 urban population will increase, at least, more two thirds with Africa and Asia leading nearly 90% of the increased urban population. Due fast urban growth, contemporary cities started to exceed their capacity to provide adequate basic services and life quality to their citizens – urban poverty increasing is one indicator. Yet, every day migrants arrive cities, every day urban population grow. Between the period 2010 and 2015 it was estimated that nearly 200,000 people migrate daily to cities worldwide. The massive urban population growth triggers the need of a rapid response of urban infrastructures and housing supplies, impossible to get in demanded short period of time. As a consequence unplanned and inadequate urban growth leads to rapid social and environmental degradation - cities are growing faster in terms of land area as they are in population. Megacities and urban population effective growing number give a clear picture of what challenges government, town planner, architects and citizens have to face. By analyzing urban transition process, contemporary cities context and challenges paper describes, at a global level, main patterns in urbanization in order to detect transverse needs and sustainable solutions. Several reports and papers were analyzed. Research heavily falls in the United Nation publications; representing a priceless data base on the estimations of rural and urban population worldwide and countries main urban settlements, the report of the Urban 21Global Conference on Urban Future, the 2011 European Commission Directorate for the Cities of Tomorrow and the Barney Cohen studies on urbanization trends and challenges. After critical analyses, information was selected and crossed-check. Two major groups of urban development were found. The first relates with cities, mainly, located in Africa and Asia where urban growth tends to be faster and uncontrolled. The second, concerns to cities located in the low-fertility countries of Asia and Europe tending to lose population and slowing urbanization process. In both, cities have to grow smart facing natural resources and land management as well as sustainable planning - including social cohesion, urban poverty eradication and equitable right to the city - as key topics for their development.

Keywords: Urban population growth patterns, Urban growth challenges, Resources management, Contemporary cities trends

Urban sprawl - the trend of urban expansion in the municipality of Coimbra

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Abstract

Changes in land use to yield goods and services represent the most substantial human alteration of the Earth system and the urbanization process is a major driver of this land conversion. Human activities in urban areas alter the land use type and the availability of nutrients and water, affecting population, community, and ecosystem dynamics, being responsible for drastic environmental problems, such as biodiversity loss, ecosystem degradation, landscape fragmentation, and climate change. Due to its singular centrality, demography, and disturbance in land use patterns, the municipality of Coimbra becomes an interesting case study. Furthermore, the area of their city is one of the country's main urban centres. It is the only municipality that, in the Centre Region of Portugal, has exceeded the 140,000 inhabitants. The main objective of the study was to characterize the spatial and temporal land use changes in the municipality of Coimbra and to evaluate the trend of their urban expansion. Therefore, the dynamic of land use changes occurring from 1990 to 2010 in this municipality was evaluated. Two periods of analysis were chosen: 1990-1999 and 1999-2010. With its economic development, population growth, and urbanization process, the municipality of Coimbra has experienced a clear pattern in land use change during the study period. Results indicated that the study area was mainly dominated by cropland and forest, the two categories of land use that have undergone more changes. The cropland area increased 1,554 ha from 1990 to 1999, mainly at the expense of forest areas, probably as a response to the European Union policies and market incentives. An opposite evolution pattern was observed from 1999-2010 where forests expanded 2,907 ha most likely as a result of the forestation policy implemented by the Rural Development Programme - Forestation of Agricultural Land. This study also showed that the overall land use change was characterized by a continuous built-up land expansion, contributing to cropland loss. However, the dimension of the city area and the population density of Coimbra showed opposite trends between the two study periods. It should be emphasized that during the 2nd period (1999-2010) the city area grew 2,444 ha (an average rate of 244.4 ha/year) and the population density decreased almost 30%. This physical pattern of low-density expansion in built-up areas contributed to a less compact city evolution, clearly an indicator of urban sprawl. The urban sprawl has become a very remarkable characteristic of European urban development producing many adverse environmental effects that have direct impacts on the quality of life and human health in cities. Therefore, it is important to design and implement suitable strategies that may be able to reduce these harmful impacts. A better understanding of the spatial and temporal dynamics of the city's expansion, provided by this study, may be a helpful input for a better planning and spatial organization of local human activities for future sustainable urban development of Coimbra.

Keywords: land use change; urban sprawl; urbanization; sustainable development; municipality of Coimbra

A study of children's impression evaluation of alley space in China and Japan — Evaluation of urban spaces for sustainability

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Abstract

In order to preserve traditional urban space for sustainability, it is important to evaluate its universal value. And in order to create new sustainable urban spaces we have to learn from the inherent value within an existing urban space. This paper focuses on the viewpoint of children to evaluate the "affordance" of traditional urban spaces in China and Japan to research universal values within urban spaces. According to Gibson's Affordance theory, Affordances and clues in the environment indicating possibilities for action, are perceived in a direct and immediate way with no sensory processing. In addition, 'a good environment design must be created through dialogue with the user of the space. Therefore, evaluation of space should not be limited to an evaluation of its natural quality, such as "nature-artificial" and "warm-cold", but also in the way we participate to the environment. The environment affords people to encourage activities, such as "to sit down", "to stand on", "to walk through", "to lie down", and so on. This point is especially important to children. The aim of this study is to find these affording factors, and compare whether this factor is different from general factors which previous research has referred to. In addition, exploring attributes with more affordance is explored. In this research, traditional alley space both in China and Japan are chosen, and a database of 19 views of alley spaces are created (11 photographs in China and 8 photographs in Japan). After collecting photograph of views of alley spaces with various attributes, SD method would be used for evaluation. 10 bipolar pair words were chosen including words referring to affordance of spaces. Then these questionnaires are given out to 50 children (age 10 to 13) in one of rural elementary schools in China. Two factors were found through factor analysis which was calculated by scores of each bipolar word for each picture, explaining 82.11% of the variability. Also, affordance factor was found to be highly related to physical factors through the correlation analysis. In addition, the factor scoring were used to conduct the cluster analysis, three clusters were identified. All photos were divided into three groups. By categorizing these three groups, space characters were classified to high affordance type or low affordance type.

Keywords: Impression evaluation; Affordance; SD method; Factor analysis; Cluster analysis

1. Introduction

1.1. Background

Traditional space is a memory of our life. Long time ago, especially in rural area, most activities happened in the traditional space where people lived. In the past, our environment seemed more natural and plentiful, and there were more playing spaces. However, in this fast-developing century, many traditional spaces have been destroyed. Furthermore, the 'dehumanization' of city space in the process of rapid urbanization has been alienating children from the urban context where they live in (Fang Wang, 2012). This destroying and constructing process was in several ways not sustainable. Nowadays, saving resources and using sustainable materials have been well-known for sustainability, but preserving and utilizing traditional spaces could be an effective way to realize sustainability. And in order to identify this kind of traditional spaces worthy of preservation, universal rules within these spaces should be explored.

If we look at photographs from 100 years ago, pedestrians were often shown moving freely and unimpeded in every direction. Cities were still primarily the province of pedestrians, with horse-drawn carriages and trolleys, and a few cars merely as visitors (Jan Gehl, 2010). Urban spaces

were mainly for pedestrians and most activities took place in the alley spaces which also a place for living. Therefore, alley space was chosen as the object of our research.

Regardless of planning ideologies and economic prerequisites, careful management of the human dimension in all types of cities and urban areas should have a universal requirement. The starting point is simple: universal human activities. Cities must provide good conditions for people to walk, stand, sit, watch, listen and talk (Jan Gehl, 2010). Also, at the same time, Gibson (1970) said our perception to the world is how the person interacts with it. In order to know what kind of space could provide such kind of conditions better, impression evaluation could be referred as a useful and necessary method.

Up to now, there are several literatures related to impression evaluation revealing multiple results, but in this research, the way we interact with the environment is evaluated for further research. Through this research, physical qualities of environment should be extracted so the designers could incorporate these qualities in their designs.

This paper focuses on the viewpoint of children. Firstly, because children's playing spaces are disappearing in the cities, because of land limitation and car usage, so children's requirements for their spaces should be researched. Secondly, because the authors considered that children are more intuitive toward affordance factors, which is more direct and immediate with less sensory processing.

1.2. Aims

This paper focuses on the viewpoint of how children to evaluate the "affordance" of traditional urban spaces in China and Japan and researching universal values within urban spaces. The aim was to: (1) analyse whether the affordance factors are different from general ones; (2) find out the kind of space indicating high affordance abilities and the kind of space indicating low affordance abilities.

1.3. Literature review

1.3.1. Affordance theory

An affordance is a property of the environment that has perceived functional significance for an individual, a relation between some structural and/or functional attributes and the individual's intentions (Heft 2001). Gibson (1979) believed that our perception to the world is a compilation of the person's environment and how the person interacts with it. This research extracts some "affordance" of traditional alley space according to this theory.

1.3.2 Children and environment

According to Matthews (1992), they develop feelings and emotions for the children from a very young age, which were about everyday environments which induce powerful, positive or negative images. The role of affect is not only important in explaining how children learn about the place, but also provides a pointer to what sorts of environments children find most satisfying, as children's place reactions are often very different to those expressed by adults. Children's reactions to the environment are more directly than adults. Their responses to the world are simpler because of their simple psychological activities. However, nowadays, children's conflicts toward environment become more and sharper because of the increasing cars.

1.3.3. Impression evaluation

KACHA (2015) did a research on the evaluation of impression in streetscapes in Algeria and Japan using kansei engineering. Toward 74 photographs, Japanese and Algeria participants showed their responses. After that, factor analysis, cluster analysis and variance analysis were conducted. The semantic space was described by three independent axes. In his paper, analysis methods and methods of impression evaluation were cleared.

YAMAMOTO (2015) also did a research of the impression evaluation of the lower part of the streetscape, and this evaluation was defined by four factors by making use of the factor analysis. Also, it indicated the relation between components in lower part and streetscape impression

evaluation, which has a definite tendency by the cluster analysis and the quantification theory-Ⅰ.

To sum up, in order to differentiate different evaluation items, factor analysis and cluster analysis were the most common methods.

2. SD method

2.1 Definition

The semantic differential (SD) measurement technique is a form of rating scale that is designed to identify the connotative meaning of objects, words, and concepts. The technique was created in the 1950s by psychologist Osgood (1950). The semantic differential technique measures an individual's unique, perceiving meaning of an object, a word, or an individual. (Paul J. Lavrakas, 2008). This method can be thought of as a sequence of attitude scales. Usually use 7-point or 5-point bipolar rating scales, which always be designed such that the left side is generally positive and the right is generally negative.

2.2 Analysis based on SD method

There were many analysis methods using SD method data, but the factor analysis was found the most common analytical method of SD data. Through the factor analysis, common factors can be found to explain how the datasets were composed. Therefore, this method was selected as the method to analyse the five-point scales words' distribution in the final research.

3. Methods

3.1 Data collection

To avoid misleading in evaluation which was caused by familiarity of Chinese children's living environment, both photographs of alley spaces in China and Japan were selected as areas for this study. Since the research is focused on alley space character with affordance factors, traditional alley spaces with history were chosen as object areas. Finally, alley space images were collected from Hangzhou (China) and Kyoto (Japan).

In Hangzhou (China), alley space images were shot in Xiaohe historical Street. Xiaohe Historical Street is one of the most notable pedestrian streets in Hangzhou. Centred on the unassuming Yuhangtang River, Xiaohe Historical Street flanked by ancient Chinese-style business and residential houses, is a typical example of urban commercial street block along the Yanghangtang River. Buildings here are mainly made of concrete on the first floor and wooden on the second.

In Kyoto (Japan), alley space images were shot in Kiyomizu area. This place is a very famous historical place in Kyoto that attracts a lot of tourists coming here. Alley spaces here are in different level. Buildings here are mainly made of wood on both the first floor and second floor.

3.2 Research process

A preliminary investigation was done before the final research. The aim of preliminary research was to decrease the number of photos. Figure 1 shows the whole research process. Factor analysis and cluster analysis were selected as main analytical method to differentiate bipolar pair words and photos.

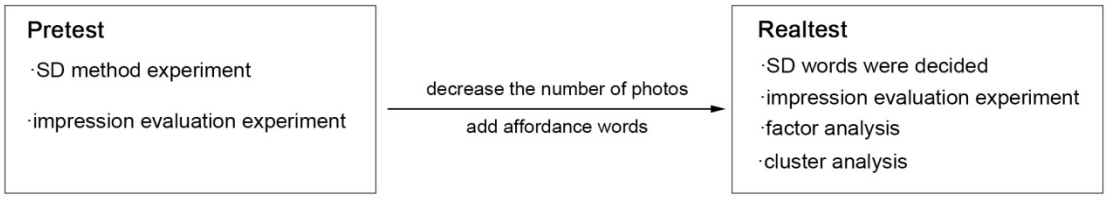

Figure 1. Research process

3.3 Preliminary research

3.3.1 Aim of preliminary research

Because the participants of this study are children, they might lose patience if the questionnaire time be too long. Since the initial photo number was about 42. So the authors have conducted the preliminary research to decrease the number of photos. And this was also a trial to control the time to finish the questionnaire.

3.3.2 Data collection and participants of preliminary research

Dataset used in this preliminary study was composed of 42 alley space images. 24 images were shot in China and 18 images were shot in Japan. All the images were taken in traditional areas in eye level using a digital camera Nikon D5100. 24 photos in China were taken in 12th of September 2015. Between 10 o'clock to 13 o'clock. 18 photos in Japan were taken in 29th of September 2015. Between 11 o'clock to 14 o'clock. All images were shot in the middle of the road to avoid heterogeneity in the vision fields. Finally, these photos were numbered as C-01, J-01 and compressed into 1754pixelx1240pixel. C means that this was shot in China and J means this photo was shot in Japan. After that, 7 Japanese students (4 females and 3 males) with an average age of 23 years old in the department of architecture were chosen to answer the questionnaire.

3.3.3 Process of preliminary research

Every image was displayed in a LCD display of a personal computer. Participants filled in a questionnaire sheet that included 7 bipolar pair adjectives, organized according to a five-point scale. Participants were requested to answer 7 questions (table 1) for each photo. These words were collected from the most frequent terms, used by impression evaluation for the space. (Kacha, 2015; Yamamoto, 2015) In total, 42×7 questions were requested. The whole process lasted for 30 minutes.

Table 1. Categories of 7 bipolar pair words for prelaminar research

Physical	Natural——Artificial
	Open——Close
	Warm——Cold
	Abundant——Simple
Psychological	Deja vu——See the first time
	Quiet——Lively
	Intimate——Alienate

3.3.4 Results of preliminary research

Since the scale of a bipolar adjective was 1-5. Total scores of each pair word for every image were figured out (Table 2). Picture with the highest and lowest score were chosen as final images. For the photos that have same scores, the authors have compared them and omitted the image which was not clear. Finally, 19 photos were selected out. 11 photos were shot in China and 8 photos were shot in Japan. Besides, one bipolar pair word, "intimate-alienate", was omitted because it seemed difficult to understand.

Table 2. An example of total scores of each photo

nature-artificial(scale form 1-5)											
C-23	**35**	C-06	28	C-07	20	**J-17**	**32**	J-16	26	**J-05**	**19**
C-15	**35**	C-10	27	C-09	19	J-04	31	J-03	25	**J-08**	**19**

C-22	33	C-24	25	C-04	19	J-18	30	J-07	25		
C-18	33	C-21	23	C-01	19	J-14	29	J-09	25		
C-17	33	C-03	23	C-20	18	J-13	28	J-02	24		
C-19	32	C-16	22	C-05	18	J-12	27	J-01	23		
C-12	32	C-02	21	C-08	17	J-11	26	J-06	22		
C-14	31	C-11	20	**C-13**	**12**	J-15	26	J-10	21		

3.4 Final research

Due to the accessibility to the research participants and language disadvantage of author, 50 Chinese children were selected in this study, with an average age of 12 years old. Almost all of them lived in rural areas in Zhejiang province. Images in the dataset were represented to participants using Power Point. Two class of elementary school were involved. Except for 6 bipolar pair words, four affordance bipolar pair words were added to test whether people's opinion towards words was different (table 3). These affordance bipolar words were selected in accordance with Jan Gehl's theory (1926) that cities must provide good conditions for people to walk, stand, sit, watch, listen and talk. Listen and talk characters were omitted because this research is about impression evaluation through images. No voice will be involved in this research. Every student need to answer 190 questions (Table 4). The whole process lasted for 30 minutes. After collecting all the data, mode score were calculated to conduct factor analysis.

Table 3. Categories of 10 bipolar pair words for final research

Physical	Natural——Artificial
	Open——Close
	Warm——Cold
Psychological	Abundant——Simple
	Deja vu——See the first time
	Quiet——Lively
Affordance	Willing to walk here-Not willing to walk here
	Willing to stand here-Not willing to stand here
	Willing to sit here-Not willing to sit here
	Willing to stop to see-Not willing to stop to see

Table 4. Differences of Pre-examination and Real-examination

	Prelaminar research	Final research
Number of photos	42	19
Number of respondents	7	50
Number of bipolar pair words	7	10
Method of representation	people's own computer	one Power Point
Participants	Master students in architecture	Chinese children
Total questions per person	42×7=294(30 minutes)	19×10=190(20 minutes)

4. Results and discussion

According to SD method data scaled from 1-5, factor analysis and cluster analysis were used to divide bipolar pair words and photos into groups. (Yamamoto,2015)

4.1 Factor analysis

Principal axis factoring with Varimax rotation was used to analyse the factorial structure of those evaluation scoring. Table 5 shows that the perception of the collected photos could be expresses through two independent factors, which explained 82.11% of the variance in the sampled perception. However, most of the variance (70.9%) can be explained by factor one.

Table 5. Results of factor analysis

Axis	Label	Items	Factors	
			Factor 1	Factor 2
1st Axis	Physical and Affordance	Natural-Artificial	**0.8138**	-0.1719
		Open-Close	**0.8614**	0.3809
		Warm -Cold	**0.8492**	0.3723
		Willing to walk here-Not willing to walk here	**0.9226**	0.3321
		Willing to stand-Not willing to stand here	**0.8436**	0.5067
		Willing to sit here-Not willing to sit here	**0.9033**	0.3712
		Willing to stop to see-Not willing to stop to see	**0.8716**	0.4305
2nd Axis	Psycho-logical	Abundant-Simple	0.6298	**0.7021**
		Lively-Quiet	0.0984	**0.9404**
% of Variance			70.894	11.217
Cumulative %			70.894	82.111
Extraction Method: Principal Component Analysis.				
Rotation Method: Varimax with Kaiser Normalization.				

On the basis of the distribution of adjective of factor loading, the two factors can be named into two character words. The first factor was mainly composed of physical words and affordance words. So (physical and affordance) were used to explain this factor. The second factor was mainly composed of psychological words. So (psychological) was used to explain this factor. In the meantime, from table 6, we can notice that the correlation between physical elements and affordance were very high. That is to say, people tend to walk or stand or sit in more natural, more open more abundant and warm-looking place. For the “nature-artificial” word, the correlation seemed not very high.

Table 6. Correlation coefficients between each word

Items	walk here	stand here	sit here	stop to see
Nature-Artificial	**0.64**	0.57	**0.60**	0.55
Open-Close	**0.91**	**0.88**	**0.89**	**0.88**
Warm-Cold	**0.90**	**0.88**	**0.91**	**0.88**
Abundant-Simple	**0.80**	**0.88**	**0.82**	**0.88**
Deja vu-See first time	0.21	0.24	0.20	0.19
Quiet-Lively	0.39	0.56	0.42	0.45

4.2 Cluster analysis

The resulting factor scoring was classified into different clusters using cluster analysis (Ward method). The results showed that these 19 photos were most suitable to be divided into 3 clusters (Fig.2). Cluster 1 includes C-07, C-08, C-09, C-10, J-02, J-07. Cluster 2 includes C-01, C-02, C-05, J-01, J-06. Cluster 3 includes C-03, C-04, C-06, C-11, J-03, J-04, J-05, J-08.

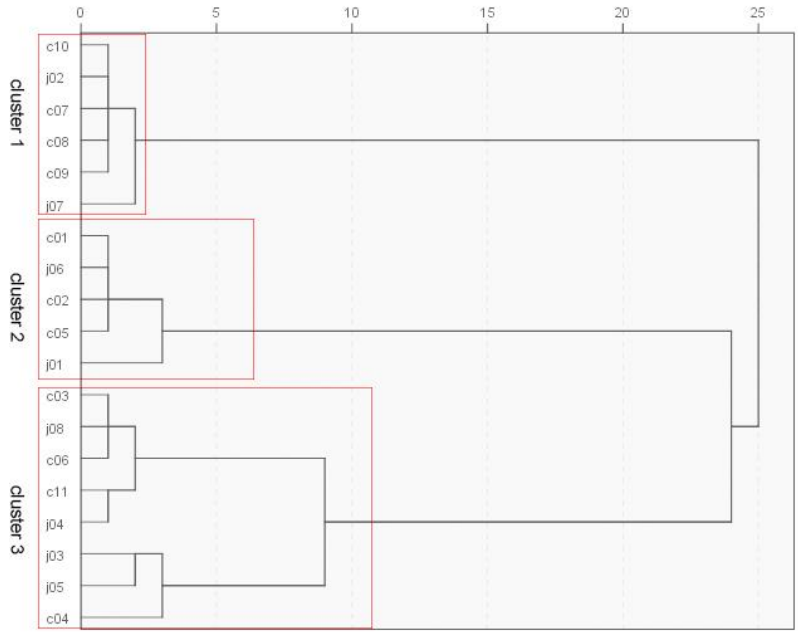

Figure 2. Dendrogram using Ward Linkage

Figure 3 shows the factor score of each photo which belonging to three clusters. The interpretation of the results showed: (1) Low Physical and Affordance (cluster 1). From cluster 1, factor 1 and factor 2 both have a negative influence on these photos. But factor 1 seems to have stronger influence on these photos, which means these photo have a character of lower physical affordance and lower psychological feelings. (2) High Physical and Affordance, Low psychological (cluster 2). From cluster 2, physical and affordance properties have a positive effect on each photo, while psychological property has a negative effect. (3) High Physical and Affordance, high Psychological (cluster 3). From cluster 3, for factor 1, except for C-03, C-06 and J-08, physical and affordance properties have a positive effect on every photo. For factor 2, except for C-04, psychological property has a positive effect on every photo.

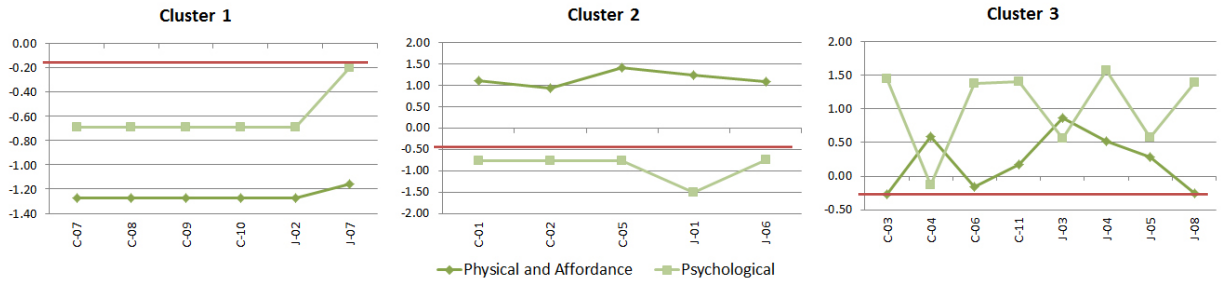

Figure 3. The relationship between each cluster and factor scoring

Above all, through cluster analysis, alley space streetscape could be classified into 3 types. This could help classifying the characters of space. Photos of each cluster were showed in figure 4.

5. Conclusion

The study aimed to analyse whether the affordance factors are different from general ones, and to find out what kind of space indicates high affordance abilities and what kind of space indicates low

affordance abilities. It seemed that affordance factor was not an independent factor. It was mixed with physical factors. Although the results of factor analysis show that affordance bipolar words score were the highest, these affordance words were mixed with physical bipolar pair words. This result may be due to the less bipolar words. Through correlation analysis, affordance character was found to be related to physical spatial elements.

Through cluster analysis, 19 photos were classified into 3 groups. Space with cold and simple character couldn't provide affordance so much. On the contrary, space with abundant and plenty character could provide high affordance and also give people psychological satisfaction. In the meantime, there were also some space with high affordance and low psychological satisfaction.

In this research, spaces with greater affordance were clarified through SD method using factor analysis and cluster analysis.

Future study will attempt to identify which components of space could have relationship with affordance. For instance, whether to create more walls on both sides could contribute to high affordance space. The conclusion of this research may contribute to help making decision when designing new spaces with enduring value.

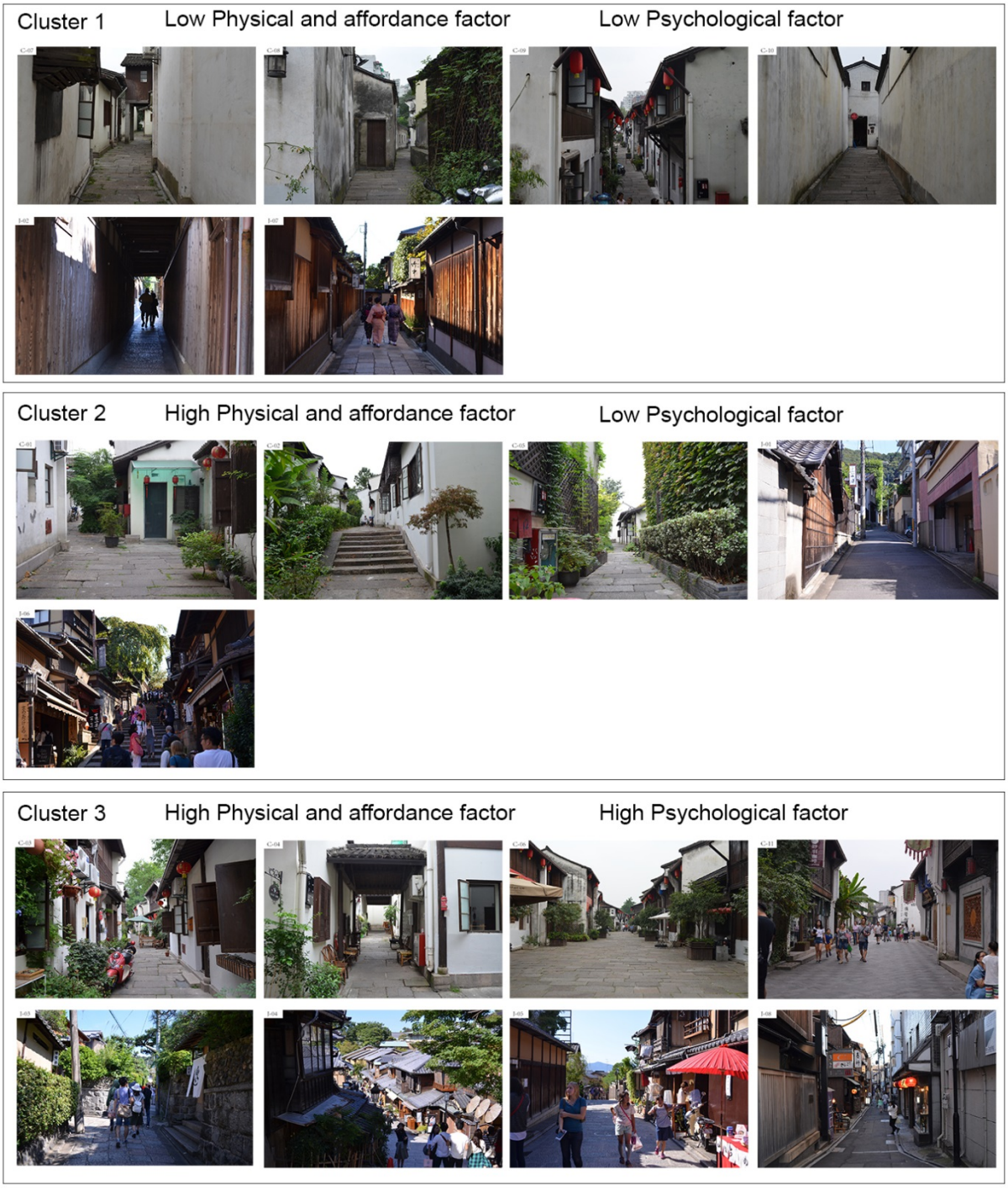

Figure 4: Photos of different clusters

Acknowledgements:

I would like to express my gratitude to all participants for their patience to answer the long questionnaire. And also my friend who help collecting the questionnaires.

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Study on the influence of the dormitory planning and design to the living environment of the foreign students — For sustainable campus planning and land management

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Abstract

Sustainable development is a very important development mode of today's human society and city modernization. As rapid growth of student number, the university campus planning and land management need to go on in a sustainable way. A sustainable planning and design not only focus on the current development requirements, but also should meet the requirements of future development.

Now global integration is the major trends of the world. More and more students go out of the native country for a further study. But the number and the quality of the foreign dormitory can't fit the demand gradually. Especially in China, this already became a big problem when you do the university campus planning because of the big population and the unreasonable dormitory design and planning. The living environment of foreign students is a very important point to judge a dormitory's planning and design is sustainable or not. Not only because the foreign student is a minority group, but also because of the high demand of this group. A good sustainable design or planning of dormitory can greatly improve the living environment of foreign students and ensure the reasonable land management.

In this paper, I will mainly to do the studey on the dormitory planning and design to find out their influences to the foreign students' living environment, to provide some data for a better sustainable campus planning and land management.

About the research object, I choose Zijingang campus of Zhejiang University as study case to do the analysis. Not only Zhejaing University is the university which have the largest number of foreign student in Zhejiang Province,[1] but also it is the best university in Zhejiang Province, it has been well designed and planned. Then about my research method, first according to collecting the detail data of foreign dormitory's general plan, building plan, interior layout, public space, green space and so on, to find out the factor that may influence the foreign students' living environment. Then make a questionnaire to validate these factors and give some suggestion to improve it. In these two method, the questionnaire survy is the main one.

The results of this research mainly divide into two parts. One is design part and another is planning part. And in each part will find several potential points to do the data analysis.In design part, mainly do the analysis in the plan of the foreign dormitory. In the planning part mainly focus on the location and surrounding environment these two points.

At last come to conclusion that the influence factors is public space,area, and direction of the dormitory building of design part. Location, surrounding environment, Communal facilities and communication space of planning part. Pay more attention about these several aspects when you do the planning and design of a university campus, the living environment of foreign students will become better and you will know how to do the sustainable campus planning and land management.

Keywords: Dormitory, Foreign students, sustainable planning and land management, Zhejiang university

1. Introduction

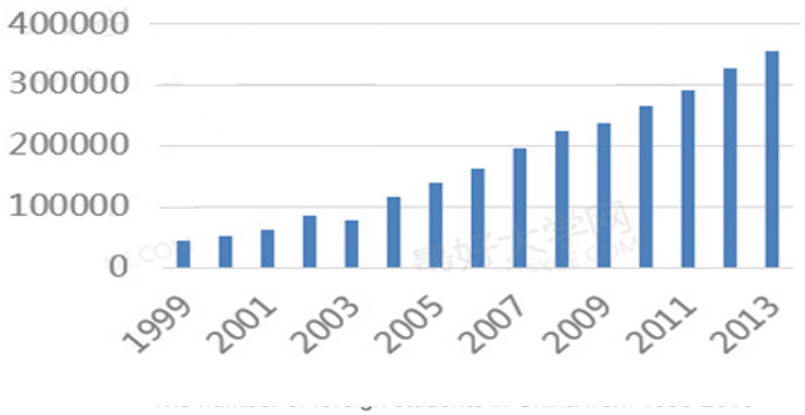
1.1. Background

With the development of society and deep understanding of sustainable development, the concept of human have been changed. The sustainable development became the most recognized development mode.

Nowadays, the scale of student number and the requirements on the campus have been increasing year by year. A well planned and designed campus not only can meet current development, but also can meet the requirement which may occur in the future. That's why the sustainable planning and land management become more and more important.

If you want to be succeed in doing a sustainable campus planning and land management, you should first know more about the living environment of the student who live in the campus, has the most direct relationship with the campus. And in the student group, foreign student has a higher requirement about their living environment, that's how I chose the research object.

What is planning of university campus? There are three stages. First, overall planning stage. Second, Architectural design stage and last one is landscape design stage. In this paper I focus on



the two front points to do the analysis.

Figure 1. The number of foreign students in China from 1999-2013

As the development of the China and the promotion of Global integration, more and more foreign students go to China for study.

We can see from the figure.1 that the number of the foreign students in China has been increasing year by year. According to statistics, up to the 2014, the total number of the foreign students in China already reach 377054. [1]

So I chose to do the study on the influence of the dormitory planning and design to the living environment of the foreign students, find some way to express how to do the sustainable campus planning and land management.

1.2. Research purpose

What is planning of university campus? There are three stages. First, overall planning stage. Second, Architectural design stage and last one is landscape design stage. In this paper I focus on the two front points to do the analysis.

With the social, economic and cultural development, the number of foreign students increasing vary fast, as the result, the number of the dormitory for foreign students can't meet the demand gradually, so there are a lot of foreign student dormitory need to be built. And not only the quantity

of dormitory, but also the quality of dormitory are getting more and more attention.

The standard for measuring the quality of a dormitory is whether there is a good life experience for the students who live in it. And the environment of dormitory make a large influence to the students' life experience. Excepting some software equipment, for example, air condition, television, the living environment also can be deep influenced by the planning and design of the foreign dormitory. A well design building can make some sense to the person who live in it. So the main purpose of this research is to find out the factors that influence the living environment of foreign students in foreign dormitory planning and design and then find some useful ideas for how to do a sustainable campus planning and land management. After all hope this paper can provide a reference to others about how to do a sustainable campus planning and land management.

1.3. Research object

In this paper, I choose the Zijingang campus of the Zhejiang University as research object. Zhejiang University is a university with the largest number of foreign students in Zhejiang province. Also Zhejiang University is a university which have a very high evaluation of living environment.

In this paper, I choose the Zijingang campus of the Zhejiang University as research object.

Pic 1. Function partition and Road analysis

The Pic.1 show the function partition and road planning of the Zijingang campus of Zhejiang University. The living area is in the north of the campus, near the small business street. In the living area, the foreign dormitory is in the south part which circled in the Pic.2 has a more quiet living environment and a shorter distance to the activity area and teaching area than the other native dormitory. The area between the living area and teaching area is the green area which greatly improve the living environment of campus. In addition, the location of foreign dormitory right

in the Central axis of the whole campus. It make foreign students have an excellent sight. Then about the road of the campus, the foreign dormitory located in the intersection of the outer loop and inner loop. It's a convenient location of road system. In total, we can see from the picture that the location of foreign dormitory is very good. [2]

In Zijingang campus of Zhejiang University there are two types foreign dormitory. The 6-floors old one and the 11-floors new one built in 2014. Besides the number of floor, the inner functions of these two types dormitory are different. In the 11-floors new built foreign dormitory, there's a public communication and activity space for students to do the communication and rest, and also there's a public kitchen for foreign students to do the cooking. Except these public space, another big difference between these two type dormitories is that the 11-floor dormitory is totally for the foreign students, but 6-floor dormitory is for both foreign students and native students. [2]

Then about the cost of the dormitory fee. The 6-floor old dormitory ask for 1200yuan/month, and the 11-floor new dormitory ask for 6000yuan/month.[2] But most of the foreign students have the scholarship, they don't need to worry about the dormitory cost problem.

2. Methods

There are mainly three methods when I doing this research. First is collecting data by internet and doing analysis by some software. Second one is field investigation, to collect some basic information and take some photos. Last one is to do the questionnaire.

The main method of this research is according to distribute the questionnaire to the foreign students in Zijingang campus of Zhejiang University to collect the detail data. The foreign students come from different countries, so the questionnaire was written in English. The way of distributing questionnaire is visiting the foreigner dormitory room one by one. At last, I got 72 questionnaires feedback totally. There are 38 males and 34 females in these 72 students. And the ages of these 72 students are from 17-35 years old, 4 doctors, 26 masters and 42 bachelors.

2.1. Survey content

Excepting some basic information, some data about the foreign dormitory, the living environment of the foreigner dormitory, and the attitude towards the living environment of the Zijingang campus of Zhejiang University, these questions have been listed in the questionnaire. About the influence degree of different factors to the living environment of the foreign dormitory, I give five choices (Very satisfactory, Satisfactory, Average, Unsatisfactory, Very Unsatisfactory). And at last of the questionnaire I add a question to let students write their own idea about the living environment of their campus.

3. Results

The statistical results of the questionnaire mainly focus on several potential factors to do the analysis.

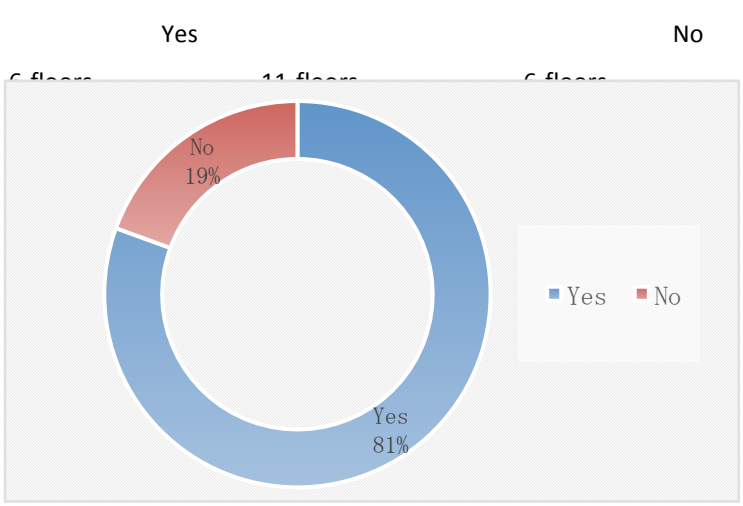
3.1. Design part of dormitory building

3.1.1. Public space inside the foreign dormitory

From the questionnaire's statistical results figure.2 we can find that there are 58 students think there are enough communication or rest space in Zijingang campus of Zhejiang University. In these 58 students, there are 50 students live in 11 floors new foreign student dormitory, 8 students live in 6 floors old foreign dormitory. In the students who think there is enough communication or rest space near their dormitory, 86.2％ live in 11-floors dormitory. In the students who keep the opposite idea, only 28.6％ live in the 11-floors dormitory. Then the main difference already previously mentioned between 6-floor and 11-

floor dormitory is having public space for communication, rest and public kitchen or not. So I think this is may a factor that influence the living environment of foreign student.

The next to is that "If answer is space do



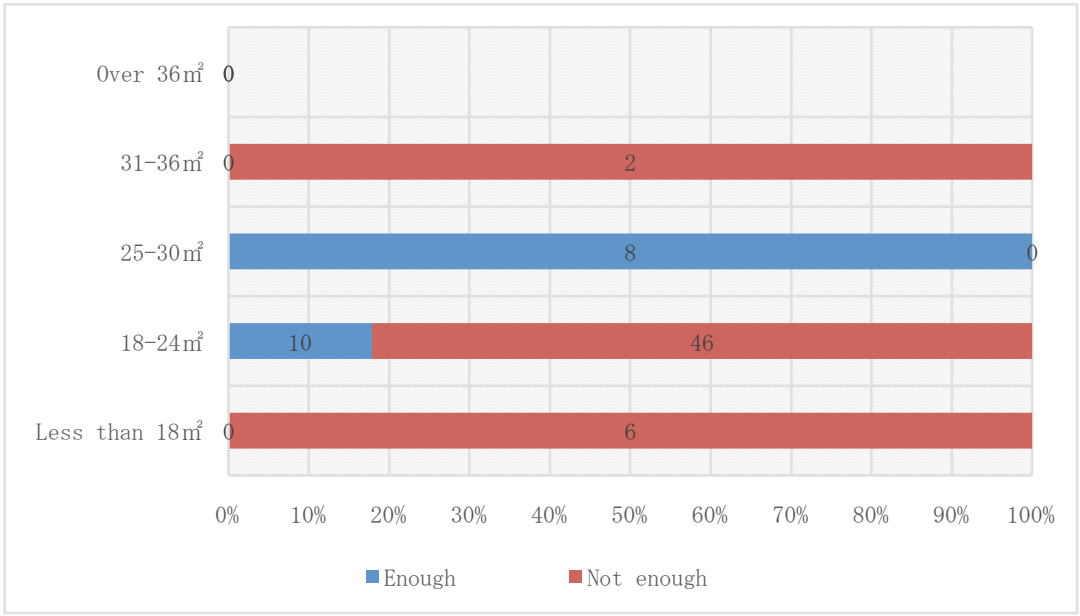
question this one your No, what you want in your dormitory to develop the living environment?" And in these 14 students who selected "No", 9 students wrote "Activity room", 3 students wrote "Cafe" and 2 students didn't fill out.

Figure.2 Do you think there is enough public space in your dormitory building?

Table 1. Distribution of the student in 6-floor and 11-floor who think there's enough public space in foreign dormitory or not.

3.1.2. Plan design of dormitory building

The foreigner dormitory room is the place where students will stay in most of their campus time. So the plan design of room has the most direct relationship to the live environment of the students.



Area of room

Figure.3 The area of the dormitory room

First about the area of the room. We can see from the figure.3 that 77.8% foreign students' room area are 18-24㎡. In these 56 students, 50 have a roommate and left 6 are live alone. These 6 students and 4 of 50 students think that the area of room is enough. The 2 students whose room area are 31-36㎡ think their room area are not enough because they share the

room with another 3 students. So I think the area of the dormitory room is a factor that influence the live environment of the foreign student.

The direction of room

Table.2 What do you think about your room's condition

Topics/Evaluate	Very good	Rather good	General	A little bad	Very bad
Ventilation	16	42	6	4	4
Sunlight	36	20	8	8	0
Thermal insulation	6	24	10	24	8
Sound insulation	4	8	12	40	8

In these 72 investigators, 50 students' room direction are south and 22 students' are north. Because Zhejiang province is in the south side of China, so in order to get more sunlight, the most of buildings' direction will choose south and north.

Then combine with the data from Table.2, 58 of 72 investigators think the ventilation of the

foreign dormitory is "rather good" even "very good". In these 58 students, there are 46 students' room direction are south, and the 8 students who chose the "a little bad" and "very bad" both live in the north room. Just as the ventilation, 56 of 72 investigators think the sunlight of the foreign dormitory is good and all of these 56 students' room faced to the north.

About the other two factors, thermal insulation and sound insulation, almost half investigators feel satisfied about the thermal insulation of dormitory, half feel unsatisfied, and in these students, there is no big trend of different direction of room. About the sound insulation, 66.7% investigators feel unsatisfied about it. In my mind, these two factors are more influenced by the material of the dormitory buildings.

3.2. Planning part of foreigner dormitory

I made a survey about the satisfaction degree of different factors in foreign students' mind. I provide five degree for students to select. "Very satisfactory", "Satisfactory", "Average", "Unsatisfactory" and "Very unsatisfactory".

3.2.1. The location of the foreign dormitory

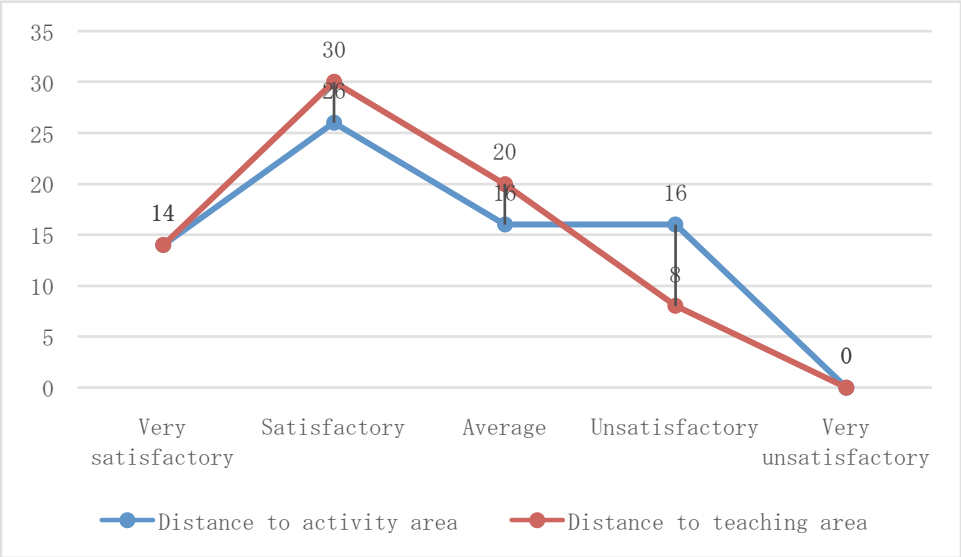
Table.3. The satisfaction degree about several aspects of the foreign dormitory

Topics/Satisfaction degree	Very satisfactory	Satisfactory	Average	Unsatisfactory	Very unsatisfactory
Dormitory Location	30	36	4	2	0
Distance to teaching area	14	30	20	8	0
Distance to activity area	14	26	16	16	0
Surrounding environment	26	38	4	4	0
Communal facilities	18	30	16	4	2
Enough communication space	18	12	18	16	8

igure .4 The comparison of the satisfaction degree to the distance from

Dormitory to activity area and teaching area

The location of dormitory is a main point of the campus planning. A reasonable location can create a better living environment for the student.



Some advantages of the Zijingang campus foreign dormitory location already mentioned in previous chapter. Then let's make clear how students think about their dormitory's location. We can see from the Table.2 that 41.7% feel very satisfactory about the location of the foreign dormitory, 50% feel satisfactory, 5% feel average and only 2 of 72 investigators feel unsatisfactory. Generally speaking, the foreign dormitory location of Zijingang campus of Zhejiang University have been planned greatly. Because 92.7%investigators, almost reach 100%, feel satisfactory about the location of foreign dormitory.

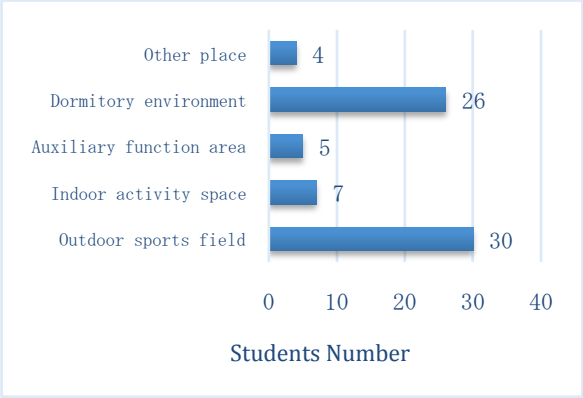
But the location of dormitory include a lot of elements. The most important one is the distance to the each different functions area. From the Table.3 I add two topics to let foreign students in Zijingang campus fill their satisfaction degree. These two topics are "Distance to teaching area" and "Distance to activity area". We can do the comparison from the figure.4 that the numbers of investigators who chose "Very satisfactory" are both 14 people. But the number of option

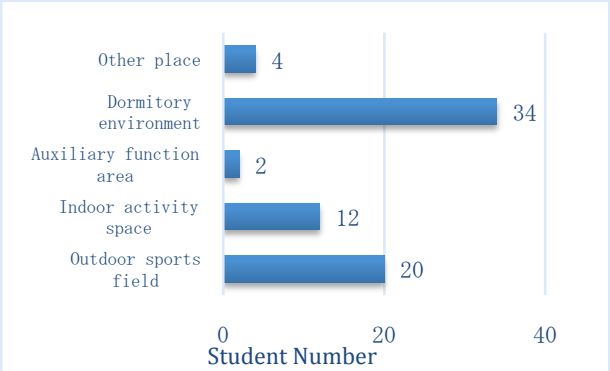
"Satisfactory" and "Average", "Distance to teaching area" is more than "Distance to activity area". On the other hand, the number of option "Unsatisfactory", "Distance to activity area" is more than "Distance to teaching area". From this data we can know that the foreign students

in Zijingang campus are more satisfied with the distance to teaching area than the distance to the activity area. But from the general plane I find that the distance to the teaching area are longer than the distance to the activity area. The reason for this result is the fact that the student like doing activities more than study or having lessons. That's why they want be closer to the activity area.

3.2.2. The surrounding environment of foreign dormitory

The surrounding environment of foreign dormitory has a strong connection to the green space ratio of the foreign dormitory surrounding. There's a lot of Greenland have been planned near the foreign dormitory in this campus just mentioned in previous chapter. And also we can see from table.3 that 36.1%investigators feel very satisfactory,52.8% feel satisfactory and only 5%feel unsatisfactory about the surrounding environment of foreign dormitory.





3.2.3. The communication space near the foreign dormitory

Figure.5 Where do you think the communication likely to happen.

Figure.6 If let you choose, where do you hope that is most communication will happen.

A good living environment of foreign student not only refers to the good environment or comfortable life these physiological factors, but also have the connection to the some spiritual factors. For example, a well communication environment between foreign students and native students.

In these two questions I set five options for selecting. The Outdoor sports field (Court, Playground…), Indoor activity space (Gym, Indoor stadium, dining hall…), Auxiliary function area (Stairs, Bathroom, Toilet, Balcony…), Dormitory environment (Lawn, Outdoor seat) and other place.

We can see from the fig.5 that "outdoor sports field" is the place that communication most likely happen in foreign students mind, totally 30 students choose this option. And then "dormitory environment" come next, there are 26 students choose this option. "Auxiliary function area" and "indoor activity space" almost has the same number of selectors, 5 and 7. 4 students choose the option "other place" and write down their idea, one is classroom and the other three is coffee shop.

The fig.6 show the place where communication will happen that the foreign students most want. And the options are as same as the previous question. But the result are quite different. "Dormitory environment" become the most selected one, total 34 students choose it. Then next is "Outdoor

activity space" and "Indoor sports field", are 20 and 12. The last two options, "Auxiliary function area" and "Other place" are same of 3. That 3 students who choose "Other place" wrote "Everywhere" and "Room".

According to analysis the data, no matter "you think" or "you want", "Outdoor sports field" and "Dormitory environment" are the most chosen ones. The option "Indoor activity space" is increasing a lot in the second question. It means that we can improve the communication by build more indoor activity spaces. Another point, the option "Auxiliary function area" is the most unchosen one in these options.

I divided the campus into three parts, living area, teaching area and activity area. Then make foreign students select if add some communication spaces, where they will choose.

We can see from the fig.7 that 52％ students choose adding communication space in activity area.. And students who choose in living area are a little more than who choose in teaching area.

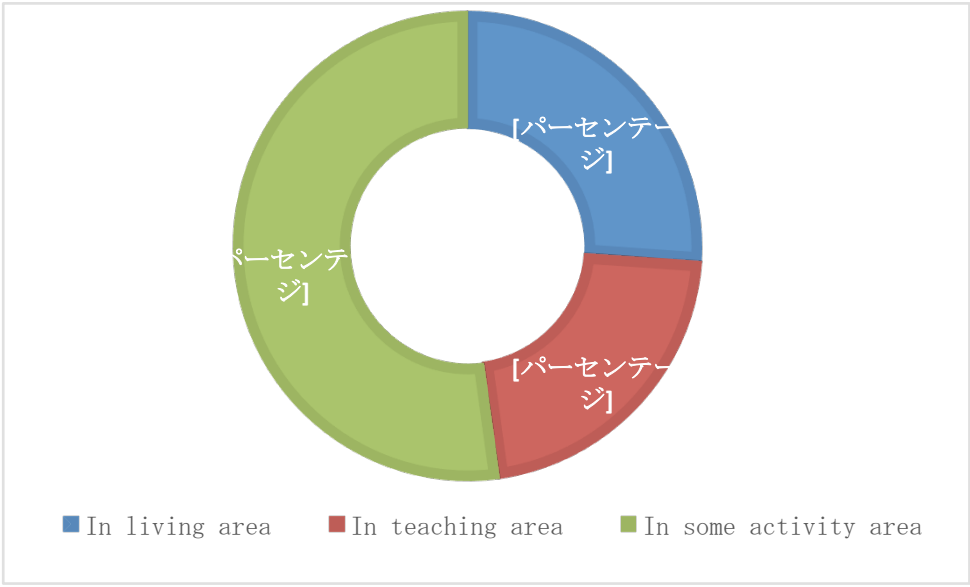


Fig.7 Where do you think should add some communication place in your campus.

3.4. Unsatisfactory or advice

At last of the questionnaire I give a question to let students write their own ideas. 52 in 72 students wrote "No advice" or "Satisfied" about this question and the other students wrote some needs or advice useful, for example, "add some activity space in 200m distance to the dormitory". "Need more outdoor seat to rest". And there are 9 students wrote, "add a small park near the dormitory." This idea is the one most people have written down. It shows that the surrounding environment still have a lot of room for improvement. Except the idea above, the others are all complain about the inconvenient caused by some defects that have no relationship to the dormitory design and planning.

4. Discussion

This research mainly according to do the basic information data collection and combined the data analysis from the questionnaire, find some factors that influence the living environment of foreign students in foreign dormitory planning and design.

From the basic information collecting, we know that the Zijingang campus has two types of foreign dormitory, 6-floor and 11-floor, and the main difference of these two dormitory is that 11-floor have a public space and kitchen for foreign student. [2] Then combined with the questionnaire statistics

we can know that add some public space such as public kitchen, communication space, will greatly improve the foreign students' living environment. (Table.1) so we know the public space in the dormitory building is a factor the influence the living environment in building design.

About the plan design of the dormitory, a room facing south will get more sunlight and wind to obtain the better ventilation and sunlight.(Table.2) In the other hand, the area of room also have some influence to the students living environment, the larger the area of room become, the more satisfaction of foreign students will increase.（Figure.3）

Then about the planning part of the foreign students dormitory. First is the location of the dormitory, it has a strong connection to the foreign students' living environment. I analyzed the location in several aspects. Here I emphasizes the analysis of the Convenience of road system (Figure.4) and the surrounding environment. (Figure.5~6) The result obviously showed that both these two factors have influenced the foreign students' living environment.

Then about the communication space in planning of the campus and dormitory. It give the influence to the foreign students' living environment in mental way. In the Zijingang campus there are mainly three areas, living area, teaching area and activity area. We can get information from the results of questionnaire analysis that the communication space in living area and activity area are much more important than in teaching area. And in activity area, the most influenced and improvability one is the indoor activity space. In living area the most influential is dormitory environment such as lawn, outdoor seat. (Figure.7)

5. Conclusions

Sum up all in this research, there total 6 factors that influence the living environment of foreign students in foreign dormitory design and planning found by this research.

1. Adding some public space such as public kitchen or communication room inside the dormitory.

2. Adding south-facing room as more as possible and increasing the per capita area of dormitory room.

3. When you do the foreign dormitory planning of some university campus, watch out the

convenience of road system and the surrounding environment. Also the relationship between the foreign student dormitory and native student dormitory.

4. Adding some communication space near the foreign dormitory and activity area also will improve the living environment of foreign student.

Using the land effectively to do the reasonable planning, developing the living environment of student, considering the possible situation in the future and being prepared ahead of time, these targets are all a sustainable campus planning want to get. If these four points can be paid more attention when you do the design and planning of foreign dormitory, the living environment of the foreign student will significantly improve and these are the beginning of a sustainable campus planning and land management. Hope my research can become a reference resource and help somebody who want do the research in this area.

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Soil contamination and human health risk assessment at a former industrial site in a densely populated urban area

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Abstract

Sustainable Land Use Planning forecasts the enhancement of communities quality of life, population growth and mobility and, as part of smart strategies for a regional growth, promotes the environmental quality and protection. Despite increasing of environmental protection rules in recent decades, many contaminated industrial sites, located inside or in the neighbouring of urban areas, are still abandoned, and represent a major concern for human health protection and social-economic lifestyle quality, since industrial wastes are one of the main pollution sources of soils and water bodies, in particular for heavy metals and organic contaminants. This paper intends to highlight the need of integrating environmental risk analysis outputs in the municipal urban planning programs as key-rule for environmental protection plans, in order to avoid human health risks associated to the rehabilitation of derelict industrial areas. In this context it is presented a site investigation study to assess the risk of human exposure to potential contaminated soils at a former of a metallurgical industrial site located in a densely populated urban area (Odivelas, Portugal), currently in process of urban redevelopment. The methodology followed the guidelines of the Portuguese Environmental Agency (APA, 2011), presented in two stages: 1st stage – Evaluation of the degree and extend of the contaminated media; 2nd stage – Human health risk assessment based on actual and future land use scenarios. The contamination model was designed based on local data, collected during three sequential investigation phases leading to the gradual knowledge of the affected media and allowing the reduction of the cost/benefit ratio, decision-key for future investigation actions. The risk model considered two on site exposure scenarios (soils ingestion and dermal contact), either for residential use and for commercial or industrial use. The study concluded that, although the soils present contamination levels above recommended threshold limits for cadmium, chromium, copper, lead, nickel, vanadium and zinc, there is no carcinogenic risk for on-site soils exposure paths (dermal contact or soils ingestion). However, due to the high metals concentration, namely lead concentration, human health risk analyses should go further for the residential neighborhood population to outwit epidemiological surveillance diseases in order to ensure human health protection and promote a sustainable urban planning based on environmental and life-style quality.

Keywords: Urban planning, contaminated sites, human health, risk assessment, sustainability

Urban cycling modal share: rising up from incipient networks and numbers

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Abstract

Today, the concept of a sustainable city is inseparable from sustainable mobility. Urban Cycling is a promising way for urban mobility in a context of a petrol crisis and financial constraints where people, jobs and goods are closer, and has been strongly encouraged by the European Agenda for transport and sustainable mobility and by international and local policies. Several studies point to a direct relationship between investments on cycling infrastructure and increase of cycling modal share. In the last decade there has been an investment in bicycle infrastructures in several cities, but there is an absence of official data collected by systematic observations to monitor the number of bicycle users, particularly in Portuguese cities where there is almost no data to rely on. To assess the rising up of bicycle usage, and potentially the increase of urban sustainability, it's necessary to understand which data are available and how they are collected. In cities where bicycle use has been increasing, municipal planning of transport infrastructures benefits from the replication of best practices from other cities. This strategy is not always able to generate effective solutions, efficient and locally adapted, mainly due to the lack of information about the de facto movements and preferences of local cyclists. Moreover, urban cyclists are not all the same; ie, they do not travel with the same purpose or frequency. In fact, for the same city, cyclists have different profiles, according to their experience level, risk perception and on-road behavior. Guidelines from renowned institutions (or popular trends) are driving municipalities to invest in single measures, but often not integrated in a plan or network, which sometimes results in insipient and uncoordinated cycling network. Cities that are investing in bicycle infrastructure are faced with decisions of where to invest and what type of facility to install. It is important to know how this kind of these investments should be done and how to prioritize them, in order to increase cycling modal share, particularly by shifting potential cyclist away from private modes. This work discusses the importance of urban cycling data collection. It addresses low cost solutions and methodologies to collect data from cyclists in order to obtain OD matrixes of commuting and other motives trips. Furthermore, it enables the analyses on behavioural determinants and potentially change mobility habits. These are presented as survey solutions to leapfrog the lack of data to sustain the bicycle infrastructure decisions and investments. Making cycling metrics available can inform authorities both for ex-ante and ex-post analyses and assess the efficiency and effectiveness of interventions. This is an important gap to overcome in order to have an informed decision-making regarding the management of urban mobility. The level of performance obtained is an important issue determinant for the promotion of cycling for commuting. Improving walking and cycling infrastructures efficiently (especially where cycling wasn't once an option) is a way for a more sustainable cities and their quality of life.

Keywords: Urban Mobility, Urban Cycling, Cycling Network, Data Collection, Lisbon

Transit-oriented development and commuting: a case study from Lisbon

David S. Vale

Abstract

Transit-oriented development (TOD) has been promoted as an effective solution to integrate land use and transport, fomenting a more sustainable urban mobility pattern. However, a clear association between the degree of integration of a TOD place and travel patterns originating or ending in these places is still missing. In this paper, we are testing this association, by analyzing commuting patterns of residents of TOD places in Lisbon, classified in accordance with their node, place, and walkability indexes (a six categories typology). Using block level statistical data (the smallest statistical unit), several multiple regression analysis were developed to explain the observed commuting modal share, using the three indexes and the six categories as explanatory variables, controlling for socio-economic data. Our results show a relationship between TOD and commuting, stressing the importance of TOD to promote a more sustainable urban mobility pattern. Therefore, although recognizing that the expected TOD mobility impacts are wider than simple commuting patterns of residents, including also mobility patterns for the workers of these places, as well as mobility patterns within the TOD, our results sustain the importance of land use and transport integration to support sustainable urban mobility.

Keywords: Transit-oriented Development, Sustainable Urban Mobility, Commuting, Lisbon

Track 4b. Sustainable Cities and Regions

Development of a framework to achieve regenerative sustainability through construction briefing – the cases of Singapore and Hong Kong

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Abstract

Traditionally, the concept of "green building" refers to "green technology" designed to "do less harm" to the human activities in buildings. However, following the criticism that this traditional concept is insufficient to achieve 'real' sustainability, a new concept known as regenerative sustainability has attracted interest as a mean to reframe the "green building" practices. This concept seeks to engage and empower stakeholders to adopt an integrated systems approach for creating buildings. This paper aims to introduce the regenerative sustainability concept and explore its relationship with, and impacts on, construction briefing, which is the first step in the design process; during briefing, clients either formally or informally inform others of their needs, aspirations and desires of a project. Specifically, these questions are addressed: 1) What kind of regenerative sustainability models are applicable to Singapore and Hong Kong? Why would they work? 2) How different are these models, in terms of pathways, partnership, governance and support tools? 3) How should stakeholders be engaged in these models, with an aim to meet the specific environmental, economic and social goals of regenerative sustainability? 4) How will such engagement methods affect the conventional way of conducting construction briefing? In other words, is there a need to change the way briefing is conducted to realize the potential of regenerative sustainability? In this study, several stakeholder engagement methods, including the Integrated Framework for Stakeholder Identification, Understanding, Engagement and Role Management (IFSIUER), are examined within the contexts of Singapore and Hong Kong. Emphasis is put on understanding how these various methods can achieve the specific goals of regenerative sustainability. Next, by applying Social Network Theory, proposals will be made on how conventional project briefing can be modified. That is, this study will develop an implementable framework for construction briefing, which will contribute to promoting sustainability in construction briefing, through incorporating the socio-technical and socio-cultural dimensions into this important decision-making process.

Keywords: Stakeholder identification, stakeholder engagement, construction briefing, regenerative sustainability, green building

The social dimension of urban resilience: a methodology to assess social dynamics contributions to urban sustainability

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Abstract

The world has been facing a staggering population growth, as well as a continuous increase in the number and size of urban areas. This contributes to social dynamics changes and to the emerging need for examining and monitoring urban systems, namely in relation to its resilience to socio-ecological problems. The purpose of this paper is to share results from a research study conducted on how urban resilience can incorporate a social dimension: what socially drives the urban system, and what, why and how social disturbances and changes affect the urban system resilience. The objective is to show an adapted methodology and its implementation in the city of Lisbon, aiming to assess the social contribution to Lisbon's urban systems resilience. A literature review performed on social-ecological systems resilience, urban resilience; and social innovation concepts, provided a conceptual foundation to adopt an existing methodology already applied in Tokyo city region (Kumagai et al., 2010). The methodology used on this study consists in five steps – translation of the social dimension into urban resilience; definition of the focal scale; identification of indicators; development history and interpretation from the perspective of long-term resilience. The translation of the social dimension into urban resilience is performed through social dynamics and social innovation concepts, considering the characteristics associated to a city urban development. To enabling the assessment of the social dynamics and social innovation, key aspects and its evolution were looked at: demography, social vulnerability, mobility and city attractiveness. The methodology was then applied to the city of Lisbon, where the city governments' policies were analyzed, and the social drivers, social disturbances, and changes affecting the urban system resilience were identified and assessed. The results indicate that Demography, Social Vulnerability, Mobility and City Attractiveness are the key essential drivers to assess the social contribution to urban systems resilience. Therefore, these key drives can be applied into other cities with the same urban development typology as Lisbon. As overall conclusion, the assessment done shows that the city of Lisbon has been facing over the last 50 years a mix of desirable and undesirable qualities. The desirable qualities have been facilitating the urban system transition to a sustainable behavior, building urban long-term resilience; while the undesirable qualities present an opportunity for the current city governance implemented policies to reverse the city social disturbances negative trends.

Keywords: Urban Resilience, Long-term Resilience, Social Dynamics, Social Innovation, Lisbon

4b_Gebauer_Abstract_Final

The intermediate city as glocal interface for its insustainability over time, through its transnational insertion: the case of Antofagasta, Chile, 1990-2012

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Abstract

Introduction. This research considers that the sustainable development occurs in the city, when together with the economic development the social and environmental ones occur in a mutually fed convergence. This development refers to the recognition of the proper elements of identity of the territory together with the society that gives shelter within it, and it is achieve when its essence and fundamental truth appears (Giddens, 2008). To get this, it is make necessary to ensure the continuity of its socioeconomic development that has its roots in the recognition of its identity, but also in the detection of the productive activities that assure its viability at present as well as in its potential future. *Methods*. At last, what this presentation stands for is that any transnational insertion, which is seeing from its "glocal interface" condition (Gebauer, 2015, pp.159), it requires to establish what each city-region offers as singular and unique feature, which is, in the case of Antofagasta, the Atacama Desert as unmistakable mark. According to this, four dimensions were analysed, which in Castells terms (1997) are flows and places. From flows, by taking first, the transnationals networks in which Antofagasta Region participates; second, the productive activities in which the region has competitive advantages; and then from places. By taking urban morphology of the city and its identity elements of international scope, in the enlarged-historical-centre (EHC), as third dimension; and fourth, the meaningful elements of its landscape and urban image which are outstanding to the Antofagasta-city-region when they interact as "glocal interface". *Results & Findings.* The research found that the proper Atacama desert characteristic requires the integration of various factors to be sustainable over time, such as: the mining production with water restriction that this type of territory demands; the fact that the region possesses a geological sub-ground that always will produce new minerals; the possession of a territory whose natural condition is to have the major solar radiation in the continent; the existence of an ancestral and unique living culture as the "atacameña"; to have the definition of the concept of enlarged-historical-centre and its consolidation, in the case of Antofagasta, as one of transnational insertion; the conception of a great-urban-project as mentioned by Carrión (2004 and 2006) and Gebauer (2015), as way to complement the strategic-urban-planning of the region, to act as "glocal interface" within the trilogy of environmental economic and social terms conditions. *Conclusions.* The research concludes in theoretical new concepts as well as new practical criterion to study the intermediate city (IC), at the level of its original centre joint to the level of the region which allows to understand the city as a whole; from the historical centre to the level of the enlarged-city-centre, and from this to the enlarged-city-region concept, in a succession of scales that allows to go towards the insertion of the region at the global-cities-system when it is analysed and understood as "glocal interface" as means to assure its sustainability over time covered by this research.

Keywords: "glocal interface"; "intermediate city"; "transnational insertion"; "enlarged city centre"; "enlarged city-region".

Influence of Urban Gating on the Publicness of Neighbourhood Parks in Chennai, India: Implications for Urban Social Sustainability

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Abstract

Public space plays a key role in promoting socially equitable and environmentally sustainable cities of the future. From the perspective of social sustainability, public spaces such as the streets, parks and squares; provide platforms for social interaction and chance encounters between people from different cross-sections of the society promoting social cohesion and building social capital. In short, public spaces unfold city's social life critical to their vitality and sustainability. However, there are increasing concerns over loss of public space in the contemporary cities due to growing factors such as privatisation of public space, urban development to satisfy affluent consumerism and global spread of gated communities. Under these circumstances, what is increasingly being under threat is the quality of publicness in public spaces, the very same quality that is argued to promote social sustainability. The present research aims to develop a deeper understanding on how the quality of publicness in neighbourhood parks is changing due to urban gating, i.e., the development of gated communities in the context of Chennai, India. Chennai, one of the Indian megacities, is transforming spatially with a growing number of gated communities resulting in neighbourhoods with two major types of parks. First category is the parks of open neighbourhoods developed by the state, located amidst the plotted development of houses. Second category is the parks developed by gated communities in the land donated by them to the state towards open space reservation. The two typologies have originated from two different planning paradigms, i.e., the state led top-down planning approach and the public-private partnership approach respectively; resulting in two different public space models with respect to access and power. Investigating these two typologies of neighbourhood parks empirically based on the ideals of publicness could deepen the understanding of how privatisation of urban development, particularly, the spread of gated communities result in loss of public space. The theory and methodology established to empirically investigate publicness in public spaces in the developed world is adapted by the author to suit the context of the developing world. Through extensive mapping and field survey, the study shows how the difference in qualities of access and power created by gated communities in the parks developed by them has resulted in the loss of public space at the neighbourhood level, so crucial to urban social sustainability.

Keywords: Public Space, Publicness, Privatisation of Urban Space, Urban Social Sustainability

Analysis about the accessibility of urban communities of ring road system

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Abstract

The demand of urban communities has been rapidly increased with the urbanization of China. Hangzhou, as a metropolis of China, the capital of Zhejiang province, is undergoing this situation that some contradiction between the supply and demand has emerged. And in Xiacheng District, a main administrative district of Hangzhou, the earliest existing urban communities were mostly built in the 1980s. From the age of 1980s to nowadays, the community has changed a lot, no matter its quality or community style, and also developed a lot in different ages. Previous researches about the urban communities planning or criterion are rich and well thought-out. However there is little analysis about the community itself or even none about its accessibility. The urban communities of ring road system are popular in the 21th century. More and more new urban communities start to adapt this road system type to organize its road network. But its accessibility and sustainability need timely researches and analysis. Compare to other road systems, whether these urban communities of ring road system account for an advantageous position. And the aim of this paper is to analyze the characteristics of urban communities of ring road system which are completely constructed after 2000 from the angle of accessibility based the theory of space syntax. This paper randomly chooses 4 communities after 2000 in Xiacheng District and then makes a comparative analysis between them. Get the basic information and community planning maps from the government websites, such as Hangzhou Planning Bureau and Hangzhou Housing Authority, and then have verification through the property management offices to make sure the data's accuracy. According to the theory of Space syntax and with the software help of Depthmap, get the integration value, which means the accessibility of urban communities, and then make a comparative analysis to them. The Yicheng Jiayuan Community has the best accessibility in these 4 ones. There comes out the general rules of development of ring road system of urban communities. At the same time, it reflects the evolution of Chinese society and tries to figure out sustainable ways for the future development. And have a better understanding about the challenges and difficulties that appear during the urbanization in China. Is it possible to predict that social structure of space using Space syntax techniques? The answer appears to be positive.

Keywords: urban community, ring road system, space syntax, accessibility, integration value

1. Introduction

1.1 Research background

China is under a rapid urbanization development after 1978. According to the population scale, cities can be divided into four kinds, small cities whose population are below 200,000, middle cities whose population are between 200,000 and 500,000, big cities whose population are between 500,000 and 1000,000, megalopolis whose population are more than 1000,000. As Figure 1 shows, the megalopolis and big cities have an obvious growth from 1949 to 2008. Especially

from 1978, the urbanization has been developing sharply (National Bureau of Statistics of China, 2010).

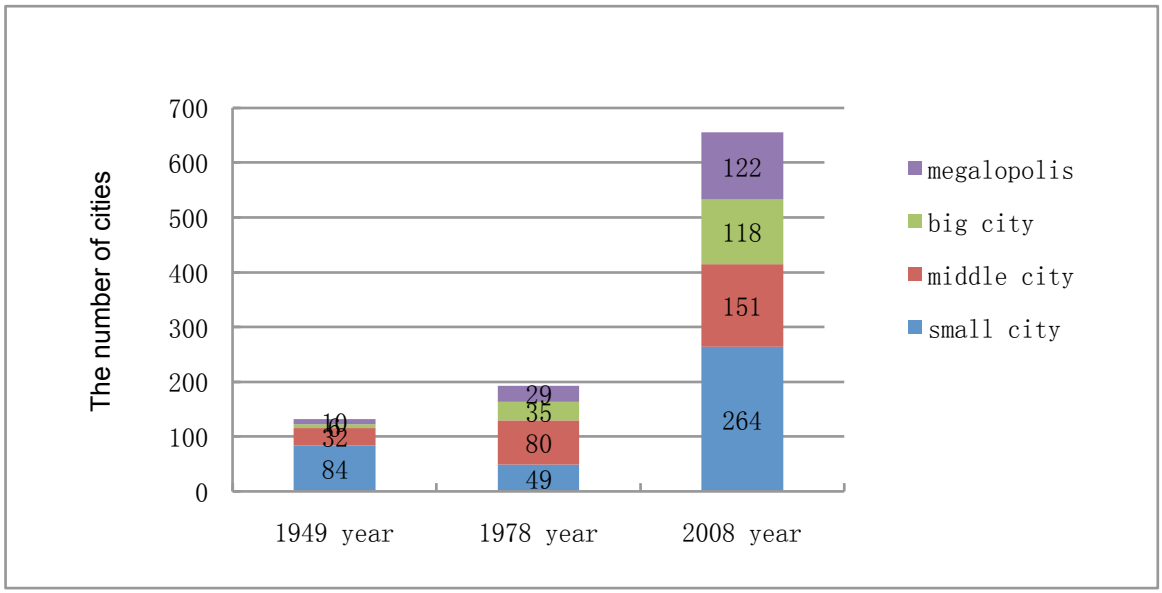

Figure 1. The rapid urbanization of China

With the increasing urbanization of the country, commercial and industrial lands squeeze people's living space. In China, the community is a certain area within the city, a large independent area, separated from the city by walls, ribbon like trees, rivers, and other regions. Some is also equipped with a complete set of service facilities, such as commercial outlets and kindergarten. There are several types of communities within different road systems. As Figure 2 shows, ring road system, endpoint road system and tandem road system are three common types to organize the road network (Chen, 2009). The main road through the community is a circle road, which with branch roads are combined to form a road network system in an urban community. The urban communities of ring road system are very popular especially in the 21th century. Thus this paper chooses the communities of ring road system after 2000 to analyze.

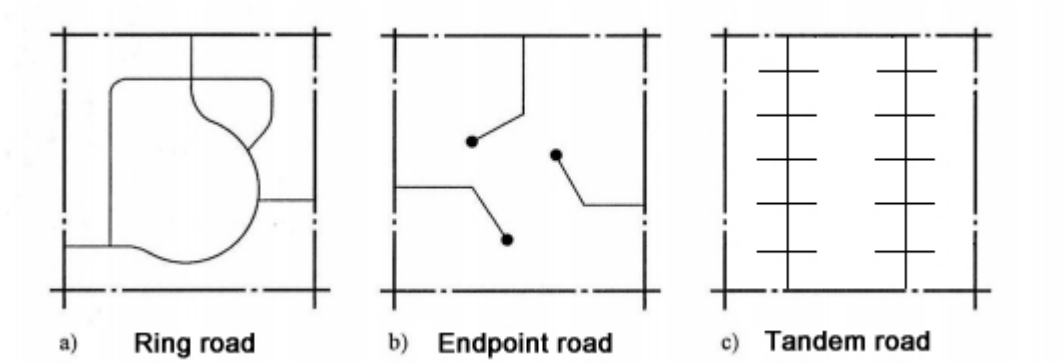

Figure 2. The common community types of different road systems

The urban communities, with the rapid development of city, have turned into a huge demand and a series of evolution. A large number of communities have been conducted to meet the large demand and most of them are concerned about the design or construction. Naturally, some unreasonable design will come along and it surely will result into a low utilization, and even the indifference of interpersonal relationships. The accessibility of communities is low and it is sometimes hard to walk from one part to another part within the community. Accessibility generally refers to the ease of transportation from one point to another point. Starting from the perspective of daily transport infrastructure is an measure to the efficient allocation. From the urban planning point of view can be an assessment to deepen the city's public service facilities rationalization and fairness arrangement. This paper will try to analyze how convenient from one part to other parts of

the communities.

1.2 Literature review

Bill Hillier thought that Space is the Machine, which reports a substantial body of research built on that theory, and a large number of articles concerned with different aspects of space and how it works. The theory of space syntax has been extensive used, and the theory is relatively consummate. But in China, this theory is not so popular used or there is more introduction than practical application or theory innovation.

As for urban community space, there are lots of planning design and analysis. The community design in the world has talked a lot about the planning design. However, the researches about the accessibility of the communities are very little and are lack of quantification. Besides most of the studies are from the subjectivity aspects by conceptual approach.

This paper is based on the theory of space syntax, using the concept of Integration value, and the software of Depth map to quantify the spatial structure of the communities. Firstly, describe theoretically first combined with the existing data. Secondly, analyze the accessibility of the four community spaces of ring road system. Thirdly investigate the present situation. Finally, from the perspective of accessibility space, make recommendations on the transformation of community space.

2. Methods

2.1 Research methods

2.1.1Statistical data collection

The overall planning of research objects are realized by the government website, Hangzhou Planning Bureau. The basic information of urban communities is firstly collected by websites. There are two kinds of websites. One is from the government, such as Hangzhou Planning Bureau and Hangzhou Housing Authority. The other is from Enterprise network, such as Fangtianxia Company and Woaiwojia Company. The data in website is rich but sometimes not accurate. Verification is needed. In China, one urban community is equipped with one residential property management office, which is the operation, control, and oversight of real estate as used in its most broad terms. Questionnaire including 5 indexes were given to them by telephone. They are completion time, gross floor area, total households and floor area ratio. After verification and correct, the data become accurate.

2.1.2 The theory of Space syntax

Space syntax is a research program that studies the correlation between human societies and space from the perspective of the general theory of the structure of populated space in all its different forms: buildings, settlements, cities, and landscapes (Hillier, 1996). Space syntax is also defined as a graph-based theory used by architects and urban designers to examine how the spatial layout of buildings and cities influences the economic, social, and environmental outcomes of human movement and social interaction (Dawson, 2002). Its techniques offer precise quantitative descriptions of the way in which the built spaces of a setting are organized (Hillier et al., 1983). According to Hillier and Hanson (Hillier and Hanson, 1984), the social meaning of the environment arises from spatial composition, and the topological structure of an environment is a primary element by which a society creates and establishes roles to develop some types of social relationships. Therefore, constructed environmental spatial patterns incorporate and give shape to social patterns.

a. Axial analysis, one of the three basic ways to divide the space.

It rests on three basic conceptions of space:

First is the convex space (popularized by John Peponis and his collaborators at Georgia Tech), an occupiable void where, if imagined as a wire frame diagram, no line between two of its points

goes outside its perimeter: all points within the polygon are visible to all other points within the polygon.

Second is the axial space (idea popularized by Bill Hillier at UCL), a straight sight-line and possible path

Third is the visibility polygon (popularized by Michael Benedikt at University of Texas), the field of view from any particular point. Figure8 refers to the three basic conceptions of space.

This paper chooses axial analysis. According to the spatial perception, divide the large-scale space into a series of small-scale space. The relevant index of each axis represents the convenience of movement, transfer, forward and other capabilities. All lines in a spatial layout have certain depth of a line from all other lien in the system. And travel along the axial direction is the most economical and convenient movement[6)].

b. Integration value, the basic variables of space syntax.

The basic variables of space syntax include connectivity value, control value, depth value, integration value, intelligibility and so on.

Overall integration value represents the tightness between one node in contact with all the nodes throughout the system; and partial integration value, usually take the activity as a goal centre and the topology steps are three, is the tightness between one node in contact with its surrounding nodes in the system. It dispersed degree that one unit space connects with all other parts in same the system. The greater the integration value is, the higher the cohesion of this part is. Surely, the organization force of this part is also stronger .The integration value is high, which means a more convenient space.

According to this, calculating the integration value to represent the accessibility of urban communities, the tightness between the urban community space and other dwellings, is reasonable and feasible.

2.1.3 Analysis by software, to calculate the integration value of the space.

The software of Depthmap was created by London University, which is based on the theory of Space syntax to analyze the structure of space. It can calculate the related variables. There are still other software based on the theory of Space syntax, such as Axman, Axwoman, and Confeego.

2.1.4 Practical observation

After analysis by the theory of Space syntax, verification is also important. Make an observation about the four urban communities, to verify if the part of highest integration value has the most activities.

2.2 Research site

Hangzhou, as a megalopolis of China, the capital of Zhejiang province, is undergoing this situation that some contradiction between the supply and demand has been emerged. Therefore, studying on the accessibility of urban community space and design rules, analyzing the current situation and its development, and assessing the utilization, can maximize the utilization of spatial structure and ease the relationship between supply and demand.

Xiacheng District is a main administrative district in Hangzhou, which has an area of 31 square kilometers and a population of 526,000 (Wikipedia, 2010).The old communities of Hangzhou, mainly built in the beginning of 1980s and increased sharply after 1980s. As shown in Figure 3, before 1989, there are 81 communities and 247 during 1990 to 1999 year. When it came to 2000 year, there appeared 307 new communities rapidly.

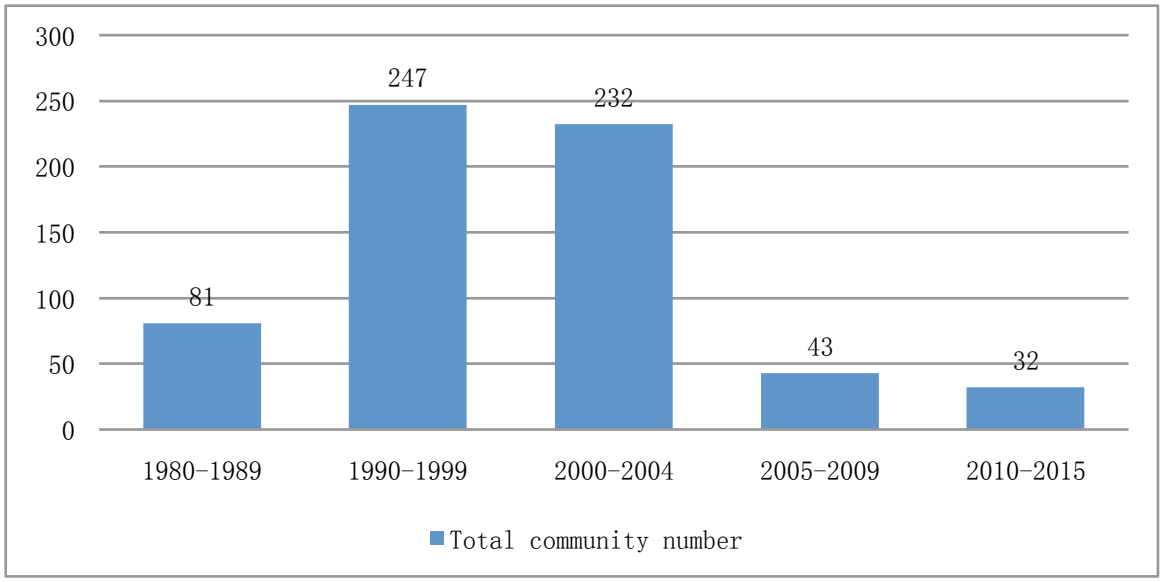

Figure 3. The urban community number of Xiacheng District

2.3 Research objects

The number of communities in Xiacheng District is totally 635. This paper chooses 4 communities of ring road system which are completely constructed after 2000 year. The selection of communities is random.

2.3.1 Shuiyin Kangting Community

The gross floor area is totally area of the community, including the residential buildings and other ancillary buildings, such as activity building and other equipped rooms. The floor area of per household can reflect people's demands for life, and life-changing standards. The floor area ratio is commonly used in real estate metric. It is the ratio of a building's available square footage to the total area of the lot on which the building sits. Some cities or towns use this ratio to enforce quality of life initiatives as well. As shown in Table 1, its completion time is 2006 year. The gross floor area is 200000 m^2. Till now, the number of total households is 1600 and thus average floor area of per household is 125 m^2. The floor area ration is 2.2. The overall layout of Shuiyin Kangting Community is shown in Figure 4. The overall planning pictures are designed by author based on the data in Hangzhou Planning Bureau.

Table 1. The basic information of Shuiyin Kangting Community

Completion time	Gross floor area	Total households	Average floor area of per household	Floor area ratio
2006	200000	1600	125	2.2

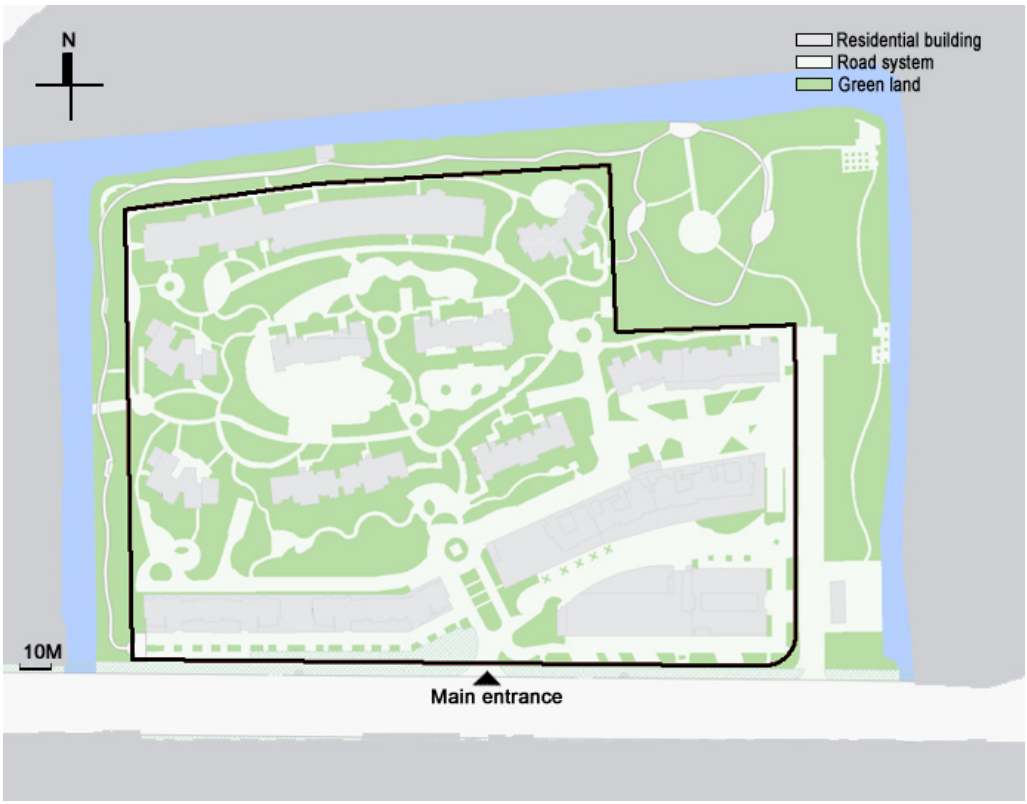

Figure 4. The overall planning of Shuiyin Kangting Community

2.3.2 Yicheng Jiayuan Community

As shown in Table 2, its completion time is 2009. The gross floor area is 100000 m^2. Till now, the number of total households is 744 and thus average floor area of per household is 134 m^2. The floor area ration is 2.4. The overall layout of Yicheng Jiayuan Community is shown in Figure 5.

Table 2. The basic information of Yicheng Jiayuan Community

Completion time	Gross floor area	Total households	Average floor area of per household	Floor area ratio
2009	100000	744	134	2.4

2.3.3 Yuandu Xinjing Community

As shown in Table 3, its completion time is 2010. The gross floor area is 129000 m^2. Till now, the number of total households is 1251 and thus average floor area of per household is 103 m^2. The floor area ration is 2.2. The overall layout of Yuandu Xinjing Community is shown in Figure 6.

Table 3. The basic information of Yuandu Xinjing Community

Completion time	Gross floor area	Total households	Average floor area of per household	Floor area ratio
2010	129000	1251	103	2.2

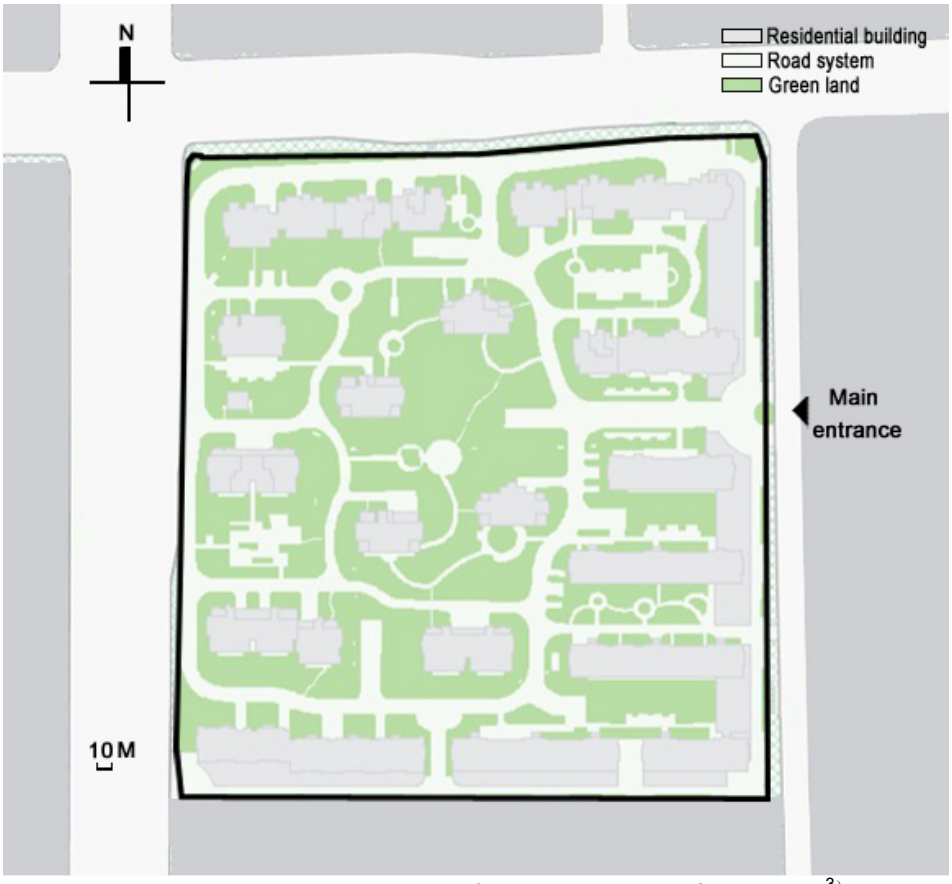

Figure 5. The overall planning of Yicheng Jiayuan Community[3)]

Figure 6. The overall planning of Yuandu Xinjing Community[3)]

2.3.4 Ziting Garden Community

As shown in Table 4, its completion time is 2005. The gross floor area is 73780 m^2. Till now, the number of total households is 437 and thus average floor area of per household is 169 m^2. The floor area ration is 2.5. The overall layout of Ziting Garden Community is shown in Figure 7.

Table 4. The basic information of Ziting Garden Community

Completion time	Gross floor area	Total households	Average floor area of per household	Floor area ratio
2005	73780	437	169	2.5

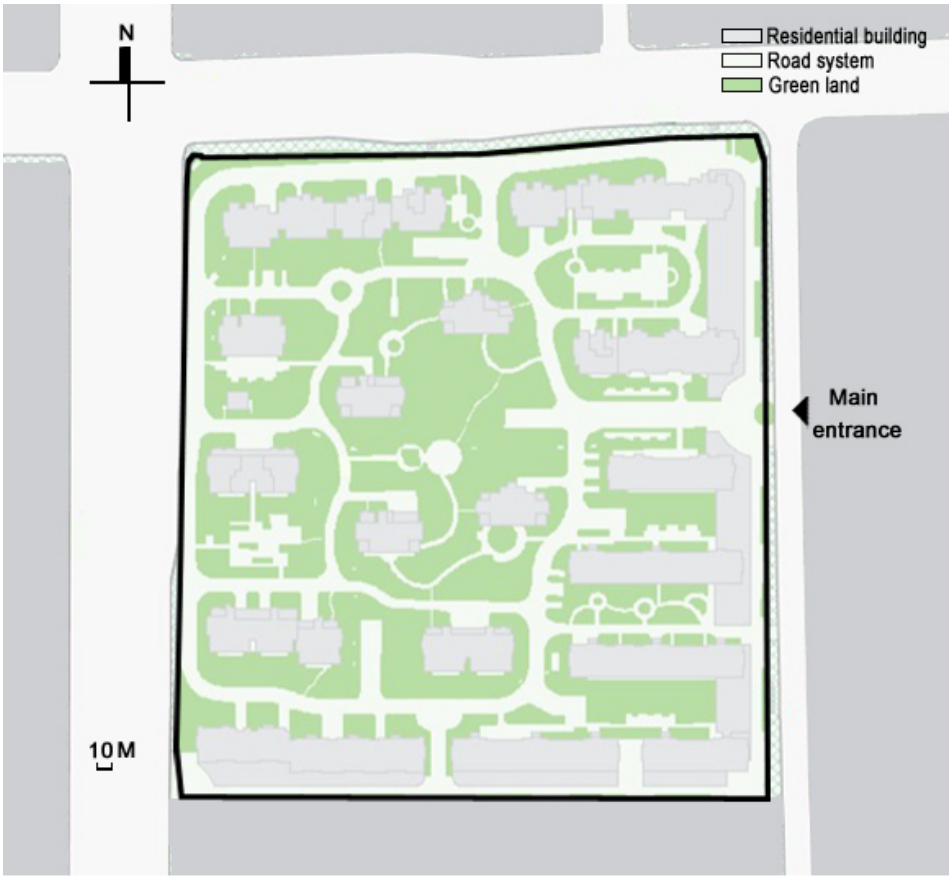

Figure 7. The overall planning of Ziting Garden Community [3)]

3. Results and Discussion

3.1 Shuiyin Kangting Community

The warmer the line's color is, the higher the integration value will be. Conversely, the lower will be. Therefore, as shown in Figure 8, in the northeast of the area, there are 3 roads that have the highest value, which means a high accessibility. The space surrounded by these roads of high integration value will be more convenient to be reached. On the north and west of the community, the integration value is lower, which means its position is relatively remote. The northeast area, are the most dynamic places. The south side of the community is the main entrance. However, its accessibility is not so high. The overall layout comes out a cool color, which may mean a low overall accessibility.

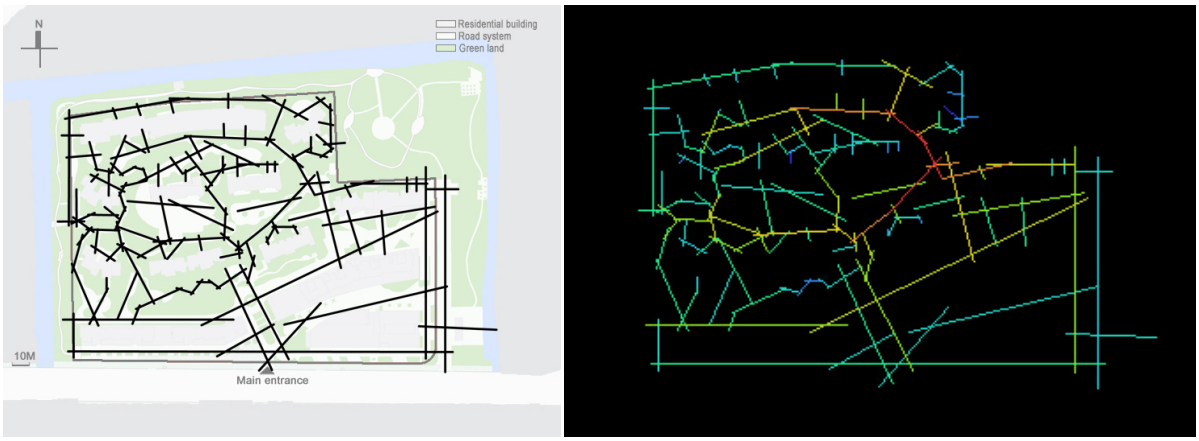

Figure 8. The axial drawing and analysis by Depthmap of Shuiyin Kangting Community [3)]

3.2 Yicheng Jiayuan Community

It is apparent from Figure 9 that the overall layout is balanced and the axial lines are mainly warm. The ring road system shows a good organization force, especially, at the east and north side of ring road, the integration value is very high. The space surrounded by these roads of high integration value will be more convenient to be reached.

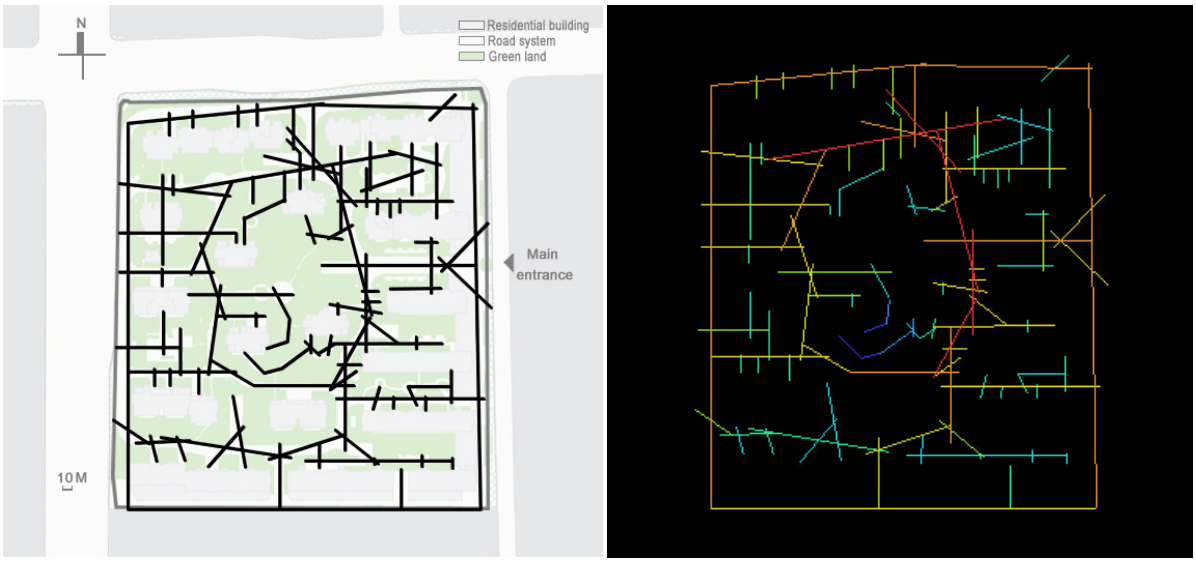

Figure 9. The axial drawing and analysis by Depthmap of Yicheng Jiayuan Community [3)]

3.3 Yuandu Xinjing Community

As is shown in Figure 10, in the north and east of the area, there are 3 roads that have the highest value, which means a high accessibility. The space surrounded by these roads of high integration value will be more convenient to be reached. However, on the east side of the community, the integration value is relatively lower, which means its position is relatively remote. The accessibility of this part is really not positive.

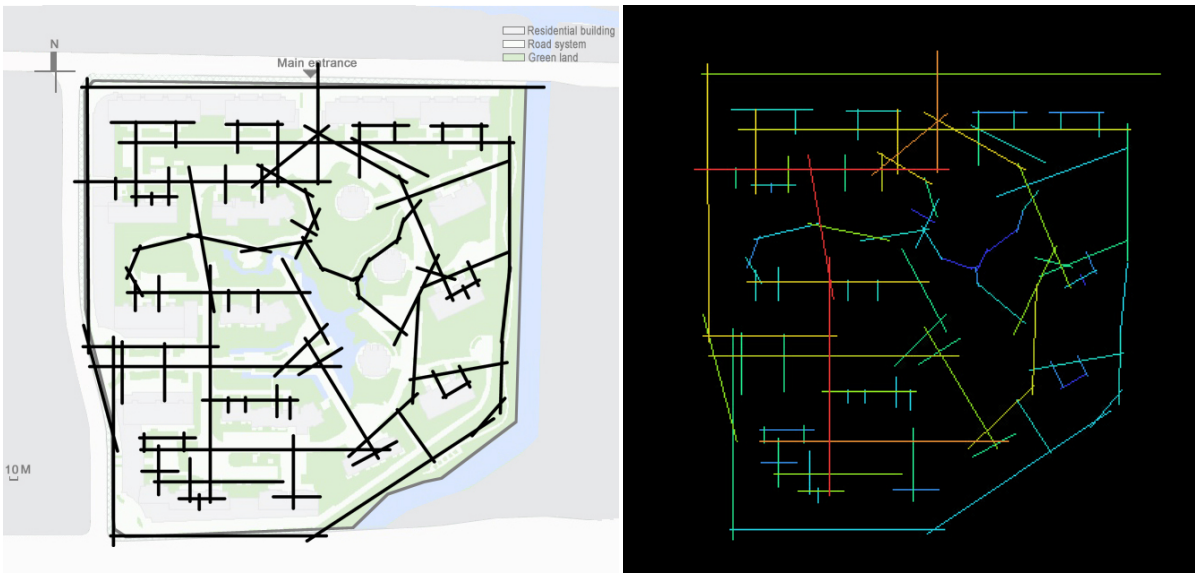

Figure 10. The axial drawing and analysis by Depthmap of Yuandu Xinjing Community [3)]

3.4 Ziting Garden Community

As shown in Figure 11, in the south side of the area, there are 5 roads that have the highest value, which means a high accessibility. The space surrounded by these roads of high integration value will be more convenient to be reached. However, in the north part of the community, the color of axial lines is mostly cool. So the integration value is lower, which means its position is relatively remote and hard to get into. Only the south side of the community, which is the main entrance, is the relatively dynamic places.

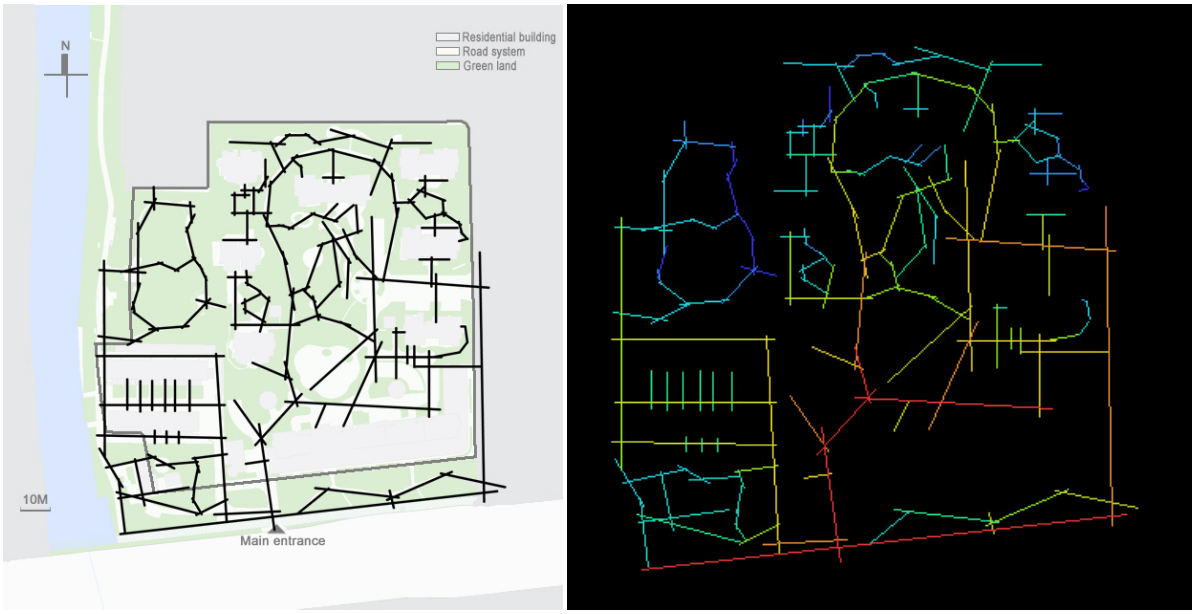

Figure 11. The axial drawing and analysis by Depthmap of Ziting Garden Community [3)]

3.5 Comparative analysis

The comparative analysis is shown in Table 5.

In terms of the overall integration value, the Yicheng Jiayuan Community has the largest average value of 1.102, which means this overall space has the best accessibility. Next is Yuandu Xinjing Community of 1.096. The accessibility of Ziting Garden Community is the lowest one of 0.614. If just according to the integration value, the residents of Yicheng Jiayuan community will have the best spatial experience, such as convenience and organization force. The residents in Ziting

Garden Community may feel it a little remote position. It will be inconvenient to get to there. Obviously, its utilization will be limited.

In terms of the partial integration value, the Yuandu Xinjing Community has the largest average value of 1.520. Next is Yicheng Jiayuan Community of a high integration value 1.480. Its smallest integration value is only 0.333, so this may become the reason that this community don't own the best partial integration value. Others are roughly the same as the condition of overall integration value.

Table 5. The integration value of the urban communities

Community	Shuiyin Kangting	Yicheng Jiayuan	Yuandu Xinjing	Ziting Garden
		Overall integration value		
Maximum	1.197	1.608	1.659	0.942
Minimum	0.531	0.540	0.714	0.376
Average	0.824	1.102	1.096	0.614
		Partial integration value		
Maximum	2.523	2.749	2.798	2.236
Minimum	0.333	0.333	0.637	0.333
Average	1.375	1.480	1.520	1.194

3.6 Practical observation

After observation to the four communities, the activities of residents in Yicheng Jiayuan Community are scattered around the ring road system, here and there. But in other three communities, the activities are relatively focused. Even some places of the communities are very quiet, which will obviously result into a low utilization and waste of resources.

4. Conclusions

Integration value determines the accessibility of the space and will affect its utilization. The larger the integration value is, the better the accessibility will be. That means it is more convenient for people to get there. Therefore, some spaces which will be needed by most people should be set in these better accessibility places. In this paper, every urban community has a place whose accessibility is better, thus some public facilities can be set in there. So setting the more needed space in the better accessibility place is significant.

Ring road system is helpful for organizing the spatial structure. A relatively good ring road system will easily make the road network orderly and compact. Residents will be easy to get there and be dynamic places. In contrast, the areas will be remote and few residents will get there, which means a low utilization and a waste of public resource.

This paper investigates how Space syntax techniques can help assess the effect of ring road system on the community and social structure. Such techniques are assumed useful in predicting the social structure of the proposed space and in assessing design alternatives. Is it possible to predict that social structure of space using Space syntax techniques? The answer appears to be positive.

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Think of a Place – Think of Macedonia: Architecture as a Cultural Sustainability Factor of the Macedonian Cities

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Abstract

The current need of policy programs for the Macedonian cities to reach the standards of sustainable and prosperous economic development and enable their promotion on the European cultural map, initiated the project 'Think of a Place – Think of Macedonia: Architecture as a Cultural Sustainability Factor of the Macedonian Cities', which aims to inspect the spatial and physical potentials of the Macedonian architectural and bio-regional heritage in order to create unique and competitive brands and to develop the overall economic and touristic potentials of the Republic of Macedonia. The project agenda encompasses: an inventory and mapping of the current cultural models in the Macedonian cities as potentials for sustainable development on a national, regional and local level; comparing the local practices with the European and the world practices in developing cultural models and performances of sustainability; a synthesis of the different meanings and functions of the *architectural culture* in favor of the sustainable development epitomized in specific project proposals for framing the architectural culture within the sustainable development of the Macedonian cities. This paper presents the first case study, the *"Remediation Project for the Quay of the River Dragor"* (in the city of Bitola), which is one of the priorities of the city's action plan, due to the long-standing desire of the citizens to solve the problem dating from the 60-ies, when after the regulation of the river, it was disconnected not only from the urban fabric but also from the city's urban and social life. In order to achieve the urban sustainability and strategic goals of the planned urban development, the concept of *ecological urbanism* was set as a wide platform for dialogue and an exchange of ideas that promote the local potentials of the joint bio-regional and urban heritage of Bitola and are its strongest features for becoming an ultimate Macedonian urban brand. Making a considerable departure from the official urban planning and design methods, which overlook the deep phenomenological 'culture-nature' context, the "Remediation Project for the Quay of the River Dragor" demonstrates the potentials of the *adaptive concepts* for this specific post-industrial landscape, offering an integrated design strategy, which relies on a wide range of contemporary interpretations of urban ecologies while incenting diversity, plurality and multiplicity rising from the 'soft' interwoven threads of the humans-city-nature relationships. Rather than demand parameters of efficiency and profit, this project stresses the importance of the ideological shift towards more interdisciplinary and flexible design and management strategies, relying on community participation, discussion and negotiation, for which architecture should develop its own, architectural policy scripts, i.e. formulate its disciplinary assumptions, goals, institutional, legal and financial tools and most importantly, the values by which they are inspired and by which its own role as an cultural agent is to be recognized in the current policies of sustainable development on a national and municipal level.

Keywords: Cultural sustainability, Culture, Architecture, Ecological urbanism, Sustainable development

1. Introduction

The intensive transition of the Macedonian post-socialist political and economic system in the liberal economy of capitalism lasting for more than two decades has caused significant social and physical transformations of the Macedonian cities. Concieved from the accidental, precarious remnants of the preceding economy, the post-industrial abberancy perpetuates the growing discrepancy between the capital city of Skopje and the rest of the country's urban and rural communities, threatening to destabilize the social and physical body of the country as a

whole. Besides the physical, many other more important existential aspects, like the issue of environmental protection and the natural resources and built heritage management, amplify the urgent need for a stronger and more comprehensive legal and operational framework that would lead the country towards a sustainable and prosperous development. The lengthy stand-by arrangement for EU accession also suggests that the positioning of the Republic of Macedonia in every sense – national, economic and cultural - is still an ongoing project for which the Macedonian scientific community has to make real efforts to build an integral, democratic approach towards the open world cultural policies.

What are the priorities and how is the role of culture been defined in the current sustainable development policies? From the moment the term '*sustainable development'* was promoted in the Brundtland report 'Our Common Future' as '*development that meets the needs of the present without compromising the ability of future generations to meet their own needs'* (World Commission on Environment and Development, 1987), it has continuously been upgraded with theories, policies and practices, which derive mostly from the three domains of the existence - environmental, economic and social. Even though culture makes a permanent and indisputable impact on sustainability, the Investigating Cultural Sustainability European Research Networks (2010) have recently realized that almost thirty years after the Brundtland report, it is still fighting its way against the prevailing environmental and economical issues, as could also be perceived from the Sustainable Development Knowledge Platform (2016).

In their latest investigations on culture, Dessein et al. (2015) distinguish three important roles it could play in the sustainable development policies: firstly, as a self-promoting, fourth pillar alongside the ecological, economical and social imperatives; secondly, as a mediator that can balance the three main existing 'pillars'; and thirdly, as the foundation that supports the structure of the goals for achieving sustainable development, i.e. the leader that intertwines the environmental, economic and social dimensions into a single, integrated and interdisciplinary concept. Although each of the three concepts emphasizes the influence of culture on sustainability, the third one guaranties the most successful results, which could be achieved through culturally informed autonomous policies that recognize the local cultural values, equal rights and cultural logic of the communities in the planning and decision-making processes and especially, the participation of the local population.

In the Republic of Macedonia, the self-promoting role of culture is still predominant and governed by the Macedonian Ministry of Culture. Cultural policies are focused on arts and heritage projects of national interest, which have little in common with sustainable development policies, mostly because sustainability is recognized only as an economic, environmental and social policy to be governed by the Ministry of Environment and Physical Planning. In 2008 this authority designed the "Vision for Sustainable Macedonia", predicated on 'balanced use of our rich social, cultural and nature heritage' as the basis for the National Strategy for Sustainable Development called 'A Better Future through Change' (NSSD, 2008a). Nevertheless, these lightmotifs were barely transcribed in the structure of the NSSD strategy, which comprised legal, environmental, energy, rural development, social issues and SME (small and medium-sized enterprises) policies, but no cultural policy was included. In practice, the gap between the rhetorical and the actual financial support of the projects for sustainability was even bigger and in most cases driven by the political constellations in power.

When it comes to the question of its role in the NSSD, the capacity of architecture as an intellectual and cultural discipline was, and is still overlooked and reduced to a complementary function of the National Strategy of Tourism. The professional practices of architecture and urban planning, on the other hand, are governed by the Ministry of Transport and Communications of the Republic of Macedonia, which is focused on transportation, industrial and communal infrastructure projects, as well as the building industry, stimulated to invest in social housing and commercial projects in which the issues of sustainability and the role of the emerging *ecological urbanism* (Mostafavi, 2010) are yet to be introduced.

Besides the bureaucratic simplification of the respectful professional disciplines which are deployed to separate 'procedures', this purely juridicial division of the departments also

ignores their multilateral and interdisciplinary interferences. When specific, overlapping themes regarding the performances of sustainability are addressed in the complex, large scale projects, one finds the multiple task of architecture split into divergent bureaucratic streams of thoughts and actions failing to recognize the real demands of the diverse and insurgent context, especially when the intricate relations between ecology (evironmental protection) and urbanism are addressed to architectural design.

This legal rigidity produces multiple consequences on people's lives on an everyday basis, perpetuating the growing animosity between the natural and man-made environment, driving the urgency of a comprehensive methodological framework that will embrace the different roles of architecture within culturally informed and sensitive environmental, economic and social policies in order to move forward to more adaptible, flexible and sustainable planning, design and management strategies, necessary to educate and facilitate the local architectural and urban practices and to raise the awareness of the social relevance of architecture as the most concrete transmitter of culture. Such policies are yet to be defined and concluded by 2030 within the inclusive NSSD concept, which together with the Spatial Planning Strategy of 2004 have provided the first integrative planning approach in the Republic of Macedonia and the overall basis for all other strategies and policies in various fields. Being in large responsible for rehabilitation and improvement of the social, economic and environmental quality of the human settlements and the living and working environment of the people, due to the requirements of EU-accession (NSSD, 2008b) architecture may be accounted for a key factor in this participatory process, which, in order to meet the objectives and the challenges of the future sustainable development needs to elaborate new inovative methods of 'rethinking space' as it is the aim of the "Think of a Place – Think of Macedonia" project presented in this paper. Committed to the Policy Guiding Principles as outlined in the Renewed EU Sustainable Development Strategy from 2006 – 10117/06 (NSSD, 2008c) this project's agenda is focused on promotion of a cooperative process between the formal (academic community and policy makers) and informal (citizens and NGO-s) participants aiming to engage the full capacity of the society as a 'creative engine' towards the goals of the sustainable and prosperous development.

2. Methods

In 2012 the interdisciplinary team at the Faculty of Architecture initiated the demonstration project 'Architecture as a Cultural Sustainability Factor of the Macedonian Cities', thus gathering academic, professional, as well as non-governmental organizations around the common goal: to promote the architectural potentials of the Republic of Macedonia on the European cultural map on the basis of a collaborative, multidisciplinary platform that embraces architecture within the multi-level policy framework of the sustainable development of Macedonian cities. The team of Croatian experts from the Faculty of Architecture at the University of Zagreb gave an initial boost to the project, proposing their know-how methodology already implemented in numerous sustainable urban projects in cities throughout Croatia as an exemplar for developing an authentic, integral approach towards the domestic sustainability issues which were outlined by the motto 'Think of a Place – Think of Macedonia'. Proposing a collaboration with the government officials and municipal administration, non-governmental organizations and experts from the social, cultural and environmental sphere, as well as with the Macedonian citizens, our team opened the initiatives to the broadest rank of participants, with the help of whom we believe will raise awareness of the fact that the sustainable and prosperous economic development of the Macedonian society is not only an academic task, but also our common civic duty.

The cooperative and inclusive long-term agenda of the project 'Architecture as a Cultural Sustainability Factor of the Macedonian Cities' encompasses the entire membership of the Association of the Units of Local Self-Government of the Republic of Macedonia (ZELS), counting 84 municipalities and the capital of Skopje as a particular self-governed unit. The ZELS 'Strategic Plan 2011–2015' (2010) and the successive municipality action plans are the official sources of information that the methodology and procedures of our cultural investigation rely on, comprising:

1. An inventory and mapping of the current cultural models in the Macedonian cities as potentials for sustainable development on a national, regional and local level;
2. Comparing the local practices with the European and world practices and importance of the cultural models in different contexts and models of sustainability in terms of their performance;
3. Synthesis of the different meanings and functions of the *architectural culture* within the framework of sustainable development;
4. Specific project proposals for framing the architectural culture within the sustainable development of the Macedonian cities.

2.1. Case Study Bitola: a Cultural Policy Script for Sustainable Urban Development

The city of Bitola, the center of the municipality with the same name and one of the most important regional, political and cultural centers of the past century was the first subject of investigation of the demonstrative project 'Architecture as a Cultural Sustainability Factor of the Macedonian Cities' (Figure 1.). The rich architectural heritage and the famous 19th-century urban lifestyle of 'the city of consuls' induced by the European fashion, are the trumps of the Strategic Plan for Local Development of the Bitola Municipality (2009-2014) aimed to revive the glory of the past through the creative vision 'Municipality of Bitola – a Desirable Place for Living and a Place with Sustainable Socioeconomic and Cultural Development'. To turn Bitola into a recognizable and competitive regional, cultural and tourist brand, the Strategy for Tourism Development in the Bitola Region 2009-2014 (final draft) prioritizes two segments: protection and preservation of the cultural, archeological and artistic heritage as provided by the Code of Ethics for Tourism brought by the General Assembly of the UN in 2001 and the environmental protection of natural resources (mountains, rivers, hunting grounds, fauna and flora).

Figure 1. The first gymnasium in Bitola on the quay of the river Dragor (Anonymous, 1911. Bitola City Museum)

One of the most acute problems of the city of Bitola that seriously challenges those strategic goals is the river Dragor (Figure 2.), which due to the continuous contamination from sewage and industrial wastewaters, is being viciously degraded and turned into a concrete disposal channel. Today Dragor is physically detached not only from the urban fabric, but also from the city's social life. The ecological and aesthetic problem of the river is not isolated from the bigger picture of the thriving post-industrial landscape of Bitola, projecting images of abandoned 'brown fields', disassembled built heritage, neglected greenery, insufficient traffic infrastructure and a whole list of other remnants of the economic 'transition'. The simultaneous presence of all these

characters on the territory where Dragor makes tactile contact with the city demanded a fundamental reengagement of the planning and design practice in favor of a mediating sustainable ecological strategy that will work beyond the official planning methods and practices and will approach this multilayered problem from different angles and perspectives.

Figure 2. The Dragor riverbank today (photo credits: Cenovski, 2012)

Similar recent projects for post-industrial sites advocate the prevailing primacy of the landscape 'as a new medium of urban order' (Lister, 2010a) in the practices of the ecological urbanism. Proposing the 'adaptive design' (Lister, 2010b) as an instrument of a whole spectrum of interventions, from remediation, reconciliation and restoration to transformation and recalibration of the post-industrial sites, the adaptive strategies respond to the demand of the resilient post-industrial contexts, offering sophisticated readings of the use of the ecology in design in order to provide long-term sustainability and health of the landscape systems. Recognizing its potentials for the purpose of our project, we proposed an adaptive design methodological platform for developing an integrated cultural-natural policy script of sustainable planning and design, based on the following presumptions:

1. Continuous conservation of the natural resources and the surrounding environment, while at the same time providing the cultural, social and economic basis necessary for the support of the population;
2. Redefining the role and methods of the creation of public space: turning 'public space' into 'common space' by introducing diverse patterns of consumption (instead of presupposed 'land use patterns'), participatory planning practices and forms of 'user-generated urbanism' (Rebar, 2010) in order to provide a public platform that establishes the eco-logics as a condition both for the ethics and the aesthetics of sustainability;
3. Negotiating memories, identities and built heritage by keeping the past 'alive', pursuing concepts that seek the built heritage to become a 'living environment'.[1]

2.2. Remediation Project for the Quay of the River Dragor

This study was in particular concerned with the specific and complex architectural transformations that the prime bioregional element, the river Dragor, has the potential to provoke, due to its immanent role of an urban re-generator in the city of Bitola. The territory under investigation

1 Environmental licensing is an administrative procedure through which the environmental agency authorises the location, installation, expansion and operation of initiatives considered effectively or potentially polluting or those that can cause the degradation of the environment in any way (Oberling et al., 2013).

expands from the residential area 'Dolvledzik' at the upper west course, to the Stock Market, near the railroad at the east lower course, measuring a total length of three kilometers of blurred, alternating suburban, urban to rural urban conglomeration (Figure 3.).

The investigation includes the following research activities:

1. Urban analysis

- mapping and making an inventory of the physical and social factors;

- producing a set of analytical-interpretative maps showing: underlying infrastructure, city traffic systems and volumes, connectivity (bridges, intersections and crossways), land-use plan, urban blocks morphology and typology, public space distribution, green areas, architectural and built heritage listing, daily activities of the population, as well as daily fluctuation intensities.

The diagrammatic character of these maps provides a synthetic perception of the essential urban features, such as: scale, intensity, connectivity, density, cohesion, morphology, typology. These urban characters were then employed in the next phase for identifying the *site-specific domains* along the city's backbone.

2. Supplementary hydrologic and hydraulic expertise encompassing a list of simultaneous ecosystem-oriented river restoration and river engineering measures (Popovska and Krstić, 2010).

Taking into consideration the current data showing very high rates of pollution of the Dragor waters due to the permanent contamination of the river from sewage and industrial disposals, as well as the very limited possibilities for reconstruction of the concrete riverbed because of the underlying industrial wastewater installation, the following ecological procedures were recommended:

- continuous conservation and preservation of the river by reducing the emission of organic and non-organic waste and other particles; construction of filter plants, wastewater treatment plants, aeration basins and a collector system;
- construction of scatter water retentions at unregulated sections at the lower course to control the water flow and reduce the negative impact on the hydrological regime;
- biological restoration of the river habitat by fish stocking and bio-engineering of the riverbed, applying minimal design and a maximum quantity of vegetation;
- improvement of the quay structure: structural consolidation and repairment of the retaining walls.

3. Urbanistic presumptions and guidelines:

- redesign of the street network: redirecting the principal right bank arterial to form a loop street outlining the central square for physical and pedestrian interconnection between the two banks at the heart of the city where the main historical axes, Shirok Sokak and Dragor, meet; redesign of the arterial profiles along the riverfronts by interpolation pedestrian and bicycle paths and meeting points ('hanging balconies') for rest and socialization;
- demolition of the existing bridges and construction of new ones with improved aesthetic and structural quality;
- reoccupation of illegally occupied public lots and their conversion into green 'pockets', i.e. common places for informal social and artistic activities;
- an inventory and listing of the existing riverfront architecture according to the status of use / ownership / building typology; preparing pre-design architectural programs for public use; interpolation of new public buildings and adaptation and restoration of the listed heritage buildings;
- extending the zone of sports and recreational terrains and facilities at the vacant suburban sites both at the upper and the lower course.

4. Site Specificity Mapping

- mapping of the specific sites and domains along the central city backbone and outlining compatible programmatic and conceptual architectural guidelines for each of them (Figure 4);

- producing a synthetic map that will display the diagrammatic interface between the river and the city and provide the synthetic key of how to intertwine the environmental, social, cultural and architectural dialogues into a collective multiple policy 'script' (Figure 5.).

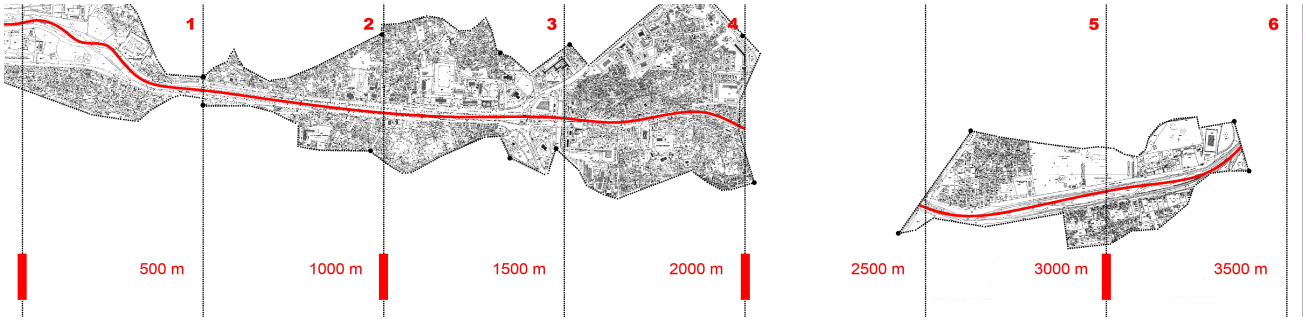

Figure 3. The field of research - site specificity mapping

Figure 4. The Dragor riverbank – segment of the north panorama

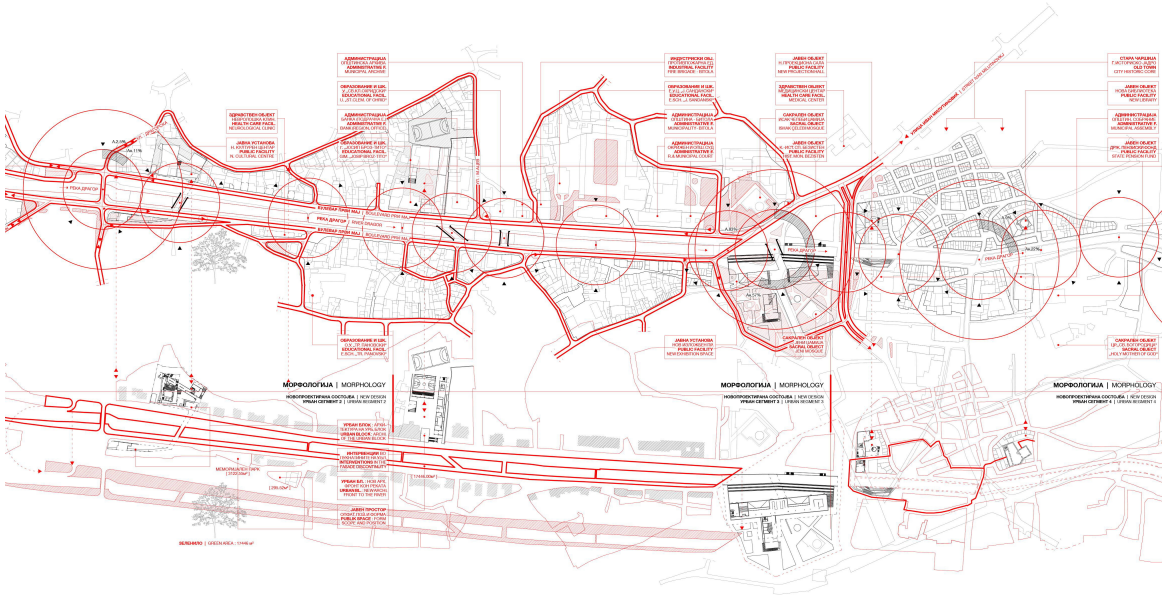

Figure 5. Detail of the synthetic map (segment 3) showing diagrammatic interface between the river Dragor and the city of Bitola

3. Results and Discussion

The synthetic map served as a conceptual design basis for the particular site specific design proposals along the riverbank, prepared by six teams of students of the master class studio. These projects thrive to reclaim the city's cultural and natural heritage in an orchestrated dialogue with the river including a wide range of features, as shown in:

1. The underground 'Invisible Body Care Center', hosting indoor and outdoor sports and body care facilities, fitted to the natural configuration of the upper course site where the river turns from its natural to its artificially shaped riverbed (Figure 6.);
2. The 'Cultural Point' at the Dragor riverfront, making a conceptual juxtaposition of the creative arts and performing center created from an abandoned fur factory with the memorial site at the opposite riverbank (Figure 7.);
3. The 'Education Complex', proposing new buildings for advanced educational programs adjacent to the historical building of the 'Josip Broz Tito' High School, also being restored for the same purpose, and a new pedestrian zone connecting this complex to the listed historical buildings of the Rectorate of the 'St. Kliment Ohridski' University and the Music School;
4. The underground 'Park Gallery' which restitutes the city's tactile attachment to the river by bringing new cultural, social and informal activities to the central park square, where the Dragor riverbank meets the main pedestrian axis, Shirok Sokak and the most important heritage buildings standing: the Clock Tower, the Yeni Mosque, the Isak Mosque and the Bezisten (the former Ottoman market place) (Figure 8.);
5. "The Old Town Rediscovered" – a conceptual reinterpretation of the distinctive appearance and the ambiental propinquity of the old town 'charshija' through contemplative 'atmospheres' that change along the circumscribed route, which connects the two riverbanks, complemented with a new "Art Point' nested in the adapted buildings of the Small Bezisten and the Ajdar Kadi Mosque (Figure 9.);
6. The Sports and Recreation Complex of 'organic' design, located at the lower course, gathering a sports stadium, a skate park and a whole range of outdoor recreational facilities sloping down the new river promenade, where the riverbed is released from its artificial concrete abutment and returns to its authentic natural meander, gently reshaped and

carved out to form a natural basin for occasional flooding and restoration of the river bio-habitat.

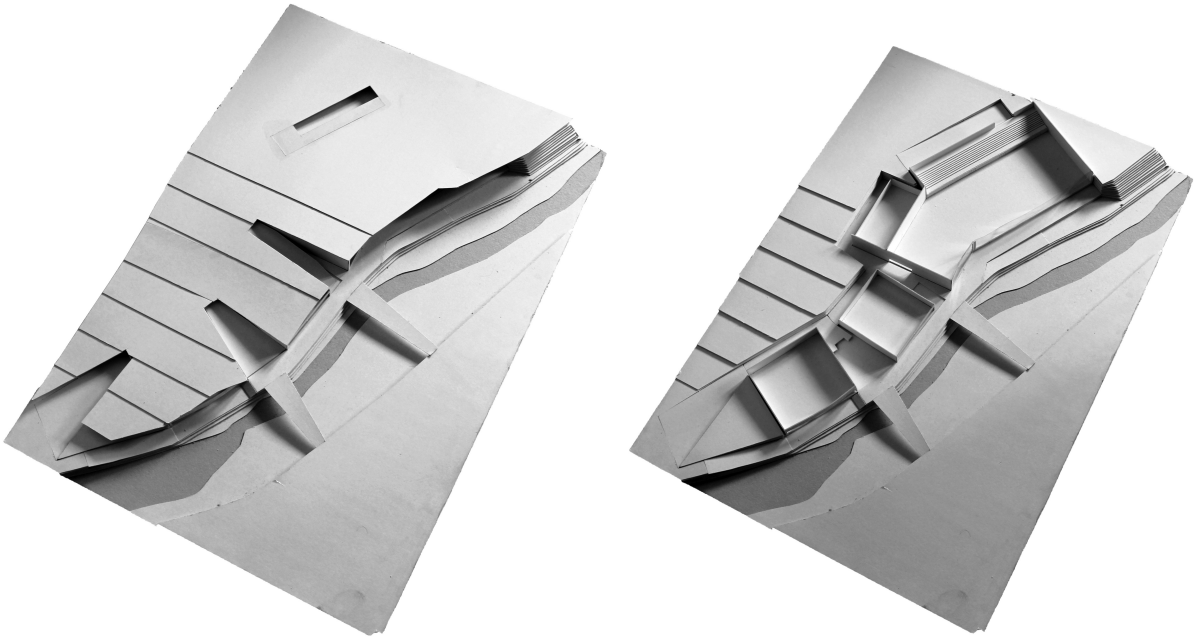

Figure 6. The Invisible Body Care Center (model)

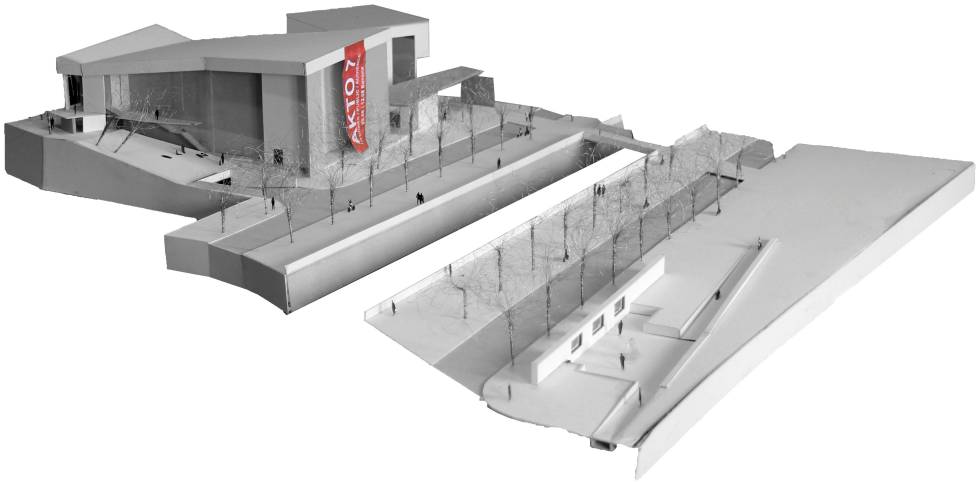

Figure 7. The Cultural Point at the Dragor Riverfront (model)

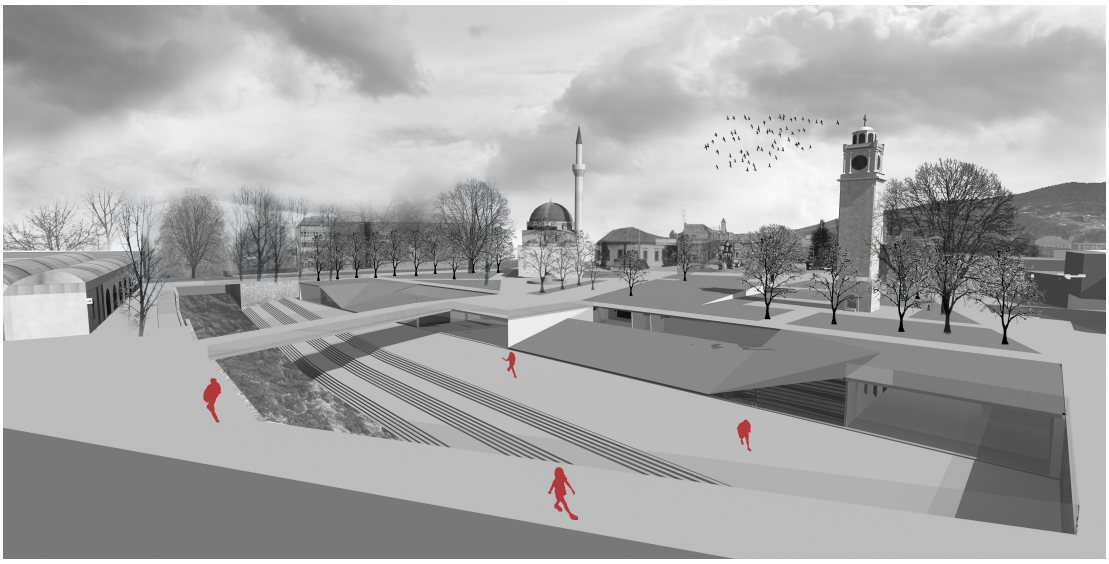

Figure 8. The Park Gallery

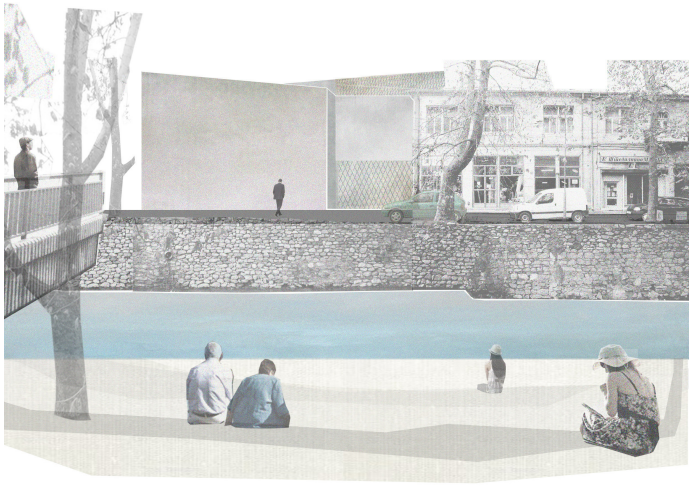

Figure 9. The Old Town Rediscovered – the new Art Point at the Small Bezisten

Conceived from the resilient context of the post-industrial landscape of Bitola, these remediation project proposals make a considerable departure from the official urban planning and design methods which overlook the deep phenomenological 'culture-nature' context, thus treating the urban territory as an abstract medium employed only in favor of efficiency and profit. Rather than importune parametric figures to shape the physical 'body', the employed adaptive method accentuates the 'personality' of the city, incenting diversity, plurality and multiplicity rising from the 'soft' interwoven threads of the human-city-nature relationships. By superceding the outmoded, insufficient and even malicious performances of the official 'detailed plans', it performs as a dynamic and interactive instrument of adaptive concepts, offering a wide range of contemporary interpretations of ecologies in the context of the post-industrial landscape.

The multiple outcomes of this demonstrative Remediation Project for the Quay of the River Dragor were experienced afterwards through a number of activities which contributed to a better understanding of the importance of the role of architecture in favor of the National Strategy for Sustainable Development for the Republic of Macedonia (2008d) and to the capacity building

of the Bitola Municipality public institutions and administration to fulfill the sustainable development goals, directions and principles, including:

1. Organizing meetings with the municipal administration during which the studies and project proposals were presented, and their relevance and sustainability discussed;
2. Training and including young researchers, whose postgraduate works are related to subjects of sustainability, in certain research activities; Establishing long-term cooperation between the academic community and the municipal authorities in their joint SD projects;
3. Informing the spatial and cultural development policy makers from the municipal and state authorities, municipal administration and non-governmental sector through joint meetings and presentations of the role of architecture in building SD cultural policies;
4. Organizing public exhibitions of the project at the 'Magaza' Art Gallery in Bitola and at the Faculty of Architecture in Skopje followed by the promotion of the monograph 'Architecture as a Cultural Sustainability Factor of the Macedonian Cities' (Hristova et al., 2013), which brought recognition to the pedagogical commitment of this project to demonstrate the outcomes of the current urban paradigm shift towards ecology and to deepen the connection between the people, culture and nature by bringing the authorities and the community to 'rethink space' together.

5. Conclusions

The intensive involvement of architecture in culture owes to the fact that it absorbs the social existence in the most concrete and persistent way. The unique, but still multifaceted nature of architecture as an art and as science embraces the multiple, layered, complex and insurgent contexts of our physical and social environments within its operational framework, which configures, and at the same time, is configured by our individual and collective aspirations. Giving shape to our social and built environment, architecture epitomizes the very idea of sustainability, which implies endurance and bearing, but at the same time, its constructive impetus perpetuates change and a new means of creation, hence encouraging development. This inherent dualism, which is the driving force of the concept of cultural sustainability, presently engages the architectural discipline as a mediator of the multitasking rapprochement between ecology, planning and landscape design, the disciplines that are responsible for shaping our cities and landscapes, but for the emphasized reasons of control and efficiency became isolated zones of practice.

The opening of the post-industrial landscapes to the deployment of the ecological urbanism nowdays demands a fundamental and contextual reengagement of culture and nature in operational strategies of integrated, synthetic cultural-natural disciplines that will reclaim the ideas of the 'genius loci', i.e. place, context and history. To accept the challenge, architecture should evolve its own adaptive and collaborative methods and instruments of thinking and practice that will open the potentials of those disciplines to respond to the ecological urgency for environmental protection and, at the same time to provide economic and social well-being for the community.

To abandon the single discipline approach and to move towards more interdisciplinary and flexible design and management strategies relying on community participation, discussion and negotiation, architecture should develop its own architectural policy scripts, i.e. formulate its disciplinary assumptions, goals, institutional, legal and financial tools and, most importantly, the values by which they are inspired. As such, they will fight the way of architecture as a cultural agent against the prevailing rational prerogatives of the official policy programs, raising the awareness for the importance of the integrative culture-nature ecological approach in the strategies of sustainable development on a national and municipal level, as it is expected from the. National Strategy for Sustainable Development for the Republic of Macedonia.

Acknowledgments

The project "Architecture as a Cultural Sustainability Factor of the Macedonian Cities", and the complementing "Remediation Project for the Quay of the River Dragor" were accomplished

by the interdisciplinary team of the Faculty of Architecture, "Ss. Cyril and Methodius" University – Skopje: Aneta Hristova, PhD, Full Professor – Head of the project, Miroslav Grcev, PhD, Full Professor, Cvetanka Popovska, PhD, Full Professor (Faculty of Civil Engineering - UKIM), Meri Batakoja, M.Sc., Teaching Assistant, and Filip Cenovski, M.Sc. Teaching Assistant, in cooperation with the interdisciplinary team from the Faculty of Architecture, University of Zagreb: Marina Pavkovic – brand consultant, Mladen Joshic, Full Professor, and Jasenko Horvat, Full Professor.

Architectural designs complementing the project for the quay of Dragor were designed by the master class students from the Faculty of Architecture, "Ss. Cyril and Methodius" University– Skopje: Ana Petrova, Blagoja Ristevski, Elena Stojchevska, Gordan Vitevski, Vlado Danailov, Monika Novkovikj, Elena Tasevska, Vesna Likarska, Mila Rorikj, Mila Dimitrovska, Barbara Irakovska, Bojana Koroshevska, Nora Bejtuli, Despina Milevska, Ana Teova.

The project was financed by the"Ss. Cyril and Methodius" University, Skopje, and logistically supported by the experts from the Urban Planning and Environmental Protection Department of the Bitola Municipality.

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Illustration credits

Fig. 3. Computer generated diagram by Meri Batakoja

Fig. 4. Digital photography and montage by Filip Cenovski

Fig. 5. Computer generated map by Filip Cenovski

Fig. 6. Model, digital photography by Filip Cenovski

Fig. 7. Model, digital photography by Filip Cenovski

Fig. 8. Computer image, Mila Rorikj

Fig. 9. Computer image, Mila Dimitrovska

Conceptualising slum in an urban African context

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Abstract

Increasing urbanisation necessitates a deeper consideration of the phenomenon of urban informal settlements or urban slums and their function within the metabolism of cities. Informal settlements need to be conceptualised and understood beyond a classification as poor neighbourhoods, to complex socio-ecological systems that affect, and are affected by, the wider urban context. Urban metabolic analysis, which excludes a detailed understanding of how urban slums (the individuals and households within them) function and contribute to biophysical and energy flows is problematic. Such an analysis is limited as it does not account for the current or future demand for services, energy and other resources that the city needs to plan and provide for. This paper critically investigates how the notion of urban slum is conceptualised in general, and the extent to which it differs in an African context and specifically, in South Africa. The term urban slum is further discussed within the broader concept of urban metabolism, using the multi-scale integrated analysis of societal and ecosystem metabolism (MuSIASEM) approach, which was applied to the Enkanini informal settlement in Stellenbosch, South Africa. The analysis shows that South Africa has a more nuanced typology of the notion of urban slums categorised as: (i) townships; (ii) housing-turned-slum; (iii) squatter camps; (iv) site and service settlements; and (v) transit camps. Beyond these definitions, the Enkanini informal settlement illustrates that urban slums, however defined, are complex systems with their own internal flows and processes that are connected in a myriad of ways to the larger urban system. The investigation into the use of Time, Money and Energy in Enkanini reveals both the productive (hypercyclic) and consumptive (dissipative) nature of the settlement. For example, in terms of Time and Money, the settlement is a provider of services with its own internal economy. In terms of biophysical flows, it is not a supplier, but rather a net consumer. However, the consumption is markedly different from the rest of the city. Similarly, in terms of Energy flows, the settlement is a net consumer, yet consumption remains very low in comparison to the wider community. This type of analysis reveals new insights into the linkages between urban informal settlements and the city. However, to enable a more holistic view on the issue of connecting the urban informal settlements to the city, a system dynamics model is currently being developed. This may greatly assist in planning for cities that are both sustainable and just.

Keywords*:* Informal settlement; Urban metabolism; Multi-scale analysis; Urban slums; Urban Africa; South Africa

Acknowledgement: This work stems from the South African case study for the Participatory Integrated Assessment of Energy Systems to Promote Energy Access and Efficiency (PARTICIPIA) project funded under the EDULINK II programme; an ACP-EU co-operation programme in Higher Education funded by the European Development Fund (EDF) and the Development Co-operation Instrument – Relations with South Africa (DCI). The work has also been funded through the South African Systems Analysis Centre scholarship and the National Research Foundation, Grant number: 99103

Recuperating an approach to local specificity for Sustainable Cities and Regions – Correlating key strategies for architecture and urban design, collective space use and architecture and environment integration

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Abstract

This paper seeks to identify and discuss alternatives to the prevailing and progressively global approach to architecture, urban design and regional planning, which is based on homogenous figure-ground arrangements that consist of discrete architectures with all their known repercussions and restrictions imposed by the predominance of the architectural object, its ground-restricting accumulation and collective space. Due to the inherent restrictions the prevailing sustainability goal is therefore frequently constrained to impact minimization. This yields the question as to whether there may exist a latent approach that foregrounds positive rather than negative or neutral impact. Can a specific combination of contemporary and historical approaches provide such an approach and enable a different type of architecture and urban design to take shape that is integrated with the regionally and locally specific biological and physical environment? Can literally new grounds be provided where construction takes place and can more extensive spaces for collective use arise? The paper examines suitable contemporary conceptual approaches and works and reviews a number of historical architectures and settlement forms to pursue the formulation of such an alternative and integrated approach towards sustainable design and planning.

Keywords: Non-discrete Architecture, Collective Non-form, Continuous and Multiple Grounds

1. Introduction

1.1 Problematic

> "The environment must be organised so that its own regeneration and construction does not constantly interrupt its performance."
>
> (Alexander 1964: 3)

The currently prevailing and progressively global approach to architecture, urban design and regional planning, which is based on homogenous figure-ground arrangements that consist of discrete architectures with all their known repercussions and restrictions imposed by the predominance of the architectural object, its ground-restricting accumulation and collective space. To phrase this problematic differently: the perception of a building taking up ground prevails, as does the preference for expressive discrete architectures that are to stand out against their local setting, while architectures and cities become at the same time increasingly globally homogenous and architecturally less attuned to local conditions. Due to the inherent restrictions of this trend the prevailing sustainability goal is therefore frequently constrained to impact minimization. This yields the question as to whether there may exist a latent approach that foregrounds positive rather than negative or neutral impact. In the introduction we initially address a number of key notions and approaches that may help doing so. This is followed by the statement of objectives.

1.1 Non-discrete Architecture

"The world was (…) closely and diversely connected before the introduction of buildings. Buildings-as-objects were only obstacles to such connections… Our objective should not be to renounce matter but rather to search for a form of matter other than objects."

(Kuma 2008: 31-32)

The prevailing trend in architectural design today is overwhelmingly singular in underlying and unchallenged purpose: architectures are discrete objects that are set apart and are to stand out from their given setting. Only the discrete object seems to issue the certainty of distinction, not only of the object, but also of the architect and the client. Discreteness asserts the perception of commodity. Idiosyncratic expression heightens the perception of uniqueness, increased value and lifestyle assurance. These are the foundations of investment driven development that engender inflated GDPs, property bubbles, and predominance of consumption, in particular of ground that then in turn becomes heightened value commodity. The relentless multiplication of such architectures makes for increasingly exchangeable (parts of) cities no matter where. Given the increasing value of object and ground there is no reason to believe that is possible to change course. Most sustainability approaches seek to operate within this logic and pursue the aim of minimizing impact.

Leaving aside for now arguments that will press the point that it is of no use to pursue unlikely scenarios this paper discusses an alternative approach for which an economic framework needs to be developed to challenge the assumption that it is not possible to break away from the self-reinforcing current trend and outcome.

This approach starts with examining the possibility of conceiving of architectures other than the discrete object, namely non-discrete architectures that are deeply embedded into their context and that enable close proximity with a freely evolving quasi-natural environment.

Numerous architects and writers have tackled the topic of the autonomous architectural object at different scales, ranging from the wall / envelope (Addington 2009) to the entire building (Kuma 2008; Leatherbarrow 2009) and the urban field (Kwinter 2001).

David Leatherbarrow posited "the buildings exposure or subjection to the many and varied dimensions of its ambient conditions amounts to a disavowal of sovereignty … only if we finally let go of the idea of the self-sufficient object will we catch a glimpse of a new – and newly significant – collective, communicative, or urban order" (Leatherbarrow 2009: 10-11). This realisation is based on the fact that the participation of the building in anticipated and unintended conditions, processes, and practices is in itself in inescapable and requires repositioning. Sanford Kwinter stated that

> "On this reconception, the unitariness of the object would necessarily vanish … What comes to the fore are, on the one hand, those relations that are smaller than the object, that saturate it, …and on the other, those relations or systems that are greater or more extensive than the object, that comprehend or envelope it."
>
> (Kwinter 2001: 14)

These approaches make clear, if in most general terms, that there exist correlations across various scales that can inform architectural and urban design criteria so that choices support rather than contradict one another. For architectures this includes among other criteria that of proximities on one datum and connectivity on another or across several. A limited number of cases were selected to show potential approaches that can satisfy these criteria. The Spidernethewood project of R&Sie(n) completed in 2007 relates to the question, potentials and limits of proximity on a single ground datum. The Brazilian Pavilion by Paolo Mendes da Rocha completed for the Osaka World Expo in 1970, in conjunction with historical underground dwellings from various regions, relates to the question, potentials and limits of proximity across a multiplied ground datum. These examples are discussed in the section on case studies.

1.3 Investigations in Collective Non-form

"Methodological investigation on collective forms has seldom been done until very recently. What is needed is not just observation and critical comment, but utilization of the observation to develop strategic tools in making our physical environment."

(Maki 1964: v)

From the early 1960 onwards the Japanese architects Fumihiko Maki and Masato Ohtaka pursued a sustained study of what they termed *group-form* as a flexible form of urban planning to accommodate necessary change. Kenneth Frampton described group form as "a podium (that) may be inserted into an urban fabric in order to provide for a long term stability while the structures on it surface would be subject to a faster cycle of change and replacement" (Frampton 1999: 30). Maki continued this line of investigation terming it *collective form* (Maki 1964), while Ohtaka pursued a notion of *artificial ground*, which resonates with Frampton's description above. Furthermore, Maki and Ohtaka also coined the notion *megaform* in reference to Kenzo Tange's Tokyo Bay project. Kenneth Frampton characterised this as follows:

> "1) A large form extending horizontally rather than vertically. 2) A complex form which, unlike megastructure, is not necessarily articulated into a series of structural and mechanical subsets (…). 3) A form capable of inflecting the existing urban landscape as found because of its strong topographical character. 4) A form that is not freestanding but rather insinuates itself as a continuation of the surrounding topography (…). 5) A form that is oriented towards a densification of the urban fabric." (Frampton 1999: 20)

One type of project discussed by Frampton in this context is the co-called mat-building. Allison Smithson introduced this term based on a discussion of the works of members of Team X and in reference to historical case studies, in particular Kasbah's and similar types of Arabic architectures. In the introduction of her renowned article from 1974 Allison Smithson stated that:

> "Mat-building can be said to epitomise the anonymous collective; where the functions come to enrich the fabric, and the individual gains new freedoms of action through a new and shuffled order, based on interconnection, close-knit patterns of association, and possibilities for growth, diminution, and change" (Smithson, 1974).

Such extensive projects foreground connectivity and in some way overcome typical figure-ground arrangements in their extensiveness in due to the fact that a new elevated ground arises from this dense fabric. Numerous aerial photos of historical precedents and plans and birds-eye model photos of current projects illustrated this article. What is perhaps surprising then is the fact that not as much attention is given to this new ground as one might expect.

Frampton pointed and out that the forces that drive urban and land development, such as the commodification of ground, related land speculation, etc. suggest that there remains no commitment to "any form of land settlement that would be consistent with the production of coherent civic form" (Frampton 1999: 39). He went on the suggest that for now "architects can only intervene urbanistically in an increasingly remedial manner and that one effective instrument for this is the large building program that may be rendered a megaform - as an element which due to its size, content and direction has the capacity to inflect the surrounding landscape and give it a particular orientation and identity. I believe that such forms are capable of returning us to a time when the prime object of architecture was not the proliferation of freestanding objects but rather the marking of ground" (Frampton 1999: 40).

Frampton's argument connects back to the question of the elements of the urban aggregate and its characteristics. Is it useful, or even possible, to base an approach towards a *collective form* or *megaform* on the premise of discrete architectures the main purpose of which is to stand out and to distinguish themselves from their setting? It would seem that such an approach would be based on the unsolvable conundrum of accomplishing coherence and continuity from base matter that is characterised by difference and therefore segregation. And, if the outcome of the aggregation of architectures aims for a specified larger form change may be precluded. Maki's studies suggest that this is not intended, as in particular by the studies in settlement pattern resulting from organic growth show. However, as todays architectural trend prioritizes discrete and often idiosyncratic form the risk is that clusters of aggregated architectures may fall victim to the same trend and

reinstate unmoveable boundaries at a grander scale, such as today's very large urban shopping malls for instance.

In order to provide useful leads for aggregated architectures several historical case studies are examined including the Neolithic settlement Çatalhöyük the hillside town Mardin both in Turkey, pit-cave underground dwellings in China and Tunisia, and also the *trace italienne* or star fort.

1.4 Multiple Grounds

In order to overcome the view that buildings take up ground and land use fragments the suburban and urban environments it is necessary to develop an adequate approach for design strategies that effectively multiply ground in such a manner that sufficient connectivity is derived. Stacking up floors, which is to common understanding of multiplying ground is characterised by disconnection between floors. Only building so densely that extensive levels occur is not sufficient as a number of built mat-buildings show. Roof surfaces, for instance, remain precisely that and are often not connected to the ground so as to render the roof surface an effective extension of the ground surface. The extensive use of inclined surface can help solve this problem. Various strata in a multiple ground arrangement can therefore be continuous and connect back to the ground datum. This can serve to provide extensive and continuous collective space and opportunity for close proximity to continuous spaces provided for local ecologies. In this kind of scenario it is imaginable that wildlife has its own continuous strata cutting across the urban matrix while avoiding undesired risky encounters.

From the mid-1960s onwards the French cultural theorist and urbanist and the French architect Claude parent developed a notion termed 'oblique space' that foregrounds the potential of inclined surfaces in architecture for human use (Virilio & Parent 2000). This approach can be suitably extended to incorporate different kinds of uses and also provisions for natural systems. However, like the other strategies discussed above the general principle of multiple grounds and connectivity requires thorough adaptation to the local terrain, water and soil regime in terms of waterways and runoff and required soil depth and composure, etc.

1.5 Overarching Criteria for Design and Planning

Based on the above discussion it is possible to set out a number of principal strategies that can inform architectural and urban design:

1) Non-discrete architectures are to form the base matter of high-density urban aggregates;
2) The concept of collective non-form is to preclude urban aggregates to settle into fixed form incapable of modification;
3) Aggregations are to provide new extensive ground(s) for collective use and connective space to sustain the local biological and physical environment.

With this the question arises as to how these general strategies can become locally specific. For this purpose it is useful to take into consideration the specific environmental history of a given location with focus on soil and water regimes, terrain and land use, urban development, etc. (Agnoletti & Serneri 2014), as well as locally specific biodiversity and bio-cultural diversity (Agnoletti & Emanueli 2016). In these approaches culture and environment are considered as correlational, however, it is also important to consider culturally specific pattern and regulations in terms of use of land and collective space.

When considering the above in terms of proximity between relatively undisturbed ecology and architectures and settlements some form of mediation becomes necessary. A useful inroad to this question can be provided by existing approaches in agro-ecosystem management:

> "Planned biodiversity will give rise to an associated biodiversity …the extra-planned organic resources, plus the planned biodiversity plus the associated biodiversity combine …to produce the ultimate agro-ecosystem function, its productivity and sustainability …multispecies cultivation clearly necessitates biodiversity management on the plot-scale. It also, however, requires consideration of its biogeographical context within the surrounding

> area, requiring recognition of processes operating on various scales." (Vandermeer et al 1998: 6)

This approach suggests that planned, associated and freely evolving biodiversity of a given location need to be considered in terms of their mutual impact, in particular when close proximity is desired. The generic catalogue of plants provided in garden centres worldwide thus needs to be subjected to closer scrutiny, a condition that is likely to shed new light on the discussion concerning the role of native and non-native species. These considerations can be complemented with insights, approaches and policies from the interdisciplinary field of urban ecology in order to factor current conditions and developments into long-term plans. Marzluff et al summarized the field Urban Ecology as:

> "the study of ecosystems that include humans living in cities and urbanising landscapes. It is an emerging, interdisciplinary field that aims to understand how human and ecological processes can co-exist in human dominated systems and help societies with their efforts to become more sustainable." (Marzluff et al 2008)

Principle problems remain the fragmentation of landscape due to infrastructure and land use, in particular in suburban areas that make it difficult to solve problems on a singular plane or ground datum. Proximity planning therefore requires strategies that operate in a complementary manner on a single datum and on multiple grounds, involving all spatial and time dimensions.

Here the question may be raised in which way the relation between the region or urban *umland* and the city may be addressed in economic terms. In terms of this thematic the biodiversity and ecology based approach for the sustainable production of agricultural goods and regrowable material resources may point towards some possibilities. This will require detailed consideration of entire supply chains. Some foundations have already been laid for such considerations. (Lockie & Carpenter 2012; ten Kate & Laird 1999; World Tourism Organization 2010)

1.6 Objectives

the perception of a building taking up ground prevails, as does the preference for expressive discrete architectures that are to stand out against their local setting, while architectures and cities become at the same time increasingly globally homogenous and architecturally less attuned to local conditions. Due to the inherent restrictions of this trend the prevailing sustainability goal is therefore frequently constrained to impact minimization. This yields the question as to whether there may exist a latent approach that foregrounds positive rather than negative or neutral impact. The following questions are posed: Can a specific combination of contemporary and historical approaches provide such an approach and enable a different type of architecture and urban design to take shape that is integrated with the regionally and locally specific biological and physical environment? What are the principal strategies that can be formulated and deployed to overcome to trend of consuming ground in a socially and environmentally unsustainable manner? Can continuous grounds be provided where construction takes place and can more extensive spaces for collective use be provided? Can these strategies give rise to the extension of the 'natural' environment directly adjacent to and across aggregated architectures?

The paper examines suitable contemporary conceptual approaches and works and reviews a number of historical architectures and settlement forms to pursue the formulation of such an alternative and integrated approach towards sustainable urban and regional planning. The discussion here within is predominately based on literature study and a number of case studies focused on the latent potential of contemporary architectures and historical settlement forms.

2. Methods

The primary methods of research include literature research and case studies. Regarding the literature study we reviewed two different subject areas.

The first of inquiry involved low-rise high density approaches to arranging settlement pattern. This involved Fumihiko Maki's analysis of what he termed *collective form* (Maki 1964), as well as Allison Smithson's notion of the *mat-building* (Smithson 1974) and Kenneth Frampton's discussion of

megaform (Frampton 1999). This first line of literature study was added to by a number of historical cast studies that showcased various ways of articulation the above listed notions. The case studies included Chinese and Tunisian pit-cave dwellings, the Neolithic settlement Çatalhöyük and the ancient Anatolian hillside town Mardin, both in Turkey.

The second line of inquiry involved the possibility of conceiving of the architectures that make up possible settlement patterns from a point of view that does not foreground the object, but instead the way architectures stage an interface with their given settings; in other words, focus is placed not only on what architecture is but also on what architecture does. This involved in the main Kengo Kuma's approach to the architectural *anti-object* (Kuma 2008), Sanford Kwinter's notion of the dissolution of the architectural object into *micro-* and *macro-architectures* (Kwinter 20019), and David Leatherbarrow's notion of architectures interaction with scripted and unauthored conditions within a given setting (Leatherbarrow 2009). This study was paralleled by a number of contemporary architectural case studies, including R&Sie(n)'s Spidernethewood house in Nimes, Foreign Office Architect's Meydan-Umraniye Retail Complex and Multiplex in Istanbul, and Paulo Mendes da Rocha's Brazilian Pavilion for the Osaka Expo in 1970.

These lines of inquiries showed that suitable concepts and built examples exist that, at least in part, feature aspects of what might be called *collective non-form* based on *non-discrete architectures*. However, a succinct effort to analyse literature and case study in this manner and to foreground in this effort the way natural systems and architectures may be interfaced in a different and more continuous manner are yet to be conducted and an overarching approach is yet to be defined that seeks to foregrounds positive rather than negative or neutral impact in the inevitably progressive process of expanding the built environment.

3. Case Studies

The case studies discussed below progress from single architectural projects to settlement patterns and focus on ways in which proximities can be organized on a single datum and on multiple grounds.

The first case study is R&Sie(n)'s Spidernethewood two-storey one family house in Nimes, France completed in 2007. The house is located on a site with densely growing vegetation that becomes part of the scheme. Nets that separate the local vegetation from spaces for exterior activities articulate the exterior spaces with the vegetation masking the volume and exterior of the building. In this way the scheme is not organised as a discrete building and formal garden, but instead into a non-discrete architecture with closely defined exterior spaces and otherwise unconstrained growth of vegetation. For this reason this project serve as a model for organizing close proximities between the quasi-natural and the human environment. However, there are specific limits to proliferating such an approach across a plane into a denser settlement: either houses are dispersed clusters with an unconstrained circulatory network between them or, if the netting is utilized also for the connections between houses the distribution needs to be dendritic in plan in order to avoid inaccessible spaces. The former carries the risk of chance encounters between species while the latter needs to be complemented with a multiple grounds strategy in order to allow for different patterns of distribution of architectures and growth of settlements.

The second case study is the Meydan-Umraniye Retail Complex and Multiplex in Istanbul designed by Foreign Office Architects and completed in 2007. The project features two main surfaces, one paved in brick for pedestrian access and collective use, and another articulated as a grass surface. The constructed terrain slopes up and down and most building volumes are located below this terrain form. As such the project suggests a *megaform* approach as discussed above. What is of interest here is an unrealised potential. The Turkish work *meydan* –used in the name of the project- implies square. The brick surface provides a version of the more formal European city square and was used successfully as a collective space until access was restricted for debatable reasons. The grass surface, however, is not possible to occupy in large parts due to the inclination of some surfaces and the effort to maintain the growth of grass. Historically meydans were, however, in the middle-eastern culture grass surfaces for a variety of informal uses. To preclude the use of the grass covered surface therefore entails constraining cultural specific use of

collective space. A terrain form with lesser-inclined surfaces could solve this problem. Moreover, the opportunity exists to not only provide grass-covered surfaces for collective use, but also wild growth areas to provide for local ecological needs. Here it is conceivable to utilize the netting approach of the above-discussed Spidernethewood project.

The third case study is Paulo Mendes da Rocha's Brazilian Pavilion for the Osaka Expo in 1970. The functional spaces of the pavilion are subterranean below an undulating ground surface with is sheltered by a canopy. Such subterranean architectures have existed throughout human history in different locations and climate zones of the world, i.e. *yaodong* pit-cave dwellings in China's Loess belt or the troglodyte berber pit-cave dwellings in Tunisia, which are typically organized as dug out courtyards from which the various subterranean spaces can be accessed. In case of the *yaodong* the connectivity between the different dwellings is the ground plane from which each dwelling is accessed via staircases. The same is true for the Brazilian Pavilion, which does not feature a sunken courtyard, but instead an on-ground space sheltered by a canopy. In contrast the berber pit-cave dwellings in Tunisia were often connected with tunnels to provide a secondary, burrowed system of connection.

In terms of settlement pattern the proliferation of pit-cave dwellings serve as a first type of settlement pattern that is of interest, which is based on the notion of a thick ground. All these variations on the theme of burrowed spaces can serve to organise proximity in section that is to say distributed over multiple grounds, but require some way of organizing proximities on the continuous ground plane. A similar example are the *trace italienne* or star forts that emerged in the 15th century in which spaces are situated in the constructed landform of the fortress shaped for defence purposes. This suggests not only an alternative to the common figure-ground arrangement that underpins discrete architecture and resulting urban fabric, but also to the majority of so-called landform buildings that operate on a formal reference to landscapes while at the same time not constituting actual, if constructed landscape.

Two other types of settlement patterns are worth considering in terms of providing multiple grounds. Both are based on aboveground construction but with variations for a flat plane and another for hillsides.

The Neolithic settlement Çatalhöyük in Turkey dates from circa. 6500 BC the settlement housed 5000 to 8000 inhabitants. The dwellings were tightly clustered and access was provided from the roof-plane that emerged from the clustering. Streets or paths on the actual ground datum did not exist, only courtyards. In some way the arrangement is similar to pit-cave dwelling based settlements, only that the collectively shared ground was elevated and the dwellings constructed above ground. The perimeter of the settlement, however, constituted a barrier, perhaps for the purpose of defence. This type of spatial organisation can also be found in the mat-building typology discussed above and the same constraints apply in terms of the elevated new ground that is disconnected from the actual ground datum. This only shifts the problem of ground lost for multiple purposes and for the provision of proximities from the building scale to the cluster, block or settlement scale.

To solve this issue for the purpose at hand it is possible to image this settlement pattern transitioning into a pit-cave type settlement when located on an inclined plane. Wherever access on the shared plane needs to be divided or restricted the above discussed netting and planting strategy can be employed, or else surface modification by way of inclination or recessed landscape design elements such as the ha-ha.

The ancient Anatolian hillside town Mardin shows how the multiplication of ground can be thought of on a steeply inclined terrain. The dwelling units are frequently introverted two-storey buildings that are densely clustered. While each building mass is clearly defined the use of the same material and the dense clustering renders individual buildings non-discrete as they blend into a continuous fabric. The roof terraces of the buildings multiply the ground in that they frequently serve as part of the public circulation system up- and downhill. Along the contours of the hillside run narrow pedestrian streets that are often covered by parts of buildings. While the new ground is not as continuous as in the case of Çatalhöyük, due to the stepped terracing, it is nevertheless continuous in terms of circulation. In all these cases shared common-sense based rules were

required to govern the use of locations that simultaneously belonged to a given dwelling and the extended collective space. Given the spatial arrangement of such examples it is entirely conceivable to implement additional continuous networks for natural local ecological systems. Contemporary examples such as Tadao Ando's Rokko housing projects as an ensemble begin to suggest such possibilities, but are perhaps still too concerned with the individuality of the different phases of the project. It is also not entirely clear whether in this case the natural vegetation elements between the different clusters are intended or accidental. As for more systemic integration so-called landscape urbanism has made some way, although here too the perceived need for idiosyncratic expression often prevails, drawing a more continuous urban fabric back to the distinguishing borders between one architects project and another. However, there exist numerous projects that each can offer valuable insights and approaches from which the contours of a still different architectural and urban approach begins to emerge.

4. Discussion

The case studies discussed above illustrate various ways to address the key strategies laid out above, which can be extended as follows:

1) Non-discrete architectures are to form the base matter of high-density urban aggregates that are at the same time capable of providing close proximity interfaces with other cultural and natural systems;
2) The concept of collective non-form is to preclude urban aggregates to settle into fixed form incapable of modification and to avoid shifting segregation based on discreteness from the building scale to that of clusters, blocks or neighbourhoods;
3) Aggregations are to provide multiple and connective grounds for collective use and to sustain the local biological and physical environment.

Each of these strategies requires adaptation to the specific local conditions, processes and patterns of use.

With the approach discussed above a number of questions arise, pertaining individual expression but also the complexity of addressing region to city core production and supply chains.

Is individual expression in design precluded by the pursued approach? The problem is that such preclusion might lead to monotonous urban design. In our view such preclusion is not inevitably part of the above outlined approach nor is it desirable from a cultural point of view. As the individual object is relinquished as the main item of design attention and emphasis other items come to the fore, the articulation of courtyards, surfaces, interfaces between different systems and even their intended interaction. This requires clarification in the long run, since such items may extend well beyond plot boundaries and some constraints may be given by requirements of continuity of items. One project that highlights a specific response to this question is Paulo Mendes da Rocha's Brazilian Museum of Sculpture in Sao Paulo completed in 1998. The museum is located on the slope with the main spaces located underground within a constructed landscape that also features a sunken plaza and a large portico. To foreground the public program of the project the concrete tiles and white cobblestone used for the neighbourhoods pedestrian walkways are extended across the project that is essentially a non-discrete architecture. The museum was initially also to incorporate the theme of Brazilian ecology. Due to this initial brief the park is integrated with the architecture, which is essentially a sunken landform building that features large water basins and planting areas. As such this project demonstrates that the continuation of more extensive systems through it and its non-discrete articulation are no real limitations for architectural expression, if perhaps of a much more humble character that redefines what a cultural building can be.

As such effective integration and adaptation to local conditions requires an interdisciplinary approach already on the scale of a single architecture, which now becomes somewhat of a microcosm of the lager city. Variation and integration from the region to the city core requires differentiation and integration with production and supply chains. However, the approach

discussed here within is likely going to involve the rethinking of the character and role of urban spaces such as parks, squares, etc. as well as preconceptions as to what is produced where. Approaches to regional catchment areas, such as in the Netherlands for instance, that determine in which distance food products for consumption are produced can be paralleled with highly integrated urban farming. In this way various items of supply chains can be distributed across what might be considered inner urban fabric. At any rate, addressing this matter does not only require a strong interdisciplinary take and the will to put policy into place to make such arrangements possible, but also a strong systems-oriented component to reorganise complex organisational arrangements without disrupting their performance.

5. Conclusions

The aim of this paper was to identify and discuss alternatives to the prevailing and progressively global approach to architecture, urban design and regional planning, which is based on homogenous figure-ground arrangements that consist of discrete architectures with all their known repercussions and restrictions imposed by the predominance of the architectural object, its ground-restricting accumulation and collective space. We sought to do so be foregrounding and discussing notions such as non-discrete architecture, collective non-form, multiple and continuous grounds. This was paralleled by case studies on the scale of singular architectures and also settlement patterns that incorporate already essential elements of what we propose as an alternative approach. Some general strategies are provided that will need to be integrated with and adapted to local conditions. As such this constitutes an approach that follows Paul Reitan's point that sustainable human societies must be "as attuned as possible to their local and regional environments, their geo-ecological support systems; lifestyles must be adapted to ecosystems in which societies live and which support them with cultures, practices, economic systems, and governing policies each adjusted to their area" (Reitan 2005). Only here this principle is applied to the systemic approach of locally specific co-existence that is to some extend provided for by means of architectural design and urban arrangement.

In so doing the intention is to move away from a general emphasis of impact minimization towards opportunity maximisation for various sustainability concerns, such as environmental and social sustainability. The extensive reduction of the natural environment and the gradually disappearance of collective social space from many cities in the world that are subjected to foreign investment driven urbanism makes a clear case for the need of alternative approaches. For the above or any other alternative to take shape there must exist the political will to do so and to put into place respective policies. Before this can happen it is necessary that extensive studies lead to speculative designs that can form the basis of discussion. This in turn requires interdisciplinary collaboration and perhaps the optimism and lack of fear to propose a latent utopia wrought out of elements that are already in existence, in a context where dystopian views or disinterest prevails. In this regard this paper can only be seen as a preliminary position statement that needs to be further developed and paralleled by design as a mode of research and development towards tangible architectural and urban scenarios.

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Low-carbon building technologies: wood and new paradigms for architecture

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Abstract

This paper takes as its premise that all technical and cultural complexes used in the production of Architecture and Urbanism has the universe of Construction as a theoretical and practical substrate; understood here as a mainly technological primordial human activity, applied in the production and reproduction of life. This assertion is based on a particular notion of technology: as the social process in which the technique itself (i.e., the technical apparatus of industry, transport and communication) is only one factor among others, and it refers to a mode of production as a totality of instruments, devices and inventions. But if sustainable development primarily refers to a kind of 'new global productive ethics' to answer the needs of the present without compromising the future generations to meet their own needs, such a development horizon must face the problem of material production taking into account all the dimensions of the productive forces involved. In this sense, this notion of development will also be understood here as being associated with technology. If the production of Architecture depends on technological operations and integrates the body of knowledge and practices organized as Construction – which is part of the broader context of political economy - so also must the technical elements that compose its field respond to the implications that determine what is now called 'sustainability' of the production process as a whole. Our argument is that there is generally a difficulty in establishing a systematic and critical view on sustainability in architecture and construction in research and practice on the subject. Thus, this article aims to discuss the strategies that exclusively turn to quantitative reduction and direct mitigation of environmental impacts related to what today is called Sustainable Architecture; it cannot be only limited to the application of certified materials or reducing waste consumption in manufacturing or energy in its operation. It also seeks to articulate this notion to the debate on *low-carbon economy*, an approach that has enabled measuring the magnitude of the environmental problem and pointing out the need for local actions that include more comprehensive policies, varying economic sectors and technological innovations. It is important to articulate other dimensions that are critical to questioning prevailing paradigms, namely: the capital dimensions, in their various production arrangements; the labor in its dynamics of circulation as a 'commodity'; the environment, as a complex system of interactions (technological, social, economic and cultural); and the formulation of public policies. It is worth mentioning that this article is part of a broader research project that seeks to articulate such concepts as the creation, development, evaluation and dissemination of Low-Carbon Building Technologies (LCBTs). Initially wood has proven to be an exemplary material for use in LCBTs, to the extent that the concept of sustainability in architecture, the global GHG emission reduction proposal, along with the principles of green and solidarity economy can be transformed into local strategies by expanding the use of components and building of prefabricated wood systems.

Keywords: Sustainability, low-carbon technologies, architecture, construction, wood construction

1. Introduction

Global temperature increases and environmental disasters arising from them appear daily as a dilemma that takes a central position in discussions for equating the economic development of countries and the search for comfort that technological development can provide. Disasters affect everyone indiscriminately; development is historically and structurally unequally distributed. In this context, the issue of sustainability has taken on great importance in recent years.

Initially, the notion of sustainability mobilized aspects only restricted to the environmental sphere, considering that effects on the biosphere resulted from the release of Greenhouse Gases in the atmosphere - GHGs; the creation of holes in the ozone layer due to the burning of fossil fuels; compromised restoration capacity in biomes from the acceleration and expansion of human activities; depletion of non-renewable energy resources; accelerated deforestation, etc. However, in the 1990's this notion was extrapolated into economic, social and political fields, making its conceptualization and implementation even wider and more complex.

At that time, the definition proposed by Ignacy Sachs (1994) gained relevance in the international debate. According to her, sustainability came to be related to five dimensions: 1) Social: better income distribution and reducing the gap between rich and poor; 2) Economical: more efficient management of resources and greater economic efficiency in macro-social terms; 3) Ecological: use of natural resources - renewable, when possible - but with greater efficiency, seeking to reduce the use of fossil fuels and reducing the amount of waste and pollution; 4) Space: Urban-rural setting more balanced, ensuring healthy equivalence between urban settlements and their economic activities; reducing excessive concentration in cities; rational exploitation of forests and agriculture; exploitation of industrial activity in a decentralized manner; 5) Cultural: defending local and particular characteristics of each region (Sachs,1994).

Since then, the term "sustainability" has been widespread and gradually incorporated into both the academic debate about the daily lives of different social groups and sectors of the economy - permeating discourses and practices undertaken by various actors, as well as non-governmental organizations to large corporations. As Limonad (2013:124) stated, "Everywhere, at every corner, it has become commonplace to talk about sustainability" - which, paradoxically, contributes to the depletion of its critical potential with respect to political, economic and even social and prevailing cultural order.

In this sense, Acselrad (2007) seeks to establish some critical status to the notion of sustainability in a context marked by very normative purposes in referring to the discussion on social reproduction. According to the author:

> About polysemy and various appropriations of the term, it is thought of as the duration of the material base of society, of reproduction, in time, and the material conditions of forming social relations. We designate per sustainability as the category through which societies have questioned the material conditions of social reproduction since the last decade of the twentieth century, discussing the ethical and political principles regulating access to and the distributing of environmental resources - or in a broader sense, the principles that legitimize the reproducibility of spatial practices. (Acselrad, 2007:1)

By convening spatial practices, this concept of Acselrad (2007) for sustainability appears closely related to the urban issue, making it urgent to consider it in the context of an increasingly urbanized world. Leaving aside what we can discuss on the basis of parameters that define today what is "urban" or what is called "rural", Brenner (2014) postulates that, in addition to the practical and empirical dimensions there is now a "planetary urbanization," ordering new appropriate analytical categories to think about the profound changes in what Henri Lefebvre already called in the 1970s the "urban phenomenon."

In the field of Architecture and Urban Planning, as well as in construction, an exacerbated proliferation also occurred, often emptying the meaning of the term "sustainability." Its derivations were always in search of a distinctive condition and were incorporated in the vocabulary specific to each area - Green Architecture, Bioclimatic Architecture, Ecological Architecture, Sustainable

Cities, and Sustainable Building - among others. According to Cook (2001), because there is no consensus as to the content that gives meaning to the terms, they end up bringing even more ambiguity to the debate.

However, it is valuable to put some aspects into perspective that lately have been establishing themselves as a consensus in the field of "sustainable buildings": it seems possible to say that a few among the most recent approaches have more strictly questioned the consolidated paradigms. In general, much of the work has been dedicated to equate a kind of 'non-traumatic alternative' within the existing conceptual systems (and give substrate to the installed production standard), to adapt the development of the civil construction sector to the environmental agenda. Important segments that integrate the supply chains that structure the sector (such as the labor force, for example) are systematically omitted from this discussion, as well as aspects of the production structure (forms of entrepreneurship, investment flows and 'sustainability' of the business itself, etc.) end up being relegated to secondary importance as a problem that must be solved by itself.

In general, there is a difficulty in establishing a systematic and critical view on sustainability in Architecture and Construction research and practices. Therefore, this article raises questions about the strategies that are exclusively aimed at quantitative reduction and direct mitigation of environmental impacts related to what today is called Sustainable Architecture: "green architecture" cannot only be limited to the application of certified materials or the reduction of waste in manufacturing or energy in its operation. Furthermore, this study seeks to articulate this notion to the debate on *low-carbon economy*, an approach that has enabled measuring the magnitude of the environmental problem and pointing out the need for local actions that include more comprehensive policies, varying economic sectors and technological innovations. In this sense, it is important to articulate other dimensions that are critical to the questioning of prevailing paradigms, namely: the capital dimensions, in their various production arrangements; the work, in its dynamics of circulation as 'a commodity'; the environment, as a complex system of interactions (technological, social, economic and cultural); and the formulation of public policies.

It is worth mentioning that this article is part of a broader research project entitled “Low-carbon building technologies: wood and new paradigms for the construction sector,” coordinated by the authors and conducted at the Institute of Architecture and Urbanism at the University of São Paulo (IAU-USP, Brazil). This project seeks to produce new scientific and technological knowledge in the field of design, architecture and construction, articulating environmental, labor and capital dimensions from its creation, development, evaluation and dissemination of Low-Carbon Building Technologies (LCBTs). Initially wood has proven to be an exemplary material for use in LCBTs, to the extent that the concept of sustainability in architecture, a comprehensive proposal for GHG emission reduction, along with the principles of green and solidarity economy can be turned into local strategies through the increased use of components and building of prefabricated wood systems. By researching, testing and proposing wood as a building material capable of aligning itself as a constructive low-carbon alternative, this research aims to address the problem of production technology in Architecture and Urbanism in all dimensions outlined here; established as a rationally determined constructive strategy, the use of wood in the industrialized production of building components can contribute to reversing the developmental construction logic that is not committed to the reduction of GHG emissions.

2. Methods

To accomplish this article, a Systematic Literature Mapping on sustainability, sustainable architecture, low-carbon economy and building technologies was conducted mobilizing recent international and national studies based on these issues. The analysis presented herein contributes to both theoretical foundation and the identification of the empirical research problem “Low-carbon building technologies: wood and new paradigms for the construction sector.”

Given the theoretical scope and practical application of research to which this article is linked, the general research strategy is "Design Science Research," originated from the field of Engineering and Applied Sciences and which is related to methods involving development of new artifacts or constructs on empirical and theoretical problems previously identified. According to Venable

(2006), design theories show how explanatory, descriptive and normative theories can be put into practical use. Furthermore, research design differs from the design of the activity itself as it is concerned with the production of new knowledge.

In the case of this research, the steps prescribed in DSR methodology are organized in its six structural axes, namely: **Axis 1:** investigates and systematizes the theoretical and practical references on sustainability, low carbon building technologies and the issue of wood in construction; **Axis 2:** development of project components and prefabricated building systems of wood for use in housing and public facilities; **Axis 3:** pilot production of components and prefabricated building systems of wood to be used in building the institution's headquarters (USP); **Axis 4**: training of professionals and construction workers during the pilot production process; **Axis 5:** testing of new production arrangements, forms of entrepreneurship that focus on small companies, self-managed groups and cooperatives, as well as to promote the dissemination of LCBTs; **Axis 6:** articulating public policies and qualified expansion of the consumer market, seeking to intervene in social processes that today structure the paradigms of construction in the country.

3. Results

The main results of the performed SLM (Systematic Literature Mapping) allows us to relate the contemporary debate of sustainability and low-carbon economy practices to architecture and construction, as well as discuss the identification model of the impacts on GHG emissions promoted by the construction chain as a whole.

3.1. Sustainability in architecture and construction

Agenda 21 on *Sustainable Construction*, published in 1999, intended to lay the foundations for proper designation of what could be *sustainable design* and became a recurring reference, feeding various international manuals of said 'sustainable' design. The Agenda compiled 12 key recommendations on economic, political, social, environmental and cultural aspects inherent to the life cycle of buildings, seeking to articulate such recommendations in a comprehensive manner, minimally consistent with the complexity that it requires (CIB, 1999).

Since then, in addition to specialized journals, several works being more or less comprehensive on the concept of sustainable architecture have been published (Olgyay, 1998; Serra, 1999; Romero, 2001; Corbellas; Yannas, 2003; Agopyan; John; Goldemberg, 2005; Edwards; Hyett, 2005; Trigueiros, 2010), promoting studies formulating recommendations and considerations on the national and international conditions for adopting "clean technologies" in the production processes of cities and their buildings.

Specifically, in relation to planning for sustainable construction, and according to the German manual designed for that purpose (Federal Office for Building and Regional Planning, 2001), it would be necessary to formulate questions and recommendations that already consider the horizon of sustainability as a decisive parameter for the compatibility of its object to environmental demands (since the establishment of the requirements and the architectural design program). It seems appropriate to register them, since they comprise an operating feature of the concept itself:

1) Regarding the adequacy of needs: is a new building necessary to meet the space requirements or can an existing building be used?
2) Regarding the optimization of program needs: does it meet the necessary requirements?
3) Considering the effects related to the site: does the site support the ecological and economic requirements?
4) Optimizing the building layout in terms of ecology, economy, functionality and configuration.
5) Questioning the durability of the use of the buildings, the possibility of multiple uses, and conversion of use.
6) Questioning the durability of building materials and building components: in order to

increase building life and reduce maintenance and refurbishment costs.

7) Questioning the optimization of building component geometries, seeking to increase usage value and expand the range of applications, ensuring greater chances of future use and reuse as well as easier maintenance.
8) Avoid using building materials and compound components that are difficult to separate, seeking to increase the potential for recycling and reuse.
9) Low levels of building material and component contamination.
10) Controlled demolition, if there is no possibility of continued usage.

In operational and methodological terms, it seems pertinent to consider this more adequate approach - somewhat less deliberative, less prescriptive - as we approach a technological context already quite marked by established practices, in a way obstinate to including new production arrangements.

3.2. From sustainable building certifications to low-carbon economy

In addition to the academic debate and institutional publications on sustainable construction, an instrument that has achieved significant importance and widespread attention in the international and domestic building markets was the environmental certification of buildings. Among them the following stand out: the British certification BREEAM (BRE Environmental Assessment Method), created in the early 1990s; the North American LEED (Leadership in Energy and Environmental Design), launched in 1998; and the French HQE (Haute Qualité Environnementale), also created in the 1990s. All these certifications promise distinction to products certified by them, adding a still purely symbolic value but embodied as a competitive advantage in the form of differential imagery in the process of circulation. Thus, such certifications more endorse the image of the producer as a company committed to the protection of the environment than the product itself.

In Brazil, besides these international certifications, there are some eminently national certification processes; two more are focused on the energy performance of buildings - the National Energy Conservation (ENCE) seal for commercial buildings, and public services; and ENCE for homes and multifamily buildings – and one intended to rate the environmental performance of housing projects financed by the Federal Bank (*Caixa Econômica*) through sustainability indicators – the Blue House Seal (*SeloCasa Azul*) (John; Prado, 2010).

Both in international and in national cases, the certification process occurs by issuing opinions to buildings that promote the optimization of natural resources and energy during its construction and operation, and should respond positively to the criteria and requirements set out in those instruments (Santos; Abascal, 2012).

Faced with the ambiguity of the certification process and other questions, we highlight the question of the interests that support granting a "green certification.” Limonad (2010; 2013) for example, points out that it would be important to ask: what are the criteria and according to whose interests are they defined? Another issue concerns importing methods designed for countries with different socioeconomic, climate and cultural conditions than Brazilian - which would require greater attention and rigor in the local implementation of such accreditation systems (Silva; Silva; Agopyan, 2003; Vieira; Barros Filho, 2009; Bueno, 2010).

From this angle, it would also be important to ask whether there is a common field of reference able to overcome the specificities of interests or even regional differences - since it is a global issue in an increasingly globalized economy.

In recent times, the idea of "sustainable development" is being consolidated in a recurrent and updated manner as a designation of economic growth that can be achieved through productive and technological processes committed to lower greenhouse gas emissions, all represented by the most impactful of these gases (but not the most aggressive, it is worth mentioning), carbon dioxide (CO_2). This design gives grounds for what has been termed "low carbon economy": by establishing benchmarks and measurement mechanisms (still in development), the various national productive sectors, regardless of their geographical location can be classified as more or less emitters of

greenhouse gases, forming a kind of global ranking of countries according to their participation in greenhouse gas emissions. We know, however, that the model still has limitations: according to the physicist Paulo Artaxo, we now have "a global economy, but not a system of governance or the global accounting of greenhouse gas emissions. We have only globalized the economy and no other sociopolitical aspect" (Revista Pesquisa FAPESP, 2016: nº239, p28).

In any case, the effort employed in achieving a system of quantitative benchmarks and objective measurement for assessing the impact of national economic processes on environmental behavior is significant. Situating the discussion on the impacts of technologies used in construction beyond the 'green certification' means to then place it in a context that is linked to such a system; it is thinking that the production of systemically building technologies is also committed to the assumptions of a "low carbon economy."

3.3. Low-carbon technologies and construction

First and foremost, any attempt at discussing development - be it sustainable or not - that does not take into account the pattern of territorial organization and the dynamics of population concentration force is admittedly inconsistent.

In 1900, only 10% of the world population lived in cities. In 2000, this percentage leaped to 50%, and the outlook for 2050 is that 75% will reside in urban areas. In the last 20 years there was an increase of 50% in the global energy consumption. In European cities, for example, around 50% of the power consumption results from the construction and operational activities of buildings, plus 25% attributed to transport operation; the other 25% are related to industries. In Brazil, according to Eletrobrás data, buildings are responsible for about 48% of electricity consumption, considering the residential and commercial sectors. Much of this energy is consumed in generating environmental comfort to users. In contrast, statistics demonstrate that the potential of conservation in already existent buildings can be up to 30%, and reaching up to 50% in new buildings.

Moreover, in the context of an eminently urban economy, the Construction sector is considered in some approaches as being the most promising to contribute to the reduction of carbon dioxide emissions and energy consumption (Visscher et al., 2013). This is because, according to Santos and Bascal (2012), this sector alone would be responsible for 40% of primary energy use, 72% of electricity consumption, 39% of CO_2 emissions and 13.6% of drinking water consumption. But these data can be considered distorted, especially in the aspect of CO_2 emissions. If we were to base it on other studies - such as the McKinsey Report, for example - "the main source of emissions in Brazil is the forestry sector. Deforestation alone accounts for 55% of GHG emissions today and will be responsible for 43% of the country's emissions by 2030" (McKinsey & Company, 2009:5).

The analysis of McKinsey's work gives the Building sector a rather important role in the context of reducing emissions. According to the report produced by the consulting firm, the residential and commercial building sector has limited representation in Brazil, accounting for about 1% of the estimated emissions of the base case scenario in 2030 [the parametric construction established for the McKinsey study was based on trend projections]. In total, the sector accounts for 8% of emissions. This advantage relative to the global average is partly due to the tropical climate, reducing the energy demand for heating and water heating systems (McKinsey & Company, 2009: 22/23 - it is worth mentioning, however, that the information is directed toward building operations - not the civil construction itself).

Despite the disparities between data sources, one question seems certain: the analysis on the various productive sectors and studies on each one's responsibility in the emission of GHGs *do not deliberately add various quantitative references related to each of the economic and productive activity subsidiaries of civil construction* so that we can get an idea of how they impact the environment. For example, it is very difficult to identify a study that systematically gathers references coming from analyses of the cement, aluminum, steel, oil and petrochemical production, lime and glass industries, etc., aggregating a heading of "Civil Construction," understood as a wide chain that is directly and indirectly governed by all those productive

subsectors. Even the McKinsey Report targets its analysis according to each productive activity; in addition to the building sector (operations, as we have seen), energy production and consumption, and the transportation sector (with reasonable impact on the proportion of emissions); chemical and petrochemical industries; steel and cement industries; in addition to a dedicated sector in waste management. The recent work by the Center on Low Carbon Economy Studies - LCE, published in 2014, brings a series of careful analyses of the impact generated by the various productive sectors facing the new instruments of environmental regulation and technological innovation prospects. However, because of the demands of the notice itself to which the research responded, the sectors are also presented by business segment: Cement and aluminum industries, Steel, Oil and Petrochemicals, Lime, Hot metals and Glass, among others. All these productive activities are critical to get an idea of the direct and indirect impact caused by operations mobilized for construction.

One of the studies that recognizes the complexity and extent of the "social sustainability agenda" and promotes a more systemic view - bringing together aspects of various productive sectors and activities which are involved in the construction chain - is the work of Agopyan and John (2011). Their study brought together an accumulated of ten years of research on the subject and presents the production chain which configures the construction sector as one of the productive chains that not only generates the greatest environmental impacts as well as high energy and material consumption, but therefore also significant amounts of waste and the disposal of waste generated at all stages of a project, whether small or large.

According to these authors, conventional materials used in construction emit greenhouse gases in three main ways: by using fossil fuels in the manufacture and transport of materials; promoting the decomposition of limestone and other carbonates during calcining, which vital in the production of cement, hydrated lime and steel; and extracting native wood, especially non-managed, which also serves as material for fuel (charcoal) - and this is the aspect that we want to highlight here.

Indeed, data from the SNIC annual report (SNIC, 2013) show that worldwide cement consumption reached amounts equivalent to 500 kg/inhabitant in 2012 - in Brazil, 353 kg/inhabitant, and its consumption continues to grow fast. Even with the instability experienced in the Construction sector, new cement plants have recently been installed. According Agopyan & John (2011), the cement industry's portion alone reached 6.1% of the country's total GHG emissions.

According to data of the World Resources Institute published in the aforementioned McKinsey & Company report (2009), Brazil is the fourth country with the highest GHG emissions. In contrast, the same report records a decisive role in curbing emissions, for which Brazil is one of five countries with the effective potential to reduce greenhouse gas emissions by applying corrective and mitigating measures. For example, implementing a large-scale reforestation program associated with the recovery of degraded and unproductive areas.

The document "Low Carbon Study for Brazil," elaborated based on a World Bank study (with the assistance of the United Nations Development Program - UNDP and the Energy Sector Management Assistance Program - ESMAP), identifies four crucial GHG emission factors in Brazil: *Land Use*, *Land Use Change and Forest* (LULUCF); energy production and use; transport systems; and solid and liquid urban waste (ESMAP, 2010).

Of these, LULUCF includes deforestation, highlighted as a major source of emissions with approximately 40% in 2008. The deforestation of native forests, especially in the Amazon, is associated with the need to expand areas of agricultural production and cattle ranches; impactful activities in that they contribute to high greenhouse gas emissions. However, the recent implementation of policies and projects to protect forests has sought to mitigate the emissions caused by deforestation. This reduction and restoration of native forests have shown high carbon uptake potential of the atmosphere (ESMAP, 2010).

Accordingly, among the policies and actions aimed at contributing to mitigate emissions and their consequential environmental impacts, ICLEI et al. (2015) cite actions to eliminate deforestation and loss of forest cover as an effective strategy to zero GHG emissions and biologically store CO_2 as being associated with the forest recovery process. It is worth noting that among the main

agreements reached at the 21st UN Climate Change Conference, the COP21, Brazil has committed to reduce GHG emissions by 37% by 2025 and by 43% by 2030, with ambitious solutions to revise its energy matrix including renewable sources, along with zero deforestation in the Amazon rainforest.

4. Discussion of results

Nevertheless, if the scale of the sustainability problem to be addressed is the city scale, and if the answers to the complex demands that today require huge urban conglomerations to be compatible with its magnitude, it would not be practically feasible to implement alternatives without some disruptions to the prevailing paradigms that structure the civil construction industry today.

As mentioned, the civil construction industry as an activity in itself does not explain all kinds of environmental implications of industrial activities and services that structure the supply chain sector. Although some subsectors are directly responsible for significant levels in the computation of total GHG emissions - such as the cement, lime and steel industries, as we have seen - the truth is that equally or more harmful environmental effects which can be attributed to construction are indirect, namely: the production, circulation and disposal of waste; population density and overload of urban infrastructure networks; exacerbated waterproofing of urban land, contributing to the heating of cities and increased speed of drained water; accelerated deforestation, both caused by changes in land use and by the extraction of timber for use in construction etc. Such breadth and complexity ends in putting forward an inescapable paradox: the "technical apparatus" that assures the viability of life and contemporary comfort achieved through countless technological benefits is the same that is largely contributing to the destruction of the life maintaining conditions on the planet.

So, how can we act on such a larger scale and in such diverse contexts? How can we produce new knowledge that effectively contributes to structural changes in economic activity? In what way can we position the questioning of paradigms that today structure the levels of production that organize all of the Civil Construction sector?

Due to its inherent complexity, this task requires enhanced engagement, involving researchers from various fields of knowledge and "a systemic approach in the shape of a coordinated set of actions, appropriate to each situation" (Agopyan & John, 2011:33). There are, however, at least three sets of aspects that allow us to secure a "systems approach" to the problem of sustainability in Civil Construction and the critical pairing of political and social aspects to the environmental dimension, as recommended by Acselrad (2007), and as seen previously. They are:

1) Aspects relating the ways in which capital has determined the pattern of productive behavior in construction;

2) Aspects related to work organization that, in a way, end up helping to prevent the introduction of "radical changes" in the construction sector;

3) And aspects relating to the installed culture that guides the ordering of today's existing production arrangements along with the formulation of public policies that would require renewed attitudes from agents working in the sector.

In trying to relate these aspects to the contemporary Brazilian context, we can identify that economic stability, improvement of regulation and expansion of budgeted funds for housing finance (Royer, 2009; Sígolo, 2014), and financial capital being invested by large developers and builders (Fix, 2011; Shimbo, 2012; Rolnik, 2016), among other factors, promoted a profound restructuring process in real estate and construction in Brazil in the first decade of the 2000s. There was a strong increase in real estate activities, which lifted the production structure of building into another stage of capitalist development. The sector indicated a profound impact from the changes in the regime of investment and movement of capital that little affected the existing production arrangements, making the concentration model remain 'oligarchic', which has been the origin of capitalist enterprise in Brazil since its inception.

As a result of this process, what has been currently taking place is the predominance of efforts to improve management processes and efficiency programs at the expense of technological development invested in the production process. This means that labor control processes serve the revenue goals of time and materials used more than mitigating the environmental impacts promoted by the industry. Due to the role of labor in the production process, then moving on to contractors subcontracting practices and manual labor, the mechanical improvement and 'digitization' of labor exploitation mechanisms linked to manufacturing processes that insist on conforming the construction site etc., have all been committed in favor of productivity and investment security (Shimbo, 2012; Baravelli, 2014).

If the "State has always worked in Brazil as the locomotive of the accumulation process" (Paulani 2011: 18), its role now is critical in directing policies that can prioritize, in the case of construction, the dimension of sustainability and encourage dissemination of low carbon building technologies.

However, the economic and political interests in effect do not seem to favor this perspective, and when building appears to be central to economic development policies, it is due to its ability to absorb large amount of manpower, generate jobs, and move through an extensive chain of supplies and materials. In this regard, the engine of these policies and programs is generally to foster more and more the enlargement of the scale at which buildings and infrastructure are produced - citing, for example, the “Growth Acceleration Program” (*Programa de Aceleração do Crescimento* - PAC), launched in 2007, and the “My House, My Life” Program (*Minha Casa, Minha Vida* - PMCMV), from 2009.

Even when there are initiatives that are directed toward regulating the quality of processes and products in construction - and here we quote the Brazilian Program of Quality and Productivity of the Habitat (PBQP-H, created in 1997) and the “Performance of Brazilian Buildings up to 5 floors” Standard (ABNT 15575 - *Edifícios Habitacionais de até 5 pavimentos – Desempenho*) – they do not comprehend the presence of a more integrated and critical sustainability approach in the first place (emphasizing the link between environmental and social adequacy and economic dimension, for example), and, secondly, and more specifically, the global concern to reduce GHG emissions.

Addressing the problem of production technology in Architecture and Urbanism in all the dimensions outlined here does not only need to take into account the simple application of certified materials or regulating energy consumption in the building lifecycle, as we have already mentioned. It is necessary to operate in the whole range of related production to reverse the logic that organizes the productive sector today - which (let`s face it) is not actually committed to reducing gas emissions which are responsible for the greenhouse effect. In seeking the development of low carbon practices for application in construction, it is necessary to establish a structuring axis of a system of research, training, education and extension, as well as an investigative approach to articulate and propose from theoretical foundations and practical references of: (1) wood projects for components and building systems of buildings and public facilities; (2) production relations and alternative arrangements of the production process; (3) the work and training of the workers; and (4) a deep questioning about the new possibilities of production arrangements, with a view to intervene in social processes that now structure the paradigms of construction in the country. Thus, we must seek to divert research approaches that use claimed 'sustainable' construction systems as sufficient alternatives in themselves, isolated from the social process which they determine.

4. Conclusion

If we start from a set of references that does not systemically add the impact generated by the building as a whole - pivotally consolidating all partial effects of industrial sub-sectors that supply it - it seems clear that the GHG emission problem in this sector of the economy cannot be tackled in a piecemeal fashion, as proposing partial mitigation strategies here or there also only has partial effects (e.g. alternatives to mitigate the environmental impact caused solely by the cement industry).

Thus, what the TCBC project proposes is to think of systemic modalities of using wood, intending to promote, on a larger scale: (1) new models of land use from setting up a qualified demand for wood from planted forests; (2) new possibilities for exploitation and use of certified wood in construction, through the design of components and building systems of wood that meet the demands for lower power consumption (both in manufacturing and in its application) and produce less waste; and (3) new forms of organization of production processes, intending to form clusters that promote the improvement of work processes (training of skilled workers) and collaborative industrial and commercial training (small or self-regulated businesses and/or cooperative organizations).

It is therefore an initiative that tests some alternatives so that we may decisively question "the material conditions of social reproduction," as stated by Acselrad, some of the "principles that legitimize the reproducibility of spatial practices" currently in use (Acselrad 2007:1).

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Assessing urban transformative capacity: A comparative case study of Seoul, Gwangju and Changwon (South Korea)

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Abstract

Cities play a crucial role in shaping coupled human-environment systems at local and global scales. With a view to amounting sustainability deficits and strong path dependencies, urban stakeholders thus have to perform radical transformations within and across the multiple socio-ecological and socio-technical systems embedded in cities. This requires a better understanding of what exactly enables stakeholders to conceive of, prepare for, initiate and steer such path-deviant transformations. Our research builds on a previously developed conceptual framework for identifying and assessing 'urban transformative capacity' (Wolfram 2015). Drawing on a range of disciplines, it understands such capacity as an emergent systemic property that reflects attributes of urban stakeholders, their interactions, and the multi-level context they belong to, including: Transformative leadership, empowered communities of practice, inclusive and multiform governance, system baseline and memory, sustainability foresight, community-based experimentation, innovation embedding and social learning. Focusing on three cities located within the same national context, this framework is adopted to identify similarities and differences in the articulation of the above attributes and their relations. More specifically, this allows to distinguish patterns in terms of strengths and/or weaknesses in enabling transformative urban change. This contribution assesses the current capacity of Seoul, Gwangju and Changwon to respond to key urban sustainability challenges through transformative change. In so doing it offers novel insights into critical barriers and drivers of urban sustainability transitions in general, and for South Korea and the cities analyzed in particular. Methodologically, a Delphi survey was realized to identify and prioritize common urban sustainability challenges in South Korea. Major cities have been screened and classified with a view to inform a selection of most heterogeneous cases. On this basis, the priority challenges of a) urban regeneration, b) community building, and c) energy transition, and the above three cities have been selected for a comparative qualitative case study. Drawing on document- and website analyses, semi-structured interviews and a self-assessment scorecard, the attributes of transformative capacity have finally been reviewed for each of the challenges in all three cities. The findings illustrate that local policies and initiatives are at the forefront of building urban transformative capacity in South Korea, whereas national policy tends to exert constraining or counterproductive influences across domains. Community building stands out as a key driver for innovations in governance, polycentric leadership, empowerment and experimentation, partly influencing other domains. In turn, urban regeneration remains dominated by incumbent practices. While differences exist across challenges, Seoul appears to perform most effectively in terms of building transformative capacity. Overall, major common gaps turn out in terms of developing systems approaches and foresight, as well as related social learning processes. In conclusion, urban transformative capacity in South Korea is built up only recently and as a result of local agency, but still displays substantial deficits that hinder more radical systemic change. In this regard, community building could play a major role in enabling further capacity development also across domains. Therefore, cities offer valuable lessons for national policies in Korea that require substantive reorientation urgently, but also for peer-to-peer learning.

Keywords: Transformative capacity, Sustainability transition, Urban governance, Community building, Social learning

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Design Research: Contents, Characteristics and possible Contributions for a sustainable Society

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Abstract

Today we tend to take for granted that research within the field of product, industrial and environmental design can contribute to a sustainable development. The historic origin, traditions for and validity of this have yet not been subject to investigation. The aim of the paper is to throw light on the etymology and traditions of design research, its relation to and possible impact on a sustainable development.

The investigation is a literary review, re-reading and interpretation of documents written by a selection main contributors, with emphasis on the founding researchers.

Since its start during the Industrial Revolution, research in the field of design has been oriented towards sustainability. The theoretical and empirical foundation and according methods have developed in a way that supports this.

The conclusion is that the traditions of design research and its according theories and methods represent a valuable resource for the creation of a sustainable future.

Keywords: Design, Industrial design, Sustainable development, Cultural sustainability

1. Introduction

The work for a sustainable development that explicitly comprises not only physical, but also cultural matters, is a relatively new occupation. It has many “white spots” on the map of knowledge and understanding. This can only be improved by better cooperation between various professional fields. It requires information from a variety of subject areas, from the natural sciences to cultural, philosophical and practical fields, put together in order to create a broader picture of the problem and thereby a fruitful result. There is need for methodologies which exceed the traditional paradigm of academic research. This has paved the way for the incision of contributions from the creative and artistic fields, with their holistic views and complex paradigms of knowledge production (De Beukelar and Duxbury 2014). This fact makes knowledge in the field of design, which aim is to create environments for a better quality of life, of particular relevance. The birth of the designer profession has its origin in the Industrial Revolution, the event that started our own era’s problems of sustainability in all its dimensions. It has always been engaged with questions related to sustainability and the human environment and living conditions, thereby taking cultural matters into account.

Although basically a practical profession which goal is to create concrete objects and environments, with according research and development methods, the profession has always had a theoretical and methodological foundation, and a professional discourse. Thereby it fulfils the official definition of research (Norsk institutt for…2006). However, because of its practical and sometimes utopian approach, it exceeds the methods of traditional academic research. In this way it makes a valuable contribution in the matter of research for a sustainable development.

2. Methods

A literary review, re-reading and interpretation of documents written by a selection of main contributors.

3. Results

The traditions of design research and its according theories and methods represent a valuable resource for the creation of a sustainable future.

4. Discussion

Historic origin

The designer profession's concern with issues of sustainability has a long history. The birth of the profession and its emphasis on research was actually a consequence of the need to solve problems of this kind. It originated as a response to the Industrial Revolution in the 19th century, which was the starting point of today's environmental problems. The industrialization of the production methods and the following urbanization made it possible to produce in large quantities and at lower cost, thereby making them available for a larger part of the population. But it also caused low aesthetic standards on the goods produced. They were regarded as unskillful imitations of hand crafted products, made without cooperation with the potential users (Pevsner 1936). It also led to exploitation of natural resources, and overcrowded and highly polluted cities with poor living conditions for the lower classes, and the exploitation of natural resources. There was need for a new profession that could improve the standard of the products and contribute to a better life in harmonious surroundings fit for the emerging modern era. In order to find solutions to these problems the new profession had to be research based.

Most of the first generation of designers were idealists. Many of them were "utopianists". Increasingly from 1890, modernist artists and designers were committed to a holistic vision of of art and society, and so believed in the need for a beauty and morality to be fundamentally conjoined (Greenhalgh 2005). They wanted to create living areas shaped like idyllic villages or garden cities outside the big industrialised cities. They were often built on historic sources, some of them medieval. The homes should be spacious and decorated with beautiful objects. This should enable a harmonious life to take place (e.g. Morris 1890). Aesthetics was not regarded as an aim in itself, but as a means to create a meaningful life. The craftsman William Morris' movement from the polluted city of London to a nearby village and his erecting of a home and workshop built on medieval ideals is a good example of this.

The philosopher John Ruskin focused on another aspect of human conditions in the new era: the distance between the new industrial worker's individual relation to the production process. The work methods were efficient, but mechanical and repetitious. The stonemason's work on the cathedrals in medieval times, where each person's physical and individual encounter with the material were put forward as an ideal (Ruskin 1849). He put forward a seemingly outdated work method and pointed to the qualities attached to it that easily could be forgotten and had to be taken care of for the sake of a meaningful life. He was thereby displaying the necessity of cultural sustainability, as we would call it today.

The aim of contributing to a better human life by designing practical, meaningful, beautiful artefacts available at an affordable price (Pevsner 1936) was to become an ideology that has been a leading star for the profession, and developed through the centuries. During the 19th and first half of the 20th century it was believed that products designed to meet these standards would be what people would prefer to buy. It was also believed that such objects had optimal and ever-lasting qualities. This would lead to limitation of consumption, thereby supporting sustainability. The ideology had a flourishing period during Functionalism. It was particularly evident in the Nordic countries, when the leader of the Swedish Design Society was a leading figure, and his creation of the slogan "More beautiful objects for everyday use" (Paulsson 1919). During the post war period, when industrialization accelerated and consumer behavior proved to follow other paths, the ideology was challenged. As a profession working in cooperation with commercial enterprises with different aims and views, compromises often had to be made, and their ideas were sometimes overruled. Their work and the basis for product development has therefore also driven by economic interests which support unnecessary consummation, not quality of life (Baudrillard 1998,

Foster 2000). In spite of this, the ideology has survived and continuously had its followers. During our own era it has merged with the idea of sustainability and the according discourse.

Nature, i.e. its forms and organic life cycle, has always been a basic ideal for the designer profession. This is evident in the many theoretical works of the first designer generation of the late 19th century. These works constituted the theoretical basis for innovation, and some were based on systematic research. The most evident example is Owen Jones' seminal book "The Grammar of Ornament", published in 1956 (Jones 1856). By ways of investigations of plant forms he presented a set of "laws" for ornamental decoration. As a standard work in most design education for several generations its message has had a profound and lasting impact. In the 1990s, along with Postmodernism's interest in classical forms and ornaments, the book had a revival and was republished in 1986.

With its focus on aesthetics and research methods exceeding academic standards, design is strongly related to the field of art. The first professional designers were mostly artists who became engaged in the field. The main difference is that the intention of a practical function always forms part of a design process (Pevsner 1936, Heskett 2002). Fine art has traditionally been regarded as an activity that takes place with a critical distance to society and beyond or "above" social ad practical needs, thereby also refusing the use of academic standards (Heidegger 1935, Adorno 1970). From the period of Romanticism and onwards artists have refused to follow academic standards in their research, and developed their own traditions based on experimentation with aesthetic means. There has therefore always existed a tension between the two professions, despite its many similarities.

In the 20th century, the era of Modernism was dominated by the idea that a better life should be created by the integration of scientific methods taken from the technical sciences in the world of art and creativity. This constituted a basic notion in the idiom of functionalism. One of the many examples is the work of the architect Grete Schütte-Lyhotzky. In order to create an optimally functional kitchen at a minimum of space, she made measures of the housewife's steps and other movements, fetched from American scientific methods (Noever 1992). The unification of technology and art was a basic requirement for innovation during Walter Gropius' reign of the Bauhaus during its early years (Wolford 1984). A Nordic example is Aino and Alvar Aalto's development of a method of making birch plywood that enabled them to produce their famous chairs (Schildt 1984). This was a development of the design community's original ideology, and believed to have the same limiting effect on consumption.

From eco-design to design for cultural sustainability

The post war era with its accelerating industrialisation and consumption caused a new wave of concern about environmental problems. Some members of the designer community realized that the profession in many cases contributed to this by designing objects that stimulated increased and affluent consumption. One of the leading figures was the Austrian-American designer Victor Papanek. He argued that the designer should react against the role of being part of this development. Instead he should act as a facilitator for the creation of survival kits and products for basic needs. These products should be produced locally out of reused materials, mainly in and for the so-called Third World. At the same time they should be an ideal for a change of attitude and production in the Western world (Papanek 1971). Papanek won many supporters, particularly in the Nordic countries, which he visited frequently.

The general concern about ecological questions from the 1960s and onwards, followed by increasing academic research on the topic, created a correspondent debate in the design community. Several designers started to develop methodologies that aimed at meeting the challenge, and buzz words like "eco-design" and "green design" started to flourish. A more lasting and better underpinned approach was that of "cradle to cradle", which was based on principles found in nature's organic life cycle (McDonogh and Braungart 2002).

During this era the emphasis was put on physical environmental matters. The next stage of the discourse of sustainable development was a growing recognition of the significance of cultural matters and the importance of developing according methodologies. In spite of the designer

profession's tradition of focusing on human well-being this was realized relative slowly, both inside and outside the design community. This means that the designer ought to make use of methodological tools that could solve these kind of problems. One of the pioneers and leading theoreticians of a holistic approach is the Italian designer Ezio Manzini. He introduced the question of the designer's role in the creation of social sustainability (Michel 2007), and later and of human resilience in a troubled world characterised by cultural conflicts and increasing migration (Manzani 2014). At present there is a growing comprehension of the importance of ontological and aesthetical traditions as a main ingredient in everyday life, and a precondition for well-being. An important contributor to this is the Japanese-American designer and philosopher Yuriko Saito. Her ideal is the Japanese notion of an organic life cycle that comprises both nature and human beings, i.e. culture. She puts forward the use of aesthetic traditions in contemporary design objects, and their use in everyday life as basic requirements for human well-being (Saito 2007). Phenomenological approaches based on the philosophers Martin Heidegger and Edmund Husserl are also being developed (Wendt 2015). They all point to the fact that a sustainable development is dependent on both cultural and physical matters (Dessein et al. 2015).

Today there is a growing concern for solving the often acute social and environmental problems in urban areas all over the world. Therefore governmental authorities and international organisations have initiated large scale urban development projects. They are normally performed by city planners and scientific experts. But in some of them artists have engaged themselves of been engaged in separate sub projects where they affect and stimulate the citizens to make solutions based on their own cultural traditions and ways of life as well as artistic experimentation (Duxbury 2015, Kagan 2013). Designers have engaged themselves in similar projects. Many of them are related to the creation of sustainability and resilience in the Third World and areas that have been subject to environmental crises. One example is the Norwegian organization "Design without Borders" (Ramberg and Verdu-Isachsen 2012). In opposite to the artistic stance, the profession that does not claim to stand beyond society. At the contrary, they welcome cooperation with commercial enterprises. I this way they are able to be fully included in the projects and cooperate directly with the stakeholders.

A research paradigm in transition

In our own era, new knowledge and understanding in the field of design has been believed to be solely practice based, and mainly performed accordingly. In contrast to the academic disciplines, where the discourse is based on the written language, it has been performed as what might be characterized as a discourse of objects (Skjerven 2005). Innovation and alteration of products have been a kind of response or reaction to other products. It has therefore been called "the making disciplines" (Michl and Dunin-Woyseth 2001).

Accordingly, design has been defined as a "tacid knowledge", meaning a competence that is impossible to express through oral or written language (Polanyi 1966). Considered the many oral discussions and written technical documentation that forms part of the design process, this is a viewpoint that focuses on a significant characteristic of the activity, but fails to express the complexity of the activity and its discourse. In the recent years it has been little used in the discourse.

During the last four decades a certain rapprochement between the professional regimes of academic and practice based research has taken place. This is mainly due to three factors. Firstly, the many amalgamations of institutions of higher education that have taken place since the late 1980s has led to an academisation of design education and research. Secondly, the academic world has become less reluctant to alternative practice based approaches and have realised their values. Thirdly, and most importantly, the societal need for solving problems in a troubled world of increasing world of pollution, migration and cultural conflicts has made it urgent to come up with concrete results, whichever research field has been used.

In addition to the basic difference in aims and methods, the barrier between academic research and design is built on the former's traditional requirement of objectively and critical distance

between the researcher and the research object, i.e. between objectivity and subjectivity. As for research within the field of design, three different approaches have been identified: research on (e.g. design history), research in (trying out new materials etc.), which both may fulfil the requirements of objectivity, and the controversial "design through". The latter means that the designer makes use of own professional creativity at the same time as investigating a research question (Dixon 2002). One of the first to confront and define these stances and to argument for a reconciliation between subjectivity and objectivity, was Christopher Frayling (Frayling 1993/94). In our own era of late Post Modernism the belief of objectivity no longer exists, and has been replaced by the argument for the use of intersubjectivity (Dixon 2002). This has also led to a reconciliation between the two reigns.

5. Conclusions

Since its birth in the middle of the nineteenth century the designer profession has been research based. It has also been and dominated by a holistic view that combines human culture and the natural environment. From the start it has been focused on human culture and sustainability, both as a cultural and physical matter. It has comprised both theoretical and practical methods, and has undergone several stages, with shifting emphasis on the two. Our own era's belief that it has been mainly based on experience and a discourse through artefacts, with little use of written language, is a myth that has created unnecessary barriers to traditional academic research. Today's increasing demand for multi- and transdisciplinary approaches in order to attain cultural sustainability has made design research more recognized. A full realization of its potentialities needs a better understanding of this fact. Research within design in a multidisciplinary setting may become a decisive factor in the development of sustainability of both culture and the human environment.

In the perspective of the positive results of the enterprises where design research and development has been included, the future should look bright. The growing recognition of the advantages of cooperation between the various reigns of research should add to this. However, there still are some challenges that have to be met. In a situation of economic downturn and decreasing sales, competition is fierce and business enterprises are focused on making rapid profit without regard to future consequences. To some degree this is counterworked by the political authorities' increasing awareness of the global environmental situation and their according measurements in jurisdiction and international agreements. The growing consciousness and knowledge of the significance of the planning of a sustainable physical and mental environment to secure a meaningful life is also an important factor.

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The emerging in mega urban regions in Malasya: the new thinking managing urbanization transition

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Abstract

Malaysian urban areas are relatively young with the majority are less than 250 years old. These established towns, municipal areas and cities were founded by British colonial administration of the country about 200 years ago. Right up to the 1970-s these towns including port towns were described as mere sleepy hollows by urban observers. Colonial capital was the mainstay for the rich tin exploitation and later rubber plantations. Towns and port towns along the coast of the Peninsula became the centres of administrative command and control for safety, security, basic services and commercial ventures to serve mainly the colonial interest and the migrant population from China and India. Although becoming islands of modernity with some market openings for modern jobs these towns were separated from the rural areas, where the majority of the local people live. The Independence in 1957 for Peninsular Malaysia and the formation of Malaysia in 1963, adding Sarawak and Sabah state to the Federation of Malaysia, started the transition in urban development in the country. The development policy with the state taking an active role in development, known as the developmental state paradigm, broadens the colonial capital base to attract capitals from other economic regions in the globalization process of production. Using data mainly from the government agencies such as the Population Census, we can trace the transformation of towns to become what they are today. Beginning with import substitution industries established urban areas grew and expanded along new roads and new highways to merge with other small towns, engulfing rural areas in the fringes in the process. With increasing attractions to rural migrants and urban fertility population of towns expanded. Soon social infrastructures grew-schools, universities, hospitals so on along with new housing neighbourhoods, commercial centres, extending the urban area further outwards. Some of these conurbations have grown so large to merit the name mega urban regions. The largest among them is the Kuala Lumpur mega urban region, being the commercial high end and services to its administrative core in Putrajaya. Being the centre of the national administration, the Kuala Lumpur mega urban region has become the home for educational, health, high end shopping area, Islamic finance and services in the region. Overlapping drivers have in the last decade transformed most of the towns founded by the colonial capital. Some, notably Kuala Lumpur has achieved the vibrancy of a mega urban region for the country and the region. Thus, in the path towards a developed country in 2020 the Malaysian urban centres continue to be the centres of growth and home to about 72 % of Malaysians in 2010. If we relax the authority defined 'urban' to include the huge development schemes with all the modern trappings the total Malaysians in urban areas are best described as almost fully urban. These are challenges to which the policy response emphasising moderation offers a critical transition in managing the urbanisation spread in the country in which urban physical spread should be blended with clear humanism that benefits the urbanising Malaysian.
Keywords: Urban transformation, managing transition, urban livability, urban prosperity, Kuala Lumpur, Malaysia

INTRODUCTION

This paper is set within the context of critical transitions in the history of urbanization in the country. It argues that external drivers working with 'local' capitals promote the rise of towns and cities at first, then expansion of cities and lately the rise of mega-urban region. Throughout the period town and city growth shows also transitions in the rise of modernity for the urban peoples whose experience began with rural self sufficient agricultural activities to the present metropolitan lifestyles. Cities become the

windows to global linkages and interdependence; No one city can survive on its own, and thus each city commands huge carbon footprints.

Cities in the country are centers of economic growth and social development; town and city growth then is beneficial to the country. But the benefits become problematic when growth takes place with mal-redistribution. Although the Malaysian policy makers (Malaysia 1966 to 1986) had constantly made balanced development as its priority since Independence (1957) class bias (Jomo 1986) in the redistribution process often times emerges to complicate the attempt to raise the overall quality of life of Malaysians. Since the 1990-s when the concept of sustainable development has begun to embed all development initiatives in countries around the world (WCED 1987) Malaysians too have to undertake development initiatives guided by the sustainable development concept, and were made aware of the need to protect the environment and natural capital. For the city habitat a more ethical life style and consumption is called for to ensure the survival of the environment and hence the planet. Our cities today are not free from blames following increasing city environmental degradation. The concept of urbanisation transition since 1881 in Malaysia is summarised in Figure 1.

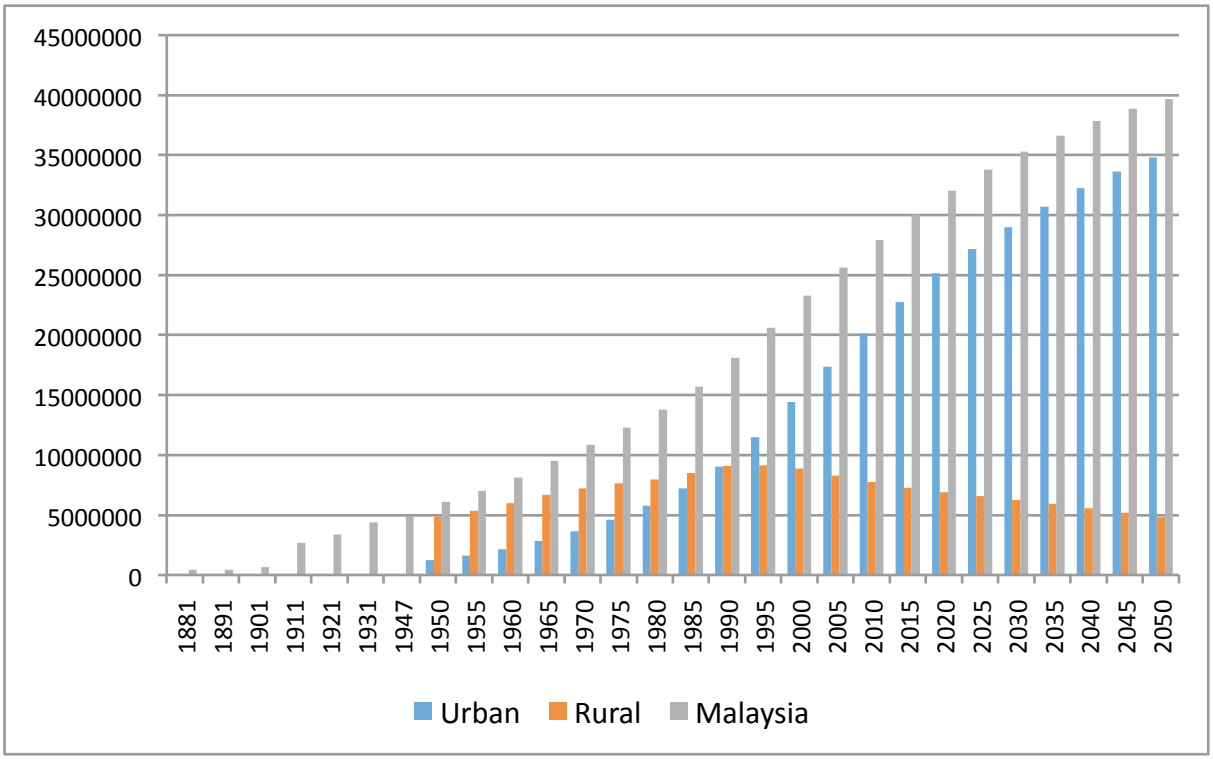

Figure 1. Figure the Urbanisation process in Malaysia 1891 - 1950

THE PERSPECTIVE AND DATA

The paper adopts an historical perspective to allow for the identification of the transitions in the urbanisation process (McGee 2009; McGee and Shaharudin 2016). Concept related to the urbanisation are obtain from the literature, and data as a basic historical journey for urbanist are drawn from the various population census conducted regularly, government refer to the economic situation, seeking progress and also challenges posed by the spatial urbanisation changes (Malaysia 1970; Malaysia 1980; Malaysia 1991; Malaysia 2000; Malaysia 2010).

THE SPATIALITY OF MALAYSIAN URBANIZATION IN HISTORY

The historical narrative to follow is organised in a framework shown in Figure 2. Overall, the critical urbanization transition in Malaysia is examined here focusing mainly on its spatiality over time with comments on life of the urban people as well the health of the environment. The paper proposes a three phase's framework to account for the urbanization transition in Malaysia. These phases are the

nascent urbanization, the phase of pseudo-urbanization and the phase of rising mega-urban regions.

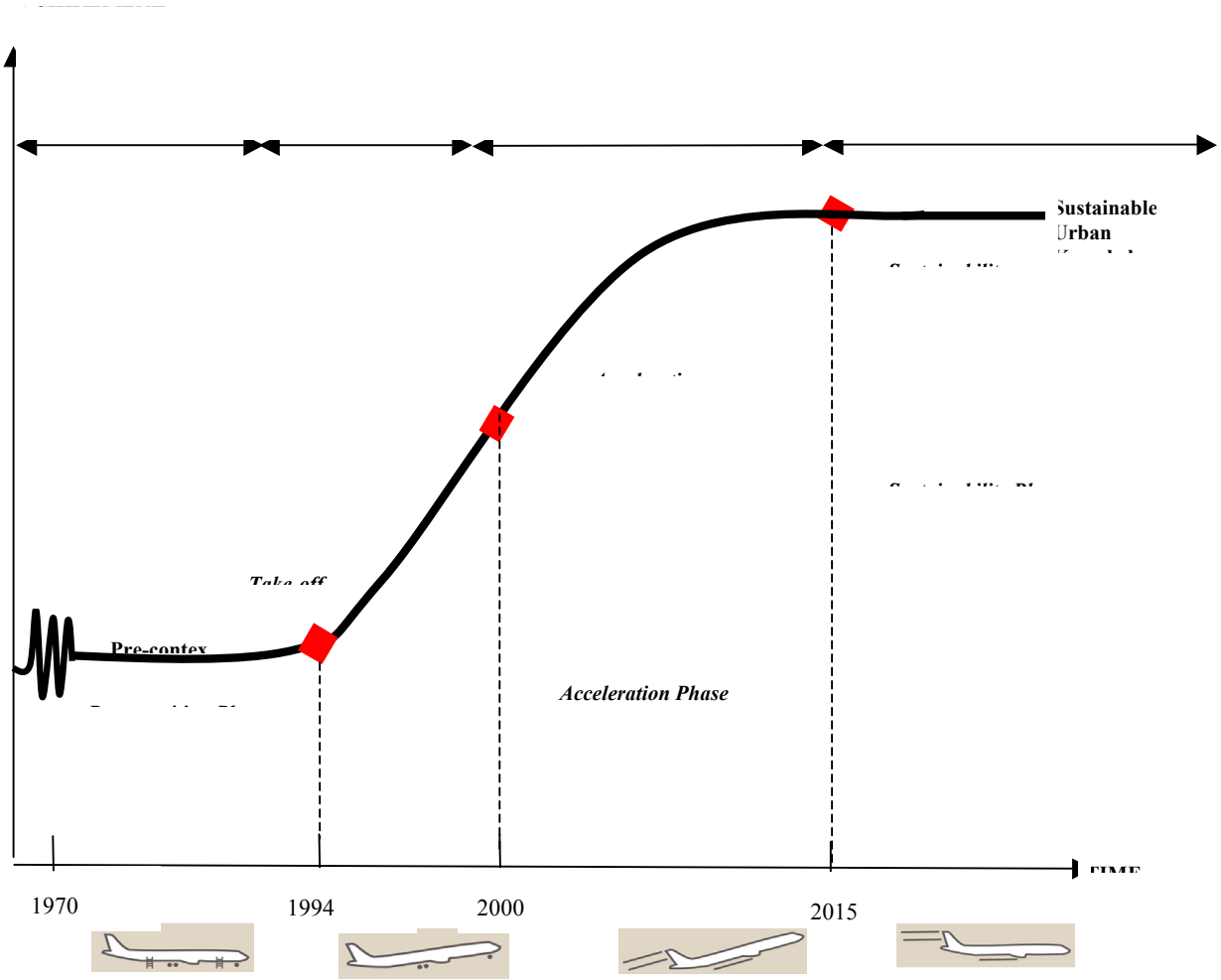

Figure 2: Paradigm of Sustainability Urban Transition

Source: Modifies from Rotmans 1994; Nevens et al 2013

Phase One: Nascent Urbanization

Urban centers and towns in today's Malaysia are the outcome of British administrative hegemony for over 200 years, encompassing parts of the period of western colonial era in the country. The age of Malay Sultanate centering on Melaka crumbled down under the siege of an earlier colonial western power- the Portuguese in 1511; later the Dutch contested and replaced the Portuguese until the 18th century when the British and the Dutch agreed to delineate their suzerainty- the Dutch in what is now named as Indonesia and the British covering Peninsular Malaysia, Sarawak and Sabah.

Malaysian urbanization involving the local populations - the Malays and all the Bumiputra population of the Peninsula, Sabah and Sarawak has a short history. Albeit the rise of the Malaccan empire around the 14th century dominating the life of people in most parts of the Malaysian Peninsula, towns

and cities of the country today are the creation of British intervention and administration of the country from about the 18th century and peopled mainly in the initial years by Chinese and Indian workers. Port towns were founded on Penang Island, Singapore and Labuan in Sabah by the British East India Company. The port towns were later taken over as the British crown colonies. On the Peninsula the port towns and Malacca were joined together forming the Strait Settlements in 1824. British intervention after that in the affairs of the Malay States secured British capitals to mine tin and gold at first with workers from Southern China mainly. The Chinese in the mines soon invested also in tin mining from accumulation of capitals while working in the mines and from merchants in the more established port towns of Penang, Malacca and Singapore (Khoo Kay Kim 1972; Gullick 2003). Soon townships grew. The founding of Lukut town on the coast of Negri Sembilan offered insights into the beginning of a township. Khoo Kay Kim (1972) related that Chinese miners in the Lukut tin mines established two rows of shop houses to serve the increasing Chinese population. The township grew with the expanding tin output. Lukut provided the story line that was seen in most of the modern cities in the country. British companies explored also the agricultural potentials with attention to tapioca, coffee and spices in some states at first. But rubber offered the best prospect since the industrial revolution in the West opened a good demand for rubber. Thousands of hectares of virgin equatorial rain forest were converted to rubber growing.

Both tin and rubber became the economic mainstay of the British administration. Towns were founded as administrative centers offering safety, and law and order such that tin and rubber could be produced without disturbances. Towns were founded in the interior Malay states. By the 1921 Population Census of Malaya (Nathan 1922) a hierarchy of towns were already functioning in the Peninsula (Lim Heng Kow 1978). Initial townships were established by the Brook family in Sarawak while an almost similar urban founding storyline of the Peninsula took place in Sabah.

Who were the urban dwellers? The majority were Chinese migrant workers, and Indian support staff especially in the Public Work Department. Some of course worked in the British administrative offices. Where were the local Malays and the Pribumi? The 1921 census indicated that about 30 percent of the Malays were also recorded as urban dwellers in the towns of the Federated Malay States working largely in marginal urban jobs, albeit among the more educated were in the administrative services as lower ranking staff (discounting of course the few high ranking local officers from high birth). On the commercial section, the domination of the Chinese migrants was almost absolute. The story of Lukut supports this observation again. The Chinese migrants started retail and services functions for the Chinese workers but the local Malays soon were drawn to the towns to fill up laboring works. The more enterprising villagers nearby began to grow and sell village produce. But the growing Lukut township had one observable long term impact- rice production had declined as the able bodied villagers circulated and worked in salaried jobs in the township (Khoo Kay Kim 1972).

If we can project the storyline of Lukut to the rest of the country then, the country's modern townships at the founding stage were alien to the very conception of modern habitat to the local population. Spatially then, the country's rural landscape had started to change- from rural self sufficient lifestyle, often times referred to by the British administrators as being leisurely and lazy in contrast to the hard working miners and rubber producers and those in the commercial areas. The actual townships used up a tiny proportion of the total area of the country but taking the commercial agricultural areas together with the mining areas- whose activities were actually urban in nature, a large area of the country had been transformed to become urban. Commercial attraction had also transformed rural villagers' preoccupation with self sufficient activities towards taking up commercial production for trade. Gullick (1951) observed in his study that in the 1890-s bullock carts of produce were seen traveling from Jelebu distrcts to market the people's produce in Seremban town.

Thus, the above observation it is clear that the spatial land use change is more than just a transition. We would like to propose that in the nascent urban development the local people had witnessed a dramatic transition- a critical one that demands them to change from the sleepy village lifestyle to the stage of being involved in producing goods for international trade. From the founding years, these urban centers grew but at a slow rate. Except for certain cities with strategic importance such as Penang - a port in the north, Kuala Lumpur as the capital of the Federated Malay States at first and in

1948 as the capital city for the Federation of Malaya and in 1963 as the capital city for Malaysia, and Johor Bahru, albeit overshadowed by Singapore at first but after Singapore left Malaysia in 1963, bloomed, while the rest of the towns grew slowly due mainly to limited economic activities. As such city growth relied mainly on urban fertility complemented by international migration from South China and India and a small percentage of rural to urban migration. Indeed these towns were the sleepy hollows reflecting the nature of the national economy that was vibrant but all export activities tended to by-pass these urban centers. By the end of the Second World War the urban landscape had become widespread throughout the country. Physically, rural areas were separated from the towns by distinct administrative boundary and physical differences.

Phase Two: Pseudo- Urbanization

The pseudo- urbanization phase was more on the internal involution of the larger towns in which the urban market failed to absorb the (over) supply of able bodied rural workers released from over populated rural self sufficient economy all over the country at the end of the second world war. Having limited education and skills to sell in modern sectors of the urban economy these local rural to urban migrants seized any opportunities available in the modern urban sectors but mostly in the lower category jobs such as gardeners, sweepers, and general laboring work at first. A more educated group with some skills in the 1960-s could command lower ends of the white collar works. Overall, with small pay these migrants moved to existing kampungs in the townships' periphery, kampungs in the towns and available squatter settlements. Poverty was rampant and each urban dweller would fight his way in the towns to survive. McGee (1971) summarized the whole scene as a process of pseudo-urbanization; an urbanization process that should theoretically have brought the promised prosperity to the migrants but ended up in the poverty syndrome of city life.

Life was hard for the ordinary migrant families. Heads of household might have to do more than one job to meet sustain basic family needs. Between 1948 till the middle 1970-s the pseudo- urbanization process persisted. The social problems associated with urban poverty is well documented in studies of major squatter settlements around the world in the 1950-s-1960-s describing the sad state of life in such place as the favelas of Rio de Janeiro (Perlman 1976), Hugo (1978) and McGee (1967) in Southeast Asia. There is no necessity for us to repeat the story here. But we need to remind ourselves that the squatter settlements in places like Kuala Lumpur might not reach the dimensions experienced by Jakarta or Bangkok in those days but life condition in those squatter settlements reproduced itself in Malaysia. Massive land development to resettle rural poor without land at the beginning of the 1950-s in what has become well known to day as resettlement into FELDA (Raja Muhammad Alias 2009) partly explained for the smaller squatter settlements in the country. In addition the smaller population of the country then (around 6 million in the 1950-s) contributed to the controlled size of squatters. Improving the education level of Malaysians after Independence helped improved access to better jobs for these migrants in the city, and future migrants could look forward to better lives in the new habitat.

The urban centers as a whole had increased in areas albeit slowly by the 1960-s (Hamzah Sendut 1962a; 1962b). Given that most towns were still embracing the sleepy hollow syndrome towns did not create the necessary growth to expand the labor market in line with the increasing urban population concentration in towns and cities. Slow expanding town population along with limited new housing development did not warrant quick adjustments to township boundary, although state capitals such as Seremban and Kuala Lumpur had gone through administrative boundary adjustments over those years. Social imbalances were noticeable across the urban social and spatial domains; Social imbalances in the city expressed themselves clearly in the political economy of the whole country.

To the extent that the pseudo-urbanization phase had produced clearer social imbalances across the town areas the country can be said to have moved into an urbanization transition from the nascent to the pseudo phase. Whether the change in the urbanization experience is a critical 'transition' is debatable. Urban development across space and through time had brought more people into city life and exposed them to modernity, albeit many from the local migrant population remained marginal to the total city life. Compared to the founding Chinese and Indian urban population these local people were not completely immersed in the city life in terms of commercial involvement, modern

trading and high end services. But more of the local population was making their way into city life, slowly but surely to tame the modern city way of life. The pseudo urbanization in this case was also a critical transition for the local people. It is true also for the 'original' urban people (the Chinese and Indians urban dwellers) they had to make adjustments to the increasing numbers of local rural to urban migrants into their midst.

Phase Three: The Rise of the Mega Urban Region Phase

We would suggest that the period during which the mega urban region phase rose began in the New Economic Policy (NEP) era-1970-1990. Failures of past balanced development policy of the 1950-1969 to bring out the necessary socio-economic equity had plunged the country into acute social imbalances that cut across ethnic and regional scales. The country's wealth was largely in foreign hands, albeit mainly British leaving the local people with a marginal amount while the Chinese and the Indians with relatively substantive holdings (Puthucheary 1960). Initiatives to overcome the existing acute social and spatial imbalances under the NEP were centered on the cities through industrialism. Cities then became the promised centers of modernization which could transform the country into the first world status by 2020. Wealth creation in cities with ethical redistribution across ethnic and spatial domain could have leveraged on the rise of true multi-ethnic and unified Malaysia in which the Malays along with the other indigenous populations were able to hold on to a respectable amount of the country's wealth and hence would help solved the nagging social equity problems in the multi-ethnic relations of Malaysia before that.

The NEP had attracted manufacturing industries for export the policy had been successful in expanding wealth to pay for the necessary social developments, and consequently in bringing social and spatial impacts on the urbanization of the country. By this time the Malaysian urbanization experience has progressed pattern in the past to for a more challenging large urban regions with rising socio-political and environmental problems. Today the country has several large urban regions. The three large urban regions began with urban conurbations whereby small urban centers, small towns, municipalities and cities expanded outwards of their original boundaries to merge into each other forming a large agglomeration of urban centers. The three are the Klang valley urban conurbation stretching from eastern Kuala Lumpur- the national capital, to Port Klang covering about 50 kilometers of continual urban land use from the main mountain range to the west coast. The second large urban conurbation is the line of urban areas stretching from Penang Island across to Prai and then stretching to Kulim industrial area in Kedah, and the third conurbation is the Johor Baru - Pasir Gudang urbanization surface. Over those years much smaller urban conurbations had grown centering on each state capital to new industrial estates covering in some cases more than 20 kilometers from the center of the state capital. To these urban conurbations labor from poorer rural areas had moved in searching for opportunities. Now that the NEP had provided more opportunities for self improvements among the Malaysian society these rural-to-urban migrants of the day had better skills than their predecessors under the pseudo urbanization phase to participate more meaningfully in the urban economy. In so doing their commitment to the city was more total since they now had better stake in the city life. They had assets in the form of houses, permanent paid jobs and better access to physical and social facilities in these large urban agglomerations. For the future more large urban conurbations are in the making. The development corridor initiatives announced by the Malaysian government in recent years-such as the Northern corridor, the Eastern corridor and the corridor in Sarawak – will promote the growth of more urban conurbations in the coming decades. Hopefully, city life in these corridors will be more sustainable since the economic drivers of these corridors are having activities of high productivity

CHALLENGES OF THE MALAYSIAN URBANISATION TRANSITION

The Malaysian urbanisation has to face up to numerous challenges, accumulating partly from the time-space squeeze from the time of founding, growing, expanding capital city and partly by the robust expanding urban complexes in response to the globalization of finance and industries in Malaysia and all over East Asia in the last twenty years since 1970.

The challenges may grafted into 10 dimensions of challenges; two associated with the environment,

two with social sustainability, two with economic sustainability, two spatial with governing requirement and institutional need as the core.

Environmentally the urban areas has to pay attention to both the natural resources and the built environment. Both are intertwined. Expanding urban areas means more lands will be converted for housing, infrastructures, more minerals especially sands will be extracted for continuing building construction. More water supply and energy have to be made available to meet the increasing domestic, commercial and industrial consumption. In the built up environment more needs to be done to control the carbon foot prints through more greening landscape, green buildings, green infrastructures and carbon emission control including wastes from food base to chemical. As the country progresses economically and socially the invisible chemical dangers is everywhere threatening the health of the people and the ecosystems.

Moving next to the economic sustainability challenges, one dimension is to promote sustainability in economic vibrancy to meet the increase in demands for work among the youth. The second dimension in the economic sustainability should pay attention also to the small and medium production industries, including those small scale agricultural producers in the urban region outside the built up area, that currently involve a growing number of entrepreneurs; Their role is important in increasing the vibrancy of the industry and also in helping to increase the range of export products from Malaysia, and consequently providing more jobs being a trading nation the Malaysian economy is open to uncertainties.

On the social dimension, one direction centres on the social infrastructures and the other on the inter-ethnic relations and the nagging issue of inclusivity that has troubled Malaysia in its quest for a truly multi-ethnic society living in harmony. With respect to the social infrastructures, there is a need for sufficient affordable housings, efficient services in health care which is getting expensive, access to education from the kindergarten to the institutions of higher learning, training institutes and centres to give a second chance to the school drop outs, and recreation and sports centres. On the challenges of the inter-ethnic issue, it is more difficult to handle because it leverages on many sensitivities related to religions, cultural norms, and habits. The concept of social inclusivity is useful and it has to be implemented with care. But to date the Malaysians have not gone on killing spree on streets and in open spaces. However, at issue is that all Malaysians need to embrace the culture of living in harmony to forge the country ahead in the global spaces.

Beyond the ten dimensions, there is a need to look to the future of the urban areas. First, it is about producing the quality of life commensurate with the region's leading position in the Malaysian urban landscape. This falls within the broader concept of city liveability; Second, it concerns with a search for a new way to come to grip with complex situations in the region, involving social and environmental interactions at the local level-the individuals, families and communities' in every day decision makings that have produced the temporal and spatial growth patterns within the mega urban region in the past. The attempt to understand the processes, physical and social, falls under the study of city complexity (Allen 1996; Batty 2005).

MANAGING THE CRITICAL URBANISATION TRANSITION

Seeing that the urbanization experience of Malaysia has been compressed in both time and space and that the critical transition is somewhat recent an out of the box thinking is called for to formulate urbanization solutions that we regard as appropriate for the people of the country to be increasingly urbanized as more people now living in urban areas as defined by the authority. In generic term the urban areas everywhere is similar in function and in showcasing modernity. Cities, towns and urban areas of the developed world show wide ranging complexity. The fact that Malaysian urbanization taking place in an overall development that is still actively developing showcases also the complexity associated with modern living in high density areas. However, the age of urbanization in the country is still young warrants the urbanization in Malaysia to be looked at differently, relevant to the social condition of Malaysia.

Being in a relatively small country but with a multi-racial and multi-ethnic population with a differing level of socio-economic achievements there is a need to approach the whole urbanization

transition problems and solutions from the conceptual frame of pursuing a style of living in what the Malaysian government term as lifestyle of moderation (Abdul Samad et al 2011). The concept entails moderation in the conduct of life including consumption but putting in 'hard work' ethics to achieve a high income country by the 2020, in order Malaysia can be with the group of developed countries of the world. There is an urgent need therefore to manage the urbanization transition that has turned the country into a highly urbanized country at present.

Local researchers have given close attention to aspects of the sustainable city concept with emphasis on the livable city idea but with local relevance. By way of illustration the main components of the livable city (Abdul Samad et al 2008) are in the main similar to the nature of livable city of the developed countries; the urban population should have their own shelter, affordable at that, modern jobs to go to every day, access to social infrastructures such schools for the children, a hierarchy of shopping areas for their needs appropriate to their levels of disposable income, good transport infrastructures and affordable modes to choose for everyday needs and holidays. By and large Malaysian urban centres have put in place most of the basic urban infrastructures, and more updating would be done in future as the needs arise.

Beyond the physical infrastructures and amenities are the necessary human values that will sustain the physical infrastructures. Through a close working of the authority, the people of urban areas at large and the local communities in the urban areas thus far has brought encouraging results in the realm of maintaining local safety through the local communities voluntary policing their housing areas, maintaining cleanliness of the housing environment to avoid the breeding of mosquitoes for example, promoting closer interactions among the members of the communities and other pursuits, all to promote the idea of being together.

Seeking and shaping a much deeper sense of human values on the physical infrastructures should relate humane and considerate use of them. Another example can illustrate this, by looking at the way people use the good city roads in their going about in the cities. The people should maintain the good condition of their city roads, repairing minor problems such as removing any wastes being inadvertently thrown out of car windows by less caring road users. More importantly drivers should drive with principles, polite to other users. What is being pursued is to educate through public demonstration of good behavior by the elderly to inculcate personal discipline, good behavior and considerations for young people.

Nurturing the human values through the framework of pursuing a living style of moderation is able to bring together people in urban communities to come together without the feeling of being marginalized because of socio-economic differences, differing housing types-banglo type, semi-banglo , terrace double storey and teraace single storey houses, a mixture so common in housing areas in Malaysian be it in towns, cities or urban areas. Together the local communities are able to share responsibilities to look after their housing area and their cities or towns or urban areas.

CONCLUDING REMARKS

The paper has shown that Malaysia is undergoing a fast urbanizing process since the founding of mining and administrative urban areas in the 19th century. Industrialism and associated social infrastructural developments have contributed to the critical transition in urbanization experience. The modern productive drivers have spread urbanization surfaces all over the country, albeit some states have seen faster urbanization faster than others, producing conurbations, agglomerations and lately mega-urban regions with population size that is much smaller compared to the mega-urban regions of Southeast Asia.

In relative term, the cities, towns and urban areas in Malaysia are showing the economic and social vibrancy. They will continue to attract people, internally from the rural and small urban areas to stay, visitors and shoppers to use the facilities. Seeing that more people are coming to the cities and urban areas a concerted effort is being mobilized by the authority through policy prescriptions to bring together people from walks of life to share the responsibility to make all sizes of urban areas livable. Not only the physical infrastructures are to be looked after in a sustainable manner but the people too, urbanites especially to showcase good universal values to support move for livable urban living.

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Planning for sustainable cities: application of walkability analysis and results to urban planning. Lisbon case study

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Abstract

Sustainable cities need to address sustainable land uses and sustainable mobility. Planning a city where it is desired for active transportation to play a major role implies appropriate land use planning. The aim of this paper is to propose a model of transferring walkability analysis into municipal level policy making and urban planning, providing objective data to support decision making. Walking is the most elementary way of moving around and accessing services and functions, either on its own or as a part of a more complex travel journey. When addressing urban sustainability, a walking friendly environment plays a major/central role, given its social, economic and environmental benefits. Today's cities, however, are enduring increasing urbanization processes that result in urban sprawl and car oriented land use patterns. Looking at urban planning practice, many countries have established master plan regulations that by the means of objective parameters can control the development boundaries, densities and diversity of uses in order to contain urban expansion and optimize the location of activities. Within the Portuguese context, master planning procedures have not been able to provide such objective inputs for decision making, these being discretionary to a certain degree when approving the location of housing, economic activities and community services. The result, as expected, is an environment where origins and destinations are often too far apart to walk to. There are various tools available that can assess the walkability conditions of the existing and proposed urban form and use, being now the challenge to transfer walkability analysis' outputs to urban planning practice, crystallizing walking as a central position for urban development. The IAAPE walkability assessment framework, developed by a research team from the university of Lisbon, allows both street and neighborhood level analysis, suitable for master and detail plan analysis. At the master plan level, the walkability assessment framework is used to analyse the urban neighborhoods and their main connection links to the surrounding areas. The framework's GIS processing features are used to identify suitable or unsuitable activity locations as well as urban form parameters, controlling the intensity of urban growth. Results allow verifying objectively how does a planning proposal contributes to the general area's walkability, thus encouraging/promoting active transportation, namely walking. Results suggest that a set of tools for walkability assessment can support the planning process for more sustainable cities, in creating pedestrian friendly environments at different scales.

Keywords: Walkability, master plan, active transportation, transport policy, healthy cities

Challenges in developing a sustainable city in a post-conflict context: the case study of Dili, Timor-Leste

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Abstract

As the onset of conflict continues to rise around the world, with cities becoming a battleground for both domestic and international aggression, there is an increasing need to delve into the challenges of sustainable development and recovery of conflict-stricken urban areas as they invest in rebuilding in the post-conflict context. In this context of altered priorities and severe humanitarian needs, the new environment and reality that communities and local governments find themselves in becomes a permissive one and one that furthers vulnerability on several fronts. This paper will analyse the case study of Dili, Timor-Leste, reviewing the history of its development over the past five centuries, from colonial occupation to its most recent growth surges, looking at how growth, expansion and development have occurred without an effective planning tool. It will explore how urban development in Dili has constantly faced obstacles through conflict and external imposition of standards, norms and procedures, be it from colonial or authoritative power or through haphazard development as a result of internal conflict and consequent population displacement, a lack of a regulatory framework, or as a consequence of external agendas of interest. The paper will further discuss how the city has developed without order, without strategy and without adequate follow-up of infrastructure, planning tools and living conditions, with large population growth rates and subsequent levels of dependency, all of which reinforcing the vulnerability of the urban population and the unsustainability of the city as a living space. As a result of this analysis, key challenges for sustainable planning and management of the city will be identified, whilst considering also the future development and expansion of this urban area and the need to build on national development efforts. These will likely include factors such as a lack of a regulatory framework, lack of institutional coordination and capacity for local development planning, population growth, continued population movement to the city and subsequent increase in levels of dependency, as well as increased vulnerability of the city and its population. The findings of this paper are the result of an analysis of secondary data from the Portuguese Historical Archive, namely planning documents and reports from the Portuguese colonial period, as well as documents from relevant government institutions and different entities that have intervened in the planning sector in Dili since the reestablishment of independence, such as UN-Habitat. The Urban Master Plan for Dili, commissioned by the Government of Timor-Leste in 2005, and imagery of the recent expansion of the city are also analysed to further the understanding of the development of the city, namely after its most recent conflict episode in 2006 that changed the shape of the city.

Keywords: post-conflict cities; unsustainable urban development; vulnerability; Dili;

Sustainable and resilient practices in informal settlement upgrading through social innovation approaches – the role of NGOs in Brazil and Guinea-Bissau

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Abstract

In the global South, as the urbanization phenomenon thrives and cities grow, the informal settlements grow exponentially and poses old and new challenges. Notwithstanding alternative solutions proposed by practitioners and backed by research and literature, massive housing programs tend to dominate the political agenda regarding both adequate housing shortage and response to urban disasters. Going against this trend of mass-orientation in the supply and recovery of housing stock, local NGOs have been prioritizing the work within the local communities. To illustrate these alternative approaches, question the role played by local NGOs, and ultimately influence urban and housing policy, three case studies were selected. In São Paulo, with start in 2005, the local NGO RedeInteracção, a representative of Slum Dwellers International (SDI) assisted for the relocation 584 families living one of the many favelas of Osasco, a satellite city of SP. In Rio de Janeiro, since 2009, the NGO *Soluções Urbanas* (Urban Solutions) have been assisting about 400 families providing them social housing services through the project *Arquitecto de família* (Architect of the Family). In 2015, in Bissau, the capital city of Guinea, an interdisciplinary team of the Portuguese- based NGO Building Humanity, worked within the community of Plack 1 to support the construction of the new facilities for a school, while raising awareness of urban disasters issues. The goal of this research is to understand the role played by NGOs in building and incremental housing processes placed in different geographical and social contexts, focusing, in particular, on livelihoods and social sustainability issues. From a comparative analysis it becomes clear how local NGO's, by incorporating social innovation tools, -such as community building, experiential learning, gender issues, disaster risk reduction measures and mapping- can highlight alternative methods and solutions to upgrading informal settlement upgrading and building community resilience

Key words: *informal settlements, slum upgrading, incremental housing, community-design, NGOs*

1. Introduction

In the global South, as the urbanization phenomenon thrives and cities grow, the informal settlements grow exponentially and poses old and new challenges. Notwithstanding alternative solutions proposed by practitioners and backed by research and literature, massive housing programs tend to dominate the political agenda regarding both adequate housing shortage and response to urban disasters. Going against this trend of mass-orientation in the supply and recovery of housing stock, local NGOs have been prioritizing the work within the local communities. In same cases they aid families along individual processes of self-help building

and incremental housing (George and Goether, 2008); or, they provide assistance in community-building regarding housing and disaster resilience (Tauber, 2015); or, finally, by looking at the needs of schools, health centres and risk prevention. To illustrate these alternative approaches, question the role played by local NGOs, and ultimately influence urban and housing policy, three case studies were selected.

In São Paulo (SP), with start in 2005, the local NGO RedeInteracção, a representative of Slum Dwellers International (SDI) and follower of their methods of community-building (Mitlin and Patel, 2010) assisted for the relocation of 584 families living in Portais, one of the many favelas of Osasco, a satellite city of SP. The process has begun with an illegal occupation of the land and building of shacks in 2000. Five years later the local community carried out a self-census, community-savings and a formal claiming for adequate affordable housing (Bose, 2013) . Since 2010, thanks to governmental funds more that 400 families have been gradually relocated by the municipality in new houses situated in a new urban setting but in some location.

In Rio de Janeiro, since 2009, the NGO *Soluções Urbanas* (Urban Solutions) have been assisting about four hundred families providing them housing services through the project *Arquitecto de família* (Architect of the Family), which assigns an architect to a particular family, in a similar away that a doctor is assigned patients. Treating architecture as a basic service to be provided for free to low-income families, the work of the architect consists of doing specific house renovation of an incremental nature. The NGO also supports the householders in micro-credit, shared economy, and empowerment in building techniques (Martini, 2016).

In 2015, in Bissau, the capital city of Guinea, witin the context of the construction of a new school, an interdisciplinary team of the Portuguese- based NGO Building Humanity field-work comprised different workshops with students, meetings with teachers, parents, community representatives; interviews with key-community-actors; audiences with national authorities; architectural and social surveys. All activities meant to support the construction, based on local resources, of the new facilities for the school of Santa Clara, while raising awareness of urban disasters issues.

Maybe given the rise of the poverty in peripheral areas of the fastest-growing cities in the developing countries (Davis, 2006) in recent times, a significant amount of research has been done on the informal settlements (Davis, D. 2014). In Brazil, the slums, locally called *favelas*, has been the focus of on field-based research that join academics, architects, humanitarians and the communities, focusing on housing inequality and community efforts to improve living conditions (Doherty 2011; Jauregui, 2003; Lara, 2012; Magalhães, 2012; Pearlman, 2010) The goal of this research is to understand the role played by NGOs in building and incremental housing processes placed in different geographical and social contexts, focusing, in particular, on livelihoods and social sustainability issues (Sanderson, 2009; Zetter and Watson, 2006). The common thread among the NGOs taken as case studies is the *social innovation* approach (Martins, 2015) and the community participatory design methods (Hamdi, 2006) to work within informal settlement communities The three examples selected present patterns, achievements, and failures in this approach. From a comparative analysis it becomes clear how local NGO's, by incorporating social innovation tools, -such as community building, experiential learning, gender issues, disaster risk reduction measures and mapping- can highlight alternative methods and solutions to upgrading informal settlement upgrading and building community resilience (Lizarralde, 2010).

2. Methods

In general terms, the research adopts a multiple-case study, following an architectural but also interdisciplinary viewpoint that allows for putting in perspective the different process and outcomes of each example (Groat et al, 2002).

Although keeping the social approach to sustainability issues related to the building and rebuilding processes, given the different access to the information, various strategies and actions were considered for each case study. In the example of Portais dos Campos, Osasco, five key informants were selected with the support of the chief representatives of the NGO RedeInteracções. The selection included a community leader, an NGO technician, a former NGO leader, a local social service technician and a municipal architect. Through semi-structured interviews, these informants were asked about the whole process and their personal participation (see Table I, in Appendices). They were invited to speak on their own behalf and based on their own direct experience. These requirements made each interview a valuable and unique testimony on the different roles played by the stakeholders throughout the three stages of the process: during the starting period of organization of the community when still inhabiting the precarious settlement (2004-2009), during the phase of demolition of the shacks and construction of the new houses when families were spread over the city benefiting from governmental subsidy to pay the rent (2009-2012) and finally after the relocation to the new neighbourhood (2012-2016). The interviewees also gave precious information about the main issues present throughout the process, which allowed for the construction of a smaller questionnaire focusing on social sustainability topics that were later applied to the community members (see Table II, in Appendices).

The new questionnaire was present to the community again under the form of semi-structured interviews to a sample of ten householders selected on a random basis, with the support of one of the community leaders, searching for some diversity among people who had returned home at the end of the working day during the three days of fieldwork. The selection includes families with a very different constitution: with a significant and small number of members, many children, few children, with one single parent (mother or father), married and divorced people, young adults, middle age and seniors, people that were there from the very beginning and lived in the original favela, and others that moved over in later stages.

Although the sample is not an accurate representation of the householders, a goal out of reach of this research due to its limited resources, the diversity achieved guarantees some inclusiveness and richness of views that allow for the comprehension of the process. In the case of Morro Vital Brazil only the first questionnaire was applied, as it was not possible to proceed with the interviews with householders in this stage of the research with the exception of one householder. In this case the selection of key informants comprised two NGO technicians, an architect and a social service one, a local contractor, a representative of the cement firm that is partner of the project and a faculty member of the local states university (UFF, *Universidade Federal Fluminense*) who participate in the laboratory research works

In both cases, the subsequent phase consisted in analysing the answers to the questionnaire cross matching the responses with the oral statements in the light of the main goals of the survey: searching for deeper meanings and individual perceptions of stakeholders and residents in relation to social sustainability issues. A few interviews conducted with stakeholders by email and in

this case interviewees were offered online feedback to clarify the questions and asked to complete their responses with explanations, justifications and some data. The information collected is meant to provide a further database on social sustainability issues of informal areas and slum upgrading that allow for different approaches.

In the case of B 4H in Guinea-Bissau the semi-structured interviews with stakeholders' comprised local and national representatives, both technicians and politicians, such as architects and national departments directors, local community leaders, man and women, local builders, and three professors. The information collected in these interviews facilitated the composing of a questionnaire, focusing on housing conditions, livelihoods, social sustainability and disaster risk issues, that was later presented to a set of ten householders, again under the form of semi-structured interviews. These were conducted in person, in the participants' homes, with the assistance of local professors for translation and communication issues, and were digitally recorded. In three cases, the visit to the houses included architectural surveys.

3. The case of RedeInteracção in Portais do Campo, Osasco, S.Paulo, Brasil

The process began with the informal occupation of a private land in the periphery of Osasco, in the conglomerate of *favelas* locally known as Portais, with a lenience agreement with the City Hall in 2002 (see fig.1). The participation of the NGO RedeInteracção started in 2000 and comprised:

- in 2002 the organisation and mobilization of the communities for the claiming process (2005)
- in 2006 support to the self-social census
- in 2007, development of the PAC (state's program of acceleration of growth)
- in 2008, assistance to the building works
- in 2010, return to monitor the evolution of the works

In December of 2015, the municipality delivered 430 houses out of 584 with 154 remaining. 21 commercial spaces were also constructed. The total area reaches 69 304m2. The density of the surrounding area is 106,6 inhabitants/hac and that of the Portais project 533 inhabitants/hac. Each unity comprises of a separate kitchen, living room, two bedrooms, laundry and a complete bathroom. The building types include single or two-storey terrace house, duplex, and the apartments. The terraces have a courtyard. The previous houses were wooden shacks, without infrastructure and highly exposed to flood risks.

The Municipal Secretary of Housing of Osasco led the process using funds of the Program of Acceleration of Growth (PAC) of the regional government. The project of the new district was designed by the renowned architect Hector Vilglieca (from Uruguay but Sao Paulo-based) who was hired by the municipality of Osasco via a public building and project competition. Beyond the houses, the urban project includes a cultural centre, an Elementary and High School (under construction), a community centre for collection and separation of waste and a kindergarten (see fig.1).

The RedeInteraccção is the Brasilian representative of the SDI, The Slums Dwellers International, which is an independent network of civil society entities and popular initiatives which act to create inclusive cities and inserts the low-income urban population within the urban development strategies as the primary instrument; community savings, self-census, and exchange. The RedeInteracção develops a work of diagnosis and participative mapping based on the methods of the SDI. This method comprises three main tools: the self-census, the social profile, and the community mapping. The self-census was discussed among the members of the community and simply included demographic data. The information collected was later shared with the municipality. The mapping and community profile provide reports on the history and current situation of the area, localization of the public services such as schools and community centres, information on the access to services and infrastructures and the community members' concerns and priorities. These tools have been proved effective in uniting the householders over communal causes and reinforcing the collective knowledge, which, in turn, is essential for triggering debate on common democratic strategies and actions. This knowledge was very useful to the communities during the interface with the municipal and private representatives allowing for more qualified dialogues and better negotiations.

The community of Portais dos Campo, in Osasco, São Paulo, with 600 families who lived in precarious conditions was the first experience of RedeInteracção in the application of the SDI method in Brazil. The SDI approach stands on the mobilization, organization, and strengthening of the community in order to transform the reality of the families who will benefit from an urbanisation process of their neighbourhood. The first step was to organize saving groups among the householders. Later the families used these savings to finish their houses.

Table 1. General census according to RedeInteracção

Portal do Campo – Osasco – S.P.	Total
Dwellings	302
Slum indwellers	940
Men	281
Women	297
Children	405

Figure 1. The community of Portais do Campo before (in the original favela) and after the resettlement process (during the construction of the new affordable houses)

Figure 2. Community building- saving groups meeting and workshop with the NGO representative

4. Analysis of results

The interviews with the key-informants reflected a series of topics associated with social sustainability are present in the three different stages of the process, i.e. the life in the shacks of the original favela in the land where the families were moved to by the municipality (see fig.1); the period of construction when the householders had to leave and received a subsidy for renting (*bolsa-aluguel*) (see fig.2) , and finally after relocation and occupation of the new houses built by the municipality (fig.3). Some of these topics came up in one or two stages; some of them are repeated in the three stages, although with varying levels of intensity, for example, the dynamics of community mobilization, which are frequently reported as stronger in the first stages. These topics formed the base of the questionnaire used in the semi-structured interviews with the householders (see Table 2) and included: the overall situation of the slum and habitability conditions, the access to information related to the institutional issues, the relationship with the local institutions, the access to public services such as education, health and transport, the overall conditions of the new district, the dynamics of mobilization, the community and groups savings, the role played by NGOs, the suitability of the resettlement process, the communication with the architects responsible for the project, the quality and access of the public amenities (such as open space, playgrounds, green areas, community centres, etc) in the new neighbourhood, the process of

distribution of the houses between householders, the transformations needed and the adaptations and improvement works realized in the new houses as well as the importance of commercial activities.

Regarding the results, it was surprising to verify that the vast majority of the householders considered the original shacks as good or very good, although they were improvised precarious houses made of wood and casual materials. Concerning the overall condition, for the most part, the householders classified them as bad or really bad, reporting severe hygienic problems. However, despite all these issues, particularly in sanitation, some householders evaluated the favela in a positive way in comparison with the current situation. Given the significant improvement that has since occurred in the provision of collective services and quality of the buildings, this evaluation may appear contradictory.

In addition to the initial response to the questionnaire some interviewees highlighted the lack of public spaces and meeting points of the new neighbourhood and that the social relationship with family and friends 'is not as it used to be'. These observations make us think that beyond all obvious difficulties existing in the favela people there had a healthy relationship with their neighbours which is something precious for them and that they haven't yet reached in the new urban setting. Although the criminality seems to have decreased from the times of the favela to now, the sensation of safety is not necessarily higher. In fact, many householders stated that the new larger streets attract people from outside the community who use the free spaces to organize noisy parties at night eventually using and selling drugs and thereby generating an insecure atmosphere.

The topic of the community savings represents one of the most consensually acknowledged accomplishments of the resettlement process. Although not all the interviews reported to having participated in the saving groups, all of them considered that initiative as 'very important'. In general, they remarked that it allowed for householders to use the savings to complete the execution of the houses as they were delivered unfinished- with no pavement, paint on walls and ceilings as well as sanitation pieces and tiles in the bathrooms and kitchens. Those who participated actively in the saving groups reported the experience as very positive regarding the strengthening of social relationships with the other members of the community. In this context, the householders emphasized the role played by the NGO and many of them could specifically mention its name (RedeInteracção) as well as the name of some of the NGO members in the field (such as 'Ana Claudia'). All the interviewees, including those who for economic or personal reasons were not involved neither in the dynamics of mobilization nor the saving groups, highlighted the very important role played by the mobilization groups and in particular the leading role played by one of the community's activists near the municipality ('Alex').

As to the adaptations made by the householders in the interior of the houses, they were frequently reported and somehow confirmed the almost complete absence of communication between the residents and the architects. As confirmed by both the architects and the householders there was no direct contact between designer and the community members. The municipality technicians were the interlocutors of the architect. Family members didn't know until the construction the type of houses that the municipality was managing for them. The key-informants, including the architect himself and the householders, unanimously regretted this lack of dialogue. The architects had access to the social census and in theory had sufficient information about the families and their real needs. However, the municipality, in the light of the PAC rules, posed a restricting budget and technical recommendations. Hence, in practical terms, architects were not entirely committed

to design houses that suited each one of the family or to respond to specific demands, such as high numbers of family aggregates or presence of the elderly or children with one single exception: a householder that has serious disabilities caused by a stray bullet incident at the time of the favela. This householder was provided with a one-storey terrace with access through ramps, and the interior of the house was adapted to the wheelchair requirements.

The relocation process during the demolition period and subsequent building of the new residences was one of the most controversial topics. While some householders accepted well the provision of a modest subsidy and the need for looking by themselves for a new place to live, others complained that the amount was insufficient and that they were forced to reside far from family and friends. On one point the householders agreed: moving to outside the favela represented a decrease in the dynamics of mobilization due to the difficulty of meeting the members of the community. The dynamics of mobilization were reactivated as soon as they returned to the redeveloped neighbourhood. However, the challenges were smaller and therefore didn't justify the type and level of activity of the previous stages when they had to struggle for new homes.

5. The case of Soluções Urbanas (SU) / Morro Vital Brasil in Niteroi, Rio de Janeiro

The NGO SU (Urban Solutions) develops works in the public spaces thanks to community actions; householders participate in targeted interventions that aim to increase local mobility.

In 2009, with support of the public Institute Vital Brasil, the NGO started the process in the *favela* Morro Vital Brasil by making a social and economic census of householders.

The SU works in partnership with and is sponsored by the world's leading cement producer Lafarge-Holcim. Together they empower men and women of the community with building techniques to be employed in their own houses. Another partner is Leroy-Merlin, who donates building materials later traded in the solidarity market where people exchange goods with the aim of providing low-income families with building materials). A third partner is TetraPack, who provide recycled tiles after receiving UHT milk boxes collected in the market. The building materials most commonly used by SU are cement, sand, crushed stone, iron rebar, wood for the rooves, as well as doors and windows.

This market is part of a project in which each family is allocated an architect who will provide assistance during the building or renovation of the houses. This project commonly called *Arquitecto de Familia* and benefits from the support of the Family Doctor program conducted by the municipality and which it seems inspired by. The Foundation Itaú Social developed an economic assessment of the Family Architect Project, whose field works started in 2013. Every intervention begins with an architectural survey and an assessment of the state of the house. A technical report points out the pathologies observed, the risks detected and three pressing interventions. Next, the architects design general solutions and establish a plan for the operation that will be reviewed and detailed by the time of execution. There is a constant dialogue between the architect and the householder throughout the process. Additionally, during the week of the market, there is a meeting involving the members of SU and the community. This is a moment to discuss general issues of the living conditions of the neighbourhood as well as aspects related to the family architect project. There have also been thematic workshops on topics linked to the

NGO's particular projects such as (1) mapping of risk, (2) garbage and organization of the community's waste collection actions (3) and civil protection issues.

The main stages of each operation are as follows:

- (1) Diagnosis, (2) identification of which interventions are necessary and which of those are a priority, (3) technical survey of the building and the immediate surrounding area where the intervention will take place, (4) planning and design of the correction of the problems; (5) access to the building materials through the solidarity market; (6) definition of the management system: organisation of community action, self-building, aid-self help building or contract, planning and preparation of the works, building supervision, post-evaluation and adjustments. In parallel, some actions are taken within the community, to enable the works: micro-credit management, building materials collection, the solidarity market, empowerment in savings issues, awareness raising of risks, and organization in collective building works.

So far, 130 houses in the Morro Vital Brasil have been subject to intervention; the average number of inhabitants per house is 3,5 and the most current works are the following:

- drainage ditches,

- water and weather proof works to prevent capillary humidity, the opening of windows to increase transversal ventilation and natural light as well as reduce the heat.

- roofs, including the introduction of insulation materials

- structural reinforcements

- retaining walls and contention of slopes

- the pavement of the access to the houses

The majority of the dwellings have one floor, between one or two rooms and a surface area from 30 up to 50m2. The precariousness of the urban infrastructure increases the exposure of the houses and householders to the risk of disasters given the impact of the rain and water system leaks.

The actions normally take place at the request of the community families. The empowerment programs involve masons, bricklayers, many of them self-builders who will later participate in the building works of their own houses and those of their neighbours; when there is paid work the money is provided by the families thanks to micro-credit. The housing improvements provided by the Family Architect project consist of construction work to correct failures of the self-built dwellings. These failures and the overall poor sanitation conditions adversely impact the health and security of the families who reside in the slums, locally called favelas. The favelas present high density and precarious infrastructure making it difficult to achieve health housing and urban sustainability. In the Morro (Hill) Vital Brazil there are four hundred and sixty families who receive technical assistance and promote building improvement (see fig.3) works thanks to micro-credit and economic solidarity.

In the case of work developed by the NGO Urban Solutions the method comprised a set of semi-infractrutured interviews with stakeholders who were identified by the leaders of the NGO. This included members of the NGO directly involved in the works, both architecture and social assistance technicians, representatives of the cement firm that sponsored the program and a professor from the university of the city of Niteroi, where the community is situated, who assisted the research on the new materials utilised in the building improvements of the houses and finally one of the householders who benefitted from the architect of the family program.

In these interviews it was possible to understand the method applied by the NGO, which was systematized as following:

- social census of the community
- community mapping of the risk areas
- identification of the houses to be intervened
- survey on the building pathologies and definition of urgent works
- empowerment of the householders
- the design of interventions in dialogue with the family members
- discussing and developing solutions with the firm Lafarge-Rocim and the University Laboratory of Materials
- a collection of building materials in the solidarity market

Figure 3. Waterproofing works in the back a house involved in the Architect of the Family project (before, during and after the works)

6. Analysis of results of the interviews

During the interviews the stakeholders pointed out the main social sustainability issues present throughout the process; they could also confirm the role played by the different stakeholders in the various stages and the obstacles that had to be overcome in each of them. Among the most common difficulties reported appears the criminality as the favela features drug trafficking and sheltering active criminal groups. This reality conditioned the constructions works as well as the present research, making it difficult to approach the householders given the very limited access to

the favela. In fact, there is a set of informal rules posed by the narco-trafficking for entering in the favela that everyone is aware of and observes without questioning. In fact, despite the involvement with the building innovation experiences carried out on site only a few students and NGO volunteers have dared to do it.[2] Nevertheless, the NGO SU established a set of social practices that made it possible to work within the community in a peaceful and seemingly secure environment. As, for instance, the solidarity market and the empowerment and training activities as well as the building works developed through collective efforts that involve the participation of dozens of community members and householders- the locally called *mutirões*. As described by different stakeholders the *mutirões* served not only the purpose of developing building tasks thanks to collective volunteer work but also strengthening the social network.

The joint work promoted by the NGO SU seems to have encouraged many householders to enrol spontaneously in the Architect of the Family program, which has grown exponentially in the past four years. As stated by the majority of the interviewees, the architects of the family who undertook the different projects mostly with a profile of young professionals looking to gain experience at an early stage of their career have adopted a social approach to design, facilitating in many ways the dialogue within the social network. Firstly, they engaged in team building, working closely with the social technicians of the NGO and interacting with the ongoing Family Doctor program. Secondly, they enabled the full participation of the householders, promoting their empowerment in building techniques and saving issues, organizing saving groups. Thirdly and finally, these architects accepted the challenge of discussing with the householders the projects and solutions in all its features and details. The response to people's needs regarding expansion and improvement requests encompassed an intense dialogue but also the use of technical drawing and, consequently the demanding task of explaining them accordingly before and during the building works. *The architect of the Family* project is an idea of establishing a long or medium-term connection within a social network. Thus, besides the consolidation of an assistance network, it aims to establish a reliable relationship between the architects and the family members. The employment of a method that adds to the social network a bond between architect and householder, seems to have formed the basis for the success of each process, and the program as a whole.

The dialogue between the architects of the NGO SU, the firms and academics that developed technical solutions is seen as globally productive by everyone involved This interaction thus resulted in the construction of a social network that has generated the principal outcomes of the architect of the family project, such as the incremental housing projects. Nevertheless, the different actors involved report some difficulties of communication that conditioned, causing uncertainties, hesitations and unnecessary delays, throughout the processes. Interviewees refer to the small size of the NGO and an eventual centralization of decision-making as possible constraints that should be overcome in future actions.

[2] These constraints prevent interviews with householders, as the best time to find them at home is later than the recommended time to leave the favela. One single interview with a householder took place outside the area, in a public place.

7. The case of Building 4Humanity in Guinea-Bissau

Learning on the field, drawing near the residents and researching by project and by doing, designing and building in a local-resources-basis, requires a close relationship with stakeholders. In a small profile NGO such as Building 4Humanity (B 4H) working with local communities in Guinea-Bissau, with the aim of building a children's library and a primary school, this relationship developed through remote communication; in the beginning, via humanitarians in the field; afterward, without intermediates, thanks to internet technologies and social networks.

Keeping the focus on the Portuguese-speaking developing countries geography, the B 4H deals with an encompassing framework concerning (1) theory and practice, (2) planning and building, (3) the social and the environmental, (4) the ethical and the educational, (5) innovation and traditional knowledge. The in-situ observation, the direct interviewing and surveys develop in Guinea-Bissau, embraced a genuine community exchange and intercultural dialogue within residents. At this point, rudimental mapping and manual drawing assisted this interaction and served the purpose of empowerment on recovery, urban upgrading and housing issues. Next, as the projects move forward and get extra financial support, these tools will turn to digital mapping and computer aid design to study more cases and enable the dissemination of evidence.

In mid-2015 an interdisciplinary team of the NGO Building Humanity (B 4H) went to Bissau, the capital city of Guinea, and worked within the Parish of Bra, which is in the neighbourhood of Plack 1, in Militar district. This area is a non-infrastructured suburban fringe where people live on the edge of poverty facing, on a daily-basis, several challenges. The field-work done by the team, composed of a small group of architects and a psychologist, comprised of: three different workshops with students, including drawing, mapping, and models construction; diverse meetings with teachers, parents, community representatives; interviews with key community actors; audiences with national authorities, including six state general-directors; architectural and social surveys. All activities intended to support the construction of a new school while raising awareness on urban disaster issues.

As a result of a two-year dialogue sustained through conferences calls, personal and social media messages, the two-week program was planned and discussed in detail with the members of the school's board. Throughout the process, the teachers consulted with both civil and religious community leaders as well as the representatives of parents and guardians. The workshops, interviews, and inquiries registered high levels of participation, thanks to the involvement of some teachers who volunteered as all-purpose personal assistants and impromptu translators (see fig.4). Despite Portuguese being the State's official language, the Guineans typically prefer Creole, a common mother tongue among a population that belongs to more than twenty different ethnicities, each of them with their own dialect.

The surveys addressed general urban daily living conditions but mainly focused on housing and building issues, exposure to natural disasters, construction skills and prevention measures to reduce the impact of rains, storms, winds, and floods. Broadly speaking, the surveys found some tendencies among the population and characterization of the neighbourhoods. Comparing the actual situation with the one described by Julio Davila (1989) and Claudio Acioly (1992) at the end of the Eighties, besides the advent of modern communications, which has undoubtedly contributed to reduce the isolation of the country and citizens, and also the implosion of Bissau's population, which has doubled, one finds little difference between the two. Indeed, now, as then,

neighbourhoods feature neither sewage nor water supply systems and the water is still collected from traditional wells; there is no public lighting except in very few main streets, and domestic electricity connection remains an exception. Several environmental problems are reported: numerous dumping areas, trash infrequently collected and consequently accumulating near houses, and, even more dangerous, shaky dry pit latrines, usually shared by several houses, becoming saturated. The Bairro Militar, the most populous of Bissau, with several tens of thousand inhabitants, has no health centre, with the result that people take between half an hour and one hour to arrive at a public hospital, and no community services are provided.

Some thirty years ago it was estimated that almost 80 % of the population of Bissau lived in informal settlements known locally as *bairro(s)*, meaning popular neighbourhoods (Davila,1989; Acioly 1992, 1993). These settlements grew in an informal way, without urban plans or observation of building regulations. Roads are rarely paved, and the space between the omnipresent one-storey houses is barely identifiable as a street, in spite of the frequent occurrence of local commerce. Although reasonably well-known, solar panels are sporadic, and although considered by people as a promising solution, the majority would prefer to be connected to the fragile public energy grid. The few communal water taps in existence are insufficient to meet the actual demand for potable water.

Dwellings are usually constructed with adobe bricks according to a local building type of one-storey house with a rectangular, sometimes square shape (10-15 meters side) surrounded by a wide balcony (around 1,80m deep) and with four to six rooms. The balcony, 'veranda', works as a place for preparing the meals, socializing and resting. These houses usually have a roof that is four-sided and covered by cheap corrugated zinc sheets, covering an area equal to 180 m2, and sometimes even larger, that includes the veranda so that the overhang protects the adobe walls from the rain. The bathroom is constructed outside, at a short distance from the home, since it is a traditional latrine, sometimes used by residents of several houses. Houses are grouped with more or less density depending on the location; for instance, on the main roads with local commerce they tend to be closer and more aligned, whereas in more residential areas they respect some distance, allowing some communal spaces in between and apparently following no order. These types of settlements seem to replicate the traditional rural *tabancas*, which the B 4H team visited, for instance, in the Pecixe Island, in Cacheu region and nearby Quinhamel, in Biombo region.

In Bissau, householders pay the Municipality a yearly land occupation tax of around 7€. Land tenure is based on the customary rules ("traditional occupation"), except when the plot has been demarcated and regularized by a property title issued by the Municipality, which is the minority of cases. The population density is very high, usually above 200 inhabitants/ha and the multiple dwelling unit is often overcrowded, providing lodging for more than one family, or for extended families, with ten, sometimes up to twenty relatives. A household with up to four or five children commonly occupies two rooms of 16 m2. The B4H team interviewed a retired civil servant whose home sheltered a record of forty-three people; although the women ran an informal trade selling a few vegetables and mangos, all of them depended on his retirement pension of around 90€/month and vegetable garden production. Salaries of thirty-five or forty-five euros are standard, and many teachers reported having two or more jobs. Taxi drivers and people working on the privately-operated buses, the so-called *toca-toca*, which employ several thousands of individuals, work between twelve and fourteen hours per day in twenty or thirty-year-old vehicles in the midst of dense traffic and polluted air for a monthly income of seventy to one hundred euros.

These numbers and housing features confirmed that Guinea-Bissau ranks amongst the poorest less developed countries in the world with a per capita income of no more than 200 US$. (UN-Habitat, 2014). Poverty also explains why the locally called 'precarious constructions' remain for a long time, despite their fragility and lower resistance to natural agents. Householders seem to be aware of the risk that they are

facing and despite the traditional African relaxed attitude, they do fear that a great storm or flood would damage their homes and harm their relatives. In accordance to this concern, they corroborate the necessity of changing their situation, improve their houses, rebuild, perhaps, build a new one. Regarding their personal aspirations, it is frequently the reference to getting a better job or starting a business, namely exploring a container-shop. The lower wages, the country's long-lasting unstable political situation, the still incipient state of the economy, human rights and the rule of law, seem, however, to positively constrain peoples' ambitions, and no alternatives remain. Many of the interviewed revealed an interest in accessing the micro-credit, but so far they have not had contact with banks or other providers.

Figure 4. Building 4Humanity team (Liliana Pires, Nuno Martins and Mario Jaleco) with prof. Beto Semedo leading workshops with pupils in Santa Clara School, in Plack1, Bissau, May, 2015

The houses in the peripheral informal areas of Bissau are of low quality and comfort standards but can reach a considerable size. Householders hardly seem be aware of these deficiencies and oversize. Areas of almost 200m2 or even 300m2 more can easily be found in the peripheral informal areas. Yet, these houses begin with a core unity, a single bedroom for a couple, normally a recent married one. As the family grew, so did the house. The current oversized houses are thus the result of successive enlargements made over one or more decades in order to accommodate new family members. The interviews allowed for uncovering the incremental housing process, informing about its stages and peculiarities as seen through the eyes of householders. Notably, they show some lack of awareness about the incremental process; not that they didn't participate in it, on the contrary, they undertook it as a self-help building task, but somehow they underestimated it, not valuing it as real change or improvement of their living conditions. So, in general they describe it with no particular enthusiasm as if they were talking about one more wall or a simple extending of the roof instead of the substantial expansion of the original tiny home. One of the interviewees residing in a visibly large house, when asked about significant modifications made in his dwelling stated that there wasn't, even though, afterward the interview, the visit to the interior of the house revealed at least a dozen different small expansions that led to a total area of more than 400m2 and more than 12 bedrooms to shelter more than 42 family members. Regarding the quality of the construction, when interrogated about any important problems the chief of the family responded 'none' and rated the quality of the house as "very good". Nonetheless, the inside visit exposed serious fragilities, such as leaks in the bedroom, not

mentioned during the interview but announced by a big piece of plastic hanged over the bed protecting from the strong rains that fall in the six-month wet season..

8. Final remarks

The case studies focusing on the work of three NGO highlighted distinct but somehow convergent social approaches to upgrading process of informal settlements. In Portais do Campo / RedeInteracção centred the community-building through the claiming actions and saving groups while in Morro Vital Brasil, *Soluções Urbanas* not only tried to engage the community through joint work and solidarity actions but also proposed to walk hand in hand with each of the families challenging them to embark on a close relationship with an architect that would assist them throughout the entire intervention, from diagnosis, to surveys, design and building. In turn, in Guinea-Bissau, Building 4Humanity emphasized the role played by education for disaster risk reduction and community design towards a humanitarian approach to architecture (Charlesworth, 2014). Despite their specificity, which refers to goals and methods, resulting in particular outcomes, it is worth mentioning a similar attempt of incorporating social innovation instruments that might bring (reinforce the sustainability of) sustainability to the projects undertaken. As such, the case of Portais gave us a lesson of struggle for safe land tenure and ownership related to a previous location as well as preparation to face the economical needs of finishing the houses, eluding the consequences of an eventual distant resettlement and the adhering to the principle of incremental housing associate with the delivery of unfinished. The case of NGO SU in Morro Vital Brazil stressed the employment of environmental principles and novel techniques, bonding householders, the community, architects, social technicians, firm representatives and academics in individual incremental housing projects. The case of B 4H in Guinea-Bissau emphasised children and community involvement and the use of vernacular principles and local materials-based design as a mean to achieve long-term goals. The three cases reveal a common pattern of pursuing social sustainability through innovation, which results in strategies and actions that boost enduring actions instead of immediate and likely ephemeral results.

Notwithstanding their particularities, these examples suggest that social innovation tools addressing the communities, in savings, rebuilding, design and disaster risk issues can make a substantial contribution to enhancing the sustainability of humanitarian approaches to architecture and urbanism.

Further developments of this research will elaborate on the local surveys in order to investigate stakeholders role and analyse the social networks. The cross analysis of the role-played by stakeholders in the different examples is supposed to disclose in which ways the NGOs have been influencing and influenced those social networks. the social system built within slum upgrading and resettlement processes.

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Theme 4 posters

Analysis of the Dependency among Neighbouring Land Use, Gross Floor Area, and Land Surface Temperature to Adapt the Future Climate

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Abstract

Global warming is changing the urban climate and human society. A report from the Royal Netherlands Meteorological Institute (Albert Klein Tank et al., 2014) identified that the temperature will rise globally by 1,0 -2,3°C in 2050. This paper focuses on the micro level of urban climate change rather global scale. Eindhoven, the fifth-largest city of the Netherlands, with a population of 224,755 in 2015 (CBS, 2015), is the research area. This paper strategically describe the dependency between land use (L), energy consumption (E) and temperature (T). In Europe, buildings account for 40% of total energy use and 36% of total CO_2 emission. Therefore, this L-E-T spatial model is focused on the built environment. The target is designing a decision supporting tool for optimal land use planning, including energy consumption and land surface temperature (LST) under climate change. In this paper, a GIS platform has been applied for the creating maps and results visualization, and a regression model has been used for investigating dependency of L-T. In the first spatial regression model, the land use types serve as an independent variable for LST. In the second spatial regression model, the gross floor area (GFA) of building serve as an independent variable for LST. In the third part of the regression model, both land use and GFA serve as independent variables for the LST. The regression model is used to investigate the relationships in a complete city. Using the statistical analysis, this paper investigated the dependency between land use, GFA, and LST in 30-meter spatial scale. As a result, it is concluded that, different types of land uses, and GFA in a neighbouring area have a noticeable influence on the central area regarding to the LST.

Keywords: Land surface temperature (LST), Land use, Gross floor area (GFA), Urban climate

1. Introduction

The urban climate and the relation with human activity has been proved since 2008 (IPCC, 2008). The Netherlands undergoing a rapidly change of land use from 2000 to 2008. Besides, the local climate report from KNMI (Albert Klein Tank et al., 2014) pointed out that the temperature will rise globally by 1,0 - 2,3°C in 2050 and 1,3 - 3,7°C in 2085 (Table 1). Land use change is especially influenced by urban expansion and open agriculture reduction is due to enhanced economic growth.

From the scientific perspective, the researches focused on the urban climate system have stated on UHI, urban morphology and urban greening (Eliasson, 2000; Mills, 2006; Ren et al., 2012). There are several studies related to urban heat island (UHI) effect in the Netherlands, which discuss the increasing urban density and climate change (Theeuwes, Steeneveld, Heusinkveld and Holtslag, 2012; Bert G. Heusinkveld, G. J. Steeneveld, L. W. A. van Hove, C. M. J. Jacobs, 2014; Ronda, Steeneveld, Hove and Holtslag, 2011; Klok, Zwart, Verhagen and Mauri, 2012; Steeneveld et al., 2011). Other UHI issue uses quantitative approach (cell analysis) to investigate the influences of urban morphology on the temperature of Dutch city (Van Hove et al., 2011; Rovers, Bosch and Albers, 2014; Janssen, 2011; Koopmans, Theeuwes, Steeneveld and Holtslag, 2014). The studies focus on the building scale and building material's influence to the urban climate, like the study of urban greening to cool down the cities (Bowler, Buyung-Ali, Knight and

Pullin, 2010). Previous studies obtained the LST data from the MODIS Terra satellite with a resolution of 1000m (Jalili, Pilesjö, Vrieling and Ettema, 2013; Shashua-bar and Hoffman, 2000; Bowler et al., 2010; Mees and Driessen, 2011) in the national scale. Next to global and national level of climate change investigations, this paper focuses on the micro level of urban climate change. In order to analyse the data into a more precise way on a city scale, this paper retrieved the data from the NASA based website of the USGS (United States Geographical Survey) by using Landsat 5 (TM) for the LST data with a resolution of 30-meter pixel size (USGS, 2015).

Table 1. KMNI'14 climate scenario (Albert Klein Tank et al., 2014).

Temperature (°C)	Climate 1950-1980	Climate 1980-2010	Scenario around 2050 (2036-2065)				Scenario around 2085 (2071-2100)			
			G_L +1 Low value	G_H +1 High value	W_L +2 Low value	W_H +2 High value	G_L +1 Low value	G_H +1 High value	W_L +2 Low value	W_H +2 High value
Year	9.2	10.1	+1.0	+1.4	+2.0	+2.3	+1.3	+1.7	+2.8	+3.7
Winter	2.4	3.4	+1.1	+1.6	+2.1	+2.7	+1.3	+2.0	+2.8	+4.1
Spring	8.3	9.5	+0.9	+1.1	+1.8	+2.1	+1.2	+1.5	+2.4	+3.1
Summer	16.1	17.0	+1.0	+1.4	+1.7	+2.3	+1.2	+1.7	+2.7	+3.7
Autumn	10.0	10.6	+1.1	+1.3	+2.2	+2.3	+1.6	+1.6	+3.3	+3.8

The city Eindhoven, located in Southeast of the Netherlands was chosen as the study area for this paper. Eindhoven, the fifth-largest city of the Netherlands, with a population of 224,755 in 2015 (CBS, 2015), which is divided into seven districts. Besides, Eindhoven city hall also include the urban climate discussion on Masterplan which will include more green and water area in the 2040 (Gemeente Eindhoven, 2013). Under this ground basis, this project aims to provide the best land use proportion that can adapt to the urban climate change and urban expansion. The main research question is how to design a decision supporting tool for optimal land use planning, balancing between energy consumption and air temperature under climate change. In this paper, the first stage of project which is about the L-T model has been analysed.

This paper aims to investigate the dependency of urban climate and human's activity that is reflected in the use function of a land. In other words, this paper has clarified the dependency of land surface temperature (LST) and land use for the city of Eindhoven, the Netherlands. To extend, the proper urban land use planning can lead to the mitigation of urban climate change in the future. Besides, it reports an investigation into the application of geographic information systems (GIS), satellite remote sensing data, and statistical methods to provide quantitative result on the effect of land use categories on land surface temperature. Furthermore, the influence of neighbouring land use and its distance has been investigated as well.

2. Data

There are three kinds of data have been used: land use data, gross floor area (GFA, which indicates building density and vegetation density) and land surface temperature (LST) data. The data source, data type, product name, projection system, file type, and the year of the data has been listed in Table 2.

Table 2. Data information.

Data type	Data source	Product name	Projection system	File format	File Type	Temporal
Land use	Statistics Netherlands (CBS)	BBG	RD-new	Shape file	Vector	2006

Gross floor area	Statistics Netherlands (CBS)	BBG	RD-new	Shape file	Vector	2006
Land surface temperature	USGS/ EarthExplorer	Landsat 5	Universal Transverse Mercator (UTM)	GeoTIFF	Raster	11.09.2006

2.1 Land Use Data and Gross Floor Area Data

The Statistics Netherlands (CBS) profiled an updated digital geometry of land use map for every three to four years since 1989. It is retrieved through visual analysis of aerial photography, called "Bestand Bodemgebruik" (BBG); which means land use file in Dutch. This land use coding system provides an insight into the distribution of different types of land use in the Netherlands. Examples of land use are: traffic areas, buildings, recreation areas, nature areas, inland waterways and open water. The land use data from 2006 has been used in this paper (CBS, 2014). The land use data are a GIS shape file described in vector by polygon. There are thirty-three different kinds of land use types in the raw file, which is reclassified into five kinds of land use categories (Table 3). U stands for urban/ built-up areas, O represents open space, barren land and construction sites, G stands for artificial plants and agricultural area, V represents natural plant and forest, W means water bodies. The new and old color system was illustrated in Figure 1. For the data related to gross floor area (oppervlak in Dutch), it is retrieved from BBG as well. The GFA data is a shape file described in vector by points. For the purpose of rasterizing, the points have converted into polygon by "voronoi polygons" tool in QGIS (Figure 2).

Table 3. New and old classes of land Use category.

New code	BBG	Description	New code	BBG	Description
U	10	Rail area	G	42	Community garden
	11	Road area		43	Leisure area short stay
	12	Airport		44	Leisure area long stay
	20	Residential area		50	Greenhouse cultivation
	21	Retail and bars		51	Other agricultural area
	22	Public facilities	V	60	Forest
	23	facilities		61	Natural area, dry
	24	Industrial areas		62	Natural area, wet
			W	70	Ijsselmeer
O	30	Dump		71	Closed sea
	31	Wreck storage place		72	Rijn & Maas
	32	Cemetery		73	Border lake
	33	Mineral production		74	spillway
	34	Construction area		75	Leisure water area
	35	Other		76	mineral production enclosed water
G	40	Park		77	Overflow area
	41	Sport		78	Other water

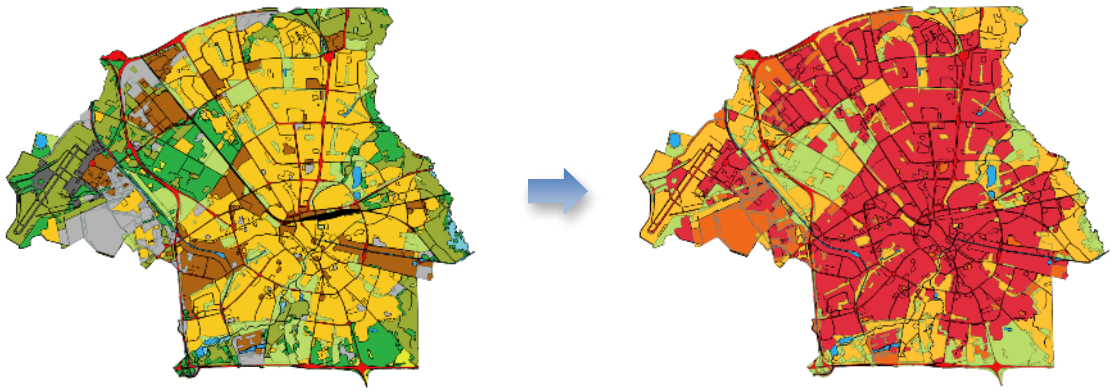

Figure 1. Land use color old (BBG) and new (based on 5 different land use types).

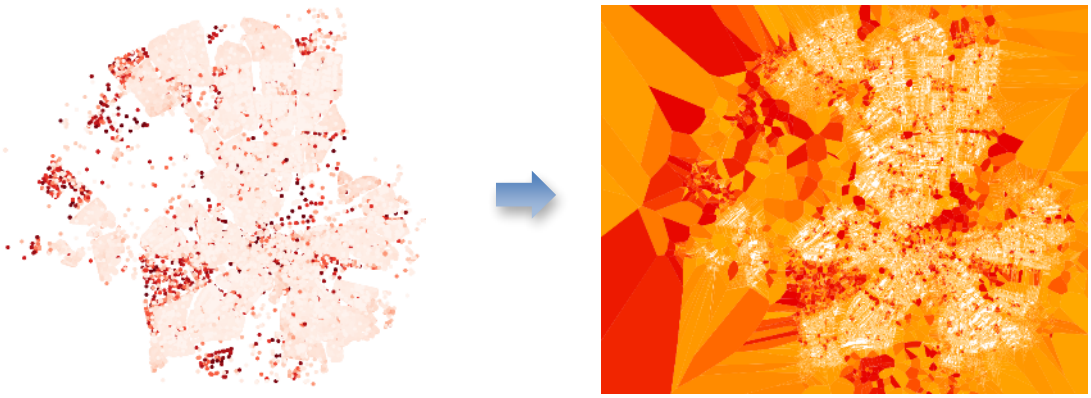

Figure 2. Eindhoven gross floor area (GFA) from points to polygon.

2.2 Land Surface Temperature Data

The following paragraph introduces the equation which has been used to transform Landsat raw data to LST Celsius degree. Following by this, the basic analysis of different land use type and their LST trend have been displayed.

During its perception through the atmosphere the emitted radiance is weakened by absorption, but also amplified by atmospheric emittances. The latter can be split to an up dwelling portion L_{up} that reaches the probe directly and a down dwelling share L_{down} that is reflected by the ground and, therefore, also reduced by atmospheric absorption. Furthermore, each investigated pixel area of the earth's surface is considered to be non-black and LAMBERTian, i. e. the uniform radiation to every direction can be expressed as product of blackbody radiation L (T_s) and ground emissivity ε, while (1-ε) defines the part of reflecting (i. e. non-absorbing) a radiation arriving at the surface. The balance, called Radiation Transfer Equation (RTE), forms a reference to the brightness temperature T_b:

$$L(T_b) = \varepsilon \times \tau \times L(T_s) + (1 - \varepsilon) \times \tau \times L_{down} + L_{up}. \quad (1)$$

Qin et al. (2001) developed the Mono-Window Algorithm (MWA) to handle the atmospheric correction and postulated the strong similarity of the two components of atmospheric emittance at a fictitious temperature Ta:

$$L_{down} \approx L_{up} = (1 - \tau) \times L(T_a), \quad (2)$$

to be approximated according to Sobrino et al. (1991) as effective mean atmospheric temperature by:

$$T_a = 0ATz \times wz\, dzW, \quad (3)$$

with the altitude A of the satellite, the vertical temperature function T(z) from nadir to probe, and the vertical water content w(z) of the atmosphere on the same path. Furthermore, the total atmospheric water content W from nadir to the altitude of the instruments is defined as:

$$W = \int_0^A w(z)\,dz. \quad (4)$$

Normally, the height profile of the absolute water content w(z) is not accessible, but the relative humidity RH(z) is, and only multiplying by the local atmospheric saturation humidity SH(z) has to be done:

$$w(z) = RH(z) \times SH(z). \quad (5)$$

This saturation value that depends only on the local temperature T(z), or $\vartheta(z)$ in °C, can be extracted from physical tables and is fitted best (see Table 4) by an exponential fifth degree power series:

$$SH(z) = SH(\vartheta(z)) = \exp\left[\sum_{k=0}^{5} d_k \times \vartheta(z)^k\right] \text{ g/m}^3, \quad (6)$$

with coefficients according to Table 5.

Table 4. Determination coefficient R^2 and standard error S for regression coefficients of Table 5.

R^2	S
1.00000000	7.911849E-5

Table 5. Regression coefficients for Equation (6).

d_5 in $(°C)^{-5}$	d_4 in $(°C)^{-4}$	d_3 in $(°C)^{-3}$	d_2 in $(°C)^{-2}$	d_1 in $(°C)^{-1}$	d_0 in 1
2.0344E-11	-4.28431E-9	1.10288E-6	-2.91730E-4	6.89899E-2	1.5786 1

As for Eindhoven, the Atmospheric Correction Parameter Calculator (NASA, 2015) was used with input of the ground conditions (altitude, pressure, temperature, relative humidity) taken from Wyoming (University of Wyoming, 2015). The online algorithm evaluated the local height profiles, especially of temperature and relative humidity, for the coordinates of Eindhoven at the times of satellite overflow to allow computing the mean atmospheric temperatures T_a by a numerical integration procedure of Eqs. (3) and (4). Furthermore, the Calculator provided the atmospheric transmissions τ, and only the emissivity ε (see Table 6) were to define for a use of the Mono-Window Algorithm (MWA).

Table 6. Epsilon for different land cover types (Source: Qin, Karnieli and Berliner, 2001).

Land cover type	Epsilon (ε)
Built-up areas (U)	0.92
Barren land (O)	0.94
Grass (G)	0.95
Vegetation (V)	0.98
Water (W)	0.99

The LST data from the USGS-EarthExplorer Landsat 5 (TM) has displayed in Figure 3. The top left image is the five kinds of land use type in Eindhoven, which contains built-up areas (U), barren land and open space (O), grass (G), vegetation (V), and water (W). On the right hand side, the land surface temperature has been displayed in gradient color band from blue (low temperature) to

red (high temperature). The thing worth to mention is that LST is higher than the average air temperature normally. The two figures below are band combination of satellite data.

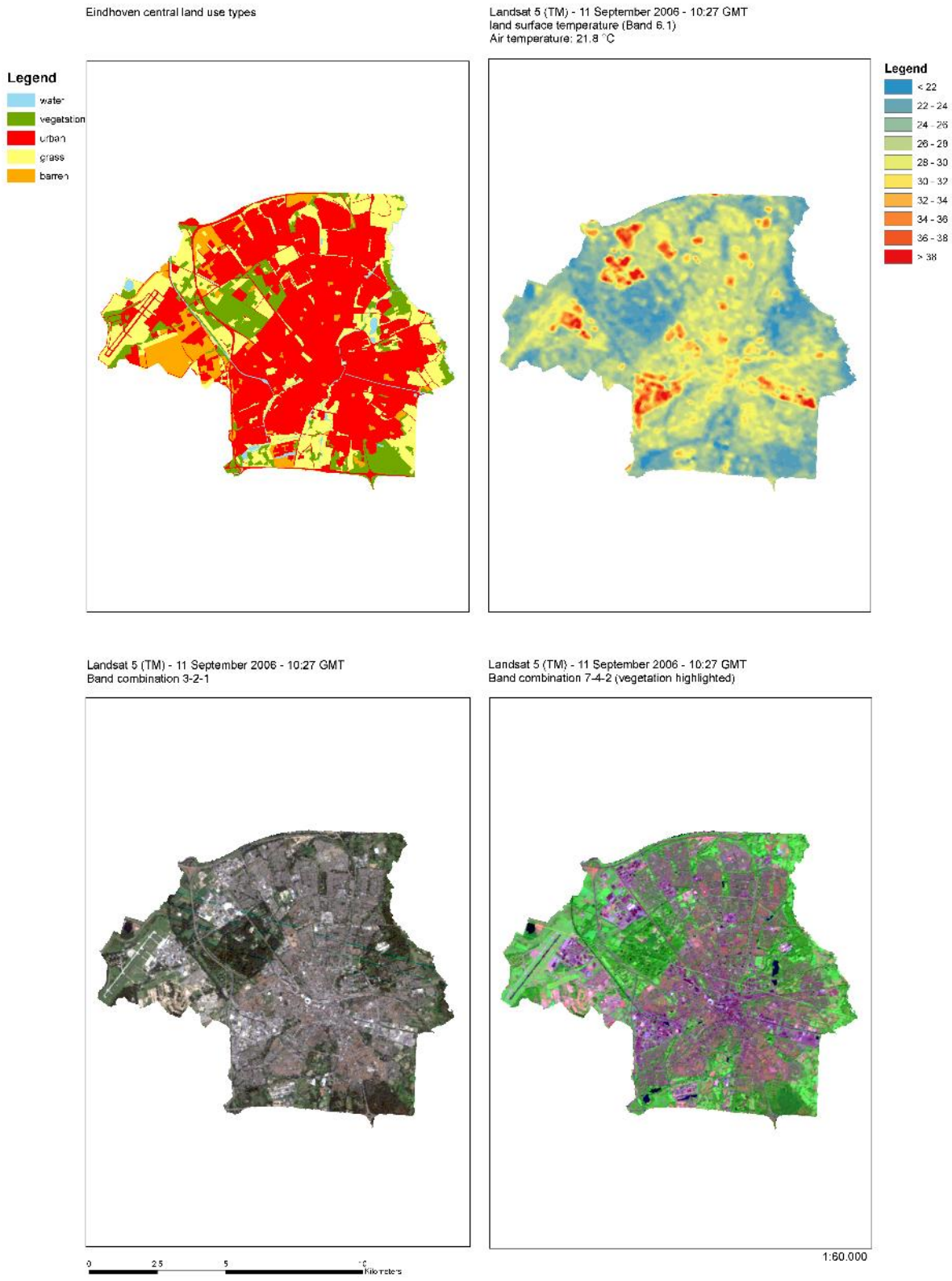

Figure 3. LST data in Eindhoven on 11.09.2006.

In the selected Eindhoven area, most of the land use function are built-up areas (U), which accounts for 56% (Figure 4). Following by this is the green area like park and agricultural (G), which accounts one fourth of Eindhoven. The rest of the lands is covered by vegetation

(11%), open space (7%) and water bodies (1%). Five cloudless Landsat image does exist for Eindhoven from 2006 to 2009, which are used in this study. An overview of the average LST regarding the five land use types is shown in Figure 5 for five days. A clear difference could be observed. The average LST of the built-up area (U) is the highest one, following by open space (O), and agricultural (G). Comparatively, the natural water and forest has the lowest LST constantly.

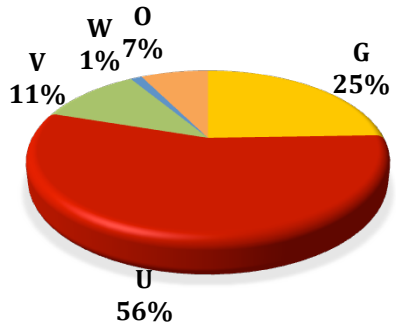

Figure 4. Land use percentage in Eindhoven.

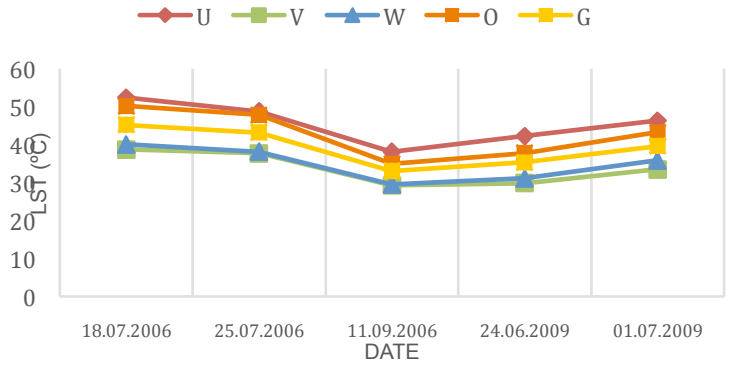

Figure 5. LST by time.

Figure 6 demonstrates the LST distribution within the same types of land uses. The degrees of LST fall between 20 to 60ºC, and each level has been devided by five degrees. Figure 6 comapres the land use types and its cells amount in gradiant level. The LST spreads from low to high value is water (W), vegetation and forest (V), grass and agricultural (G), open space (O) and urban built-up area (U). For the land use of water body, more than 90 % of its LST is lower than 35ºC. Among those, half of the water cells have a LST around 30ºC. LST of natural and vegetation land are concentrated in the 30ºC, which account for 90% of the cells. The cells of the grass and agricultural have the moderate LST in 30ºC to 35ºC. The open space and construction area have comparatively high LST in 30ºC (15%) and 35ºC (70%). The last but not least, urban area's LST is the highest one among all types of land uses, which lies between 35 ºC (50%) to 40 ºC (40%).

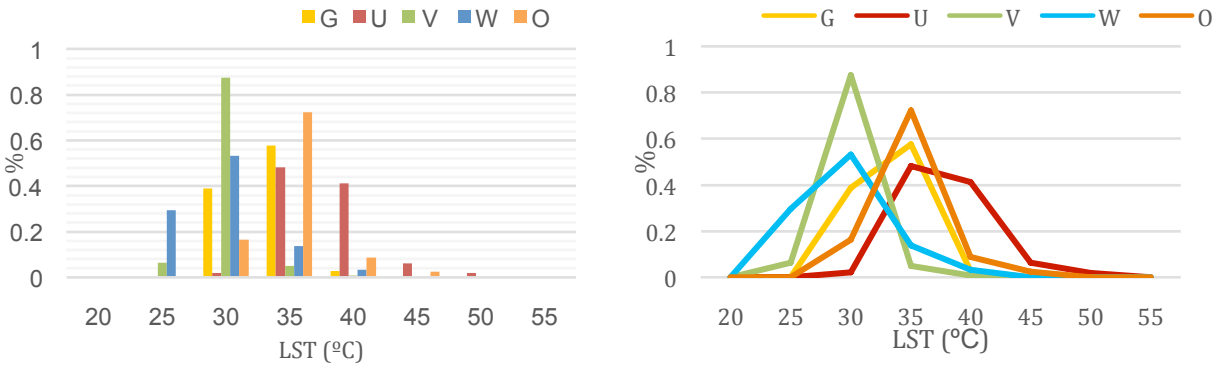

Figure 6. Land use and LST by cells percentage within same land use type.

3. Methodology

Previous papers worked out different scales of urban modelling which focus on dependency of L-T, L-E, and E-T. Based on the reviewed papers, the regression model is an effective and efficient method to investigate the dependent variables of an urban model (Mirzaei, 2015). In this paper, a GIS platform has been used (ArcGIS and QGIS) to create the related maps and visualize the results. A regression model has been used for investigating the dependency of land use to LST

and GFA to LST. Analysis of variance indicates statistical effects of different categories of land-use type in neighbouring areas where undertaken. There are three main parts in the regression model. Firstly, the spatial regression model which the land use types serve as an independent variable for LST. Secondly, the spatial regression model with grass floor area (GFA) of building has keyed in as an independent variable for LST. Within the final part of the regression model, both land use and GFA insert as independent variables for the LST. The regression model is used to investigate the relationships on extended spatial scales from neighbourhood to city.

3.1 Research framework

The Decision Support System (DSS) scheme of the L-E-T interaction model is illustrated in Figure 7. Firstly, the data related to land use (L) map, energy consumption (E) map and temperature (T) map have been collected. Next, the L-E-T interaction model was developed, which will utilize detecting the casual relationship between indicators of the land use change, energy consumption, and temperature change. Furthermore, the forecasting of the three sub-models will be built up following the previous researches and integrating with the collected database. The interaction model will be further elaborated for various forecast scenarios. Finally, the detected interactions will be applied to simulate the effect of the potential policies and strategies for different spatial transition scenarios. The local policies and the master plan of Eindhoven city will be investigated. During the model development, the spatial transition scenarios can be used to check the L-E-T interaction effects. Through this circular working procedure, the sustainable interaction model can be adjusted to its optimal condition. Finally, it can be a tool for sustainable land use planning which provides decision support for policy assemblers and urban planners. The following platforms have been applied to explore the relationship between the E-L map, L-T map, and T-E map in different spatial and temporal scale:

-Cellular automata (CA) platforms like NetLogo for the simulation of spatial interaction,

-GIS platforms like QGIS and ArcGIS for the maps and results visualization,

-System dynamics (SD) platforms, for example VenSim for the forecasting functions.

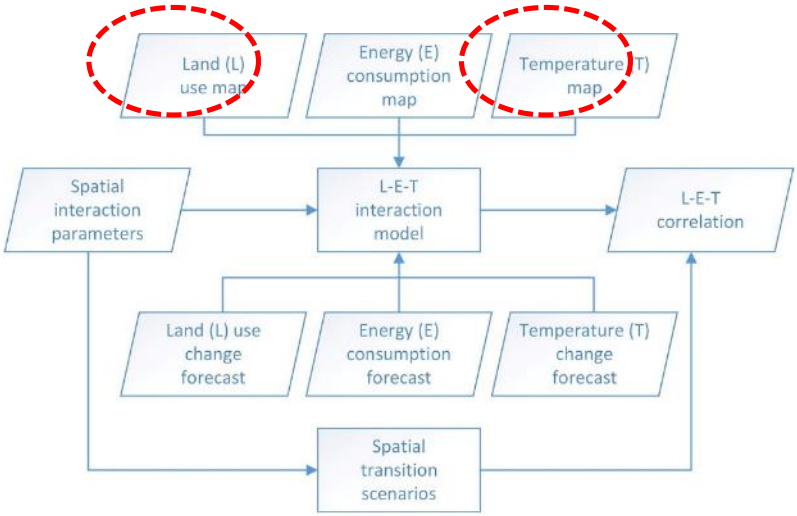

Figure 7. L-E-T research framework (Chen, de Vries and Han, 2014).

This paper reports the first stage of the sustainable L-E-T model, which analyses the correlation of land use and land surface temperature since 1996 (see the red circle in Figure 7 and Figure 8). Figure 8 illustrates the L-E-T hypothetical correlation. The land use type and GFA are independent variables which influence the LST. However, there is no algorithm that can clearly state the correlation of central land use types and neighbouring land use types. Thus, the represented land use-temperature modelling aims to compare the spatial data, finding correlationship of land use and LST, and to build up the equation to describe the correlation. This research uses the statistical method to investigate the correlation between urban climate and land use types. There are three types of data: the land use map, the gross floor area map, and the map of land surface

temperature. The L-E-T interaction model will be built in the future study. As for future forecasting maps of energy, land use, and temperature will be built based on the Masterplan of the city.

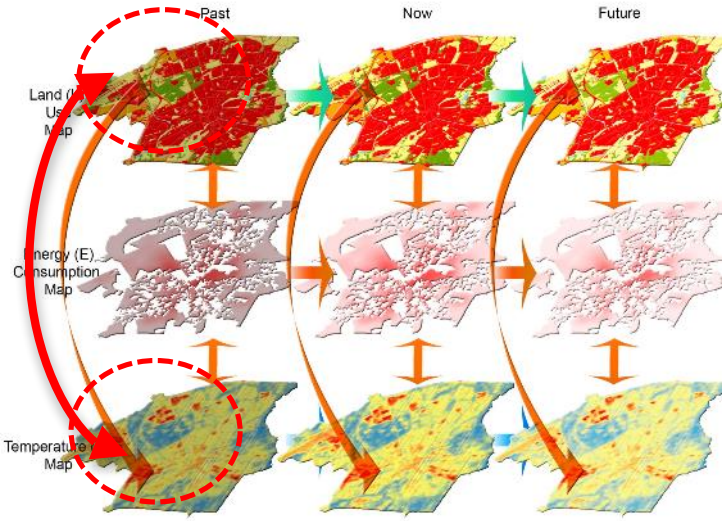

Figure 8. L-E-T hypothetical model.

3.2 Data Rasterizing

The research methodology of neighbouring cells and central cells are based on Balazes (Balazs et al., 2009). The way how this paper investigates the neighbouring cell and central cell expanded by the distance shows in Figure 9. The central cell calls R_0, and neighbouring cell calls ring one (R_1), which contains 8 cells. Ring two (R_2) is the outer area which contains 36 cells. The total amount of cells in Eindhoven area is 96097, and each cell is 30-meter pixel size.

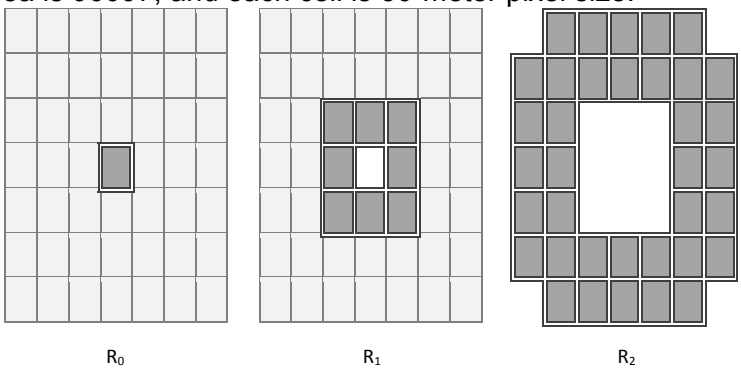

Figure 9. Cells which take part in the calculation of B_0, B_1, B_2 surface parameters.

This paper deals with two kinds of data types, the vector data includes land use and GFA, and the raster data from LST. In order to match the two kinds of cell in the same location, the software File Management Engine (FME) has been used. The ground location of MinX is 152907, MaxX is 165996, MinY is 379074, and MaxY is 389864. Within these area, the tool “Numeric Rasterizer” was used to raster the cell into X spacing 30-meter and Y spacing 30-meter. Figure 10 illustrates the rasterizing result of the land use and GFA. After the rasterizing, all the land use data, GFA, and LST data import as text file into excel to investigate further analysis. Additionally, SPSS and N-Logit are tools using for analysing the regression and bivariate correlation where undertaken.

Figure 10. Cells of land use (left) and GFA (right) after rasterizing in FME.

Equation of the L-T hierarchy model are presenting as following. Equation (7) specifies the hypothesis relation of land use and GFA with the urban climate model. The multiple linear regression acts as a main method to analyse the correlation between land use and LST. The statistical data of different neighbouring land use types has been used in this multiple linear regression model. $LSTx$ is the Celsius degree of LST within the central cell. $LSTL$ means the regression influence from land use, and $LSTGFA$ means the regression influence from the gross floor area.

$$LSTx=LSTL+LSTGFA+\varepsilon \quad (7)$$

Equation (8) specifies the hypothesis relation of central land use and its neighbouring cells. The land use percentage $L\%$ presents the amount of the specific land use over the total cells in the specified ring. $R0$ represents the central cell, $R1$ represents the first ring of neighbouring cells, and $R2$ represents the second ring of neighbouring cells (Figure 9).

$$LSTL=k=R0nnkL\%=R0L\%+R1L\%+R2L\% \quad (8)$$

Equation (9) specifies the hypothesis relation of central gross floor area and its neighbouring cells. The GFA presents the average value of gross floor area among total cells in the specified ring.

$$LSTGFA=k=R0nnkGFA=R0GFA+R1GFA+R2GFA \quad (9)$$

4. Results and Discussion

This paper examines the regression by SPSS and NLogit. The result of regression can be categorized into three groups: the regression of land use to LST, the regression of gross floor area (GFA) to LST, and the combination of land use and GFA its influence to LST. It is worth to mention that the chosen independent variables of GFA to LST have linear relation in between, thus some analysis only include four types of land uses. The accumulated total land use distribution is 1 in ring one (B_1) and rang two (B_2), therefore with the distribution of 4 types of land use, the 5th land use percentage is obvious, and will interfere the results because the independent variables are collinear to each other. The GFA is partially reflected in the built-up land use.

Firstly, Table 7 reveals the regression result of land use to LST, which includes G, U, V, W for four types of land uses. The R-squared value is 0.41958. The coefficient of all the independent variables are significant. The urban land use (U) coefficient for the central cell (B_0) is opposite from the cells in the first neighbouring ring (B_1). The built-up area (U) has negative coefficient (-0.39559) to LST for the central cell, and positive coefficient (3.22954) to LST for the first ring

neighbouring cells (B_1). It is assumed that the ring one (B_1) has eight cells, which accounts for much larger area than central cell. Besides, the overall delta LST value of ring one (B_1) to central cell is positive (radiation) while delta LST value of ring two (B_2) to central cell is negative (absorption). Thus B_1 influence to urban land use has positive influence among all.

Table 7. Regression result of the land use to LST (R-squared: 0.41958).

LST	Coefficient	z	Prob. |z|>Z*	LST	Coefficient	z	Prob. |z|>Z*
Constant	35.4630***	866.05	.0000	G_R_1	-2.62742***	-18.97	.0000
G_R_0	.53543***	4.25	.0000	U_R_1	3.22954***	24.61	.0000
U_R_0	-.39559***	-3.31	.0009	V_R_1	-6.52441***	-42.34	.0000
V_R_0	1.33497***	9.52	.0000	W_R_1	-3.82153***	-19.39	.0000
W_R_0	.62139***	3.85	.0001				

Secondly, Table 8 demonstrates the regression result of GFA to LST, which includes central cell (B_0), ring one (B_1), and ring two (B_2). The R-squared of this regression model is 0.00103. The coefficient of central cell is 0.00017, ring one is 0.00085, and ring two is 0.01234. Among these three, only the coefficient of ring two to LST is significant. This result might be caused by the cell's number difference, which ring two has 28 cells more than ring one. Overall, it can be concluded that the influence of gross floor area to LST is not as obvious as expected.

Table 8. Regression result of GFA to LST (R-squared: 0.00103).

LST	Coefficient	z	Prob. |z|>Z*
Constant	35.5914***	2590.84	.0000
GFA_ R_0	.00017	.50	.6137
GFA_ R_1	.00085	1.00	.3191
GFA_R_2	.01234***	8.63	.0000

Furthermore, Table 9 and Table 10 show the regression result of both land use and GFA to LST. The different combination of four kinds of land use types has been chosen for Table 9 (G, V, W, and O) and Table 10 (G, U, V, and W). The result includes the independent variables of central cell, ring one, and ring two. For Table 9, the land use types include grass (G), vegetation (V), water (W), and open space (O). The R-squared value is 0.45152. Compare with land use, the coefficient of GFA to LST is relatively small. The coefficient of ring one and ring two is higher than central one. Besides, the ring one has positive coefficient while the central cell and ring two have negative coefficient.

Within Table 10, the land use types of grass (G), urban built-up (U), vegetation (V), and water bodies (W) were shown. The R-squared value is 0.47900. Compared with the coefficient of land use- LST, the coefficient of GFA-LST is hard to distinguish. Similar to the previous Table 9, the coefficient of ring one and ring two is much higher than central cell. Furthermore, the built-up area has negative coefficient to LST on central cell and ring two (B_2).

Table 9. Regression result of the land use and GFA to LST (R-squared: 0.48152).

LST	Coefficient	z	Prob. |z|>Z*	LST	Coefficient	z	Prob. |z|>Z*
Constant	38.7569***	2355.16	.0000	G_R_1	1.33574***	11.33	.0000
GFA_ R_0	-.82187D-4	-.34	.7308	V_R_1	2.47212***	15.23	.0000
GFA_ R_1	-.00064	-1.05	.2934	W_R_1	1.65748***	7.83	.0000
GFA_R_2	.97769D-04	.09	.9244	O_R_1	.40074**	2.07	.0384
G_R_0	-.09278	-1.33	.1827	G_R_2	-6.92613***	-75.90	.0000

V_R_0	-.19017**	-1.97	.0485	V_R_2	-11.6573***	-96.25	.0000
W_R_0	-.21447*	-1.80	.0719	W_R_2	-9.56198***	-48.34	.0000
O_R_0	-.08526	-.74	.4606	O_R_2	-3.57022***	-24.44	.0000

Table 10. Regression result of the land use and GFA to LST (R-squared: 0.47900).

LST	Coefficient	z	Prob. |z|>Z*	LST	Coefficient	z	Prob. |z|>Z*
Constant	35.5325***	798.55	.0000	G_R_1	.82034***	3.88	.0001
GFA_ R_0	-.8321D-04	-.35	.7281	U_R_1	-.47305**	-2.36	.0182
GFA_ R_1	-.00065	-1.06	.2898	V_R_1	2.00843***	8.50	.0000
GFA_R_2	.46025D-04	.04	.9644	W_R_1	1.08729***	3.84	.0001
G_R_0	-.03812	-.30	.7623	G_R_2	-3.22009***	-19.98	.0000
U_R_0	.05414	.45	.6506	U_R_2	3.65387***	24.05	.0000
V_R_0	-.14161	-1.01	.3146	V_R_2	-8.08417***	-45.48	.0000
W_R_0	-.14237	-.87	.3833	W_R_2	-5.65921***	-23.12	.0000

This paper has explored the urban model focusing on the land use, GFA, and surface temperature. The regression model is used to investigate the relationships on different the spatial scales of research from neighbourhood to the whole city of Eindhoven. Using the statistical analysis, this paper investigated the dependency between land use, GFA, and LST in 30-mter spatial scale. As a result, it is concluded that, different types of land uses, building density and vegetation density in a neighbouring area do have influence on the central area's land surface temperature. However, there are some missing discussion points, the further research will distinct between the central cell and the neighbouring cells. (1) The LST is effected by the irradiation from the sun of the central cell. (2) The LST is effected by the density of the neighbouring cells. This can have two reasons: they absorb energy from the central cell, or they radiate energy to the central cell. The delta T difference of neighbouring and central cell will be used to investigate the absorption (delta T negative) and radiation (delta T positive). The effect depends on the land use type, and it is related to the density. Thus for the future study, we propose to combine these elements in a new urban model for responsive environmental morphology which includes land use/cover, energy, and surface temperature. Furthermore, the dependency between land use (L), energy consumption (E) and temperature (T) will be strategically analysed in more detail. Finally, a decision supporting tool for optimal land use planning, including energy consumption and air temperature under climate change will be built.

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CO_2 emissions and water tradeoff: future electricity generation in China

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Abstract

Energy, emission, water resource and environment are significant factors for China building a well-off society in an all-around way and achieving sustainable development. Electricity, as an important water consumer and CO_2 emission source, is to play a more significant role in energy end-use through electrification process and will exert greater influence on China emission and water use constraints. However, though China has proposed her carbon emission control project, coal is predicted to maintain its dominant position in power generation sector in short term because of the huge electric demand volume. Pathway dependence on thermal power especially coal power limits the sphere of transition on power structure in China, while the technology structure of generation unit is the key characteristics of electricity sector. Therefore, it is of great significance that balancing water use and emission of electricity sector with analyzing the tradeoff among different generation technologies, particularly for thermal power. This paper analyzes the emission and water consumption factors of a number of power generation technologies, which contains both traditional technologies, like subcritical thermal generation, and leading technologies with relatively high energy efficiency. Afterwards, total emission and water consumption in China electricity sector under various generation technology combinations are calculated respectively, based on former predictions of electricity demand scenarios research. It reveals that the emission of China electricity department will decrease from 2030 till 2050 while water consumption will increase, mainly because new installed capacity turns to sustainable energy technologies. However, China has long formulated her macro-energy and climate mitigation policies without sufficient consideration of the water issues, and policy on water resource to some extent neglects the influence on energy consumption and emission as well. How to coordinate energy and emission policies with the water counterpart and utilize the coordination effect requires better understanding and further research, which is of great importance for China to realize her sustainable development and ecological civilization.

Keywords: Sustainable development; electricity generation scenario; CO2 emissions water nexus; water use intensity of electricity generation

Knowledge Cities and Sustainable Innovation in Developing Countries

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Abstract

The development of the knowledge city requires partnerships, knowledge and information flows, and open access to resources in order to empower collective intelligence and to co-create capabilities of user/citizen communities for designing innovative living and working scenarios. This recent perspective calls for an integrated approach of analysis considering a system of capitals. Drawn from this approach, the present paper aims to provide insights for advancing sustainability innovation in urban and regional contexts. The case study method has been adopted to illustrate how sustainable innovation takes place in complex service systems and networks, such as the smart urban context. The case we focused on is Curitiba, in Southern Brazil, which is well-recognised as the world's leading liveable, green, and inclusive city. Curitiba is an eco-system that is based on mechanisms of continuous learning process and on resource integration. These mechanisms work not as isolated actions but as a process of practices institutionalization, that creates new citizens as empowered actors. This research provides some insights on how sustainability innovation takes place in a complex capitals system. Finally, it provides a holistic and integrated conceptualization of knowledge city toward perspective of sustainable innovation; accordingly city becomes a practice to enhance the sustainability of territories.

Keywords: Knowledge cities, Sustainable innovation, Capital System, Developing countries.

1. Introduction: Knowledge Cities and Sustainable Innovation

The implementation of knowledge cities increased productivity innovations and social changes that depend on knowledge capital. The 2000 document "Transition to sustainability in the twenty-first century" was adopted in Tokyo by more than 50 national and international science academies. Its interpretation is a sustainability challenge to society and requires a more effective use of existing science and technological knowledge through a greater integration between science and wisdom in society as a whole which is the base of knowledge (Carrillo, 2002).

Over the past decade, the "green twist" has been put on the top of political agendas of many cities around the world since climate change was finally acknowledged as a threat to sustainability and development (Betsill and Bulkeley, 2007). Efforts have been focussed on the reduction of carbon emissions caused by urban mobility and improvements on urban accessibility, quality of life and growth; e.g. a series of green urban transport policies, such as strict regulations on emissions from buses, free parking and lower local taxes for green cars and the purchasing of cleaner bus fleets (Bertolini et al., 2008)

Since the seventies, the city of Curitiba is considered a transportation, urbanization and respect for the environment model. It is one of the ten smartest cities in the world. In 2010, Curitiba was cited in a research published by Forbes magazine as the third smartest city in the world and it can be categorised as a knowledge city (Glaeser, 1999).

The evident success of the knowledge cities concept resulted in a new debate on the relationship between local and regional areas and sustainable development. Storper (1997) points out the advantages inherent to cities that use social capital to implement sustainable innovations, such as trust, shared values, norms, "eye" contact and learning. These elements can promote networks, collaborative relationships and trust building, values that structure the formation of social capital in

knowledge cities (Amin, Thrift, 1994; Putnam, 1996; Bagnasco, 1999).

Geographical proximity works as a catalyst for meaningful learning experiences and innovation (Maskell and Malmberg, 1999). This is because innovation is a social phenomenon that depends on interaction so that tacit knowledge shared by a number of institutions in a common space can be transmitted. This means that cities are privileged arenas for social interaction and generation of knowledge (Storper and Venables, 2004).

The notion of knowledge as added value is particularly useful for the analysis of cities as knowledge systems. Such dimension allows the use of knowledge to reduce poverty and achieve a sustainable development. Lessons learned from experiences in cities or nations can contribute to a better understanding of what it takes to build a global capital system (Carrillo, 2002).

In this context, ideas emerge that value long-term relationships and sustainable innovations. This promotes the association between a range of partners constantly seeking new forms of cooperation that will help them to perform traditional tasks more efficiently, and provides a platform from which such partners can achieve goals that neither could achieve on their own (Elkington, 2012).

Based on this, the present research guiding question is: to which extent services provided to the community in Curitiba are influenced by its recognised as knowledge city? The authors aim at analysing the concept of knowledge city in the light of sustainable innovations.

Sustainable innovations favour a rational use of natural resources (energy, water and materials), avoiding or mitigating environmentally harmful actions that threat the ability of future generations to meet their needs (Brundtland, 1987; Nidumolu et al., 2009). A new paradigm of sustainable development encompasses economic aspects, respect for the environment and social responsibility (Elkington, 1997).

The sustainable innovation concept refers to innovations with lower environmental impacts. The innovations may be technological or non-technological (organizational, institutional or marketing-based) and can be motivated by economic or environmental considerations (Arundel and Kemp, 2009).

In a broader view, sustainable innovations can be seen as a kind of innovation that comprises new or modified processes, practices, systems and products in order to benefit the environment and consequently improve environmental sustainability (Oltra and Saint Jean, 2009).

Sustainability is commonly defined as a pact between generations (Ehrlich and Holdren, 1971; Polonski and Rosenberger, 2001). Therefore, Elkington (1999) proposed the concept of triple bottom line according to which sustainable development should synchronize economic growth, ensuing social results and ecological balance. Later, Elkington (2012) deals with the importance of preservation and management of natural resources; the financial consequences of a company's actions to stakeholders; and accountability to improve balance in the system, with respect to rights and responsibilities.

According to Dormann and Holiday (2002), innovation is the result of the integration between creativity, competence, world vision and leadership which require strategic and operational commitment. Barbieri et al. (2010), in turn, state that innovative actions that follow the three dimensions of sustainability are not the rule because the inclusion of social and environmental dimensions requires new tools and management models, which have only recently begun to be developed.

The results presented during the conferences promoted by The Centre for Sustainable Design from 2003 to 2006 presented the following categories of drivers for sustainable innovation: (i) resources and environmental hazards: growing consumption of energy and materials due to population growth, particularly in China and India; climate change; costs of oil dependence and its potential economic and social instability, conflicts and military tensions; water shortages due to increase demand and drought resulting from climate change, pollution and loss of biodiversity; (ii) sustainable production and consumption policies: waste management (reduce consumption, reuse and recycling of materials), training and capacity building, sustainable energy and mobility,

sustainable lifestyles, sustainable consumption and production, sustainability applied to construction and tourism; (iii) environmental regulations on products aiming at reducing energy consumption. The authors acknowledge the existence of market and financial drivers that, although generating less impact, affect a company's competitiveness: replacement of materials, consumers' demand for sustainable products, environmental liability of companies, products and brands. (Charter and Clark, 2007).

A peculiarity identified by Rennings (2000) relates to the importance given to social and institutional innovations, which agree with Brundtland's (1987) notion of sustainable development and Elkington's (1997) triple bottom line. From a social point of view, sustainable innovations mean changes in the consumer's lifestyle and behaviour. From an institutional point of view, those innovations include institutions and global or local agencies involved with the management of large areas and issues related to sustainability, such as climate change and biodiversity (Rennings, 2000; Rennings and Rammer, 2011).

Therefore, innovation is a dynamic process that requires creativity in order to develop new ideas or assimilate existing ones in a new way; the emphasis is on making something better, being that a physical product; a service; the process by which products are produced, services are rendered or administrative processes are organized (Zhuang, 1995).

2. Method

We adopted the method of case study, pointed out by Yin (2009) as a research strategy that addresses the logic of planning, the techniques of data collection and analysis of specific approaches. This paper is about the first phase of a study that will investigate several cities, especially in Latin American, according to the concept of knowledge cities.

Previous works on knowledge cities (Van der Meer and Van Winden, 2003; Berry and Glaeser, 2005; Ergazakis, 2006; Asheim et al, 2007; Hájková and Hájek, 2014) demonstrate that two dimensions are usually present in the construction of understanding: a) intelligence, inventiveness and creativity of individuals living in a city acknowledged by the talent and knowledge of its scientists, artists, entrepreneurs, and other groups of people willing to disseminate knowledge; b) collective intelligence of the population, which is the capacity of human communities to cooperate intellectually in creation, innovation and invention. This dimension is based on institutions that allow cooperation on knowledge and innovation.

Carrillo (2002) proposes a method that adds three dimensions to this knowledge-based system. The first focuses on the acquisition and accumulation of knowledge and the sharing of information, experiences and resources. The second deals with knowledge management through identification, coding, structuring, storage, retrieval and dissemination. Finally, the third applies knowledge management as a strategic tool, in order to systematize and add value to the knowledge generated (Figure 1).

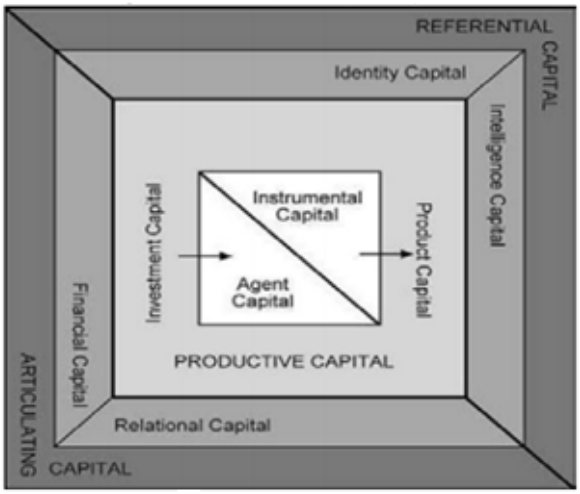

Figure 1. Generic Capital System. Source: Carrillo (2006, p. 146).

A knowledge-based system can be implemented through the so-called capital system (CS), which systematize and organize the information and data that reveal assets and liabilities of a particular social group, a territory or organizations. Figure 1 CS seeks to contribute to the social construction of a culture of knowledge; its ultimate goal is supporting development based on knowledge. The CS considers knowledge as a social construction in which knowledge-based structures are adopted by the society of knowledge. On the other hand, the CS provides a method to be implemented in cities and a broad spectrum of observed variables which is used as reference in the Knowledge Cities World Summit. (Carrillo, 2006; KCWS, 2016).

3. Results and Discussion

Curitiba is the capital of the state of Paraná, in southern region of Brazil. It is located in a plateau some 934 meters above sea level. Its official founding date is 29 March 1693. In the seventeenth century, its main economic activity was mining and subsistence farming; from the eighteenth to the nineteenth centuries, droving; the late nineteenth century was dominated by yerba mate cultivation and logging. The massive arrival of European immigrants and the construction of Paranaguá-Curitiba railroad, linking the coast to the First Plateau of Paraná, were very significant. Up until the twentieth century, its economic profile was characterized by commercial activities and services. After that, industry gained more ground. The city faced, especially in the seventies, a fast process of urbanization, largely caused by migrations from rural areas that were replacing agricultural labour force by machines. Curitiba faces now the challenges of a great metropolis. It was awarded prizes and acknowledged as a smart city and knowledge city (Prefeitura Municipal de Curitiba, 2016).

Unemployment in the Metropolitan Region of Curitiba (RMC) reached 5.7% in the third quarter of the year, the second lowest rate amongst the 21 areas surveyed by the Brazilian Institute of Geography and Statistics (IBGE) in the Continuous PNAD (from November 2015). The participation of women in the labour market went from 45.84% in 2005 to 48.59% in 2009 (IPPUC, 2010). Table 1 presents some data on the city.

Table 1. Data on Curitiba. Sources: Prefeitura Municipal de Curitiba (2016); IBGE (2010).

Total population (2010)	1,751,907 inhabitants
Area (2010)	435.27 km^2
Population density (2010)	4,024.87 inhabitants / km^2
HDI (2010)	0.853
GPD (2010)	R$ 53,106,496,770.00
GDP per capita (2010)	R$ 30,400.49
Illiteracy rate (2015)	5.7%
Green area per inhabitant (2009)	51.5 m^2 / inhabitants

Many of Curitiba projects are designed to be self-sustainable and to allow the operation of other programmes. Green Exchange is a good example of this systemic approach to planning: in the city slums, to each classified garbage bag, people receive rice, beans, eggs, bananas, carrots that the city purchase at low prices from areas with surplus production. The results are good nutrition

and better public health (Pierce, 2000). In Curitiba, garbage collection is universal - almost 11% higher than the national standard. Most of the city's households (91.7%) have sewage treatment (IPPUC, 2010).

The remaining resources generated by the city's recycling programme are used to fund education and other health programmes for the poor. Many of these educational programmes are housed in decommissioned but fully operational city buses turned into mobile classrooms. Many educational and social programmes generate an income: free day-care centres create working opportunities so low-income population can work in arts and crafts products, which are then sold at local souvenir shops (McKibben, 1995).

It is worth mentioning the project Faróis do Saber (Lighthouses of Knowledge). It consists of a network of community libraries, with free internet access that affords entertainment and culture to the entire population. Initiatives such as those are responsible for the city being elected by the UNESCO as a model for the reconstruction of Afghanistan. Forbes cited it as one of the smartest cities in the world.

The whole territory is served by public transport and the distance between people's home and the bus stop cannot exceed 500 meters. The number of bus stops/10,000 inhabitants has remained a steady 37 in the last ten years. The number of vehicles adapted to people with disabilities increased from 29.11% in 2000 to 90% in 2010 (IPPUC, 2010).

The RIT (Integrated Transportation Network) is model project (Carvalho et al, 2012). There was an increase of 18.15% in the number of users from 1999 to 2010, period in which population growth was 12.39%. Although private vehicle ownership increased in 77% over the same period, the percentage of RIT users in relation to number of travellers remains around 50% of the total of travellers; the increase in the number of ticket-paying passengers in the period was 15.66%. (Figure 2).

Figure 2. Bus Rapid Transit (BRT) System. Source: Guia Geográfico de Curitiba (2016).

Figure 3. Oscar Niemeyer Museum. Source: Guia Geográfico de Curitiba (2016).

Although there was a 57% increase in the public transport fleet (1,540 to 2,420 vehicles), air quality in Curitiba and surrounding areas have more days of good quality air and reduced particle pollution, according to the ConAMA index that registered an 18% drop in 2010; this represents an average 48% drop per vehicle. Technological improvements in the vehicles engines followed reduction targets proposed by the European Community Agenda 21 and the city's policy (IPPUC, 2010).

Despite population growth the proportion of green areas to the total area of the city, as well as the square-footage-per-person remains stable: Curitiba is still one of the Brazilian capitals with most green areas/inhabitant.

Subsequently, the authors associate the above data to capital systems elements (Table 2).

Table 2. Capital System analysis for Curitiba (Brazil). Sources: Prefeitura Municipal de Curitiba (2016); IBGE (2010)

Capital	Meaning	Evidences
Identity Capital	It includes formal and informal capital elements that contribute and/or contributed to determining the individuality of the city, its clarity and differentiation (or identity profile: its characterization, its sense of belonging). Internal value references: elements generated in an attempt to determine the essence and purpose of a city as a collective enterprise. The quality of identity construction determines the sense of purpose and belonging of its citizens.	Immigration: From village to metropolis: Curitiba's key feature was the arrival of immigrants from various backgrounds. Europeans, Asians and Africans contributed to the formation of the city's population, economic, social and cultural structure. There is a significant ethnic and cultural diversity. "Sou Curitiba" project is a creative economy project that fosters the development of innovative souvenirs, oriented to the opportunities generated by big tourist events, albeit not limited to them. The notion is to work so their outcomes are a gift to society.
Intelligence Capital	System's capacity for feeling, for making sense and respond to external agents and events that are significant to the city's well-being (i.e. strategic planning agencies, future public and private urban centres, prospective studies). External value references: elements generated in an attempt to visualize and understand its context, to compare with its identity and to develop a strategy.	It is the only city in Latin America among the ten most sustainable in the world (Institute Ethimosphere/2009. Singled out by Forbes Magazine (2009) as the 3rd most "smart" city in the world, a title that reflects its commitment with sustainability, quality of life, good infrastructure and economic dynamism. Curitiba was unanimously awarded the Globe Award Sustainable City/2010 (Globe Forum, Sweden - which elects each year the most sustainable city in the world). That same year, it received a distinction as the greenest metropolis amongst other 17 Latin America cities, according to a Siemens environmental study and the research unit of The Economist.

Relational capital	Ability to develop quality interaction with all significant internal and external players. Quality of interaction between its significant internal actors, the city and its significant external agents.	It is the only Latin American city recognized by Mother Nature Network as an easy and safe place to bicycle, given its network of cycle lanes separated from vehicle lanes.
Financial capital	Financial: Ability to generate and maintain a healthy monetary base. Currency denomination of a set of values.	In September 2013, Curitiba authorities announced a 12 measures cycle lanes plan to be implemented by 2016. Among them the connection of eight urban parks by a 47 km cycle lanes circuit, building of parking spaces for bicycles at bus terminals and approval of a law to allocate 5% of residential and non-residential areas to motorbike and bicycle parking.
Human Individual Capital	Ability to create conditions for full physical and psychological development of its inhabitants. Capacity to generate value to individuals	Its economy grows at rates higher than the national average. In the past eight years, its Gross Domestic Product (GDP) recorded a real growth of more than 48%, from R $ 20.5 billion in 2002 to R $ 48 billion in 2010.
Human Collective Capital	Ability to increase the potential for achieving the objectives of its constituent communities. Collective and team capacity to generate value.	The city achieved the country's highest literacy rate (96.86%) for the third consecutive time; it displays the best performance among Brazilian capitals in the Basic Education Development Index (IDEB). It has the first university in Brazil (Federal University of Parana) created in 1912. It has also the first so-called Federal Technological University of Paraná (UTFPR), in Brazil.
Instrumental Material Capital	Means of production based on physical elements, through which other capital increase their ability to generate value.	Curitiba foresaw future requirements and focussed planning policies on its citizens. Since 1970, the urban planning made the city a model of urban management, public transport and environmental preservation.
Instrumental Intangible Capital	Means of production based on knowledge through which other capital increase its ability to generate value. Ability to transfer knowledge and promote innovation in all major areas of city life.	Curitiba is Brazil's 2nd technological innovation centre, according from the Institute of Applied Economic Research (IPEA); it is considered the 2nd best city for business in Brazil and 5th in Latin America, according to América Economia /2005 and 2006.

Such policies resulted in good quality of life standards, as evidenced by indicators that measure cities development. The Local Human Development Index (IDHM) is 0.856; Living Conditions Index (ICV) is 0.808; and the quality of life composite index, 81.75%; literacy levels are 96.86% (IBGE, 2010; IPPUC, 2010).

One way to ensure that sustainability is incorporated into innovation processes involves understanding how to ensure that sustainability is part of the creative process of knowledge cities. Considering the effects of level of aggregation observed in Curitiba, the territorial context appears to have the potential to generate sustainable innovations depending on the degree of involvement of individual or collective players. Such aspect places great emphasis on social technologies that

generate and disseminate knowledge.

Knowledge and innovation networks are formed over time and become strongly affected by the development of local interactions. Innovation actions depend on different modes of knowledge creation and have a different spatial sensitivity (Asheim et al., 2007). Curitiba known as a green and smart knowledge city is a prominent case of sustainable innovation.

The objective of spatial proximity through investments in urban mobility allows the articulation of development strategies between segments that generate space. Their aim is to create externalities that favour innovation, through a conjunction of material (adequacy, implementation and renewal of infrastructure) and immaterial actions (exchange of knowledge and information), as well as through the strengthening of political representation (Moura, 2009). These elements are better equipped to generate resources for the attraction and reproduction of activities and investments; to create physical, institutional and cultural proximity, to influence the organization of production base. Therefore, the creation of externalities involves and arises from municipalities or parts of its territory that already have a minimum of technical, scientific and institutional conditions able to contribute to the innovation process (Benko and Lipietz, 1994).

4. Conclusions

The present research describes the convergence of sustainable innovation and knowledge cities, and the ability to cooperate and trust through a network of relationships that connects individual and collective players. In the context of Curitiba, the authors observed that knowledge cities can disseminate information, build confidence through personal relations, economic cooperation and sustainable innovations that a are legacy to the community and valuable in terms of resource optimization.

Optimization of resources that are achieved through tacit knowledge, for example, enlarges local competitiveness. Cooperation, which is inherent to social capital, allows the tacit knowledge that derives from human capital to generate competitive advantage; it permeates relationships with local and foreign companies, public and private players that interact in networks and spread through to the community. Such a scenario may lead to the generation of sustainable innovations.

The city of Curitiba illustrates how sustainable innovations are created from trust and reciprocity, as well as common norms of behaviour, shared formal and informal commitment and sense of belonging, which can be used productively by individuals and groups to promote actions that benefit the community.

Cooperation, inherent to the sustainable innovations in Curitiba as part of a social relationship system, makes us think in collective action, especially when discussing social responsibility in local development contexts. Therefore, in the backdrop of knowledge cities, the focus is on social values and on multiple forms of cooperation not individual qualities.

Finally, the results of the evaluation of capital system demonstrate that actions aimed at social well-being tend to strengthen civil society; they allowed the researchers to identify Curitiba as a knowledge city and a source of sustainable innovations offered to the whole community. Local cooperation multiplies social capital and increases the possibilities for the emerging of new sustainable innovations.

The next stages of the research include the quantitative measurement of the capital system and a comparison with regional and national data.

Acknowledgements

This work is being supported by the Faculty Meridional (Faculdade Meridional – IMED) the University of Caxias do Sul (Universidade de Caxias do Sul - UCS), the National Counsel for Scientific and Technological Development (Conselho Nacional de Desenvolvimento Científico e Tecnológico - CNPq) and the Coordination for the Improvement of Higher Education Personnel

(Coordenação de Aperfeiçoamento do Pessoal de Nível Superior – Capes).

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Sustainable city: conjunctures of Malasyan urbanisation progress and the rising challenges

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Abstract

This paper is about the urbanisation spread in the fast developing Malaysia, arguing that socio-economic progress has contributed towards the fast rate of urbanisation, town and city growth, yet the dynamic socio-economic structure challenges the continuing efforts at achieving sustainable city while the country moving towards a high income country. Using an historical perspective and utilising secondary data from various sources the progress of urbanisation in the country is assessed. In the Malaysian Population Census 2010 the urbanisation rate for the country stood at 72 per cent. The rate could be higher had the definition of 'urban' been relaxed to include modern settlements in rural areas. Malaysia is thus moving fast in becoming an urban country. Yet about 50 years ago the urbanisation rate was less than 30 per cent and towns and even the capital city, Kuala Lumpur, was described by researchers as mere sleepy hollows. But since the 1970's the Malaysian urbanisation landscape has been transformed to showcase fast spreading urbanised space upon which are seen rising urbanised regions with urban nodes consisting of past small towns, urban agglomerations with past larger capitals of States in the Federation of Malaysia as seeds, and a mega-urban region centring on Kuala Lumpur, the Federal capital. A multi-layer of factors promote the fast urbanisation and towns' and cities' growth rates. With colonial capitals initiating townships, import substitution promoting new township, it is the export industrialism since 1970-s that has pushed the fast rate of the urbanisation surfaces in the country, helping to move for modernism and the betterment of quality of life of Malaysians. Yet the fast urbanisation rate in the country taking place in a somewhat short space of time along with layers of past dependent in a complex meshed of contending factors produce layers of challenges that slow down the progress towards achieving 'sustainable city' in the country. Efforts from across the linear socio-economic thinking, propelling progress thus far for the Malaysian society need to change to realise sustainable city life.

Keywords: sustainable city, urbanisation, urban agglomeration, Malaysia,

Regional Development Approaches

Malaysia's approach towards regional development planning itself has undergone several changes over time. It began perhaps by a simple rural-urban dichotomy on development emphasis. This emphasis was and is still very much operationalized based on the agriculture-manufacturing duality that makes up the basic economic identities of the places. Early attempts at creating regional labels include the ideas of Jelapang Padi, the pineapple and tin regions, and many other agricultural labels aimed at highlighting the major economic activities of the area much like the cotton and corn belts of the United States. When the complexities and interconnectedness of urban life began to take the form of environmental degradation and social problems including that of health, unemployment, congestions and pollutions, the development of the urban began to utilize comprehensive strategies via structure plans (under the Urban Planning Act 1976). The development of rural areas early on focused only on introducing modern infrastructures such as roads, electricity and tapped water as well as efforts at making agriculture more efficient, at least until the 4th Malaysia Plan when development included industrial as well as agricultural programmes. The idea of the 'region' in Malaysian regional development then was more to encompass unincorporated or non-municipal areas rather than any effort at integration or comprehensiveness. Early programme based regions include Integrated Agricultural Development Projects such as the Muda irrigation schemes. Then regionalization moved to the opening up

of new agricultural settlements especially that of FELDA. Later, seven regional development authorities were developed in Peninsular Malaysia under the now defunct Ministry of Regional Development. These regional authorities; KEJORA, KESEDAR, KETENGAH, DARA, KEDA, PERDA and JENGKA are still very much planning and developing the 31% of total land in Peninsular Malaysia under various ministries.

Development Corridors in Malaysia - Past and Present

Development Thinking and Experiences Through the Malaysian Development Plans (1956-2010)

Malaysia had grappled to solve both the raging social as well as regional disparities as the outcome of over a century British intervention and administration of the former Federation of Malaya, Sarawak and Sabah, now embraced in Malaysia. Until the 1970 the development paradigm of the newly independent Malaysia was stressing on economic and social development of the rural area where the majority of the poor population of the country was found as well as promoting import substitution industries in the main cities, both for job creation in the face of the increasing urbanization rates as well to strengthen the Malaysian economy through diversification of its economic base beyond the export of tin and rubber, and timber. These development strategies were outlined in the first and second Malayan Development Plan and Malaysia Development Plan 1 (Malaya 1955; Malaysia 1960). The outcomes of the strategies were less than successful in meeting the goals that had been set for the Development Plans. Thus, towards the end of the 1960-s hard core poverty group was still substantive, lingering around forty per cent of the population. Regional and social imbalances were still very visible. To make matters worse the social imbalances cut across racial lines, making the Malaysian state very vulnerable.

The New Economic Policy (NEP) introduced in the Second Malaysia Plan (Malaysia, 1970) was a bold strategy to address those imbalances, focusing on poverty eradication and social restructuring to evolve a truly multiracial Malaysian society. The policy was to run for two decades stressing on expanding the economic cake through sustained economic growth. With expanding wealth social and infrastructural developments were accelerated. Rural development strategy of earlier decades was made more focus on regional development while deliberate export industrialization strategy expanded industrial areas in cities to cater for the surge of foreign direct investment. Absolute poverty was slowly reduced in number, as reported in the subsequent five-year development plans (Malaysia, 1976; 1981; 1986). The paradigm stressing on economic growth and social development was continued in the period covered by the fifth to the ninth Malaysia Plans for the period 1990 to 2010 (Malaysia 1990. 1996, 2001, 2006).

While acknowledging the overall achievement in economic growth and poverty eradication and the overall increase in the quality of life of the Malaysians as well as the general improvement of inter-racial mixing, the Malaysian environment leaves much to be desired. The Malaysian state has to grapple with degrading environment to which much attention has now been devoted. There have been strong calls for solutions from multi-stakeholders. That economic growth and development which has not been tempered with responsibility to nature may in the end bring down the level of quality of life achieved so far.

The paradigm of development has changed drastically from time to time in Malaysia in response to the change in intellectual and practical experiences from the rest of the world, in short from the pursuit of economic growth of the 1960-s to growth with redistributions in the 1970-s and beyond. A new paradigm has yet emerged after Rio de Janeiro 1992, pinning on sustainable development (WCED 1987). This development paradigm considers economic growth and social development with environmental conservation- emphasizing on our responsibility to nature and to human beings (Harvey 2006) with inter-generational equity.

There must be a balancing formula in the development effort, so that economic growth for wealth creation which can be spent to improve the citizen's quality of life without causing excessive damage to the environment. Implied there in, the people will enjoy their increasing economic power, social advancement through education, increasing mobility in well provided physical infrastructures and shelters in well managed ambience, in the end. Although the issue of environment was factored strongly in the Third Malaysian Development Plan, 1976-1980 and

traces of its spirits in subsequent development plants only in the current ninth Malaysia Plan has the sustainable development concept shaped almost all aspects of activities and life in the country. In the light of the changed paradigm, there is need then to look for a framework in the effort to effect a sustainable development for the Sabah Development Corridor.

The Malaysian Development Corridors

In the ninth Malaysian Development Plan (Malaysia 2006) the Malaysian government introduced the concept of development corridors with the broad aim to developed the so called lagging regions of the country. These are; Northern Corridor Economic Region (NCER), East Coast Economic Region (ECER), Iskandar Development Region (Iskandar, Johore - Malaysia; Sarawak Corridor of Renewable Energy (SCORE) and Sabah Development Corridor (SDC). These five development corridors should provide the necessary fit to the earlier industrial corridors of the development decades under the New Economic Policy namely; the Penang- Kulim- Sungai Petani - Gurun industrial region, The Klang Valley industrial region which has the oldest industrial estates going back to the 1950-s and the Johor – Bahru Pasir Gudang Industrial complex. These industrial regions have risen to become the propulsive regions for the Peninsula, with the capabilities to effect economic and social transformations of the country. In the march to 2020 when Malaysia will achieve its developed country status, the development corridors could fill up the necessary development needs in lagging areas that the industrial regions on their own have somewhat limited effects. Figure 1 shows the overall development corridor in Malaysia (Malaya) during after Independence (1957) until now and Table 1 summarizes the economic development and relationship with the development corridors.

Future Direction of Urban Development?

The first observation is that the process of transformation from first nature to the second nature in case of becoming urban is not a linear process. This is a common assumption in traditional urbanization planning where people move from the traditional to the modern with urbanization being the vehicle for such a move. In a country that emphasizes science, technology, growth and the idea of being modern, it is an understandable assumption. Those that question the move are labelled as outdated, naive, anti-development, and perhaps even ‘subversives.’ Yet the study showed that the process of accepting the urban is a complex series of selections, discarding and adopting from both the urban and rural with contestations from both side of the spectrum. The rural do not shed its identity totally in the face of urbanization, and urban values are always questioned even though the idea of urbanization as westernization and therefore of ‘yellow culture’ is no longer dominant.

In such a process the traditional both help and hinder the process of being urban. Traditional activities such as agriculture and food making often provide an entry point to the urban market, and urban technologies allow inclusion in the mass production base of the consumerist urban society. The study also showed that the process is dependent on social acceptance of the specific element of urbanization undertaken with some elements of urbanization, especially that of physical infrastrutures are easier to adapt and accept rather than others such as social connectivities between rural and urban.

Moving planning from a top down approach to a more bottom up governance framework cannot assume that the structure is in place for such a shift. A society that is all to embedded in a top down hierarchical process, from that of a feudal society, to a colonial structure and local rule that combine both elements, a re-examination of local grassroot networks is necessary for governance to be in place. Current development programmes should no longer be assumed to have a deterministic impact on communities. Rather, the uncertainty of success is dependent on the communities’ acceptability of the programmes and the risks of individual development efforts vary given the underlying networks that link individual community members to the programmes themselves.

Sustainability of Rural Landscape of Langkawi Geopark in Malaysia: A New Dimension

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Abstract

Langkawi archipelago, a magnificent with plethora of richness in geological landscape and biodiversity in Malaysia. It is the oldest rock formation in the country with unique and outstanding geological features and rich diversity of flora and fauna as well as the unique socio-cultural heritage provided the ideal foundation to be developed as a premiere tourist destination based on geopark concept. In this regard, Langkawi Island was endorsed as a Global Geopark by UNESCO Cultural Network of National Geopark (GGN) in 2007. This recognition requires that the development of the island must be undertaken to promote a balance between conservation of heritage resources, development of infrastructure based on tourism as well as local needs and recreational activities. Over the centuries, our landscapes have undergone many changes due to profound shifts in cultural, institutional and economic relationships with nature. Similarly, Langkawi Geopark has undergone rapid development in recent years, thus posing significant challenges to the protection of forests, agricultural lands, rural villages settings and other natural and culturally modified green areas for urbanization. This has resulted in significant alterations in the structure and functions of ecosystems, which are consequently impaired in their capacity to deliver the expected services. Sustaining these rural landscapes has long been seen as a critical issue in sustainable development. This study is conducted to advance fundamental knowledge about landscape characteristics conservation in rural area. The purpose of this study is also to explore the public perspectives on aesthetic value of landscape characteristics in the natural environment and cultural settings. The methodology used in this study adopted a mix method approach to analyses the landscape characteristics conservation. The study adopted 5 landscape characteristic namely i) landscape and accessibility, ii) traditional elements, iii) Malay vernacular house design, iv) social values and, iv) environmental character of the surrounding land. The most distinctive features of Malay vernacular houses are made from timber, mainly consists of traditional Malay architecture attribute such as the carving design of the roof, wall, door, and window. With the rapid development it is quite fortunate that there are a number of rural areas which are still able to maintain the characteristics and features of traditional rural landscape. The study indicated the majority of the respondent perceived that the important of the traditional Malay architecture and their identity need to be preserved and conserved. The respondents also indicated that they were concerned with regard to the Malay cultural value on the new development of the villages. There was overwhelming respond to maintain and conserve the paddy fields landscape as the important characteristic of the rural landscape of the Langkawi. The paper also suggests new ways of conserving the rural landscapes of Langkawi Geopark in a sustainable manner to further enhance the aesthetic and cultural values as well as to promote ecotourism. This could be undertaken through government support in identifying and zoning of unique rural traditional landscape at the same time providing financial incentive. Furthermore, a heritage fee could be collected to support this important initiative to ensure sustainability.

Keywords: Urbanization, Rural Landscape, Ecosystem Service, Langkawi Geopark, Ecotourism

Sustaining Community with Regional Identity: A Comparison Study of the Ceramic Producing Regions of China's Changsha and Japan's Seto and Tokoname

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Abstract

Owing to urbanization and globalization, the characteristics of local communities across the world have been gradually disappearing. This paper seeks to explore the approaches to sustaining a community as a ceramic producing region in a global age. Three recognized places with ceramic traditions have been chosen as research targets, namely, Changsha in China, Seto and Tokoname in Japan. The author paid several field trips lasting 2 months altogether to these places for the study. After a comparison of the targeted places, the following findings can be found: (1) all the three places enjoyed a ceramic prosperity in the past and have already declined in large-scale daily ceramic production. Instead, private ceramic studios producing non-daily ceramics, such as souvenirs, high-end items and decorations, are prospering. Different from the past when almost all the residents in the three places took on ceramic jobs, only a small number are still doing so. (2) The residents in the three places widely recycled ceramic products or tools in their buildings, landscapes and other occasions in daily life, which is a strong regional identity. Residents in Changsha have almost stopped doing so till now; instead they prefer modernistic concrete and cement buildings and landscapes to the old ones with recycled ceramic resources. However, local communities in Seto and Tokoname continue their old tradition of using ceramic material in construction. Meanwhile, new ceramic facilities are created, such as story walls telling local stories, square sculptures, galleries converted from abandoned kilns. There are also companies mashing abandoned ceramic resources into powders, with which other featureless construction products are made. (3) national and local governments in China have realized the enormous value of the ceramic tradition in Changsha and been trying to restore local ceramic culture by establishing a relics park demonstrating local ceramic traditions and renovating public facilities with ceramic elements. But local residents do not participate in the process. (4) Almost all the ceramic events, such as festivals, have disappeared in Changsha. In Japan's Seto and Tokoname, international ceramic research symposiums have been held in recent years. Local schools have opened courses to introduce local ceramic history and teach local residents especially students to make ceramic handicrafts. (5) Compared to Changsha whose residents are barely engaged in the process of restoring ceramic traditions, Seto and Tokoname are a better case to continue local ceramic traditions through the joint efforts of local residents, governments, NGOs, experts and industries. Residents in Seto and Tokoname are better aware of the uniqueness of their ceramic traditions than their Chinese counterpart. In conclusion, a model of sustaining local community with unique ceramic traditions has been proposed, which combines the joint efforts of various stakeholders, especially the participation of local residents.

Keywords: Sustainable Community, Ceramic Reusing, Changsha Kiln, Seto and Tokoname Ceramics

Mobility Service Companies (MOSCO): mediating households' urban mobility and activity patterns

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Abstract

Urban mobility systems have shifted dramatically from conventional public transport modes (bus, underground, train and taxi) to an intricate set of alternatives (more walking, biking, vehicle-sharing, minibus, transport-on-demand, etc.) that increase the range of possibilities for the daily set of interconnected trips. Information on the urban mobility alternatives has also become ubiquitous, principally with the IoT and its mobile forms (e.g., smartphones). For shorter term mobility decisions (e.g., going to a restaurant), sources like route planners (e.g., Google Maps) are standard now. However, despite the myriad information sources, it is not always straightforward for individuals and households to make the most efficient longer-term mobility choices that include structural decisions such as house/work locations, private car acquisition or holding monthly cards. Actually, longer-term decisions involve all complex issues referred above. In the face of this complexity, these decisions too often include buying a private car (or several). Inter alia, the dominating modal share of cars is responsible for much of the urban unsustainable development (eg, air pollution, noise, space deprivation, accidents, run-overs).

The mediation of households and the complex urban mobility system is lacking. Such mediation services already exist in the energy sector with the Energy Service Companies (ESCO). Just like ESCO's assist with managing energy services, the aim of this research is to explain and illustrate how Mobility Service Companies (MOSCO) can mediate the household mobility planning and decision-making that, ultimately, can reduce their annual mobility budget and, eventually, environmental footprints. To accomplish this, a set of households are used as test-beds for the proof-of-concept of this new mobility support service. The approach used here is to identify household mobility profiles and compare current mobility indicators (eg, weekly budget, CO_2 emissions) with alternative plans.

Results suggest that households can significantly reduce their mobility budgets and environmental footprints. Still, further action is required to effectively implement the new mobility plans as these remain potential alternatives. Anyhow, tackling the complexity of household mobility planning is required with potential gains both individually and collectively.

Keywords: Mobility service companies; mobility surveys; mobility plan; foundational, discretionary and mandatory activities

1. Introduction

Societal changes are occurring over the last decades. Importantly, households evolved from a relatively standard 4 members to a set of diversified structures (e.g., single-parenting, single elderly, etc.) with strong implications in the interpersonal relationships and daily organization. Together with increasing complexity of daily activities, personal mobility is becoming multifaceted, where regular daily commuting is no longer standard that turned into varied mobility plans over weeks, seasons and years. Moreover, urban mobility systems have shifted dramatically from conventional public transport modes (bus, underground, train and taxi) to an intricate set of alternatives (more walking, biking, vehicle-sharing, minibus, transport-on-demand, etc.), and their intermodal combinations, that increase the range of possibilities for the daily set of interconnected trips. Information on the urban mobility alternatives has also become ubiquitous, principally with

the IoT and its mobile forms (e.g., smartphones). For shorter term mobility decisions (e.g., going to a restaurant), sources like route planners (e.g., Google Maps) are standard now. However, despite the myriad information sources, it is not always straightforward to make the most adequate choices for longer-term mobility choices that include structural decisions such as house/work locations, private car acquisition or holding monthly cards. Actually, longer-term decisions involve all complex issues referred above. In face of this complexity, the final decision is too often buying a private car (or several). Inter alia, the dominating modal share of cars is responsible for much of the urban unsustainable development (e.g., air pollution, noise, space deprivation, accidents, run-overs).

We hypothesize that households might be inefficient in their mobility management with the collective results of excess energy consumption, congestion, and losses in productivity. On the other hand, we can postulate that these households (and to a larger extent companies) are rational entities that know potential alternatives to their current mobility patterns, although they often do not choose them. The reasons for not choosing them could be categorized into 5 broader groups of reasons: 1) lack of awareness or knowledge to make the full accounts of mobility options (e.g., "I did not include depreciation of car in total car ownership expenses and that it would ultimately impact so significantly my household budget"); 2) lack of information regarding the existing transport alternatives (e.g., "I wasn't aware of car-sharing system, costs and potentialities"); 3) social ties that interfere with mobility plan of the household (e.g., "I have to take my kids to school before work"); 4) personal constraints or resource limitations (e.g., impaired mobility citizens); and 5) other benefits for the household compensate the lack of efficiency identified strictly from a transportation perspective.

Reducing this inefficiency for the first 4 causes presented could potentially be achieving through the mediation of households and the complex urban mobility system. Such mediation services already exist in the energy sector with the Energy Service Companies (ESCO). Just like ESCO's do for energy services, the aim of this research is to explain and illustrate how Mobility Service Companies (MOSCO) can mediate the household mobility planning and decision-making that, ultimately, can reduce their annual mobility budget and, eventually, environmental footprints. For that, a set of households are used as test-beds for the proof-of-concept of this new mobility support service.

2. Literature Review

Household´s organization of regular mobility involves a wide set of requirements (of each household member and of the remaining alters of their social networks that somehow are involved in these mobility plans – e.g., grand-parents who take care of children) and information on the existing mobility solutions (e.g., public transport network and services, tariffs, timetables, total costs of car ownership, etc.). Household mobility is defined by all trips household members undertake, where these trips can vary by purpose and how they are organized, on a weekly basis. Trips have been defined by the type of activity that they serve and organized in three groups, such as subsistence, maintenance, and discretionary (Bhat, 1999) and as mandatory, flexible, and optional (Primerano, 2007).

As described by Pritchard (2015), trips can be classified by type of activity into two general categories: "Foundational trips" and "Non-foundational trips". The first set includes trips related to activities that are fixed both in terms of location and time of day over the week or in some days of the week, such as work or school. The second set are "Non-foundational" trips that can be divided in two sub-groups: "Discretionary" and "Mandatory". The first group includes the trips related to non-foundational activities that can be dismissed and are both flexible in time and location, e.g. jogging, movies; the second are the trips that are related to non-foundational activities that have to be made sometime and somewhere (where location and time are flexible, as well), e.g. necessary shopping where the date, time and place can change.

Opposed to single trips and more indicative of the true decision-making process associated with travel are trip chains. Their importance when analyzing travel behavior has been highlighted by many studies (Van Acker, 2010). A trip chain is generally accepted to be a sequence of trip segments between any pair of anchor/foundational activities (e.g. home, work, or school)

bounded by stops of 30 minutes or less (Mcguckin, 2005). Household types, such as single non-worker households, single worker households, couple non-worker households, couple one-worker households, and couple two-worker households has been found to be the main determinant of activity-time allocation, nature and complexity of trip chains (Lee, 2007). In face of their structural long-term decisions (for instance, residential, work and school location choices), households need to choose one or more modes of transport (including private car use), to complete required trip chains for all household members. For all types of trip chains (both work and non-work related) the pattern of these trips drives the modal choice (Ye, 2007). Therefore, the potential trip chain influences the mode choice but the mode choice also has an important impact on the nature of the trip chain. This relation between mode and chain is very important because household tend to structurally commit to a specific modal choice (e.g. purchasing an automobile or transit monthly card) and forget, before making that important decision, about other available options. This commitment in many cases can be binding, with individuals being reluctant to shift modes (Simma, 2001). Still, we argue that this "binding" might become weaker, with many vehicle sharing options arising, provided that households know and consider these options in their activity and mobility planning decisions.

Nowadays, the household social network has an important role in the household mobility, for example a grandmother that picks up the children from school or people that carpool to work. A growing number of authors have begun to highlight the need to understand mobility within the context of broader social processes (Dugundji, 2012). For that matter, we believe that by exploring the nature of those trips with a group of the elicited alters (social network contacts) would allow us to build a more careful and real alternative mobility plan for the household. Studying social activity patterns and the associated travel has been explored successfully through the incorporation of social network analysis tools, mainly with the use of egocentric network tools (Arentze, 2008) (Carrasco J. A., 2006) (Moore, 2013). As such, household travel surveys (HTS) have to be complemented with social network analysis (SNA) to fully capture the households' decisions when planning their activity and mobility patterns (Santos, 2011). The survey methodology for SNA begins to explore the participant's social network through the use of an egocentric name generator. This is the standard method to enumerate networks within the field of social networks (Marin, 2007). Respondents are asked to name individuals they consider very close or somewhat close emotionally. It follows a modified version of the interview-based data collection methodology with participant-aided sociograms presented by (Hogan, 2007). The respondent is then asked what type of support they could expect to receive from any of these alters following the method presented by (Widmer, 2013). This social network data collected complements HTS data to provide important insights into the patterns of household's mobility with interference/dependence on these alters.

3. Methodology

To describe the concept behind MOSCO, the analogy to medicine can be used. These "Doctors of Mobility" would make a diagnosis of the current household's weekly mobility plan and then suggest a therapy to possibly correct "diseased" (or better saying inefficient) mobility options. In order to address the issue of household activity and mobility patterns, we had to collect a diversified set of variables that are often not collected simultaneously. The survey was developed to incorporate household behavioural economics (Ampt & Ashton-Graham, 2013), household travel survey (HTS) and social network analysis (SNA), of the alters that somehow influence the household mobility organization, following (Pritchard, 2015) methodology.

The approach used here is to first identify household activity and mobility profiles. For that, we collect information regarding the weekly activity and mobility patterns of household members, determine regular mobility requirements and the network of subordinations, namely with elicited alters (specially those considered "very close"). Data collection is made through detailed personal interviews and by collecting mobility data from Google Maps' personal timeline tool. We then compare current mobility indicators (e.g., weekly budget, travel times, CO2 emissions) with those potentially obtained after presenting alternative mobility plans.

As stated before the objective of the survey questionnaire is to identify household mobility profiles. For that purpose, the interviews were designed to extract information to characterize the household, including their social mobility network and their daily mobility plans. The interviewees were informed that the survey was to be used for the present research only and confidentiality would be ensured. The respondents could read the terms of the survey and formally authorized the use of the provided personal information for that matter.

The survey is organized in four different sections:

1. Introductory questions;
2. Sociodemographic and mobility characterization of the household;
3. Social network characterization; and
4. Week mobility diary (including social network relationships).

The first section is composed of introductory questions that aim to understand the household awareness of their mobility efficiency, mainly in terms of travel time and travel money budgets; their awareness of possible alternatives, in terms of reorganization of mobility plan, alternative modes and alternative location choices for activities and residence. Furthermore, inquiries are asked if they took into account the household mobility requirements (such as, how many times car is used? Distance of regular trips? Work-home distance? Possibility of sharing mobility? etc.) before making long-term decisions (namely, residential location choice relative to work and school locations).

The second section focus on the characterization of the household elements and their mobility, and includes general demographic questions such as household size, age, gender and the level of education of members. Regarding the household mobility, the survey includes questions regarding motorization rate, driver's license, transit monthly cards and their residential, work or school locations.

The third section explores the household's social network through the use of an egocentric name generator. In this section, the interviews are initiated by asking the household respondent to think of the people whom they share their weekly mobility (limited to 15 alters) and then consider which alters (personal network members) are either very close or somewhat close. After that for each alter, the relationship type (e.g. parent, friend), age, gender, occupation and type of support they could expect to receive from them (Emotional support, Financial support, Support in kind, Support in services) are asked. Finally, the ego is asked how frequently they meet in person with each of the alters.

The objective of the fourth section is to capture what is assumed to the regular household weekly travel behaviour. The household respondent is asked to recount all the household trips from the week before. The departure and arrival times are recorded, as is the origin and destinations as well as the purpose and the transport mode used. The type of trip (foundational, discretionary or mandatory) and whether or not the trip was made alone or with others is also recorded. Respondents are encouraged to recall all trips even short walking trips. For that, respondents who had their Google maps location mode active were encouraged to analyse their timeline records in Google maps to recall all details of their weekly mobility.

The household postal code and work or school location were introduced in Google Maps, in order to obtain realistic trip distances and duration (respondents were not asked for the routes they chose). For the remaining trips (non-foundational), we introduced a reference point or city area, since inquiries were often unsure of specific addresses. The remaining data relating to transit was obtained through operator's websites and information provided by Google Maps for trip distance and duration. Values obtained were subsequently introduced in the database.

For the current proof-of-concept, we opted to limit our survey to the 5 working days (Monday to Friday), since weekend days are more prone to variability and therefore do not include foundational activities, so often. The surveys were applied only in a work week.

The amount of money spent on fuel does not truly translate the financial burden associated with the ownership and use of a car. For this reason, and aiming to make a more realistic

comparison between the different transport modes analysed, the inclusion of other costs was necessary (depreciation, maintenance, repairs, etc.). So, car ownership costs are divided into operational costs (opex.km), influenced by the distance travelled, and capital costs (capex.time), influenced by duration of ownership. We used a flat rate of 0,23 €/km for the operational costs (that include fuel, maintenance and repair costs, tolls, insurance). Capital costs correspond to depreciation costs (we assumed that vehicles are acquired with full payment upfront and did not consider credit or leasing costs). For that the flat daily depreciation cost is 5,30 €/day. Refer to (Moura, 2009) for details on the calculations and assumptions. Thus, the weekly car ownership total costs (TC) were calculated with the following equation:

$$TC=d=15tripsltrips,d\times opexkm+d\times capextime$$

, where $l_{trips,d}$ are the trips made over a day d;

d is the day of the week when the car is not used.

In the case household members travel with transit, weekly costs are based on the monthly transit card costs divided by 4,3 (average number of weeks per month). Therefore, the household's total mobility costs over a week are the sum of both car ownership and transit costs, to which we added parking costs and Municipal tax for parking if they exist.

Besides operational and capital costs, we accounted also for the externalities of mobility options, by calculating emissions produced by the transportation mode that the household use and included all regulated pollutants and CO2. We did not include the remaining externalities (such as noise, soil deprivation, accidents, etc.) for simplification purposes. To quantify the emissions for the pollutants produced by cars, we used the factors obtained in (Moura, 2009) for the different cars used by the household.

Table 1. Assumption Values.

Parameter	Value	Unit
Car Ownership Costs [a)]	0,320	€/km
Ownership Cost/Use of Vehicle [a)]	0,230	€/km
Depreciation [a)]	5,300	€/day
EMEL (Municipal tax for parking) - 1 car [b)]	0,030	€/day
EMEL (Municipal tax for parking) - 2 cars [b)]	0,150	€/day
Environmental damage costs - CO_2 [c)]	0,025	€/kg
Environmental damage costs - CO [c)]	0,500	€/kg
Environmental damage costs - NO_x [c)]	2,800	€/kg
Environmental damage costs - NMVOC [c)]	1,000	€/kg
Environmental damage costs - PM [c)]	40,000	€/kg
Conversion liter/kg - Gasoline [a)]	0,748	kg/l
Conversion liter/kg - Diesel [a)]	0,820	kg/l
Emission factor CO2 - Gasoline [a)]	3,186	gCO2/g
Emission factor CO2 - Diesel [a)]	3,138	gCO2/g

Sources: [a)]Moura, 2009; [b)]https://www.emel.pt/pt/; [c)]Bickel, 2006.

For the emission factors for transit, we considered only the emissions for the bus, because our approach includes only the operational stage of the energy lifecycle. As such, underground and rail are considered not to produce atmospheric emissions, although the electricity that powers them has environmental footprints. The emission factors considered for the bus are CO_2 (Lisboa, 2014), CO, NOX, NMVOC and PM (EMEP, 2013). Therefore, the total emission, for each regulated pollutant, is the multiplication of the emission factor by the kilometres travelled by household members in different modes. These emissions were converted into monetary terms by multiplying emissions by environmental damage costs proposed by the HEATCO report (Bickel, 2006), which

guides the Cost-Benefit Analyses in the EU.

To characterize the household social network, as stated before, we used the egocentric name generator. This tool provides the names, characterization and kind of support that the household could expect from the alters that interfere in their weekly mobility. This social network data was combined with the shared mobility data that was collected in the weekly trip diary, in order to understand and characterize better the household mobility. For example, to understand the relationship with the person whom they share the trip with and why. This characterization can add a very important indicator in the household mobility planning, for instance, the type or purpose of trip and the member or members that they share with.

The tools presented above, were also used, in the characterization of the alternative presented to each household, in order to reduce the overall household mobility money budget.

The assumption values used in the previous calculations are resumed in Table 1 (above).

4. Results and Discussion

This study is a "proof-of-concept" and, for that purpose we wanted to test this pilot with a more limited set of participants and, with that in mind, we recruited in IST and nearby people. The questionnaires, previously described, were made to four different households and, each one of them has a different mobility profile. For a better understanding of the differences between the households recruited, we summarized in Table 2 some of the characteristics of each household.

Table 2. Households Characteristics.

Household #	Household Size	Residential Location	Household Code	Age	Occupation	Occupation Location	Car	Monthly Travel Card	Social Network Size
1	4	Póvoa de Santa Iria	P1	41	Staff	Avenidas Novas (Lisboa)	1		3
			P2	44	Designer	Oeiras	1		
			C1	14	Student	Portela de Sacavém			
			C2	10	Student	Portela de Sacavém			
2	3	Algueirão	P1	43	Staff	Avenidas Novas (Lisboa)			1
			P2	49	Production Director	Parque das Nações (Lisboa)	1		
			C	13	Student	Avenidas Novas (Lisboa)			
3	1	Arroios (Lisboa)	P1	29	Staff	Santo Antonio (Lisboa)	1		7
4	4	Avenidas Novas (Lisboa)	P1	32	Engineer	Avenidas Novas (Lisboa)	1		3
			P2	31	Student	Avenidas Novas (Lisboa)			
			C1	13	Student	Quinta das Conchas (Lisboa)		1	
			C2	2	Baby				

Note: by Social Network Size we mean the number of alters elicited by the respondent (those people that are close to the ego) that interfere in the household mobility; and by Household Code we mean P for parent and C for Child.

We present hereon each of the household characteristics and analyses, separately, and then compare the results for an aggregate analyses.

Household 1

The household 1 is a family composed by 4 members (2 adults with 44 and 41 years old and 2 children with 14 and 10) and they own 2 cars, that each adult uses on a daily basis. Both work locations are distant from home (38 km and 23 km). Conversely, children school and sport

activities are close to home. Children do not have transit monthly cards, but they take the bus. During the week the household uses 5 different transportation modes. This household has a daily support from other family members ("very close" alters) who take care of the children after school, until parents return home. The support provided includes additional transportation to sports activities. This household recognize that their mobility plan is not efficient in terms of money budget because they know there are alternative plans that cost less, but they think that the alternatives plans they know, are not adequate in terms of schedule. Before making long term decisions, as for example buy a house away from work, they took in to account their mobility plan, but the need to have help and support to take care of the children had a bigger importance. This was the benefit for the household that compensates for the transport inefficiency. As for the decision to buy the cars they did not take in to account the depreciation costs. Weekly household travel distance and time are presented in Table 3, while Table 4 includes the corresponding number of trips.

Table 3. Household 1 Weekly Mobility – Travel time and distance.

Modes		Car 1 (P1)	Car 2 (P2)	Car sharing	Bus	Walking	Total
Distance (km)		238	447	35	12	1	733
Duration (min)		502	600	90	180	20	1392
Members	Parent 1 – P1 (km)	238				1	239
	Parent 2 – P2 (km)		447			1	448
	Children 1 (km)	98	30	7	10		145
	Children 2 (km)	110	19	35	10		174
	P1 (min)	475				20	495
	P2 (min)		600			20	620
	C1 (min)	185	60	30	60		335
	C2 (min)	225	40	90	150		505
Shared Mobility (km)		88		35	2		125
% Foundational Trips		35	24	8	10		77
% Discretionary			4			3	7
% Mandatory			16				16

Note: by Car sharing we mean that the household member was driven by another member of the social network.

As illustrated in Table 4, foundational trips (i.e., those related to work and school) are dominating in this household. The average time per day spent by household members for foundational activities is 8 hours; 0,5 hours for discretionary trips and 2,5 hours for mandatory activities. The trip-based modal split of the household indicates that 78% of daily trips are made by car, 7% carpooling, 11% by bus and 4% walking. Finally, the household has an average 4,7 number of daily trips per household member (including walking trips).

The household social network (namely, the family members who take care of children after school) has a great impact on the weekly shared mobility. Shared trips are always related to foundational activities and purposes vary between picking up the children, lunch, sports and returning home. The household only shares mobility with 3 different people, as can be seen in Table 5. Note that motive/purpose of trips are coded. "A1" and "A2" refer to alters elicited by the respondent (those people that are close to the ego).

Table 4. Household 1 Weekly Mobility – Number of Trips.

Member	Foundational	Discretionary	Mandatory	Total
P1	21 *(91%)*	2 *(9%)*		23
P2	15 *(52%)*	6 *(21%)*	8 *(28%)*	29
C1	20 *(100%)*			20
C2	21 *(100%)*			21
Household's total trips	77 *(83%)*	8 *(8,5%)*	8 *(8,5%)*	93
Average nº trips/day/member	3,9	0,4	0,4	4,7
Average nº trips/day/adult	3,6	0,8	0,8	5,2
Average nº trips/day/child	4,1	0	0	4,1

Note: The questionnaire includes all activities from the moment household members leave home until they return. For example, leisure activities of children after being at home are not captured.

Table 5. Household 1 Weekly Mobility – Number of Trips.

Modes		Car 1 (P1)	Car sharing	Bus
Distance (km)		88,0	35,0	2,0
Duration (min)		185	90	30
Members	P1	A1		
	P2			
	C1	A1	A2	Friends of C1
	C2	A1	A2	
Motive/Purpose		8 e 14	13 e 15	9
Type of Trip		1	1	1

The total household costs in mobility and emissions are presented in Table 6. Not surprisingly, the cost related to car ownership dominate and account for 92% of mobility costs of the household. Importantly, the mobility options generate an additional 13% of external costs.

Table 6. Household 1- Weekly Costs for the current situation

	Weekly Costs		
	(€)	*(%)*	(€/member)
Total Car Ownership Costs	179	*92%*	45
Transit Costs	15	*8%*	4
Total Mobility Costs	194		49
Total Emissions Costs	27	*13%*	7

The household, as mentioned before, recognizes that public transportation (rail) can be an alternative for their mobility plan, but they judge the schedules not adequate according to their needs and expectations.

Among the various possible alternatives, we took into account the great need for mobility, as the location of the residence is far from the parent workplaces or the workplaces are far from the children school or sports activities. Having that in mid, the alternative plan that we considered was selling the 2nd car used by P2, since it is the car allocated to more frequent and longer travels, driving alone. All other household members remained unchanged, since their mobility options involved other household members or alters (carpooling). The alternative mobility plan proposed was to replace this car by a suburban rail monthly card (CP) that adds more walking from/to railway station and for lunch, longer travel times (about more 300 min/week, i.e. 30% more than the current situation) and some rearrangements on the weekly activities and trips due to loss of car

availability. Alternative plan costs are described in Table 7.

Table 7. Alternative Plan Costs for Household 1 and comparative analyses

	Weekly Costs (€)			
	Current Plan	Alternative Plan	Variation (€)	% Variation
Costs of Car Ownership	179	76	-103	-57%
Public Transport Costs	15	30	+15	+100%
Total Mobility Costs	194	106	-87	-45%
Total Emissions Costs	27	10	-17	-63%

Importantly, this change generates weekly savings of 45% of the travel money budget, despite the increase of 30% on the P2's travel time budget – i.e., a reduction of 0,3 €/min of additional travel time. If P2's perception of value of time is higher than 0,3 €/min (i.e., 18 €/h), than he might not consider the effort worthwhile – obviously, not accounting for the several positive externalities such as less emissions (-63%) or more active daily life.

Household 2

Household 2 is a family composed by 3 members (2 adults with 49 and 43 years and 1 child with 13) and they own 1 car. They live about 30 km away from their work and school. They use only 2 different modes of transportation over the week. This household has a daily support from another family member who takes care of the child when needed. The support provided does not include additional mobility, as the children walks from school to the alter's home. This household acknowledges that their mobility plan is not efficient in terms of money budget because they know there are alternatives plan that cost less, but they think the alternative plans they know are not adequate in terms of schedule. Again, other benefits compensate for the apparent transport inefficiency. Before making long term decisions, they took into account their mobility plan, but the situation, in terms of work location, was different at that time. As for the decision to buy the car they did not take in to account the depreciation costs. Weekly household travel distance and time are presented in Table 8, while in Table 9 includes the corresponding number of trips.

Table 8. Household 2 Weekly Mobility – Travel time and distance

Modes		Car	Walking	Total
Distance (km)		433	10	443
Duration (min)		960	145	1105
Members	P1 (km)	304	10	314
	P2 (km)	433		433
	C (km)	302	2	304
	P1 (min)	475	135	610
	P2 (min)	930		930
	C (min)	460	25	485
% Foundational Trips		49	16	65
% Discretionary		6		6
% Mandatory		16	13	29

As illustrated in Table 9, foundational trips are dominating in this household, although mandatory trips have a higher share in the mobility pattern than household 1 (with 8,5% only, when compared to 24% of household 2). The average time per day spent by household members for foundational activities is 6 hours; 0,2 hours for discretionary trips and 0,7 hours for mandatory activities. The trip-based modal split of the household indicates that 80% of daily trips are made by car, while the remaining walking. Finally, the household has an average 5 number of daily trips per member

(close to the number found for the household 1).

Table 9. Household 2 Weekly Mobility – Number of trips

Member	Foundational	Discretionary	Mandatory	Total
P1	20 *(71%)*	2 *(7%)*	6 *(21%)*	28
P2	24 *(71%)*	2 *(6%)*	8 *(24%)*	34
C	11 *(85%)*	2 *(15%)*		13
Household's total trips	55 *(73%)*	6 *(8%)*	14 *(19%)*	75
Average nº trips/day/member	3,7	0,4	0,9	5
Average nº trips/day/adult	4,4	0,4	1,4	6,2
Average nº trips/day/child	2,2	0,4	0,0	2,6

The total household mobility and external costs are presented in Table 10. Total costs are approximately the same has for the previous household who had 2 cars for a 4-member household. Importantly, the external costs are higher and generate an additional 30% to total mobility costs.

Table 10. Household 2 Total Costs

	Weekly Costs		
	(€)	*(%)*	(€/member)
Total Car Ownership Costs	138	*100%*	46
Total Mobility Costs	138		46
Total Emissions Costs	38	*27%*	13

The household, as mentioned before, acknowledges that suburban railways can be an alternative for their mobility plan, but they think that the schedules are not adequate.

Among the various possible alternatives, we took into account that the parents and the child work or school location are very close and they have the same schedules for coming to work or going home. Having that in mid, the alternative plan considered for the household 2 is to sell the car and buy transit monthly cards. This option is rather extreme as the household may want to travel during the weekends and holidays (which we didn't inquire in our survey), as it eliminates flexibility and may limit spatial choice in activities. This alternative entails more walking as they need to walk to the train station. Importantly, this mobility plan decreases travel time budget by about 460 min/week – i.e., 48% less than the current situation. The alternative plan costs are compared in Table 11.

Table 11. Alternative Plan Costs for Household 2 and comparative analyses

	Weekly Costs (€)			
	Current Plan	Alternative Plan	Variation (€)	% Variation
Costs of Car Ownership	138		-138	-100%
Transit Costs		21	+21	+100%
Total Mobility Costs	138	21	-117	-85%
Total Emissions Costs	38	0	-38	-100%

Although the option might sound somehow unrealistic, this more extreme alternative plan sheds light on the potential mobility expenditure gains of 85% and nearly 50% travel time reduction, besides the radical reduction of emissions. Although we have not the record for their weekend mobility, this household definitely has activities that might require a car. Although car sharing is not available close to the residential location, and car rental services are not sufficiently fast and easy to contract, we can argue that, in the future, such options might be more beneficial for the household than enduring the car ownership costs. More simply, paying for taxi services might be cheaper than owning car, if transit is the option for the working days' trips. A less extreme option

could be leave the car at home and use public transportation for commuting over the week. Savings wouldn't be so impressive but more feasible and acceptable for the household.

Household 3

The household 3 has one 29 years-old member and owns 1 car. She lives in Lisbon near work and sports activities. She uses only 2 different transportation modes. She has to pay a municipal tax for parking and has to pay parking near work. She acknowledges that her mobility plan is not efficient in terms of money budget because she can have a transit monthly pass instead of having a car. Before making long term decisions, she took in to account her mobility plan and chose a house near work. As for the decision to buy the car she did not take in to account the depreciation costs. Weekly household travel distance and time are presented in Table 12, while in Table 13 includes the corresponding number of trips.

Table 12. Household 3 Weekly Mobility – Travel time and distance

Modes	Car	Walking	Total
Distance (km)	66	4	70
Duration (min)	370	80	450
Shared Mobility (km)	23	3	26
% Foundational Trips	44		44
% Discretionary	14	33	47
% Mandatory	3	6	9

As illustrated in Table 14, this single person has a rather small share of foundational trips and high share of non-foundational trips, suggesting that the weekly mobility plan is more diversified. The average time per day spent for foundational activities is 9 hours; 2,1 hours for discretionary trips and 0,25 hours for mandatory activities. The trip-based modal split of the household indicates that only 60% of daily trips are made by car and remaining walking. Finally, this person has a distinctive 7,2 trips/day, suggesting a hectic daily mobility.

Table 13. Household 3 Weekly Mobility – Number of Trips

Member	Foundational	Discretionary	Mandatory	Total
Adult	16 *(44%)*	17 *(47%)*	3 *(8%)*	36
Average nº trips/day/adult	3,2	3,4	0,6	7,2

This person's social network has a great impact on her weekly shared mobility, since she is a "helper" of other households. Shared trips are of all types, foundational, discretionary and mandatory. The purpose varies between work, visiting family, picking someone up, coffee, exercise and returning home. She shares her mobility with 7 different people, as can be seen in Table 14.

Table 14. Household 3 Shared Mobility

Modes	Car	Walking
Distance (km)	22	3
Tempo (min)	125	55
Member	A1, A2, A3, A4	A5, A6, A7
Motive/Purpose	1, 6, 7, 9, 14	1, 9, 13
Type of Trip	1, 2, 3	2

The total household mobility and emission costs are presented in Table 15. The striking difference of this single-person household is the total mobility costs per person, of 66 €/week (50% more than households 1 and 2). Naturally, this person engages in more activities outside home, besides not benefitting from economies of scale. This single person still has to make trips to the supermarket and other mandatory activities as does a household of 4. The main causes for higher mobility costs are related to parking costs and sharing the car ownership burden alone.

Table 15. Household 3 Shared Mobility

	Weekly Costs		
	(€)	*(%)*	(€/member)
Total Car Ownership Costs	21	*32%*	21
Municipal Tax for Parking	0,16	*0%*	0,16
Other parking costs	45	*68%*	45
Total Mobility Costs	66,16		66,16
Total Emissions Costs	0,54	*1%*	0,54

The household, as mentioned before, recognizes that public transportation (bus and underground) can be an alternative for her mobility plan, but she thinks that the schedules are not adequate. Among the various possible alternatives, we took into account that her house is near her work and both locations are very well served by underground and bus. Having that in mind, the alternative plan considered for the household 4 is to sell the car and buy a transit monthly card. As such, more walking is added to reach the bus station. However, there is a decrease in travel time budget by about less 75 min/week – i.e. 7% less than the current situation. The alternative plan costs are compared in Table 16. Unsurprisingly, the savings are huge reaching a mobility money budget reduction of 87%, while reducing by 7% the travel time budget as well.

Table 16. Household 3 Alternative Plan and comparative analysis

	Weekly Costs (€)			
	Current Plan	Alternative Plan	Variation (€)	% Variation
Total Car Ownership Costs	21		-21	-100%
Municipal Tax for Parking	0,16		-0,16	-100%
Other parking costs	45		-45	-100%
Transit costs		8,75	+8,75	+100%
Total Mobility Costs	66,16	29	-57,5	-87%
Total Emissions Costs	0,54	0	-0,54	-100%

Household 4

Household 4 is a family composed by 4 members (2 adults with 32 and 31 years old and 2 children with 13 and 2) and they own 1 car. They live in Lisbon near work, school and sports activities. Child 1 (C1) has a transit monthly card (for the underground and buses within Lisbon). Altogether, household members use 4 different transport modes during the week. They have to pay an annual municipal tax for parking. This household has a daily support from other family members who take care of the children while parents are at work or studying. The household knows that their mobility plan is not efficient in terms of money budget because they own a car that is parked almost every day. Before making long term decisions, they took in to account their mobility plan and chose a house near work, school and sports activities. As for the decision to buy the car they did not take in to account the depreciation costs. Weekly household travel distance and time are presented in Table 17, while Table 18 includes the corresponding number of trips.

Table 17. Household 4 Weekly Mobility – Travel time and distance

Modes		Car	Car sharing	Underground	Walking	Total
Distance (km)		17	56	40	22,4	135
Duration (min)		65	80	200	325	670
Members	P1 (km)	15	56		14	85
	P2 (km)	11			6,4	17
	C1 (km)	6		40	2	48
	C2 (km)	9				9
	P1 (min)	55	80		210	345
	P2 (min)	45			80	125
	C1 (min)	20		200	35	255
	C2 (min)	35				35
Shared Mobility (Km)		6		40		46
% Foundational Trips		4	8	20	31	63
% Discretionary		16			8	24
% Mandatory					13	13

As illustrated in Table 18, this household has the lowest average mobility level, with 3,2 trips/day/member. The average time per day spent by household members for foundational activities is 5 hours; 0,3 hours for discretionary trips and 0,7 hours for mandatory activities. The trip-based modal split of the household indicates that only 39% of daily trips are made by car, 20% carpooling, 16% by underground and 39% walking. Clearly, this household has the highest share for walking, indicating that members have their foundational activities close to their residential location, which is consistent with the lowest total distance travelled per week (when compared to all other households interviewed).

Table 18. Household 4 Weekly Mobility – Number of Trips

Member	Foundational	Discretionary	Mandatory	Total
P1	15 *(56%)*	6 *(22%)*	6 *(22%)*	27
P2	6 *(40%)*	9 *(60%)*		15
C1	12 *(75%)*	4 *(25%)*		16
C2	1 *(17%)*	5 *(83%)*		6
Household's total trips	34 *(53%)*	24 *(38%)*	6 *(9%)*	64
Average nº trips/day/member	1,7	1,2	0,3	3,2
Average nº trips/day/adult	2,1	1,5	0,6	4,2
Average nº trips/day/child	1,3	0,9	0	2,2

The household social network has an impact on the weekly shared mobility that is mostly related to foundational and discretionary activities. The purpose varies between work, visiting family, picking up someone, lunch and returning home. The household share their mobility with 3 different people, as can be seen in Table 19.

The total household mobility and emission costs are presented in Table 20. The striking difference of this household is the lowest total mobility costs per person, of 10 €/week and lowest footprint (less than 1€/member). The main causes are related to living close to main weekly destinations and not using car often.

Table 19. Household 4 Shared Mobility

Modes		Car	Car sharing	Underground
Distance (Km)		6,0	56,0	40,0
Duration (min)		25	80	200
Members	P1	SA	Work colleagues	
	P2	SA		
	C1	SA		friends
	C2	SA		
Motive/Purpose		6, 7, 9	1	2, 14
Type of Trip		1 e 2	1	1

The household, as mentioned before, acknowledges that having a car parked most of the time increases their mobility money budget. Having that in mid, the alternative plan considered for the household 5 is to sell the car. The alternative plan costs are compared in Table 21. Again, the savings are significant and reach a mobility money budget reduction of 78%.

Table 20. Household 4 Total Costs

	Weekly Costs		
	(€)	*(%)*	(€/member)
Total Car Ownership Costs	30,32	*77%*	7,5
Municipal Tax for Parking	0,16	*1%*	0,04
Transit costs	8,75	*22%*	2
Total Mobility Costs	39,23		9,8
Total Emissions Costs	0,62	*1,5%*	0,15

Table 21. Household 4 Alternative Plan and comparative analysis

	Weekly Costs (€)			
	Current Plan	Alternative Plan	Variation (€)	% Variation
Total Car Ownership Costs	30,32		-30,32	-100%
Municipal Tax for Parking	0,16		-0,16	-100%
Transit costs	8,75	8,75	0	0%
Total Mobility Costs	39,23	8,75	-30,48	-78%
Total Emissions Costs	0,62	0	-0,62	-100%

5. Conclusions

Results suggest that households significantly reduce their annual mobility budgets and the corresponding environmental footprint (refer to Table 22, below). Still, these are potential reductions and further action is required to effectively implement the new mobility plans of all household members. Tackling the complexity of household mobility planning is required with potential gains both individually and collectively.

The main conclusion is that there is room for significant financial and environmental savings, if households accept changes and 'dieting' their current mobility patterns. Some alternatives are more radical and the comfort of having one car for the household can compensate the non-strictly necessary cost of ownership. Another important conclusion is that we confirmed from this small set of households that not all costs are taken into account when families make their structural decisions and plan for their regular weekly mobility together with residential, work and school locations choices. Furthermore, the diagnosis and suggestions for remedies should be tailor-made,

as the importance of social network support makes it clearly impossible to find standardized solutions for different cases.

Table 22. Summary of key indicators of household mobility

Key indicators	Household			
	1	2	3	4
Total distance travelled/member (km)	183	148	70	34
Number of trips/day/member	4,7	5,0	7,2	3,2
% Foundational trips	77%	65%	44%	63%
Additional mobility shared with alters (km)	123	0	22	62
Total cost/member (€)	48	46	66	10
% External costs	14%	28%	1%	2%
% Savings potential	45%	85%	87%	78%

At this stage of the "proof-of-concept", we could not convey to each household the alternative mobility plans designed here nor the potential savings. The next step is thus to test their receptiveness and to be able to identify obstacles to those solutions and, if needed to adapt and change the alternative to serve the household better.

At the moment, we conclude that profiles of household weekly mobility can hardly be determined and the determination of dieting solutions should be tailor-made. Possibly, a standardization of interventions can be achieved as more cases are addressed. In fact, the indicators to differentiate household profiles are yet to be determined, although total distance travelled and distribution of trips between foundational and non-foundational activities are candidates for such identification of mobility profiles. Finally, important information can be captured from these interviews to better understand the trade-off decisions by households when planning activities and mobility, and identify the benefits that compensate the inefficiency identified strictly from a mobility perspective. These and other aspects have to be further researched. Overall, the idea of "Doctors of mobility", "mobility coaching", or MOSCO, is clearly a interesting endeavour to pursue.

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