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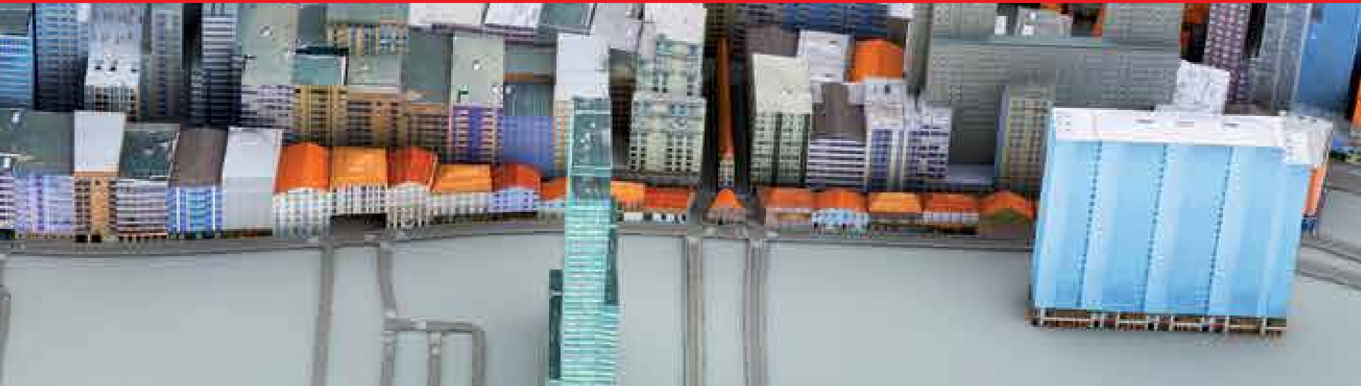

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Notice

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Meet the editor

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Preface

Urbanization, i.e. the process whereby large number of people congregate and reside in big cities or in urban areas, gradually increases. Urban areas are generally characterized as relatively dense settlements of people and they are expanding as never before. Nowadays, more than 50% of the world's population lives in urban areas and demographic projections show that by 2025 the population growth of urban areas will constitute about 90% of all world population growth.

Urban areas are geographical points of problems and potentials. New economic dynamics, technological, social and cultural innovations occur and new opportunities appear. Additionally, social inequalities and environmental problems get worse in urban areas. In general, the increased urbanization creates both new opportunities or challenges and simultaneously new problems for human life. Thus, examining urban development, the planning and process by which urban areas grow is a challenge for contemporary life and it constitutes a scientific field where scientists originating from many fields are in contact and a lot of new issues are raised.

The main topics usually employed by Urban Development concern the following:

a. **Urban planning**. It is concerned with the control of housing and land uses mainly because of urban population growth or urban sprawl, as well as the design of urban environment including infrastructures, like transportation networks, and it aims at ensuring sustainable urban development. Urban planning can also include urban regeneration, i.e. the physical and functional recovery, by implementing urban planning methods to mainly existing metropolitan areas suffering from decline.
b. **Cultural heritage exploitation and sustainable urban tourism**. Many cities are important heritage centres, having historic buildings, archaeological sites, amazing new buildings, cultural traditions etc, and by "attracting" tourists they connect their development with urban tourism. On the other hand, tourism may have negative effects on these cities, creating congestion, damages on the archaeological sites or the cultural heritage etc.
c. **The effect of urban development on ecosystems and environment**. Urban environment is both affected and affects its surrounding environment. Urban environment or ecosystems and "peri-urban" environment or earth ecosystems are increasingly dependent on the patterns of urban growth, since urbanization

significantly influences the functioning of urban and global earth ecosystems and the services provided to urban people. Concerning urban environment, the most important inhabitant needs include, easy access to environmental infrastructure systems and services, availability of open urban spaces like parks and other green areas, provision of healthful housing. Furthermore, the most important adverse impacts on the urban environment affecting and caused by people are: water and air pollution, energy usage and wastage, solid and liquid waste management, land and ecosystem degradation, degradation of historic structures and cultural resources.

d. **The sociological consequences of urban development**. Urbanization has many sociological effects on the structure of urban society. As such, we can make reference to social inequalities and urban poverty, criminality since crime levels usually might rise along with population density, social exclusion for some people like immigrants, illegal housing or the creation of slums in many cases.

e. **The economic problems relating to all of these factors**. All the above factors create economic problems that should be examined in the context of urban economics. Urban economics studies issues affecting cities and urban life and tries to solve economic problems of cities by applying appropriate tools and theories. The basic economic problems of a city might concern urban development and land use, real estate markets, urban transportation and local government finance, as well as various public policy issues affecting city life.

For a better understating of the conditions under which cities prosper and for a suggestion of policies by which positive urban development can occur, these issues should be studied. The chapters included in this book belong in the context created by the above issues.

I would like to thank all the authors for writing interesting chapters and spending time and effort in the preparation of this book. In addition, I would like to acknowledge Dr Marius Minea for reviewing two chapters. I believe that the book will be beneficial to the readers.

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Part 1

Infrastructures and Urban Planning

1

Reappraising Urban Planning and Urban Sustainability in East Africa

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1. Introduction

In recent times, sustainable urban development has been a major challenge confronting the African region generally. This situation is further exacerbated by Africa's rapid urbanization at an average rate of 3.3 per cent per annum between 2000-2005. A rapidly urbanizing region, projected estimates indicate that by 2025 approximately half of the African population will be urban (UN-Habitat, 2008/9). This outstanding demographic shift on the African continent, and particularly Eastern Africa, presents current and future challenges for urban and regional planning (Lwasa, 2008; Rakodi, 1997). Furthermore, according to the UN-Habitat State of the World's Cities Report, 2006/7, rapid urbanization in Africa has occurred in the absence of a stable economic base though recent economic experiences show averagely high GPD rates for various countries. With chronic poverty widely prevalent, urbanization and slum formation are inextricably linked (UN-Habitat, 2007). Compounding this situation current statistics indicate that slums grew at a rate of 4.53 per cent per annum while overall urban growth rates were 4.58 per cent in the same period (UN-Habitat, 2008/9) almost leveling the urban growth is thus synonym to slum growth.

Africa urbanism is increasingly characterized by endemic poverty levels, fragmentation of the formal economy, weak institutions, declining employment and non-existent or deteriorating service provision (Clarke, 1995; UN-Habitat, 2009). But African urbanism also presents unique positive aspects and processes of urban space definition, use and spatial development patterns in which individual ingenuity for survival innovatively utilizes urban space in a productive way. These two strands of African urbanism present opportunities but also have created daunting challenges for sustainable urban development. Sustainable urban development in Africa and East African which would ensure social service provision, sustainable economic development, housing delivery, good urban governance, guided spatial development and urban environmental management. More recently urban development is challenged by mitigation and adaptation to climate change (Lwasa, 2008; Rakodi, 1997). The urban sustainability question in East Africa will require well designed pathways for urban development. This also raises the critical question of whether existing theories, models and practices of urban development offer solutions to the development and planning needs in the African continent and Eastern Africa in particular (Lwasa, 2008; Akatch, 1995).

This chapter critically assesses the role and impact of urban planning processes in Africa generally, and Eastern Africa in particular, with regard to addressing the scale and magnitude of current urbanization challenges. The chapter broadly outlines the global perspectives on urban planning followed by emergence and nature of urban planning in sub-Saharan Africa. An overview of urban planning instruments follows with emphasis on current approaches being applied and their possible impact addressing the daunting urbanization challenges confronting the region. The instruments are examined in context of current urban development experiences in East Africa critiquing the predominant master planning and structure planning approaches. Finally, the chapter outlines leverage points for innovative planning approaches for sustainable urban development and responsiveness to the urban realities of East Africa.

2. Method and materials

A compendium of studies have culminated into this synthesis of appraising urban planning in East Africa. Two extensive literature review studies have examined the experiences of planning in general and urban planning in particular conducted in respect to cities in Kenya, Uganda and Tanzania. The review was conducted between 2006 and 2009 parts of which have been published in the UN-Habitat Report on Planning for Sustainable Cities and several other papers. These studies have focused on the theoretical underpinnings of urban planning comparing the theories and models to the current urban imprint while examining the alignment between the global north models of urban development and the existential spatial structure of cities in East Africa. The Master Planning and Structure Planning approaches are examined in view of urban realities in the region. Urban development models at city-wide to neighborhood scales are also examined in the review to identify divergences and convergences of global north and global south experiences focused on East Africa, the results of which is the synthesis in this chapter. Three additional studies have been conducted in the cities of Nairobi and Kampala at various scales from neighborhood to city-wide levels delving into issues of the current urban imprint, the role of urban planning (*including planning by inaction*) in creating the imprint and what leverage points can be harnessed for urban planning innovation. The latter have extended debates on various substantive planning issues, which are covered in the later sections of the chapter. The three thematic studies include the Making the Edible Landscape, Urban Planning Reality Studio and the Innovative Urban Planning Project. Ranging from two to three years of study, the projects deployed multi-faceted methods including participatory learning and action, service learning methods bringing various stakeholders to working together in identifying scalable and practical solutions to locale specific urban issues. The knowledge from these studies is the basis of this synthesis of appraising urban planning approaches. The synthesis links neighborhood level experiences to city-wide realities and potentials. The systemic failures of 'traditional' planning approaches are identified which are the springboard to identifying leverage points for innovative planning that takes into account urban realities in the region.

3. Urban planning a global perspective

Globally urban planning can be historically traced in northern Europe before it was spread to other regions including Africa. On the advent of planning in Africa, theory and models for urban development were largely transferred from Europe and overlaid on African traditional systems that were arguably unprepared for the new systems of housing, standards, public services and development control procedures that were characterized by top down approaches(Smyth, 2004, Shalaby, 2003, Ndura, 2006). Planning practice remains very similar to colonial administration bent on the legal approach. Urban planning in East Africa still follows approaches and practice that respond to substantive and process theory; positive and normative theories with various planning colloquiums such as centralized versus transformational planning systems(Bennett, 2003). On the other hand are the Global South theories, models and practices with a couple documented while many remain undocumented or systematically described(Ndura, 2006). This divide provides a very good basis for our understanding in the subsequent sections of the entry points for innovation in urban planning. Based on the theories outlined, planning practice in East Africa has largely been influenced by paradigms of Master Planning, Structure Planning and currently under test in some countries of the region is innovative planning (Valk, 2002, Simpson and Chapman, 1999). These paradigms have pursued planning in different ways; functional versus territorial planning; geographical and administrative area planning and time horizon planning(Bennett, 2003).

3.1 The dominance of the master planning approach

In Eastern Africa, urban planning is understood to refer to physical land use planning, consisting of three key elements: first, an overall framework, usually a master plan, second, a set of planning and building standards and regulations and third, a development control system (Clarke, 1995:3). The master planning approach remains the most dominant in the region. This situation has been attributed to a large extent to the nature of professional training, which is still undertaken within a context of strong architectural and civic design traditions underpinned by the political, social and cultural values of the North (Jenkins et al, 2007; El-Shakhs, 1997). Therefore, as Shalaby (2003) aptly noted, "urban development is very much a social process constructed by planners whose orientation is shaped by global North theory and or their own experiential knowledge, which does not necessarily fit with the social problems and needs".

Master plans depicted on a map state the desired form of an urban area at a future point in time when the plan is 'realised' (UN-Habitat, 2009:60). The master planning approach has been critiqued in the planning literature, and in practice replaced by processes and urban plans that are more flexible, strategic and action oriented. According to Jenkins et al; (2007:132), some of the major criticisms of the master planning approach, include the focus on the plan as a product rather than on its effects; the stress on spatial factors and land use compared to social; economic and environment issues, the less focus on rapidly changing forces which shape urban development; the failure to recognize the significance of spontaneous settlement and the practical issues involved; the norms and standards which are global north dominated; the inadequate consideration of critical issues of financial analysis; governance, political interests and the realities of urbanizing poverty. As observed by Clarke (1995:14-15), the net effect of the inadequacies of the traditional master planning approach is that the majority of urban growth has taken place outside the planning 'rules of the game' directly contributing to social and spatial maginalization or exclusion (UN-Habitat, 2009; Jenkins et al; 2007). Although it has received critique, the approach remains particularly strong in majority of African countries with a general reluctance to reform the systems giving rise to organic approaches and interventions by the various stakeholders in the cities.

In a similar vein the much promoted flexible instruments including the 'Structure Planning approach has also faced problems and critique. Structure planning addresses a broader range of social, economic and physical development thereby enabling a more flexible base for the preparation of local plans (Jenkins et al; 2007; Akatch, 1995). On the other hand, action planning is an implementation-oriented approach to solving problems at a local level with community participation as a key to success and using local adaptation of experiences from other contexts effectively translating to a "learning by doing" approach (Clarke, 1995; Nigel, 1998; Hopkins, 2001). Despite recognizing the stakeholders, in principle enabling participation and flexibility around changing envisaged future structures of the city or neighborhood, this approach has not substantively addressed the issues around governance political interests and multi-stakeholder engagement. Therefore, part of the failure of urban planning instruments in Africa generally is attributed to their conceptual and contextual weaknesses to align with African environment and difficulties arising from the complex and dynamic interplay between global, national and political economy in which urban planning has to be undertaken in the region (Akatch, 1995; Mabogunje, 1990). Consequently, an important lesson learnt from the failure of the approaches in Africa generally is the inherent danger of transplanting planning systems and approaches from one context to another given the highly varied nature of urban societies globally. In addition, urban planning is still perceived as a specialist and technical activity, the exclusive preserve of skilled and commonly foreign trained segment of the professionals and or foreign consultant (Akatch, 1995; UN-Habitat, 2009).

Despite the rich theory and approaches, the question is whether the outputs and means of achieving elaborated plans have translated into spatial-social changes in cities of East Africa. An additional question is whether envisaged outcomes of the plans correspond or fit with the societal values, needs and aspirations? As noted by (Diaw et al., 2002), planners have been equipped with sufficient skills and knowledge necessary for responding to the planning needs but this has largely remained for plan outputs and less to implementation of the outputs. Several research, evaluation and commentaries have presented the successes and failure of planning in the Global South(Mukwaya, 2001, Goodfellow, 2010, DPU, 2004, Arimah et al., 2009). From Orangi project in Karachi to Lima and Bogota, Lagos and Nairobi, literature shows fewer successes of planning which has been largely dominated with Global North theories and models (Egbu et al., 2006). Literature shows that adapting the theories and approaches to locale specific realities has a potential for transformative urban development. From the Orangi Project for example, experiences show that local human capacities and resources can create a spin to urban development that is parallel to the top-down approaches though community participation is plagued by challenges of scalability. The inability of spatial plans to subsequently realize societal goals, to deal with housing problems, poverty, urban services, urban environment and enhancement of urban governance is evident in most of the cities of sub-Saharan Africa(Jain, 2003). While efforts and sectoral initiatives by development agencies, UN organizations spearheaded by UN-Habitat, Civil Society Organizations and Governments are also yielding less than the badly needed results of planning (Jain, 2003). Planning and its outputs or outcomes in this context can then be looked at as a distinctive fusion of Global North and or Global South practices.

Looking at these experiences, then a question can be posed as to whether global north influenced planning and practice is relevant for 21st Century urbanization in sub-Saharan Africa? Whereas the intention is not to disqualify its relevance, it is of critical importance that entry points are identified for renewed and innovative planning that is responsive to societal needs in the context of African urbanism. The subsequent sections will endeavor to provide some pointers to this question and raise some of the much needed changes in theory, policy and practice around which planning innovations are needed.

4. Urban planning in the Global South

Pre-colonial settlement and urbanization is recognized in literature but in Eastern Africa, urbanization is largely viewed as part of European colonization. Urban planning processes are also inextricably linked to European town planning practices. In particular, it should be noted that British colonial rule profoundly influenced the nature of urban development in East Africa especially from the late nineteenth century until independence. As Akatch (1995:42) points out, the African region provided ideal experimental grounds for new colonial centers with urban planning processes literally exported as part of the cultural baggage of imperialism. Indeed, as aptly stated in the UN-Habitat Global Human Settlements Report, (2009:60), "frequently, these imported ideas were used for reasons of political, ethnic or racial domination and exclusion rather than in the interests of good planning systems". Thus the current planning systems and urban imprints are largely a legacy of colonial planning practice manifest in a physical sense through the segregated residential quarters (Jenkins et al; 2007).

Furthermore, there are also strong connections in terms of planning legislation, institutional structures and administrative processes (Okpala, 1987). In this regard, town planning legislation for many countries in the region, for example, Kenya, Uganda, Nigeria, Zimbabwe, Zambia has its roots directly in British town planning laws and was transported without modification to the new situation, irrespective of the different circumstances prevailing in the recipient country (Akatch, 1994). However, as Kanyeihamba (1973:243) argues, the adoption of transported legislation was a recipe for failure for a variety of reasons related to different political, cultural, social and economic conditions prevailing in the recipient countries. This situation was further compounded by the dire shortage of specialized manpower experienced during the colonial period, which still prevails to date in the region.

Following the attainment of political independence, very little attempt was made by the new African governments to change the urban functions of the towns and cities, which were inherited from colonial governments (Akatch, 1995). This notwithstanding, rapid urbanization was perhaps the most dramatic social phenomena that marked the end of the colonial era in Africa. From a situation in 1950 in which the total population was no more than 28 million, the figure had by 1984 jumped to well over 125 million (Mabogunje, 1990). Consequently, according to Jenkins et al (2007:115-117), planning activities in colonial Africa undertaken under the influence of western planning institutions left a mixed legacy comprising often contradicting processes and policies. These include a new 'tidal wave' of urban growth, exclusive land policies, a public sector expected to offer solutions to the pressures of urban growth, financial and technical capital inadequacies, segregation and social differentiation.

Therefore, the influence of received planning concepts lingers on in East Africa and is continuously reinforced by the substantial influence of International Development Agencies, the 'donor community' and the planning doctrines of the global north (Watson, 2002). Surprisingly, post-colonial governments have tended to reinforce and entrench colonial spatial plans and land management tools, sometimes in even more rigid form than colonial governments (Njoh, 2003). The net effect has been that these urban plans remain relatively unchanged and unresponsive (UN-Habitat, 2009). Consequently, as Okpala (1990) argues "there is substantial external influence on the planning and development of the African urban system. The performance and service delivery capacities in the African region have also been hampered as a result of inadequacy in the quality and quantity of personnel.

4.1 The interface between planning and urban development in East Africa

There are many experiences of the interactions between planning and urban development in East Africa that are driven by current planning practice. This interface of the practice and the urban development experiences show how social and political processes have shaped urban development, contesting the principles that planners often come up with in developing planning policy. The experience is what some scholars like (Rakodi, 2001) have expressed as 'politics first' before planning can work while scholars have rechoed the gaps between the plans and urban development reality in sub-Saharan Africa (Lwasa, 2006, Koojo, 2005). The interface can be described as one engulfed in a mix of the 'traditional' planning concerns of societal values based on the substantive planning needs on one hand and the procedural equirements(Bennett, 2003, Koojo, 2005) with the later superseding the ability of plans to address the substantive needs. Thus conditions of inadequate urban infrastructure, housing, social services, space utilization or underutilization, congestion, inefficient public transport, poor environmental services and low urban economic transformation have been engulfed in a complex set of procedures that are known by few planners or urban managers and driven largely by politics. The result is a mixed type of urban development that which can be described as informal with pockets of formal areas creating a duality (Koojo, 2005, Egbu et al., 2006). Planning exists and professional planners are applauded with their persistent effort to ensure orderly and sustainable urban development but the translation of such effort to social reform and change remains a fundamental planning question because of the mismatch between the plans and urban development experiences.

4.2 The Disjuncture between plans and urban development in sub-Saharan Africa

Success of urban and regional planning in East Africa has become unpredictable(Egbu et al., 2006, Arimah and Adeagbo, 2000). Planned outcomes are often not achieved because cities develop as a result of millions of independent consumption and production decisions by different individuals, organizations and groups. On the other hand, many positive outcomes of planned interventions are unanticipated (Ssemambo, 2000, Mukwaya, 2005, Jain, 2003, Andersson et al., 2004). There is evidence of positive outcomes of urban planning which has largely been through piecemeal planning(UN-Habitat, 2008, Ssemambo, 2000). This has created pockets of isolated well planned, upgraded and developed neighborhoods, industrial parks and transportation corridors in East Africa. The failures of planning are attributed to many factors including; lack of municipal resources, enforcement, land issues, human resource adequacy and capacity but the issues of governance and institutional aspects have of recent become outstanding (Lwasa, 2006, Rakodi, 2001, Goodfellow, 2010). Yet the major 'players' in urban development who are the developers of differing categories and character have not been well linked to the values of planning and orderly development. But the other argument as put forward by (Leibowitz et al., Jain, 2003) the planning profession may not have actually embraced let alone been able to understand the values of communities and African urban populations. Evidence has also been generated around the missing link between the planning policy strategies and planning action very much shaped by the practice of development control (McGill, 1988). Debunking some of these practice frameworks is still a highly technical and major challenge, which maintains planning arguably as abstract that is largely non-responsive to social needs and change. The fundamental basis for urban and regional planning is for development to meet the needs and aspirations of the population or enable such population to creatively innovate to meet their own needs. It is important to recognize the differing needs and aspirations of a diverse society and or population with possibly locally defined values. This is where innovation in planning needs to strike and break the continued urban development trends in East Africa. There have been recent calls for sociocratic type of planning or ecological planning and with many concepts used, it is a type that assess the existing resource base of a community and or city to devise strategies for a catalytic spatial plan that would enable the population to unleash their potential. Resource here implies; social/political assets, capital assets, human assets and natural/man-made assets. Following the discourse of the major issues of planning theory, urban development and the analysis of planning successes and failures, it is necessary to turn to where planning needs to innovate. One can argue that planning in East Africa is at crossroads, calls for a type of 'new planning' that which among the most urgent issues needs to deconstruct the current urban development imprint.

5. Towards new innovative planning approaches

5.1 Innovation in planning: What it is? And why?

The concept innovation has been defined differently by different people(Bennett, 2003). This is because it has become a buzz word in quest for solutions to the unresolved questions and problems in various fields(Crossley et al., 2005). Innovating has been known in natural science and business as creating or finding something new in a particular context. This section attempts to provide an understanding of the concept of innovation as a launch pad for the subsequent sections of the chapter. In the context of this chapter, "*innovation is understood as the development of systems that are 'new' in the context of planning, utilizing creativity that can be based on adapted local conditions principles and methods*". This planning innovation would require debunking various aspects among which is the planning colloquium that has been followed for a long time. Such innovative planning would have to consider debunking of the 'business analogy' as observed by (McGill, 1988) in which he explains the operations of commercial businesses, their targets and means to achieve those targets. One needs to understand the process theory of business in this case commercially oriented business and the substantive issues of commercial business and the linkage between the business entities with the targeted market population. In the context of spatial planning, substantive issues are urban development sectors and so are the contemporary procedures characterized by a fusion of formal and informal processes. Planning innovation for better communities will have to emerge largely from sub-Saharan Africa where different actors in urban development would need a platform for exchange of ideas, knowledge and skills for developing strategies on how to ignite the much needed social change for sustainable and inclusive urban development.

5.2 Innovative approaches

From the onset, it is important to point out that the problems associated with planning approaches discussed above, and the changing urban and environment contexts have led to the emergence of more innovative or contemporary approaches to urban planning. In particular, various countries in Eastern Africa (Kenya, Uganda) have adopted new approaches to urban planning, which are under test. Strategic planning and sociocratic planning provide the framework for the new innovative approaches. Although these approaches are still under test, a few successes and potentially scalable innovations have emerged through learning by doing and engagement with communities around the longstanding urban problems in East Africa.

Strategic planning reflects the "process" view of planning and is characterized inter alia by cross sectoral co-ordination, financial feasibility, enabling mechanisms by the public sector to support both formal and informal private sector activities, realistic choice mechanisms and monitoring as well as evaluation (Jenkins et al; 2007; Clarke, 1995). Consequently, the emerging output is not just a physical development plan, but a set of interrelated strategies for city development including land, environmental management, infrastructure, economic opportunities, finance leading to a process of integrated urban development (Clarke, 1995).

Urban problems confronting East Africa are unique, locale specific and have led to evolution of locally responsive instruments of city-wide to neighborhood management (Akatch, 1995, Lwasa 2008, Lwasa 2011). Innovation has emerged in respect to financial mobilization, decision-making frameworks and processes as well as knowledge management for scaling of successes that would enable progression from micro-scale innovation to city-wide impacts. Planning innovation, can be based on adapted local conditions to spur local opportunities with built-in mechanisms for sustained social transformation for a livable urban environment". A key theme emerging with reference to urban planning and land use management in East Africa is the need to draw on real social, economic, cultural and political resources to promote solutions which are appropriate to context while 'best practices' from other countries may serve as inspiration to be de-contextualized from place of origin.

The new innovative urban planning approaches have differing entry points. Whereas adapted strategic planning provides city-wide or city regional frameworks, neighborhood innovations revolve around thematic and substantive planning issues of local economic opportunities, environmental management, service provision, managing utilities and promoting cultural diversity. Thus at these scales of intervention, the urban planning innovations have key elements of being strategic, flexible rather than fixed, action oriented, stakeholder or community, linked to political processes, environmentally responsive, socially inclusive, integrative in nature, focused on the outcomes of the planning process.

The urban planning innovations do not suggest models or solutions, which can be transplanted literally from one context to another, but rather offer general ideas, which can be considered in relation to the specific urban planning issues confronting the Eastern African region.

Therefore, in support of the UN Habitat Global Human Settlements Report, (2009), the new approaches can be grouped under the following categories as follows:

Strategic spatial planning which includes a strategic spatial planning system with long range, spatial planning frameworks and principles, and broad and conceptual spatial ideas.

Spatial planning as a *tool for integrating public sector functions* – this new approach focuses on decentralized solutions as well as a desire to 'join up' or integrate the functions of the public sector and inject spatial or territorial dimension into sectoral strategies. Perhaps most importantly this approach recognises that achieving environmental sustainability will require sectoral interests to work together and cut across traditional disciplinary and professional boundaries.

New approaches to *land regularisation and management* – Informality remains the most critical issue for urban planning in terms of regularization and management. Consequently, new regularization approaches require an attitudinal shift in government to recognize the potentially positive role of informality or 'emerging sector'; requires policies, laws and regulations, which are adapted to the dynamics of informality and requires efforts to improve the support for and legitimacy of the planning system by those involved in informality.

Participatory processes and partnerships in planning – In general, it is widely acknowledged that broad-based participation in planning can empower communities and much needed social capital leading to better design of urban projects while also allowing for participants' concerns to be incorporated into strategies. In this regard, a critical aspect would be the need to clearly redefine community roles transforming them from largely 'receivers' to major decision making stakeholders at various levels including verification of objectives, resource assessment, formulation of programmes and monitoring and evaluation (Lwasa, 2008; UN-Habitat, 2002; Fainstein, 2003). This would constitute an important first step towards responding to the failure of past development efforts that have had the unfortunate tendency of relegating the efforts of local communities to backstage in the articulation of their development needs.

Successful participation, however, remains ultimately contingent upon certain pre-conditions relating to the *prevailing political system*, the legal basis for participation and available resources and empowered local governments as well as organized communities and stakeholders. It is also important to acknowledge the important role of public-private partnerships, which have often been developed around public infrastructure especially when existing municipalities lack resources to provide the infrastructure.

Approaches promoted by international agencies - Significantly, in recent times, these forms of broader *'participatory planning'* described above, have been attempted by International Development Agencies and United Nations organizations spearheaded by UN-Habitat in important initiatives including the Urban Management Programme (UMP), Sustainable Cities Programme (SCP), Local Agenda 21 (LA 21) and City Development Strategy (CDS) projects in various pilot situations although their impact still needs to be understood more specifically in context (Jenkins et al; 2007; UN-Habitat, 2006).

New Urban Forms: *'New Urbanism' and the 'Compact City'* - On the one hand, and at a city-wide scale, the 'compact city' approach argues for medium to high built densities, enabling efficient public transport and thresholds to support concentrations of economic activity, services and facilities. On the other hand, 'new urbanism' adheres to similar spatial principles, but at the scale of the local neighborhood. This position promotes a vision of cities with fine-grained mixed use, mixed housing types, compact form, an attractive public realm, pedestrian-friendly streetscapes and defined centers.

However, it should be pointed out that there is considerable overlap between these categories; some emphasize process and others outcomes and sometimes a combination (UN-Habitat, 2009). In the Eastern African context, efforts at attempting innovative participatory planning approaches have largely been spearheaded by international agencies, for example, the joint initiative of UNEP/UN-Habitat Sustainable Cities Programme in Dar-es-Salaam, Tanzania and the Local Agenda 21 initiative in Nakuru, Kenya. In general, the urban Environmental Planning and Management (EPM) approaches, technologies and know-how through urban local authorities based on broad-based stakeholder participatory or city consultation approaches offer innovations space.

6. Practice and promise of innovative urban planning

Planning practice is influenced by many factors including education and training. This section will give experiences of the practice and potentialities of scaling up the innovations. The section is based on real cases of the studies conducted in the region.

6.1 How can planning innovate?

There are possibly many ways through which planning innovation can be achieved and in this section of the chapter, an attempt is taken to describe some of the key areas in which innovations are required and how such innovation can be harnessed.

6.2 Innovative planning research, moving from projects to policy and programs

Spatial planning research has received little attention compared to development and economic planning with the two misconstrued as synonyms. Research is taken as inquest to learn what, why and how on issues of urban development. Thus even a simple field visit trip by a building inspector on a site can be monitoring but when data is collected for use later it has many research implications. Spatial planning focused research is required on substantive issues to influence outputs and outcomes of planned interventions. This has in a way directed spatial planning in terms of 'projects' and one can argue that there has been a 'projectization' of planning itself and urban development in general. The consequence is a scattering of often slightly improved neighborhoods, industrial parks and developments due to piloting while many remain in poor conditions. The key urban challenges on which planning research is useful and needed include urban livelihoods, urban environment, urban poverty, urban transportation about which knowledge is scattered, inadequate or requiring to identify alternative models for provision of services and guiding urban development. In addition there are various dynamic conditions in the urban field including governance, resource mobilization and management, the increasing role and creativity of the private-sector which despite being vibrant are also less understood from the planning point of view.

Following the adage that “knowing a problem cause means you have solutions for it”, its imperative for planning to reflect on these challenges probably with adapted or different lenses. From basic to applied research and now participatory research, these domains offer great opportunities to support planning innovation, knowledge generation and making informed planning interventions. Some of these research undertakings have been very revealing. For example whereas the planning has always grappled with the issue of ‘standards’ in respect to land and housing, the revelation is that possibly many people are not in position to afford such ‘high standards’ and coupled with other factors this influences the urban development imprint in the region(Rakodi and Lloyd-Jones, 2002, Rakodi, 1997, Rakodi, 2001). Research indicates that with this experience and projectization, a move from projects to policy thinking is necessary(McGill, 1988, Arimah and Adeagbo, 2000, Lotz-Sisitka). A move that entails programming of urban development but which recognizes incrementalism or phasing but most important ensuring sticking to plans through the routine actions that would lead to the desired goals. Participatory research has provided some insights but maybe not answers (Lwasa and Kadilo, 2010). A triple helix model that would enable a platform of knowledge generation and exchange would be useful, one which brings together, local governments, governments on one hand, research organizations/NGO’s as second category and communities as the third category, to investigate problems and search for local-based solutions within affordable ranges (Egbu et al., 2006, Higgs, 2008, Williams et al., 1999). The bringing together of various actors in urban development is now widely recognized and some of the initiatives include Urban Fora for discussion, prioritizing and directing knowledge generation for search of solutions.

A key input for planning is information on the substantive issues as well as processes (Mahavir, 2005, Lwasa, 2005) which is related to knowledge. Planning usually is preceded with collection of large data volumes, which sometimes are never processed to useful information nor getting utilized. Given the gamut of planning information needs, it means that any initiative to collect, analyze and utilize planning information could have experienced a situation of ‘too much’ data and ‘less’ utilized. This is not a surprise because planning usually projects development into the future, which may be uncertain. From social and economic surveys to spatial information on land use and other physical components, data are collected but partly analyzed. Arguably, there is an assumption that with the scale of data collection, the solutions to urban problems would be understood, explained and solutions derived. Not all the data collected by planners is actually used in a plan-making exercise. In fact "very little," a planner will discretely reply as observed by (Mahavir, 2005) that only 60% of data actually become input for plan making. The reason that planners collect so much data is a conventional approach influenced by the planning models described earlier in the chapter. Huge amounts of time and other resources are spent on collecting and analysing the same data, which in turn delays the start of the planning process, sometimes by several years Mahavir further observes. Differentiation, between essential and desirable data should provide the answer to the resources an aspect not given due attention. The key issue here is that both in terms of financial resources and time, this information takes an enormous share but if an evaluation is conducted, one wonders whether such scale of data analysis has really translated into solutions in East Africa. The innovation around planning information is likely to come from strategic determination and use of planning information given the level at which our information systems are. This would mean skimming through the available information as well as urban problems to identify essential data for the planning exercise. Those which if utilized would have a multiplier effect in solving other related problems. This implies dealing with the 'most important problem' that Amdam and Veggeland (1998) called the 'garbage-can-model' in which the decision making process are activated through identifying the problems, active participants and a stream of solutions by those experiencing such problems.

In practical terms, assuming urban problems of livelihoods for majority of dwellers and public transportation are serious issues in a city. If collection of data about each would have to run baselines, it would be a huge undertaking. By strategic determination and skimming, the stakeholders may view livelihoods as the most important problem and would be interested in innovatively creating employment that may translate in improved incomes, possibly having multiplier effects on housing and vibrant urban economy. This is applicable to existing cities and neighborhoods and from our research, livelihoods based strategies have a place in innovative planning(Lwasa and Kadilo, 2010). In comparison, the public transport multiplier effect may be largely in regard to the energy sector and incomes (KCC and Bank, 2000). It should be noted that the resources required for the example of studying livelihoods are likely to be far much lower than those for improving public transport. One must note however that coupling urban system components such as the two raised here would possibly produce better results and possibly in a much quicker way. However the multiplier effects should not deter investment in large infrastructure like transportation. Basing on a Kampala experience, it emerged that over 60% of the urban dwellers use either walk or cycle modes of transportation to and from their places of work. Yet resources that go into improving roads and traffic counts have been enormous. In this case innovative planning that tackles either livelihoods coupled with alternative modes of transport or one that addresses only alternative modes of transport would most likely respond to the existential needs compared to traffic counts and improvement of road infrastructure.

6.3 Mobilizing resources for planning; From costs of plan production to societal costs

Mobilizing resources has been touched on mainly as a big challenge in urban management(McGill, 1988). Mobilizing financial resources remains a long standing huddle in planning and urban development. Attention has been put on costs for producing plans as the case for the Master and Structure Plans. One important point is that most city or municipal scale plans have been produced with largely external funding. This is likely to continue unless there emerges an alternative strategy for mobilization of resources. There is also the much talked about local and or community level mobilization of resources which has either fallen a victim of projectization or simply not upscaled despite the good lessons(Andersson et al., 2004). There is little evidence of existing systems and initiatives for utilizing locally available resources for planning and its interventions. Yet the costs of not planning are actually those of not doing it and the planning profession cannot afford to continue this way. The societal costs are huge and if one attempted to translate them in monetary terms, it is alarming. For example in one of the study within Kampala, health related impacts of environmental burdens were monetized for the direct and indirect costs and results show that 15% of a household income is spent on defensive expenditure or cost-of-illness expenditure. For that neighborhood alone, a total economic value of $ 1.7 m (Lwasa et al., 2008)was calculated and if one factors in the neighborhoods with similar conditions, the cost is by no doubt high. The costs have become increasingly huge for our society. A possible innovation would be to use an ecological planning approach which localizes problems and solutions as well building on the existing resources available. One of the key principles of such planning is transparency in order to respond to social needs. It is probably what (Bennett, 2003) calls sociocratic planning.

6.4 Redefining community roles

Planning in sub Saharan Africa still remains largely technocratic, a field of practice for highly-trained and sophiscated professionals with less inclusive rules, regulations and standards(Koojo, 2005). Such planning expects adherence or non-adherence from the communities with the later followed by the 'stick' using the regulations. While it is important to have rules, regulations and standards, there is also need to recognize that such should be responsive to social needs which differ from neighborhood to another and between societies. Societal needs reflect both existential and ideals but what planning policy in East Africa responds to is largely the societal ideals. One needs to reflect on the 'societal values' theory in planning which among other tenets underpins the ideals of 'space'. In the context of urban space, one would have to muddle through differing conceptions of space depending on how it is defined and who defines it. The other issue is who determines how it would be used. Connected to the space paradox is power which is defined in governance structures(Leibowitz et al.). Existing and contemporary planning such as the rationalistic planning are silent about the roles of communities in regard to the ideals, space definition and decision making. Yet broadly speaking planning is about dialogue to enable decision making and from African perspective planning in current times is arguably about responding to needs of majority urban dwellers who have remained in deplorable conditions. In this vein, the planning has not adequately promoted decision making that is embracing communities. Often, solutions are handed down to them and this has for a long time shaped the community thinking as that of being on the receiving end. Redefining the community roles from largely receivers to major decision making stakeholders(Andersson et al., 2004) is a key innovation. This is one of the most talked about approach to 'new planning' but which has not been fully tested due to limitations regarding resources. But not testing participation has also not yielded positive results for better communities. It is important once again to note that deconstructing a neighborhood would possibly require enormous resources than constructing it with the communities progressively and incrementally.

6.5 Innovative urban design

As the search for inclusive urban space utilization solutions progress, innovative urban design is responding to the realities of societal needs through innovative research and knowledge generation. A mix of innovators whose desires to see a transformation of the East African cities is leading to emergence of a community of practice. For example because residential land use puts the greatest demand on urban land compared to any other use, its importance is no doubt placing it high on the planning innovation agenda. Based on a case in Kampala which was preceded by urban management policy innovation, urban design can now consider integration of urban agriculture with housing making the best use of limited space but providing housing, incomes and food while maintaining the environmental services. Making the Edible Landscape project by Kampala City Council was showcased at WUF III Vancouver and during the last session of WUF IV, Kampala was again showcased as one of the innovative cities by responding to the societal experiential needs (food, incomes, nutrition) through designs. Although both the results and outcomes of this innovative design are yet to be fully realized, it is a very promising innovation worth replicating and up scaling. It has further advantages of providing a basis for urban adaptive designs to climate change and variability. As contributors to GHG's and the cities vulnerability to climate change effects, adaptive urban designs that focus on plot-level hydrological, climatic and vegetative systems can have profound impact through cumulative progression of localized changes.

6.6 Informality, formality and institutional reform

From commentaries, research and evaluations, the informalization of urban development in East Africa has been well documented(UN-Habitat, 2008). Informality is however occurring amidst formal rules of engagement in urban development(Jain, 2003). Planning has not been spared by this informalization. There has been a good discussion of the fusion of the two seemingly different systems(Lwasa, 2006). Whereas informality has largely imitated the formal rules with adaptation, formal systems are also characterized by informality. In Kampala and Nairobi for example, the dualistic nature of urban development ((Koojo, 2005, Lwasa, 2006, Nkurunziza, 2008) describes informality of housing, infrastructure installations, services but also the development control procedure which is an important planning-policy action. The key issue regarding formality and informality concerns rules of engagement defined by institutional setup. These specify how individuals relate in urban development, their roles and responsibilities. Experience shows that institutions are characterized by three blanket levels for enforcement of the rules. The first is the *official policy rules* which are often well documented. The second is the *unofficial policy rules* that are not documented but are part of the routine policy-action of individuals in positions of public institutions. While the third are what can be considered as the *official-unofficial policy rules* that are neither documented but the guides of routine planning-policy action. To substantiate these rules, the discussion will focus on the last two. The unofficial policy rules are the type which individuals practice based on patronage, favors and sometimes selfish acts. Because of the risks associated with boldly identifying oneself as an agent of unofficial policy rules, this is always hidden and due to this the third category is created. The third official-unofficial policy rules are a very powerful type which lie beneath the official policy rules. They are exercised by a network of individuals in or out of organizations and often known by all staff from the top to bottom connecting to the clientele through selective information dissemination and informal channels. The rules are often described as 'usual' based on connivance, sharing information from identifying 'clients' execution of 'missions'. This has created different layers of procedures and stages in planning but also planning policy-action. Planning has not properly addressed these dynamic political and social processes of dispensation of services. The innovation in this sphere is by no doubt 'noble' and will have to involve adapting the official policy rules. The role of leadership is very significant in enabling innovation in this sphere and critical in this much desired change.

6.7 The planning toolbox

For long, the planning toolbox has also remained a black box in the sense that it has been so technocratic. The planning toolbox has components such as accurate data, equipment, the

Acts, the models and principles. If unpacked, the toolbox is changing but not at a speed desirable to fit in with the strategic determination of planning information to focus on essential data as well as linking policy guides to policy-action. Contemporary planning tools are dynamic and changing very fast(Mahavir, 2005, Lwasa, 2005). In Uganda for example, the toolbox has changed but there are still many areas for improvement around which innovations can be generated. In this section the planning toolbox elements of Acts, data and equipment are the focus. Starting off with the Acts, in East Africa have not been inclusive and sensitive to the needs of Africans. In addition the code of conduct professional and ethics have not been strengthened for long until recently. For example in Uganda the revision of the Town and Country Planning Act 1964 into the new Physical Planning Bill is very laudable and provides a platform for innovation(2008). One of the many innovations in the new bill is the response to the longstanding planning question of 'planning area boundary', by including rural areas and implicitly the peri-urban, the bill provide mandate to planning authorities to prepare or cause prepare plans for areas with a potential to explode outside the official planning area boundary as local physical development plans. In Kenya the creation of the Nairobi Metropolitan Ministry in 2008 is a laudable effort in establishing formal structure to address the metropolitan growth of the city. Planning education needs to quickly embrace these new changes from the public policy domain and prepare future planners to respond within such laws. While the other two components of accurate data and equipment are some of the areas with urgent need for innovation. While working in partnership with other professions and disciplines, it is important to address the need for spatial information, techniques for plan formulation and design of planning information systems that would probably reduce the costs of planning information collection and analysis as discussed earlier. The emergence of Global Navigation Satellite Systems (GNSS), Global Positioning Systems (GPS), Geographic Information Systems (GIS), Remote Sensing with associated systems of Spatial Data Infrastructure (SDI), web-based mapping, online planning are areas worth exposing to future planners (Lwasa, 2005). These techniques and tools provide means for quick accurate information which can aid quick response to planning problems while helping in establishing planning information systems. They also provide a powerful advantage of enabling community-access to planning information, designs and neighborhood conditions that reduces the burden on the part of planning authorities.

6.8 Planning education

For a long time there has been an argument that planners in Africa have a theoretical-professional-practice foundation with a global north touch(James Otieno, 2009). This is true given the history of planning education in sub-Saharan Africa that was characterized by first level training in a different discipline before receiving training in planning at graduate level. Evidence shows that the switch to African based training and education in planning has provided the much needed human resource to confront the urban development challenge with argument that local training will enable planners to gunner experiential knowledge in terms of planning needs, problems and solutions(Diaw et al., 2002). But what is yet to be seen is the translation of this experiential training into real solutions to the local planning problems and challenges(DPU, 2004, Breidlid, 2009). One of the many attributes of this type of training is that it still largely remained shaped by planners whose skills, theory, practice and models do not properly align with the urban development pathways in East Africa.

Thus innovation around education is necessary and such would have experiential knowledge but also solutions that are responsive to the problems of African urbanism. For example the issue of planning standards for housing (materials, sizes, plot coverage) has been discussed at different fora and international level but has not been substantively resolved nor have flexible or adaptive standards developed (Rakodi, 1997). However good practices or cases from various countries including Uganda, Tanzania have considered mixed residential with light industry to take into consideration of home-based small scale industrious activities. This is just one among the many ways in which planning education can be innovative. This innovation required in broad requires an in-depth review and reorganization of the education system.

7. The limits of planning innovation

It is important to emphasize that despite the promises of innovative urban planning in Eastern Africa, many of the challenges and problems remain unresolved. These will limit the possibilities for a move to renewed planning and sustainable urban development in East Africa.

One of the challenge in the region is the exponentially rising population growth and rapid urbanization in proportion to the planning response. For example, it is anticipated that the urban population in Africa will increase from 129 million in 1980 to more than 762 million in the year 2025 by which time it is estimated that over 52 per cent of the region's population will be living in towns and cities as compared with about 30 per cent of urban population recorded in the region by 1986 (Akatch, 1995:40). Whereas the growth isn't a problem in self, if compared to responses from the public and private sectors, these don't match. Thus the characterization of public responses in terms of overconcentration of resources and infrastructure in capital cities, inadequate and or defective national planning policies, lack of institutional and inter-sectoral co-ordination, ineffective development control enforcement measures and inadequate involvement of relevant stakeholders (Akatch, 1995:39; Clarke, 1995; UNCHS, 1999; UN-Habitat, 2009). Other initiatives such as the Sustainable Cities Programme and the Local Agenda 21 have inherent weaknesses that will challenge achievement of urban planning innovation. The difficulty in measuring the impact of the participatory processes, performance of local authorities, leverage of city consultations and inability of various partners to remain engaged with the same city for a long period of time have been projected as likely to maintain overambitious in nature of plans generated through city consultation (UN-Habitat, 2009). In addition, while different urban issues, political, economic and institutional systems, as well as different cultures and value systems, all shape the planning system in diverse ways, following and adhering to the normative principles will also pose some challenges.

8. Conclusion

This chapter set out to critically examine the role and impact of urban planning processes in Eastern Africa particularly with regard to addressing the sheer magnitude and scale of current urbanisation problems confronting the region. In setting the general context, the nature and emergence of urban planning in the region was briefly examined. In particular, it was emphasized that the evolution of urban planning in the region can be directly traced to the background of urbanisation in Africa, which is inextricably linked to European colonisation with the net result of there being many experiences of the interactions between global North oriented type planning and urban development experiences in sub-Saharan Africa (Lwasa, 2008; Akatch, 1995; Kessides, 2006). In addition, various urban planning instruments in sub-Saharan Africa were critically examined. From the onset, it was emphasized that the master plan approach remains the most dominant to date, although in recent years this particular instrument has been increasingly criticized for being complex, excessively bureaucratic, time consuming, non participatory and too static in nature. The potential offered by new urban approaches was briefly discussed including the key elements underpinning them although it was emphasized that these approaches did not suggest models or solutions, which could be literally transplanted from one context to another.

In conclusion, spatial planning in East Africa is at cross-roads and facing a huge challenge as the demographic shift creates an urbanized. Planning innovation is necessary to change the current urban development trends and imprint but such innovation will have to involve various stakeholders and in various spheres. The key spheres that could have multiplier effects include; planning practice, planning research, planning information and redefining community roles. For better communities in urban areas the response of the planning profession should address the social needs and endeavor to harness the potentials of communities based on the realities of current development. This is the key for transforming urban communities in East Africa. The time for planning innovation in East Africa is past and in this context the planning profession as well as other stakeholders should take initiative and start now because the cost of not adequately planning is so huge. However, several weaknesses of the participatory processes have been identified that create limits of new approaches to urban planning in the Eastern African region.

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2

Leidsche Rijn: Balancing the Compact City with the Randstad Motorway Network

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1. Introduction

In the mid-1990s, the Dutch economy grew at a pace of 3 to 4 percent annually (CBS, 2009). The use of the country's major infrastructure increased accordingly, and the urban areas in the western part of the country, the Randstad, continued to expand to meet the soaring housing demand. After decades of state intervention, the government started to loosen its grip on local and regional urban development. The government's policy on spatial planning shifted away from the concept of planning new towns to focus on more compact urban development (compacte stad). The policy reasoned that a compact city would have a smaller environmental footprint because of more effective land-use and shorter daily travel distances. With its Fourth Report on Spatial Planning (VROM, 1988: Vierde Nota) and the additional VINEX-report (VROM, 1993: Vierde Nota Extra), the Ministry of Spatial Planning, Housing and the Environment no longer seemed to dictate that one solution that fits all. Rather, it sought to implement developments that suited the regional territorial characteristics and the preferences of the concerned authorities. Thus, Utrecht ended up with the largest VINEX-development in the Netherlands. In fact, Utrecht is the fourth largest city by population in the country, after Amsterdam, Rotterdam and The Hague.

Although the concept of the 'compact city' may be simple, it had deep implications for the relation between infrastructure planning and town planning. Back in the seventies and eighties two major new town developments were built south of Utrecht to house its expanding population. The physical distance between the mother city and its new towns allowed the unobstructed expansion of the national motorway network. In the nineties Utrecht preferred a development that kept its inhabitants close by so they would remain bounded to Utrecht, both economically and socially. The development of Leidsche Rijn with a projected 30.000 housing units sought a close physical relationship with the mother city. For the first time the extending city and the expanding motorway network became at odds with each other. The area between Utrecht and Leidsche Rijn left little space to accommodate a wider A2 motorway and its environmental impact. Encapsulating the A2 motorway in a two kilometre long tunnel was proposed as the most suitable way to integrate the road in the new urban district. With no effective regulation in place and no similar practice to fall back on, the Leidsche Rijn land tunnel broke ground to allow the use of motorway tunnels for a new and promising application: environmental and spatial integration of motorways in urban areas. This chapter focusses on the struggle and trade offs in the adjustment between spatial planning and infrastructure planning in one of the key urban development projects in the Netherlands: Leidsche Rijn.

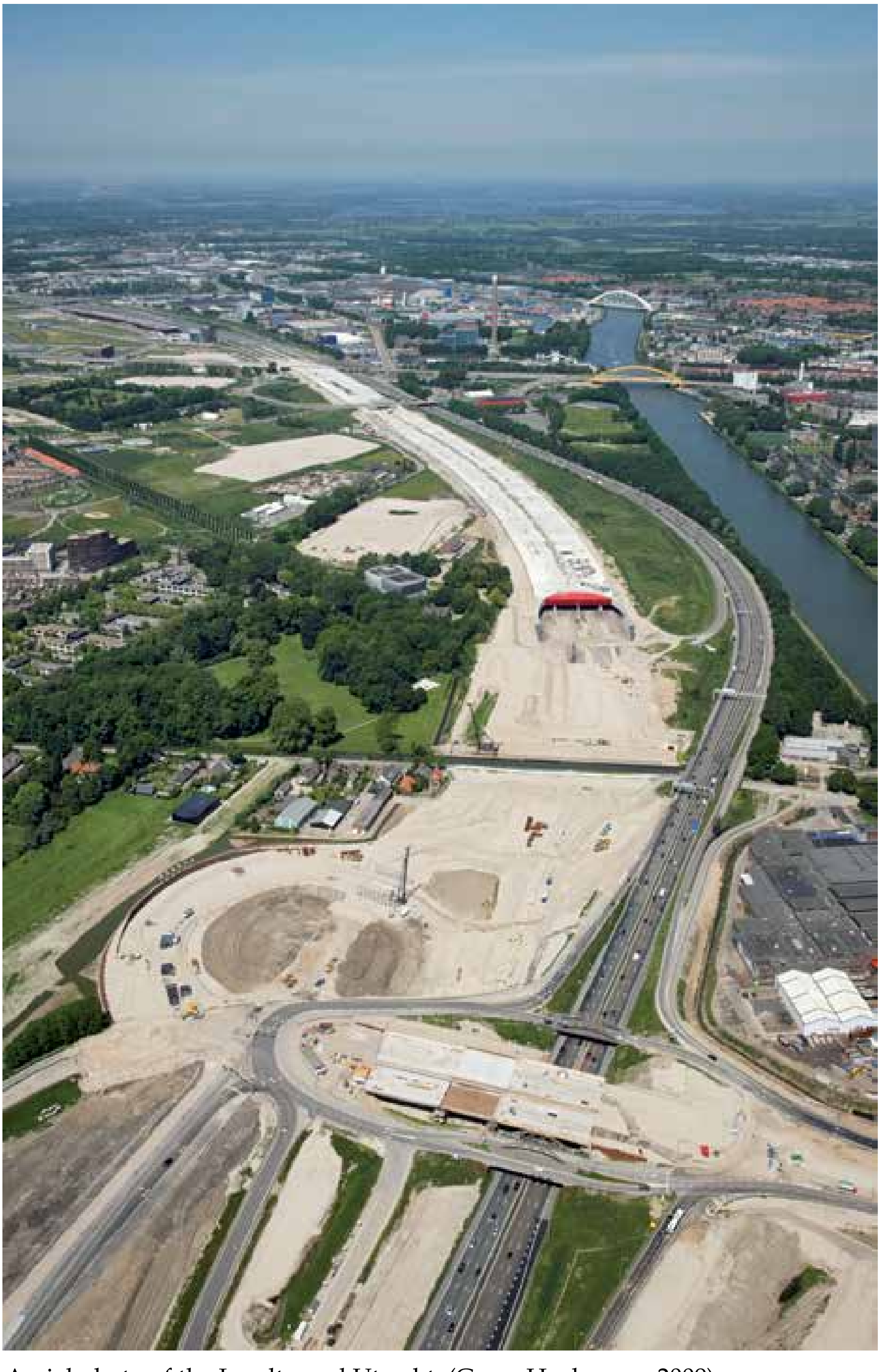

Fig. 1. Aerial photo of the Landtunnel Utrecht. (Gerry Hurkmans, 2009).

2. Outline

This chapter deals with the growing tension between the necessity to widen the Randstad's motorway network and its urban footprint. It poses the question how to integrate large scale infrastructure in urban areas. This design/engineering/planning task requires a multidisciplinary approach, combining insights drawn from urban and spatial planning, civil engineering, safety assessment, environmental impact assessment and governance.

Because most foreign readers aren't familiar with the topography and the spatial development of the western part of the Netherlands three key areas are highlighted first: the Randstad, the Green Heart and Leidsche Rijn. This sets the stage for explaining why Leidsche Rijn is a good indicator for the changes occurring in the leading concepts of urban planning, spatial planning and infrastructure planning in the Netherlands. It allows the discussion of the main concept of the Leidsche Rijn in order to explain why the city wanted to integrate the A2-corridor in the urban development. That integration had deep consequences for the physical shape of that road as it required the construction of a major road tunnel. As soon as the concept for a tunnel was embraced by the local and regional governments the deal started to unravel under pressure safety concerns, voiced by the national government. The safety of the users of the tunnel and the safety of those that would live or work next to it seemed at risk. At this point the chapter moves into an interdisciplinary area where only a few specialist speaks each others professional language. Due to a lack of mutual understanding between politicians, urban planners, safety assessment officers and transport planners the project moved in to a deadlock which took years to resolve.

The storyline is based on the review of many of the relevant policy documents and plans written in the Dutch language on this matter, on in depth interviews with key players in the process and the various environmental and safety assessments. The final form of this chapter is that of a rigorous multidisciplinary case study.

3. Randstad and Green Heart

Utrecht is one of the four Dutch cities that jointly constitute the Randstad. The Randstad is the framework commonly used to describe the densely populated western part of the Netherlands. In the mid 1960s that Randstad was discovered by academics from the Anglo-Saxon world as an alternative model for metropolitan growth. For London, in particular, struggling to contain its large continuous urban area, by the so-called Green Belt, the Randstad seem to demonstrate that a large urban population could be organised in a networked polycentric configuration, and function well at the same time. That idea appealed to writers like Gerald L. Burke (Burke, 2006) and Peter Hall (Hall, 1966, 1977, 1983). The Randstad was seemingly less congested than a classic metropolis and possessed an invaluable asset: the Green Heart.

The simple concept of a large green area surrounded by a ring shaped conurbation settled quickly in the minds of students, practitioners and academics alike. It also helped to place Holland on the map and that seemed necessary. In 1966 Gerald L. Burke already noted that although The Netherlands is known for its city planning, "less widely known are the policies of regional planning which have been developed in the Netherlands since World War II" (Burke, 2006).

When Gerald L. Burke wrote his book he referred to the brand new Second Report on Spatial Planning (V&RO, 1966) and to the documents that preceded it. In the late fifties the Netherlands started to formulate its national spatial planning agenda. The 'Working Committee on the Western part of the Country' produced in 1958 its report including the famous plan for the 'schematic structure of the urban ring', a conceptual vision on the spatial structure of Randstad (Berveas et al, 2001). At the end of the fifties it became clear that the Green Heart was being threatened by (sub)urbanisation. Especially the open zones in between the larger cities on the urban ring were at risk. The 'Working Committee on the Western part of the Country' advised to keep the cities in the ring structure separated, both functionally and spatially. The strategy was to apply designated buffer zones between the urban areas and to plan new cities on the outside of the ring as opposed of the inside the ring (in the Green Heart). An increasing set of sophisticated instruments was used to preserve these formal buffers, ranging from land acquisition to legislation (Bervaes et al, 2001). Time was to prove that these buffer zones would be more robust than the Green Heart itself.

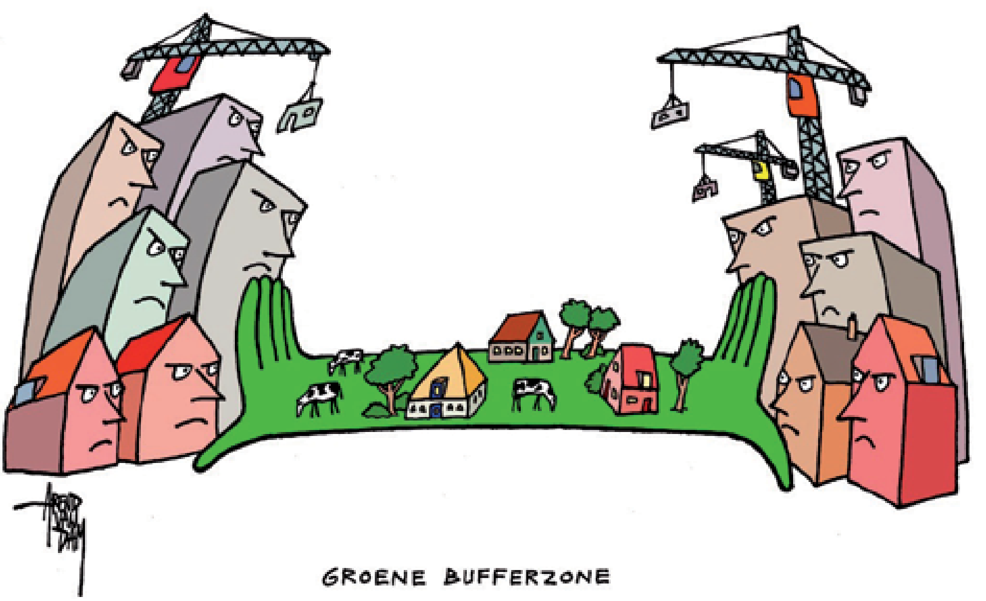

Fig. 2. Green buffer zone (Arend van Dam, 2008)

As soon as the Dutch government adopted the Green Heart concept that same government began two other initiatives that were in direct contradiction to the idea to maintain the Green Heart as an open space. The first initiative was the publication of the structure plan for the national motorway network in 1966 (Dutch: Structuurschema Hoofdwegennet 1966).

It proposed the rollout of a dense grid of motorways over much of The Netherlands - including the Green Heart - where ten (!) additional motorways were planned. Secondly, it developed and adopted the 'groeikern' approach. Groeikern (growth municipality) is the Dutch equivalent of the British 'new town' and the French 'ville nouvelle' policies. The

Dutch government decided to focus urban growth in a limited number of municipalities to give these a specified quantitative task to increase their housing stock, and subsequently their population and urban area.

Fig. 3. Structure plan national motorway network 1966 (V&RO, 1966)

4. Third and Forth Report on Spatial Planning

The 'growth municipalities' entered officially the planning stage at the time of the Third Report on Spatial Planning (V&RO, 1976, 1977). A steep increase of the number of inhabitants in a part of these municipalities can already be traced back a decade earlier. Some of the 'grow municipalities' turned into independent towns; some of them were merely the extension of the larger agglomerations. The Third Report listed eleven official 'growth municipalities'. Each of the four larger cities in the Randstad was outfitted with at least one 'growth municipality' that was firmly situated in the area that was still considered to be an integral part of the Green Heart: Hoofddorp in the Amsterdam region, Zoetermeer in The Hague region, Capelle aan den IJssel in the Rotterdam region and Nieuwegein in the Utrecht region. Most of the roads that were foreseen in the 1966 structure plan for the national motorway network never made it off the drawing board. Motorway construction still made a significant impact on the Green Heart with the construction of the A2 (Amsterdam - Utrecht - Den Bosch), the A4 (Amsterdam - The Hague), the A20 (Rotterdam - Gouda), the A67 (Hilversum - Utrecht - Breda), the N11 (Leiden - Bodegraven) and to a lesser extend also the A1 (Amsterdam - Hilversum).

The Forth Report on Spatial Planning (VROM, 1988) and its extended version called VINEX (VROM, 1993) abandoned the 'growth municipality' strategy and introduced the so-called VINEX-extensions. The VINEX-extensions, with its new residential areas at Noordrand (Rotterdam), Ypenburg (The Hague) and Oosterheem (Zoetermeer) and Leidsche Rijn (Utrecht) pushed the envelop of the Green Heart further inwards. No new motorways were planned but most of the existing roads would be widened. At the turn of the century, after four decades of spatial planning, the overall concept of how the urban areas, open spaces and infrastructure of the Randstad related to each other had fundamentally changed.

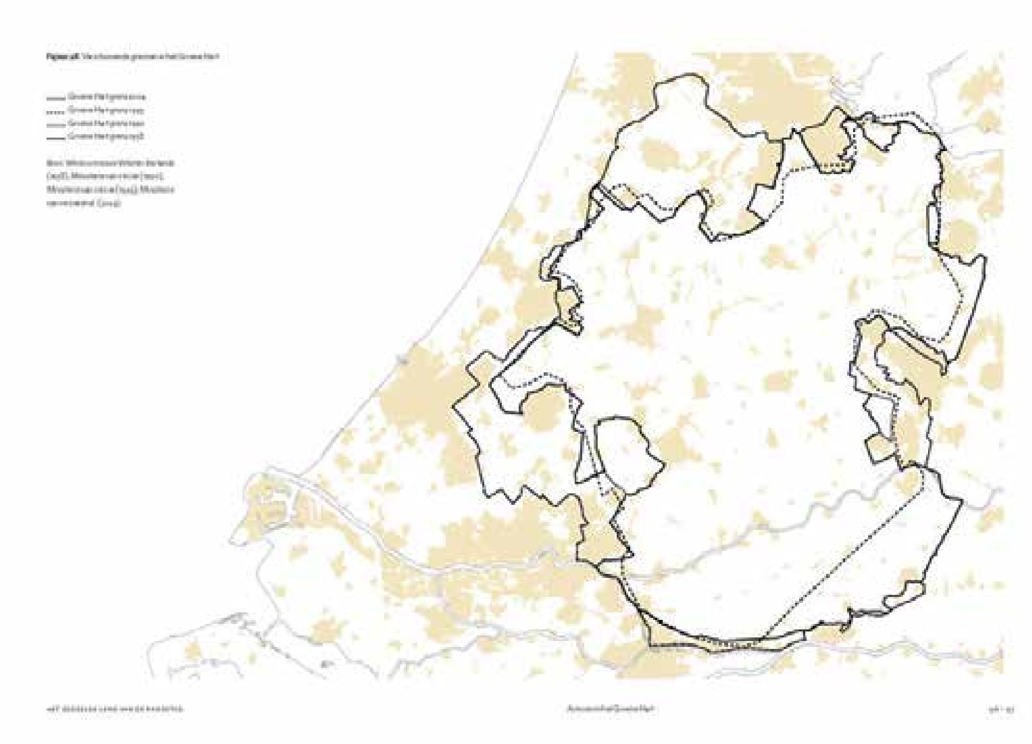

Fig. 4. The shrinking boundaries of the Green Heart (Pieterse et al, 2005)

5. Leidsche Rijn

Leidsche Rijn is one of the most prominent products of the VINEX-report and reflects much of the developments that took place elsewhere in the Randstad. Leidsche Rijn expands the city of Utrecht (313.000 inhabitants) with 20 to 30.000 housing units, a large urban park and even larger employment areas. The development annexes the villages of Vleuten en De Meern. By doing so it almost doubles the urban footprint of the municipality of Utrecht. The larger Utrecht region had developed according a decentralised poly-centric model using new towns to accommodate the demand for high quality living in the region. It was a response to the concern that cities would become too large, too congested, too polluted. The Utrecht region witnessed the construction of two successful new towns: Nieuwegein (61.000 inhabitants) and Houten (48.000 inhabitants), separated from mother city Utrecht by a orbital motorway. Houten became a poster-boy for sustainable transport with its clever combination of transit-oriented development and a sophisticated bicycle network. The construction of the motorway network that connected the various cities and towns in the decentralised Randstad infrastructure didn't pose any difficulties for development of Nieuwegein and Houten. Motorways were in the 1970s still lean and mean. Their environmental impact was limited while the space between Utrecht and its new towns was superfluous.

Leidsche Rijn, conceived two decades later, signals in many respects a clear break from previous spatial planning concepts. Leidsche Rijn is based on the compact city concept. That city model assumes that keeping distances within urban regions short will result in environmental benefits through reduced travel(time) and more effective land use. Keeping new developments close to Utrecht meant that city had to develop westwards into the area that was an integral part of the Green Heart since that concept was coined. The Fourth Report on Spatial Planning adjusted the planning border of that Green Heart to allow the development of Hollands largest greenfield development. The ambition to minimise the distance between Leidsche Rijn meant furthermore that the urban development had to make effective use of the space along the A2 motorway, space that would normally be leftover due to the environmental footprint caused by noise, air pollution and risks. Because the capacity of the A2 was insufficient, the road had to be widened from 2x3 lanes to 2x5 lanes. Both projects, extending Utrecht and extending the A2 corridor had to take place in one integrated development project.

6. Masterplan Leidsche Rijn

In the early 1990s, a young urban planning firm received the commission to develop a master plan for Utrecht's new VINEX development Leidsche Rijn. The office was by then know as Max 1, currently as Maxwan. Maxwan proposed a different direction than most urban planners tended to pursue. Usually planners pay close attention to the environmental constraints of a site and use them as a starting point, trying to keep housing and other soft functions (such as education and care facilities) at a secure distance from major arteries or other producers of noise, air pollution and safety issues. This explains why in the Dutch practice green spaces are often used to fill up the gap between infrastructure and residential areas. But as a result, those green spaces often end up fragmented, noisy, polluted and not well suited to the recreational purposes that green spaces are mostly associated with.

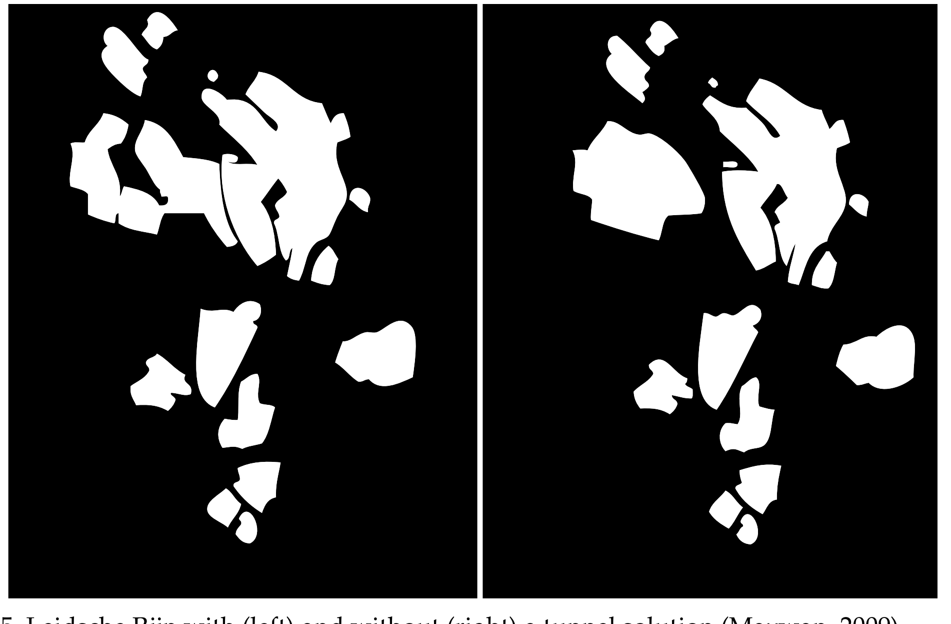

Fig. 5. Leidsche Rijn with (left) and without (right) a tunnel solution (Maxwan, 2009)

Maxwan proposed to implement an innovative approach, like shifting the course of the motorway while at the same time tunnelling it. The company received that approval, and in 1995 delivered its Masterplan Leidsche Rijn, commissioned by the City of Utrecht. Therefore, the city of Utrecht proposed its Master Plan Leidsche Rijn to contain the noise and air pollution of the A2 motorway with a two-kilometre tunnel situated a few hundred meters from its original alignment in 1995 (Projectbureau Leidsche Rijn, 1995). The tunnel was partly suppressed with the assumption that a tunnel in the local soft soil conditions (with a high ground water level) would be cheaper to build as a 'floating construction' than as a submerged tunnel or as a full-fledged land tunnel. In addition, a suppressed tunnel is beneficial because it does not function as a barrier between the existing city of Utrecht and the new Leidsche Rijn development. Encapsulating the motorway allowed Maxwan to built housing and city centre functions next to the motorway. This allowed to plan a large urban park right at the heart of the development site where all residents could easily access it and not be burdened by noise or air pollution.

7. Safety concerns and the project's first revision

Not long after the Masterplan Leidsche Rijn proposed its tunnel solution, concerns were voiced regarding the internal and external safety of the Landtunnel Utrecht that was such an integral part of the overall Master Plan Leidsche Rijn. Safety experts from the Construction Department of the Directorate General for Public Works and Water Management (part of the overall Ministry of Transport, Public Works and Water Management) pointed out that constructing a tunnel in the A2 would violate the existing rules and regulations for the transportation of dangerous goods, especially the transport of liquid flammable gasses, a category that contains predominately Liquefied Petrol Gas or LPG (Rijkswaterstaat Bouwdienst, 1996).

The Netherlands had many road tunnels by the late 20th century, and the majority were motorway tunnels that crossed one of the many waterways in the delta of the Rhine and Meuse rivers. Compared to tunnels in the mountainous parts of Europe, these tunnels are short in length. The fully enclosed sections of these tunnels often measure less than thousand metres. On the other hand, these tunnels tend to be rather wide. Tunnels with four lanes in each direction are not the exceptions. Their vulnerability does not stem from their length, but from the large volume of traffic that uses them and from their strategic position under water.

The general rule in the Netherlands is that all transportation of dangerous goods occurs on the motorway network because motorways provide higher levels of road safety. There is an exception to this rule. When a tunnel can be bypassed by using a bridge, then the use of that bridge is preferable. The bridge should be used, even if it increases the external risk for local inhabitants. This exception exists because of the economic risks involved in losing a tunnel. A scenario that includes the transport of dangerous goods could develop into an accident that could effectively put a tunnel permanently out of use. A truck carrying LPG could cause a problem such as a boiling liquid expanding vapour explosion (BLEVE). Although the chance that such a scenario develops may be remote, the possible impact of the scenario is devastating and, therefore, poses a considerable risk (Molag, 1998). It is unrealistic to expect that an underwater tunnel damaged in such an event could be repaired. It would become necessary to build a new one. Such a scenario could leave the Rotterdam Harbour, for instance, without a decent road connection for a period of four years. The indirect economic damage would be so extensive that the ministry is not willing to take any chances. Thus, it banned the transportation of the most damaging dangerous goods from its tunnels (Directie Transportveiligheid, 1997). The multifunctional tunnel at Leidsche Rijn seemed to violate this regulation. The development of the Leidsche Rijn project, however, was in such an advanced stage that simply banning the tunnel was no longer feasible politically. A different solution had to be developed.

In response to the safety concerns regarding the transport of dangerous goods, the Ministry of Transport, Public Works and Water Management opted to replace the full tunnel with a series of three shorter tunnels. This would reduce the impact of the most extreme anticipated scenarios on the A2 motorway users. Shorter tunnels contain fewer people, thus reducing the maximum number of potential causalities. The Ministry also opposed the idea of a 'floating tunnel' along a new alignment. The idea was not considered technically feasible. A fully submerged tunnel was out of the question because of the high ground water level that increases the cost to build such a structure. The construction of aboveground tunnels next to the current A2 emerged as the preferable solution.

The tight integration between urban development and road expansion required the Master Plan to be adjusted. Breaking up the tunnel meant that the environmental impact of the motorway would be felt in the area, noise and air pollution would be especially prominent. Raising the roof of the tunnel to a level of 6.5 metres above the surrounding area meant that the tunnel would function as a physical barrier. A preliminary concept responding to these issues, the Creative Alternative Integration A2 / Leidsche Rijn, was subsequently included in a revised master plan: the Ontwikkelingsvisie Leidsche Rijn Utrecht (Projectbureau Leidsche Rijn, 1996). It became the first major revision of the Masterplan and the tunnel concept.

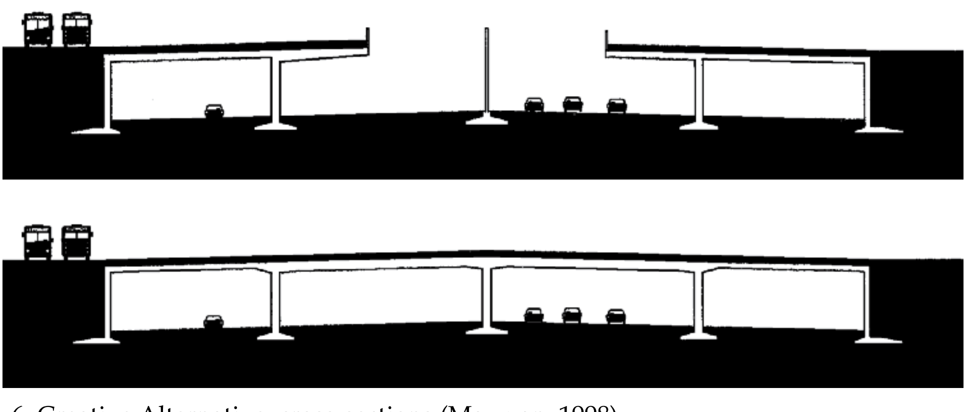

Fig. 6. Creative Alternative: cross-sections (Maxwan, 1998).

The 'Creative Alternative' consisted of three short tunnels, measuring 450 m, 408 m and 188 m. The Ministry did not allow housing to be built on top of these sections; instead, the area is designated for recreational purposes. Noise barriers would have to be used to reduce the environmental impact along the open sections.

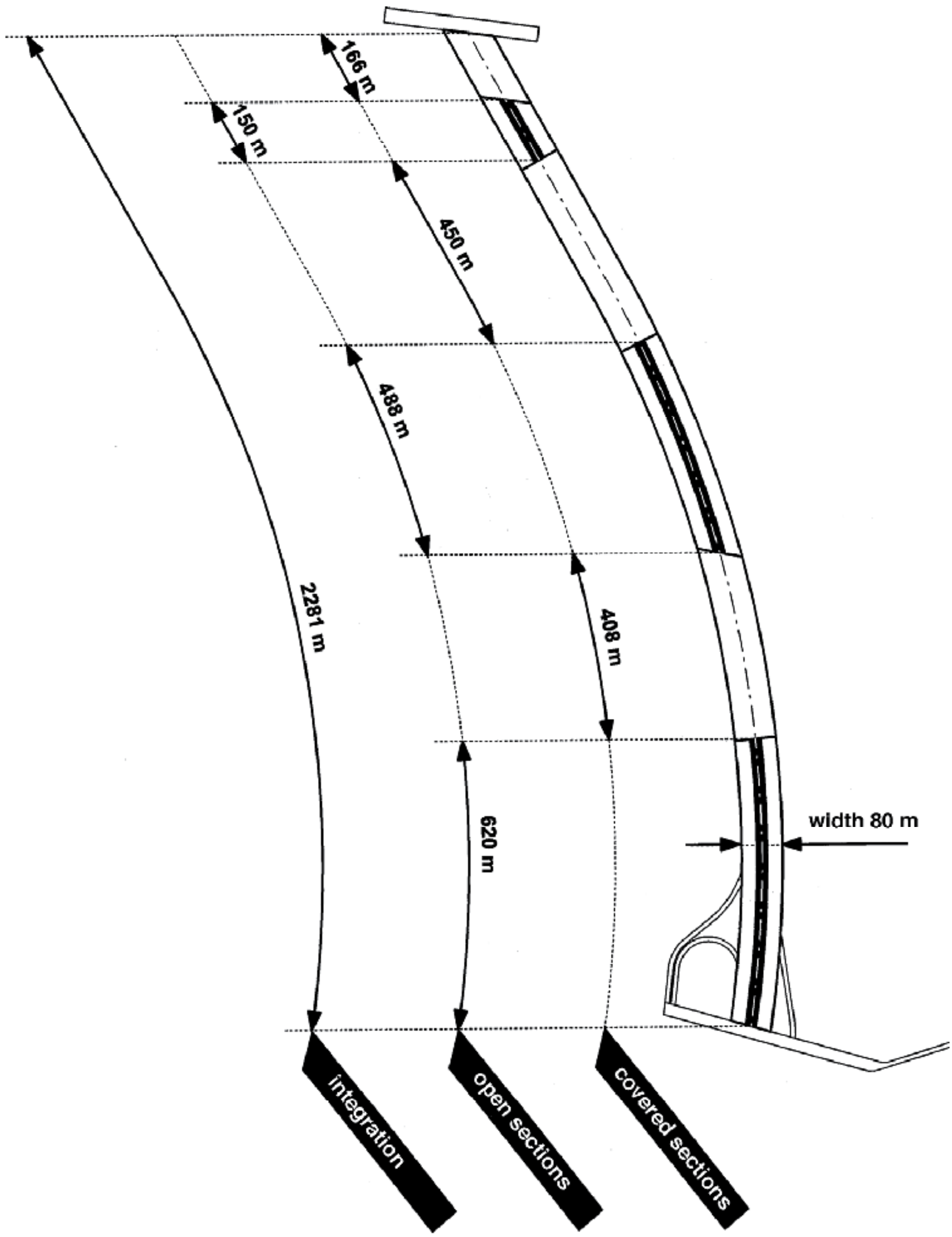

Fig. 7. Creative Alternative: alignment (Maxwan, 1998).

Fig. 8. The Creative Alternative with horizontal cantilevers (Maxwan, 1998).

In 1998, the Projectbureau Leidsche Rijn published an additional investigation into the requirements to integrate the A2 in Leidsche Rijn from an urban perspective (Maxwan, 1998). The project bureau's objective was to optimise the Creative Alternative. Its report contained, among other things, the results of two interesting partial studies.

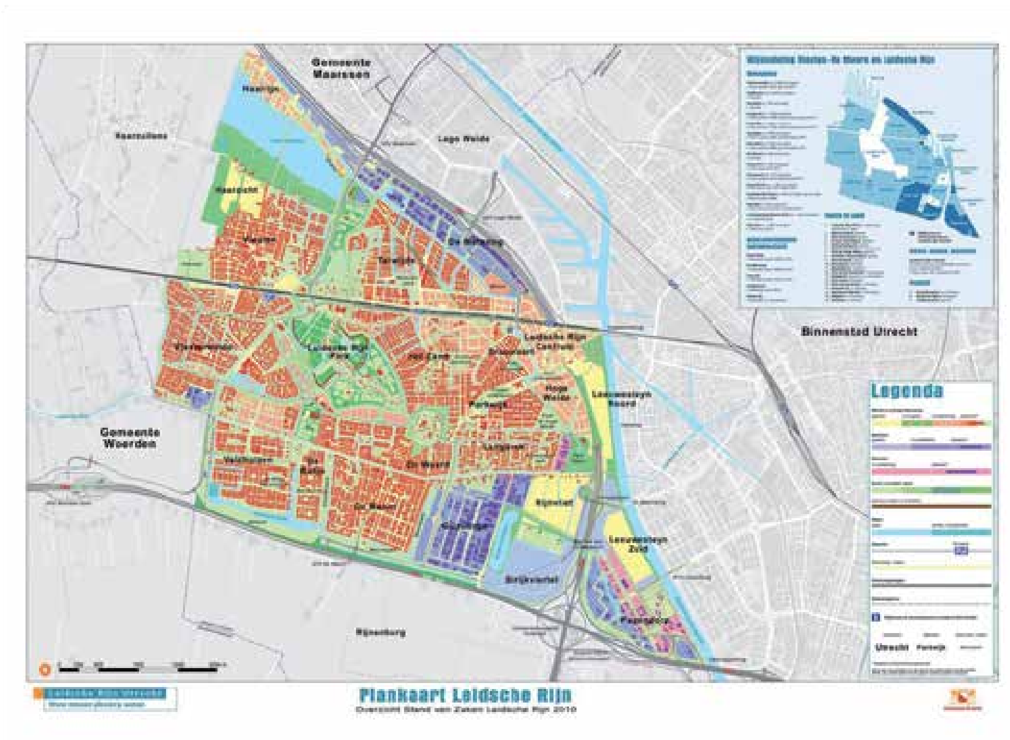

Fig. 9. Masterplan Leidsche Rijn (Utrecht, 2011).

Noise levels Creative Alternative (A2 Land Tunnel at Leidsche Rijn)

distance, measured from the middle of the road height, measured from the road surface		45 m 4,5 m	45 m 7,5 m	100 m 4,5 m	100 m 7,5 m
1A	8.00	59	62	55	56
1A	10.00	59	61	55	56
1A	8.00	56	57	53	52
1C	8.00	57	59	53	53
1C	8.00	57	57	51	52
* 1C	8.00	55	55	49	50
1C	8.00	55	55	51	50
1CS	8.00	56	57	51	52
1CS	8.00	56	57	51	51
1CS	10.00	56	56	51	51
1E	8.00	56	57	52	52
1F	8.00	56	57	51	51
2A	8.00	59	60	53	54
2A	10.00	59	59	52	53
2AS	10.00	57	57	52	52

in dB(A), 150.000 vehicles/day, porous asphalt (1C: two layered porous asphalt construction)

Fig. 10. Noise levels of the Landtunnel Utrecht using different sets of noise barriers and cantilevers, image by TNO (Maxwan, 1998).

The first study (conducted by TNO) looked at the noise production of the motorway and the impact of using different sets of noise barriers and cantilevers. It appeared that the use of a two-layered porous asphalt construction in combination with horizontal cantilevers promised the best results.

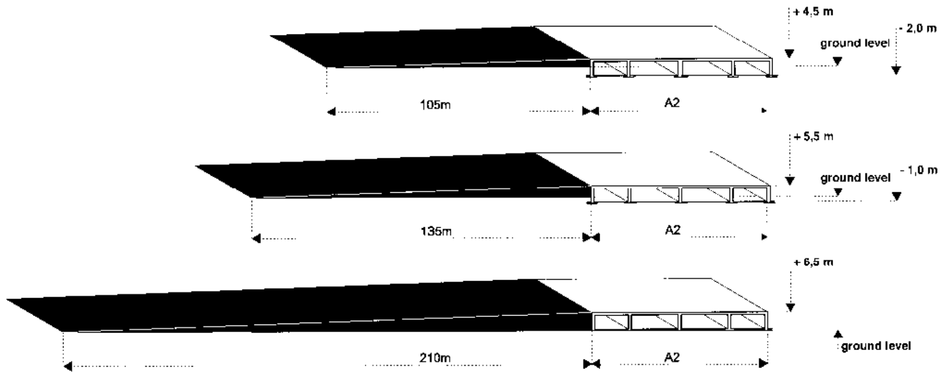

Fig. 11. Sloping as a means to integrate the Landtunnel Utrecht at Leidsche Rijn (Maxwan, 1998).

The other, somewhat simple, study visualised the use of sloping as a means to integrate the 'hollow dike' with its surrounding area. The study concluded that, along the motorway, a slope with an angle of three percent and a length of 210 metres was necessary to minimise the impact of the height difference introduced by the physical height of the land tunnel. The extensive slope was required to facilitate soft modes of transportation (walking and cycling) between the VINEX-development and the city of Utrecht. The exploration also showed that a partially submerged tunnel could do with half of that sloping area, or 105 metres.

8. Green Link A15

In a parallel process, the municipality of Rotterdam also called for a multifunctional tunnel to cover a section of the A15 motorway in 1998: the Green Link. The situation is comparable as the A15 separates Rotterdam from its largest VINEX development: Carnisselande. The A15 is a section of the Rotterdam Ring that connects the Rotterdam harbour area to its hinterland. The municipality of Rotterdam faced a similar line of argument as that by Utrecht. The regional Directorate General for Public Works and Water Management (RWS Zuid-Holland) told the urban planning department of the Municipality of Rotterdam that a tunnel would not be feasible because of the need to transport dangerous goods along the A15. RWS Zuid-Holland only allowed small tunnel sections of 80 metres, with a minimal spacing of 50 metres between covered sections. Rotterdam called in the support of the Delft University of Technology (TU Delft). The city was not convinced that the construction proposed by RWS Zuid-Holland could effectively reduce the environmental impact of the A15 motorway that had to be extended to five lanes in each direction. It requested an in-depth investigation into the safety issues regarding motorway tunnels. The A15 presented an ideal showcase. The A15 accommodates an enormous volume of dangerous goods that flow directly from the (petro) chemical industry in the Rotterdam Mainport. There are 200,000 transports yearly, which greatly exceeds the volume that passes Leidsche Rijn. If a solution could be found here, it would be a true breakthrough. This pilot programme required TU Delft to develop regular exchanges with Rotterdam's Urban Planning Department, the Construction Department of the Directorate General for Public Works and Water Management (RWS Bouwdienst) and the Rotterdam Fire Brigade.

The Rotterdam Fire Brigade proposed implementing a sprinkler system in the tunnel to rule out the development of any scenario that starts with a regular fire and could potentially develop into a more severe accident. In addition, TU Delft proposed containing the impact of any explosive scenario by physically separating the tunnel's tubes. Unfortunately the models that were used at that time to assess tunnel safety in the Netherlands did not allow the incorporation of any claims about the effectiveness of a sprinkler system or an improved tunnel tube configuration. Though potentially effective in practice, these measures had no impact on the outcome of the assessment itself. To influence the assessment's outcome, it appeared more important to consider the likely, but less extreme, scenarios in which regular trucks were involved, such as a 'large vehicle fire'. Isolating lorries in a separate tube from the rest of the traffic results in a notable reduction in the number of deaths due to such events, offsetting the increased mortality in the case of unlikely but more extreme events. Given that the new tunnels were built on land, it seemed that the potential economic risk was manageable as well. In the unlikely scenario that the roof is blown off, the infrastructure could be 'easily' repaired. Because urban tunnels are not situated under water, they are unlikely to lose their functionality as a small 'polder' (Hoeven, 1999). The RWS Bouwdienst provided the calculations and confirmed that the concept was sound (Rijkswaterstaat Bouwdienst, 1998). The Rotterdam Fire Brigade formulated requirements for a Category-0 tunnel. This concept did not ban the transportation of any type of dangerous goods through the tunnel but emphasised the necessity of prevention and automated repression (Broekhuizen, 1998).

Fig. 12. Green Link A15 (Hoeven, 1999)

Although the Green Link was ultimately not built, the publication of the concept by TU Delft, including the results of RWS' own analysis and the Category-0 requirements by the Rotterdam Fire Brigade, made it clear for the first time in the Netherlands that transport of dangerous goods does not rule out the implementation of multifunctional tunnels. That insight was still contested by the Directorate-General for Freight Transport of the Ministry of Transport, Public Works and Water Management at that time. The issue continued to assert pressure on proposed multifunctional tunnels, such as the Landtunnel Utrecht.

9. Weighing five alternatives followed by a final concept revision

In the year 2000, new EU regulations on air quality were introduced and caused a stir in the Netherlands. Much of the country suffered from high levels of background pollution that were near or above the future limits set by the EU. Those limits were easily exceeded near major motorways or other sources of air pollution. The technology institute TNO delivered the first set of air quality calculations (nitrogen dioxide and particulate matter) for the A2 based on the new requirements. The calculations showed that wider than expected areas along the open parts of the land tunnel at Leidsche Rijn could not be used for residential purposes. This would mean a significant breach of the urban quality of the area and an undesirable decrease in the number of housing units that could be built. The municipality of Utrecht, the project bureau Leidsche Rijn, RWS and the Ministry of Housing, Spatial Planning and the Environment jointly commissioned a study by ARCADIS and the Architectengroep. The final report of that study was delivered in December 2001 (Brouwer, Rijnboutt, 2001). Three partial studies by TNO and ARCADIS were included in the study that investigated air pollution, safety and noise. The study unexpectedly concluded that noise was the environmental impact with the largest consequences for land use in Leidsche Rijn, rather than air quality or safety. The ARCADIS/Architectengroep study evaluated five alternatives: 1] the original 'Creative Alternative', 2] the 'Creative Alternative' with horizontal cantilevers over the road, 3] an alternative that covered only the northern part of the alignment, 4] an alternative based on short tunnels with lengths of just 80 metres, 5] a fully covered surface tunnel.

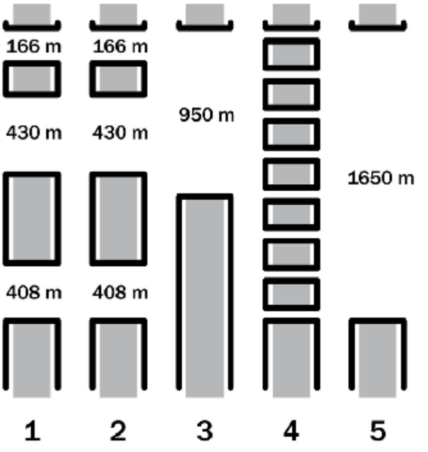

Fig. 13. Alternatives 1, 2, 3, 4 and 5 (van der Hoeven, 2010).

The new air quality assessment by TNO provided detailed insight in the diffusion of the emissions in the project area (TNO MEP, 2001). With more experience under the new regulations and an adjusted value for the background emission, each of the alternatives seemed to keep the nitrogen dioxide values below 40 µg/m^3 at a distance of 50 metres from the road. Only the 1650-m long full-length tunnel (alternative 5) showed a small area where emissions peaked at 41 µg/m^3. Presented in this chapter are the nitrogen dioxide diagrams for alternatives 1, 2, 3 and 5. Alternative 4 is not presented because it was not evaluated in the TNO study. TNO calculated emission levels at distances of 50 and 100 metres from the road. No calculations were made for the area above the tunnel. The fact that no emissions are displayed here does not mean that the area is not exposed. The impact of the noise barriers was taken into account in the study.

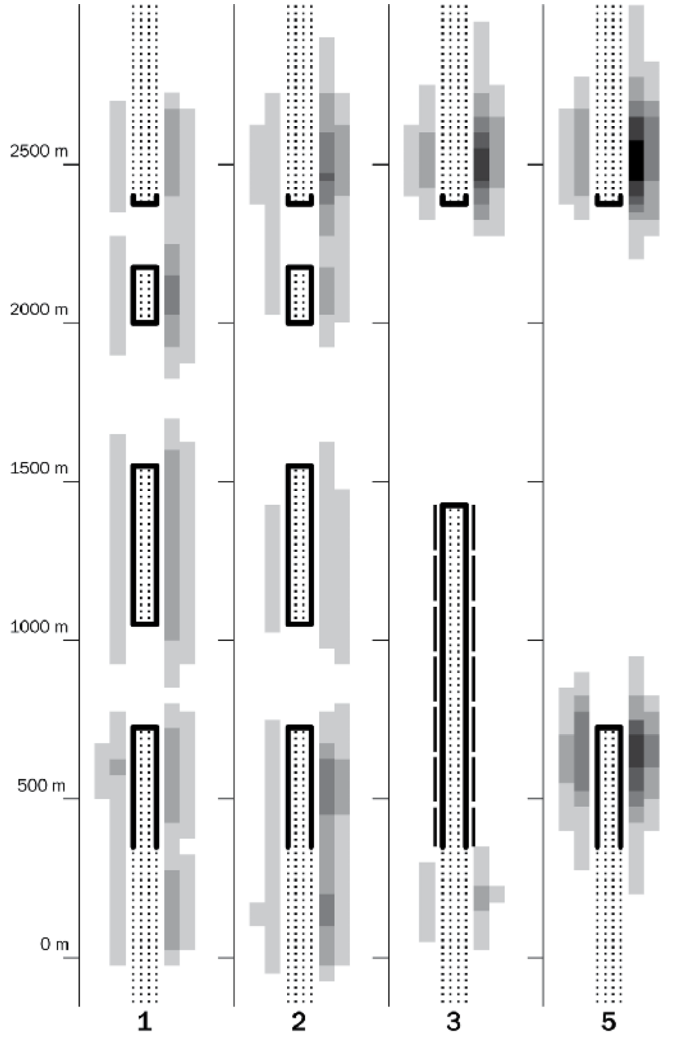

Fig. 14. Calculated nitrogen dioxide emissions alternatives 1, 2, 3 and 5 (van der Hoeven, 2010).

Wind does seem to have an impact, which can be seen in the higher concentrations on the east side of all alternatives. The length of the tunnel matters as well. The concentration of air pollution at the ends of the tunnel increases as the tunnel becomes longer. Two walls separate in alternative 2 the inside lanes from the outside lanes. The inside lanes, designed for local traffic, are fully covered by the cantilevers and, with the addition of the wall, effectively enclosed in a 1650 meters long tunnel. Compared to alternative 1, this results in increased emissions at the tunnel's ends, and reduced emissions near the open sections. Alternative 3 contains 40-meter high buildings bordering the open sections of the motorway; this alternative effectively reduces the air pollution without creating peak concentrations like those at the other end of the tunnel.

A safety assessment was conducted by ARCADIS (ARCADIS, 2001). The ARCADIS study concludes that the existing laws and regulations, as well as the framework used in the assessment do not pose a major obstacle for any of the five alternatives. In all alternatives, the group risk that users of the motorway tunnel collectively faced stayed well below the indicative norm of 10-2/N2, despite the transport of LPG.

TNO converted its 1998 noise assessment into contours that could be displayed on maps that enabled TNO to calculate the surface of the area affected by noise levels of 50 and 55 dB (TNO TPD, 2001). An overview of the impact of the five alternatives on the surface of the development area, the loss of real estate revenue, and the loss of the number of housing units is presented. These figures belong to the 55 dB contours that require the maximal legal exemption from the Ministry of Spatial Planning, Housing and the Environment. The figures that belong to the 50 dB contours are considerably larger.

nr.	housing units	development area	revenue
1	-204	-3,6 ha	-8,2 M€
2	-145	-2,5 ha	-5,8 M€
3	-259	-4,5 ha	-10,4 M€
4	-249	-4,3 ha	-10,0 M€
5	+2	+0,1 ha	+0,1 M€

Fig. 15. Table indicating lost development area, lost housing units and lost real estate revenue because of noise levels that exceed the 55 dB limit for each alternative (van der Hoeven, 2010).

The study also provided investment figures. The differences in the construction costs of the alternatives appear to be relatively small. The original Creative Alternative was estimated to cost 460 M€, while the optimised Creative Alternative (using horizontal cantilevers, as favoured by the Projectbureau Leidsche Rijn) was estimated to cost 501 M€ to build. A fully covered surface tunnel required an additional 10 M€ for a total of 511 M€. The fully covered surface tunnel would allow more residential area to be developed than the other alternatives and less development area was exposed to noise levels over 50 and 55 dB. RWS ruled out residential development above the 13-hectare large tunnel surface, unlike the Donau-ufer Autobahn in Vienna. The full-length tunnel was, nevertheless, able to generate higher income for real estate development. Effectively, the financial differences between the optimised Creative Alternative (alternative 2) and the fully covered surface tunnel (alternative 5) disappeared altogether. The financial difference between the original Creative Alternative (alternative 1) and the fully covered surface tunnel was reduced to less than ten percent.

nr.	revenue	investment A2	investment A2 + lost revenue
1	-8,2 M€	460 M€	468 M€
2	-5,8 M€	501 M€	507 M€
3	-10,4 M€	466 M€	476 M€
4	-10,0 M€	496 M€	506 M€
5	+0,1 M€	511 M€	511 M€

Fig. 16. Table indicating lost real estate revenue (55 dB), the required road investment and the sum of road investment and lost revenue for each alternative (van der Hoeven, 2010).

ARCADIS and the Architectengroep advised the decision takers to opt for any of the first three alternatives. They ruled out the alternative of a series of short tunnels that only covered a length of 80 metres because of its lacking spatial quality and the emission levels, although the TNO report did not explore this option. They also ruled out the fully covered surface tunnel because it was considered undesirable from the safety point of view, although the ARCADIS the report did not provide research-based evidence to substantiate such a claim.

In 2002, the government and the municipality of Utrecht reached a deal based on an optimised version of the Creative Alternative. The project's costs were finally assessed at 535 M€. The Ministry of Transport, Public Works and Water Management agreed to pay 323 M€. The Ministry of Housing, Spatial Planning and the Environment contributed 99 M€. The municipality, region and province of Utrecht agreed to add 83 M€ to the project's budget. Saving in other areas of the project generated an additional 30 M€. The landscaping of the surface tunnel's surrounding area could be realised with less excessive sloping (Nieuwsbank, 2002).

In 2006, just before the start of construction, the Directorate General for Public Works and Water Management and the municipality of Utrecht revised the tunnel concept one last time as they agreed to build a fully covered tunnel, without referring to potential safety or air quality issues. Meanwhile, an agreement was reached with the LPG sector to increase the fire resistance of the trucks that deliver LPG to gas stations, which reduces the likelihood of accidents involving these transports (Infrasite, 2006). The background levels of nitrogen dioxide and particulate matter were declining as a result of the imposed measures to meet the new European limits.

10. Friend or foe?

The final outcome of the Landtunnel Utrecht development may surprise. The urban planners of Maxwan had sided with the local authority of Utrecht for over a decade (1995-2006) in a continuous struggle with the Ministry of Transport, Public Works and Water Management in order to achieve the Masterplan Leidsche Rijn as it was originally envisioned. It faced sustained opposition from that Ministry. The Ministry however is responsible for many policy objectives and comprises many departments. Maxwan and Utrecht may have failed to recognise who is foe and who is friend in this large organisation. In the discussions the author had with the urban planners of Maxwan it became clear that the classic polarity of municipality versus ministry dominated their viewpoint.

The author was in 2000 consulted by the project manager of the regional Directorate General for Public Works and Water Management, responsible for the widening of the A2. The project manager was transparent about the fact that he opposed the overall concept of the Masterplan Leidsche Rijn. In his eyes Utrecht's compact city policy was little more than a strategy to annex its neighbouring municipality Vleuten-De Meern. However, once it would be decided to built the Landtunnel Utrecht, he felt it should be done properly as a fully covered tunnel. It should not be broken up in smaller segments or just be partially covered. The author was not at liberty to share this information with Maxwan or Utrecht.

The Construction Department of the Directorate General for Public Works and Water Management had initially raised the red flag regarding safety. The director of that Department, Rinus Olierook, chaired during this time a committee that had to initiate a large scale programme investigating multifunctional land use, a programme that would later become Habiforum. He recognised Leidsche Rijn as a perfect showcase of that principle. He made that clear in an interview that was published by the author.

11. The bigger picture

Looking backwards the task to unite the different viewpoints in order to reach an joint agreement seemed less daunting than the decade of moving back and fourth may suggest. What could have caused it to take so long? The introduction of this chapter sketched the larger context in which the spatial developments in the Randstad took place. The latest stage in that development (VINEX) was a time in which the larger cities like Utrecht, The Hague and Rotterdam, and smaller cities such as Eindhoven, Amersfoort and Delft broke free from the boundaries that the 1970s motorway network had imposed on them. The urban footprint of these cities expanded over the motorways. With that the network that was carefully planned to bypass cities became part of many urban areas.

The fight that enfolded in the case of Leidsche Rijn focused on details such as noise, air pollution and safety. That fight may not have been fought so hard if it did not represent a more fundamental discussion on accessibility. The motorway network was the designated network that would facilitate unrestricted transport of all goods and persons in all thinkable volumes. The dense grid of motorways that planners had drawn to accommodate the growing traffic was not built. Instead traffic concentrated on a few major corridors. Building homes and workplaces in these corridors exposed the population to their environmental impact. The major concern voiced by infrastructure planners was that the environmental impact could require that restrictions were imposed on specific goods and the volumes of vehicles that used these corridors. The construction of a tunnel represented more than just a local solution. Policy makers wrote in this context literally about the precedence and the irreversibility of such a solution. Unintended Leidsche Rijn may have become the poster boy of a more generic planning challenge in the Randstad.

Once the struggle was decided and it became clear that city and infrastructure had to life together, the length of the tunnel or its cover no longer mattered.

Fig. 17. Artist rendering of the Landtunnel Utrecht at Leidsche Rijn (Maxwan, 2009).

12. Conclusion: A first of its kind

The construction of the Landtunnel Utrecht at Leidsche Rijn signals the changing relation between the planning of infrastructure and the development of urban areas, as well as the coming of age of the Dutch multifunctional tunnel. With few references to fall back on, it took the involved stakeholders almost a decade (1995-2006) to agree that the environmental impact of an expanded A2 motorway required a landtunnel in order to develop Leidsche Rijn into a high-quality residential area for 30,000 homes. All stakeholders had to go through a collective learning process before they realised this fact. Environmental issues were intertwined with safety and financial issues for a long time, until a deal was reached on the project financing.

After more than a decade, it was decided in 2006 to construct the Landtunnel Utrecht as a 1650-m full-length covered tunnel, which resembles closely the initial concept that was included in the 1995 Master Plan. The path-finding process that took place between 1995 and 2006 required a unique and in-depth investigation into the interaction between (partly) covered tunnelling concepts, safety issues, noise production, air quality, financing, and urban development. Not all decisions were made according to the evidence that was produced in the process. The overall investigation can, nevertheless, be used as an evidence-based reference for the next generation of multifunctional tunnels in the Netherlands and abroad. It made clear that the motorway network in the Randstad had become an integral part of its built environment and that this fact requires new concepts and solutions.

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3

Digital Amenities of a Smart City

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1. Introduction

Urbanization is essential and necessary to compete with other global cities in a networked world with vague boundaries between countries. A city is a place where creative ideas are exchanged, and, consequently, these ideas blossom a fruit of entrepreneur. Silicon valley is a good example of a melting pot for creative ideas, which was made possible by universities and low rental cost-offices (Glaeser, 2011). However, for already packed cities, it is difficult to provide such an amenity, thus a mechanism must be established by which people can access information and ideas.

One major defect of urbanized society is a lack of community kinship. Human are social and reciprocal in the game of survival (Giddens, 1991). We feel comfortable when we are surrounded by family members and neighbors. A community is necessary from the psychological viewpoint and the manual cooperation as well. In a busy urban life a community tie is very loose or does not exist at all. Strongly digitized time schedule and work labor of modern era prohibit the conglomeration of a community. Connecting people is the first step toward community revitalization in a city.

Deepened urbanization of modern societies, advancement of technology development, and industrial systems have had an impact on social and cultural paradigms from our lifestyles to the way we work (Nei et al., 2007). Especially, development of IT (Information Telecommunication) technology has led to dramatic changes in the urban environment and human activities, and has looked for a way to an integrated model of smart cities where men and environments can interact in a smart way.

A book titled "Creative city" was published in England by Charles Landry. It suggests conditions and objectives in becoming a smart city, where citizens would live in a safer, and securer manner. It also emphasizes the restoration of a community (Landry, 1995). The suggestions were derived from the socio-economical, and political point of view, though there were a few technological ideas for efficiency of administrative and municipal operations.

Researches about a ubiquitous city or a smart city have been undergone recently, actively in Korea. The Korean government granted a big research fund for a national level project. They aimed at conceptualizing and realizing a smart city. Even though the project is in its final stages, the results are insignificant because it failed in figuring out a concrete service framework that supports human activities in a smart city environment. It brought up a gigantic picture of covering all domains from safety and security to education and health. It remained as a picture, but did not proceed into an elaborate model with detailed execution information.

Fig. 1. Digital amenity. (Uk Kim, ubiquitous amenities lab, Hongik University)

In the urban environment, 'quality of life' is a fundamental requirement for human life. As modernization and urbanization proceeds faster than any previous period since human enlightenment, life has become unpredictable, thus making the sustenance of quality of life the most important goal among architects, planners and urban designers. Recently utilization of IT technology is actively searched in pursuit of smart cities that guarantee in sustaining quality of urban life.

The value of human dignity should not be undermined, and the minimum standard of health and comfort must be secured. Ergo amenity should be considered as the most basic component in providing smart spaces of this purpose (Bell, 2000). Referring to amenity, it includes various factors such as nature, architecture, climate, social character and personal emotion. Thus, amenity should resolve cultural, ecological, political and social conflicts of human needs and provide necessary civil services, individually and collectively. Digitally complemented amenities (figure 1) are suggested here to enhance the services based on digital infra-structure. In this study, essential services of digital amenities are realized using ubiquitous technologies, and are entitled as "u-services" of a smart city (Kim et al., 2009, 2010).

2. History of cultural innovation

Human skills for survival have been embedded into our DNA as intelligence, and they are the resources for the innovation of human culture like social and economical systems. Human instinct and intelligence ignites the development of technologies, which in turn guarantee financial success in a capitalistic society. Thus, it is inevitable for technological innovation, in every aspect of human culture, to explode and continue.

The first step to implement a digital amenity is to find out the required civil services. By reviewing significant footsteps of cultural innovation in human history, the crucial aspects of conception about environment, materials, relationships and commodities can be categorized by the following: time, space, resource and people (Pinker, 1997, 2007).

Along with the invention of tools, time was digitalized in the form of the calendar, and human life has been scheduled far more densely than ever before. Densely scheduled life gives human the opportunity for the development of innovative technology.

Following the invention of the calendar, the invention of the printing press presented human kind with a way to share, reserve, and transmit knowledge to future generations. Such following communication technologies as radio, television, cellular phone and internet allow real time information to be transmitted globally.

As seen in figure 2, there have been four essential factors at the center of the innovation of technology and human culture; time, space, resources and people. Digital amenities will focus on these factors in the development of necessary civil services for the sustainability of a smart city. At the same time, citizens are exposed to life long learnings of innovative technology and evolving culture, which is critical for creative living in a smart city. Therefore, it is needed to collect information, monitor collected data, and broadcast to the public.

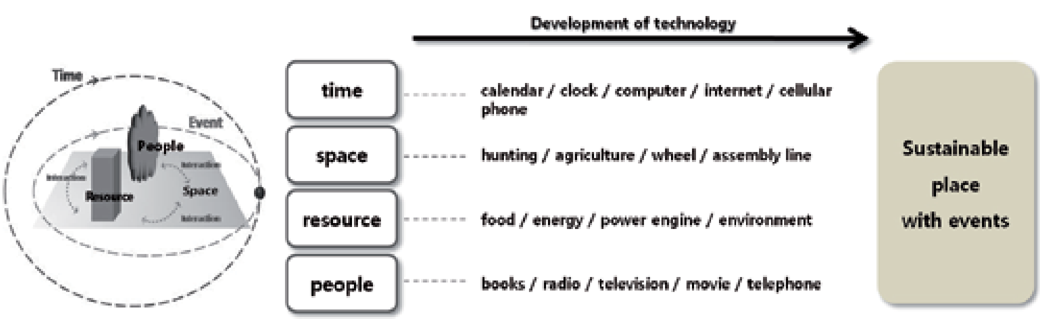


Fig. 2. Time, space, resource and people. (Uk Kim, ubiquitous amenities lab, Hongik University)

3. Computational model of urban spaces

Existing spaces of a city are classified into four classes shown in table 1, in which the necessary services are extracted to meet civil requests in a city. These services are designed in a scenario format that represent realistic patterns of urban life.

The spatial model of the four classes is based on a computational model of life events (Rucker, 2005) for predictability, including Class 01: uniform type, Class 02: queuing type, Class 03: random type, and Class 04: clustered type. The Class 01: uniform type spaces can be found in a structured form, making up a block of a city. The Class 02: queuing type is a linear space that flows in one direction. A plaza or agora can be considered as a Class 03: random type. Further, a random but focused space is classified as a Class 04: clustered type space.

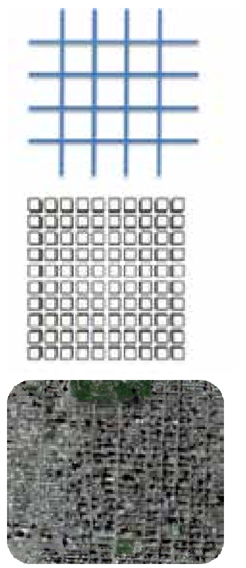
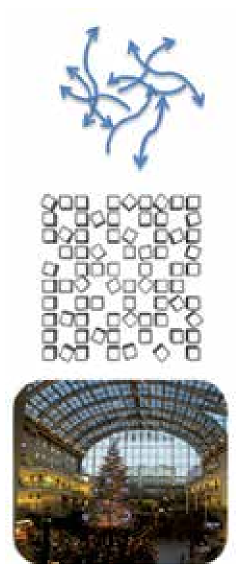
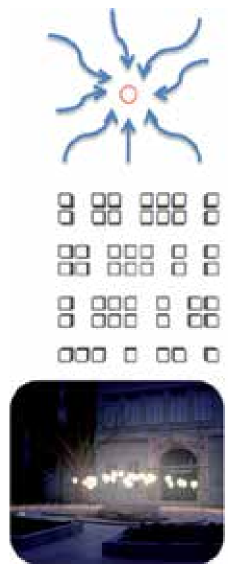
Class 01. Uniform space	Class 02. Queuing space	Class 03. Random space	Class 04. Clustered space
			
Manhattan, New-york	Subway platform, Paris	Factory shopping mall, Sapporo	Winterwolken, Berlin

Table 1. Urban space classification. (Uk Kim, ubiquitous amenities lab, Hongik University)

Based on the analysis of four urban space types, civil services are studied and organized in a series of events and respective actions. Four factors of figure 2 have been the starting point to conceptualize the digital amenity that provides citizens designed services in a smart city.

4. Service framework and evaluation methods

Digital amenities would provide services that would enhance life values for citizens. These services are gathered, organized in a scenario format, and evaluated through ICT for everyday life, types of a spatial model, and content factors described previously.

The values for citizens can be divided into technological values and psychological values as shown in figure 3. The technological values can be measured by the speed and efficiency of service delivery with the amount of cost and energy. The psychological values ascribe feelings of safety, security, and happiness.

To model a smart city with digital amenities, not only are physical spaces required to be based on ICT environments, but they are also required to be incorporated into a conventional internet based data community, say virtual space shown in figure 4. The networking of scattered spaces is also required to uplift life values in terms of content storage and distribution.

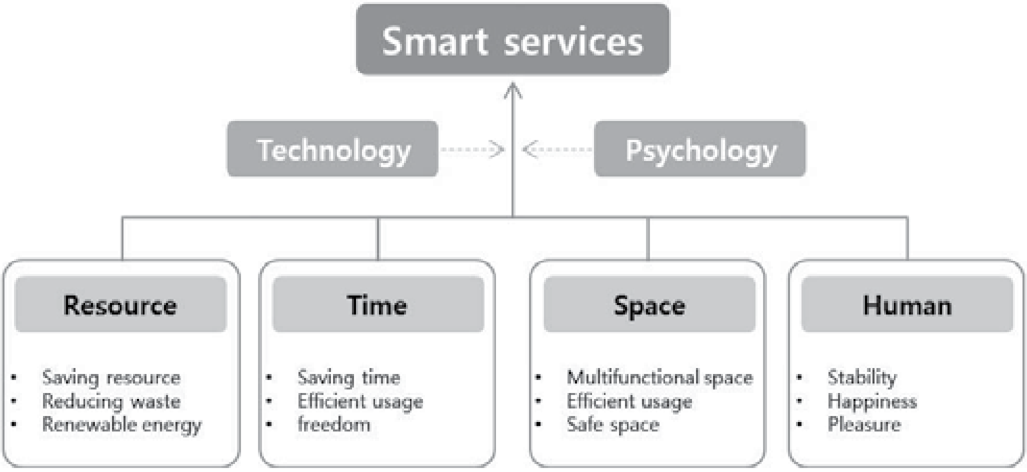


Fig. 3. Smart services with values. (Uk Kim, ubiquitous amenities lab, Hongik University)

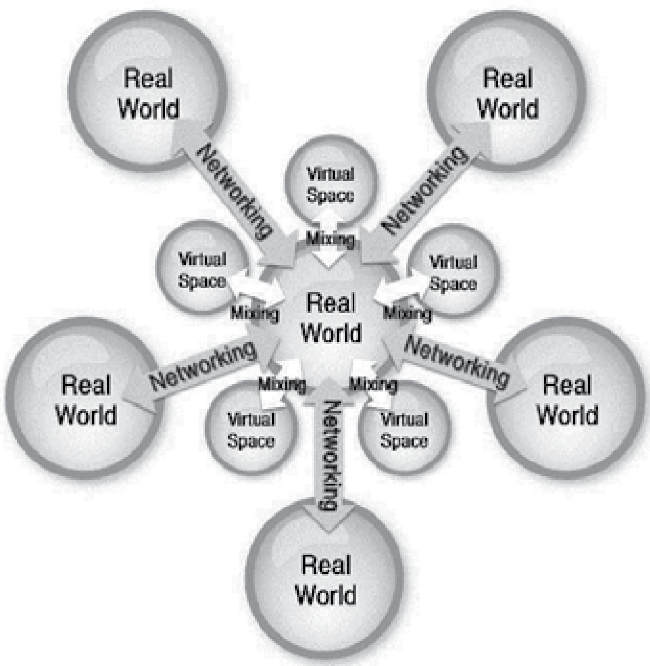


Fig. 4. Mixing and networking using ICT. (Uk Kim, ubiquitous amenities lab, Hongik University)

By analyzing the unit service models defined from the ubiquitous city research, the services that satisfy the needs of a target city are derived, in which they are evaluated and articulated for further implementation of a platform and rule engine. For the evaluation of services, the QFD(Quality Function Deployment) and SVD(Service Value Deployment) methods (figure 5) are utilized in order to prioritize the services based on space classes, customer requirements and technology properties.

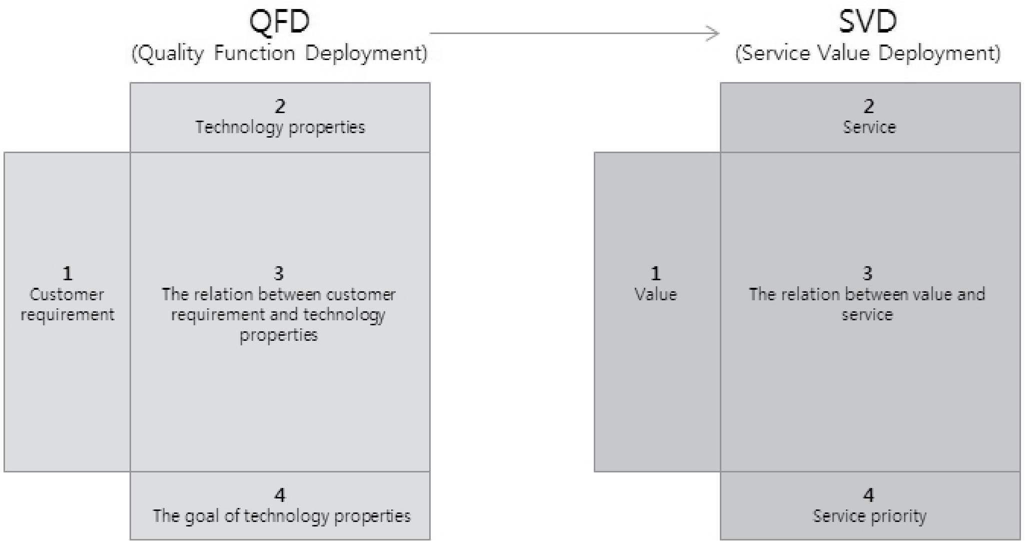


Fig. 5. Evaluation methods of services. . (Uk Kim, ubiquitous amenities lab, Hongik University and Seung Sik Yoon, UBIDUS Co.)

5. Service scenarios and device images

Evaluated and articulated services are used in turn to prepare service scenarios. Firstly, content factors of a city are analyzed according to their correlations along with their interfaces. Secondly, various personas are employed to document plausible events that constitute ordinary urban life patterns. Following tables illustrate service scenarios realized for the project.

<table>
<tr><th colspan="4">Scenario 1</th></tr>
<tr><td>Name</td><td>Sex</td><td>Age</td><td>Job</td></tr>
<tr><td>Hee-sun, Kim</td><td>female</td><td>35 age</td><td>office worker</td></tr>
<tr><td>Characteristics</td><td colspan="3">Passes the Street Light on way home</td></tr>
<tr><td>Purpose of Activity</td><td colspan="3">Check village notifications and other information through local information browsing</td></tr>
<tr><td colspan="4">It is inconvenient to check village information, since it is too late in the evening. Before returing to home, we use the Street Light located on the street to check on village notifications.
① Walk towards the Street Light located near the local mart.
② Check for village information and notifications using the Street Light
③ Check the results for the recent polling event</td></tr>
<tr><td colspan="4">①  ②  ③ </td></tr>
</table>

Table 2. Scenario 1. (Uk Kim, ubiquitous amenities lab, Hongik University)

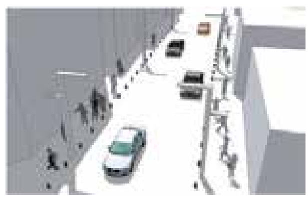
<table>
<tr><th colspan="4">Scenario 2</th></tr>
<tr><td>Name</td><td>Sex</td><td>Age</td><td>Job</td></tr>
<tr><td>Young-ha, Park</td><td>male</td><td>45 age</td><td>researcher of urban</td></tr>
<tr><td>Characteristics</td><td colspan="3">Use the Street light frequently for retrieving information</td></tr>
<tr><td>Purpose of Activity</td><td colspan="3">Need information for passing-by population</td></tr>
<tr><td colspan="4">Mr. Park, who is a researcher for city planning, wishes to gather information about passing by population of Hong-Ik university during weekdays and weekends.
① Input setting parameters to the Street light where the research is to be conducted.
② Gather information about passing by population through Street lights.
③ Continue research using data gathered from Street lights.</td></tr>
<tr><td colspan="4">①  ②  ③ </td></tr>
</table>

Table 3. Scenario 2. (Uk Kim, ubiquitous amenities lab, Hongik University)

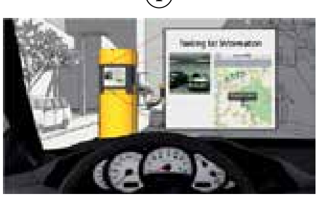
<table>
<tr><th colspan="4">Scenario 3</th></tr>
<tr><td>Name</td><td>Sex</td><td>Age</td><td>Job</td></tr>
<tr><td>Su-ji, Choi</td><td>female</td><td>27 age</td><td>office worker</td></tr>
<tr><td>Characteristics</td><td colspan="3">Fashion mania. Uses her car frequently</td></tr>
<tr><td>Purpose of Activity</td><td colspan="3">Goes to Dongdaemun using her car, searches for nearby parking spaces</td></tr>
<tr><td colspan="4">She is planning to drive to Dongdaemun fashion mall to purchase some clothes. Dongdaemun is a crowded area, and searches for the nearest parking space.
① Search for Parking spaces prior to visiting Dongdaemun.
② System searches for empty parking spaces, and delivers the directions.
③ Park in the parking area, and continue shopping.</td></tr>
<tr><td colspan="4">①  ②  ③ </td></tr>
</table>

Table 4. Scenario 3. (Uk Kim, ubiquitous amenities lab, Hongik University)

Scenario 4			
Name	Sex	Age	Job
Dong-jin, Seo	male	48 age	shop owner
Characteristics	Cannot leave his store		
Purpose of Activity	Wishes to gather part-time workers for his shop		

He owns a local shop, and wishes to hire a part-time worker. He uses the Media board to post a hiring ad to reach local communities.

① Use his own notebook to register an ad on the Media board.

② People of the local community look up the wanted information using the local Media board.

③ People of the local community can access information about the shop using the Media board.

①

②

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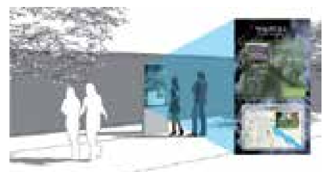


Table 5. Scenario 4. (Uk Kim, ubiquitous amenities lab, Hongik University)

Scenario 5			
Name	Sex	Age	Job
Jin-seok, Park	male	33 age	government employee
Characteristics	Officer of the Mapogu Office. In charge of developing tourist attractions in the Hongdae area		
Purpose of Activity	Survey and Polling		

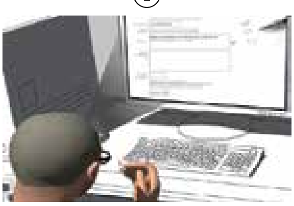
He, who works for the Mapogu office, is in charge of developing tourist attractions for the Hongdae area. He acquires information through polling and surveying using the Media board.

① Post polls and surveys using the internet.

② Citizen A uploads the realtime image and location information.

③ Citizen B posts an opinion.

①



②

③

Table 6. Scenario 5. (Uk Kim, ubiquitous amenities lab, Hongik University)

Scenario 6			
Name	Sex	Age	Job
Young-su, Kim	male	33 age	office worker
Characteristics	Uses the Smart device very well. Interested in the Gangnam province.		
Purpose of Activity	Upload realtime information of Gangnam area, and share it with other people.		
He, who is interested in the Gangnam area uses various smart devices at his office, home, bus, and other places to upload and share information about the Gangnam area using a virtual space called USL World.			
①	After his date in Gangnam area, he accesses the USL world using his smart phone.		
②	Upload pictures taken in Gangnam area to the USL World.		
③	Using realtime social networking services, he posts comments on other peoples photos.		
①	②	③	

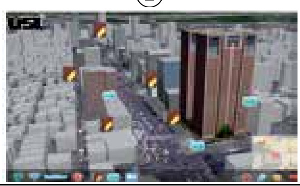


Table 7. Scenario 6. (Sung Ah Kim, Sung Kyun Kwan University)

Scenario 7			
Name	Sex	Age	Job
Jae-won, choi	male	31 age	worker
Characteristics	Uses the Smart device and public bicycle very well. Interested in the bicycle road of Hangang river.		
Purpose of Activity	Upload realtime environmental information of bicycle road of Hangang river, and share it with other people.		
He, who is interested in bicycling, uses various smart devices and public bicycles at the bicycle road of Hangang river to upload and share information about integrated urban platform.			
①	After his date at the bicycle road of Hangang river, he accesses the integrated urban platform using his smart phone and devices.		
②	Upload pictures taken in the bicycle road of Hangang river to the integrated urban platform.		
③	Using realtime social networking services, he posts comments on other peoples photos.		
①	②	③	

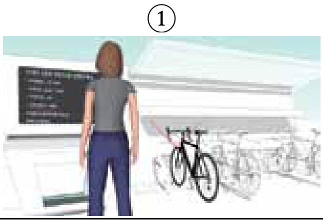
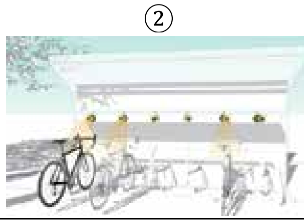




Table 8. Scenario 7. (Uk Kim, ubiquitous amenities lab, Hongik University)

The ICT devices and display forms that can be used in the services are designed according to technical feasibilities. Their images are captured in table 9.

<table>
<tr><th>Street light</th><th>Community board</th><th>Adaptive media display</th></tr>
<tr>
<td>

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<td>

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</td>
</tr>
<tr>
<td>- Life information service
- Exercise information service
- Personal exercise management base on smart key
- Emergency call service</td>
<td>- Local information service
- Life information service
- Augmented reality service
- Interactive community service
- Emergency call service</td>
<td>- Construction guide service
- Construction information service
- Roundabout way guide service
- Environment information service</td>
</tr>
</table>

Table 9. Examples of smart device implementation. (Uk Kim, ubiquitous amenities lab, Hongik University and Seung Sik Yoon, UBIDUS Co.)

6. Service rules and platform

The integrated service management and monitoring environment for smart services is suggested. The unit smart services construct an information architecture (figure 6) that gathers the 'Event' generated by citizens, and relates them to the 'Action' that should be taken by the digital devices/artifacts, while managing these two elements using service 'Rules'.

The u-service (or services based on ubiquitous technology) can be abstracted to a series of ‘Events’ occurring according to the’Actions’ evoked by a user or the environment. Often times, the environment encapsulates various sensors and input devices based on IT technology, and output devices such as a computer, smart-phone, digital signage, and/or large sized information displays

The ‘Event’ that triggers an ‘Action’ of a smart space can be an input signal, actively or passively, created by a user of the system, or an event that is automatically generated by the system, such as a timed event, or an output signal from a nested procedure of the smart space. The ‘Action’ can be classified as a triggering of contents, applications, or mechanical outputs of a smart space.

The series of ‘Events’ that provoke ‘Actions’ of a smart space can be modeled so that the interactions of a user to a given smart space can be normalized and systemized. If we define a u-service as a series of ‘Actions’ caused by a single, or a series of events within a smart space, we can couple the relations of corresponding ‘Actions’ caused by appropriate ‘Events’, and call it a ‘Rule’.

The input data from the citizens' behaviors are modeled into 'Events', which are mapped to one or more 'Actions' that is to be performed by the digital devices that provide smart services (or u-services). 'Events' and 'Actions' are bound through 'Rules', thus enabling a platform to manage services through those specified 'Rules'.

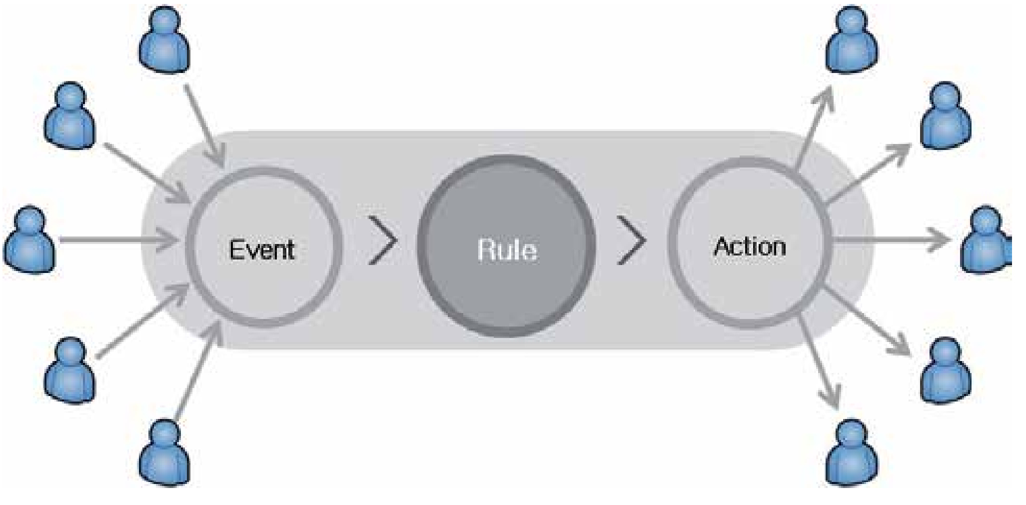

Fig. 6. Information architecture. (Uk Kim, ubiquitous amenities lab, Hongik University)

By associating ‘Actions’ to ‘Events’ using ‘Rules’ in a smart space, it is possible to normalize & systemize a u-service. If we can conceive the concept of a ‘u-service’ as delivering needed contents to a needed user, using appropriated devices & networks through associated applications, the coupling of ‘Actions’, ‘Events’, and ‘Rules’ to define a ‘u-service’ can provide a method to normalize u-services.

The ‘Rules’ can be archived and modified according to the needs of the associated u-service given a specific time frame, thus provide a platform in which u-services can be modeled, authored, and managed. A customizable integrated platform model (figure 7) is framed so that it provides adequate information for appropriate devices. The Platform detects and processes the citizens' needs based on various ICT (Information Community Technology) environments.

The service offered to the citizens using ICT environments can be modified /adapted /expanded according to the unit space, and individual context of the space.

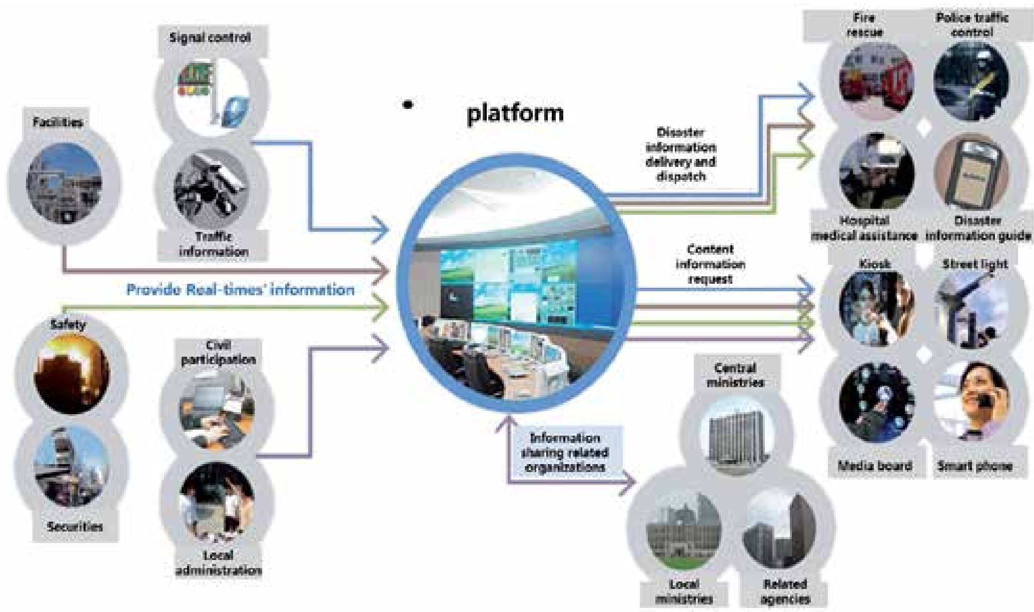

Fig. 7. Smart service platform. (Uk Kim, ubiquitous amenities lab, Hongik University and Seung Sik Yoon, UBIDUS Co.)

Prototypes of SDK (Standard Development Kit), API's and Simulators that are needed to integrate the unit smart service to the platform is also provided, and Service Management Rules are developed to provide maximum benefit and efficiency.

To ensure the successful management of services, a "Business Ecology" is suggested to the Government and Private sector business partners.

7. Implementations

The methodology of evaluating the feasibility and usability of implemented u-services include the user response analysis (usability, value analysis), surveys of citizen groups, and technical analysis (technical efficiency, technical robustness)

To enhance the credibility of the service analysis, we cooperated with the test-bed implementation, evaluation and maintenance task defined in a smart city. We perform a recursive service model evaluation process (figure 8) by evaluating and revising the service models through 2 stage test bed implementations.

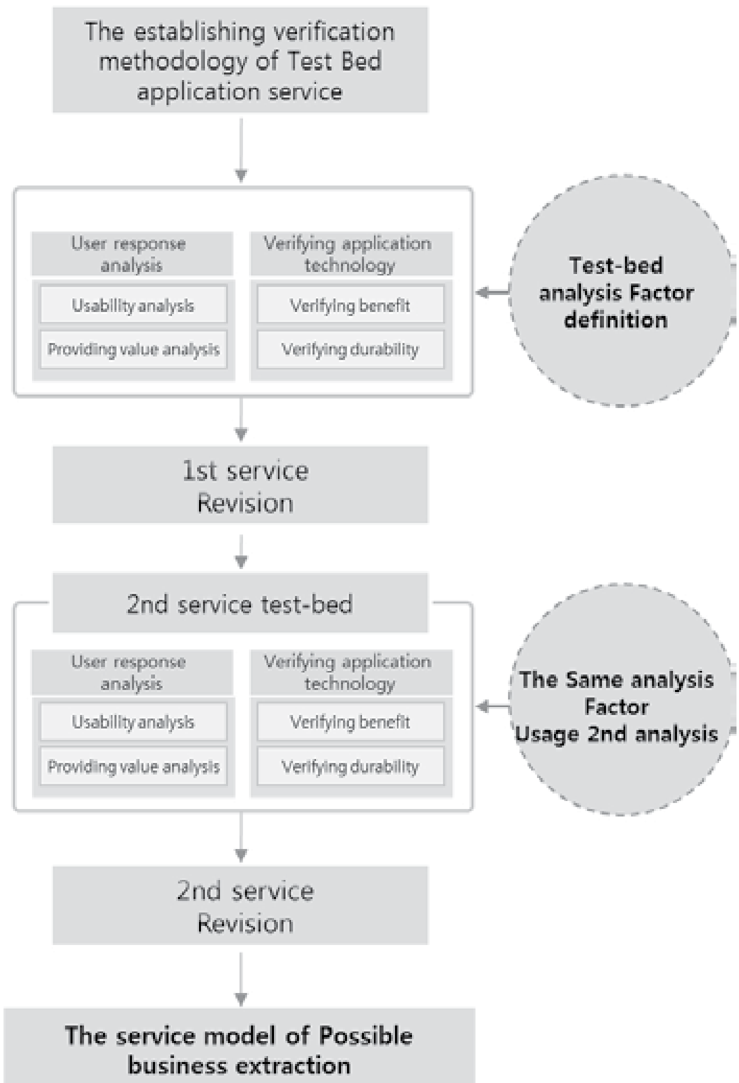

Fig. 8. Service model evaluation process using test-beds. (Uk Kim, ubiquitous amenities lab, Hongik University and Seung Sik Yoon, UBIDUS Co.)

The 1st stage test-bed will evaluate the user response according to the usability and values provided, which is based on the data gathered from the implementation of the service test-bed. As for the 1st stage of technical evaluation in the test-bed, factors such as the efficiency of the technology implemented, and durability of the technology under field environment are examined.

During the 2nd stage of the test-bed, the usability and technical evaluation results from the 1st stage are used to upgrade the system and service models. The revised system and service models are tested in the 2nd step test-bed, according to the same evaluation factors used in the 1st stage.

8. Conclusion

Ubiquitous technologies are being adapted here to create new value to urban amenities for better human environment. Through u-services of digital amenities, not only will the quality of human life be improved, but traditional functions of a community will also be restored by connecting members geographically, and networking them socially.

A great amount of money is required to facilitate digital amenities. Although digital amenities are in principle, the infra-structure of digital environment, the investment should be allotted for people, for the objective of implementing a smart city is to increase human capital for sustainability of the city.

A sustainable business model that will increase the life value of citizens while building up a successful business ecology will be derived as a result.

9. Acknowledgment

The research project which is described in this paper has been carried out for almost a decade. During that period a good number of graduate students have participated in this project. I have to thank them for their contribution to research outcomes. I also thank Professor Sung Ah Kim of Sung Kyun Kwan University and President Seung Sik Yoon of UBIDUS company for their advice and cooperation.

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4

Emerging Technologies for Urban Traffic Management

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1. Introduction

Nowadays, the number of vehicles on the road and the need of transporting people grow fast. Road transportation has become the backbone of industrialized countries. Nevertheless, the road network system in cities is not sufficient to cope with the current demands due to the size of roads available. Building additional or extending existing roads do not solve the traffic congestion problem due to the high costs and the environmental and geographical limitations. As a consequence, the modern society is facing more traffic jams, higher fuel bills and high levels of CO2 emissions.

Vehicular traffic is one of the most critical concerns of modern societies where cities are ever growing. The *United Nations Population Foundation* published in its technical report (UNFPA, 2007) that for the first time, more than half the world's population lives in urban areas and the balance of people continue shifting to the cities. As a consequence, drivers and passengers spend a large percentage of their day stuck in traffic.

Traffic congestion in urban areas is a serious problem that has an important economical, environmental and road safety impact. The technical report of the *Texas Transportation Institute* shown that in 2010 traffic congestion represented an $101 billion annual drain on the U.S. economy, with 4.8 billion hours and 1,9 billion gallons of fuel spent on traffic, the equivalent of one work week and three weeks worth of gas every year (Schrank et al., 2011). According to the *Intelligent Energy Europe* in the European Union (EU), traffic congestion costs $50 billion per year or 0.5% of the community Gross Domestic Product (GDP), and by 2010 this figure could go up to 1% of EU GDP.

Therefore, traffic congestion has an important environmental impact. According to the technical report on traffic congestion and greenhouse gases (Barth & Boriboonsonsim, 2009) a third of America carbon dioxide (CO_2) emissions come from moving people or goods, and 80 percent of these emissions are from cars and trucks. According to the Eurostat data, road transport accounted for 19.5% of the EU total greenhouse gas emissions in 2008 (Bakas, 2008).

On the other hand, regarding road safety impact, the technical report of the Commission for Global Road Safety indicates that road crashes kill at least 1.3 million people each year and injure 50 million. Significantly, 90% of these road casualties occur in developing countries.

Each year 260,000 children die on the road and another million are seriously injured. By 2015 road crashes are predicted to be the leading cause of premature death and disability for children aged five and older (Commission for Global Road Safety, 2009).

It is essential to improve the safety and efficiency of transportation. Several research groups focus their attention on the emerging technologies as a feasible alternative to solve the traffic and transportation problems. The primordial objective is that emerging technologies can contribute to the solution of transportation issues by making transport safer, more efficient and competitive, more sustainable and more secure.

In this way, emerging technologies are established as basic elements of transportation systems. The increasing capacity and flexibility of emerging technologies could make it possible to create cooperative automotive systems and reduce investment, operational costs and accidents, making more efficient transport systems. Emerging technologies must guarantee the required demands of transportation systems. Communication technologies should be used to build vehicular networks to reduce traffic congestion and improve safety. Safety and efficiency on roads can be substantially improved with the deployment of intelligent systems such as adaptive traffic control, incident detection and management systems both in cities and highways. To enable these systems, vehicles must be equipped with wireless radios and communication devices must be placed on the roadsides. Roadside units can be utilized to extend the network coverage, enabling communication between distant vehicles (i.e. beyond its radio range), support a high-speed and low-latency network and provide services to both public and private companies. In this sense, recent advances in technology, particularly in the areas of mobile computing, a new generation of wireless ad-hoc networks, which is named *Vehicular Ad-hoc Networks* (VANETs), is emerging. In this kind of network vehicles could communicate with each other on the road and the intention of this network is to solve traffic problems by means of *vehicular to vehicular* communication (V2V) and *vehicular to infrastructure* communication (V2I) as shown in figure 1. For this communication, some devices known as *on-board units* (OBUs) must be placed at each vehicle. These devices can send or receive data to or from *roadside units* (RSUs). Nevertheless, if a vehicle cannot directly send its data to an RSU, it can relay its data to other vehicles until the data reach to the RSU using a multihop transmission strategy (Yang et al., 2007).

In the near future, it is expected that urban and vehicular networks will co-exist and be interconnected for exchanging and sharing of information and services. This mixture of networks represents an important opportunity for optimizing traffic flow in urban areas, improving urban transportation services, and monitoring the environment. However, in order to enable interconnectivity between these networks and support the development and deployment of such type of applications there still exist important challenges in terms of heterogeneity, security, privacy, quality of services and scalability that need to be overcome.

It is being proposed to accelerate and coordinate the deployment and use of vehicular networks applications and services for road transportation and their connections with other modes of transport, to ensure seamless access and continuity of services. Some areas involved in this integration are: optimal use of road and traffic data, traffic and freight management, road safety and security, integrating vehicular networks applications in the vehicle, data protection and liability. The direct benefit will be a faster, better-coordinated and more harmonious use of intelligent transportation systems and services, which in turn will contribute to more efficient, cleaner and safer transportation.

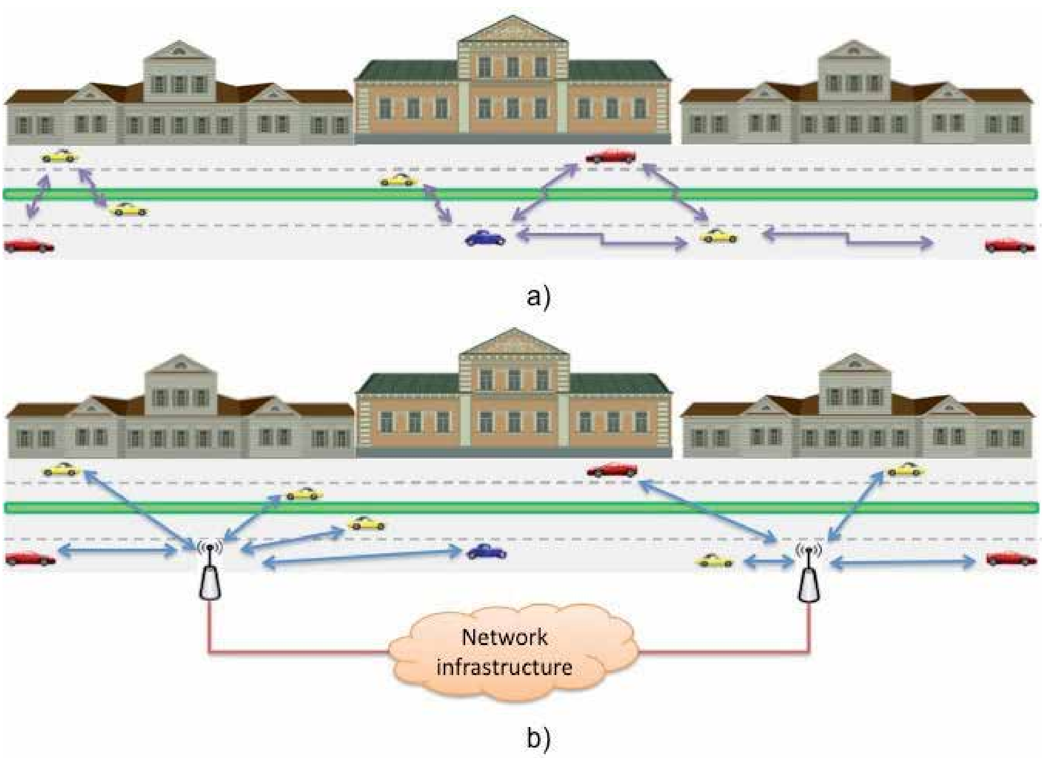

Fig. 1. Communication modes for VANET a) vehicle-to-vehicle mode (V2V) and b) vehicle-to-insfrastructure mode (V2I).

This chapter gives the readers a global vision of traffic and transportation issues and how the application of emerging technologies might contribute to the solution of transportation challenges. The chapter is organized as follow: The first section of the chapter provided a global view of traffic and transportation issues. The second section of the chapter provides an overall view of the fundamental challenges of vehicular networks and their applications. The third section presents a global analysis of the emerging technologies that can be used in the vehicular communications. Finally, the last part of the chapter describes several sensing platforms for collecting information about traffic conditions.

2. Challenges of vehicular networks

In comparison to other communication networks, vehicular communication networks come with some unique attractive features: unlimited transmission power, predictable mobility and plethora of potential applications. However, vehicular networks have to cope with some important challenges that include: 1) extreme heterogeneity, 2) rapidly changing topology subject to frequent fragmentations and congestion, 3) the stringent application requirements on real-time and robust message delivery, 4) security of the information and users. In this section of the chapter we analyse some of these challenges that the vehicular networks face.

2.1 Extreme heterogeneity

VANETs are an important component of any Intelligent Transportation System (ITS) and a promising environment to support a number of safety, driving and entertainment applications. However, to support such applications important heterogeneity challenges need to be overcome:

- *Wireless technologies.* Existing network technologies are different in terms of geographical coverage, data transfer rate, transmission range and supported content types. Thus, a vehicle using one network technology may not be able to communicate with a vehicle using a different technology. Even tough most on-board devices utilize the 802.11p standard; VANET applications would require to interact with nodes or networks utilizing a different technology. For example, a VANET application may require interacting with a wireless sensor network dedicated to manage traffic lights using the Zigbee technology or to gather data from on-board sensors or devices using Bluetooth.
- *Routing protocols.* Recently, many VANET routing protocols have been proposed (Li & Wang, 2007), these protocols have important differences in the mechanims they utilize as many of them target at different VANET environments. For example, some of them consider highly populated environments whereas others are optimized to operate in sparse networks. These differences mean that additional mechanisms are necessary to enable interoperability among heterogeneous routing protocols. The research community has already identified this problem and possible solutions have been investigated (Nundloll et al., 2009).
- *Sensors.* In future VANET scenarios different on-board and roadside sensor will be available. On-board sensors will be utilized to capture different vehicle, driver or surrounding parameters whereas roadside sensors will help gather road conditions affecting driving safety (e.g. big holes, thick ice, malfunctioning cars). All this information is important not only for driver in the vehicle but also for neighbouring drivers. However, sensors accuracy, measurement units, among others may vary from one manufacturer or model to another. Thus it is necessary to further investigate mechanisms that allow to correctly exchanging sensed data.
- *On-Board Units (OBU).* Some manufacturers have started to release to the market different on-Board units. Telargo[1], Kapsch[2] and Efcon[3] are examples of such manufacturers. These units offer different capabilities (e.g. positioning, communication, I/O features, sensors) and use different software platforms. This heterogeneity is a clear concern for developers as developing an application that can be deployed on different on-Board-units may be too difficult or in some cases not possible.

2.1.1 Standards

VANETs standards are important for applications as they guarantee interconnectivity and interoperability. Connectivity is an important characteristic of wireless networks. In the Internet model paths between two nodes are always there. In VANETs is not the case.

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[1] http://www.telargo.com/overview/technology/on_boardequipment/obu.aspx
[2] http://www.kapsch.net/cl/en/ktc/portfolio/products_components/Pages/on-board_units.aspx
[3] http://www.efkon.com/en/products-solutions/ITS/gnss-onboard-unit.php

Mobility is to be considered especially as the path becomes sparser. Regarding operability heterogeneous protocols are also to be considered. For instance in pocket switch network the capabilities and behaviour of the sensors vary largely. Two standards are described in turn (Zeadally et al., 2010; Spyropoulos et al., 2010):

- **Dedicated Short Range Communication (DSRC)** short to medium range service for vehicle-to-vehicle and –roadside communications. It provides high data transfers and low communication latency in small communication zones.
- **Wireless Access in Vehicular Environments (WAVE)** a universal standard as the DSRC effort of the ASTM E2213 working group migrated to the IEEE 802.11 standard group. It works at the media access control and physical layers and enables communications even for vehicles coming from opposite directions.

In (Ma et al., 2009) some additional evaluations procedures are presented as alternatives for analyzing vehicular traffic.

2.2 Application requirements for VANET

Covering the whole requirements for vehicular networks and their applications is imperative for carrying out in an efficient and effective way their functions. As new advances in hardware and software communication technology emerge, new applications are enabled in different contexts including vehicular networks.

2.2.1 Classification of applications for VANET

Vehicular software applications may be categorized into four groups (Popescu-Zeletin et al., 2010):

- *Safety* related to the different kinds of collisions that most frequently occur between vehicles and other objects such as animals, trees, and pedestrians. This kind of real-time proactive application usually is vehicle-to-vehicle. They use beacon messages, a single-hop position based or fast-bidirectional communication regime, their latency cannot be higher than 100ms, whereas the packet delivery ratio cannot be lower than 99%.
- *Assistance* provides features such as repair notifications, remote diagnostics, context information, navigation facts, and alerts. This type of time-to-live provider application usually is vehicle-to-backoffice or vehicle-to-roadside. They use normal messages, bidirectional communications; their latency cannot be higher than 400ms, whereas the packet delivery ratio cannot be lower than 95%.
- *Resource* captures domain issues such as traffic bottlenecks and fuel consumption amongst other, including environmental issues. This type of time-to-live traffic application usually is vehicle-to-backoffice or vehicle-to-roadside. They may use beacons or alerts, a multi-hop position based communication regime, and their latency cannot be higher than 400ms, whereas the packet delivery ratio cannot be lower than 95%.
- *Infotainment* also known as in-car comfort entertainment, usually do not use inter-vehicular communications. This kind of time-to-live ad-hoc application usually takes place in-car or vehicle-to-roadside. They use alerts, a multi-hop position based communication regime, and their latency cannot be higher than 400ms, whereas the packet delivery ratio cannot be lower than 95%.

Some other requirements must be considered for all the above applications, for instance whether they need sensors, human-machine interfaces, GPS, or maps in order to provide extra functional capabilities. Table 1 shows the requirements for types of applications for vehicular networks (CAMP Vehicle Safety Communications Consortium, 2005).

Application	Communication Type	Rate	Maximum latency	Data transmitted	Range
Traffic signal violation	V2I	10 Hz	100 ms	Signal phase, timing, position, direction, road geometry.	250 m
Curve speed warning	V2I	1 Hz	1000 ms	Curve location, curvature, slope, speed limit, surface.	200 m
Emergency brake lights	V2V	10 Hz	100 ms	Position, heading, velocity, acceleration.	200 m
Pre-crash sensing	V2V	50 Hz	20 ms	Vehicle type, position, heading, velocity, acceleration, yaw rate.	50 m
Forward collision	V2V	10 Hz	100 ms	Vehicle type, position, heading, velocity, acceleration, yaw rate.	150 m
Left turn assist	V2I or V2V	10 Hz	100 ms	Signal phase, timing, position, direction	300 m
Lane-change warning	V2V	10 Hz	100 ms	Position, heading, velocity, acceleration, turn signal status.	150 m
Stop sign assist	V2I or V2V	10 Hz	100 ms	Position, velocity, heading.	300 m
Electronic Toll Collection	V2I	10 Hz	50 ms.		15 m
Internet Access	V2I	10 Hz	500 ms		300 m
Automatic parking	V2I	10 Hz	500 ms	Position, distance	300 m
Roadside service finder	V2I or V2V	10 Hz	500 ms	Position, velocity	300 m

Table 1. Requirements for different types of vehicular networks applications

2.3 Data dissemination schemes

Given the complexities of VANET in terms of their dynamic topology, mobility models, hard delay constrains, and the different system architectures utilized, transporting information from one vehicle to another or to all vehicles within a given region or area is a highly challenging task. A lot of research has been carried out to develop protocols and mechanisms that can provide network services (e.g. routing) to applications in a VANET environment. Next, a classification of the different protocols for transporting information that have been proposed is presented and briefly analyzed (Li & Wang, 2007; Maihofer, 2004; Nundloll et al., 2009; Zeadally et al., 2010; Mauve, 2010):

- *Broadcast*. This routing method is generally utilized for disseminating information such as traffic, weather, emergency, road conditions, among others, to other vehicles. This communication scheme sends packets to all nodes in the network using flooding. When messages need to be disseminated beyond the radio transmission range, a multi-hop mechanism is then utilized. Thus, in a native broadcast implementation, all receiving nodes simply rebroadcast the received messages. To limit message duplication, nodes broadcast messages only once, and a time to live parameter can be utilized to limit messages area of distribution. Using this routing scheme, delivery of messages to all nodes is guaranteed, however, a large amount of bandwidth is consumed, this is why this routing scheme only performs well when a small number of nodes is participating within the VANET and its performance drops quickly when the size of the network increases.

- *Geocast*. It is a multicast routing service that delivers messages to nodes located within a given geographical region. These routing protocols generally define a forwarding zone that limits flooding of messages. Using this routing scheme it is possible to, for instance, report an accident to vehicles located within a given region or alert a driver when driving on a motorway in the wrong-way.
- *Forwarding*. The purpose of this routing scheme is to transport messages between two nodes via multiple hops. This mechanism is useful when the requested information is only of interest to a few nodes. For example, a node may request information to a nearby car parking about free car parking spaces and fees. When a node is requesting information, a unicast message is sent. To forward the message to its destination a route is reactively constructed, for example, by looking at local routing tables or by asking nearby nodes whether they know about the destination node.
- *Clustering*. The cluster-based approach consists on grouping nodes located within a given region (e.g. nodes with direct link with each other). For each cluster, a cluster head node is selected which is responsible for managing inter and intra-cluster communication. The cluster-based structure functions as a virtual network infrastructure whose scalability favors routing and media access protocols although an overhead cost is paid when forming clusters in highly mobile network environments and network delays may occur on large networks.
- *Beaconing*. This routing mechanism is suitable for applications that require sharing information with other vehicles periodically (e.g. exchange of local traffic information). In this routing scheme a node announces information periodically. Receiving nodes, do not re-broadcast the received message immediately, instead, they integrate and store received information on its local information cache. On the next beacon, a message is constructed using both local and the incoming information and broadcasted to neighboring nodes.
- *Position-based*. For this routing scheme to work, information on the location of each node is fundamental. To decide how to route messages, nodes utilize geographical location information obtained from sources such as street maps, traffic models and on-board navigational systems. Routing decisions at each node are done taking into consideration the position of the destination node and each node's location information. As routing tables are not required, no overhead is incurred on maintaining and establishing routes.
- *Delay-tolerant*. There exist scenarios where the density of vehicles is really low and consequently establishing end-to-end routes is not possible. For example at nights, traffic in cities can be really low and available vehicles may not be close enough to receive and forward messages. Also, in rural areas vehicles density may be low. In sparse networks like those, a delay-tolerant protocol can be utilized. This routing mechanism is based on the concept of carry and forward, where a node carries messages and these are only forwarded when another node moves into its vicinity, otherwise, they are simply carried.

- *Ad-hoc (address-based/topology-based).* This category groups routing protocols initially designed to operate in *Mobile Ad-hoc Networks* (MANET) environments. VANET attempts to test these routing protocols in such new environments have been carried out. However, requirements on these address-based and topology-based mechanisms such as unique address identification among others make these protocols less suitable for VANETs.

2.4 Security on VANETs

As mentioned before vehicular networks could help improve traffic management and roadside safety. Several efforts have been focused on the development of applications for these kinds of networks. However, those applications will have important requirements regarding data security. Vehicular communication security is a major challenge, having a great impact on future development of vehicular networks. According to Weimerskirch, security is defined as "protection against malicious manipulation of IT systems and plays an important role when designing and implementing such applications" (Weimerskirch et al., 2010).

In this sense, VANET's applications face important challenges in the security area, as they are more vulnerable to attacks. In vehicular communication scenarios, due to exhaustive data exchange amongst vehicles and the infrastructure the potential risk of violation of data security is greatly increased. Therefore, applications could be used for illegal objectives such as tracking people on their vehicles or to disseminate false information about traffic conditions.

In vehicular networks is needed an exhaustive risk analysis in order to identify potential attacks. However risk analysis has not yet been studied in an extensive way. Some works as the proposed in (Aijaz et al., 2006) and (Schneier, 1999) are cited by different authors on attacker capabilities in vehicular communications. In (Huanqun et al., 2008) authors presented some possible security threats and attacks scenarios which are described as follow:

- *Eavesdropping.* This consists on diffusing wrong information in the networks to affect the behaviour of the drivers.
- *Denial of service.* This is related to restrict the accessibility of services.
- *Bogus information.* This consists on faking a warning message.
- *Spoofing.* This is related to taking-over the identity of an authorized device.
- *ID disclosure of other vehicle.* This scenario is related to put under surveillance vehicles by means of vehicular networks.
- *Cheating with sensory information.* This problem consists on altering information (such as perceived position, speed, direction, among others) in order to avoid liability especially in the case of an accident.
- *Theft.* Breaking in someone else's vehicle, i.e. impersonation.

There are several research efforts in the area of security in vehicular networks. A majority of works converge towards a design with vehicles frequently beaconing their position along with warnings on their condition or the environment. Typical beaconing periods considered are in the order of one beacon per 100 milliseconds per vehicle. Other efforts have been focused on the definition of security architectures as the developed by the *Vehicle Safety Communications consortium* (VSCC), which defines a PKI-based approach for messages, sent in vehicle-to-vehicle and vehicle-to-infrastructure communication environments (Papadimitratos et al., 2008). However, VANET applications will bring a series of challenges on the security area that help to solve several issues such as integrity, privacy and the non-repudiation of messages and authentication.

2.4.1 Integrity

Integrity is related to honesty and verification of the information. For applications trustworthiness of data is more useful that trustworthiness of nodes communicating data. Data trust and verification ensures that, on the one hand, the exchanged information can be trusted, and on the other hand, the receiver nodes can verify the integrity of the received information in order to protect the vehicular network from attacks and impersonation security. In (Leinmuller et al., 2007) authors classify the trust and verification concepts into proactive security and reactive security. According to Leinmuller the former has been researched extensively and consists of digitally signed messages, a proprietary system design, and Tamper resistant hardware (Caladriello et al., 2007; Hu & Labertearx, 2006; Garfinkel et al., 2003). The latter consists of signature-based, anomaly-based and context-based approaches. Their main characteristic is that they correlate the received information with information that is either already available into the system from observations on normal system operations or that is introduced additionally (Brutch & Ko, 2003; Zhang et al., 2003).

2.4.2 Privacy and non-repudiation

As mentioned before, security in vehicular networks must be designed to prevent potential attacks caused by drivers reacting dangerously as a result of receiving erroneous messages. Non-repudiation is related to define mechanisms, to prevent an entity from denying previous commitments or actions. Vehicular applications require a strong mutual authentication with non-repudiation because all safety-related messages may contain life-saying information. For instance, the diffusion of fake safety messages by an attacker could produce potentially dangerous situations on the road.

Privacy is related to protect user information, while at the same time authorities have to be able to reveal the identity of message senders in case of an eventuality (Raya et al., 2006). Therefore it is critical to develop mechanisms to preserve privacy in vehicular networks. Some of the proposed techniques to provide privacy are: anonymous certificates, group signatures and pseudonym certificates. The anonymous certificates technique is based on the usage of a list of anonymous certificates for message authentication, which is stored in a central repository (such as a transportation regulation center). The second technique is in charge of providing anonymity to a group of members. Any node of the group has the capacity of verifying whether a group member sent a certain message, however it is not necessary to know the real identify of the sender node. Finally, pseudonymous authentication is a technique widely accepted in vehicular networks. Its main use is anonymous authentication.

In (Rivas et al., 2011) authors analyse other important issue in the security area for vehicular networks, the detection and eviction of misbehaving and faulty nodes. Due to the attacker's ability or just to the devices aging process at some point in the time there will be misbehaving or faulty nodes in the vehicular networks. Several works in the literature study this issue. For instance, in (Golle et al., 2004) authors proposed a heuristic approach, which consists in finding the best explanation for corrupted data. In reference (Xiao et al., 2006) authors proposed an approach to detect attacks based on radio signal strength analysis and use the idea that a vehicle cannot be on different places at the same time. In (Raya et al., 2007) authors proposed an approach that uses the Tamper Proof Devices (TPD) and assumed the existence of a honest majority on the attacker's neighborhood. TPD are used to execute their protocol and revoke themselves if they detect that have been tampered.

2.4.3 Message authentication

Vehicular networks require a mechanism to help authenticate messages, identify valid vehicles, and remove malevolent vehicles. Reference (Kargl et al., *2006)* explains that authentication ensures that a message is trustable by correctly identifying the sender of the message. With an ID authentication, the receiver is able to verify a unique ID of the sender. The ID could be the license plate or chassis number of the vehicle. In other cases receivers are not interested in the actual identity of nodes. They are satisfied if they are able to verify that the sender has a certain property. Property authentication is a security requirement that allows verifying properties of the sender, e.g. the sender is a car, a traffic sign. For applications using location information, location authentication allows verifying that the sender is actually at the claimed position, or that the message location statement is valid. Some protocols have been proposed for safety messages in vehicular networks. On the one hand, some of these protocols rely on the concept of pseudonymous authentication, also known as *Baseline Pseudonym* (BP). In this kind of protocols each vehicle generates its own pseudonyms, in order to eliminate the need of pre-loading, storing and refilling pseudonyms and the corresponding private keys. In this way, the burden of key and pseudonym management is greatly reduced. Other protocols are based on *Group Signatures* (GS) for V2V communication (Lin et al., 2007). GS is more robust than pseudonymous authentication, as any two group signatures generated by a node cannot be linked (Calandriello et al., 2007).

3. Wireless technologies for vehicular networks

To support vehicle to vehicle (V2V) or vehicle to infrastructure (V2I) communication in ad-hoc and dynamic environments wireless technologies such as WiFi, WiMAX, 3G, ZigBee and Bluetooth among others, are available (Jain et al., 2009). All these technologies feature important differences in terms of transmission range, transfer data rate, geographical area of coverage, supported content types, etc. In a VANET environment different subsets of this type of technologies can be present at a same time and place; therefore, support for heterogeneous wireless technologies is important. For example, a tracking application may require GPRS connectivity, intersection collision avoidance may require of DSRC communication and text message application may require Bluetooth. The main features of these technologies are described as follows.

3.1 WiFi (802.11p)

The IEEE 802.11p protocol is also known as Wireless Access in Vehicular Environment (WAVE). This protocol was specifically designed operate in V2V and V2I settings, and makes use of spectrum band and channels allocated to the *Dedicated Short Range Communications* (DSRC) by the U.S. *Federal Communication Commission* (FCC) in 1999. The DSRC radio uses a 75 MHz spectrum at 5.9 GHz (Figure 2). The main aim of this standard is to provide support public safety applications that can save lives and improve traffic flow. The DSRC band is a free spectrum and is licensed by the FCC. The license regulates its usage and the technologies that make us of it, this is, all radio manufacturers, must fulfil FCC regulations (Jiang & Delgrossi, 2008). The DSRC band offers 7 licensed channels with a transmission range of up to 1000 meters and a transmission data rate between 6 to 27 Mbps, supporting speeds of up to 200 Km/h. The Department of Transportation of the United States and the automotive industry are strongly supporting the development of DSRC devices (i.e. on board units and road side units) and applications (Jiang et al., 2006).

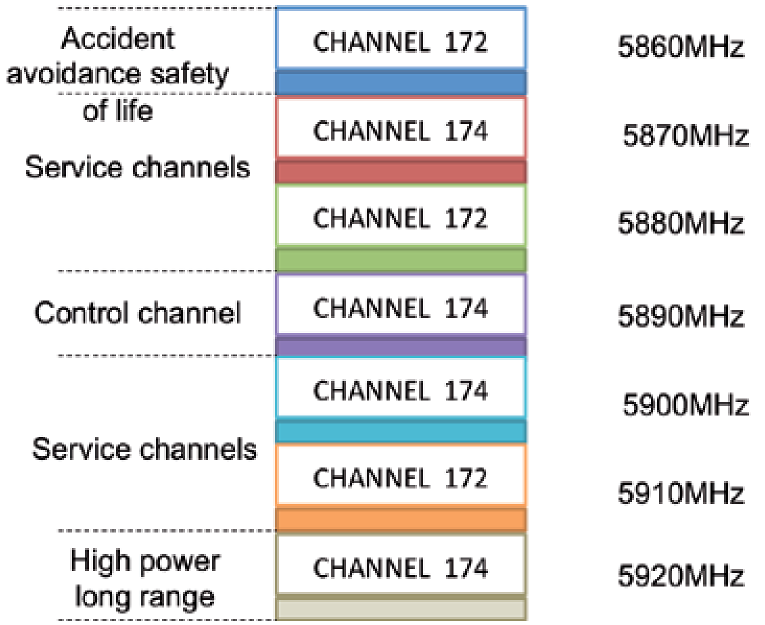

Fig. 2. Available channels for DSRC.

3.2 WiMAX (IEEE 802.16)

WiMAX is a high bandwidth technology designed to provide broadband wireless access over large areas to home and business and to a large number of users. WiMAX is an implementation of the IEEE 802.16 standard and was created by the WiMAX Forum[4] in 2001 (Ghosh & Wolter, 2005). To date more than 500 companies are members of the WiMAX Forum. Some of the potential usages of WiMAX include: mobile broadband connectivity across cities, last mile broadband access, VOIP, Internet connectivity, in-building coverage, temporary coverage and coverage on a mobile vehicle, among others (Peters & Heath, 2009). WiMAX maximum operating range of coverage is 100 Km and supports speeds of up to 1 Gbps (on fixed stations). WiMAX speed depends on the distance covered, the closer the

[4] http://www.wimaxforum.org

WiMAX station the higher the speed and the farther the station the lower the speed. Table 2 summarizes the mobility performance of WiMAX (Cudak, 2010).

Mobility	Performance
Stationary, Pedestrian 0-10 km/h	Optimized
Vehicular 10-120 km/h	Graceful degradation as function of vehicular speed
High Speed Vehicular 120 – 350 km/h	System should be able to maintain connection

Table 2. WiMAX mobility support.

3.3 Cellular technology (3G)

The third-generation (3G) system comprehends a set of standards that aim to support global communication for mobile telecommunication services such as mobile Internet, video calls and mobile TV. These standards are defined in the IMT-2000 vision of the International Telecommunications Union. The most popular implementations of 3G are: UTMS or 3GPP which is widely utilized in Europe, Japan and some parts of Asia and CDMA2000 also referred as 3GPP2 which has been deployed in the United States, South Korea, Belarus, Romania, and some parts of Russia, Japan and China (Etoh, 2005). The IMT-2000 standard aims to provide minimum transmission rates of 2 Mbps for stationary or walking users, and 348 kbps in a moving vehicle (ITU, 2011).

3.4 Zigbee

This technology is built upon the IEEE 802.15.4 standard which defines the physical and MAC layers for low cost and low rate personal area networks. Zigbee has a coverage range of up to 400 meters and a maximum data rate of 250 kbps with network latency between 15 and 30 ms (Backer, 2005). It operates in three different radio bands: 868 Mhz in Europe, 915 Mhz in the USA and Australia, and 2.4 Ghz worldwide. The Zigbee Alliance defines 7 application profiles including building automation, remote control, smart energy, health care, home automation among others. Besides, the research community is also investigating the usage of Zigbee in vehicular applications such as intra-car wireless sensor networks (Tsai et al., 2007), wireless vehicular identification and authentication system (Dissanayake et al., 2008), wireless sensor networks for CO_2 monitoring (Hu et al., 2009).

3.5 Bluetooth

Bluetooth is a low power consumption and short-range communication system (power-class-dependent: 1 meter, 10 meters, 100 meters) originally designed to replace cables connecting electronic devices. Bluetooth devices can communicate with up to 7 slave devices forming a piconet network (1 master + 7 slaves), where a piconet is an ad-hoc computer network of interconnected Bluetooth devices. Piconets can communicate with each other forming a scatternet, in which some devices act as bridges to provide communication between piconets. The Bluetooth core system utilizes a protocol stack consisting of a radio protocol, a link control protocol, a link manager protocol and a logical link control and adaptation protocol. It operates in an unlicensed band at 2.4 to 2.485 Ghz. The list of Bluetooth applications includes wireless headsets, printers, keyboards, game controllers (e.g. Nintendo's Wii and Sony's PlayStation), medical equipment, bar code scanners. -

Examples of vehicular applications includes wireless control and communication with mobile phones, multimedia and entertainment devices.

4. Sensing platforms

Successful of vehicular networks will depend upon the definition of sensing platforms that allow providing a means of collecting/processing/accessing sensor data. Comprehensive and accurate data are the primary requirement of vehicular networks. Various technologies have been enhanced/developed in recent years to improve this data collection quantity and quality though two main categories can be identified:urban sensing technologies, where field infrastructure is needed and intra vehicular sensors technologies in which a vehicle needs to be equipped. This section describes the most relevant sensing platforms for collecting information about traffic conditions.

4.1 Intra vehicular sensors

Advances in vehicular communications make it possible to implement vehicular sensor networks, i.e., collaborative environments where mobile vehicles that are equipped with sensors of different nature (from toxic detectors to video cameras) interworking to implement monitoring applications. Vehicles continuously collect sensor data from urban streets (e.g., images, accelerometer data, among others), which are then processed to search for information of interest (e.g., recognizing license plates, or inferring traffic patterns). This challenging environment requires novel solutions with respect to those of more-traditional wireless sensor nodes. Additionally, vehicles can be used by the VSN to improve its performance, for example, vehicles have much higher power reserves than a typical mobile computer, power can be drawn from on-board batteries, and recharged as needed from a gasoline or alternative fuel engine, vehicles are orders of magnitude larger in size and weight compared to traditional wireless clients, and can therefore support significantly heavier computing (and sensorial) components.

Some intra vehicular sensors are:

- *MobEyes*. A middleware that supports VSN-based proactive urban monitoring applications. This middleware exploits wireless enabled vehicles that are equipped with video cameras and a variety of sensors to perform event sensing, processing and classifying of sensed data, and inter-vehicle ad hoc message routing (Lee et al., 2009).
- *On-Board Diagnostic systems (OBD).* These are commonly used in most vehicles. The OBD-II interface is a standard that provides almost complete engine control and also monitors parts of the chassis, body and accessory devices, as well as the diagnostic control network of the vehicle. OBD-II systems provide real-time data streams, including data from a host of sensors, e.g. oxygen, coolant, pressure, temperature, airflow, vehicle speed, steering angle. This information can be used for fine-tuning the vehicle performance (Birnbam, & Truglia, 2000).
- *Vehicle tracking systems.* Also found in most vehicles. Automatic vehicle location (AVL) systems allow for easy localization of the vehicle (Lim et al., 2009).
- *Collision warning (CW).* This sensor is combined with a laser ranger finder and vehicle speed sensor in order to predict dangerous happens in the forward direction. The

speech suggestion of CW will be activated and the evaluation degree is also sent to the far-end monitoring center (U. Lee & Gerla, 2010).

- *Vehicle navigation System.* This sensor can display the current position of the vehicle or local area in which the vehicle navigates. To locate the vehicle and the driver at the required location, a *Global Position System* (GPS), map matching, and dead-reckoning (DR) are used with integration of an *Inertia Measurement Unit* (IMU) for enhanced positioning performance and availability (Chen et al., 2009).
- *Comfort-meter.* This sensor uses the algorithm refered to as ISO 2631-1 in which the ride comfort standard for the drivers in the vehicle vibration environment is specified. Here the input signals are the accelerations of three axes. These signals will be transformed into the decision index, which specifies the ride quality (T. Lee et al., 2009).

4.2 Urban sensing

Urban sensing is a paradigm on collecting information about systems and the environment, which are closely related to and affected by human activities. Most prior work on sensor networks is based on collecting and processing environmental data using a static topology and an application-aware infrastructure. Urban sensing, on the other hand, involves collecting, storing, processing and fusing large amounts of data related to everyday environmental changes resulting from human activities, vehicles and other agents. This form of sensing is performed in highly dynamic and mobile environments.

Urban sensing applications are emerging in several areas. A good example of human centric urban sensing is Active Mapping. It is built on top of a geographical map, and collects and exchange information about human activities such as location and other details. Therefore it provides a platform for people interaction and also serves as an interface for registering context-aware events. An important application area within urban sensing is urban information systems. A common design approach is to build a publish-and-subscribe mechanism and provide differentiated services to meet individual user’s interests. Therefore, real-time, context-aware and online information management systems of urban sensing applications are highly encouraged.

Urban sensing can be primarily divided into two kinds: static infrastructure and human-centric urban sensing.

The former includes urban multifunction traffic lights control system, equipped with sensing infrastructure that has often been an effective measure applied to regulate vehicle flow inside cities. This static infrastructure uses real-time measurements such as inductive loops or pattern-recognition digital cameras to decide the suitable traffic signal. Infrared remote control apparatus recognizes the signal light control of each intersection. Moreover, these infrastructures are equipped with communication networks that enable adaptive coordination between different intersections in order to improve the traffic flow globally.

The latter has typically been used in the context of human-in-the-loop sampling scenarios where human involvement is mainly in the sampling or the sensing process (through handheld mobile devices etc.). In (Lim et al., 2009) authors propose to redefine or extend the definition of human-centric urban sensing. In the proposed framework, human-centric urban sensing refers to human involvement in the data assimilation, processing, inference as well as decision, control and feedback processes.

According to research of Lee and Gerla (U. Lee & Gerla, 2010), some technologies for communications in vehicular environments are DSRC/WAVE, cellular networks, WiMAX/802.16e, WiFi/802.11p. These technologies will enable operations related to the improvement of traffic flow, highway safety, and other ITS applications in a variety of application environments.

Given the above sensors and communications technologies, it is possible summarizes vehicular networking scenarios as shown in figure 2.

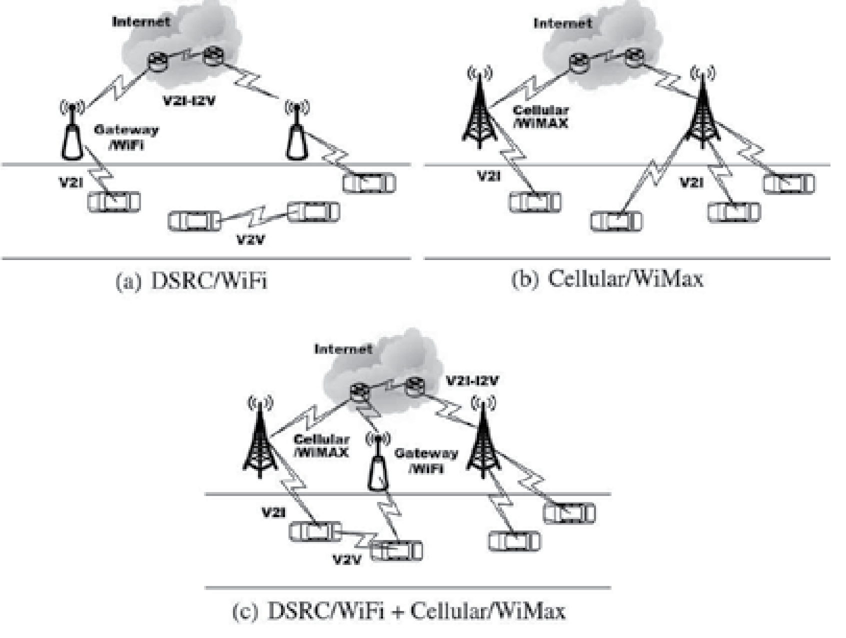

Fig. 2. Wireless vehicular networking scenarios.

Vehicles only equipped with DSRC can operate on infrastructure-free mode (V2V only), infrastructure mode (V2I), and mixed mode (V2V and V2I) as shown in Fig. 2a. Vehicles equipped with other broadband wireless access (i.e., cellular, WiMAX), can operate on scenarios where vehicles can talk to each other via Internet as in Fig. 2b. For instance, people with smartphones and Internet access can conform a P2P overlay network via the Internet. Finally, when vehicles have both DSRC and other broadband wireless access methods, we can have a mixed access scenario (Fig. 2c). Researchers have mostly focused on the first scenario, yet the second scenario has recently received a lot of attention due to the widespread usage of smartphones and WiBro (Lee & Gerla, 2010).

In (Hounsell et al., 2009) authors describe other models and technologies that can be used for traffic data collection. For example, inductive loops embedded are used to detect the movement of vehicles over a road surface and is extensively used in traffic responsive traffic signal systems to provide relevant information about traffic conditions such as traffic density, flows and speeds, among others, that can be used to optimize traffic flows. Beacon-based technology detects a vehicle by a 'beacon' positioned at a known location employing various technologies such as microwave, infra-red and dedicated short-range communication (DSRC) beacons. Closed-circuit television (CCTV) provides a mechanism to monitor traffic operations at key locations in urban networks, such as major junctions, road bottlenecks, tunnels and so on. Information of this kind of systems is used as a basis for managing traffic control strategies, for confirmation of incidents, and to record conditions or events over a period of time.

5. Conclusions

One of the major priorities for governments is to define mechanisms and schemes that could help solve traffic problems that modern society faces. Governments are addressing their efforts in the use of emerging technologies as base elements for transportation system. In the last few years a suite of systems and applications for vehicular communications has emerged. This suite includes applications that can be utilized for improving vehicular safety, enhancing traffic control, and making more efficient the driver tasks and comfortable the time passengers expend inside the vehicle. With technologies like these, it is possible to develop transport systems that are capable of optimizing fuel consumption, minimizing traffic congestion, reducing CO_2 emissions and more importantly reducing human casualties.

In addition, there exist an important number of private and public initiatives that have been created and are dedicated to the development and research of vehicular systems. Still, because of the characteristics of VANETs in terms of, for example, its dynamic network topology, mobility patterns, low latency, among others, development and deployment of vehicular applications is still very challenging. What is more, to correctly operate, most VANET applications require support of special infrastructure (i.e. RSU) to extend vehicles short range communication coverage enabling and extending data dissemination. Unfortunately, the number of available RSUs and OBUs in today's scenarios is still very limited and this condition limits and makes difficult to deploy and evaluate existing applications. In this chapter we have analyzed some of the main challenges that the development of vehicular networks face. We presented a general study about some of the emerging technologies that can be used for vehicular networks. We have also showed some platforms that can be used as data collectors about traffic conditions, warning or emergency situations. Successful development of VANETs and the related applications are conditioned to the definition of standards that facilitate the integration of heterogeneous systems. Similarly, the creation of strategies for increasing users acceptability and accessibility to vehicular applications and technologies is necessary. Finally, to guaranty privacy and security of users, data and applications novel mechanisms need still to be developed.

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5

A CA-Based Model for City Traffic Including Bicycles

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1. Introduction

Questions concerning the possible mechanisms and ultimate utility of a modal shift towards alternatives to motorised transport in the developed world represent an important topic within the context of the very current problem of 'greening' urban environments, in addition to their relevance with respect to health and social aspects of transportation. The study of physical properties of traffic through measurements and modelling is essential to forming a comprehensive view of a transportation system's characteristics for any purpose, from day-to-day traffic management to long-term urban planning, and can play an important role in the planned inclusion of non-motorised traffic in cities. The focus of our work is on cycling in Dublin which is, like other old cities in Europe, characterised by relatively dense networks of narrow streets and little flexibility with regard to infrastructure. This chapter presents a simulation model suitable for the study of heterogeneous traffic on urban networks and its application to conditions similar to those present in Dublin, where bicycle traffic is sparse, road sharing with positional discipline is the most common form of bicycle-traffic inclusion and dedicated infrastructure and bicycle-related controls are absent.

The incorporation of multi-modality into traffic flow models, whether microscopic or macroscopic, theoretical or simulation-based, is a task of increased complexity in comparison to the mode-homogeneous case. This stems from differences in spatial occupation, speed, driver/rider behaviour and other transport mode properties. The concrete questions that arise are those of spatial representation, behaviour and inter-mode interaction modelling and all of these feature strongly where heterogeneity is due to the presence of bicycles. The predominantly urban setting of motorised/non-motorised traffic mixes adds to the modelling challenge, as intersection-based manoeuvres and interactions also need to be taken into account.

Bicycle and bicycle-motorised mixed traffic have a number of aspects that have been of interest to researchers. The characteristics of bicycle-only flow and related road capacities have been studied since the 1970s. This work, aimed at determining the bicycle flow fundamental diagram and defining levels of service, is reviewed in [3]. The authors present a cellular automaton bicycle-only flow model of their own, verified by means of data collected by the authors. Another cellular automaton model of bicycle-only flows, with multiple occupancy of cells and slow/fast distinction between cyclists is presented in [5]. Forms of heterogeneous flow that includes bicycles differ widely, depending on infrastructure and on locality-specific rules and customary behaviour. Corresponding models are, consequently, very diverse. The authors of [6] review a number of models aimed at representing the broadly heterogeneous traffic of Indian cities, all employing space-continuous simulation, either in a stretch-of-road or network context. Work described in [2] was aimed to develop a feature-rich lane-based network model using car-following rules, different for cars and bicycles. The model was validated in terms of volumes at multiple points in a sample real network. The authors introduce the idea of bicycle-motorised vehicle interaction event counters, but do not report on any conclusions drawn from such data. More recent models of highly mixed traffic flows [4, 8] employ multi-cell occupancy cellular automata. These models, while not applied by the authors to traffic including pedal-cycles, do take into account motorcycles and three-wheelers and could easily include non-motorised traffic in the modelled mix.

Interactions between bicycles and motorised traffic can be classified into 'lateral interference' and 'cross-flow' interactions. The former occurs where bicycles and motor vehicles are moving side-by-side and affect each other in some way, primarily by inducing deceleration in the other type of vehicle. The latter refer to interactions arising, from bicycle flows intersecting with motorised flows, in circumstances created specifically by the presence of bicycles. A typical instance of this is the situation where cars turning off to the near side from the middle of a two way street[1] are in conflict with bicycles sharing the road and continuing straight ahead. The *'lateral interference'* type of interaction is dealt with in [11], where an optimal velocity model is extended by the inclusion of a friction component, which accounts for the effect of pedestrians on cyclists and cyclists on motorised vehicles, each mode belonging to a distinct but spatially adjacent flow. In [1], spatially fine grained cellular automata are used to model interactions between a multi-lane bicycle stream and an adjoining car stream. The interference of bicycles with the car flow is expressed through a higher probability of cars slowing down when faced with 'friction' or 'blockage'. *'Cross-flow'* interactions are examined in [14]. Here empirical data is used to quantify bicycle flow in a wide lane in terms of distribution, critical gap and follow-up times. A logit model is suggested for the derivation of right-turning car flows as a function of the bicycle arrival rate. In [7] that same scenario is investigated with the cellular automaton model of [5], where a single cell can be occupied simultaneously by multiple bicycles. While simulation updates here are synchronous in general, instances of conflict between flows are resolved using a sequential subgrouping of updates affected by the conflict: the update sequence is decided stochastically, using probability weighting that is an integral part of the behaviour model. The study of interactions between left turning bicycles and straight moving cars on a two-way street in [13] uses a two-dimensional optimal velocity model. In the combined forecasting model presented in [10], interactions are accounted for through link impedance functions whereby *higher* bicycle flows *increase the impedance* of motorised flows and vice versa, with dramatic effect in terms of general flows in the network.

The simulation model presented here is based on cellular automata (CA) and includes elements of interaction between bicycles and motorised vehicles of both the 'lateral interference' and 'cross-flow' type. These are represented using a general modelling framework, which we have defined for the systematic construction of network models with the one-dimensional CA space as basic building block. An intersection of two one-way streets is used as an example of the model's application and corresponding simulation results are presented in diagrams of a type that provides a comprehensive view of interactions between individual flows involved in the simulation scenario.

[1] This is a left turn in Ireland, UK, etc. but a right turn in France, US etc.

Section 2 describes the simulation model while Section 3 details the model's application to a scenario of bicycle-car road sharing on two intersecting one-way streets. The output of the scenario simulation is also discussed. Section 4 summarises model performance and insights gained and discusses directions for future work.

2. Model

The modelling of traffic has three immediately identifiable aspects: the spatial one, which represents the road network and it's occupancy by vehicles, that of traffic participant behaviour within the spatial context and, finally, the control aspect, which seeks to mimic traffic management features, introducing additional constraints for the behaviour model. Each of these aspects is described in a separate subsection.

2.1 Spatial model

The modelling framework has been described in [12] and rests on the idea of representing each network route of interest in the model, for any vehicle type, as a one-dimensional cellular automaton (CA) space or *OCAS*. Road network intersections can, consequently, be seen as a group of individual conflicts, each involving exactly two OCASes. From the point of view of representing heterogeneous traffic, this spatial model has two favourable features: (1) it allows the use of CA systems with differently sized cells, facilitating the representation of different vehicle types and (2) it defines an implicit topology based on vehicle routes, as opposed to infrastructure, which is important in the case of bicycles as these are often involved in cross-flows with motorised traffic on the same road. From the point of view of network traffic simulation, the model's spatial description language (convergence and divergence of OCASes) takes the form of network topological data, simplifying the network's description and the definition of navigation rules.

The spatial representation is built from a sketch of the modelled real space, including the routes for various vehicle types that are to be included in the model and their breakdown into cells. The description of the model is extracted from the sketch and formalised using the following set of constructs.

1. OCASes - one is defined in the model for each route taken by any type of vehicle. Each OCAS consists of a string of cells of equal size with the following associated properties:
   - cell size, which can differ between different OCASes in the model, depending on the vehicle types being accommodated
   - length (in cells)
   - turning points, each expressed as the index of the first cell of the OCAS section representing the turn or bend
2. 2-OCAS conflict - one is defined for each point where two routes meet, either to converge or to intersect. It is expressed through start and end cell indices in each of the two OCASes, demarcating two *OCAS conflict sections*. The last cell before a conflict section is that one beyond which a vehicle on the containing OCAS should not proceed without checking for vehicles approaching the conflict on the other OCAS, if it is to ensure no crash. A conflict section itself represents that part of the road that must be cleared to ensure that vehicles on the other OCAS in the conflict can move unimpeded.

3. OCAS divergence - one is defined for each point where more than one OCAS "part ways". In many cases, OCASes will be identical over much of their route, but diverge at some point. A divergence can involve 2 or more OCASes.
4. 2-OCAS behaviour-based relation - these are defined for pairs of OCASes whereby the behaviour of vehicles in one OCAS is affected by the presence of the other OCAS and its vehicle occupancy. The relation may be one- or bi-directional between the OCASes. An example of the latter is a two-lane road with lane changing allowed.
5. Cell overlap instances - each overlap between two cells in the natural-space sketch is recorded as part of the model. Apart from the case of superimposition between different OCASes, overlap of cells is allowed within a single OCAS and in that case is used to model the difficulty of a turn.

2.1.1 Example cases

Now the use of the spatial constructs described above will be demonstrated on the examples of a one-way street shared by bicycles and cars, shown in Figure 1, and an unsignalised intersection of two such one-way streets, shown in Figure 2. What follows are spatial model specifications corresponding to the pictures of the two elements.

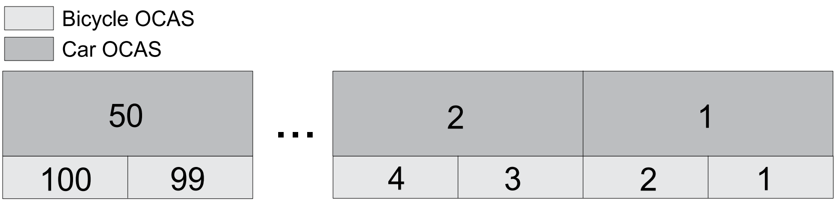

Fig. 1. Spatial model graphical representation for a stretch of road which is wide enough for motorised/bicycle road sharing in the form of two side-by-side streams, with the assumption of positional discipline. OCASes to model the road stretch are drawn into its geometry for the Irish left-hand-drive rule, without loss of generality. The particular road example is 50(100) cells long for cars(bicycles).

Stretch of road spatial specification:

1. OCASes: 2 (1 car OCAS and 1 bicycle OCAS, described in Table 1)
2. 2-OCAS conflicts: none
3. OCAS divergences: none
4. 2-OCAS behaviour based relation: because street is narrow, cars in car OCAS slow down to pass bicycles in bicycle OCAS
5. Cell overlap instances: none

Two one-way street intersection spatial specification:

1. OCASes: 8 (directions SN, SW, EW and EN each have a car OCAS and a bicycle OCAS, see Table 1)
2. 2-OCAS conflicts: 13 (shown in Table 2)
3. OCAS divergences: 4 (shown in Table 4)
4. 2-OCAS behaviour based relation: in each of directions SN, SW, EW and EN, because street is narrow, cars in car OCAS slow down to pass bicycles in bicycle OCAS
5. Cell overlap instances: specified in Table 3

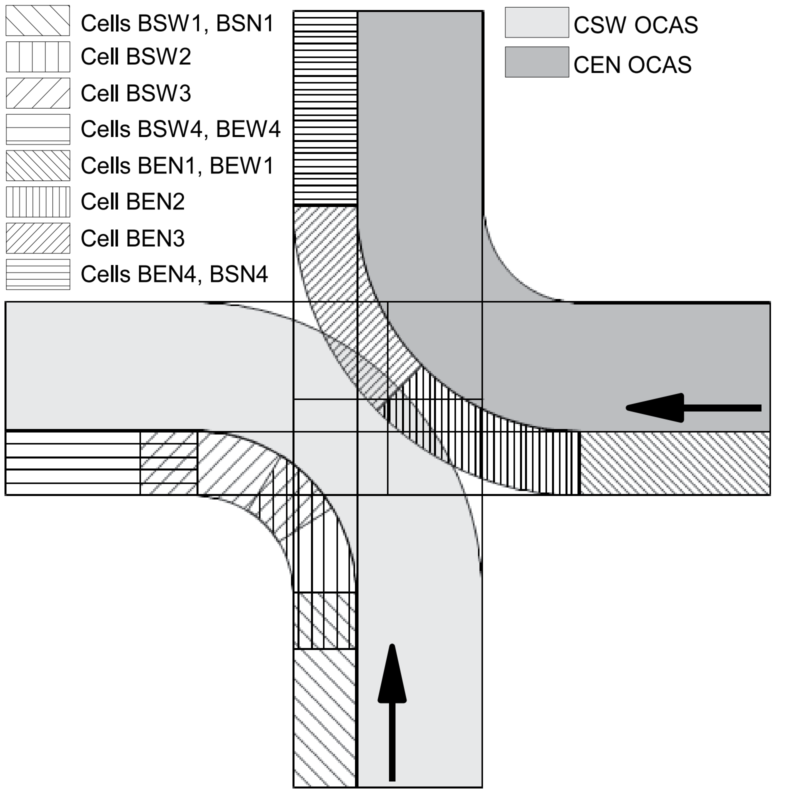

Fig. 2. Spatial model graphical representation for an intersection of two one-way streets, each wide enough for motorised/bicycle road sharing in the form of two side-by-side streams. OCASes to model the intersection are drawn into its geometry for the Irish left-hand-drive rule and can be named BSN, CSN, BEW, CEW, BSW, CSW, BEN and CEN (bicycle south-north, car south-north etc.) without loss of generality. The CSW and CEN OCASes are indicated with two different shades of gray. The division of OCASes into cells is shown for the BSW and BEN OCASes, with the use of different hatching patterns.

Spatial element	OCAS name	Length	Cells overlap	Turning points	Cell size
Road stretch	car	50	No	None	$7.5m \times 2m$
	bicycle	100	No	None	$3.75m \times 1m$
Intersection of 2 1-way streets	SN car	2	No	None	$7.5m \times 2m$
	SW car	4	Yes	Cell 1	$7.5m \times 2m$
	EW car	2	No	None	$7.5m \times 2m$
	EN car	4	Yes	Cell 1	$7.5m \times 2m$
	SN bicycle	4	No	None	$3.75m \times 1m$
	SW bicycle	4	Yes	Cell 1	$3.75m \times 1m$
	EW bicycle	4	No	None	$3.75m \times 1m$
	EN bicycle	4	No	Cell 1	$3.75m \times 1m$

Table 1. OCAS descriptions for spatial elements shown in Figures 1 and 2.

	CEN	**BEN**	**CEW**	**BEW**	**CSW**	**BSW**	**CSN**	**BSN**
CEN							MFR(1-2)	
BEN			AFL(1-2)		ACR(1-4)		AFR(1-2)	MFR(3-4)
CEW		AFR(2-3)			MFR(1-4)		AFR(1-2)	AFR(2-3)
BEW					AFR(1-4)	MFR(2-4)	AFR(1-2)	AFR(2-2)
CSW		ACL(2-3)	MFL(1-2)	AFL(2-3)				AFR(2-3)
BSW				MFL(3-4)				
CSN	MFL(1-4)	AFL(2-3)	AFL(1-2)	AFL(2-3)				
BSN		MFL(3-4)	AFL(2-2)	AFL(3-3)	AFL(1-4)			

Table 2. Conflicts for two one-way street intersection. The table is a matrix in which each pair of entries at symmetrical positions are two different views (one from each involved OCAS) of the same conflict. Entry format is *<conflict view type>(<cell range of the OCAS conflict section>)*. The OCAS named in the heading of the corresponding column is the view owner, while the OCAS named in the heading of the corresponding row is the other OCAS in the conflict. The conflict view type and OCAS conflict section of the entry both pertain to the view owner OCAS. Conflict view types are "across from left" (AFL), "across from right" (AFR), "merge from left" (MFL), "merge from right" (MFR), "across cut left" (ACL) or "across cut right" (ACR). The cell range of the OCAS conflict section is given in the form *<start cell index>-<end cell index>*, where both indices are non-zero natural numbers, i.e. the first cell is numbered 1 etc.

2.2 Control model

Control, for the purposes of our model, is defined as any rule, device or object used to place a constraint on how traffic participants behave, generally with the aim of avoiding accidents and improving traffic performance. Control can affect a traffic system in diverse ways, thus being ‘insertable’ into the model in different places and in different forms. Of immediate interest, however, is control relating to conflict resolution.

The resolution of conflicts in the case of the intersection of two one-way streets can be realised by: (a) using traffic lights or (b) defining a priority rule. Giving full priority to the south-to-north flow and giving it to the east-to-west flow are two possibilities: these are not equivalent, which they would be in the case of homogeneous traffic that always travels straight ahead.

2.3 Participant behaviour model

The vehicle behaviour model is based on the Nagel-Schreckenberg (N-S) update rules [9]. What follows is a formulation of those rules using a combined velocity-limiting value, since this limiting value is the focus of the modifications to N-S described herein.

0. Determine the combined velocity-limiting value: $v_{\mathrm{CL}} = \min(v_{\mathrm{MAX}}, d_i)$
1. Acceleration: if $v_i < v_{\mathrm{CL}}$, $v_i \to v_i + 1$
2. Slowing: if $v_{\mathrm{CL}} < v_i$, $v_i \to d_i$
3. Randomisation: with probability p_{R}, $v_i \to v_i - 1$
4. Vehicle motion: each vehicle is advanced v_i cells

where i is an identifying index of the vehicle to which the rules are being applied, v_{CL} is the combined velocity-limiting value, v_{MAX} is the maximal velocity for the vehicle type, d_i is

	CEN4	CEN3	CEN2	CEN1	BEN4	BEN3	BEN2	BEN1	CEW2	CEW1	BEW4	BEW3	BEW2	BEW1	CSW4	CSW3	CSW2	CSW1	BSW4	BSW3	BSW2	BSW1	CSN2	CSN1	BSN4	BSN3	BSN2	BSN1
CEN4	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
CEN3	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
CEN2	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
CEN1	1	1	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
BEN4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
BEN3	0	0	0	0	0	1	0	0	1	1	0	0	0	0	1	1	1	0	0	0	0	0	1	0	0	1	0	0
BEN2	0	0	0	0	0	0	1	0	0	1	0	0	1	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0
BEN1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CEW2	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	1	1	0	1	1	0
CEW1	1	1	1	1	0	1	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	1	1	0	0	0	0
BEW4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
BEW3	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	1	0	0	1	0	0	1	0
BEW2	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0	0	1	0	0	0	0
BEW1	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CSW4	0	0	0	0	0	1	0	0	1	0	0	1	1	0	1	1	1	0	0	0	0	0	1	0	0	1	1	0
CSW3	0	0	0	0	0	1	1	0	1	1	0	1	1	0	1	1	1	1	0	0	0	0	1	1	0	1	1	0
CSW2	0	0	0	0	0	1	1	0	1	1	0	1	1	0	1	1	1	1	0	0	0	0	1	1	0	1	1	0
CSW1	0	0	0	0	0	0	1	0	0	1	0	1	1	0	0	1	1	1	0	0	0	0	0	1	0	0	1	0
BSW4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
BSW3	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	1	1	1	0	0	0	0	0	1	0
BSW2	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	1	1	0	0	0	0	1	1
BSW1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1
CSN2	1	1	1	1	0	1	0	0	1	1	0	0	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0	0
CSN1	1	1	1	1	0	0	1	0	1	1	0	1	1	0	0	1	1	1	0	0	0	0	0	1	0	0	0	0
BSN4	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
BSN3	0	0	0	0	0	1	0	0	1	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	1	0	0
BSN2	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1	1	1	1	0	1	1	0	0	0	0	0	1	0
BSN1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	1

Table 3. Cell overlap table for intersection of two one-way streets. Cell names take the form *<B | C><two-letter direction><cell number>*, where the first letter (B or C) indicates a bicycle or car OCAS, the two-letter direction is SN, SW, EW or EN and cell number is a non-zero natural number. Each cell in the spatial model is associated with a column and with a row. The table entries indicate whether the cell associated with its row and the cell associated with its column overlap (1) or not (0). The matrix corresponding to the table is, as expected, symmetrical.

Divergence	List of OCASes, with index of first diverging cell
1	BSN(1), BSW(1)
2	CSN(1), CSW(1)
3	BEW(1), BEN(1)
4	CEW(1), CEN(1)

Table 4. List of divergences in intersection of two one-way streets. Each divergence is given an identifying number and is associated with the list of OCASes that diverge. The index of the cell at which the divergence occurs for each OCAS is given in parentheses.

the number of free cells to the nearest other vehicle ahead of vehicle i and v_i is the velocity of vehicle i. The variables are dimensionless: distance is measured in cells and velocity in cells per time step. The update is performed in parallel, which means that in each time-step

d_{Ti} or d_{Ci} or d_{Bi}:	5	4	3	2	1	0
$v_{LT}(d_{Ti})$ **for bicycle approaching turn:**	∞	∞	∞	1	1	∞
$v_{LT}(d_{Ti})$ **for car approaching turn:**	2	2	2	1	1	∞
$v_{LC}(d_{Ci})$ **for bicycle approaching unresolved conflict:**	∞	∞	∞	1	1	∞
$v_{LC}(d_{Ci})$ **for car approaching unresolved conflict:**	2	2	2	1	1	∞
$v_{LB}(d_{Bi})$ **for car approaching bicycle in adjacent OCAS:**	2	2	2	1	1	1

Table 5. Velocity limits on approach to turn/conflict/bicycle, chosen so as to allow vehicles to reach the velocity of 1 at the last cell before turn/conflict/bicycle, while decelerating, at most, by 1. The table is for maximal velocity, v_{MAX}, of 3 for cars and 2 for bicycles. The numbers in the header row represent the number of steps ahead that would cause entry into turn or conflict or bring a car beside a bicycle. The infinity symbol is used to denote the particular factor does not limit the velocity at the given distance.

the velocity update rules (1-3) are applied to all vehicles in the simulation, then the position update rule (4) is applied to all the vehicles.

Our model is based on these rules, adapting them, as described in the following sections, to the spatial model definition method laid out in Section 2.1.

1. Three factors are added to contribute to the **combined velocity-limiting value**:
   a) proximity of an intersection at which the vehicle is going to turn
   b) proximity of an unresolved conflict
   c) (in the case of cars only) the longitudinal proximity of a bicycle in an OCAS adjoining the car's OCAS

   The combined velocity-limiting value becomes:
   $$v_{CL} = \min(v_{MAX}, d_{Ui}, v_{LT}(d_{Ti}), v_{LC}(d_{Ci}), v_{LB}(d_{Bi})) \quad (1)$$
   where d_{Ti} is the distance from the i^{th} vehicle to the nearest turn ahead, d_{Ci} is the distance from the i^{th} vehicle to the nearest unresolved conflict ahead, d_{Bi} is the distance from the i^{th} car to the nearest bicycle ahead in the adjoining bicycle OCAS and $v_{LT}()$, $v_{LC}()$ and $v_{LB}()$ are the velocity limits respectively imposed by the three factors, as functions of the relevant distance. The values of $v_{LT}()$, $v_{LC}()$ and $v_{LB}()$ for applicable distances are shown in Table 5. The conflict resolution methods depend on the control layer of the system, i.e. on the particular rules in place for a scenario, and are discussed in Section 3.
2. Instead of looking for the nearest vehicle ahead, a vehicle checks for **cell impingement**. Because of the possibility of overlap between cells, particularly at intersections, a vehicle moving along an OCAS must check not only if a cell ahead of it is unoccupied but also if all the cells that overlap it are unoccupied. The number of unimpinged cells ahead of the i^{th} vehicle is denoted d_{Ui}. The implementation of this rule makes use of a *cell overlap table*, such as the one in Table 3, to look up cell overlap instances.
3. While the previous two changes simply assign new meaning to variables used by the N-S rules, there is a need for the introduction of a new rule to handle **network navigation**:
   Rule 5: If a divergence lies ahead of the vehicle, at a distance at which slowing down for a turn would have to take place (see Table 5), the vehicle must decide which of the diverging routes it will take.
   The decision method will depend on the simulation scenario.
4. The rules are applied to **both bicycles and cars**. Each type of vehicle has a separate v_{MAX} value.

3. Example simulation scenario and results

This section is organised into three sub-sections. The first one contains a description of the example scenario, while the other two discuss the result format and the actual results.

3.1 Simulation scenario

The **simulation space** consists of the intersection of two one-way streets, for which the model was derived from Figure 2, and four stretches of road, each modelled using Figure 1. The stretches of road are connected to the open ends of the intersection, all together forming the shape of a plus sign (+). In this way, each OCAS in the intersection part of the model is extended before and after, by 50 cells if it is a car OCAS and by 100 if it is a bicycle one. Vehicles enter the simulation space from the east and the south and leave it at the north and west, the direction of their movement through the intersection matching the arrows in Figure 2.

The **insertion of vehicles** into the scenario space is carried out as follows: at each time step, for each OCAS on the south and the east stretches of road a new bicycle(car) is created with probability $p_{\text{IB}}(p_{\text{IC}})$. An attempt is made to insert it, with velocity $v_{\text{MAX}} - 1$, at the farthest cell closer than v_{MAX} to which the path is not obstructed (i.e. the farthest cell $i < v_{\text{MAX}}$ for which all cells in range [1,i] are unimpinged). If cell 1 (the first cell of the OCAS) is impinged, the vehicle is discarded. Vehicles arriving at the end of the north and west OCASes "fall off the edge" as if the OCAS were extended indefinitely and there were no vehicles on the extension.

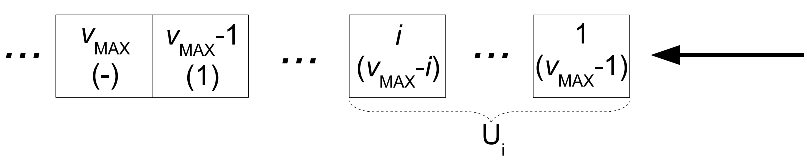

Fig. 3. Illustration of vehicle insertion method. Two numbers are shown in each cell: the cell's index (above) and an insertion ordinal number (below, in brackets). The arrow indicates the direction of insertion, which is first attempted onto cell with insertion ordinal number 1, then into cell with insertion ordinal number 2 etc. The picture also shows the cell range, $U_i = [1, i]$, which must be fully unimpinged for insertion onto position i, with ordinal number $v_{\text{MAX}} - i$, to succeed.

With regard to **control**, two cases were simulated: where the priority is given to the south-to-north flow, by imposing the *LHS rule* (called this since it entails giving way to vehicles arriving from the left), and where priority is given to the east-to-west flow, by imposing the *RHS rule*. Any vehicle giving way employs a *'soft yield'*. This means that it inspects the conflicting OCAS for any arriving vehicles and if it deduces, based on the other vehicle's velocity, distance and the rules for vehicle behaviour, that the other vehicle cannot, in the next time step, reach a cell that overlaps with it's own path, it advances. The inspecting vehicle thus avoids crashes but does not attempt to clear the intersection quickly enough to ensure not to obstruct other vehicles.

The **time step** corresponds to 1s of real time. **Maximal velocities** of 3 for cars (corresponding to 81km/h) and 2 for bicycles (corresponding to 27km/h) are used. The **randomisation**

parameter is $p_{\mathrm{R}} = 0.1$. **Simulation length** is 100000 time steps, which corresponds to approximately 28 hours.

3.2 Result format

The diagrams in Figures 4 and 5 were designed as a device for a summary view of how flow (i.e. the average number of vehicles that pass a certain point in the road during a unit of time) on different OCASes affect the overall performance of the intersection. For this purpose we define a measure called *realisation*:

$$R = \frac{\sum\limits_{o \in S_O} q_o}{\sum\limits_{o \in S_O} p_{\mathrm{I}o}} \tag{2}$$

where S_O is the set of OCASes for which the realisation, R, is being calculated, o is an OCAS identifier, q_o is the flow on OCAS o and $p_{\mathrm{I}o}$ is the insertion probability for OCAS o. While this value does not have a physical meaning, it can aid the understanding of how successful a scenario is in serving the arriving vehicles. Higher values of R are, indeed, more favourable.

Figures 4 and 5 each show three diagrams, one for each OCAS set of interest, those sets being: all OCASes, car OCASes and bicycle OCASes. What follows is a description of how a single diagram is produced.

- The results used are the average flow values on each of the 8 OCASes for each simulation instance. A simulation instance was run for each combination of insertion probabilities and the applied values were $0.0 \leq p_{\mathrm{IB}} \leq 0.7$ and $0.0 \leq p_{\mathrm{IC}} \leq 0.7$, with step 0.2, for each OCAS[2].
- Each simulation instance, based on its calculated R, is assigned to a 'slot', $s_V \in N_0$, such that $0.1 s_V \leq R < 0.1(s_V + 1)$.
- The insertion probabilities for each OCAS are averaged over the simulation instances in each slot.
- The diagram is drawn so that a column over each slot shows the corresponding average insertion probabilities calculated in the previous step. The column is divided into sections, one for each OCAS, and its depth of shading indicates the number of simulation instances assigned to the slot (darker for higher numbers).

3.3 Discussion

The general pattern of lower inputs resulting in better *realisation* holds, unsurprisingly, for all the diagrams. Also, when analysed visually, the diagrams show that, on average, bicycles fare better with the RHS rule, in that their flow realisation is higher than that for cars, while with the LHS rule the two types of vehicle have more similar average realisations. This can be concluded from the fact that the darker areas for bicycles in RHS rule simulations (Figure 4b) appear at higher realisations than for cars (Figure 4c) and at similar realisations (Figure 5b and c) in the case of LHS rule simulations. Considering average composition of the traffic for low realisation values, we can identify flows or combinations of flows causing these. For example, the lowest realisation values for cars in the RHS rule case (Figure 4c) occur at high bicycle inputs and dominant SW car flows. This indicates that SW car flows are impeded by bicycles more than other car flows at the intersection. In the RHS rule case, SW and SN

[2] This corresponds to 65536 simulation instances.

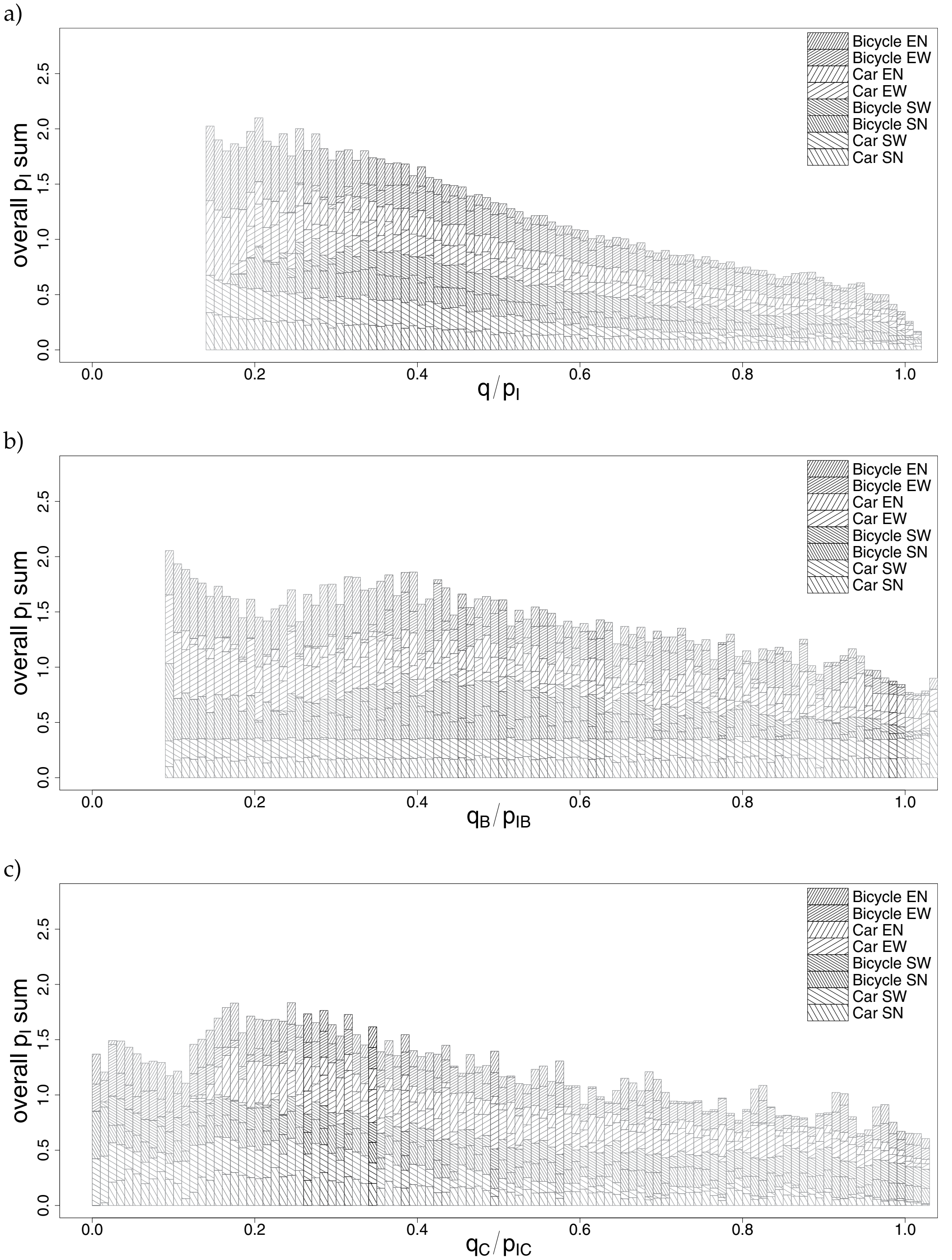

Fig. 4. Overall input as a function of: (a) overall (b) car and (c) bicycle flow realisation (flow per input), for intersection of two one-way streets with east-to-west priority (RHS rule).

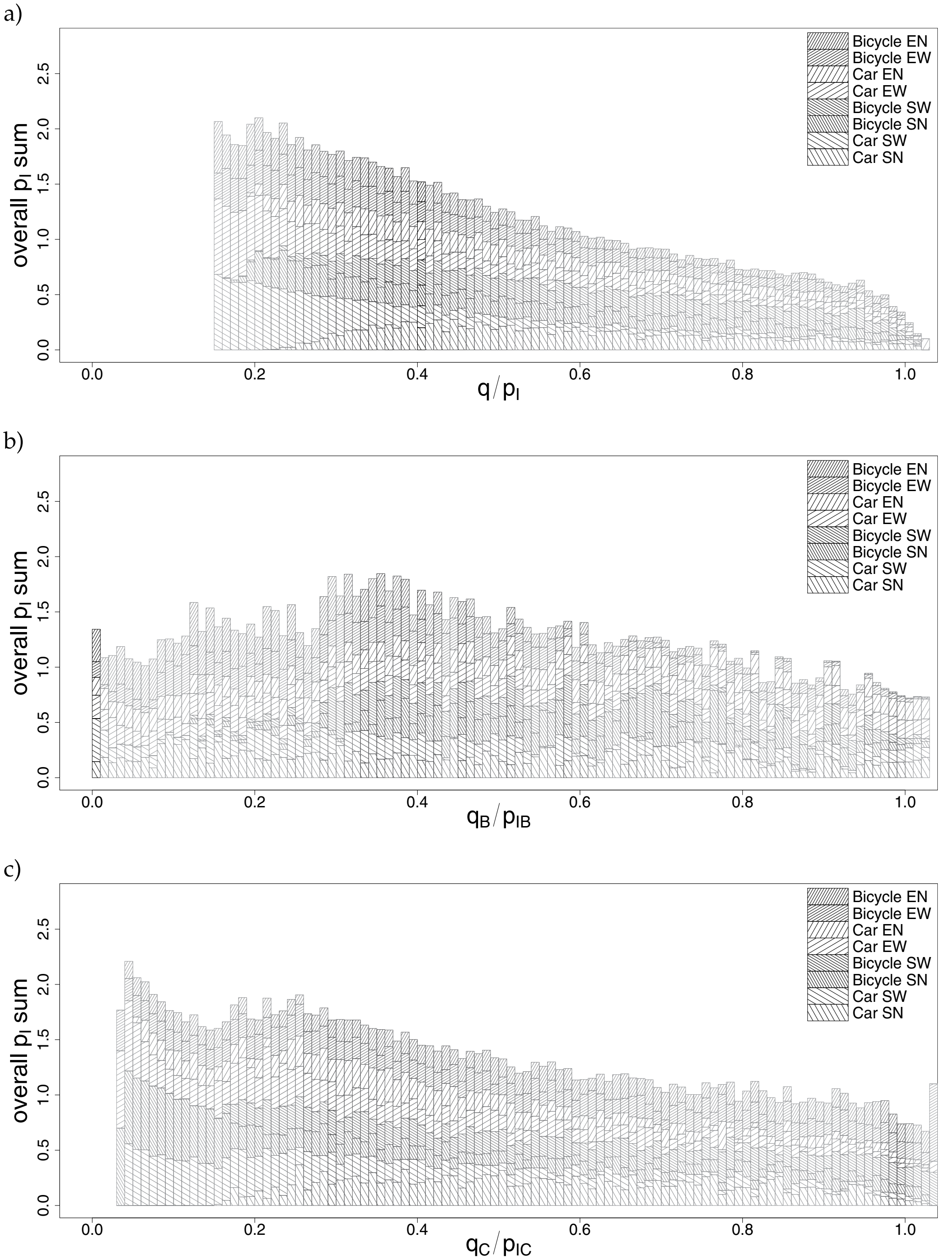

Fig. 5. Overall input as a function of: (a) overall (b) car and (c) bicycle flow realisation (flow per input), for intersection of two one-way streets with south-to-north priority (LHS rule).

car flows are largely constant across all bicycle realisation values (Figure 4b), showing that bicycles are not affected by cars moving in the SW and SN directions. In the LHS rule case, SW car flows have a big impact on the overall and car flow realisation (Figure 5c) but not on that for bicycles (Figure 5b). An interesting piece of information that can be gleaned from the diagrams is that the very low realisations for cars and bicycles do not coincide in any of the simulation instances, as the diagrams in Figures 4a and 5a do not contain any realisation values below 0.14.

4. Conclusion and future work

This chapter has described a cellular automaton (CA) based framework for modelling heterogeneous traffic on networks. The main focus in the design of the framework was preservation of the simplicity of traffic participant behaviour rules used in CA models, even in the complex space of a road network traversed by heterogeneous flows. This has been achieved by placing the bulk of the problem's complexity in the specification of spatial relations between vehicle routes, which are in themselves simple (one-dimensional CA systems). This approach emulates the real life property of traffic participants whereby they are able to navigate networks unknown to them in advance, by looking around and reacting consistently to a number of streams of other traffic around them, as opposed to approaches that derive specific interaction rules for each road feature such as an intersection. It also provides a method for systematic derivation of model data from the geometry of a network feature, allowing for extension facility, in spite of the complex nature of the modelled scenarios. Finally, it eases implementation maintenance, as the extensions to the model are simply in the form of data sets added to a catalogue of modules. The results of numerous simulations are summarised in diagrams showing insertion rate combinations, as a function of flow realisations, and are the outcome of a search for a clear way of providing a single overall view of an intersection's performance.

Future work will be based around larger network scenarios, following the application of the modelling framework to additional network elements. Comprehensive network flow data, especially for combined bicycle-motorised traffic, is hard to obtain, hence the meaning of the results and their qualification with respect to model parameters will be predicated on a combination of available data and theoretical analysis. The ultimate aim is improved understanding as to how co-dependence between network topology/road geometry on the one hand and vehicle flows on the other can differ between the motorised only case and that of a heterogeneous mix including slower and more vulnerable participants, that is, bicycles.

5. Acknowledgement

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6

Bricolage Planning: Understanding Planning in a Fragmented City

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1. Introduction

Neither the City nor Planning are what they used to be. Both, in the last decades, faced heavy changes that profoundly destabilized the way the discipline of planning conceived itself and its object, the city.

In the last few decades, mainly under the pressure of urban sprawl, economic globalization, increasing social and ethnic differentiation, the city lost some of the most basic elements that defined it since antiquity: density, centrality, demarcation between urban and rural and functional and economic complementarity between its neighbourhoods. As frequently presented in the work of scholars on urban fragmentation, today's city is a loose agglomerate of quasi-autonomous socio-spatial entities, each evolving "independently" of the others, relying on its own resources and on exchanges within networks involving territories and actors on supra-city levels, like the regional or the global levels[1].

This new "urban condition" was and still is perceived in the intellectual and the political spheres with very different appreciations. For some, in the name of the "right to difference" and "cultural resistance" in the face of homogenization, urban fragmentation is a welcomed situation where new forms of social and political "liberations" could take place (Soja & Hooper, 1993; Ley & Mills, 1993). For others, it is a spectre that haunts the future of urban societies, leading to social reclusion or to balkanization; and in any case to the disruption of what is perceived as the basis of the social and political urban life (Donzelot, 1999; Van Kempen, 1994; Harvey, 1996).

By profoundly marking the realities and the perceptions of the city in its present and future, urban fragmentation is raising a major challenge to urban planning. However, urban

[1] In fact, what is usually considered to be a scientific corpus on urban fragmentation is a quite vast and heterogeneous compilation of studies and essays in various disciplines, and we can find in it different – sometimes contradictory – definitions of urban fragmentation. We choose here to consider a more general definition that presents the essential characteristics of urban fragmentation and demarcates it from other concepts of socio-spatial differentiation like segregation, marginalization and relegation. We do not consider that the modeling this definition offers of the urban reality fits all urban agglomerations; we also believe that different types of socio-spatial dynamics may well be at work simultaneously. However, the dynamics that the archetype of urban fragmentation highlights are definitely the most challenging to urban governance and urban policies and pose the most serious questions for the planning discipline.

planning itself as a discipline, theory and practice has known, for the same period, important changes. In fact, the decades since the late sixties has known a proliferation of competing planning theories. These theories reflect different philosophical, political and practical positions on deep cultural, political and economical changes.

In "deconstructing urban planning" Dear (2000) offers an interesting panorama of the urban planning discipline after World War II, in the United States, Canada and Britain. Boelens (2010) focuses on the Netherlands, however we believe that his conclusions that intersect with those of Dear touch the reality of the situation of the urban planning discipline in a wider scope. In both presentations we see a clear move from the technocratic urban planning of post-war reconstruction to the boom of planning theories in the 1970-1990 decades, to the "pastiche" urban planning and the profound crisis in the planning discipline today.

Urban planning witnessed the rise of what is called 'new scientism', a systemic urban planning approach with its technocratic drift towards modelling and rationalization of decision-making. At the same time in the 70s, the rising politicization and demand for larger popular participation in decision-making in politics spilled over in planning leading to different forms of what Dear calls 'Choice theory' approaches: citizen participation and mutual learning in the transactive-creative approach, advocacy planning approach, neo-marxist radical critique theory of planning and communicative planning approach.

Boelens (2010) uses the term "post-structuralist" theories of urban planning to describe this category of theories and includes in it other more recent works. These theories are clearly affected by the evolutions in social and philosophical studies : building on Habermas's theories on communicative action we have "the interactive and collaborative planning" (Healey, 1997; Innes, 1995), on Foucault's theories "the discursive approach to planning, politics and design in the public realm" (Hajer, 1995, 2001), on Lefebvre's work "the heterogeneous conception of space and time" (Amin & Thrift, 2002; Massey, 1999; Thrift, 1996), on Lacan, Deleuze and Guattari "the multiplanar approach to planning" (Gunder & Hillier, 2009; Hillier, 2007), but also "the actor-centred institutionalism" (Scharpf, 1997) and "network urbanism and planning" (Dupuy, 1991).

However, these different theories and approaches to planning had the difficulty to assert themselves and conquer the planning practice. *"By the late 1980s, planning theory had become a conflictual Babel of separate languages, almost all of which were voluntarily ignored by practitioners. For its part, planning practice had devolved into a ritualized choreography of routines"* (Dear, 2000, p. 124). By the 1990s, this fragmentation of the discourse on urban planning theory led in practice to the development of "pastiche planning". We can see a clear move in this decade into an eclecticism in the planning practice where urban planners tend to take "a bit of this, and a bit of that" to formulate and manage their projects.

For Dear (2000) this stresses the deep crisis in planning faced with radical changes in the traditional environment of the planning discipline. In fact, as of the late 1980s, planning became increasingly privatized: *"the growth of planning personnel in private sector positions, the packaging and marketing of planning for sale, and the prominent trend in planning education toward a development-oriented curriculum"* (Dear, 2000, p. 125). The 1980s recession and the political change with the neo-liberal policies as of the 80s, with the Thatcher and Reagan administrations and their attack on the ideologies of planning, contributed also largely to this crisis of this discipline. These changes sent planners increasingly to subordinate positions. The overarching systemic perspective of traditional land-use planning and the political charge of participatory and advocacy planning that gave the planner a central role in urban development did not fit this era of "privatization planning". Planners become more or less apolitical mercenaries who use their knowledge to perform three tasks: providing technical documents and expertise in land-use planning, using their negotiation know-how in order to persuade stakeholders of the set project and agenda, and monitoring and evaluating the performance of a project (Dear, 2000).

This depoliticization of the planning practice, however, does not mean the depoliticization of the stakes of the issues the planning agendas are dealing with. Urban planning is more than ever a political question. In the context of urban fragmentation more entities are developing autonomously from their surroundings or even the rest of the city, consequently complexifying issues of access to resources and land control, rendering them more conflictual. Decentralization and market power have attracted more stakeholders in the planning arena with very different and conflicting interests and agendas. This has heavily weakened the legitimacy of "functional" public urban planning. In fact, apolitical land-use planning technicism, dominant in the planning practice, cannot deal with this governance complexity.

The answers and alternatives proposed by the "post-structural" theories of planning revolve on the central question of dealing with this politicization of planning. However, despite their refreshing and invigorating aspect and their occasional appropriation by some urban practitioners and decision makers, as said earlier, they failed to evolve into effective and durable practices. Boelens (2010, p. 30) offers however for that a somehow different explanation than Dear: *"I assume that this might have something to do with the fact that time and time again these alternatives were still formulated within the existing planning framework, from a specific governmental, or at least government-related, view on planning: from the inside-out."*

In fact, in his "actor-relational approach" (ARA) to planning and by building on works on "associative democracy" (AD) (Cohen & Rogers, 1992; Hirst, 1994; Pierre, 2000 cited in Boelens, 2010), Boelens (2010) urges a somehow radical break from the government-led planning. He defends the rise of an "entrepreneurial style of planning" led by a "planning regime" based in civic society and private actors. In this regime the public actor is a partner but not a leader. The problem here with the public sector "*is the rigidity that surrounds the way it seeks to manage plural interests and the subject role this assigns to the private sector*" (Webb, 2010, p. 3).

Clearly, planning today is a field in reconstruction where new ways of thinking and making the city are experienced. This proposition of Boelens is one among several in planning studies that focus on the need for the development of a localized network of actors that would work together in order to develop "bottom-up" or "outside-inwards" planning agendas and territories. These propositions see themselves as ways to deal with the increasing fragmentation of space and society and the development of multi-scale actors in today's network society. New tools are put forward, and more importantly, effort is made to charter new ways for gathering resources and organizing actors to act together in a synchronized way on the urban realm.

However, in today's cities, urban development does not necessarily follow urban planning. Urban development initiatives are booming everywhere: various local authorities, private developers even civil society actors are leading their own urban development initiatives. These developments, of different scales and kinds, are in their great majority non-state initiatives and do not necessarily fit in a metropolitan urban strategic plan.

This situation poses different central questions to planning theory and to the future of planning. Is planning even necessary in this new context? Can urban development lead to urban planning? What does that mean for planning theory and practice?

We believe that in the age of the fragmented city, planning still has an important role. In fact, as Thévenot (1995) puts it, next to being a "prolongation of intentionality", a plan is also a communicative space around the semantics of action. And in today's city shaped of an agglomerate of places under the pressure of unstable global market dynamics and egocentric NIMBY local logics, planning could bring a necessary political dimension. We believe also that planning could be constructed from the bottom-up not necessarily by articulating development initiatives but by building on them.

This chapter aims at investigating these questions by relying on Sociology of Science and Science Studies' concepts and tools and case studies on Beirut suburbs' municipal networks. From these case studies we can see that in a fragmented city and on a local level, urban development initiatives are not necessarily a chaotic juxtaposition of autonomous projects. Local networks including different kinds of actors may well be in action. These local networks represent laboratories experimenting governance arrangements, urban planning tools and territory building strategies, without necessary calling them so. Some of these networks may join at a time or another to face more challenging supra-local issues. They do so by relying on their experience to attempt to engage in a more formal planning at a supra-local level. In this optic, planning and territories seem "condensations" of networks and development initiatives. Finally, the study of these experimentations in the light of the actor-network theory (ANT) may help understand what we call here a "bricolage" approach to planning.

2. Theoretical and methodological framework

Sociology of Science is a field of research in sociology that focuses on the science production's environment. Science and technology studies (STS) is a more interdisciplinary field of research that concentrates also on the study of science production and its relation to society, its values and politics. Both fields study the actors involved, the organization of work, the social and cognitive motivations, the communication tools, the place of objects in technology development, as other related subjects like the building of legitimacy and the power struggle in the scientific world. Number of theories and concepts sprung out of these works. Here we will be focusing on two of them: the actor-network theory (ANT) and the laboratory concept that will be translated in our field through the notion of "bricolage planning".

2.1 Actor-Network Theory (ANT)

The actor-network theory (ANT) is a large corpus of research that developed as of the eighties around the work of several authors in the field of the sociology of science and science and technology studies, mainly Michel Callon and Bruno Latour. These works investigate the ways research networks develop in the fields of science. One of the main ideas of ANT is the consideration of objects (material or ideas) as actors – or actants as they call them – in these networks. Beyond social actors' power game logics, ANT draws the attention to the central role that these objects play in the construction and evolution of these networks.

In an article titled "elements for a sociology of translation", Callon (1986) introduces one of the most interesting applications of ANT. The articles uses the metaphor of "translation" and "betrayal" to explain how an innovative idea gets to be systematized after getting different kind of actors and actants to work together for its success. The translation is a four stages process. First there is the problematization the lead actor makes of a certain phenomenon transforming it into an issue that needs to be dealt with by an intervention. This problematization may well get other actors and actants interested and thinking how this may concern them, Callon speaks of interessment. This interessment is the stage where the lead actor will target these actors and actants to get them to participate in the proposed intervention. If this happens and these actors bring in their resources to be part of the intervention. Callon speaks of translation if this is the case, if not he speaks of betrayal and dissolution of the actor-network. A fourth stage is that of mobilization that questions the possible generalization of the intervention to similar phenomena. In this stage the lead actor becomes the spokesman of a certain complex reality to the outer-world.

The basic analytic position that made such a method relevant is what Callons (1986) calls "free association" indiscriminately between elements of Nature and elements of Society. This means that objects and actors are equal members in any network building. They equally can hold the network project by "translating" the project options, or equally can make it fail. They're not only instruments in the hands of the different actors, they have their own logic and modus operandi. For actors to enrol them they must "interest" them, even adapt them by extending their capacities to fulfil new tasks.

Here, actor has a somehow different definition than its common understanding. *"Actors are entities, human or otherwise, that happen to act. They are not given, but they emerge in relations"* (Law, 2004, p 102). An actor does not exist outside of an actor-network, he's an actor because he manages to define or alter relations between other actors or actants with whom he gets to form a network. He does so by using intermediaries. *"The intermediary does not serve to merely describe a set of relations, it also manages to order the actions of others. […] Through translation the identity of actors is defined and negotiated and interaction is managed"* (Tait, 2002, p. 73).

Networks too hold a different meaning. "*For actor-network theory, networks are not stable systems of links and nodes (like a telephone system); instead they are metaphors for associations and connections between entities which may be heterogeneous in character. Furthermore, they do not have scale in the traditional sense, but are simply longer or more intensely connected (Latour, 1997, p. 3)"* (Tait, 2002, p. 73).

Interestingly, urban planning and urban development are both, somehow, processes bringing together different actors (politicians, planners, technicians, economic, associative) and objects (spaces, construction materials and tools, but also a large set of legal, administrative, managerial, conceptual, scientific, literary and negotiation tools) and connecting them in different ways. In the last ten to fifteen years we see a rising interest among urban planning and urban studies scholars in ANT and other STS concepts. In the light of ANT different authors tried to understand different urban phenomena. Here we present some of these works.

The conception of the City as a technical object is not new[2], however the new orientations in STS and the development of sociotechnical concepts had an important repercussion on urban studies. One of the main entries developed with the reflections around the impact of new technologies and most importantly the need to adapt the existing infrastructures to new functions and usages. One of the most influential works in this line is the book "splintering urbanism" of Graham & Marvin (2001). It identifies a linkage between infrastructure evolution and social and economical evolution leading to further fragmentation. The theoretical framework of "splintering urbanism" is partially founded on ANT literature. Another interesting insight is that of Hommels (2005) reflecting on urban "obduracy". In this article the author builds on two concepts of STS, the Social Construction Of Technology theory (SCOT) and ANT[3], to explain the stability of sociotechnical systems, mainly infrastructures, despite the rapid change of technological innovation. Other authors apply ANT in the study of the implementation of different technologies in the urban environment or their management (i.e. Bowler (1998) on recycling urban waste, Martin (2000) on the use of GIS and Beckmann (2004) on questions of safety and mobility).

Actor-network theory is also mobilized in global and world cities literature. Smith (2003a, 2003b) uses ANT to rethink and refold space and time and redefines world cities as "bodies without organs" stretching like an actor-network through space and time. Smith's writings defy the dominant portrayal of world cities as conceived in the political-economy approach through works like those of Saskia Sassen (2001).

On another level, the work of Jonathan Murdoch (1997a, 1997b, 1998, 2006) largely appropriating ANT has been very influential, and represents an interesting reflection on its application in geography, governance and planning. In this regard the traditional split between society and nature, actors and factors is abolished, only networks remain. Space itself is reconfigured : "*there exists no absolute time-space – just as there is neither absolute nature nor absolute society – but only specific time-space configurations, which are conditioned by motives and relations in networks*" (Boelens, 2010 reporting on Murdoch, 1997a).

In planning STS concepts and especially ANT has also had an important impact. For Thévenot (1995)[4], A plan's efficacy is proportional to that of the objects he's mobilizing, objects that give power to the planner over a situation. In the production of a plan, where an

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[2] "In 1979 the Journal of Urban History published the first special issue on the city and technology. A new research agenda emphasized the importance of examining the "intersection between urban processes and the forces of technological change" (Tarr 1979, 275). More precisely, the main purpose of these urban historians was to study the effects of technology on urban form. Researchers studied the role of technologies like street lighting, sewage, or the telegraph in the processes of geographical expansion of cities and of suburbanization. Technology was analyzed as a force that shaped society and the cities, but its own character and development were regarded as rather unproblematic and even autonomous; this new trend in urban history was similar to the early work in technology studies." (Aibar & Bijker, 1997)

[3] To which she adds another entry she develops under the name of persistent traditions to stress the weight of socially interiorized practices

[4] Thévenot in this article stresses some of the limitations of ANT but overall his "regime of familiarity" concept could well be sought as an STS concept.

intention is projected in time and space, a "detour" by a certain number of objects is necessary. "*This detour is generally associated with the confection of equipment transposable from a situation to another, consequently associated to the notion of investment, by opposition to the direct use of existing instrumental resources*" (Thévenot, 1995)[5]. Consequently, though he acknowledges the crisis of planning as an emanation of a top-down "public intentionality", he defends planning as a possible and necessary communicative constructive space; and he believes that this other version of planning is feasible by focusing on the objects of the "composite devices of coordination" present in all plans.

Tait (2002) mobilizes ANT to question central-local relations in the British planning system and the room for manoeuvre it leaves for local actors. ANT analysis shows how some actors by their presence in one network – even in an enrolled position – can *"draw on network resources to order others and construct their own (albeit limited) room for manoeuvre".* The ability for ANT to take in consideration all groupings even the temporal an informal ones help to understand not only the central and stable but also the local and unstable. Tait's article shows also how texts can be of central importance since they may define groups and enrol them in an actor-network construction initiated by others. But texts leave also space for interpretation and consequently for manoeuvre and adjustment. They're central in the construction of power in planning.

Bryson, Crosby & Bryson (2009) use ANT to understanding strategic planning and the implementation of strategic plans as "a way of knowing". The article builds on the MetroGIS experience, an organization that works on fostering geospatial information sharing and map building in the metropolitan area of the Twin Cities region in Minnesota, USA. The authors come to the conclusion that conventional understanding of strategic planning as "fixed and stabilized category of action", and strategic plan construction and monitoring as standardized objects and methods, abstract strategic planning and strategic plans from the actor-networks within which they're enmeshed. They believe that an ANT perspective can allow an understanding of the central role of objects – here maps and map making – in connecting entities with other entities, and as Latour (2005, p.119) puts it, bringing "*multiple realities [together so] that may lead to stability and unity*". Here participatory map making where realities are confronted and complemented could help to understand, in an actor-network, the "here-and-now" and point to the "there-and-then."

Boelens' (2010) actor-relational approach (ARA) that we mentioned earlier is a bold analytical and action framework that relies heavily on ANT. This approach resorts to ANT because it "*sidesteps the stifling duality between macro- and micro-*" and "*offers a subtle extension to the discursive, entrepreneurial or growth management approaches, by including things and entities as autonomous (not passive) forces or (f)actors of importance*." (Boelens, 2010, p. 38). This gives to the approach the possibility to defend an endogenous (local actors) perspective to development, and at the same time an opening to external investment as long as they're inscribed in the actor-network that this planning approach helps emerging. ARA also owes much to ANT in the way it operates: Boelens clearly identifies links between his seven steps scheme and Callon's four stages of translation. However Boelens identifies some "imperfections" in ANT and tries to go by them by resorting to urban regime theory and associative democracy literature.

[5] Personal translation from French

The main critiques of Boelens to the adoption of ANT as a framework for the analysis of urban planning could be summarized in three points. First, the absence of a normative dimension in ANT while planning is much a discipline where intention has a central place. Second, the secondary role of objects compared to human-actors in planning where objects are always intermediary and rarely actors, which makes a strong focus on objects not always productive. Third, the agnostic – if not cynical position (Webb, 2010) – of ANT towards central values like democracy and sustainability.

Boelens' critiques have received interesting responses from other authors (Rydin, 2010; Webb, 2010). We rally those responses and believe that ANT has much more potential than that assigned to it by Boelens. For instance, as Rydin (2010) argues, the objects we should focus on in applying ANT framework to planning are less the objects of the planning procedures than the objects that make part of sociotechnical systems that planning is trying to affect. In this case we might well find objects "authoring" networks by problematizing a social situation and getting some human groups to take positions and change their relations with other actors and objects. ANT has also a particular relevance in the study of informality and manoeuvring spaces (Tait, 2002). By mapping the actor-networks we can identify the nodes where some actors could hold a position giving them the opportunity to widen the possibilities by enrolling actors and resources in other networks or by forming their own networks. As for Boelens argument about the lack of normative dimension in ANT, we believe effectively that ANT puzzles: it cannot be classified neither as a normative theory nor as a critical theory – the standard two categories of planning theory. However this makes much the point of ANT: "*Planning activity involves a range of actors and actants interacting, engaging with each other (a rather neutral term), enrolling each other (a less neutral term) and producing outcomes which are a mix of the desired and un-desired, the intended and the unintended consequence. Thus ANT itself challenges the simple distinction critical and normative planning theory*" (Rydin, 2010).

Another recurrent question that poses much of a challenge to the sociology of translation in ANT is its difficulty in analysing stability. In fact, the sociology of translation was developed to understand innovation and the formation of innovation networks. Callon's (1986) identifies a fourth and last step in a translation, the "mobilization of the allies", to get the maximum support to the translation and wider its scope, but Callon does not say anything of the aftermath of the translation, how will this actor-network stabilize itself on the long run. It might be more or less easy to get actors to work together to achieve a certain translation at a certain moment but it is more difficult to maintain this cooperation. Time will bring other problematizations – to use Callon's terminology – causing other actor-networks to emerge and probably hinder the stability of this actor-network.

This distinction between the short-term and long-term is central to our argument. For an urban development to go through, a certain agency between different objects and actors must be stabilized as an outcome of one actor translating others for a certain project very limited in space and time. The will of this "author", as long as he manages to mobilize the necessary resources for his urban development, is the only thing that counts. In the light of ANT, city-level urban planning seems more complex and difficult to achieve than urban developments. In fact, it faces two important challenges. On one hand, urban planning tradition has always been linked to a certain conception of public interest. The authorities in charge of planning, in lot of cities, are still conceiving their role in that perspective.

Consequently, in order for their planning strategy to get through, they're forced to enrol in their actor-network a lot more social actors (in a participatory approach) or technical actants (in a regulatory approach), and most of the cases, both. And they must make a central extra effort to present their case as an emanation of public interest. On the other hand, this actor-network not only needs to secure agencies between different actors and actants at the moment of plan making, it also needs to do it on the long run, and sometimes with actors and actants that are not yet present. It is clear that in this perspective there is wider possibility for "betrayals" than in the case of local urban development initiatives that can be put together by few actors who do not necessarily claim public interest and usually are more delimited in time.

We will address this stabilization issue through the notion of laboratory that will translate, in the field of planning, through the idea of "bricolage planning"

2.2 "Bricolage planning"

Laboratories had been an important field of study in the Sociology of Science and in Science and Technology Studies since the seventies. A large number of authors contributed to their study. There is no single model of what is a laboratory and how it functions. However, since we're in the ANT perspective, we propose here to adapt this broad definition of a laboratory that is relevant to our argument: laboratory "*is a typical form of organization of the 'society of knowledge'. Its capacity to act on the world of objects and its dynamism are related to its know-how and to its capacity to reconfigure the entities of the natural and social world*"[6] (Vinck, 2007, pp.161).

Laboratories are "unstable environments" in different aspects. On one hand, Vinck (2007) stresses that in the case of the laboratory, organization is somehow different than in traditional bureaucracy or production environments. It is more fluid and open. Researchers of a laboratory come in and out of a laboratory, their contribution may be punctual and they're even not necessarily working in the same physical place. On the other, in a laboratory, researchers work with objects (physical or ideal) whose forms, statuses and boundaries are not stabilized and pose interesting questions to science. The way a laboratory operates is by reconfiguring resources: *"Laboratories fusion and reorient existing sociotechnical entities, disconnect and transform them to set them up in new phenomenological and relational universes"*[7] (Vinck, 2007, pp. 162).

This experimental aspect of the laboratory is it's real strength, it makes it do things (innovations, discoveries) that cannot develop in other types of organizations. However, it is also its major Achillies' heel. This openness and instability can easily lead to the disruption of the laboratory. Good communication and mutual understanding is here central. It is common in laboratories to have people from different disciplinary backgrounds, with different methodologies and sometimes values. To get these researchers working together, there is a great deal of communication issues to be stabilized. That's why in laboratories protocols, classification methodologies, definitions and other conceptual objects are central for its functioning.

In this fragmented world where diversity and disruption render intelligibility more difficult, we believe that the laboratory model – where experimentation and accumulation are the

[6] Personal translation from French
[7] Personal translation from French

base of knowledge, protocols the base of meaning and flexible networking a mode of production – could well serve urban planning. It is in this light that we propose here a "bricolage planning".

Bricolage is a French word that usually designates a "do-it-yourself" activity. We rely here on the definition and conception Claude Levi-Stauss (1962, pp. 26-27) gives to this activity: *"there still exists among ourselves an activity which on the technical plane gives us quite an understanding of what a science, that we prefer to call 'prior' than 'primitive', could have been on the plane of speculation. This is what is commonly called 'bricolage' in French. […] The 'bricoleur' is apt to perform a large number of diverse tasks; but, unlike the engineer, he does not subordinate each of them to the availability of raw materials and tools conceived and procured for the purpose of the project. His universe of instruments is closed and the rules of his game are always to make do with whatever is at hand, that is to say with a set of tools and material which is always finite and is also heterogeneous because what it contains bears no relation to the current project, or indeed to any particular project, but is the contingent result of all occasions that have been to renew or enrich the stock or to maintain it with the residues of anterior constructions and destructions "*[8].

We borrowed the idea of 'bricolage planning' from Rowe & Koetter (1978) in their classic book "Collage city". In the face of the crisis of planning they defend an approach to urban planning that would not fall into scientism nor surrender in the face of dominant 'laisser-faire' ideology. We largely follow their line of thought and believe that a 'bricoleur' attitude to planning that gives up the belief in "true answers" and go for "what is at hand" could be a viable alternative. However, we distance ourselves from formalist – design-oriented – 'bricolage' they're defending, and defend a wider actor-network building 'bricolage' that try to hold together actors, spaces, development projects and planning tools.

In our discussion of the crisis of urban planning it was clear that this discipline hasn't managed to build a solid practical alternative to what has been the core of the discipline for decades, urban planning – presented as a "rational" exercise to build a "functional" city. The city that is no more what it was, and rationality is much questioned. The proposed alternatives in the literature are for collaborative participatory planning, advocacy planning or what Boelens (2010) calls an outside-inward approach to planning, giving the initiator role in creating a planning regime to civic society and private sector actors.

The three alternatives mentioned above have different philosophical and political backgrounds in defining what is seen as the best fitting way to articulate public authorities' will with those of other actors. The collaborative planning approach believes in the role of participation, the advocacy planning believes in the potential of the counter-project to inflect imposed top-down planning, while the actor-relational approach of Boelens (2010) defends an associative democracy of planning giving public authority a secondary role. However, all three approaches are rooted in the need to build a cohesive and comprehensive planning project – focus of the planning activity – before engaging in any action on the ground. It is mainly in that bricolage planning is different.

Bricolage planning based on ANT, at this point puts as ANT the "how" before the "what". Its main concern is to make actors able to act. In a fragmented world, the capacity to act is a complex exercise, since power and resources are diluted in different structures and places. It

[8] The translation from French is that of Rowe & Koetter (1978)

needs a great effort of network building and resources' gathering. To do so these actors "problematize" situations, "experiment" with tools and try to "generalize" their experiments by systemizing them. Issues faced in urban settings maybe pretty much similar, each situation remains unique and poses important challenges to models of city planning and management. So the importance of local experimentation and learning processes.

In a fragmented world, problematization helps setting a boundary that is necessary to apprehend any issue. In the structuralist conception a problem will be a malfunction in some aspect of the structure. It is usually resolved by the intervention of the proper responsible actor or administration. In a fragmented and networked world, problems are interrelated to each other; actors implicated in them too. In a Bricolage perspective – that does not claim a higher understanding of the world – problematization helps to understand what exactly to look for, and what and who is concerned. The what and who will define the bricoleur's "world of instruments", to use Levi-Strauss words.

Experimentation is to make trials by testing an idea or a method on a restricted number of resources. The bricoleur takes chances only with a limited amount of his resources. In fact, as Levi-Strauss says, the bricoleur's universe of instruments is closed and its rate of renewal is not stable. In this experimentation, what is at stake is a restricted "reality": does this solution fit the problem at hand? Experimentation does not claim to offer answers of wider strategic nature. But at the same time the results of the experimentation, as in the laboratory, brings in questions on the place of this experimentation in the wider scheme of things.

This is when the generalization takes place. It poses the question of the reproducibility of the experimentation conclusions in variant situation, on one hand, and it leads to thinking how the new instrument that has been produced could serve for wider strategic tasks. It is at this stage, and in response to these challenges, that the question of stabilization of the experience to serve in different context, and that of strategic thinking, come to impose themselves. This is when the bricoleur becomes an engineer, when the "what" reclaims its place next to the "how", in brief, when planning emerges.

Experience here is the key word. It means the knowledge of the existing resources, and a know-how in articulating them. We consider that experience represent a central explanatory variable of the success of a bricolage planning process. This bricoleur's experience is crucial for having a certain control and capacity of action. There are different kinds of experiences. Some are held by different actors and could be mobilized by the actor-network at a certain moment to face a certain challenge, others are constructed through experimentation and generalization. The primary kind of experience is that of familiarity. A regime of familiarity is one where direct contact – even in the literal sense of the word – defines the relation between an actor and an object (Thévenot, 1995). This is usually a relation that results of daily interaction between actors and between actors and objects (tools, ideas and spaces). Local actors have this kind of knowledge concerning their locality, its places, issues and assets. Other actors may have a familiarity with special sectorial issue, this is the case of some NGOs or professionals. But usually the most interesting kind of experience for an actor-network is that constructed in the network through experimentation. This experience is not likely to be lost by the "betrayal" of a certain resourceful actor leaving the network.

Bricolage planning is hence an actor-networks building and stabilizing operation. It relies on small direct operations, mainly urban development operations that could be more or less easily put together by mobilizing ad-hoc resources. At the same time it has long-term ambitions in dealing with an issue, a community or a territory. These ambitions are not necessarily clearly stated, and the way to reach them hardly obvious. This makes the analogy with the laboratory very interesting. The actors are there, but they may come and go in the network depending on projects' availability. It is from the accumulation of different experiences that a general scheme, a larger vision – a "theory" in the laboratory's world – could emerge and be defended as a strategic option guiding the actor-network activity. This is how different autonomous urban development initiatives could lead to an urban planning strategy, which in turn guides the orchestration of other urban development actions. As in a laboratory, it is communication that is at the core of the bricolage planning actor-network's activity and stability.

In this study, we use some Beirut suburbs' municipal actor-networks as case studies for developing our 'bricolage' planning approach. We believe that in these suburbs municipal actor-networks have worked for the last twelve years as bricoleur, using their universe of tools to put together number of urban development initiatives, while some of them are moving now to become "engineers" in planning larger scale territories. We'll try to analyse how agencies of local actors, spaces and projects in fragmented cities emerge as actor-networks, how they experiment different actions and put together and coordinate different development initiatives, how capitalization of experiences may lead them to developing larger urban planning strategies.

3. Beirut as a case study for analysing actor networks in urban planning

3.1 Beirut a fragmented city in (re)construction

Beirut, along with Belfast, Nicosia, Sarajevo, is one of the cities of the world that is most associated to the image of division. Fifteen years civil war (1975-1990) largely contributed to this image: division of the city along a demarcation line into two large communitarian hemispheres (Christian communities to the East, Muslim communities to the West), displacement of large numbers of people from all communities and emergence of a mosaic of fiefs controlled by different warring communitarian militias. In these years, the already existing fragmentation (Farah, 2011) reached unprecedented levels. Due to security reasons people's mobility fell sharply making the local neighbourhoods the everyday horizon of most of the population. The pre-war economy, focused on a large service sector in Beirut central areas and industrial activity in the suburbs, was completely destroyed. A new economy of services, largely financed by expatriates and war money, was developing in each militia territory. Pre-war socioeconomic socio-spatial differentiations took an even greater magnitude with special high-end developments booming in the "safer" peripheries of the agglomeration.

In the post-war era, the new central government put on the table an ambitious reconstruction strategy. The strategy aimed at one hand to "reconnect" and open up the territories of the war and, on the other, to turn Beirut into an important business platform of globalization in the Middle East. This strategy was not presented as a whole as one project and debated as such. It was rather a combination of different projects managed by governmental agencies directly depending of the prime minister: the Council for Development and Reconstruction. The strategy was based on road infrastructures to boost mobility and link the different war territories. It also decreed a number of large urban development projects in the suburbs and the city-centre in order to bring in a new dynamic of investment in the real-estate and service sector.

Even though the government could count on a centralized state structure, the backing of a large business community and the general enthusiasm for reconstruction, the majority of the large urban development fell behind the expectations of their promoters and mobility did not prove to be synonym of openness. Physical barriers that cut Beirut into different sectors in the war were progressively pulled out. Still mobility across the across demarcation lines between communities' territories was kept limited. The communitarian distribution of the population in the post-war era was similar to that of the war. Communitarian political parties or traditional leaders were still very influent in different zones of the city and continued to act on "their" zones of influence through a wide variety of affiliated NGOs offering services to the population – services that came to be more precious with the extensive economic neoliberal policies of the government.

As of the mid-nineties the reconstruction project was in a bottleneck. The peace in the Middle East did not come. The continuing external and even internal confrontation jeopardized the chances of Beirut to emerge as a central business platform for the region. Most developments faced the political resistance of the dominant communitarian parties and leaders in the regions where they were planned to be constructed.

The different communitarian political groups on the national level saw in the "return of the municipalities" a way to break out of this stalemate situation. Municipal elections were organized in 1998 after 35 years of break out. Municipalities were seen as a way to partially compensate the retreat of the central state from a lot of social issues that it had no longer the finances nor the needed structures to deal with.

3.2 Municipal building in Beirut post-war suburbs: Sharing a similar history and facing the same challenges

The agglomeration of Beirut is a large urban continuum covering 468 km2, stretching over 60 km along the Mediterranean coastline and reaching 25 km to the east (Faour et al., 2005). It includes around 121 municipalities. The area called the suburbs of Beirut comprises a number of municipalities in the peri-central areas of the agglomeration. This area is where fragmentation dynamics are the most developed. We can see near to each other, however in almost complete autarchy, informal settlements, high-end neighbourhoods, an airport, a large university campus, various large scale public buildings, a golf club, industrial zones, populous communitarian neighbourhoods, hotel resorts and large malls. It is somehow the perfect example of Dear's (2000) chessboard model of a fragmented city.

The localities of the suburbs share practically the same historical path. These suburbs are not the mere extension of the old city-centre of Beirut. They always had their own economical and political development that, though linked with the city-centre, was not dependent of it. Back in the early fifties of the last century, the suburbs were still made of dispersed middle-sized to large localities organized by municipalities where the traditional family clans competed for the municipal council. Each village was separated from the other by large agricultural fields. This situation was heavily altered by the tremendous urbanization and industrialization of the sixties and seventies and later by the civil war. The urbanization transformed these areas into a dense urban continuum. The municipal limits are no more recognizable. The population also changed due to massive migration and immigration. The civil war further destroyed the old village centres, displaced populations, brought others and set demarcation lines between warring zones. In the aftermath of the war, the suburbs were a heavily fragmented area characterized by an important identity crisis.

On a political level these transformations also had common impacts on the different localities. The suburbs of Beirut have shown ancestral resistance to the extension of the central city on what they considered their territory and refused any kind of political integration to the city. However, the traditional family clans and the municipalities have been shunned aside by centralized communitarian parties and militias who took control of large areas in the suburbs of Beirut during the war and maintained this control politically after the war. On the other hand, immigration – brought by the continuous rural exodus and the displacement of populations during the war – posed another serious problem. The wide majority of the population in the suburbs did not vote in the locality where it was living but in the locality of origin where usually it kept strong social ties. There is hence a strong dissociation between the geography of vote and the geography of residency in these suburbs adding an important layer of complexity to the identity crisis of the localities.

A first challenge for these municipalities are facing in post-war Beirut is, on one hand, how to carve a place for the municipal affairs in the face of large metropolitan projects like the reconstruction strategy of the central government or the communitarian territorialisation of political and religious groups covering large areas in the agglomeration. Another challenge consisted in articulating different dynamics and projects in various neighbourhoods within a single overarching policy.

As of 1998 – date of the first municipal elections after the war, and first elections in 35 years – all the municipalities have proven to be an important actor in the production of urban spaces in the suburbs of Beirut. Despite their lack of means and the heavy control procedures imposed by the central authorities, the municipal actors have frequently succeeded in building large local networks that helped them bring in important resources to engage in substantial urban development activities. Faced with the urge to respond to pressing needs in equipment, infrastructures and services in large populated areas heavily damaged by the civil war, these networks have demonstrated genuine creativity in putting together audacious projects, sometimes in concordance with the central authorities and sometimes, as we will see, in clear defiance to it.

3.3 Local divergences as explicative variables

All municipalities of the suburbs of Beirut have engaged in a certain form of bricolage planning in rebuilding their municipal space. The degree to which they succeeded in doing so is depending on the specificities of each locality. These divergences may well provide some aspects of the "why" next to the "how" that ANT will allow to grasp.

These specificities are the following variables: homogeneity of the population of the locality vs. co-existence of groups with strong identities (community, ethnicity, class), physical state of the locality (in need of urgent and major interventions or not), presence of powerful partisan structures, nature of the leadership at the head of the actor-network (party or clan affiliated), existence of dynamic entrepreneurial vs. traditional notabilarian leadership, diversity of the core actors in the actor-network, reach of the network horizontally (number of actors) and vertically (number of scales). Needless to say that these variables are not independent. Our analysis is based on a sample of three municipalities: Ghobeiri, Chiyah and Furn AlChebbak. These are three contiguous localities that share practically the same history but at the same time represent these three very different situations. Each case could further be considered an archetype representative of many similar situations in the suburbs of Beirut.

Ghobeiri is a locality with a population dominantly of one community (Shiite). It has large informal settlements covering half of the municipal perimeter, and a neighbourhood that was particularly affected by the war since it is locqted on the demarcation line. Two large communitarian parties (Hezbollah and Amal) are present in this locality and are very active through their own networks of NGOs. The municipal council is dominated by a communitarian party (Hezbollah). The municipal actor-network leadership has a very entrepreneurial and dynamic attitude with strong experience in social and associative sectors. Its core actors are all directly affiliated to the Hezbollah. Despite its lack of diversity the municipal actor-network, has a large number of members (mainly the NGOs of the party), has access to the national political sphere (again through the party) but also occasionally to development institutions at the international level.

Chiyah is a locality heavily affected by the war. It is cut in two by the war demarcation line with heavy damages in its physical structure. Still today two zones can be identified in its perimeter: an area with a population dominantly of the Christian communities to the east of the demarcation line and an area with a population dominantly of the Shiite community to the south and west of the demarcation line. Until 2005, the only major party structure active on the ground Amal in the neighbourhoods at the west of Chiyah. Registered voters are mainly from the Christian communities. The municipality is held by a family clans' coalition from the Christian communities. The municipal actor-network is characterized by a very entrepreneurial and ambitious leadership coming from the business world. It has a relatively diverse structure of core actors including family clans and a community parish. It has access to a large and diverse number of actors at the local level, but also at other scales, like the minister of interior, the presidency of the Republic and a large part of the business community.

Furn AlChebbak is a locality with a population dominantly of the Christian communities. It was affected by the war, however, far less than in the two other localities. It even developed during the war with the resettlement of a large part of the commercial activity in the south-eastern suburbs in its souk. The municipality is held by a family clans' coalition from the Christian communities. The leadership of the municipal actor-network could be described as traditional notabilarian, cautious and not keen to ambitious projects. Its core actors are notables from the family clans. In fact, the whole actor-network is restrained with only few actors mainly at the local level.

We will not present systematically the different cases. Instead we will use these cases to stress different aspects of the municipal governance, policies and actions in these localities that are directly relevant to our discussion of planning in a fragmented city and more particularly, to bricolage planning.

4. The construction of municipal actor-networks

4.1 Forging a locality's identity

One of the main tools that was mobilized by the leaders in building their municipal actor-networks is the "locality's identity". This was used to problematize municipal issues. As said earlier problematization defines the universe of instruments from which the bricoleur actor-network will pull out the tools it needs for its action.

For the leaders of the actor-networks, reviving – or even constructing – a sort of local identity is crucial for bringing in other local actors to support their actions and gaining legitimacy of representation in the population's eyes. It is also important to problematize the municipal perimeter and redefine the centralities in it and with the rest of the agglomeration. In fact, asserting a locality's identity is a claim of emergence of a new centrality in the Beirut agglomeration; it is a way to warn the central government and its metropolitan reconstruction project that there is a local dynamic that should be take into consideration. It is also a way to affirm the need to recompose the urban structure according to other normative values.

History's reconstruction has an important role here. Those whose history is linked to that of the locality are the "legitimate" representatives of this locality while the others are often stigmatised as intruders and usurpers. The same goes for geography. Places do not have the same "weight": some places hold a certain symbolic or strategic importance for the population or more specific groups. Focusing on the importance of these places in the identity of the locality and the need to protect it and develop it, through conservation or projects, is a way to get new actors involved in the municipal actors-network.

If we look at the municipal discourse in Chiyah, we see a thoroughly constructed locality's identity. In the municipal publications, Chiyah's history is that of the traditional clans. The historic notables are presented as a pantheon of great leaders. The heavy antagonism that marked the relations between the family clans is here absent. Next to these notables a large place is given to the religious institutions and mainly the priests of the Maronite parish of Chiyah. However there were also a lot of absentees in this discourse, especially the war years. It is only presented as a dark period that brought destruction to the locality and which memory should be shunned away. The parties, the displaced and the squatters of the war are all absent. All these groups may contest in a way or the other the legitimacy and relevance of the municipal discourse by providing different versions of the "history" the core members of the actor-network are trying to impose on Chiyah.

The Chiyah's actor-network provides also his own version of the geography of Chiyah. Chiyah West and Aïn AlRemeneh are names given during the war to the neighbourhood controlled by the parties. These names are totally absent from the official municipal discourse. The leadership of the network resuscitates old names of these areas, names that are particularly relevant to the family clans whose own histories are affiliated to these toponymies. These toponymies were a way to reclaim these areas. In any case, the central message is clear: Chiyah is indivisible and all neighbourhoods in its municipal perimeter represent a one and single unity that should be reunited again despite the war scars around the traditional elements of historical and geographical centrality.

The construction of the locality's identity in Ghobeiri is at the extreme opposite of that of Chiyah. The history of the locality is that of the resistance. A resistance that goes beyond Hezbollah's fight against Israeli occupation, to be "that of the oppressed, against any occupation". This discourse allows to aggregate a large majority of the population of Ghobeiri while at the same time ridicules the claims of the family clans opposition that seem reactive and egocentric in front of such a national and noble cause. Two other aspects of Ghobeiri history are emphasized. On one hand, the "religious piety" of its population and the number of clerics and religious scholars born here, to emphasize a continuity with the conservatism and religiosity of the party. On the other hand, the picturesque village and green areas before the massive urbanization of the 60s and the "irresponsible urban policies" of the central authorities that destroyed this "haven of peace".

This last point, emphasizing a geographical reading of the historical identity of Ghobeiri, is linked to the central challenge for the municipal actor-network: the Elyssar project. Elyssar is a large urban development project in the suburbs of Beirut, one of the development projects of the metropolitan reconstruction strategy of the central government. It is put under the jurisdiction of a special public agency specially created for this purpose. The political stalemate on the national level in the late nineties gave a stop to the project but kept the project zone under the authority of Elyssar public agency. However, this zone includes very large areas of Ghobeiri, its main real-estates reserves and the seashore. It is also composed of large informal settlements. The municipal actor-network depicts this as in the continuity of "irresponsible policies" of the national authorities, especially since it leaves the informal settlements with no assistance and deprives the municipality from intervening in this strategic sector.

In Furn AlChebbak, the locality's identity is constructed pretty much as that of Chiyah: family clans' history, a prominent place for the Maronite parish and a resuscitation of the old toponymies. Here too the toponymy is a way for local actors to reclaim the different neighbourhoods. However, the actor-network core actors have gone a step further than Chiyah's actor-network, by changing the name of the locality in order that the three large neighbourhoods that form Furn AlChebbak find their place in it. This would be anecdotic if it wasn't one of the first measures of this municipality. This is related to the fact that family clans are much linked to one or the other neighbourhoods. Those family clans, at the centre of the actor-network want to stress this linkage and to confirm symbolically the geography they're promoting. This "federalization" of the geography of the locality had then its rationale in the structure of the municipal actor-network and its governance. However, it had its impact on the way this actor-network will construct its urban planning agenda.

In fact, the new geographies promoted by the three actor-networks have a similar impact on urban planning. They aim to transform the municipal perimeter that lost all significance in the war into a territory. This situation is different from the first historical development of the municipalities in Lebanon at the turn of the twentieth century. Back then, the family clans were the only political actors in the localities and their claim on the municipal perimeter was unquestioned. The new municipal actor-networks in these suburbs faced a multitude of conflictual appropriations and actors contesting their representativeness. Negating the existing territorialisations and imposing a new top-down territorialisation is here much in the continuity of the normative physical planning that modernizing nation-states tried to impose on their national territory. This implicates a holistic vision of the territory and a large systemic project to develop it.

It can be seen in the case of the three municipalities that the issue of local identity develops before any vision is proposed to the territory. It seems as an initiator for building a network that could then be mobilized to imagine and defend a project. The fight for defining a locality's identity could best be understood in a governance perspective. Asserting the legitimate representativeness of the municipal actor-networks and mobilising local actors into coalition building to compensate the shortcomings and limitations of the municipal institution and assemble the needed resources for action. These actor-networks, in 1998, tended to reclaim their "rights" on all their municipal perimeters. Instrumentally speaking they knew that they lacked the usual urban planning tools to back these claims. Even more importantly, they were incapable of imposing such projects on the different local actors.

4.2 The municipal vision: Positioning the municipal actor-network strategy

The three municipal actor-networks have opted to three different positions in the way to overcome the resistances to their claims over their municipal perimeters. The municipal vision is central in this positioning. The municipal vision is, after the locality's identity, the "second half" of the municipal discourse. What we call here a municipal vision is a number of statements that could represent a more or less cohesive body of ideas of what are the major objectives this municipal actor-network is defending and what he hopes to achieve for the locality. Each municipal vision could be decomposed in a series of projects and actions. These projects and actions are of various kinds. Some are development projects including construction or restoration of public – sometimes private – buildings, public spaces, facilities and monuments. It may well be autonomous projects restricted to one or the other of these actions. In addition to these projects, we can also consider a diversity of actions in the governance, social and cultural fields. What brings all these projects and actions together and inscribe them in a vision are the more or less clear objectives they answer to.

4.2.1 Place-making urban planning

In the case of Chiyah, though the municipal actor-network had a strong implementation in the Aïn AlRemeneh neighbourhood, it was practically disconnected from the actors and actants of Chiyah West. In this area, the Shiite communitarian party Amal had strong support and was well present. The municipal actor-network was in no position to impose a top-down project on this party, neither on the population of Shiite community in Chiyah West. Consequently, the municipal actor-network of Chiyah chose to go down the road of the compromise. The municipal vision it presented was a way to seal this compromise.

The municipal actor-network in Chiyah first concern was to overcome the stigmas of the war and its consequences, mainly the tension on the demarcation line. Turning this area of tension into a place of encounter and openness between the southern and the south-eastern suburbs seemed the only reasonable way to provide sustainable peace and chances for development. To do so, the municipal actor-network had to enrol significant actors from Chiyah West. The municipal vision had precisely this role. This vision proposed the rise of an economic and functional centrality on the demarcation line. The main tool here was a large scale development project and included: the restoration of the old village centre neighbourhood destroyed by the war and cut by the demarcation line, the construction of different public facilities and of a public housing project, and the backing of the development of an existing dynamic souk in Chiyah West near the demarcation line. Next to the public initiative, the development project bets on private sector initiatives. The project of the Maronite parish – an important landlord in this neighbourhood – to build several residential, offices and retail units in this area, was in this sense.

However, this project necessitated first the resolution of the displaced and squatters issues, by restoring their rights in this neighbourhood to the first, and providing indemnities to the latter. This will later show a critical issue that will hinder the whole development project the municipal actor-network was counting on. The development project was never officialised in any document. It was a set of projects and actions put together conjointly and in complementarity by different actors. We will elaborate on the project in the next section. But we can say here that in urban planning terms and for pragmatic reasons, we have a smooth slide from the normative physical planning perspective of the locality's identity to an "urban project" perspective.

The urban project is a plurivocal term that encompasses very different situations (Toussaint & Zimmermann, 1998; Mangin & Panerai, 1999; Ingallina, 2001, Pinson, 2009). Its main characteristic is a strong anchorage in the local, a place, that is seen as the starting point of the project. The urban project is a return to the materiality of the urban. It is a counter-movement to the resolute abstraction of earlier urban planning to found planning on material reality. But it also has a communicative dimension where the project becomes a "*mediation apt to make emerge a form of collective life since it articulates a mental representation to a significant appropriation of the material world*" (Rémy in Toussaint & Zimmermann, 1998). Consequently, it is usually an open to public-private complementarity and partnerships. All these dimensions are present in the urban development project of the municipal actor-network of Chiyah. Through this project the municipal actor-network hopes to make emerge from the local a centrality that could position the locality on the metropolitan level and at the same time federate its different actors together.

4.2.2 Guerilla urban planning

The case of Ghobeiri is largely different. The municipal actor-network chose the confrontation path. In fact, there was no room for compromise. The negotiations between the central government, Amal and Hezbollah around the Elyssar project arrived to a dead-end in the nineties, and the positions of the different stakeholders were still the same. On the other hand, it was not acceptable to have a negotiation between a central government and a municipality on this issue after the stalemate of the project. The municipal actor-network who wanted to "conquer back" its municipal perimeter had opted to two strategies. The first is what we call here a "guerrilla urban planning" in order to change, bit by bit, facts on the ground. The second is what we can call the "modernizing path".

In fact, as in the case of Chiyah, the municipal actor-network of Ghobeiri, even with the backing of the party, had no enough power to impose its will on a government led project. On the other hand, even if the Resistance based discourse on the locality's identity was well received in the informal settlements of Elyssar, these neighbourhoods are traditional Amal influence zones. The political goal of the "guerrilla urban planning" strategy is to gain support of the population and render the application of the project more difficult. This "guerrilla urban planning" in its applications could be in a way assimilated to Davidoff's (1965) advocacy planning. As in advocacy planning a certain technical expertise was provided to groups "with no voice" in order for them to have a greater control on their environment. However, to the difference of the advocacy planning approach, what was provided was punctual interventions and not alternatives to the Elyssar project. On the other hand, these interventions are done in clear contravention to the law that forbids the municipality from intervening in the Elyssar project's area.

This is why we chose to give it the "guerrilla" character.

The "modernizing path", though it aims at regaining Elyssar, had a larger ambition. "Modernizing" the locality was in a way challenging the adversaries of Hezbollah who saw in its access to the municipal council a dangerous drift of conservatism. In fact, this party was never member of any government and its partisans were rarely present in state administrations. Though, the party had strong and well reputed NGOs with very professional administrators, the 1998 elections was the first implication of the party in a leading governance position. Consequently, the municipal governance was seen as a test to the party, but also as an opportunity to present a model. The municipality of Ghobeiri, one of the rare large municipalities where the party succeeded in having the mayor to be one of the party prominent figures, was seen as one of the places where Hezbollah hoped to set the example. "Modernizing" meant, first and foremost, providing adequate and quality facilities this densilly inhabited locality was lacking.

The municipal actor-network in Ghobeiri main message in its municipal vision was that the marginalization and the backward image the locality was facing could be turned around by a solid strategy of investment in public spaces and facilities and by an ambitious and dedicated local authority. Ghobeiri was a relatively large locality in the Beirut suburbs with an important number of large private enterprises, hotels and public institutions, which meant a high annual tax income for the municipality. However, Ghobeiri had also large informal settlements, a deteriorated public realm and a very large population constituted mainly of low-income households, bringing important challenges to the municipality action, and expected large spending.

Though it chose to experiment other types of planning and never used the traditional tools of normative physical planning (like Master plans and regulations), and always refused to acknowledge the presence of a well structured municipal vision, it is clear that the municipal actor-network of Ghobeiri kept moving with no concessions towards direct control of its municipal perimeter. The "guerrilla urban planning" expressed by the implementation of infrastructures and facilities served this goal by proceeding in a long term one-step-at-a-time approach.

4.2.3 Reactive urban planning

The municipal actor-network of Furn AlChebbak had a notabilarian and conservative leadership that didn't saw much need to invest in large network building. It was content with its own family clans and notables' networks, and these networks were sufficient for winning the municipal elections. This municipal actor-network of Furn AlChebbak saw the role of the municipality in the most traditional way. In fact, Furn AlChebbak has a somehow different situation than Chiyah or Ghobeiri. It didn't suffer the displacement and the demarcation line as did Chiyah, nor did it find itself in harsh opposition to the central authorities over the fate of informal settlements in its municipal perimeter. Furn AlChebbak saw an important redeployment of retail activity in its souk during the war, and the concentration of a large number of public administrations and important road infrastructures in its municipal perimeter after the war making it one important centrality in the suburbs of Beirut. Consequently, the municipal actor-network positioned itself in a rather indifferent attitude vis-à-vis the reconstruction metropolitan project of the central government, and was not tempted to engage itself in large development projects.

The "federalization" of the municipal perimeter is a prompt indicator that the main concern here was to affirm a conservation of existing actor-network. Consequently, there's no project to approach the development of the municipal perimeter in a holistic way. We could say that the urban planning approach of Furn ALChebbak is that of an "ad-hoc" urban planning that deals with issues separately in a very reactive way. This situation became to change in the three or four last years with the abrupt boom in construction in Beirut and the impressive rise in real-estate value. We'll be presenting these changes and their implications in the next section.

Through the locality's identity and the municipal vision the municipal actor-network have problematized the municipal issue in a way to construct their own "reality" in the Beirut fragmented city and society. This problematization have also brought to them the actors and the actants that will form their universe of instruments. It is this universe of instruments that they'll be using to engage in number of experimentations that will characterize their bricolage planning.

5. Facing fragmentation: Experimenting new tools of municipal action

5.1 A "revolution" of communication strategies

The most visible change introduced in municipal action in post-war Beirut is surely the communication trend. Traditionally, municipal governance and municipal projects were dealt with in closed circles between the notables and the technicians of the municipality. Word of mouth was the main way of informing the population about policies and projects. In todays' municipalities, we can see a serious concern of the municipal actors to mobilize new tools of communications.

In all three cases we've studied, we can see the creation of websites, municipal publications, posters and municipal billboards in the public space, publicity for events and frequent interviews in local and national media. Special attention is given to municipal projects. The use of 3D simulations is also frequent. To these media tools, we see also changes in the municipal practice itself towards more openness and transparency. The minutes of meetings are published on the websites or are displayed in the hall of the municipal building. Regular meetings are organized to present to the population the achievements and the projects of the municipality and receive comment. Some municipalities even worked on the training of their employees, who are most in touch with the population, for better communication. These tools have been undoubtedly successful. They've been used on and on in new editions since 1998. We can even see a professionalization of this activity with design studios coming in and the work on the "visual identity" of the municipality (logos, colour palette…).

These tools are part of what is usually called "city marketing". It has two goals. One is directly related to governance ant the need to transcend fragmentation and get in touch with the population and the different local groups. The other is more strategic and related to the overall development of a city or a locality. It is based on the assumption that a positive vivid image of the locality could boost dynamic of private initiatives in the locality and attract new investments to it. It is urban planning without planners, a setting where image building will suffice for the development of a city or a locality. Governance and management on the other hand become central. However, this should not be confounded with the collaborative urban planning approach (Healey, 1997) based on Habermas communicative theory. We can see here a genuine effort to include local actors in the municipal actor-network dynamic, but only in an enrolled position. Though municipal actor-network leaderships may refer to these activities as participation, as in the three sample cases, they are more likely top-down information displays. There's no room for debate in these strategies. As propaganda and legitimation tools, these marketing tools are effective. They've positioned the municipalities in the local representations as major dynamic actors in the localities. However, they don't seem really to serve in getting local actors into the municipal actor-network. This is done through other "incentive schemes" and usually through direct contact.

5.2 Private public partnerships opportunities and limitations

As said earlier, the municipal vision was to be achieved mainly by a large development project on the war demarcation line at the heart of the old locality central neighbourhood. However, only a few actions were executed. The fact is an essential perquisite to the project was the resolution of the displaced and squatters issue in the area where the project was to be developed. But the resolution of this issue lagged to different political and technical administrative reasons. This provoked a large crisis for the development project that was aborted aggravating an already existing trust issue[9]. So, as of 2000, the municipal actor-network decided to redeploy its project elsewhere in Chiyah. And it chose to do so on the far east of Chiyah, "deep" in Aïn AlRemeneh.

Here, we saw the development of a large continuum of public spaces, gardens, sport terrains and a large socio-cultural and sports centre in construction. These projects developed by the municipality in this area articulated with other projects, like the different facilities of a parish church, other private sport terrains, some restaurants with kids' playgrounds. In this area the municipality worked in close collaboration with the Maronite parish and its coalition of associations, as with a local shop owners' association. The main cooperation was on the complementarity of activities and the boosting of the attractiveness of this area through the organization of several festivals and other manifestations.

It is the incapacity of the municipal actor-network to "interess" and "enrol" Chiyah West that blocked the first municipal development project in Chiyah. Only, in the case of the souk in Chiyah West, a strong collaboration with the shop owners' association of the souk allowed a partial integration of the place in the municipal project. In opposition, the second development project, the area to the east of Aïn AlRemeneh was still in construction and attracted a large number of dense apartment buildings projects aiming for middle-class buyers. This new population, interested in the promise of green public spaces, as the nearby shops, local investors and the coalition of the Maronite parish associations, interested in the activities and the clientele such spaces would attract, all backed the project.

[9] As the deputy mayor confirmed to us in an interview (2006): "nobody wants to live on a demarcation line".

Analysing actor-networks is most interesting for understanding urban planning opportunities and limitations. On one hand, it shows that setting urban development projects is more complex than just a question of grasping opportunities and engineering complex coordination between different actors. It is first and foremost a reconfiguration of the existing relations and the definition of new ones, and that is a case-specific issue. In the case of Chiyah, early projects were an opportunity to develop different types of experiences that give the municipal actor-network a clearer idea of what it could or could not do. On the other hand, the case of Chiyah got us to concur with Rydin (2010) that it is by focusing on the sociotechnical objects of the systems urban planning aims to change that we can get the best grasp urban planning processes. In fact, sadly, the demarcation line issue seems clearly to be tenacious and difficult to enrol in a municipal actor-network. It even is itself capable to enrol different socio-spatial entities and powerful actors "profiting" from the demarcation line's actual state, in what we can call here the demarcation line actor-network[10].

5.3 Urban infrastructures as a controversial issue

The fate of the population of the informal settlements was the main issue in the controversy around the Elyssar development project in the west of the southern suburbs of Beirut. Though the project considered the construction of social housing for 3000 persons, this number was far below the actual number of inhabitants of these settlements. In the mid-nineties, the Shiite parties, Hezbollah and Amal, engaged in long negotiations with the prime minister, in order to introduce changes to the project mainly including more social housing, but with no success. In fact, the issue was treated in the frame of larger negotiations between these actors implicating other projects and political understandings. The confrontation led to a standstill of the project. This however had important consequences on the life of the population of these informal settlements who were not only facing economic and social tenuousness but also harsh environmental conditions. It was the latter that seemed to provoke the most serious problems pushing the municipality to intervene to unblock dangerous and untenable situation.

The municipal actor-network of Ghobeiri engaged in four other types of interventions in this zone, always under the banner: dealing with unacceptable situation. This is how it came to install a water infrastructure network to numerous households in an informal settlement, build a breakwater made of sandbags to protect another from high sea waves, organize an informal souk in a neighbourhood and launch a pilot waste sorting project in another. There is a gradual evolution in the cases. In the latter projects, urgency seems less pressing, and we see less unilateralism form the part of the municipal actor-network, other actors – like international development institutions – are getting involved.

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[10] Among these actors we can identify political parties that built strong influence for themselves in the neighbourhoods along the demarcation line by claiming to defend these neighbourhoods. We can also identify a squatter population that fear displacement in the event of the resolution of the issue. And more importantly we have the central state that refused to engage in a project of large restructuring of the demarcation line – the study being offered by the Urban planning agency of the French region of Ile-de-France – because the demarcation line is considered too much of a complex political issue!

Despite the harsh attack of the Ghobeiri municipality on the Elyssar project, and behind it the central government, that shows that a "guerrilla urban planning" is not a confrontation approach through and through. There is room for conciliatory manoeuvre (Tait, 2002)[11]. The shrewd political diplomacy of the mayor of Ghobeiri made the central government intervene for improving urban services in an informal settlements, and the enrolment of the latter in the municipal actor-network of Ghobeiri[12]. It further created a precedent for more intervention by the municipality in Elyssar area.

In fact, the capitalization on experiment and generalization is done here through a track that includes different elements. The first is acceptance and recognition of the positive impact of these interventions by the local actors but also but also other actors on the national and international level. This is how international development agencies got implicated in assisting in some of these interventions. The second, is the gradual slide from a "guerrilla urban planning" oriented against Elyssar, towards an "informal settlement upgrading approach" (Abbott, 2002a, 2002b). This means that the confrontation with Elyssar was becoming less the dominant angle of approach, it was replaced by the construction of a bolder project: making a territory of an area in the southern suburbs of Beirut or what is usually called The Suburb.

The Suburb is Hezbollah's area of influence in the southern suburbs of Beirut. Hezbollah has a long implementation in this area and a very large and successful network of NGOs that has assured it large support. Hezbollah has also a long tradition of intervention as a construction and public works actor in this area. However, it is only recently – in the aftermath of the 2006 war with Israel – that the party got involved in urban planning per se with the project for reconstructing the southern suburbs. But even in the case of this project, we do not see an overall planning strategy for The Suburb, instead, a large series of buildings' reconstruction projects. In fact, the party has always maintained the absence of such a strategy and justified his interventions by the urgency of intolerable situations while condemning the withdrawal of the state institutions from their role.

The question of urban infrastructures is probably one of the most ancient and central tools in urban planning. Back in the 19th century, Haussmann used road infrastructures, mainly the tracing of the boulevards as a way of restructuring the whole city of Paris. In the case of Ghobeiri, this is particularly appealing: the project of metropolisation and reconstruction executed large road infrastructures contributing clearly to the separation of Elyssar from the rest of Ghobeiri. Through other types of infrastructures, lacking in the informal settlements neighbourhoods, the municipal actor-network of Ghobeiri tried to physically and socially connect these neighbourhoods with the rest of the locality, but at the same time slowly restructure the whole area. The infrastructures of inclusion could be see as a vector of this strategy, the development of public facilities is another.

[11] However, in an interesting reverse of the example of the urban planning officers of Tait's (2000) case study where they create a room of manoeuvre in executing urban planning directives, the mayor of Ghobeiri creates for himself a room of manoeuvre in contesting central government. He uses his statute of political player at the national level – as a former member of the leadership of Hezbollah – to access the political apparatus of the state and diffuse the confrontation.

[12] It is also appealing that the municipal publications do not mention the CDR project, presenting the resolution of the issue as the consequence of the municipality's involvement.

5.3.1 Creating facilities through a public led strategy for real-estates stock constitution

The question of "modernizing" the locality was central to Ghobeiri's municipal vision. "Modernization" in the representation of the municipal actor-network of Ghobeiri was mainly linked to the production of quality public facilities accessible to the population. Though Ghobeiri is a large locality with a population of more than 100.000 inhabitants, the aim of the municipal actor-network was to produce facilities that could serve at the level of the whole southern suburbs. The main obstacle in the face of this objective was clearly financial: where to get the money for such large projects? The municipal actor-network seems to have developed over the years a very successful strategy in this regard.

All these projects necessitated first the availability of land owned by the municipality. But, trying to purchase a suitable terrain for a predefined project would surely get the sellers to raise the price. The municipality tried to get around this problem by creating its own real-estates' stock. No particular project was linked to any purchase. At the same time, a portfolio of projects that the municipality believed representative of the priorities of Ghobeiri was defined and, sometimes, preliminary studies were commissioned to identify scenarios and costs. It was only at this moment that the municipality turned to different donors to finance one or the other project. These donors are usually keener to finance a project whose land and study are available, diminishing sharply the amount of their contribution. It was in this logic that the municipality managed to execute different facilities with the intervention of different donors.

The availability of land and its price have guided the constitution of the real-estates' stock. It made the whole process – as the municipality claims – quite an ad-hoc one. However, the municipality gradually became to identify more accurately the needs of the locality and the possible locations where these facilities should be constructed. In fact, it conducted a number of surveys to map the physical, economical and social situation of the locality. Consequently, it evolved from an ad-hoc planning approach to a more systematized one. Though we're in front of a project that do not speak its name: no such holistic strategy was acknowledged by the municipal actor-network and no documents referring to it were ever produced.

The question of real-estate has always been central in urban planning. Speculation, in fact, could represent an important complement to infrastructures development, by financing retrospectively their execution through taxes – much of the urban development since Haussmann has relied on this logic. It can be also a major source of socio-spatial segregation. A lot of tools have been experienced in developed countries to control real-estate speculation (Lacaze, 1995). Real-estates' stock building is a most common one. The wit in the municipal actor-network of Ghobeiri resides in combining this tactic with discreetness an active donor financing. It is a way to compensate the need of formal or informal private-public partnerships.

These experimentations of the municipality of Ghobeiri represent a corner stone for the generalization of the bricolage planning approach of the municipal actor-network if it was to be deployed on a larger level.

5.4 Negotiating urban extensions through orientation schemes

In the north of the municipal perimeter of Furn AlChebbak we can find a very large green area that is still exploited as an agricultural area due to zoning regulations that protect it against urbanization. This area is one of the rare large real-estates stocks in the central areas of the Beirut agglomeration. Clearly it is keen to attract developers who are pressing for a change in its zoning regulations. The municipal actor-network is facing a more serious challenge in dealing with this issue. The leadership of the municipal actor-network had always maintained the need to protect this area as a green lung in a very densely urbanized zone. Today, a reflection on the future of this area was initiated in order to face the pressures. As the municipality lacks powerful leadership and control over its territory, these discussions have been oriented towards the adoption of a master plan.

Thévenot's (1995) defence of the Plan as an important communicative tool makes sense here. What a master plan tool offers is less a prospective perspective but a large contribution to the stabilization of a complex and fragile governance. The actors around the table do not represent a common front and have different agendas, however, none could get to implement his one by himself. Negotiations are here central, the approval of all the actors around the table is necessary for the development of the project. Orientation schemes are excellent tools in this sense; they're general enough to gain the largest adhesion from the actors and flexible enough to evolve through the negotiations.

In our sample case, the future of this area is crucial for the Furn AlChebbak municipal actor-network. On one hand, a number of notables at the centre of the actor network are landowners in this area. On the other hand, whatever development is put on rails in this area will have tremendous impact on the rest of the locality. For investors, the development of the area represents lucrative but also important long-term investments. As for the central government authorities, this area holds strategic importance. Whatever the compromise that gets out of these negotiations, all actors around the table want assurance that their concerns will be taken in consideration and that all the parties will respect their engagements. The role of the master plan is to provide some guarantees for all actors. Market is pushing towards an important intervention of the municipality and the directorate of urban planning to allow greater development, but, the issue implicates number of notables and family clans in Furn AlChebbak and might destabilize established alliances holding the municipal actor-network together.

6. Scaling up networks to foster their stabilization

All three municipal actor-networks are facing important political challenges imposed by changes on the higher levels of government. The political situation on the national level that led to the municipal elections of 1998 is no longer what it was. As of 2005, the high political polarization on the national level has its consequences on the local level, where parties chose to move towards more aggressive local strategies to enrol municipalities and NGOs in their own networks. This pressure is destabilizing some of the municipal actor-networks, and local actors acknowledge the limits of municipal action. Some major issues, mainly economic issues, could not be dealt with on the local level. Scaling up begins to seem as a way to stabilize the municipal actor-networks and capitalize on decade-long experimentations.

The creation of Unions of Municipalities is the main instrument for such a stabilization through up-scaling. Two unions in these suburbs were created as of 2007, one including the municipalities of the southern suburbs and the other that of the south-eastern suburbs. The unions represent an important (re)problematization of the municipal issue. The definition of a new spatial perimeter for municipal action poses the question of territorialisation.

In the case of the southern suburbs, there was an existing territorialisation going on through Hezbollah's construction of The Suburb. Though the municipal actor-networks of the southern suburbs – controlled by the same party – defended a claim on their municipal perimeters, they didn't have the same attachment to it as in the case of Chiyah or Furn AlChebbak's municipal actor-networks. Their territorial reference was always The Suburb. The creation of the union here was then in the continuity of the municipal actor-networks efforts of the last decade. It built on their experimentations. The creation of the union is an effort to fusion the different actor-networks in a larger one working at the scale of the southern suburbs and responding to issues that the municipal level is incapable to tackle; one of these issues being the place of these suburbs in the larger metropolitan development.

The case of the union of municipalities in the south-eastern suburbs is largely different. Local family clans here control the different municipalities and have strong attachment to their localities and their autonomy. However, as of 2005, they're faced by the imminent danger of destabilization and marginalization by the political parties on the national level. The creation of this union is somehow a formation of a cartel that can give weight to these local actors and put them on the negotiation table for a better articulation of these suburbs with the rest of the agglomeration. The real challenge here is how to give consistency to a body lacking clear leadership and identity. In fact, the union here does not coincide with any significant reference to the municipal actor-networks and remains open to new memberships. This leads to the difficulty of constructing a convergent vision of what the union should be and what it should do, that would mobilize actors and help merge the different municipal actor-networks. Consequently, in opposition to the union of the southern suburbs, no territorial systemic planning approach defining complementarities is actually possible. Building on previous experimentations is also difficult since these experimentations for the majority were case-specific. Nevertheless, these municipal actor-networks are trying to engage in common reflections about issues they identify as priority and that touch them all, like youth and education. Here, paradoxically the union is a space of experimentation to produce tools that will serve at the municipal level.

7. Bricolage planning opportunities and limits

In the light of the three sample cases, we identify here three central elements in the development of bricolage planning: the constitution of the "universe of instruments", the experience and the articulation to larger dynamics; and behind them all, the initial profile of the municipal actor-network as explanatory variable.

The universe of instruments is very important in the capacity of action of a municipal actor-network. The main determinant of this universe of instruments is the problematization of the municipal question by the actor-network through the locality's identity and the municipal vision. Failing to present an inclusive locality's identity nor an ambitious municipal vision may represent an important weakness to any municipal actor-network. It is through these tools that it can enrol actors and places with substantial resources to allow it to engage in audacious or innovative initiatives. However, problematization could develop in different manners and contextual variables may have an important impact on the universe of instruments of a municipal actor-network. Existing problems, for example, never were a factor leading to proactivity. Nevertheless, it usually presses other actors to take position once an actor makes an issue of it. In fact, urgency may well be a catalyser of municipal actor-network development and the constitution of the universe of instruments. Other important factors are the initial diversity and reach – mainly in terms of scale – of the core actors. The presence at the centre of the municipal actor-network of members with access to other types of actor-networks gives them larger room for manoeuvre, possibly creating ad-hoc coalitions that will enlarge the universe of instruments of municipality.

In the cases we've studied we saw a mobilization of a large variety of tools developed in different "cultures" of planning: communication tools, advocacy tools, physical planning tools and place making tools. As in the "pastiche" trend dominant in planning (Dear, 2000), the municipal actor-networks do not hesitate to cumulate initially contradictory logics. In fact, they themselves are patchworks of actors with different skills and backgrounds. Here, the only concern is the capacity to act, and the dominant state of mind is pragmatism. In today's cities, where decentralization usually translates in an administrative fragmentation of urban agglomerations, we consider that the situation of the municipal actor-networks of Beirut's suburbs is far from being exceptional. Faced with the formidable challenge of articulating local dynamics with larger ones, the urban municipal actor-networks are the still trying to find their way, mainly by experimenting different tools. Decentralized cooperation has and still is largely contributing to the travel of tools and experimentations. This tendency will surely grow with the development at the national and international levels of forums and NGOs that work precisely on the dissemination of "good practices" between local actors. However, some tools are keener to be mobilized than others in particular situations, according to variables related to the municipal actor-networks' profiles.

The master plan tool most probably be used when the municipal actor-network core actors lack the needed resources to engage in their project. Its legal power has the advantage of presenting guarantees of stability to the enterprise, consequently, making of it a central tool for enrolling new strategic actors. At the opposite, a resourceful, large and diverse municipal actor-network may well discard the master plan tool. A municipality faced with pressures of providing rapid and effective solutions, will see the master plan track as time-consuming and a door for other "unwelcomed" actors to enter and impose "unnecessary" negotiations. In these cases, an ambitious, but clearly identified vision may well suffice. It defines the frame through which each actor in the actor-network will bring his contribution to the larger project. As for the real-estates' stock building tool it might well be somehow exceptional, requiring in order to be effective a very resourceful municipal actor-network capable of managing a complicated multi-step initiative (buying real-estates, building scenarios' portfolios and negotiating with donors), and discreet enough so not to jeopardize the whole operation. A municipal actor-network with centralized decision-making processes is needed to succeed to do so.

The question of experience is also central in the success of Bricolage planning. Two types of experiences are central here, that of the place and the people, and that of the issues and the tools. As we said before, the experience of the place and the people is linked to what Thévenot (1995) calls the regime of familiarity, and in our case the local actors. It is central to guide the municipal actor-network's action through the subtleties of the local. An actor-network that didn't succeed to enrol the proper local actors will have tremendous difficulty in acting in a certain place. The least it'll be facing is indifference, the worst, open resistance and sabotage. Knowledge of tools and professional experience is the other type of experience central to the success of municipal action, and it is usually a difficult one to achieve for municipal actor-networks with no reaches on other scales. This is why a municipal actor-network articulated to large partisan actor-networks has an important initial asset compared with other localized ones. However, less formal relations or affiliations in the case of localized networks, like those headed by family clans, could also play an important role. Access to specialized NGOs or development institutions may well provide the needed expertise. Experience is also something that could be constructed over time. Of course, municipal actor-network are faced with the pressure of elections and the need to produce results within municipal terms, which makes time a costly commodity. But, in some cases, where the electoral outcome is not directly dependent of municipal development performance, even marginal municipal actor-networks who can secure long-term in office might well have the time to learn and build their own experience. This explains for example how in Lebanon – where the disjunction of the geography of vote and geography of residence dissociates electoral politics and local development – we can observe, after twelve years of the first post-war municipal elections, a general increase of professionalization of the municipal action.

The articulation to the larger context is the central issue that pushes these actor-networks to pass from ad hoc development to bricolage planning. As we said earlier, the main challenges to the municipalities in building their territory and reclaiming their place as central actors in their localities, are on one hand incorporating the neighbourhoods and local actors' projects and concerns in their territorial construction and at the other articulating it with larger metropolitan and communitarian territorial constructions. It is clear that ad hoc development is a good way to incorporate local actors and places, since it allows the municipal actor-network by initiating development projects with them and in them. It even enables it to resist against larger territorialisation, by providing an alternative to this territorialisation or by mobilizing. However, the municipal actor-network will have to face sooner or later the question of urban planning. That can be the result of a gradual evolution, where success in executing multiple development projects is paving the way for a more integrated perspective. Or it can be the result of abrupt and important changes on other levels that may bring in considerable effects on the local level and impose on the municipal actor-network an overall reflection to deal with these challenges. This is mainly the case with the economic dimension that is not usually at the centre of municipal policy.

This evolution towards a larger strategic perspective does not necessarily mean that a viable municipal planning will consequently emerge on that level. First, planning is a more comprehensive exercise than development. It aims for the long-run; an articulation of different aspects of human life, towards "the greater good of the population". Consequently introducing new dimensions like participation, legitimacy and the articulation to other territorial scales, all new questions with their own stakes that the accumulated experience in urban development doesn't necessarily help to treat. Secondly, the margin of manoeuvre is limited for a municipal actor-network in dealing with well-established and organized actor-networks on the national level with large resources. In a situation of confrontation, the latter's wills will prevail in the long run, since they're capable of interesting local actors and destabilizing municipal actor-networks. Municipal planning is hardly a guaranteed outcome of ad hoc development.

Bricolage planning could furtherdevelop on an intercommunal level. Again here, the experience of the municipalities in Lebanon is interesting in that regard. To get a say on strategic issues, mainly economic ones, municipalities are creating or integrating municipal unions. In fact, in the last three or four years, a number of unions are engaging in studies and strategies for constructing a common territory based on territorial planning schemes where the economic dimension is central. This process is still in its first phases and it is too soon to comment it, but it is clear that it is largely in the continuity of the municipal revival in Lebanon. It builds on its experience, and is here to complement the shortcomings of the municipal actor-networks on the planning dimension. Time will tell of the fate of an intercommunal bricolage planning actor-network approach. This may well just be a headlong rush to escape the limitations of the municipal level, or just a rebound by municipal actor-network leadership seeking by the change of scale to restore stability in a actor-network wary of exhaustion, but that will ultimately be caught up by its structural limitations.

We surely have presented and commented here three sample cases, but in reality, we consider they represent the same central case, that of networks trying to restructure their urban environments and bring in development to their areas. Local divergences are surely important variables leading the municipal actor-networks on different tracks; but at the end we see clearly that the stakes are practically the same: linking a complex governance to a fragmented socio-spatial urban space, while securing the stability of the network and restructuring the urban landscape. All three samples have gone from problematization to generalization differently but, all the same, they all walked this bricolage planning path. In fact, this path is as ANT has shown that of every network trying to move into action and keep its stability.

As presented by different authors, urban planning practice seems largely domesticated by powerful interests ascepticized from any political dimension. Though we concur with the overall impression on the actual trends in the profession of planners, we believe that urban planning practice however, is on the contrary strongly repoliticizing. In fact, planning is more and more thought and developed by other actors than planners, actors that want to use planning to find their place in complex governance landscapes. Fragmentation has led to the multiplication of these actors, especially on the local level. Beirut's experience shows that these actors are capable of networking, experimenting and learning, moving to larger scale perspective even in extreme conflictual conditions. The bricoleurs of Beirut are hardly alone. Urban planning is indeed in reconstruction. Its renaissance may well be through the things that it tried long to escape: embracing politicization, small scale and fragmentation. Bricolage planning is indeed a step in that direction

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Part 2

Ecosystems and Urban Environment

Assessing Hydrological Elements as Key Issue for Urban Development in Arid Regions

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1. Introduction

In search of better livelihoods and facilities more people are moving towards urban centers. At present approximately half the world population resides in cities. Cities provide greater social and economic benefits to their inhabitants as compared to rural areas and this has resulted in massive demographic shift especially in the developing world which in turn has threatened the environmental stability.

According to the UN Reports, 2008, roughly 75 percent of the population lives in urban areas in the industrialized nations and will continue to grow at a rate of less than half a percent in the coming twenty years. On the other hand cities in the developing world will see about 95 percent growth in urbanization in the coming twenty years mainly due to migration, population increase and conversion of rural settlements into urban areas. A combined increase of this urbanization in the developed and the developing world will be that about 60 percent of the world's population will be living in cities by 2030.

Though cities occupy less than three percent of the world area, the high density of population and industrialization has resulted in severe environmental degradation. The worst environmental issues are faced close to the homes in the developing nations. They include inadequate domestic water supply, excessive waste accumulation and lack of proper hygiene and sanitation. The main reason for these environmental issues is that the infrastructural development has not kept pace with the increasing population. Other environmental issues associated with urbanization include severe air pollution, ground and surface water pollution, habitat loss, soil erosion, loss of bio-diversity and ecological disruption.

Arid regions of the world, especially those of middle-east Asia are not far behind as far as this demographic shift from rural to urban areas are concerned. The petroleum based economy of these regions have led to the springing up of major urban centers in countries like Saudi Arabia, United Arab Emirates, Oman, Qatar, Kuwait and Bahrain,(Bonine, 2009).

With proper planning and management cities can actually reduce pressure on the natural resources and increase energy efficiency. Innovative building designs, better waste management and improvement in transportation infrastructure can help in building sustainable cities. However often hydrological and climatological parameters such as the amount of rainfall, the volume of runoff generated, infiltration rates and drainage basin characteristics are neglected during urbanization process. These features are more commonly neglected in the arid regions mainly due to the lack of sufficient data which restricts the modeling capacity for extreme events. Topography is one important parameter which is not taken into consideration during town planning in these regions and instances of flash floods and water logging are becoming common due to such negligence.

Use of satellite imageries, digital elevation models, field observation and geophysical and hydrological investigations can help in reducing the complications related to urbanization in arid regions.

This book chapter focuses on the elements of hydrology which should be taken care of during urban planning and development with special emphasis on arid regions. A few case studies assessing the hydrological elements for urban planning have been cited as examples for arid region models.

2. Methodology

To implement the above mentioned tasks, the scientific methods adopted are mainly GIS based, confirmed with field measurements in the site under study. Nowadays the use of modern remote sensing technologies with the help of satellite imageries such as SRTM, SPOT 5, IKNOWS, QUICKBIRD, supply detailed coverage with resolution of 90, 20, 10 and 1 meter respectively. Digital Elevation Models (DEM) can be worked out to visualize in three dimensions, the topography and, drainage, flow direction and undulations on the topography of the area under study. An initial pilot visit to the area is needed to observe the major features of the area, the ground conditions including rock and soil type. Pounding areas and potential pounding areas to be figured- out and located. Analyses of collected topographic maps for identification of natural drainage of the site and the surrounding areas, and delineation of the catchments boundary are a necessary step in these procedures.

Collection of meteorological data (precipitation, temperature, evaporation, wind speed and directions) and topographic maps is an important aspect to evaluate the climate and hydrology of the area. This is followed by processing of collected data. The data are presented in tables and graphs. Mean, maximum and minimum of each variable are calculated. Rainfall distribution maps, frequency analyses, estimation of surface runoff are worked out. The maximum rainfall and run-off generated should be taken note of.

The above mentioned accomplishments are then subject to detailed desk study. The baseline data thus include: site overview plan, satellite image of the area, DEM, site topographic survey plan, and drainage network map.

The methodology involves carrying out detailed morphometric analysis of the basins within the area under study. Morphometric parameters such as basin shape and basin relief influence the nature of hydrographs and hydrological variables.

Based on the result of the hydrological processing identification of flow direction, flow accumulation and stream generation can be obtained and drainage channels can be classified into different orders using Strahler's 1964 classification. Other basin parameters such as basin area, basin perimeter, basin length and stream length are further used to obtain the different ratios such as Drainage Density, Bifurcation Ratio, Stream Frequency, Form Factor, Elongation Ratio, and Circulatory Ratio.

Ground surveys include essentially preparation of a geologic map of the area, showing the main structural elements of the earth that may affect the units of urbanization such as buildings, roads etc., and gathering information on the subsurface stratum to depth in the order of few meters to some 30 meters. The subsurface picture can be elucidated using geo-electrical techniques, (Reynold, 2011). A number of instruments are available to achieve this goal. Nonetheless the use of SYSCAL-Pro 72 unit proved to be very useful. Resistivity surveys using multi-electrode resistivity technique gave good results. Dipole-Dipole configuration with the unit electrode spacing ranging from 2.5 meters to 5 meters depending upon the ground clearance can be adopted. Dipole-Dipole configuration is selected for the survey as it gives the best horizontal resolution as compared to all the other methods present. RES2DINV Software, (Loke, 2002) can be used for inverting the apparent resistivity values to a resistivity model section. The least square fitting technique (Loke and Barker, 1996) is used for getting the best fit for the resistivity model by iterations.

Infiltration is another important hydrological element for urban development studies. Field measurements of both infiltration capacities and infiltration rates of the different soil types in the area are necessary to accomplish the hydrological picture of the water budget in the area, (Hopmans, 2011).

All these accomplishments and measurements, as mentioned earlier, should be GIS based so that the different layers can be compared and inter-layer relationships can be worked out. Based upon these relationships the area under study can be zoned according to hazard prone areas as far as hydrological elements are connected to urbanization.

3. Case studies

3.1 Delineating the wet/dry zones in the Qassim province of Saudi Arabia (Faisal K. Zaidi et al, 2010)

3.1.1 Introduction

Central Saudi Arabia experiences an arid type of climate with mean annual rainfall rarely exceeding 150 mm. The low rainfall has resulted in scanty vegetation in the region except for the wadis where farms and date palm plantations can be seen due to the availability of groundwater. However the chance of flash floods increases to a great extent due to lack of vegetation cover in the events of heavy rainfall.

The city of Buraidah which is the administrative capital of the Qassim province has undergone rapid urbanization in the recent years and due to lack of proper urban planning a lot of low lying areas and stream channels have been allotted to housing colonies. During the heavy rainfall in the month of November 2008 and March 2009, many such housing colonies in the low lying areas were inundated by flood water.

The stagnant water in the lakes became a threat for the environment by providing the breeding ground for mosquitoes and other water borne disease. Thus it was decided to drill a few bore wells in these manmade lakes with the dual purpose of recharging the aquifer and getting rid of the stagnant surface water thereby preventing environmental degradation.

Electrical Resistivity Survey was carried out at 4 locations (Figure 1) for investigating the depth of the wet zone in these localities. Based on the depth of the wet zones the approximate depths of injection bore wells were estimated.

Fig. 1. Location of the 4 localities in Buraidah, Qassim

3.1.2 Methodology

The resistivity survey was carried out using the multi-electrode resistivity technique. The surveys at all the 4 locations were carried out using the Dipole-Dipole configuration with the unit electrode spacing ranging from 2.5 meters to 5 meters depending upon the ground clearance using the SYSCAL-Pro 72 unit. RES2DINV Software, (Loke, 2002) was used for inverting the apparent resistivity values to a resistivity model section. The least square fitting technique (Loke and Barker, 1996) was used for getting the best fit for the resistivity model by iterations.

3.1.3 Results and conclusions

Site 1

The first site M1 was in the Buhairatil Khaleej, Figure 2, which is situated in the South of Buraidah City. The total line length of the survey was 360 meters with the unit electrode spacing of 5 meters using dipole-dipole configuration. The depth of investigation at this site was around 72 meters.

Fig. 2. Location map of Buhairatil Khaleej with the direction of the survey line

Result

Figure 3 shows the result of the resistivity survey. The resistivity values range from 7.07 ohm.m to 36.9 ohm.m.

Conclusion

The depth of investigation in the present case is about 72 meters. The resistivity value for the total depth of investigation does not show a very high contrast and in general is very low ranging from 7 ohm.m to 37 ohm.m. indicating the presence of a wet zone throughout the entire depth of investigation. However at a depth of about 30 meters from the surface the resistivity value increases indicating the presence of relatively dry zone. This boundary (Figure 4) can well be the contact zone between alluvium and weathered limestone as the site is situated in a stream channel. The 2 zones of relatively high resistivity shown in Figure 6 may be due to the presence of less weathered limestones.

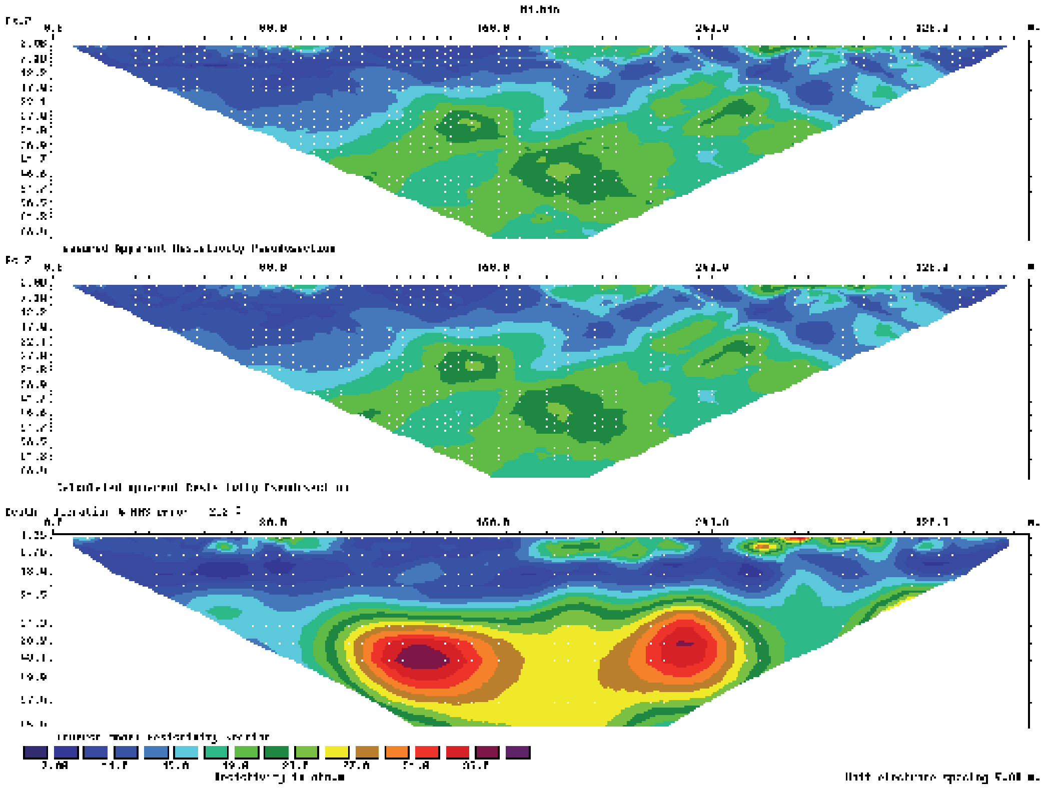

Fig. 3. Results of the resistivity survey at site M1

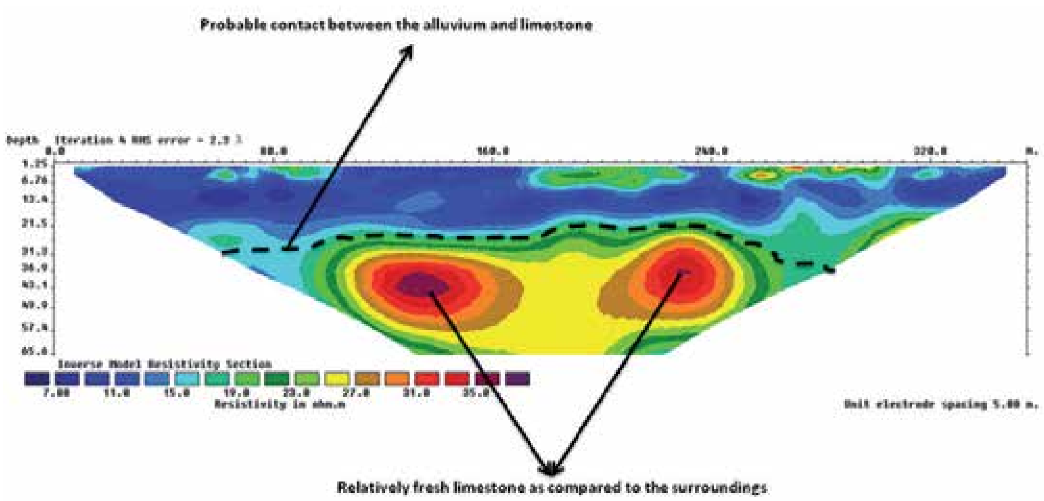

Fig. 4. Interpretation of the resistivity results at Site M1

Site 2

The second site M2 was in the Bohairatil Iskan Qadeema (Figure 5) which is situated in the Buraidah City Center. The length of the profile for this survey was 288 meters with the unit electrode spacing of 4 meters using Dipole-dipole configuration. The depth of investigation at this site was around 57 meters.

Fig. 5. Location map of Bohairatil Iskan Qadeema with the direction of the survey line

Result

Figure 6 shows the result of the resistivity survey carried out at Buhairatil Iskan Qadeema. The resistivity values range from 2.93 ohm.m to 7000.5.6 ohm.m.

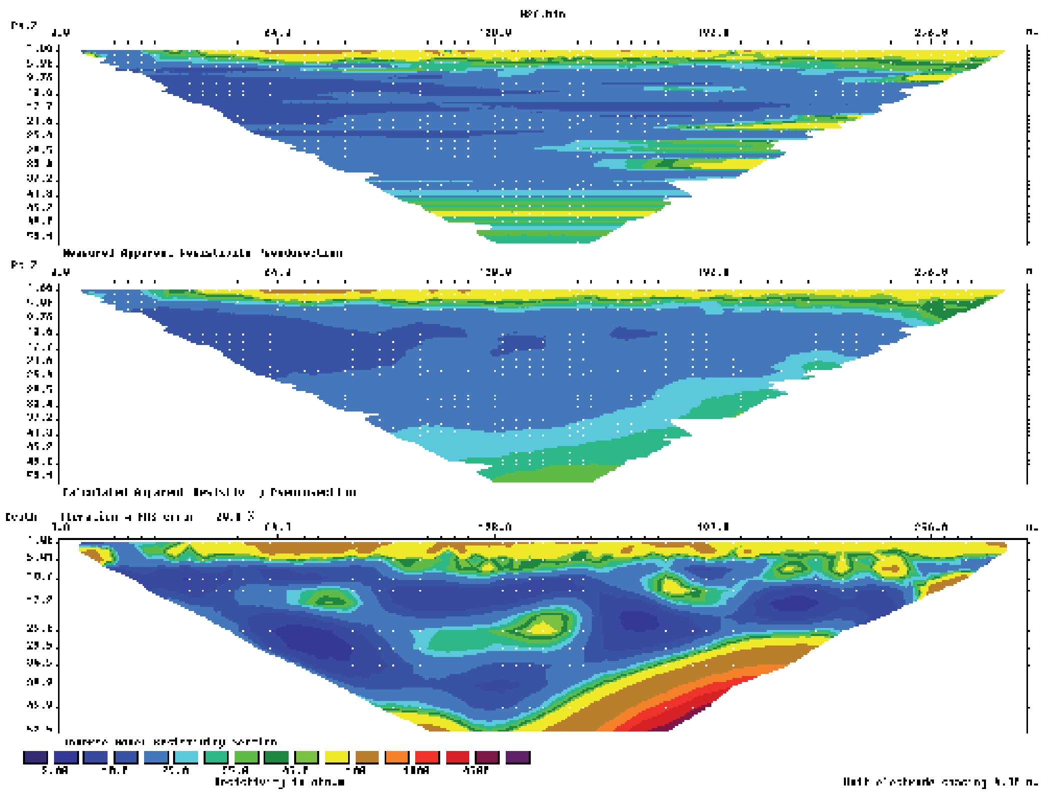

Fig. 6. Results of the resistivity survey at site M2

Conclusion

The results (Figure 7) clearly indicate the presence of an approximately 40 meters thick wet zone starting from 6 meters below ground level up to 46 meters below ground level. The resistivity values within this zone range from 2.93 ohm.m to about 30 ohm.m. The lake still had some water and this probably explains the presence of a thick wet zone. Bore wells drilled to a depth greater than 45 meters could be helpful in injecting the water collected in this lake during rains.

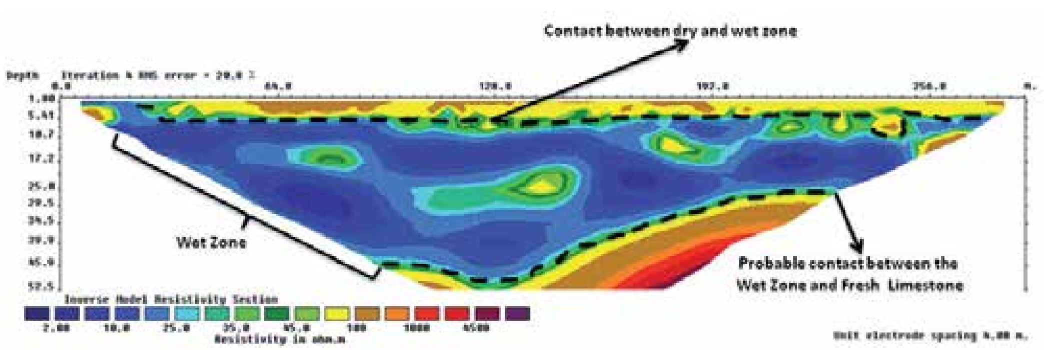

Fig. 7. Interpretation of the resistivity results at Site M2

Site 3

The third site M3 was in the Bohairatil Iskan Jadeeda (Figure 8) which is situated about 1 km North East of the site M2. The length of the profile for this survey was 288 meters with the unit electrode spacing of 4 meters using dipole-dipole configuration. The depth of investigation at this site was around 57 meters.

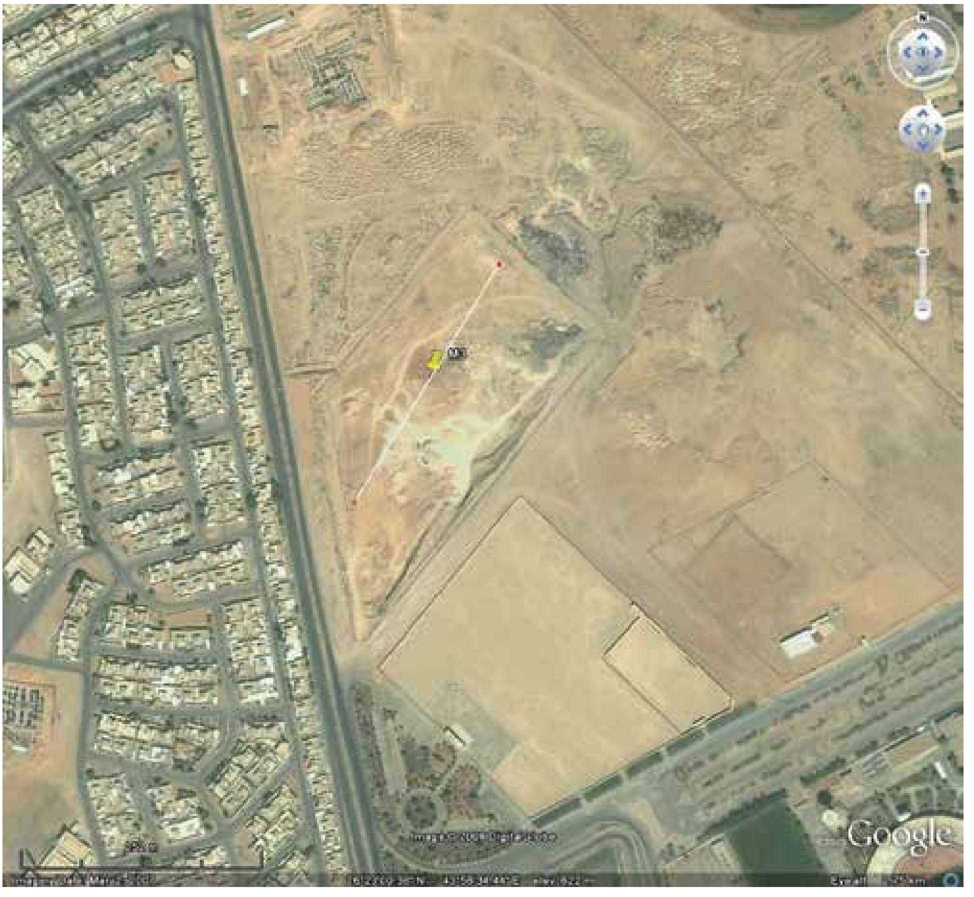

Fig. 8. Location map of Bohairatil Iskan Jadeeda with the direction of the survey line

Result

The cross sections of the lake walls showed the presence of weathered Limestones with calcrete infillings and the presence of folds. Figure 9 shows the result of the resistivity survey carried out at Buhairatil Iskan Jadida. The resistivity values range from 0.17 ohm.m to 2258.20 ohm.m.

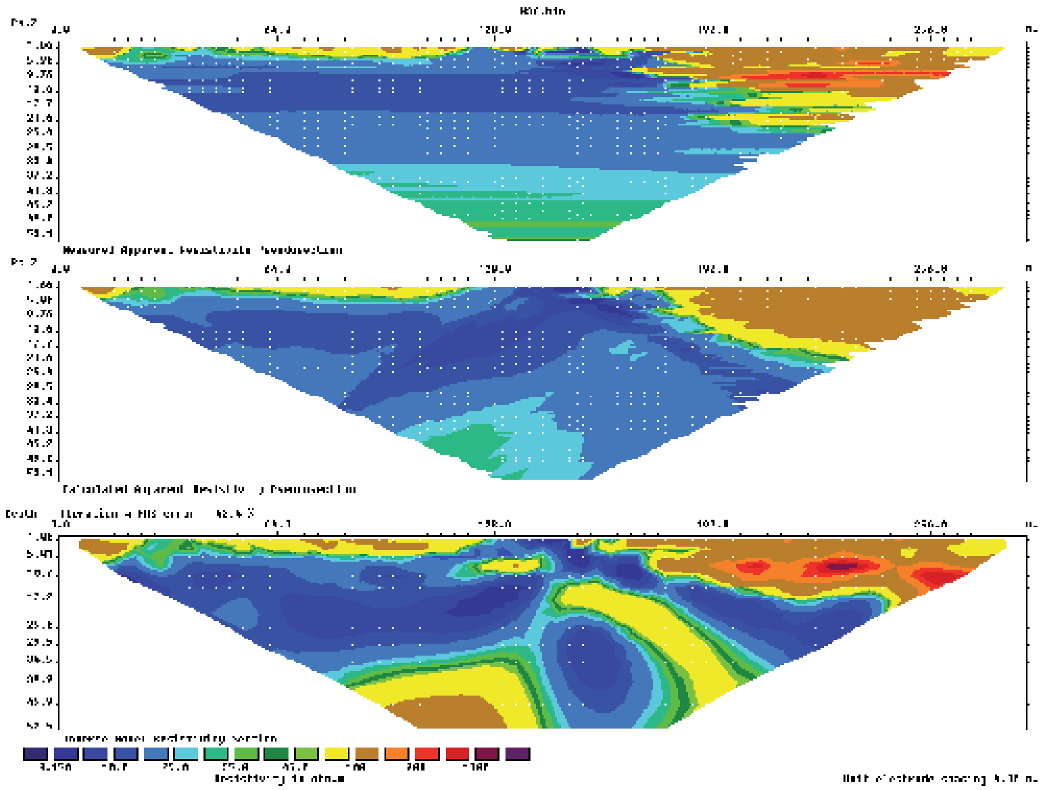

Fig. 9. Results of the resistivity survey at site M3

Conclusion

The wet zone thickness in the present locality is about 35 meters with some local variations as seen in the middle of the section where the wet zone extends up to the entire depth of investigation. This fact could be explained by the presence of structural features which might have resulted in partial weathering of the limestones thus resulting in varying degree of water saturation. The difference in water saturation around this zone is clearly reflected in the resistivity contrasts in the cross-section in figure 16. In the Eastern part of the profile some fresh limestone outcrops were present and it has been reflected in the form of high resistivity in the right side of the profile, (Figure 10). In general the wet zone thickness in the section varies from about 6 meters below ground level to about 40 meters below ground level. Injections well drilled to a depth of around 45 meters could solve the purpose of getting rid of excess water at this site.

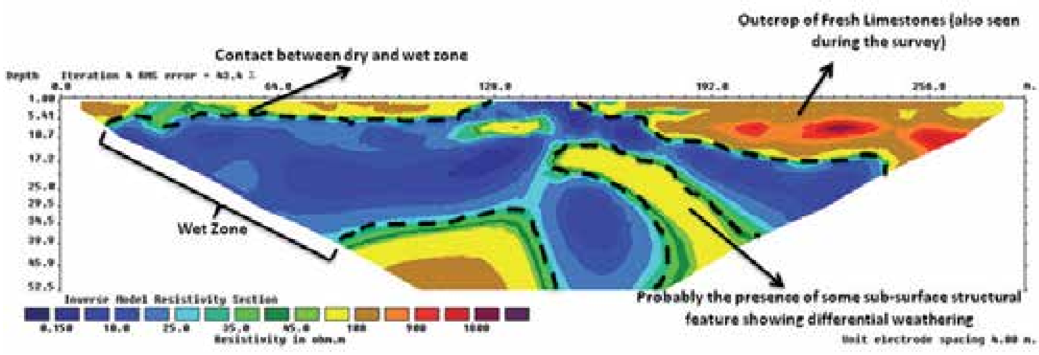

Fig. 10. Interpretation of the resistivity results at Site M3

Site 4

The fourth site M4 was in the Bohairatil Riyan (Figure 11) which is situated in the North Western part of Buraidah City. The total line length of the survey was 180 meters with the unit electrode spacing of 2.5 meters using dipole-dipole configuration. The depth of investigation at this site was around 36 meters.

Fig. 11. Location map of Bohairatil Riyan with the direction of the survey line

Result

The cross sections of the lake walls showed the presence of weathered limestones with calcrete infillings and the presence of nodal structures. Figure 12 shows the result of the resistivity survey carried out at Buhairatil Riyan Jadida. The resistivity values range from 0.81 ohm.m to 137.60 ohm.m.

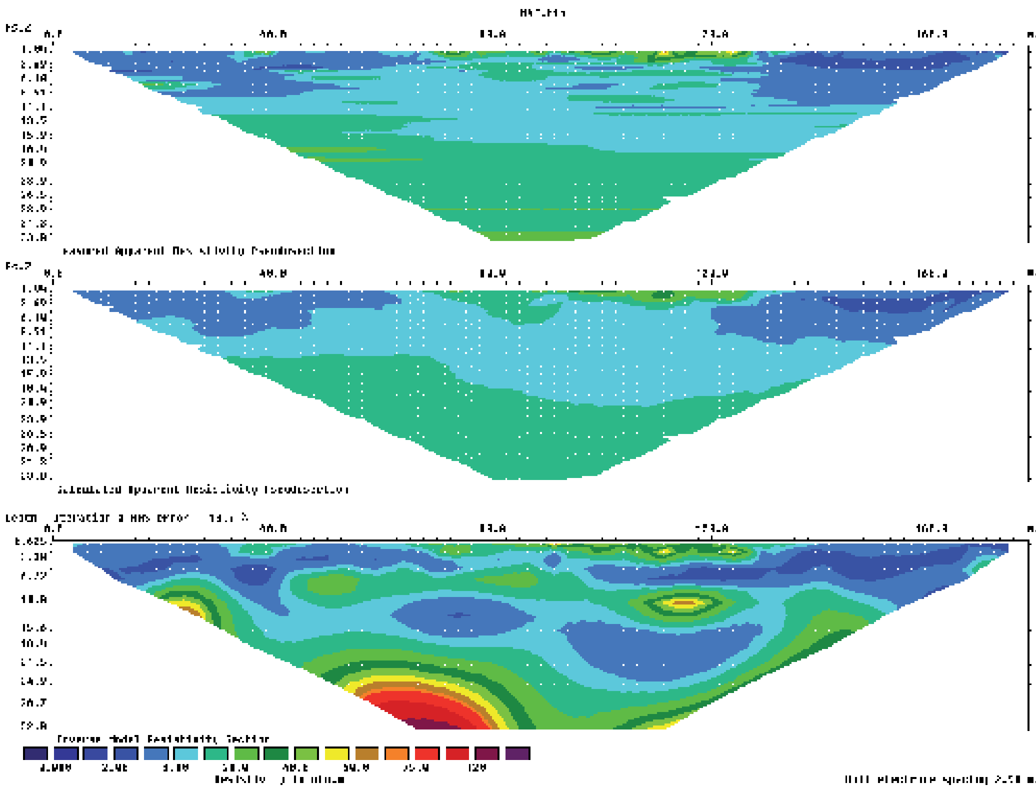

Fig. 12. Results of the resistivity survey at site M4

Conclusion

As mentioned earlier the resistivity values for this site ranges from 0.81 ohm m to 36.9 ohm.m. which is very low. In general the section shows the presence of wet zone through the entire depth of investigation. However the depth of investigation in the present case is limited only to 36 meters due to the unavailability of open space for laying the resistivity cables. On the lower left portion of cross section in Figure 13 the probable contact between the dry and wet zone is shown at about a depth of 25 meters. From the general depth of the dry zone in the previous 3 sections it can be concluded that drilling injections wells to the depth of about 45 meters may solve the purpose of getting rid of the excess water at this site as well.

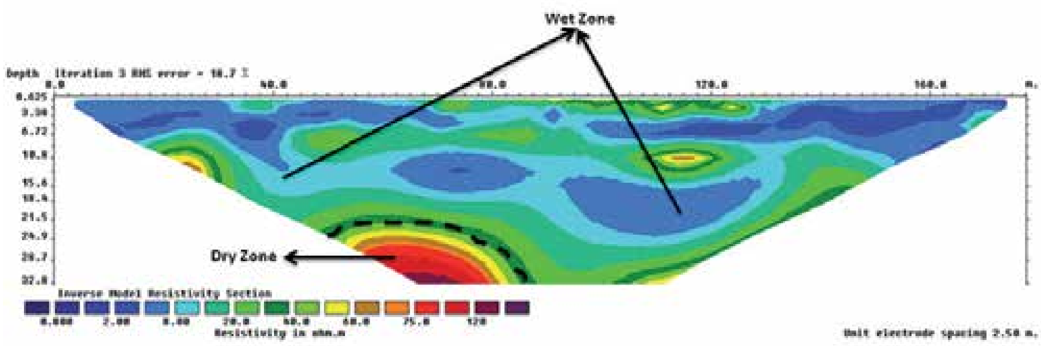

Fig. 13. Interpretation of the resistivity results at Site M4

3.1.4 Discussion

The probable presence of alluvium was detected only at the first site M1 at Bohairatil Khaleej with a sharp contrast in resistivity value at around 30 meters from the surface and is in accordance with the field observation which shows that this site is located in the course of a Wadi. The resistivity values are low at the other 3 localities as well indicating the presence of wet and weathered limestones. Presence of alluvium in these localities can be ruled out based on the exposed wall sections in the lakes which show beds of limestones intercalated with calcrete infillings. At the locations M2, M3 and M4 a contrast in resistivity values are observed at a depth ranging from 30 meters to 45 meters below ground level. It is recommended that wells drilled up to depths ranging from 45 meters to 55 meters in all the 4 localities can be efficient in getting rid of the excess rain water collected in these lakes during rainfall.

3.2 Assessing elements of surface hydrology for environmental quality characterization of a site northwest of Riyadh, Saudi Arabia (M. T. Hussein et al, 2009)

3.2.1 Introduction

Elements of surface hydrology, specially rainfall and surface runoff, are important factors in environmental quality characterization for urban development. In arid regions, these elements are difficult to forecast and may cause negative complications, especially in planning and design, if not been aware of. The study area under consideration lies within an urban center in the north west of Riyadh City, Saudi Arabia (Figure 14), between longitudes 46º 37´ 26" E- 46º 39´ 20" E, and latitudes 24º 45´ 00" N- 24º 46´ 45" N. The main purpose of this study was to workout elements of surface hydrology as part of an environmental assessment for urban development.

The tasks undertaken to achieve this purpose were:

- Review of the published topographical information to identify significant hydrological features such as, current and historic stream flow paths and potential ponding areas.
- Review of the already existing infrastructure to identify significant features such as culverts and any potential surface flow restrictions.

- Collate and review any existing data relevant to the site and the immediately surrounding area were reviewed and collated. This included but was not limited to ground conditions, meteorological records, historic records and/or photographs of flooding or pounding.
- Site visit to assess broad surface hydrology.
- Identification of relevant standards and guideline values.
- Identification the approximate extent of catchments contiguous with the site, and estimate the approximate flow rates, flow directions and pounding levels in typical and severe rainfall events.

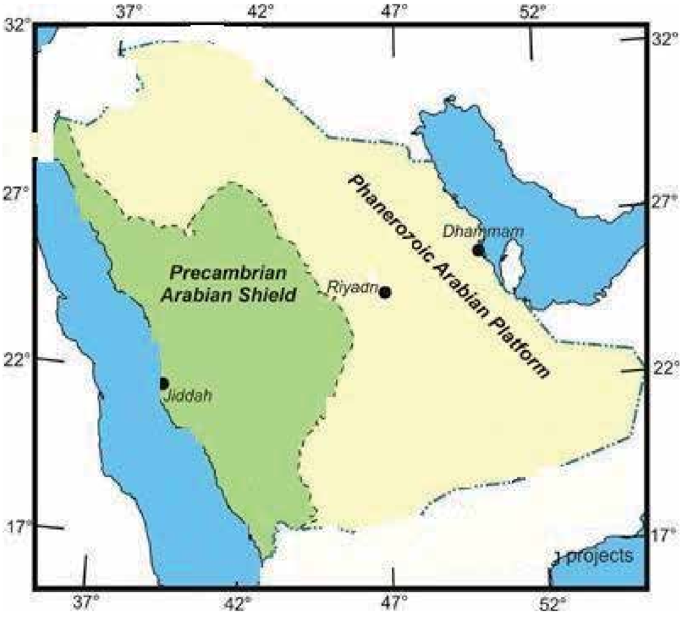

Fig. 14. Location map of the study area

3.2.2 Methodology

A field visit to the site was made, in which the boundaries of the study area was walked over and major features on the area were noticed, ground conditions including rock and soil type were identified. Ponding areas and potential ponding areas were figured- out and located. Meteorological data (precipitation, temperature, evaporation, wind speed and directions) and topographic maps were collected. The meteorological data were then treated for statistical analysis

The collected topographic maps and data were used for the identification of natural drainage of the site and the surrounding areas, and delineation of the catchments boundary.

The above mentioned accomplishments were subject to detailed desk study, and data analysis. The acquired data were analyzed and presented using Microsoft EXCEL, Global Mapper V. 6 (Global Mapper Software LLC), and WMS V. 7 (Environmental Modeling Systems, Inc.) GIS V. 8 (ESRI).

Site description

The site is comprised of three blocks and it is bounded to the east by the Riyadh-Al Qassim highway and to the south by the North ring road. To the north and west, the site is bounded by residential areas.

The Jurassic Arab Formation limestone underlies most of the site (Vaslet et al., 1991). Unconsolidated deposits of silt, sand and gravels are observed on the wadies. The only hydraulic connections in between the site and its surroundings are the culverts under the roads surrounding the area. Dumped fill material and construction debris covers about 3% of the site area.

3.2.3 Results

Field observations

GPS locations, types, dimensions of all culverts within the project site were measured (Table 1). The coordinates were measured by a hand held Garmin GPS and are reported in degrees, minutes, and seconds. The culverts in the site include three types: multispan box, double tube and single tube pipe culverts. Table 2 shows locations, and dimensions of existing ponding areas in the site and potential ponding areas.

Culvert No.	Coordinates		Culvert Type	Dimensions	Location	Remarks
	Latitude	Longitude				
1	24.76898	46.74325	Multispan box (3)	18X1.25 m	Block A	in
2	24.76843	46.64344	Single pipe	0.9 m	Block A	in
4	24.76392	46.64519	Single pipe	0.9 m	Block A	in
5	24.75934	46.64331	Single pipe	0.9 m	Block A	in
9	24.75852	46.64165	Single pipe	0.9 m	Block B	in
6	24.75905	46.63718	Multispan box (3)	7.4X1 m	Block A	out
7	24.76052	46.63682	Multispan box (5)	22.1X 1.4 m	Block A	out
8	24.77024	46.63979	Double pipe	2.0X0.8 m	Block B	in
3	24.76792	46.63875	Single pipe	0.8 m	Block A	in

Table 1. Culvert types and dimensions

Coordinates		Approximate Dimensions	Location	Remarks
Longitude	Latitude			
24.76898	46.74325	20X40 m	Block A	wet
24.76354	46.64509	22X30 m	Block A	dry
24.75866	46.64159	20X25 m	Block A	Partially wet
24.75856	46.6416	30X35 m	Block A	dry
24.75939	46.63317	15X20 m	Block A	dry

Table 2. Pounding and potential pounding areas

Catchment area and drainage analysis

Catchment area and drainage analysis of the study area were depicted with the help of published topographic maps (sheet 4624-14), SPOT 4 image and DEM analysis.

Analysis of DEM of the area show that the western part topography is land marked by part of Wadi Hanifa Escarpments, high lands occur towards the north east of the study area (Figure 15).The southern part occupies the relatively lower most elevations in the study area. Within the study area the general slope is towards the south (0.02). Drainage analysis of the study area shows four sub dendritic systems that drain towards the south and finally joining Wadi Hanifa (Figure 16).

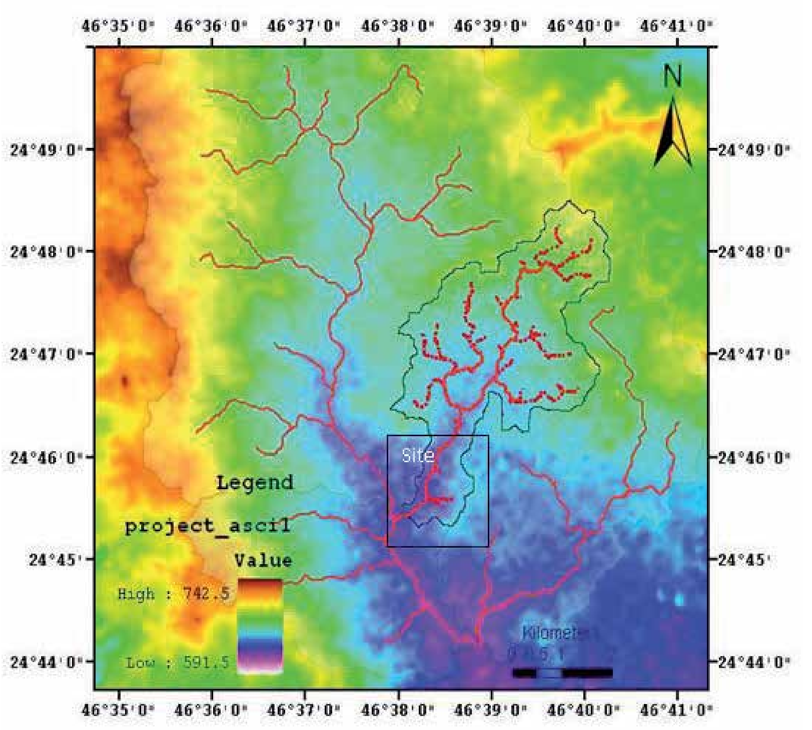

Fig. 15. Topography and general drainage systems of northwest Riyadh

The site of the present study lies in the downstream of the middle sub catchment. This sub catchment (Figure 4) covers a surface area of about 11.25 km2. The stream length within the site varies from 68.29 to 686.16 m with an average of 396.23 m. Within the site the stream slope varies from 0.0009 to 0.016 with an average of 0.00632 (Table 3).

The site represents the trunk of the sub catchment under consideration. All calculations of surface hydrology are based on the surface area of this catchment (Figure 17).

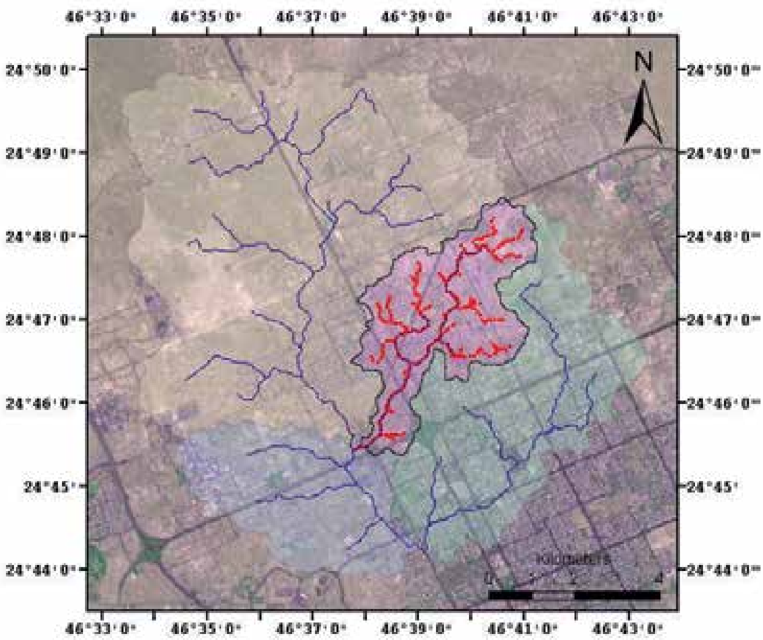

Fig. 16. The four sub drainage systems and their catchments areas.

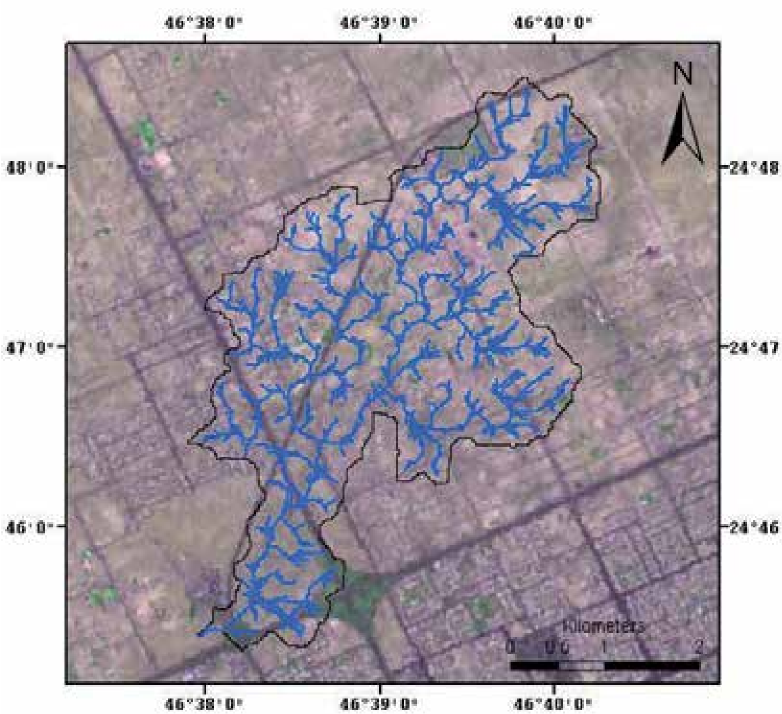

Fig. 17. Detailed drainage system of the site and its surroundings.

Area (km2)	11.26
Slope	0.02
Shape Factor	3.87
Sinuosity	1.18
Perimeter	27369.96
Mean elevation (m)	649.47

Table 3. Sub basin characteristics

Climate

Climate is characterized by a very hot summer, mild winter and little irregular rain with much variation in quantity. In general Riyadh area is influenced by the Mediterranean winter, precipitation and by local factors, such as the relief and distance from the sea. During winter time (November-February) the middle latitude cyclones tend to travel from the Mediterranean Sea towards the equator and then travel inland reaching the Najd Plateau. Monsoonal rains are caused by the tropical type cyclones in the Indian Ocean and travel over the Red Sea. The coldest month is January. Summer extends from sometime in April to the beginning of September (PME, 2005).

Rainfall

In Riyadh area the amount of rainfall is irregular through the years and through the months. Winter and spring is the rainy season, there is almost no rain between May and September.

Average monthly rainfall for the period 1985-2005 is shown in Figure 18. Rain occurs mainly in November-January, through February and relative higher quantities of some 25 mm occur in March and April period. Less than 3 mm may occur during the month of October. The amount of rainfall is extremely variable from year to year and from month to month. Annual rainfall rarely exceeds 125 mm (PME, 2005).

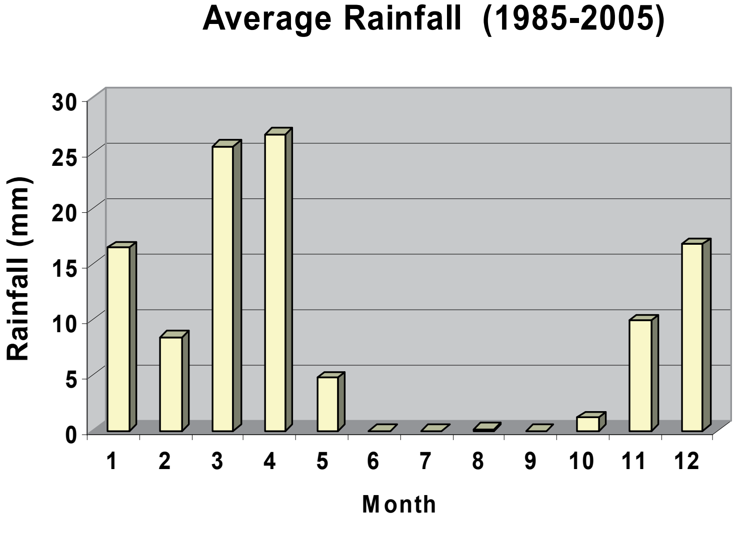

Fig. 18. Average total monthly rainfall

The maximum total daily rainfall records at King Khalid Airport station is shown in Figure 19: Maximum daily total rainfall The maximum recorded daily rainfall was 47.8 mm and it was on December, 20th 1995. The minimum was 25.4 mm and was recorded on April, 11th 1991.

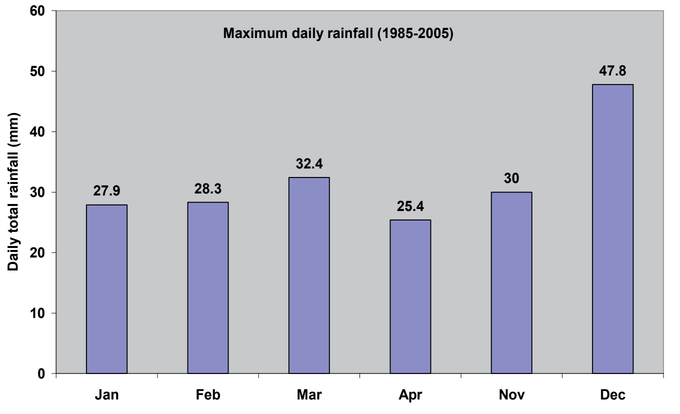

Fig. 19. Maximum daily total rainfall

Air temperature

The maximum air temperatures are reached during summer (June, July, and August) and minimum temperatures are attained during winter (December and January). Air temperature ranges from 8◦ C in winter to some 43◦ C in summer (Figure 20). The average monthly temperature is in the range 14.1◦ C to 43◦ C. The annual average temperature is 24.6◦ C. The coldest month is January while the hottest months are June, July and August.

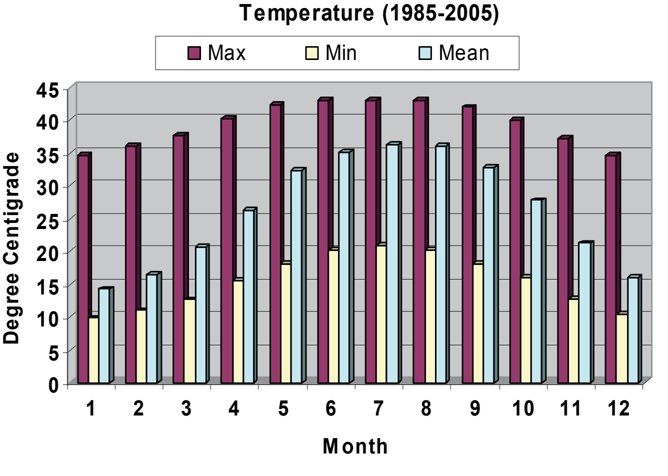

Fig. 20. Minimum, maximum, and average monthly temperature.

Relative humidity

Since Riyadh city is located on the Najd Plateau, away from any water body, the relative humidity is very low. The Average values for relative humidity ranges from 19.5% in June and 52.5% January (Figure 21). Annual average relative humidity is 34.4%. These values reflect very dry or hyper arid climate.

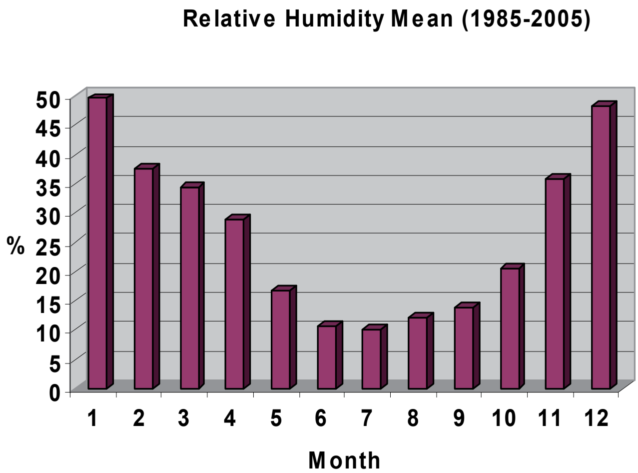

Fig. 21. Average monthly relative humidity

Solar radiation

Solar radiation is an important factor that influences evaporation in the area. In Riyadh area the monthly solar radiation ranges from 328 cal/cm2 per day (January) to 597 cal/cm2 per day (June). Cloudness ratio is 0.721 (January) to 0.765 (June). The average annual value for solar radiation is 477 cal/cm2 per day.

Wind

Mean monthly speed value ranges from 3.8 km/hr in October to some 6.8 km/hr in July. In March it reaches its maximum at some 6.9 km/hr. The average annual wind speed is 5.1 km/hr. The prevailing wind directions are primarily North and Northeast (Figure 22 and Figure 23).

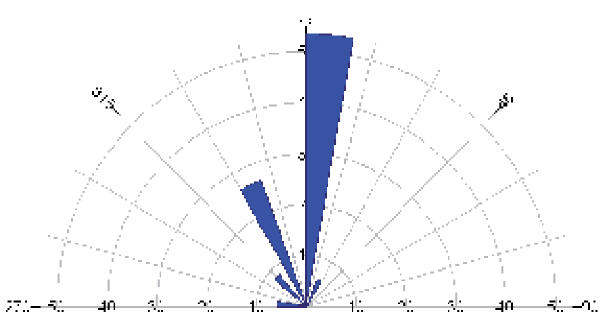

Fig. 22. Prevailing wind direction (Years 1985-2005)

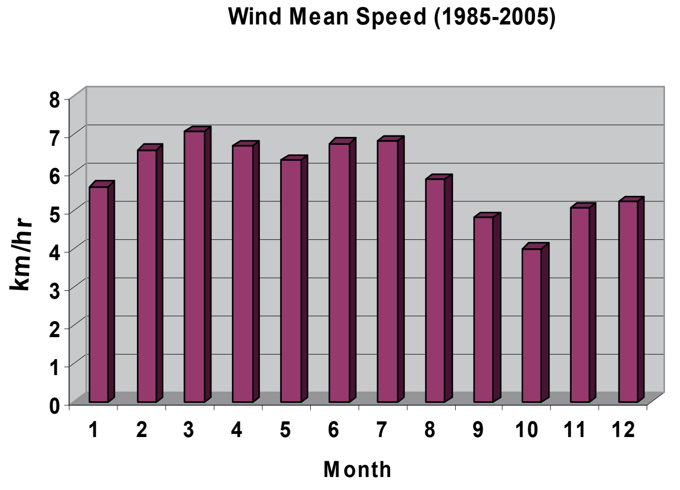

Fig. 23. Average monthly wind speed

Evaporation

Pan evaporation rates are very high in Riyadh throughout the year (Figure 24). Annual average evaporation has been measured at King Khalid Airport station as 2910 mm. During rainy months of December, January, February, March and April, rainfall exceeds evaporation.

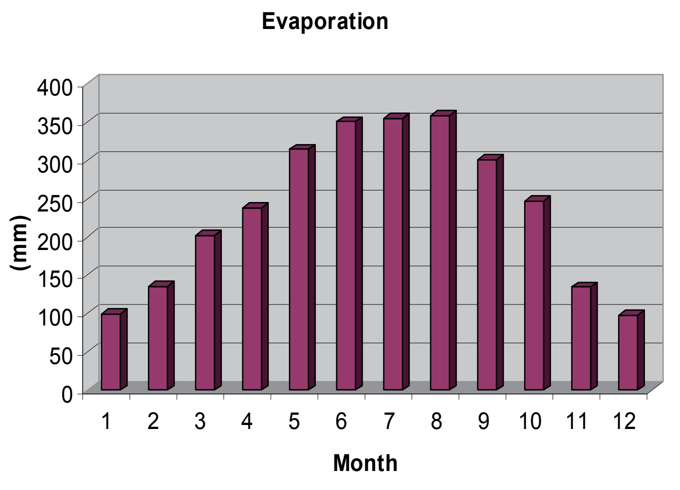

Fig. 24. Evaporation (1985-2005)

Runoff

Surface runoff in the site was calculated by the Rational Method (U.S. Soil Conservation Service, 1964; Chow et al., 1988; McCuen, 1998; Willson, 1990; McCuen, 1998). The Rational method is used primarily for computing peak flows for small urban and rural watersheds.

This Rational formula is characterized by consideration of the entire drainage area as a single unit, estimation of flow at the most downstream point only, and the assumption that rainfall is uniformly distributed over the drainage area. The Rational Formula is as follows:

$$Qp=0.278\ C*I*A$$

where:

Qp = Peak runoff rate(m^3/sec)
C = Runoff coefficient (dimension less)
I = Rainfall intensity (mm/hr)
A = Drainage area (km^2)

The Rational Formula follows the assumption that:

the predicted peak discharge has the same probability of occurrence as the used rainfall intensity (I), the runoff coefficient (C) is constant during the rain storm and the recession time is equal to the time of rise.

Peak runoff rates have been calculated by the Rational Formula using the maximum total daily rainfall records for the period 1985-2005 (PME, 2006). The runoff coefficient, (C) was taken to be equal to 0.75 corresponding to residential area/business area/asphalt streets. The total daily rainfall was converted into rainfall intensity (I) in mm/h. The results of calculation are shown on Table 4.

Month	Rainfall (mm/day)	Rainfall intensity (mm/h)	Peak runoff (m3/sec)
Jan	27.9	1.16	2.73
Feb	28.3	1.18	2.77
Mar	32.4	1.35	3.17
Apr	25.4	1.06	2.48
Nov	30	1.25	2.93
Dec	47.8	1.99	4.67

Table 4. Peak runoff rates for maximum daily total rainfall Period (1985-2005)

According to maximum total daily rainfall record reached on December 20th 1995 at 47.8 mm/day, the peak runoff has been calculated using the rational formula to be 4.67 m3/sec.

Assuming higher values of rainfall storms at 2.5 mm/h and 5 mm/h, recalculation of peak runoff under these assumed conditions will be as shown in Table 5:

Rainfall Intensity (mm/h)	Q, peak flow (m3/sec)
2.5	5.86
5	11.73

Table 5. Peak runoff assuming high values of rainfall

3.2.4 Conclusions and recommendations

The assessment of topography, drainage and meteorological data of the in northwest of Riyadh City in Saudi Arabia showed that the site represents the mouth of a catchment area that drains towards the main course of Wadi Hanifa. The surface area of the catchment was found to be about 11.2 km2 with an average slope of 0.02. The analyses of the flow path indicated that the flow is towards the southeast. The climate is characterized with a very hot summer, mild winter and little rain. The prevailing wind direction is towards the north and northeast. Total rainfall data showed that the maximum daily rainfall for the period 1995-2005 was 47.8 mm. Peak runoff was calculated using the Rational formula to range between 4.7 and 11.73 m3/sec.

Based on the results of this study, hydraulic design of storm water drainage system should take in consideration that almost all of storm water will flow through the middle of the site. This study forms a small model showing the importance of characterizing hydrological elements as part of a comprehensive environmental analysis for future urban planning. Historic meteorological data and particularly rainfall, estimation of peak runoff integrated together with satellite image interpretation and digital elevation model are important for any detailed urban design.

3.3 Identification of areas prone to hydrological hazards in Riyadh city, Saudi Arabia (Faisal K. Zaidi, et al, 2011)

3.3.1 Introduction

Saudi Arabia is one of the most arid regions of the world however this has not prevented it from the growth of big cities along the coasts like Jeddah and Damam and along the ancient Wadi system such as Riyadh, Madinah and Makkah. Though the average annual rainfall in Saudi Arabia is only about 100 mm/year,(PME, 2005), it is not free from hydrological hazards especially in the big cities like Jeddah and Riyadh mainly due to rapid urbanization which has led to the development of housing colonies in topographically low lying regions and obstruction of the natural drainage systems. The flood hazards in the city of Jeddah in November, 2009 as result of heavy rainfall and blockage of natural drainage system is a good example in the recent times.

The present study focuses on the city of Riyadh, (Figure 25) which has grown rapidly over the past few years and can be subjected to flooding hazards in events of heavy rainfall. The objective of the study is to identify the areas in Riyadh city which may be prone to such hydrological hazards.

Riyadh city has grown from an area of 1 km2 in 1901 to about 2435 km2 in 2010, (www.arriyadh.com). The population of the city is about 4.8 million. The temperature varies from 43° C in July to about 8° C in January. The overall climate of the city is arid with average annual rainfall not exceeding 105 mm/year, (PME, 2006). The city is typically bordered by a complex system of valleys (known as wadis in local language) along its western limits. The average elevation of the city is about 690 meters above mean sea level with the main drainage following a Northwest-Southeast pattern and is typically controlled by the Najd Fault system, (Powers et al, 1966).

3.3.2 Methodology

The methodology involved carrying out a detailed morphometric analysis of the basins within the Riyadh city. Morphometric parameters such as basin shape and basin relief influence the nature of hydrographs and hydrological variables. Drainage basin morphometric analysis of the study area was carried out using the SRTM DEM data, (http://srtm.usgs.gov/data/obtaining.html). The DEM from SRTM is available on 90 m by 90 m spatial resolution. The DEM was treated before it was subjected for hydrological processing in GIS.

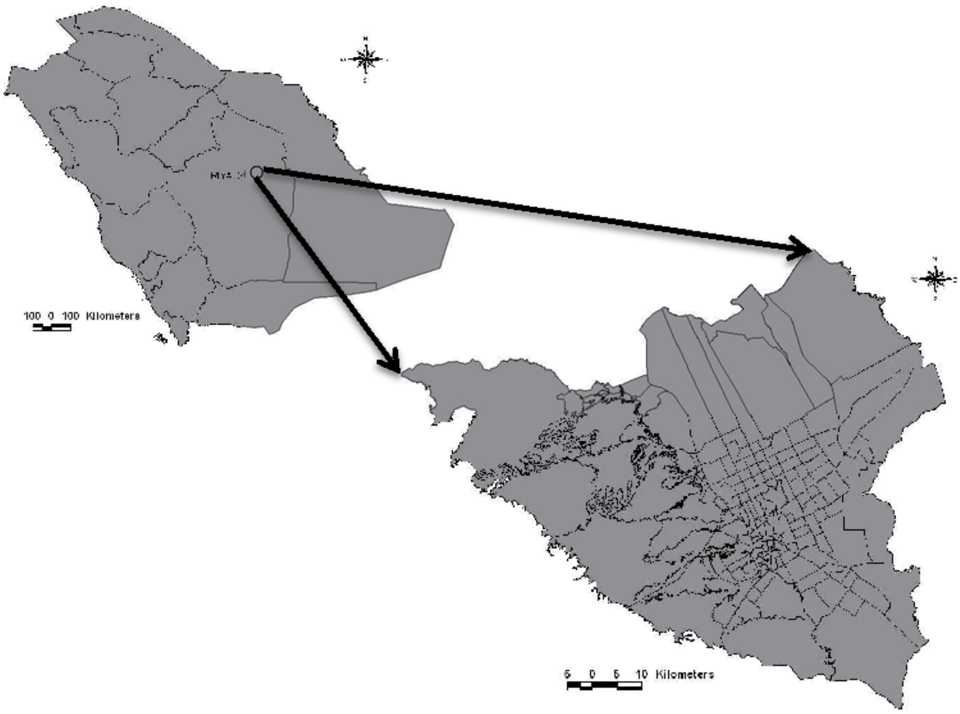

Fig. 25. Location of Riyadh city (study area) within Saudi Arabia

Based on the result of the hydrological processing which involved the identification of flow direction, flow accumulation and stream generation, (Figure 26), the Riyadh city was divided into two basins which are identified as the Hanifa Basin and Sulay Basin, (Figure 27). The drainage channels were classified into different orders using Strahler's 1964 classification. Other basin parameters such as basin area, basin perimeter, basin length and stream length were obtained which was further used to obtain the different ratios such as Drainage Density, Bifurcation Ratio, Stream Frequency, Form Factor, Elongation Ratio, and Circulatory Ratio.

3.3.3 Results

Based on the results of the hydrological processing, the DEM of the study area was divided into two basins namely the Hanifa basin which trends in a Northwest-Southeast direction and lies in the western part of the study area and the Sulay Basin which trends in a more or less North-South direction. Hanifa basin occupies an area of 4199.51 km2 whereas the Sulay basin has an area of 1514.43 km2 .The various morphometric parameters for the two basins were calculated and have been discussed in the following sections, (Table 6. Figure 28 shows the two basins with the stream patterns and the city of Riyadh.

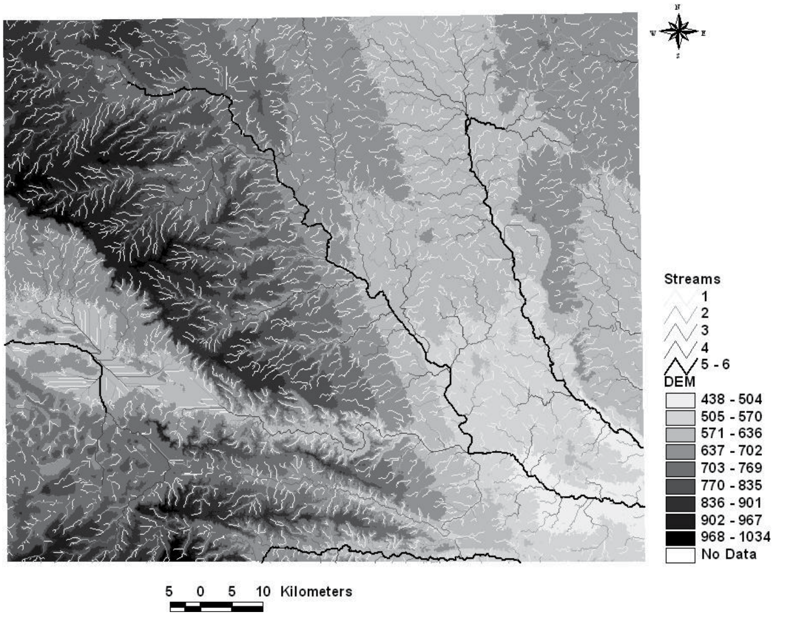

Fig. 26. DEM and the streams in the study area

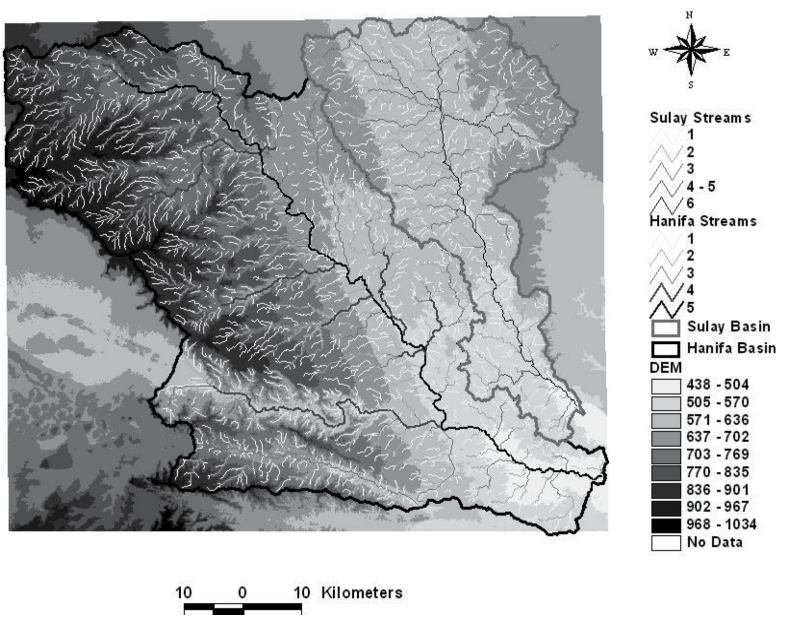

Fig. 27. Hanifa and Sulay Basins

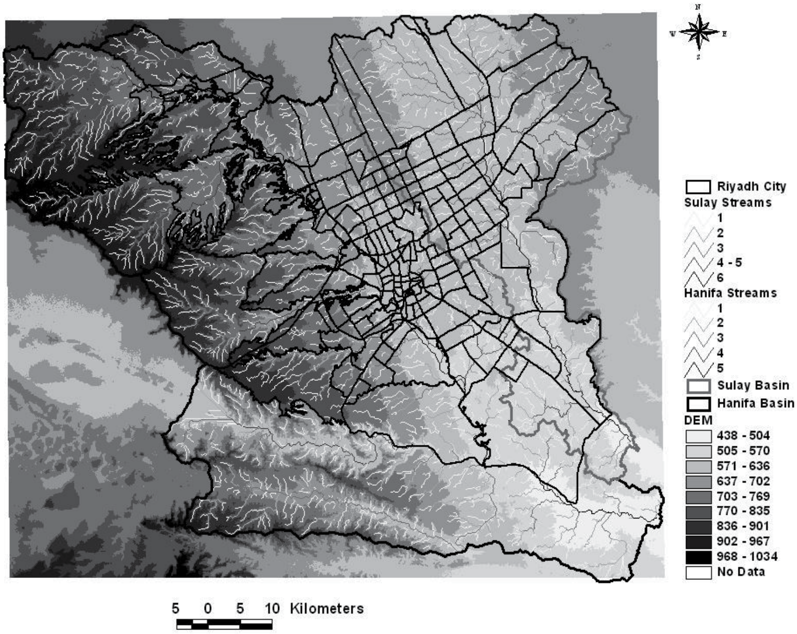

Fig. 28. Extent of Hanifa and Sulay Basin and the city of Riyadh

Drainage density

Drainage Density is the ratio of the total stream length in a given basin to the total area of the basin, (Strahler. 1932, 1945). The drainage density of the Hanifa Basin is 0.88 km/km2 as compared to 0.92 km/km2 for the Sulay Basin.

Bifurcation ratio

Bifurcation Ratio for the Hanifa basin is 6.45 where as it is 3.38 for the Sulay basin. Bifurcation ratio is the number of streams of any given order to the number of streams in the next higher order, (Horton, 1932). A high bifurcation ratio indicates more chances of flooding as water from different channels tend to accumulate in a single channel rather than spreading out.

Stream order

Strahler's, 1964 system was taken for the stream ordering. The number of streams gradually decreases as the stream order increases. Hanifa basin is a 5th order basin whereas the Sulay basin is a 6th order basin.

Stream length

The total stream length for the Hanifa basin is about 3700 km whereas the total stream length for Sulay basin is about 1390 km. The length of stream is maximum in case of first order in both the basins.

Basin	Hanifa	Sulay
Area (km2)	4199.51	1514.43
Total Stream Length (km)	3707.55	1389.71
Drainage Density(km/km2)	0.88	0.92
Total number of Streams	1651.00	630.00
Stream frequency	0.39	0.42
Drainage Texture	0.35	0.38
Bifurcation Ratio	6.45	3.58
Length (km)	125.50	76.50
Basin Perimeter (km)	410.68	289.52
Ht Max (mts)	1033.00	714.00
Ht Min (mts)	438.00	484.00
Basin Relief (mts)	595.00	230.00
Form Factor	0.26	0.46
Elongation ratio	0.58	0.57
Circulatory Ratio	0.31	0.23
Slope (%)	6.60	2.30
Relief Ratio (m/Km)	3.30	2.29

Table 6. Morphometric parameters of Hanifa and Sulay Basins

Stream frequency

Stream frequency is the ratio of the total number of stream segments of all the orders in the basin to the total area of the basin, (Horton, 1945). The stream frequency for the Hanifa Basin is 0.39/km2 and 0.42/km2 for Sulay basin. The stream frequency is dependent on the rainfall and the temperature of the region.

Basin length

Basin length is the longest length of the basin from the head waters to the point of confluence, (Gregory and Walling, 1973). Hanifa basin has a length of 125.50 km and Sulay basin has a length of 76.50 km.

Form factor

Form factor is the ratio of the basin area to the square of the basin length. The form factor varies inversely to the basin length. Circular basins have a form factor close to 1. The form factor for Hanifa basin is 0.26 and 0.46 for Sulay basin indicating the presence of elongated basins which is quite evident from the Figure 3.

Elongation ratio

It is the ratio of the diameter of a circle having the same area as the basin to the basin length. The elongation ratio for the Hanifa Basin is 0.58 whereas it is 0.57 for the Sulay Basin. The elongated shapes of the basins are a result of the guiding effect of thrusting and faulting in the basin, (Vaslet et al, 1991).

Circulatory ratio

It is the ratio of the basin area to the area of the circle having the same perimeter as the basin. The circulatory ratio for Hanifa basin is 0.31 and the circulatory ratio for Sulay Basin is 0.23. This factor is influenced by the lithological characteristics of the basin

Slope

The Hanifa basin shows a high relief ratio (3.30 m/km) and has an average slope percentage of 6.6 as compared to Sulay Basin which has a relief ratio of 2.29 m/km and an average slope percentage of 2.3. The results clearly suggest that Hanifa basin has a more rugged terrain as compared to Sulay basin.

3.3.4 Discussion

Arid areas are susceptible to flash floods mainly due to the lack of vegetation. Urbanization in such areas has further aggravated the problem, especially where human interference has obstructed the natural drainage pattern. Furthermore in arid regions it is difficult to predict the rainfall and surface run off characteristics and may cause negative complications during urban planning, (Hussein et al, 2008). This is true for most of the cities in arid regions such as Riyadh.

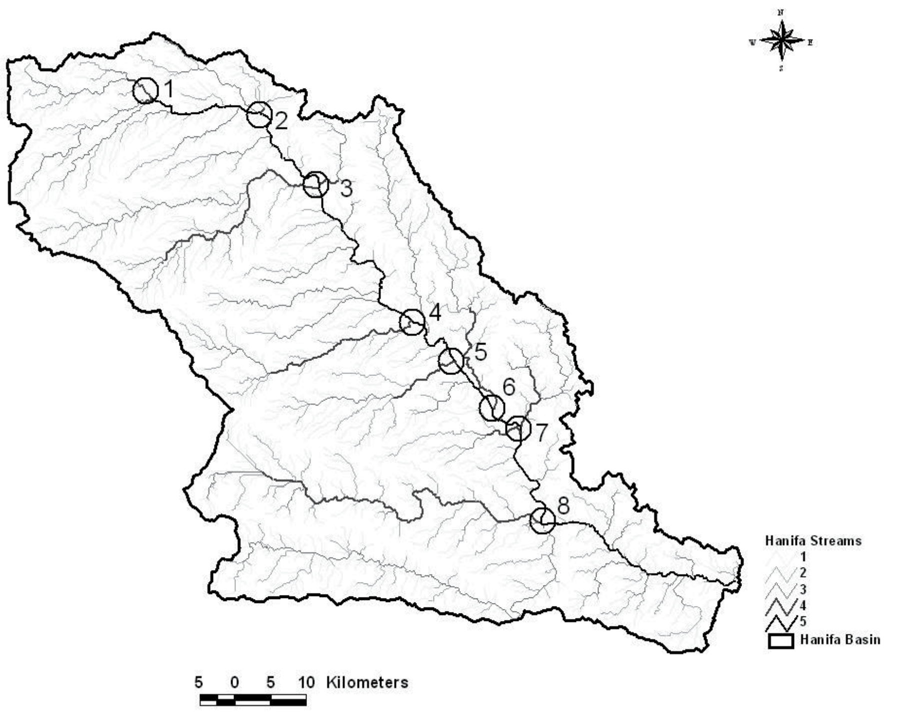

Fig. 29. Areas prone to hydrological hazards in Hanifa basin

As shown from the results above the Hanifa Basin is more important from the point of hydrological hazards mainly because of the large basin area as compared to Sulay basin.

This implies that during the same intensity of rainfall in the region, water in the Hanifa Basin will be collected from a larger catchment as compared to Sulay Basin, thus bringing a greater volume of water to the main drainage. Secondly the Hanifa Basin has a more rugged topography as compared to Sulay basin, (see Figure 27 and Table 8) which means the velocity of the water will be much higher. Third and most importantly the bifurcation ratio of Hanifa Basin is much higher as compared to Sulay Basin, (Table 8). This is true specially for the 5th order streams which clearly means that more number of 4th order streams meet at different points to form a 5th order stream in Hanifa Basin, (Figure 28). From the perspective of hydrological hazards a high bifurcation ratio increases the chances of flooding as water from a given stream order, rather than spreading out when they meet the stream of the next higher order, tend to accumulate in one place.

Based on this observation, all the 4th order sub-basins of the Hanifa basin have been identified and demarcated (Figure 29). The mouth of these basins are the potential sites for hydrological hazards in case of heavy rainfall and should be carefully monitored during the rainy seasons in the region to prevent damage to life and property.

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8

Rainwater Harvesting in Large Residential Buildings in Australia

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1. Introduction

Australia is one of the driest inhabited continents, with highly variable rainfall. A growing urban population and frequent droughts in recent years have made water supply a major issue in Australia. A number of alternative water sources have received attention in Australia including rainwater harvesting, grey water reuse and wastewater recycling. Among these, rainwater harvesting has received the greatest attention as rainwater is fresh in nature and can be easily collected and used for non-potable purposes. However, many Australians still show a reluctance to adopt rainwater harvesting systems. Statistics from the Australian Bureau of Statistics (ABS) show that about 47% of respondents say that the main reason for not installing a rainwater tank is the perceived 'higher cost' (ABS, 2011). Government authorities in Australia provide financial incentives to encourage home owners to install rainwater tanks. For example, Sydney Water Corporation in Australia offers a rainwater tank rebate of up to $1,500 (here $ is in Aus$) depending on the size of the tank installed and the type of water use.

Many home owners do not readily see the benefit of a rainwater harvesting system over the long term, which may be attributed to the limited understanding of the life cycle costs of the system. Domenech and Sauri (2010) investigated the financial viability of rainwater harvesting systems in single and multi-family buildings in the metropolitan area of Barcelona (Spain). In single-family households, an expected payback period was found to be between 33 to 43 years depending on the tank size, while in a multi-family building a payback period was 61 years for a 20 m^3 tank. Imteaz et al. (2011) found that for commercial tanks connected to large roofs in Melbourne, total construction costs can be recovered within 15 to 21 years depending on the tank size, climatic conditions and future water price increase rate. Tam et al. (2009) investigated the cost effectiveness of rainwater harvesting systems in residential areas around Australia and found that these systems can offer notable financial benefits for Brisbane, Sydney and the Gold Coast due to the relatively higher rainfall in those cities as compared to Melbourne.

Notable research has been conducted on the relationship between rainwater tank sizing and water savings. Khastagir and Jayasuriya (2009) used water demand and roof area to develop a set of dimensionless number curves to obtain the optimum rainwater tank size for a group of suburbs in Melbourne. A paper by Ming-Daw et al. (2009) focused on the development of a relationship between storage and deficit rates for rainwater harvesting systems. Results showed that as the deficit rate increased so too did the storage size of the tanks. Eroksuz and Rahman (2010) conducted research on the use of rainwater harvesting systems for multi-unit blocks in three cities of New South Wales (NSW), Australia. They found that in order to maximise water savings, larger tanks would be more appropriate and these tanks could provide significant water savings, even in dry years. A study in Brazil by Ghisi et al. (2009) aimed to assess the potential for potable water savings for car washing at petrol stations in the City of Brasilia found that an increase in the tank size enhanced the reliability of the rainwater tank notably in meeting demand. Kyoungjun and Chulsang (2009) showed that rainwater collection would only be feasible in South Korea during six months of the year. They also found that increased cost and marginal increase in reliability make larger tanks unsustainable. They also found that a benefit cost ratio higher than 20% could not be gained due to the low cost of water in South Korea. They suggested the cost of water supply would need to be increased by a factor of five for the rainwater harvesting system to become economically viable in South Korea.

There is often a lack of 'easy to use' computing tools which examine the viability of rainwater harvesting system in large buildings. The financial viability of a rainwater harvesting system depends on factors such as local rainfall, roof size, water demand, capital cost, interest rate, maintenance cost and mains water price. This chapter presents a computing tool that can be used to examine various scenarios of a rainwater harvesting system to compare water savings and financial benefits based on life cycle cost analysis. The first part of the chapter presents the computing tool followed by a case study illustrating the use of the computing tool and the associated results.

2. Rainwater Tank Analysis Model

A computer model, which is referred to as the Rainwater Tank Analysis Model (RWTAM) is presented here. The RWTAM can be used to examine the water saving potential and financial viability of a rainwater harvesting system in multi-storey residential buildings. The RWTAM can provide a wide range of results for a proposed rainwater harvesting system including the major cost and benefit elements.

The RWTAM is Windows-based and was developed using Visual Basic. It has various input and output interfaces to enter data and obtain results on water savings and costings of a proposed rainwater harvesting system. The program has 5 main menus: File, Water Savings, Cost Analysis, Settings and Help. Each of these menus has a number of sub-menus as shown in Table 1.

A 'continuous simulation type' water balance model based on daily time steps is used in the program, which calculates the inflow to and outflow from the rainwater tank based on water demand and rainfall data on a given day. The water demand is assumed to consist of toilet flushing, laundry, car washing and irrigation demand. The irrigation demand is difficult to estimate. This is due to the fact that on the days of rainfall and possibly on a number of subsequent days after a significant rainfall event, the irrigation demand would be nil or would be smaller than a normal dry day. In order to account for this, the following approximate but simple procedures are adopted: (i) For 1 day of rainfall, there would be no

Main menu	Submenu	Function	Description
File	Open Rainwater Data File	This allows the user to select the relevant daily rainfall data file for the study area.	The daily rainfall station's data from the study area is needed.
	Exit	This allows the user to exit the program.	Exit the program.
Settings	RWTAM Input	This allows the user to enter data (for calculating rainwater savings) such as lot size, roof area, number of occupants and water demand.	Example in Figure 1.
	LCCA Input	This allows the user to enter various input data for cost analysis such as capital cost, government rebates and installation costs.	Example in Figure 2.
Water savings	Annual Water Savings	This function produces an average annual water savings vs. tank size plot as shown in Figure 3.	Tank sizes covered range from 10 kL to 100 kL. Example in Figure 3.
	Annual Water Savings	This function presents the annual average water savings in kL for each tank size.	This helps to interpret the results.
	Yearly Water Savings	This function produces a text file containing water savings achieved for a given tank size.	User needs to select a particular tank size.
Cost analysis	Benefit Cost Ratio (BCR)	For a selected tank size, this function gives a BCR which considers the whole life cycle of the rainwater harvesting system.	If the BCR > 1, the rainwater harvesting system presents a net saving.
	Breakdown of Life Cycle Costs	This function produces an output windows showing the cost for each of the major categories.	Example in Figure 4.
	Breakdown of Capital Cost	This function produces an output windows showing costs for each of the major categories: rainwater tank, concrete base, pump (indoor), pump (outdoor), accessories, plumping cost, electrical costs and governement rebates.	Example in Figure 5.

Table 1. Main menus and submenus of RWTAM model

irrigation during the day but irrigation would resume on the next day. (ii) For 1 to 7 days of consecutive rainfall, there would be no irrigation during the rainfall days plus none for the equal number of previous days of consecutive rainfall. (iii) For 8 to 21 days of consecutive rainfall, there would be no irrigation during the rainfall days plus no irrigation for the equal number of previous days of consecutive rainfall up to 7 days. The water demand on a particular day is then calculated by adding the indoor demand, car washing demand and the required irrigation (garden and lawn) demand for the day.

From the water balance model, the following output values are estimated on a daily basis: (i) net rainfall entering into the tank (ii) water in the tank (ii) water demand (iii) mains top-up and (iv) water savings. The mains top-up is the amount of mains water needed to top-up the rainwater tank to the specified minimum level (e.g. 10% of the tank volume). For the cost analysis, RWTAM undertakes life cycle cost analysis (LCCA), which is the procedure of assessing the cost of a product over its life cycle or portion thereof (AS/NZS, 1999). The life cycle cost is the sum of acquisition and ownership of a product over its life cycle (AS/NZS, 1999). All past, present and future cash flows identified in the LCCA are converted to present day dollar value and are a function of discount rates. All costs considered here are in Australian dollars. This study uses the concept of nominal cost (the expected price that will be paid when a cost is due to be paid, including estimated changes in price due to changes in efficiency, inflation/deflation, technology and the like) and nominal discount rate (the rate to use when converting nominal costs to discounted costs). To convert a nominal cost (C_N) to discounted cost (C_D), following equation is used (AS/NZS, 1999):

$$C_D = C_N \times \left(\frac{1}{(1 + d_n)^y} \right) \tag{1}$$

where d_n is the nominal discount rate per annum and y is the appropriate number of years.

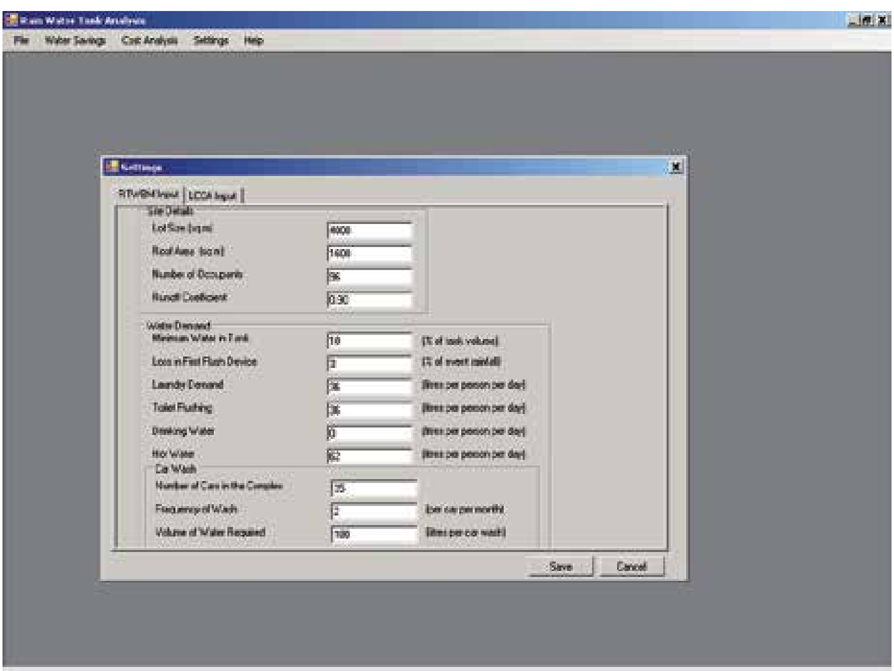

Fig. 1. Input interface of the RWTAM program for water savings

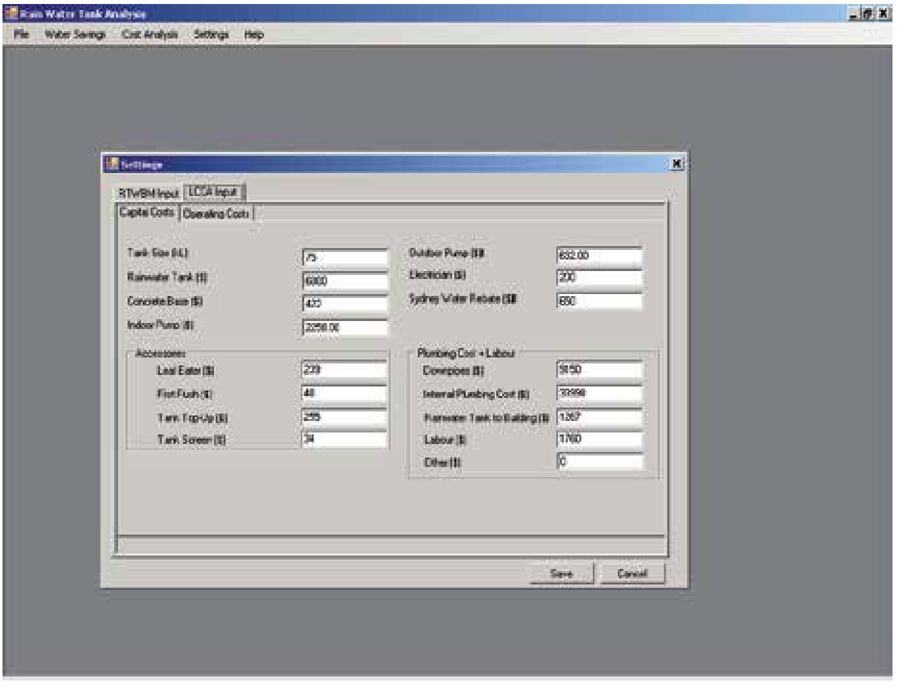

Fig. 2. Input interface of RWTAM program for life cycle cost analysis

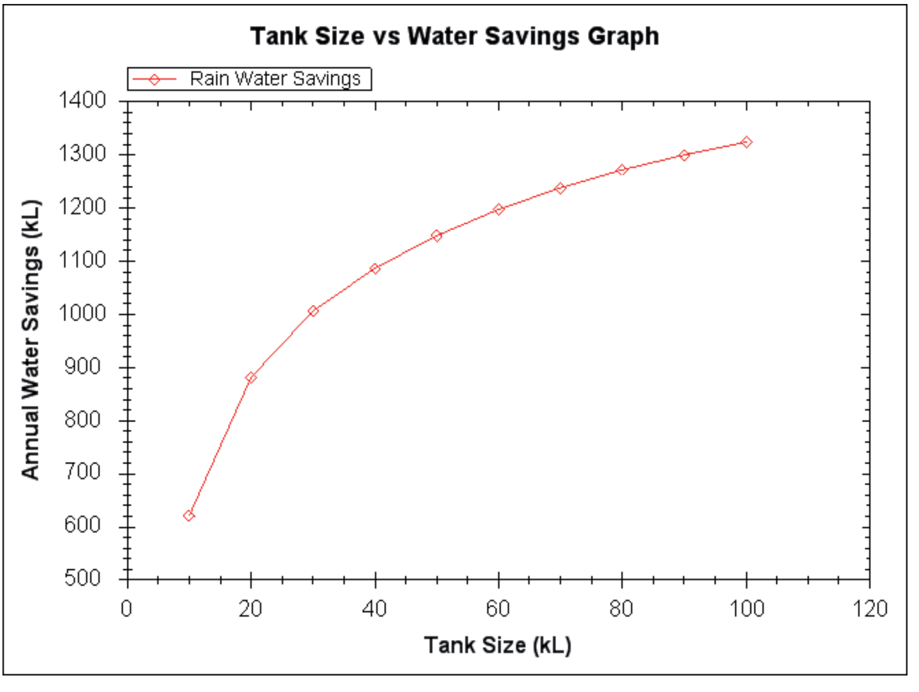

Fig. 3. Average annual water savings graph as an output from the RWTAM program

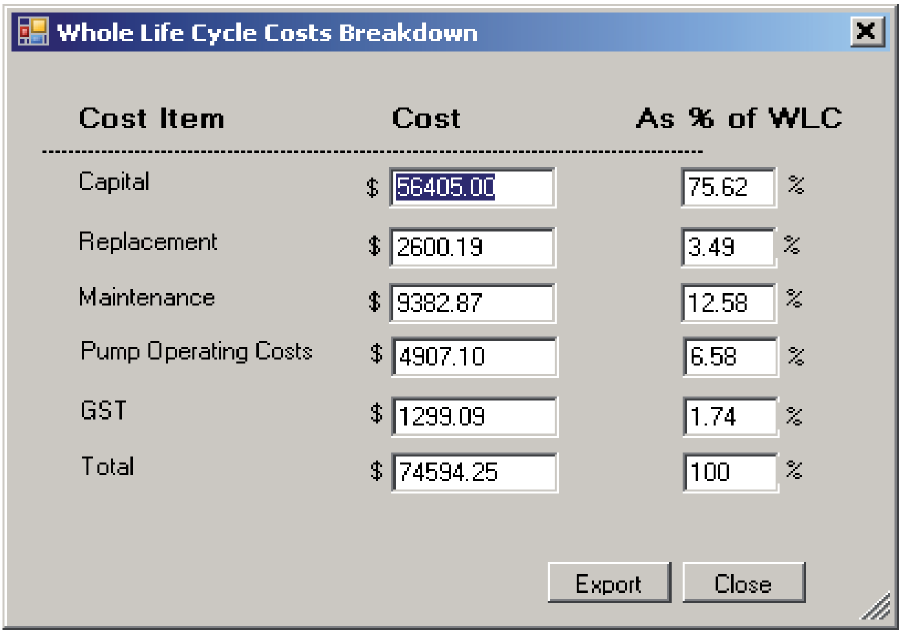

Fig. 4. Whole life cycle (WLC) cost breakdown as an output from the RWTAM program

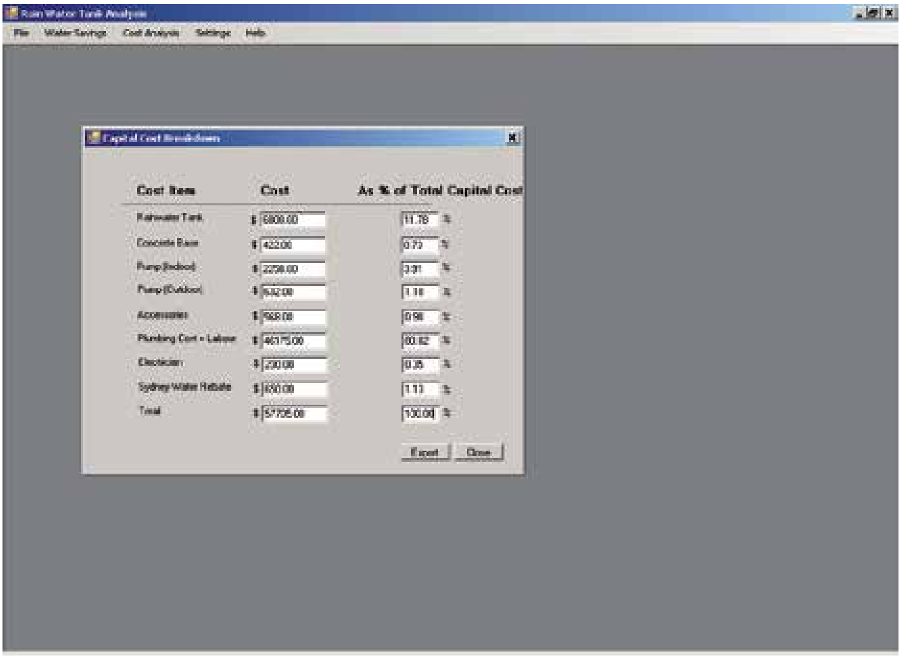

Fig. 5. Breakdown of capital cost as an output from the RWTAM program

The various steps involved in running the RWTAM are as follows. (a) Install the program in a local directory called 'Rain Water' (b) Open the program by double clicking on the 'Rainwater Tank' icon. (c) Open the rainwater data by going to the 'File' icon and selecting the daily rainfall data file relevant to the multi-storey building site in question. (d) Select 'Setting menu' and enter the data for Rainwater Tank Water Balance Model and LCCA. (e) Obtain output/results on water savings and cost analysis selecting the 'Water Savings' and 'Cost Analysis' icon, respectively. The various menus and submenus are self-explanatory and easy to work with.

3. A case study in Sydney Australia

An example is presented here to illustrate the application of the RWTAM. For this example, a hypothetical multi-storey building is considered, located in the Botany Bay Council area in Sydney, Australia. Daily rainfall records over 60 years (Jan 1946 to Dec 2005) from Sydney Airport station are used. A 75 kL tank size is selected for the purpose of this case study. Two different site areas are considered: 2000 m^2 and 4000 m^2 with roof areas of 800 m^2 and 1600 m^2 respectively. For each of these two site areas, three different floor arrangements are considered assuming four apartments per floor and 3 persons per apartment: (a) 4 floors consisting of 16 apartments having 48 persons (b) 6 floors with 24 apartments having 72 persons (c) 8 floors with 32 apartments having 96 persons. In the life cycle cost analysis (LCCA), it is assumed that the rainwater harvesting system has a life of 60 years.

According to the Building Sustainability Index (referred to as BASIX) for multi-unit buildings, all new houses in the state of New South Wales (NSW) must save at least 40% of potable water as compared to an average traditional non-BASIX house (NSW Department of Planning, 2005). This involves rainwater harvesting, the use of various water efficient appliances in the apartment such as 4A rated washing machines and dishwashers, 3A rated dual flush toilets (the higher the A-rating, the more water efficient the device is), water efficient shower heads and taps and native, low-water-use plants. Both BASIX and non-BASIX (i.e. traditional) approaches with rainwater harvesting systems are examined in this case study. It is assumed that rainwater is used for toilet flushing and laundry (indoor water use) and irrigation (garden and lawn); the relevant water demand data is obtained from Sydney Water Corporation.

In the water balance model, the effective runoff is generated by calculating the precipitation minus the losses which are the runoff coefficient and first flush losses. A plot of the annual precipitation is shown in Figure 6 which shows a notable variability of total rainfall from year to year and also a drop in total rainfall values from 1991 to 2005. However, annual total rainfall values may not have direct influence on the water yield of rainwater tanks which is mainly governed by distribution of rainfall events in a year and magnitude of rainfall events. For example, if the event rainfall is too high, most of the runoff will leave the rainwater tank as overflow as the tank would overflow very quickly.

The building area or the catchment area is assumed to be 40% of the total site area, which forms the tank footprint. The loss arises from gutter overflow, evaporation and first flush. It is assumed here that one litre of water is diverted to first flush per square metre of roof area. Once the first flush device is full, the remaining rainwater is diverted to the rainwater tank. Therefore the first flush losses are 800 litres for the 800m^2 roof and 1,600 litres for the 1,600m^2 roof. The total losses as a component of the runoff for each of the roof areas are presented in Figures 7 and 8. It can be seen in Figures 7 and 8 that the total losses increase with the runoff generated. For this scenario, the loss generated from the 800m² roof is exactly half of that generated by the 1,600m² roof. The runoff coefficient is assumed to remain constant throughout the life cycle analysis period, which is assumed to be 60 years.

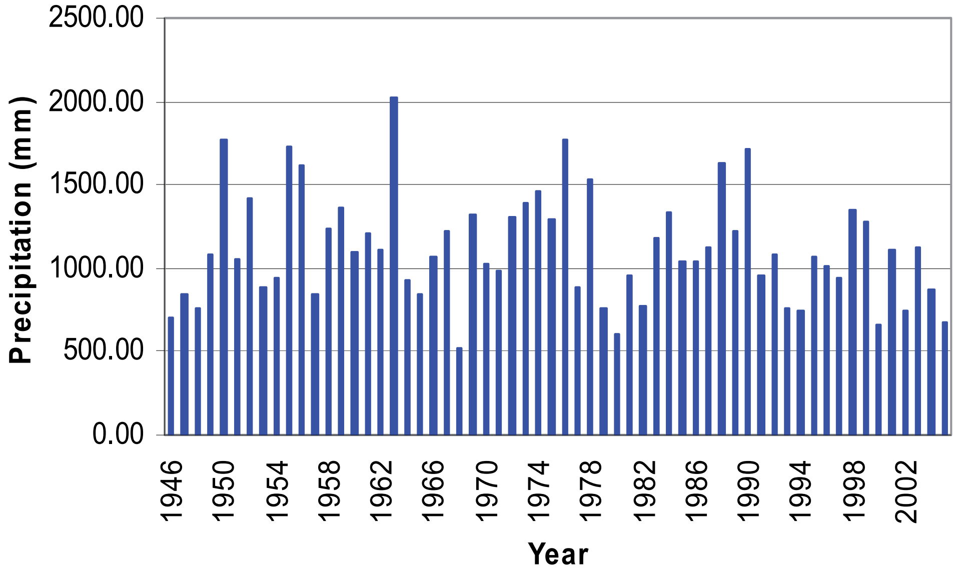

Fig. 6. Variability in annual precipitation values from 1946 to 2005 at Botany Bay (Sydney)

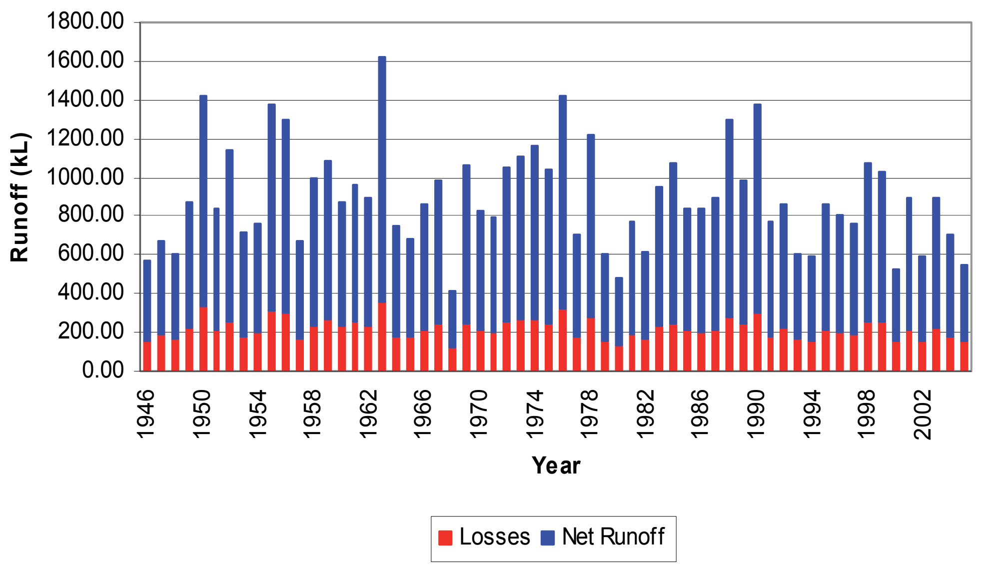

Fig. 7. Loss and runoff (2,000m² site area)

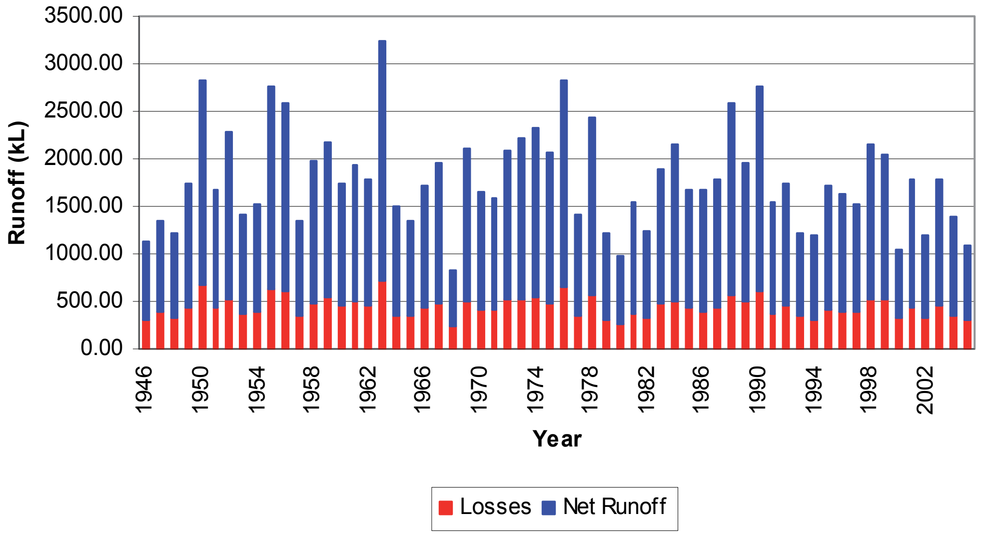

Fig. 8. Loss and runoff (4,000m^2 site area)

Figure 9 illustrates the difference between the effective runoff generated from the two roof areas, with the 1,600m^2 roof generating twice the runoff of the 800m^2 roof area. It can also be seen that the runoff is directly proportional to the rainfall.

In order to assess how much water is available per year in relation to the water demand, four graphs representing different scenarios are presented in Figures 10 to 13. The water available is the effective runoff entering the tank minus the overflows. It can be seen in Figure 10 that the water available (or the net water entering the tank) exceeds the water demand for more than half of the years out of the sixty years analysed. This does not mean that no mains top-up is required as the rainfall can happen in large storm events resulting in greater tank overflow. With an increased water demand relating to the six-floor scenario, the water available only exceeds the water demand for a few of the sixty years and only exceeds the water demand once for the eight-floor scenario.

As the water demand keeps on increasing, the water available cannot keep up and mains top-up is required. Ironically, the higher water demand means that more mains top-up needs to be used which results in higher water savings. It can be seen from Figure 11 that the water availability exceeds the water demand only once for the four-floor scenario. The six-floor and eight-floor scenarios require mains top-up every year.

It can be seen in Figure 12 that with the larger site area (i.e. 4,000m^2), despite the increased irrigation demand, the water availability far exceeds the water demand for the majority of the years for the four and six floor scenarios. In fact, the water availability exceeds the water demand for all but two years for the four floor scenario. Only twelve years miss out for the six floor scenario and about half the years for the eight floor scenario. Figure 12 shows the advantage of having a larger roof area to capture a greater amount of rainfall into the tank.

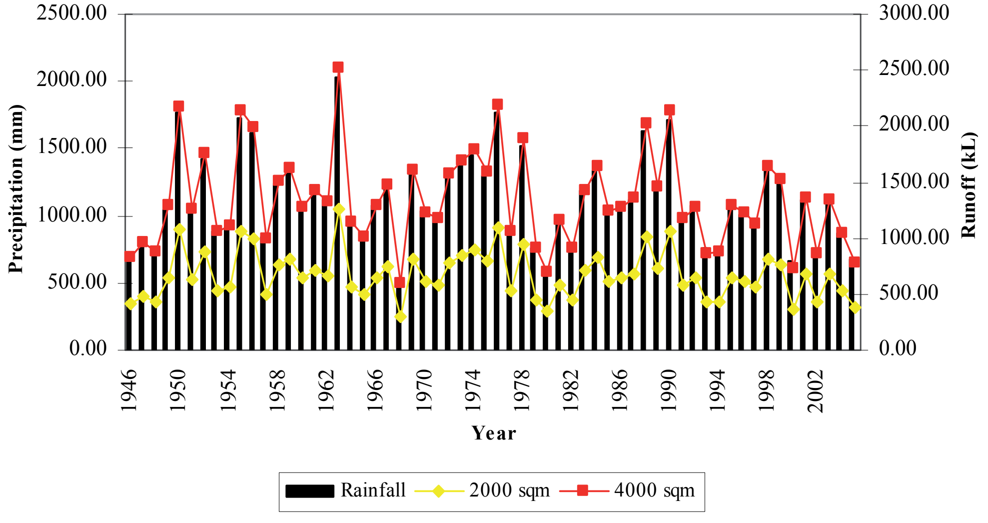

Fig. 9. Comparison of effective runoff for two roof areas

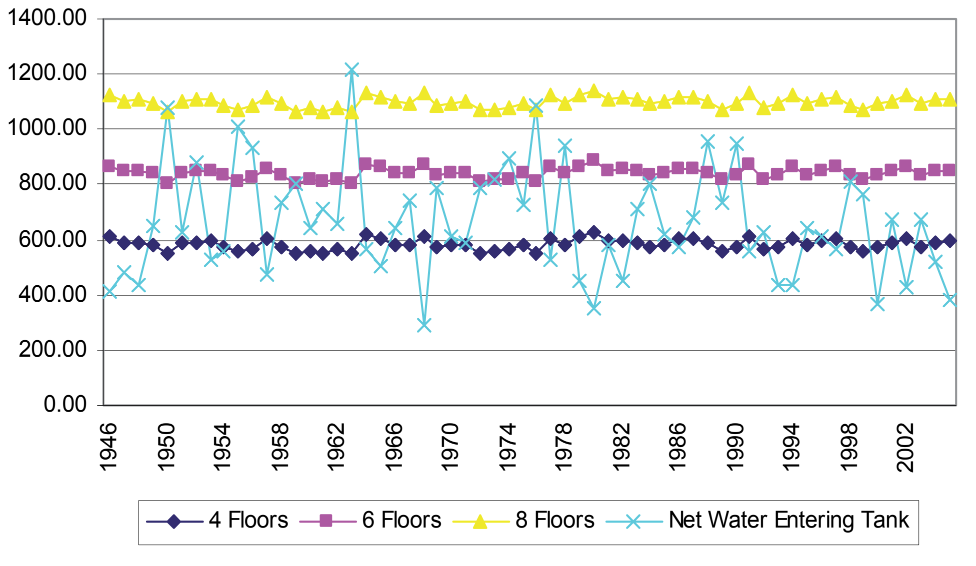

Fig. 10. Water entering tank vs. water demand (BASIX and 2,000m² site area)

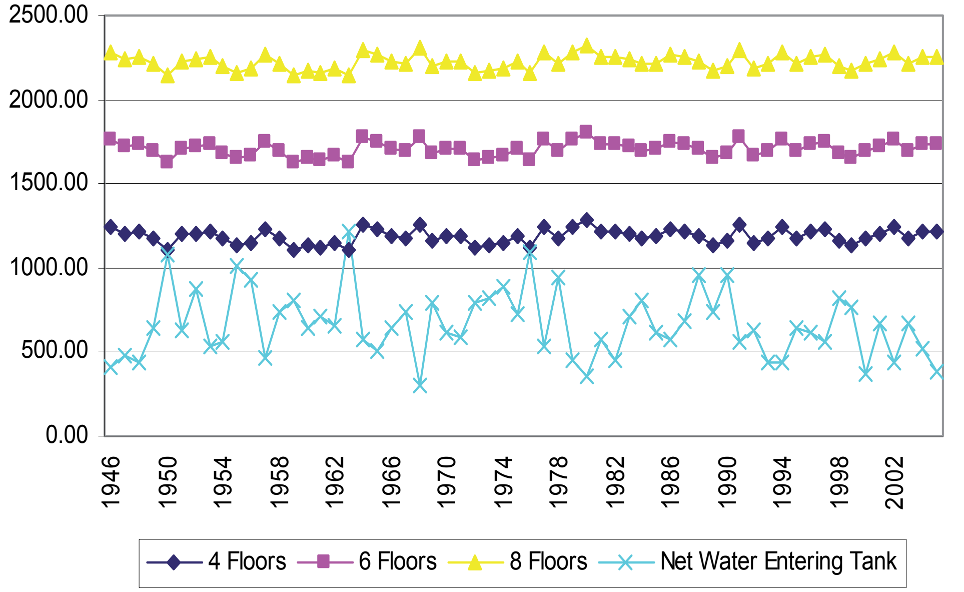

Fig. 11. Water entering tank vs. water demand (Non-BASIX and 2,000m² site area)

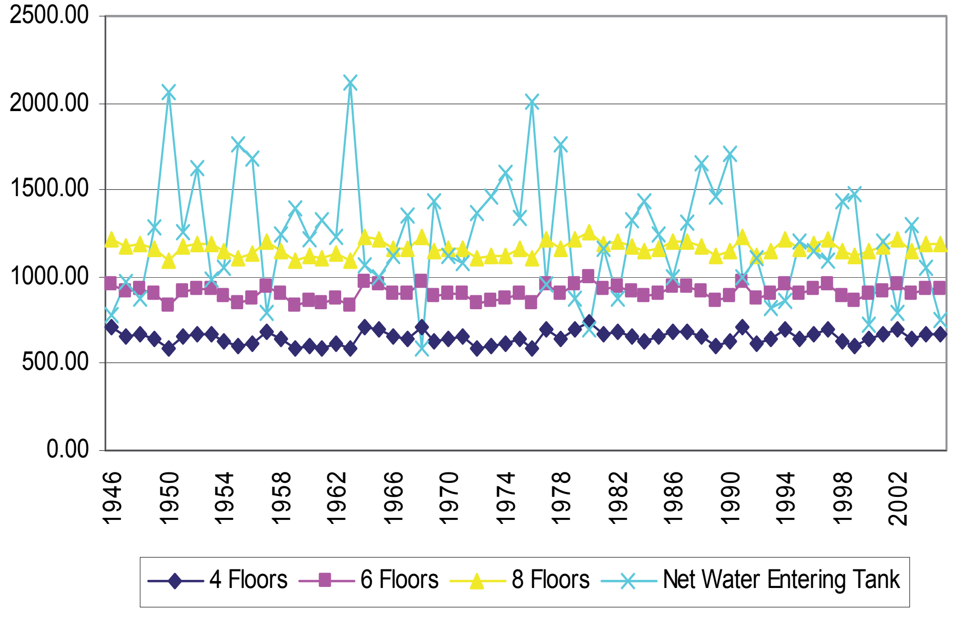

Fig. 12. Water entering tank vs. water demand (BASIX and 4,000m² site area)

Figure 13 shows that as the water demand increases, the water availability is unable to meet the demand. Despite the larger roof area, the water availability exceeds demand for about eighteen of the total sixty years for the four-floor scenario. The water availability exceeds demand only twice for the six floor scenario and none for the eight floor scenario.

The average mains top-up required per year over the sixty year analysis period is shown in Figures 14 to 17. It can be seen that the mains top-up required increases with the water demand, with the eight floor scenario requiring significantly more mains top-up than the four and six floor scenarios. There is also a significant difference in the mains top-up required between the BASIX and non-BASIX approaches. It is also noted that the mains top-up required decreases when the roof area is increased as a result of the increased runoff entering into the rainwater tank.

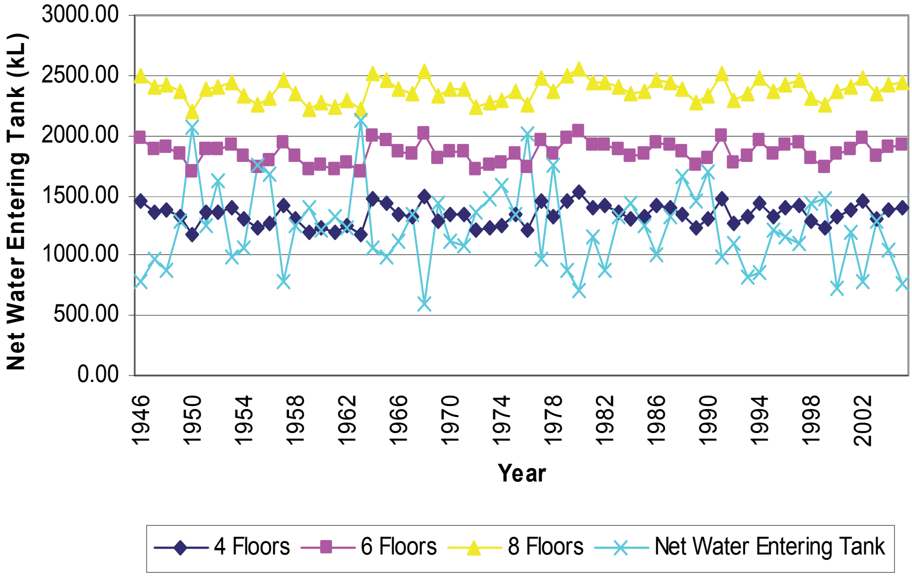

Fig. 13. Water entering tank vs. water demand (Non-BASIX and 4,000m² site area)

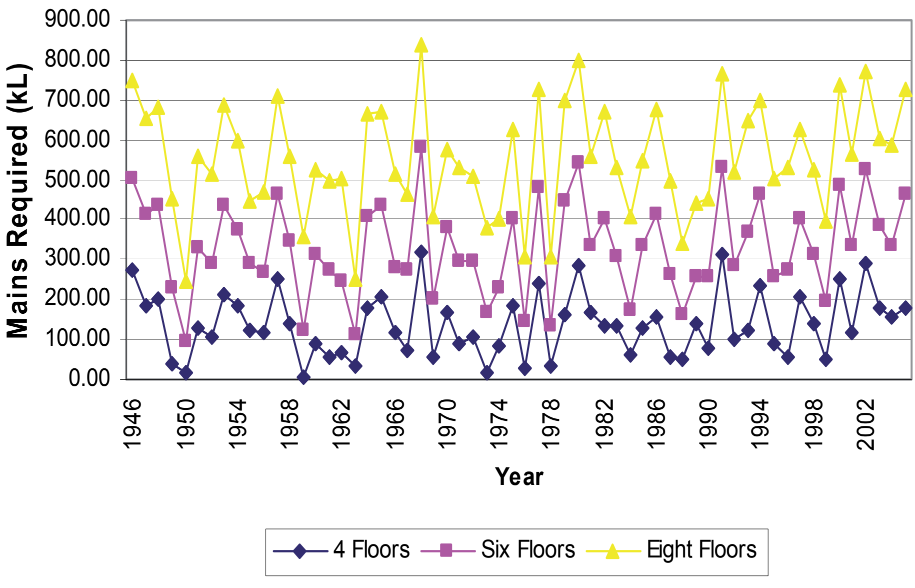

Fig. 14. Mains top-up required vs. water demand (BASIX and 2,000m² site area)

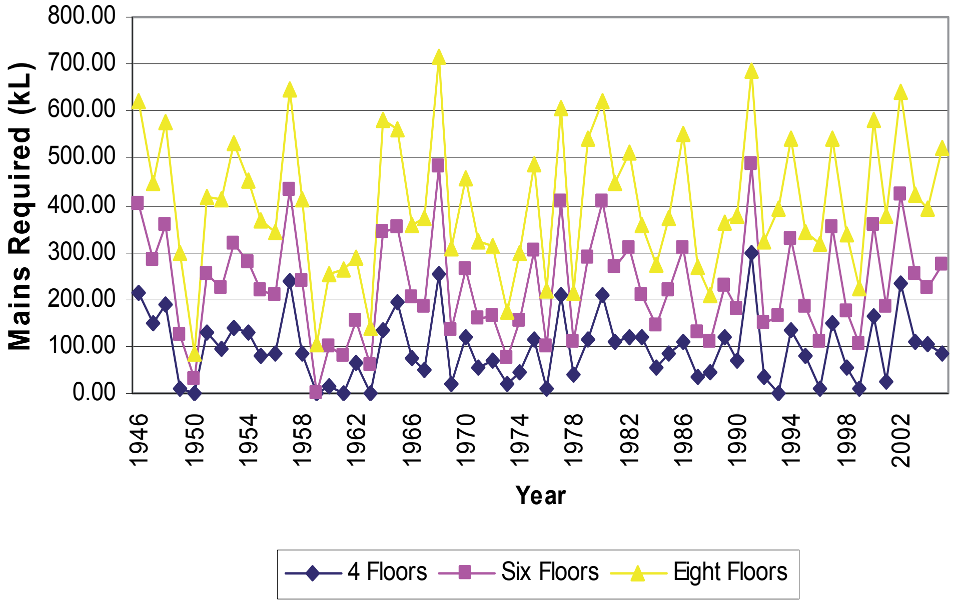

Fig. 15. Mains top-up required vs. water demand (BASIX and 4,000m² site area)

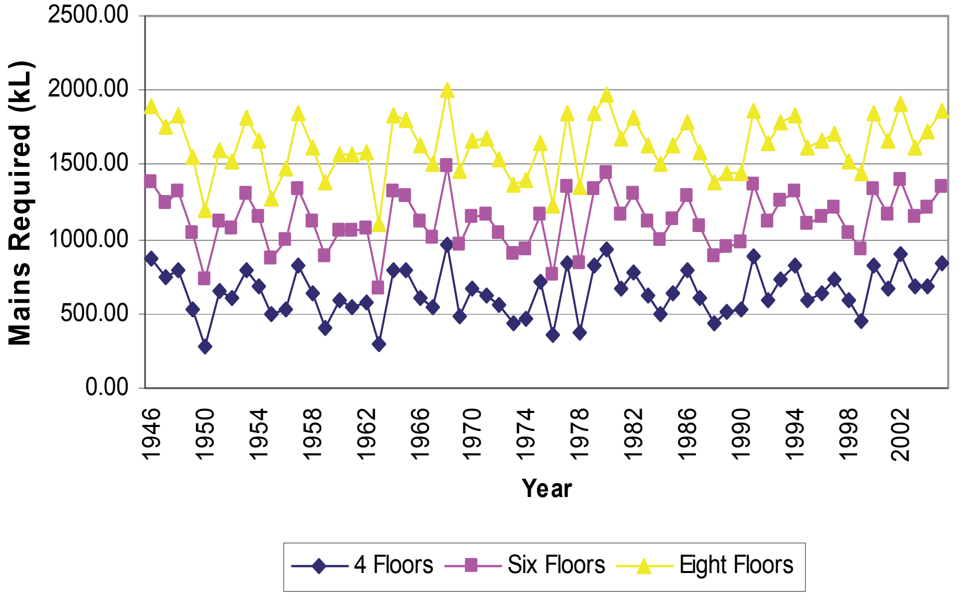

Fig. 16. Mains top-up required vs. water demand (Non-BASIX and 2,000m² site area)

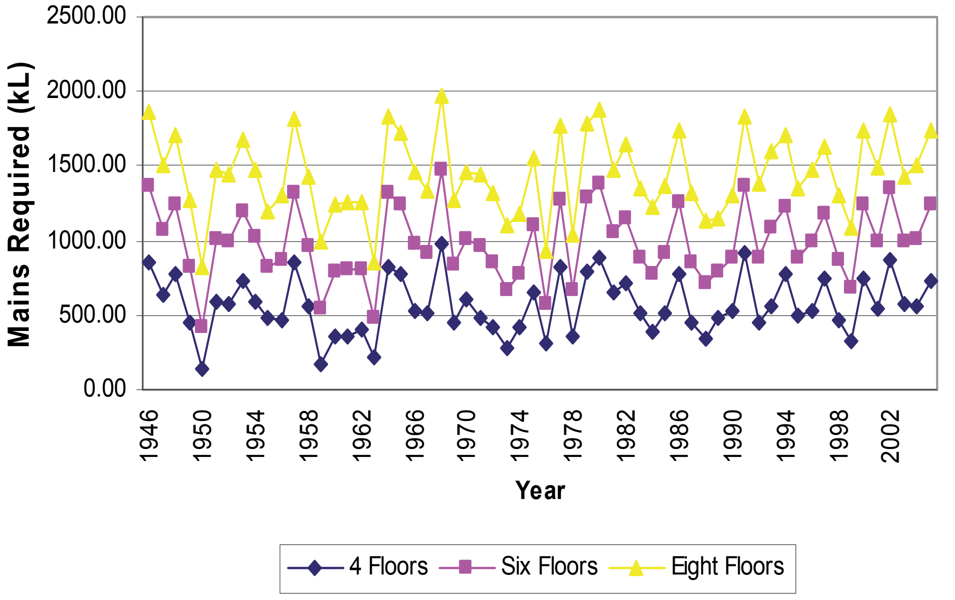

Fig. 17. Mains top-up required vs. water demand (Non-BASIX and 4,000m^2 site area)

The water saving is the most significant component of a rainwater harvesting system as this eventually determines the viability of the system. A rainwater harvesting system that produces little water savings is unlikely to be financially viable. Figures 18 to 21 compare the average water savings over the sixty year analysis period for a number of scenarios.

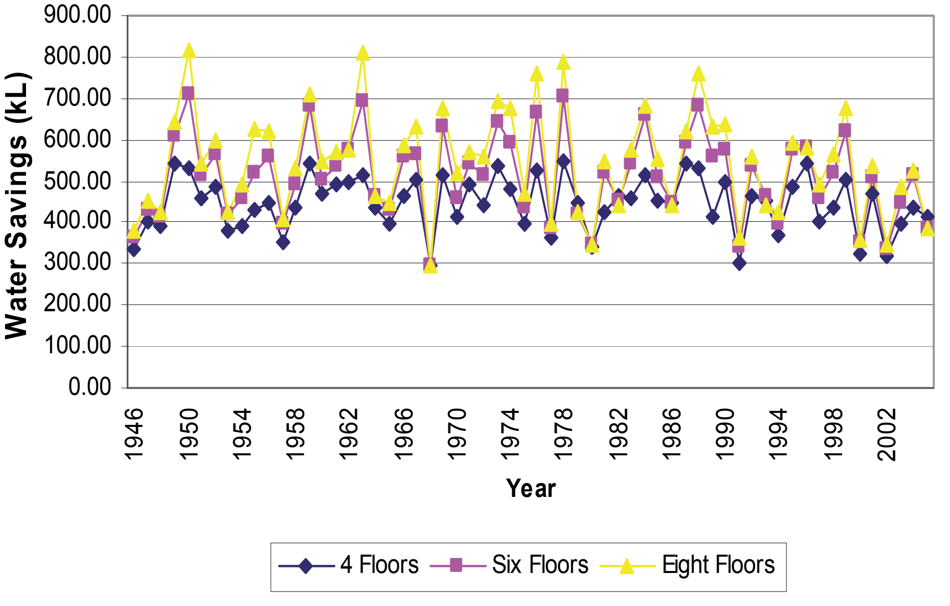

Fig. 18. Water savings (BASIX and 2,000m^2 site area)

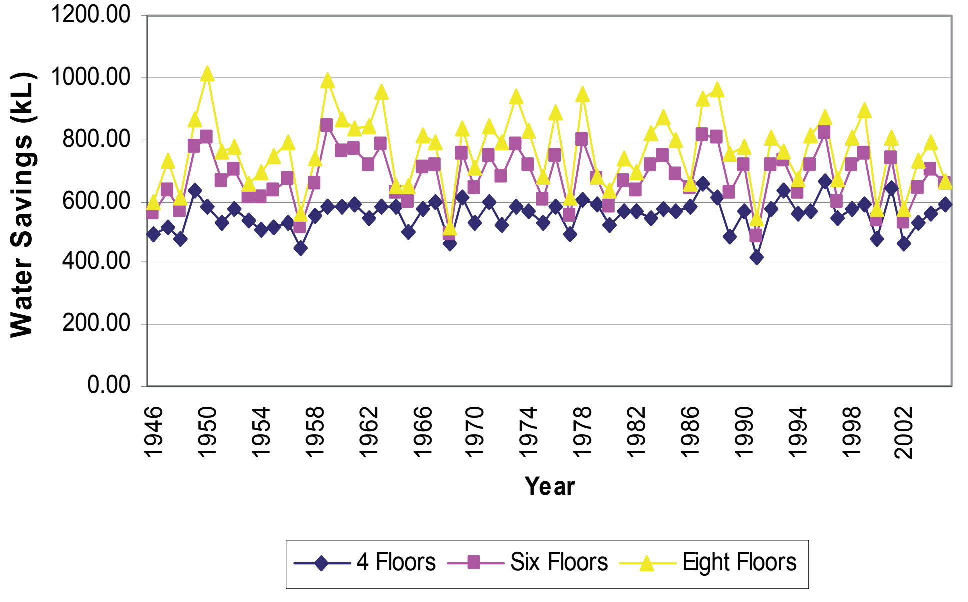

Fig. 19. Water savings (BASIX and 4,000m2 site area)

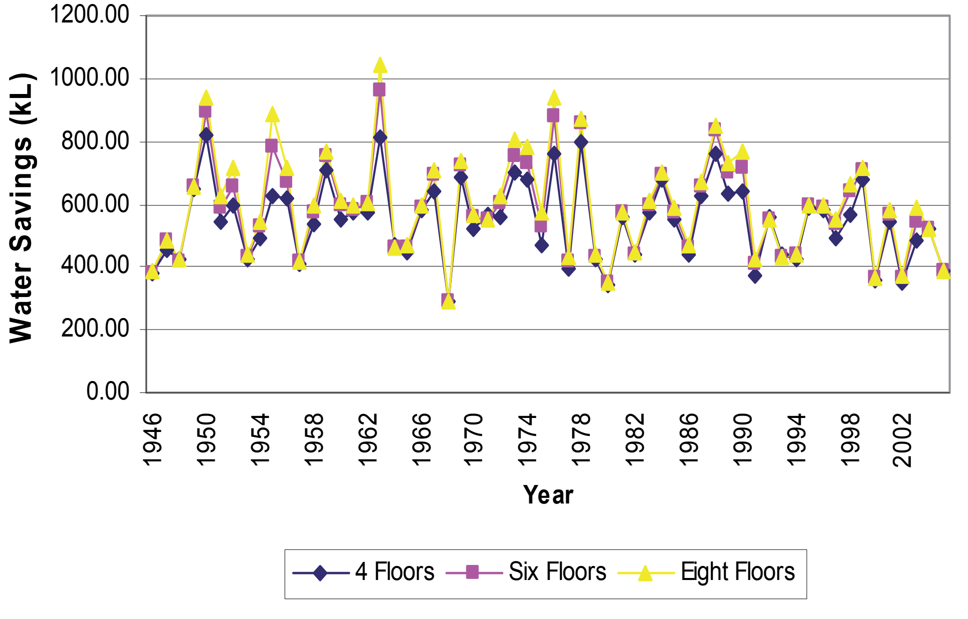

Fig. 20. Water savings (Non-BASIX and 2,000m2 site area)

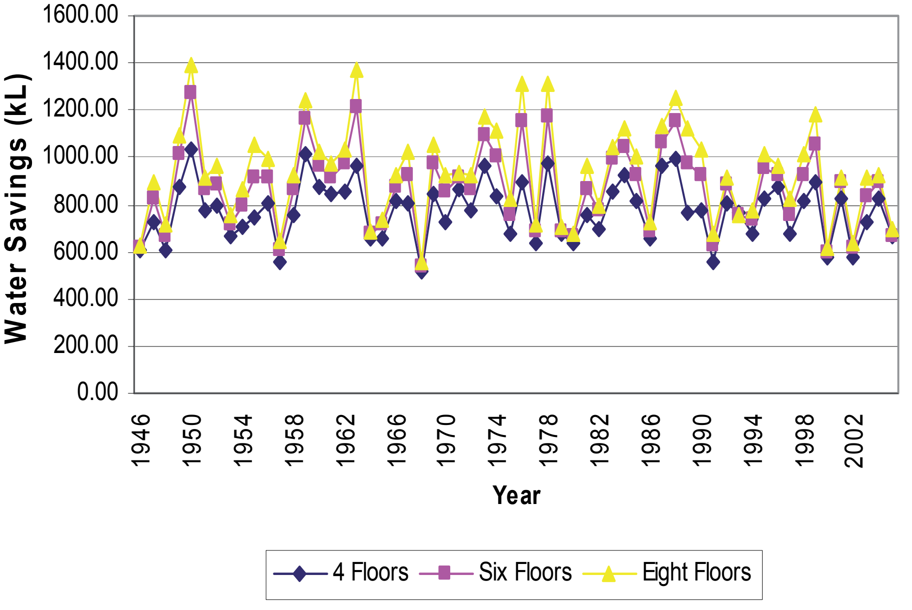

Fig. 21. Water savings (Non-BASIX and 2,000m² site area)

These figures show an increase in water savings in relation to an increasing water demand. The water savings also increase with an increased roof area despite the mains top-up required decreasing for larger roof areas. It can also be seen from these figures that the maximum water savings occur with the non-BASIX approach for an eight-floor scenario with a 4,000m² site area. It is this scenario that is likely to be the most financially viable option although the increased installation costs of the additional floors might offset the additional savings gained.

The following scenarios are considered in the life cycle cost analysis (LCCA). Four different interest rates/discount rates are considered 5%, 7.5%, 10% and 15% per annum. It is also assumed that water price would increase at three different inflation rates: 2.6%, 3.5% and 4.5% per annum. Two different water prices are considered: $1.264/kL and $1.634 per kL. All costs considered here are in Australian dollars.

Scenario 1: BASIX compliant four-floor case built on a site area of 2,000m²
Scenario 2: BASIX compliant six-floor case built on a site area of 2,000m²
Scenario 3: BASIX compliant eight-floor case built on a site area of 2,000m²
Scenario 4: BASIX compliant four-floor case built on a site area of 4,000m²
Scenario 5: BASIX compliant six-floor case built on a site area of 4,000m²
Scenario 6: BASIX compliant eight-floor case built on a site area of 4,000m²
Scenario 7: Non-BASIX compliant four-floor case built on a site area of 2,000m²
Scenario 8: Non-BASIX compliant six-floor case built on a site area of 2,000m²
Scenario 9: Non-BASIX compliant eight-floor case built on a site area of 2,000m²
Scenario 10: Non-BASIX compliant four-floor case built on a site area of 4,000m²
Scenario 11: Non-BASIX compliant six-floor case built on a site area of 4,000m²
Scenario 12: Non-BASIX compliant eight-floor case built on a site area of 4,000m².

The maximum water savings are achieved when water demand is the highest. This occurs for Scenario 12 where the annual water savings achieved is 934kL. The minimum water savings occurs for Scenario 1 which produces an average of 446kL water saving per year. The minimum mains water requirement, however, occurs for Scenario 4 which on average requires 95kL annually and produces yearly water savings of 555kL. Furthermore, the model shows that for some years, mains top-up would not be required at all. It is also found that the performance of the rainwater tank improves significantly with the increasing size of the roof catchment. The larger roof area results in a larger inflow to the rainwater tank providing greater savings, if the harvested water can be utilised.

The capital and operating costs are estimated using the Sydney market price for each of the scenarios mentioned above. The highest capital and operating costs are produced for Scenario 12 as a result of the increased plumbing reticulation costs involved with plumbing the extra floors and additional lengths of down piping required for the larger building area. An increased water demand also results in higher pump operating costs than the other scenarios.

A LCCA is performed on each of the above scenarios to determine the most viable option i.e. the highest benefit/cost ratio. The price of water, the inflation rate of water and the interest rate/discount rate are also considered as variables. The best case benefit/cost ratio is found to occur for Scenario 10 and the worst benefit/cost ratio for Scenario 3. It is found that the financial viability improves at lower interest rates and higher water prices. The best case scenario is therefore found to occur at a water price of $1.634/kL at 4.5% inflation rate for water price and an interest rate of 5%. The benefit/cost ratio produced is 1.39 which results in a payback period of 38 years. It is noted that the rainwater harvesting system is not able to payback at an interest rate of 7.5% and other higher rates for the scenarios considered here. At the current water price, it is only possible to payback if the inflation rate of water is at 4.5% which is likely to happen considering dwindling water supplies in Sydney and recent water price increases. At the higher water rate of $1.634/kL and 4.5% inflation, the BASIX compliant unit is able to payback with the eight-floor scenario being the most viable at a benefit/cost ratio of 1.15 and a payback period of 50 years.

Figure 22 shows the yearly cumulative costs and benefits for the best possible scenario. In the first year, the difference between cost and benefit is $33,904 which indicates that there is a loss of -$33,904. As the years go on, the cumulative benefits increase and the cumulative costs decrease. At year 38, the benefit is equal to the cost when the savings crosses the x-axis. The water price, rate of inflation, and operating cost determine how fast the benefit becomes equal to the cost. It can be seen that the total benefit in 60 years is $20,539 indicating that not only has the rainwater harvesting system is paid back, it has saved the owner $20,539.

It can therefore be concluded, from a financially viable perspective, that it is possible to achieve a payback for a rainwater harvesting system under some favourable conditions. The largest single factor affecting the viability of a rainwater harvesting system is the cost of mains water. The higher the cost of mains water, the more viable the rainwater harvesting system becomes. From an environmental perspective, rainwater harvesting systems have the ability to reduce reliance on mains water leading to lower infrastructure cost and possible deferment of new infrastructure such as dams.

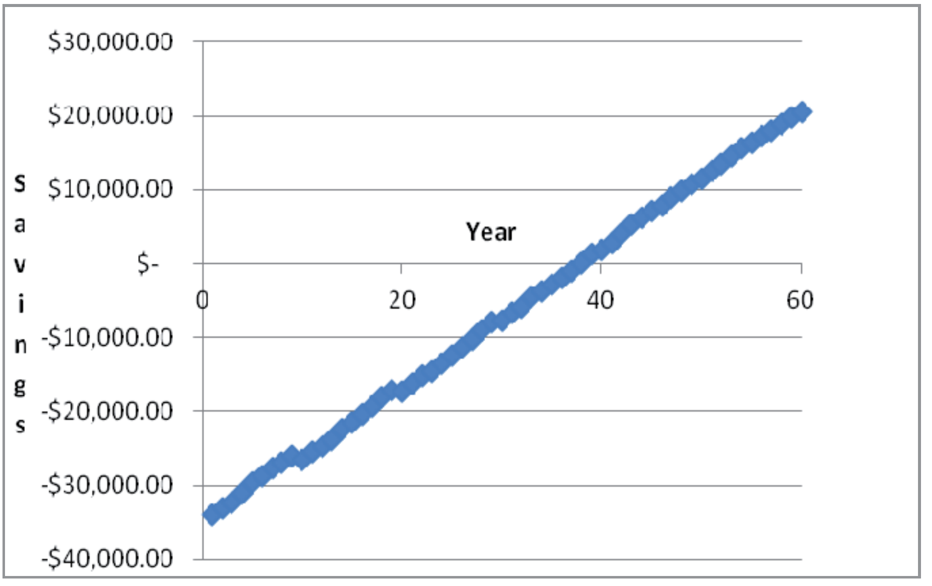

Fig. 22. Annual benefits and costs of the best possible scenario for the rainwater harvesting system

A breakdown of the different cost components of the whole life cycle cost is presented in Table 2. It can be seen that the capital cost comprises the highest component (66%) whereas the maintenance cost is the second highest contributing 18%. The pump operating cost only contributes 6% of the total cost although when added to the pump capital, replacement and maintenance costs the total expenditure of the pump jumps to $9,872 or 19% of the total life cycle cost. This is quite significant and whether or not a rooftop rainwater tank is justified may be a subject to further research as with a rooftop tank there would be no pump cost. Although, the weight of a 75kL rainwater tank is likely to add significant structural cost to the building which may not justify a rooftop rainwater tank.

Cost item	Life cycle cost (Aus$)	% of whole life cycle cost
Capital	$34,575	66
Replacement	$4,151	8
Maintenance	$9,375	18
Pump operating cost	$2,847	6
GST	$1,222	2
Total	$52,173	100

Table 2. Breakdown of whole life cycle cost for the best possible scenario of the rainwater harvesting system

4. Conclusion

This chapter presents a computing tool that can be used to examine the water savings potential and financial viability of a rain water harvesting system in a multi-storey building.

A case study is presented for a 75kL rainwater tank, located in Sydney, Australia. It is found that the performance of a rain water harvesting system in terms of water savings improves significantly with the increasing roof size and water demand. It is also found that for most of the typical scenarios the rain water harvesting system is not financially viable at the current water prices in Australia, which is highly subsidized and in the current high interest regime (greater than 7%). In a few cases however, the rain water harvesting system is likely to be financially viable, in particular at smaller interest rates and higher water prices. It is also found that the capital cost represents the highest component in the whole life cycle cost of a rain water harvesting system followed by the maintenance cost. The outcomes of this study suggests that government authorities should consider increasing the subsidy for a rain water harvesting system to offset the financial burden of the home owners to encourage the installation of rain water harvesting systems. It should be noted that there are significant environmental benefits of a rain water harvesting system such as water conservation and on-site retention of pollutants. Rainwater harvesting system also increases the resilience of the urban water supply system, which is important during drought years, which is common in Australia. Rainwater harvesting system is also likely to defer construction of major water supply dam and desalination plant.

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Part 3

Cultural Heritage and Urban Development

9

The Impact of Different Urban Housing Patterns on the Sustainable Urban Development of a Historic City, Bursa/Turkey

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1. Introduction

Throughout history, cities have been built to serve a variety of functions; as forts, market places, and as centres of administration or industry. All cities have experienced periods of growth and decline and all tend to raise contradictory views concerning the nature and purpose of the city as an urban system (Elliott, 1994). Over the last fifty years cities have been transformed from fairly concentrated and identifiable towns into amorphous urban areas, sprawling into their hinterlands without any visible borders between town and country. Transition from the industrial society to the information society as well as the globalization process led to changes in space and spatial organizations; thus, most of the cities around the different regions of the world have been subject to important social and cultural alterations. As a result of this urban transformation process around the world, different physical and social structures emerged in different regions.

The developments in political, economical and technological fields caused a very rapid urbanization in Turkey. However, providing sufficient number of residences that are available for people with average income as well as constructing the substructure necessary for these residences have not been succeeded; therefore, a lack of healthy accommodation problem, which is typical for underdeveloped or developing countries, has arisen. Besides the very high level of migration from rural to urban areas due to the rapid industrialization, Turkey has also been influenced by the migrations from abroad. Tekeli(1998), indicates that, squatters, build - and -sell apartment blocks and cooperative housing societies as well as housing financed by the state have emerged as solution to these problems in this country. He also points out the fact that none of these presentation forms has been a form to enrich the life quality nor to create good quality environments. Moreover, "Pull down-rebuild" processes in the city centers led to the demolishing of historical and cultural values, to the permanent density increase, to the loss of green areas as well as to the insufficiency of the social substructure. The urban development in the cities caused a permanent decrease in quality of life, which is determined as the main indicator of sustainable urban development by many researchers (e.g.Redclift, Woodgate,1997;Mitchell,2000). In the report of WCED (1987), the concept of sustainable development has come to be associated with efforts to increase the quality of life without endangering the natural resource base of the society. In another official report, the Strategy for the UK, "A Better Quality of Life" published by the UK Government in 1999, sustainability was defined as the simple idea of ensuring "a better quality of life for everyone, now and for generations to come". The quality of both the natural and the built environment, the perceptions of one's neighbourhood, the opportunities provided by the environment for self-betterment and community building, and the extent of real and perceived ownership, all influence quality of life. However, cities are no more sufficient to meet the psychological, social and cultural needs of their residents. In view of these circumstances; reasons of this insufficiency and alternative ways of solutions should be investigated.

In the light of these, the scope of this chapter is determined as examination of different housing patterns of Bursa in the context of sustainable urban development. Bursa is one of the most important Anatolian cities which comprises the oldest and most authentic examples of monumental and civil architecture and which combines rich tradition, culture, history and nature at the same time. It is a valuable city shaped by a rich cultural heritage and succeeds to reach our times without losing its importance. In the south of the Eastern Marmara, Bursa has been one of the oldest settlements in Anatolia and the first capital of the Ottoman Empire, due to its geographical location, agricultural convenience of its natural structure and its importance from military point of view. Today, being the fourth biggest city of Turkey, Bursa is economically very dynamic and has been undergoing a rapid industrialization and urbanization process. It has one of Turkey's highest population increase rate as a result of its being a focus of large inner and outer immigration. There has been a huge migration from other regions as well as from Balkanic countries since 1950s. For these reasons, unfortunately, the unique historic identity of Bursa has suffered a lot, however the city is still withstanding the onset of rapid urbanization. The author puts stress on the changes in urban housing patterns of Bursa caused by the immigrants and their impact on the form of the city, in the context of sustainable urban development.

This chapter consists of six sections which includes an introduction on urban development process in Turkey. The second section highlights the importance of urban housing patterns to achieve sustainable development dealing with the theoretical literature on the related concepts and indicates the relationship of sustainable urban development and urban housing patterns. The effects of migration on the development trends of housing environments in Turkey and urban development and housing processes in Bursa are explained in the following sections. The fifth section covers an analysis of the immigrant housing patterns both around the historic city center and in periphery of the city. The paper concludes with a discussion on the effects of immigrant housing districts on the sustainable development of the city, offering some strategies and implementation policies.

2. Importance of urban housing patterns for sustainable urban development

As Burton, et.al. (2000) cite, the last decade has witnessed a burgeoning interest in the concept of sustainable development. In particular, the need to develop sustainable cities, in other words to achieve sustainable urban development, has become a global political aim. In fact, sustainable development summarizes the challenges that the world is facing; to manage a global social and economic development, which neither deteriorates the ecological systems, nor exhausts the natural resources. Cities have been given a central place in discussions about sustainability problems, because in cities many people live closely together and are engaged in a large number of activities. As a socio-cultural entity the city fulfils a number of functions for specialised types of people, whose occupations and social roles differ from those of rural dwellers (Hatfield Dodds, 2000, Gullberg, et.al., 2000). Where and how people live play an important role in achieving sustainable development both in physical and socio-cultural contexts.

To understand how certain groups are allocated to certain parts of the city it is important to understand the urban housing market. The housing stock of a city constitutes more than just accommodation; it is a link with the past, a record of history, a silent witness to the periods of city growth and decline, especially in historic cities. In historic cities, changes concerning home environments show a dramatic transition procedure from past to future; from tradition to modernity. On the other hand, the specificity of a historic city- its identity, history, culture and distinctiveness- has very close relationships with diversity and complexity of urban housing patterns, which are directly related with socio-cultural, socio-economic and political structure of the city. These arguments show that the immense diversity and complexity of housing within different neighborhoods, cities, and countries, and their effects on sustainable urban development are worth emphasizing.

Housing constitutes the largest space user in the city and has always played an important role firstly in shaping urban regions and then achieving their sustainable development. The operation of the supply and demand for housing divides different groups of people to different types of housing in different parts of the city. The result is a rich residential mosaic which can be named as urban housing pattern. It is not a static but dynamic phenomenon due to fluctuations in additions to the stock, demolitions, and conversions. (Short, 1996), (Knox, 1994), (Hartshorn, 1992).

The decentralization of employment and commercial functions, and out-migration of higher income groups to newer peripheral housing change urban housing environment and weaken neighborhood viability. By this way the process of residential decline begins with the transformation of rural land to residential use, and then higher-density apartment construction in inner rings together with population and density increase. The last stage is the renewal of obsolete areas, with the construction of moderate -or low income multiple-family housing or luxury apartments (Hartshorn, 1992). All of these stages bring about unsuitable conditions to achieve sustainability in cities.

There is much more diversity in housing conditions among Third World countries than there is in the developed world. Housing conditions and housing problems of the two worlds are quantitatively and qualitatively very different. Third World countries vary from each other in all fields including housing systems, policies and stocks. The only common denominators are low levels of income, a limited inheritance of quality housing, inadequate investment in residential infrastructure, and high levels of urbanization (Bourne, 1981). The urban housing market of the third world can be identified in two distinctive social and spatial patterns. While the upper and middle classes are living in well-constructed, even luxuriously designed and landscaped houses, the poor are in the high density slums typically on the periphery, called squatter settlements and typify many cities of the Third World. Some of them are temporary, others are more permanent and better organized; but most are unplanned, with low quality housing, high unemployment, and insufficient social services. In some areas, these spontaneous residential settlements represent from one-third to one-half of the total population of the metropolitan area (Bourne, 1981), (Hartshorn, 1992).Today, all of these characteristics are assumed as indicators of unsustainability. Jenks (2000) discusses the suggestions which are made to overcome the unsustainability of peripheral development through the tax system in the formal sector, and inclusive processes in the informal sectors. However, it is an approved fact that these kinds of precautions in terms of material arrangements are not enough to achieve sustainable development of any urban area.

The main idea to emphasize is that the urban housing pattern is fracturing the city into distinct areas which are the basis for identifiable communities of shared attitudes, adopted as the basic actors of sustainable urban development. As Short (1996) points out, the identification of these communities and their creation and restructuring is a very important topic for housing all over the world. This shows that, it is an important necessity to examine urban housing process both in spatial and socio-cultural dimensions. In the last decades, researchers studying on the concepts of sustainability and sustainable development agree on emphasizing this necessity and have consensus on two distinct requirements of sustainable development; physical and socio-cultural. Physical requirements of sustainable development can be classified under the headings of “high quality of life”, “optimum density”, “minimum energy and resource use”. On the other hand, socio-cultural requirements can be classified under “changes in world views”, “development ethics”, “awareness and responsibility of environment and sustainability” and “participation in the sustainability studies” as the leading keywords (Çahantimur,2007). In this study different patterns of immigrant housing in Bursa are analysed in terms of physical requirements of sustainable urban development. The subcomponents of these requiements were identified by the author as follows: physical environment conditions, vitality/diversity, accessibility, flexibility, safety and efficiency of the environment as the subcomponents of “high quality of life”, density of people, density of buildings and density of functions as the subcomponents of “optimum density”, use of recycled materials and systems, minimum use of motor vehicle as the subcomponents of “minimum energy and resource use” (Çahantimur, 2007). First of all, urban development process in Turkey, explaining the effects of internal and external migrations will be summarized in the following section.

3. Effects of immigrant housing on urban development process in Turkey

Socio-economic developments and industrialization as well as political choices made during and after World War II effected settlement strategies and housing production models in Turkey. As a result of serious internal migration from rural to urban areas which started with industrialization, the urbanization phenomenon in all its aspects has become one of the basic problems of the country. Illegal housing and squatter developments increased rapidly around large cities and the dwelling shortage doubled every year (Tapan, 1996), (Erkut,2000).

The basic institution facilitating the negative impact of migration is “gecekondu”. The term “gecekondu” literally means “built in one night”, and has become the Turkish equivalent of squatter (Erkut, 2000). As Şenyapılı (1996) indicates, the gecekondu phenomenon has a past of half a century in Turkish cities, similar to what happened in many large cities of Third World countries. They are self – help built housing units on public land and there is no differentiation between the owner, the user and the builder of these houses. Starting with 1970s, builder and owner of gecekondu differed from each other, which led to the commercialization and decrease in environmental quality. After 1980s, market value dominated in Turkey and an informal market started with its own rules and operating system, which does not allow the ordinary migrant to build a gecekondu anymore. Erkut (2000) summarizes this process as follows; the "use value" of houses was the dominant characteristic of the first generation gecekondu. Throughout time, the commercialization of the gecekondu process resulted in the construction of informal settlements that created illegally subdivided lands which are either rented or sold. The "market value" is the dominant characteristics of second generation of gecekondu. The development process of gecekondu areas after 1980s is explained by Şenyapılı (1999) in a very clear way. He points out that the peripheral areas of cities in which formerly only the gecekondu population was interested started to become popular with higher income groups who tried to get away from the disturbing conditions of cities and they began to be used for building collective housing units, mid-income group cooperative houses and private houses. The gecekondu areas close to city centers and transportation networks gained more value and were taken over by large companies to build multi-storey apartment blocks. On the other hand the agricultural lands were sub-divided into plots to be sold and small illegal apartment blocks were built over these plots. In the existing gecekondu areas for which reconstruction plans could be obtained, the owners whose lands were large enough and close to the main roads and centers were having small apartments built by contractors, while others were setting up similar two- or three-storey apartments themselves by using their own family resources, with no regard to environmental standards and reconstruction rules, just as they had done when building gecekondus. The remaining lands awaited the opportunity of being converted into apartments, and the owners of gecekondus who could manage to move into small flats, started to rent them out. Thus, this new development model did, for the first time, lead to the replacement of the organized and neat gecekondu districts by areas where widespread "moving" and "deterioration" became predominant (Şenyapılı, 1998).

In developing countries, social housing (mass housing) areas are alternatives to squatter settlements. The social (mass) housing concept defines the housing production which has arisen as a result of projects aiming at producing a large number of dwellings by public or private associations for the low- and middle-income groups, in other words, for those who cannot acquire a dwelling through their own savings. They can be grouped into two; as the first group, providing multi-storey apartment blocks for rent or ownership produced by public associations, and as the second group, providing land with infrastructure or land together with a partially built dwelling supplied by the state or local governments for low income groups, with the aim of turning a self-help housing production into a planned procedure (Tapan,1996).

Tapan (1996) claims that the mass housing applications in Turkey have brought along a new urbanization model with a planned physical development. The mass housing projects usually produced outside the existing urban area are not affected by the urban fabric. They are applications that shift the urban population to the periphery of cities and have common administrative and maintenance organizations. Unfortunately, most of these settlements don't have enough relations with the city center, but there is another fact that efforts for developing infrastructure in this respect have gained impetuous.

4. Bursa as a historic city and an industrial center

Bursa is one of the most important Anatolian cities which comprises the oldest and most authentic examples of monumental and civil architecture and which combines rich tradition, culture, history and nature at the same time. It is a valuable city shaped by a rich cultural heritage and succeeds to reach our times without losing its importance. In the south of the Eastern Marmara, Bursa has been one of the oldest settlements in Anatolia and the first capital of the Ottoman Empire, due to its geographical location, agricultural convenience of its natural structure and its importance from military point of view. Today, being the fourth biggest city of Turkey, Bursa is economically very dynamic and has been undergoing a rapid industrialization and urbanization process. It has one of Turkey's highest population increase rate as a result of its being a focus of large inner and outer immigration. There has been a huge migration from other regions as well as from Balkanic countries since 1950s. For these reasons, unfortunately, the unique historic identity of Bursa has suffered a lot, however the city is still withstanding the onset of rapid urbanization (fig.1).

Fig. 1. Bursa in Turkey

4.1 Urban development process in Bursa

Today, landscape of Bursa is composed of diverse civilizations. The societies governing the region during history have left important cultural heritage. Each civilization trying to establish its sovereignty has also been influenced by existing social and cultural structure of the region. The "cultural synthesis" that forms the city culture is more dominant in Bursa than most of the other Anatolian cities. When the city is examined in terms of historical and social aspects of the cultural evolution, the traces of six periods can be seen. These are; the Prehistorical Period, the Hellenistic Period - including the Aegean migrations and the Persian Hegemony, and The Bithynia Kingdom, The Roman Period, The Byzantine Period, The Ottoman Period and The Republican Period (Anc. of Bursa,1984),(Süel,1996).

The facts that Bursa is located very near to Istanbul, which is an important world city, and that the trade roads have been organized accordingly have been an important factor in the historical evolution process of this city. Automotive and textile ranking first, Bursa is an important industrial city as well as an important international trade center. This situation caused an increased demand for the fertile agricultural fields in Bursa. In the light of these, it is thought that it will be necessary to summarize the processes of urban development and urban housing in Bursa.

Tekeli (1999) thinks that in order to understand the urban transformations experienced by this city and the influences thereof, first of all, the geographical location of the city should be studied. Bursa is located in the south of a fertile plain field, in the north terrace of the Great Mountain's [Mount Uludağ] skirt. Besides this natural structure, another important determinant character of the geographical location is the close distance between Bursa and İstanbul- the city which has conserved its world city properties for centuries. These conditions explain the formation of a pre-industrial city and its transformation to a larger trade center. Bursa became important thanks to silk production in 555 A.D. and has been taken by the Ottomans in 1326. The city has a castle of 800 m lenght in the east-west axis and 500 m width in the north-south axis, an inner castle comprising the palaces of the city governors and an "under castle" part in front of the eastern door which constitutes the main entrance of the city (fig.2).

Fig. 2. Bursa Castle and its near environment in 1921 Map (Bursa Metropolitan Municipality Archieves)

Tekeli (1999) has observed that the city has experienced three important structural changes by now. He briefly explains these changes as follows:

- In the second half of the 14th century, the first major transformation took place. Concomitant to the expansion of the Ottoman territory and due to the delay in the conquest of İstanbul, Bursa became the center for long distance trade. Consequently, bedesten-centered "çarşı" system at the outer castle emerged and became a new focal node of prestige for the city, which determined the development dynamics as well as the identity of the city.
- In the second half of the 19th century, the reconstruction under the influence of the Ottoman Empire's modernization programs stimulated the second major transformation. In this process, Bursa assumed the role of silk thread supplier for European silk weaving industry. On the other hand, influenced by the changes in the political and socio-economical structures of the Ottoman Empire, Bursa is accepted as one of the first cities that created their modern public spaces, after Istanbul and Izmir (Tanyeli, 1999).
- The third major transformation was caused by the urbanization experienced in Turkey after World War II, especially by the changes due to the qualitative increase in industry observed after 1970s in Bursa.

Tekeli (1999) highlights that the fate of Bursa is closely associated with five basic functions and locational specifications of the settlement. The first dimension is related to the central location of the city at the edge of a fertile plain and in the center of a rich agricultural hinterland. The second dimension involves the proximity of Bursa to a world city –İstanbul. The third dimension covers the functions of the city as a long distance trade center. The fourth dimension involves the function of the city as an industrial production center. The fifth dimension is related to leisure and theraphy functions due to the existence of thermal springs. All of these dimensions effected the housing stock of the city, therefore it is also necessary to clarify the developments experienced in housing regions, in order to clearly understand the urban transformation of the city. In the following section urban housing development process of Bursa is summarized.

4.2 Urban housing in Bursa

At the beginning of the 21th century, the city is occupying a very large space. The expansion in the east-west direction is 30 km and in the north-south direction 16-17 km. The population is almost 2 million, in other words the city has reached metropolitan dimensions. The economical structure of the city is very dynamic and diverse. It reflects the problems of an industrial city, of which macroform has rapidly expanded. Tekeli (1999) explains the materialization of urban housing transformation in Bursa in two different ways. One of them is pulling down the existing city patterns and building rapidly new apartment-buildings instead. The second one is the expansion of the city borders by opening new areas for construction. Both of these two implementations has increased the accommodation capacity of the city. Today, we can mention about five main housing groups in Bursa, different from each other in terms of typology. Dostoğlu (2000) classified them as follows:

- traditional housing including most authentic examples of Ottoman civil architecture, which are found both in the center and near environment of the city (fig.3) ,

Fig. 3. Examples of traditional houses in Bursa (A.I.Çahantimur archive)

- apartments, of which construction has started with the modernization movements of the Republican Period (fig.4),

Fig. 4. Examples of apartment blocks in Bursa (A.I.Çahantimur archive)

- squatters (gecekondus), which have been constructed on the forbidden areas in the city periphery by immigrants with their own resources. They have been developed in time in accordance with their family needs and financial sources, as a result of the shortcomings in supplying the housing demands because of the internal and external migrations (fig.5),

Fig. 5. Examples of squatter settlements(gecekondus) in Bursa (A.I.Çahantimur archive)

- social housing blocks which are built with the aim of solving the housing problem in 1950s as an alternative to squatter settlements (fig.6) ,

Fig. 6. Examples of social housing blocks in Bursa (A.I.Çahantimur archive)

- villas and luxury mass housing blocks which have developed as a result of the increased car ownership and nostalgia for a life with garden and are preferred by high income groups in order to avoid the stress of urban life (fig.7).

Fig. 7. Examples of villas in Bursa (A.I.Çahantimur archive)

Unfortunately, in spite of several construction plans prepared and different propositions submitted for the housing problem as from the 1960's, 65% of the housing areas have been established illegally - as is the case with the other big cities. This situation shows that the planning effected only by market powers is not capable of inspecting the city development and in that sense market fails to solve the important problems of the city (Altaban, 1999). In figure 8, the map showing the boundries of the metropolitan city in 1998 can be seen.

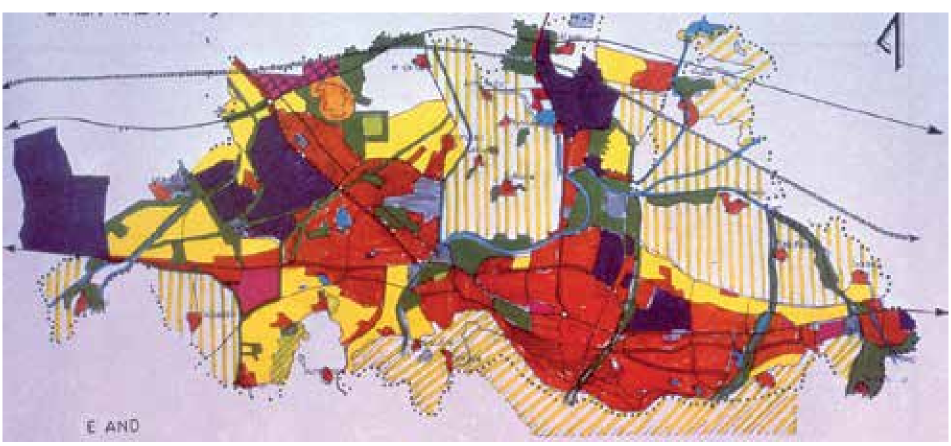

Fig. 8. Map of Bursa in 1998 (Bursa Metropolitan Municipality Archieves)

5. Analysis of the immigrant housing patterns in Bursa

Bursa, as an important industrial city in Turkey, is expanding very rapidly like other big cities in developing countries. Most of the development is in the form of urban sprawl at the fringe of the urban areas. This urban sprawl has led to many environmental and transportation problems and the loss of valuable agricultural land. On the other hand, the squatter settlements around the historic city core, especially the ones ascending Mount Uludağ, in the south of the historic city walls, threaten both the unique identity of the city and natural characteristics of the mountain.

Being circumscribed by Mount Uludağ to the south and fertile agricultural land to the north, Bursa has a linear macroform and is sprawling out in east-west direction. Until 1980s, urban development of the city in physical and spatial context had been mostly to the east. After 1980s, establishment of new industrial zones in the west of the city eventuated in the beginning of a new urban housing development to the west of the city. In figure 9, urban development of Bursa by periods of time is seen. In the figure, the red color represents the urban sprawl until 1958, the green represents the urban sprawl between the years 1958-1976, the yellow represents the urban sprawl between the years 1976-1982, blue represents the urban sprawl between the years 1982-1990, purple represents the urban sprawl between the years 1990-1995.

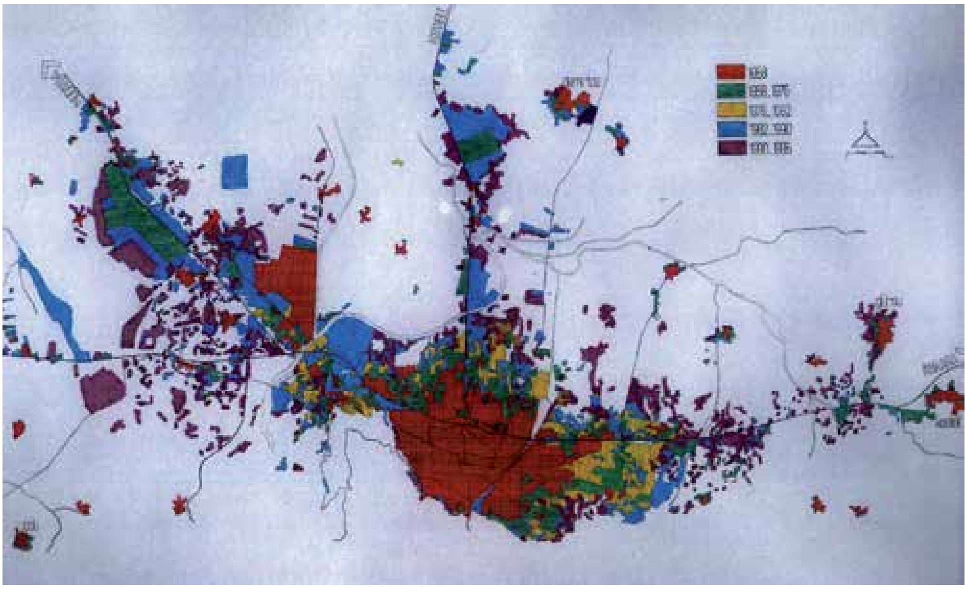

Fig. 9. Urban development of Bursa by certain periods of time (Bursa Metropolitan Municipality Archieves)

Between 1945 and 1960, planned development of industry caused a fundamental increase on the population of the city with internal migration. Mutman (2003), mentions about two important cases which occured during this process. One of them is the development of a gridal settlement area composed of one- or two-storey houses which provide a low standard of living in the northwest of the city. These houses were built to accommodate the immigrants from Balkanic countries. The other is the removal of the factories founded near the city centre to the north side of the city. This radical decision brought about development of new settlement areas around these factories in the periphery of the city.

Types of immigrant housing in Bursa can be classified in four groups, which can be defined as follows;

1. Immigrant housing with gridal layout pattern which is composed of one- or two-storey houses in the northwest of the city (fig 10),
2. Apartments provided by big companies for their employere, near the industrial areas (fig 11),
3. Squatter settlements surrounding the historic city center to the south and sprawling on the agricultural plain throughout the east-west axis of the city (fig 12),
i. Social housing blocks located especially in the east and west ends of the city around the squatter settlements (fig.13).

Fig. 10. Examples of gridlined pattern (adapted from google earth)

Fig. 11. Examples of company dwellings (adapted from google earth)

Fig. 12. Examples of gecekondu settlements (adapted from google earth)

Fig. 13. Examples of social housing blocks (adapted from google earth)

Due to the rapid urbanization process, some legal arrangements accelerated the enlargement of the city borders. In this way, houses in the first two groups are now being located inside the legal borders of the city. But unfortunately, houses in the third group keep on spreading to the fringes of the city in an uncontrolled way. On the other hand, although having been developed as an alternative to the squatter settlements by collaboration of the state and the local government, social housing blocks in the fourth group have negative impact on the silhouette of the city with their massive appearences. In figure 14, types of urban housing patterns in Bursa can be seen, where the color blue represents traditional houses, yellow represents cooperative houses, red represents apartment blocks adjacent to each other, green represents the other apartment blocks.

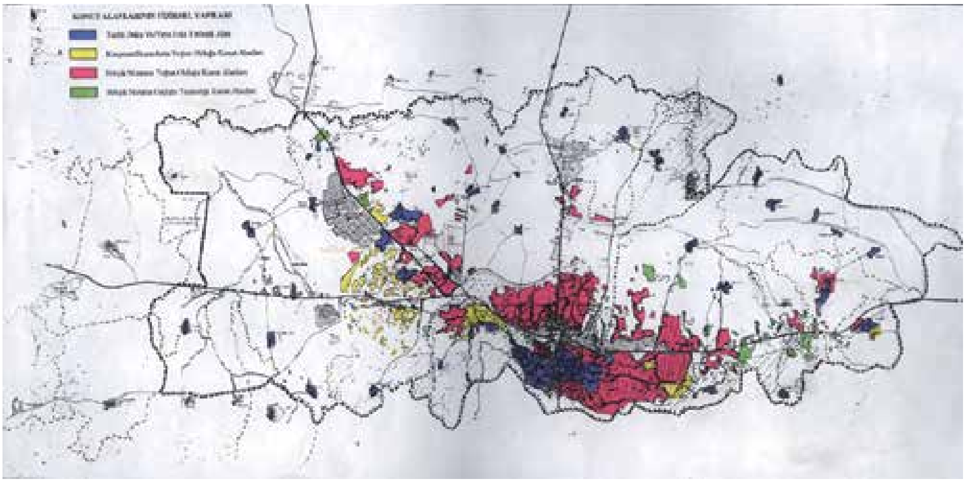

Fig. 14. Different Types of Urban Housing Areas in Bursa (Bursa Metropolitan Municipality Archieves)

In this study, immigrant housing patterns defined in the third and fourth groups, which cause many difficulties in achieving sustainable urban development by giving rise to dispersion of the city, are examined. Squatter (gecekondu) settlements and social housing areas are taken into consideration in two different groups according to their location in the city macroform. As well as being an important historic city, Bursa has had the characteristics of a metropolitan area for a long time. In the light of this fact, it is thought that the analysis of the immigrant housing patterns both around the historic city center and periphery of the city is necessary in order to compare their effects on sustainable development of Bursa and to offer some strategies on the basis of these comparisions. Data collection techniques such as the use of the archives, personal and group observations, interviews, and identification of physical characteristics constitute the data collection methodology. The spatial data obtained from immigrant housing patterns in two different areas will be evaluated together with social and cultural data by means of "objective analysis of physical environment" and "normative analysis" . A conclusion will be drawn with the help of a comparision between the effects of different immigrant housing patterns in the context of the physical requirements of sustainable urban development, as have been mentioned in section 2. The analyses are explained in the following sub-sections.

5.1 Immigrant housing around the historic city center

The first settlement area of Bursa was established inside the historic city castle and then outspread to the areas around the castle, as it was mentioned in section 4.1. The concept of "külliye" which means a living complex including a "han", which is composed of a number of small accomodation units for people and their animals that were used for transportation, a "medrese" which means school, a "hamam" which means public bath, an "aşevi" which means soup kitchen and a mosque is the main characteristic of Ottoman urbanization strategy. As being the first capital city of the Ottoman Empire, Bursa still has many of these living complexes named as "külliye" and traditional neighbourhoods around them. Today the most conserved parts of the city are the neighbourhoods inside the historic city walls and the neighbourhoods around four important "külliyes". However, as a consequence of the urbanization process most of these neighbourhoods has lost their original residents and now they're hosting the low and middle income immigrants who came from the other regions of Turkey. Evenmore, new immigrant houses constructed illegally by the migrants began to mushroom around these traditional neighbourhoods. Especially in the south of the city, there are many immigrant neighbourhoods between historic city walls and the Mount Uludağ (Fig.15). In these neighbourhoods where the topography is made up of steep slopes, houses are mostly put over each other resembling a slow climb up to the Mount Uludağ (Fig. 16).

Fig. 15. A house between the historic city walls (A.I.Çahantimur archive)

Fig. 16. Houses on the lower slopes of Uludağ (A.I.Çahantimur archive)

These immigrant settlements in and around the historic city threaten sustainable urban development of the city in terms of both physical and socio-cultural dimensions. When analysed in terms of physical requirements of sustainable urban development which were defined as quality of life, optimum density and minimum use of energy and resources, the effects of immigrant housing around the historic city center can be summarized as follows;

- Quality of life: The elements of built environment are immigrant houses, either one- or two-storey houses with poor construction materials and systems, or traditional houses. They both have deficiency in terms of physical conditions because of insufficient financial resources and inadequate infrastructure. The squatter settlements composed of "gecekondus" threaten natural beauties and resources of the Mount Uludağ, which is one of the most important natural assets of the city. The poor transportation opportunities and inadequate roads opened without permission cause difficulties in terms of accessibility and safety of the environment. The vitality and diversity of the traditional neighbourhoods are also under the threat of increasing gecekondus because of their damaging effect in the image of the historic city.
- Optimum Density: General opinion about the most appropriate density for sustainable urban settlements is as high as acceptable for the physical and socio-cultural carrying capacity of the environment. The term density includes not only the number of people per hectar, but the buildings and the different functions as well. The immigrant settlements around the historic city mostly have an appropriate density of people and buildings, but there are no other kinds of buildings than houses and this situation shows that the density of functions is lower than required.
- Minimum Use of Energy and Resources: In the past, these kinds of immigrant houses were constructed with traditional materials like brick, stone and timber, and building systems. Consequently they can be recycled and are suitable for ecological sustainability. However, today they are constructed with reinforced concrete which can't be recycled and therefore unsuitable for ecological sustainability. Being near to the city center, people living in these settlements do not have to use motor vehicles in their daily lives, anyway most of them do not have any motor vehicles of their own. The residents use public transportation and this is a desirable action to minimise the use of motor vehicles which is a vital requirement for ecological and physical sustainability.

5.2 Immigrant housing in the periphery of the city

Social housing blocks planned as alternatives of squatter settlements are located in the periphery of Bursa, usually in the proximity of squatter settlements (fig.17)

Fig. 17. Examples from social housing blocks (A.I.Çahantimur archive)

They are funded by the state and constructed with the collaboration of local governments and private sector companies. Although it is easy to observe the rapid land-use changes to urban sprawl and the agricultural land loss in Bursa, detailed and up-to-date information is not available from official sources. However, it is a known fact that a widespread expansion of peripheral development is still going on, along the east-west axis of linear macroform of the city. The vast and widespread expansion of peripheral development not only takes up valuable land and increases transportation problems, but also has adverse effects on the historic identity of the city together with psychological, social and cultural needs of people. Whatever drives its development the periphery usually suffers from inadequate investment in the infrastructure necessary to integrate it into the city. When analysed in terms of physical requirements of sustainable urban development, the effects of immigrant housing in the periphery of the city can be summarized as follows:

- Quality of life: The elements of built environment in the periphery are immigrant houses, either one- or two-storey houses with poor construction materials and systems, or multi-storey social housing blocks. The first one -gecekondu- has deficiency in terms of physical conditions because of insufficient financial resources and inadequate infrastructure. The second one -social housing blocks- have better physical conditions indoors than gecekondus, but outdoor conditions are not better than gecekondus'. Social housing areas as well as squatter settlements threaten the fertile plain and agricultural activities. Accessibility and safety of these settlements differ from each other according to their location in the city and socio-cultural structure of their immigrant population. There is no vitality and diversity in these environments, because the houses or blocks they contain are all the same kind and are standing side by side along narrow roads.
- Optimum Density: The immigrant settlements in the periphery of the city mostly have a high density of people and buildings, because of multi-storey social housing blocks and apartment-like gecekondus. However, the number of other kinds of buildings is not big enough to say that there is a high density of functions.

- Minimum Use of Energy and Resources: All of the immigrant houses in the peripheries are costructed with reinforced concrete and have inadequate standarts of environmental control. Therefore they are not suitable for ecological sustainability. Being away from the city center, the residents of these settlements have to use motor vehicles more than the ones near to the city center. This situation makes the reduction of car use and traffic emmisions impossible.

5.3 Conclusion: The impact of immigrant housing on the sustainable urban development of Bursa

As a result of archival data analysis and observations made in the selected immigrant housing neighborhoods, physical, historical and socio-demographic data have been obtained regarding these areas. The analysis of data connote that, immigrant housing areas both around the historic city center and in the periphery of the city have negative impacts on the sustainable urban development of Bursa. Immigrant settlements both around the historic city center and in the periphery of the city-, damage the identity of the city in terms of spatial and socio-cultural components, which are significant for achieving physical and socio-cultural sustainability of the city. Especially gecekondus around the city core threaten the uniqueness of the architectural and cultural heritage of the historic city. On the other hand, immigrant settlements in the periphery of the city increase urban dispersal which cause the agricultural land to be lost. They divide the city into sub-centers that are not easy to access. In most of these settlements “quality of life”, that is the overall aim of sustainable urban development, is low in all its aspects. These settlements are faced with most of the indicators of unsustainability like inadequate infrastructure, unhealthy environments, deficient open and green space, poor access to the services and transport systems.

6. Discussion: Strategies for sustainable urban development of Bursa

There is an urgent need for new strategies and policies to strengthen the role of Bursa as a historic city, providing socio-cultural integration, economic vitality and sustainable living environments. More flexible and responsive planning tools that require a strategic understanding and good local knowledge are needed to manage these development goals. It must be highlighted that a considerable effort in developed countries has been devoted to the measurement of sustainability indicators. To adopt this approach may be the starting point for Turkey, as for the other developing countries. Research and analysis of specific realities in different urban settlements are required in order to find possible ways of achieving sustainable urban development of historic cities in developing countries, like Bursa.

As understood from the related literature and successful implementations all over the world, achieving sustainable development requires appropriate policies of planned higher density, mixed – used development in city centers and in peripheries along corridors well served with public transportation. The planning approach to the development of historic city center in Bursa should be more sensitive to the existing traditional fabric, which can accommodate a whole range of economic activities. The value of the social network of traditional neighbourhoods, cultural diversity and economic opportunities should be recognized and, rather than being swept away, they should undergo environmental improvement in order to increase carrying capacity of the historic city core. On the other hand, the ongoing migration and urbanization processes and location of the existing immigrant housing settlements show that Bursa will be a polynucleated metropol in a very near future. The important points of attention for the future developments should be first of all improvement of public transportation and road capacities, and then intensification of existing low-density areas, particularly around transport interchanges and along transport corridors. These will bring about the prevention of existence of new settlement areas in the periphery of the city.

As a last word, action for sustainable urban development needs to be taken at all levels, but local authorities and communities themselves may be best able to set priorities for and to implement projects. Consequently, investigations about the psychological and socio-cultural aspects of urban environment have to be considered as a vital part of the sustainability policy of the historical cities.

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10

Istanbul's Backbone – A Chain of Central Business Districts (CBDs)

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1. Introduction

Istanbul is one of the most attractive metropolis of Europe today. *Cultural capital of Europe in 2010*, the city is invaded by millions of tourists and ten thousands of business people every year. Istanbul is the primate city of a very self-confident Turko-Islamic state which is inhabited by nearly as many people as the population of Germany. The city is Turkey's keystone to Europe – that is more important as the commonly mentioned link between the continents. Recently Istanbul's position within Europe has been cemented by being chosen as Europe's capital of culture 2010. A remarkable exhibition (Istanbul 1910–2010) gave a detailed view to the urban development and structure of the city (catalogue: Bilgin 2010). Just before this, in 2009, the Urban Age Conference took place in Istanbul. Within a publication (Urban Age 2009) joined to that conference some relevant topics for modern Istanbul are mentioned: globalisation and the city's position (Keyder, Sudjic 2009), urban development (Güvenc & Ünlü-Yücesoy, Geniş 2009) and local trends (Aksoy, Sarkis 2009).

The urban development is hard to describe because it is changing very fast: what is constant in Istanbul is its permanent change. The growth of the city and the fragmentation of its core areas are well documented in different publications starting in the 1990s (Heller & Gerdes 1991, Dökmeci & Berköz 1994, Tokateli & Boyaci 1999) and continuing until recently (Ersoy 2009, Güvenc 2010). Seger & Palencsar contributed with a monography 2006.

Our attempt to characterise the metropolis and its development *focuses on its central business districts*. Recognising the urban morphology, several areas with special central functions, CBDs of the past or in action, create the unique diversity of ambience and richness of culture (McAdams 2007).

This article will focus on the following issues:

- Each of the periods of urban development in Istanbul *created their own and unique CBD*, spatially separated, especially from the Ottoman time.
- *Urban extension* in different periods (and not urban renewal) is the base of the *chain of CBDs*. Urban extension is a special way of *production of space*. The spatial separation of the "new and modern" grants independent development aside from the problematic infrastructures of older parts of the city.

- The "Chain of CBDs" consequently grew in several time periods, the location of the younger CBDs is related to the city´s recent focal points.
- As a result, a chain of *CBDs of different origin* and function represents Istanbul's development from historical times to now. Due to the crucial functions of each of that CBD areas, the term "backbone" was created.
- Even the metropolis Istanbul is fragmented differently, the chain of CBDs marks a line of important urban spaces: the city's backbone.

Each of these central areas is characterised by an individual scenery, founded in the period in appearance and sometimes subject to manifold change later on. In the methodology, to identify urban spaces by different perceptional variables, we use the ideas of *Kevin Lynch*: different areas are also distinguished by their *image*, that means by origin, shape, function and spatial pattern (Lynch 1960). The urban elements (CBDs) which will be presented in this article are identified by their different history, as well as by their special function nowadays. The knowledge for this is based on former investigations (Seger & Palencsar 2006, Seger 2010), catching the urban morphology for special issues as was done for Istanbul in parts before (geographically: Leitner 1981).

The chain of subsequently added CBD structures has two dominant and prominent final points – the *historical core* and the *post-modern skyscraper city*. In between, a continuous line of CBDs and central places form the backbone of the city, as Fig. 1 shows. Walking that line, one moves from Topkapi and the Bazaar area to the Galata bridge, reaching the Istiklal Boulevard and Taksim. Passing the nowadays crowded Şişli (Tesvekiye, Nişantaşi) one arrives at Gayrettepe, Levent and Maslak – the uppermost central areas today. In the following article one can repeat that walk. Chapter 2 illustrates features of the historic centre as the main cultural CBD and the touristic centre nowadays, chapter 3 deals with the modernisation at the end of the 19th century on both sides of the Bosphor and at Pera. Chapter 4 analyses the rise of the city in the decades after WW II. Chapter 5 presents the northern and most innovative part of the chain of CBDs and in chapter 6 the specific urban form of the different CBDs of Istanbul's backbone will be revisted.

2. Historic centre past and present – The backbone's traditional CBD

The CBD of the monocentric city in former times leads to the Greece, Roman and Ottoman periods of Istanbul. The Greek city of Byzanz got its first imperial function when the Roman emperor *Constantine the Great* decided to chose it as his new capital in 330, naming it *Nova Roma*, and later Constantinople. A huge fortification, the Theodosian wall (379), remains nowadays in the early Byzantine period. The area east of that wall is the so called *Historic Peninsula* – delineated to the north by the Golden Horn Bay and to the south by the Marmara Sea (Photo 1). Due to the Byzantine monuments (e.g. the *Hagia Sophia*) and the later built Ottoman mosques and palaces (e.g. the architecture of *Mimar Sinan*) these areas of the ancient imperial town were chosen as *world cultural heritage sites* in 1985.

The partition of the Roman Empire took place in the year 395, the end of the Empire's western part (with Rome as its capital) happened at the latest by 476. The East-Roman Empire and its capital Constantinople existed until 1453, when the surrounding Ottomans overtook the city. Weak in the last centuries for diverse reasons, Constantinople was a successful stronghold in Medieval times, such as when in the 7th century it resisted the Arabic-Islamic. In that time Constantinople was the *primary global city of arts and culture*, especially in relation to the underdeveloped Central Europe.

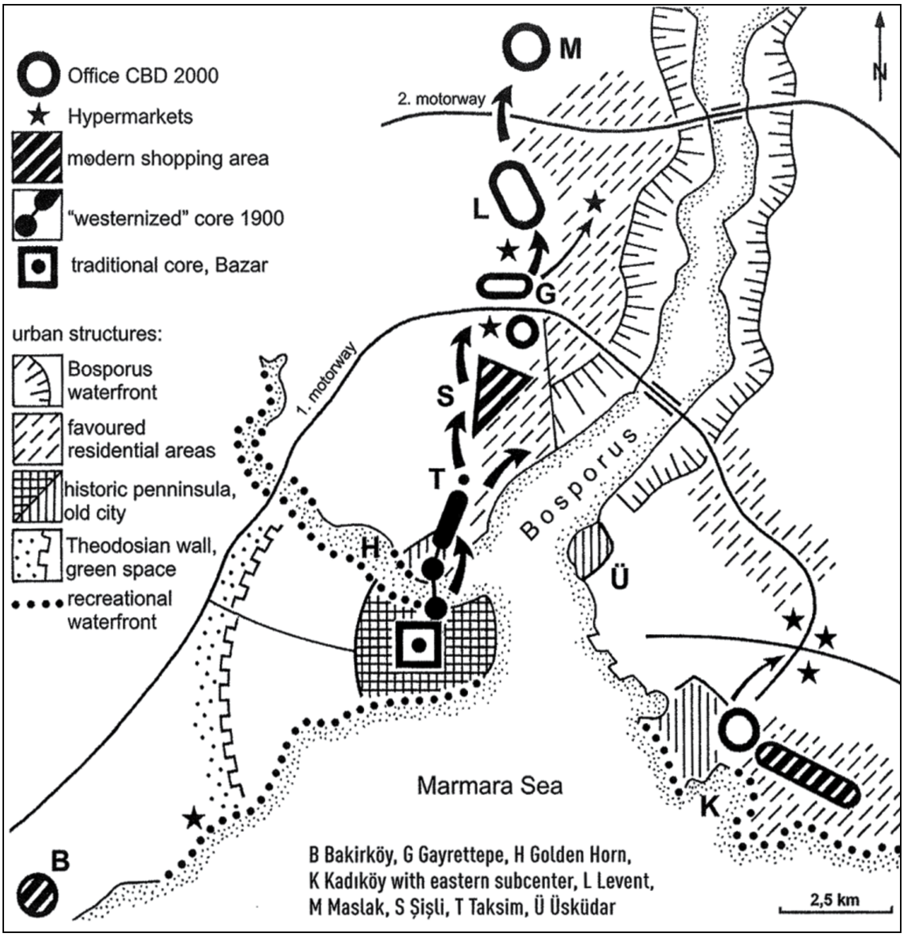

Fig. 1. Istanbul's backbone – a chain of CBD areas from the historic peninsula via Taksim and Şişli (T, S) to the skyscraper areas of Levent and Maslak (L, M), 2010. A consequent movement of central urban functions towards the spatial hot spots of the city leads to that chain of CBDs. Draft: M. Seger

When the Ottomans took over the city, a new and very different layer of built culture formed the shape of the city. Form follows function, of course, but form follows in a very unique way *special cultural ideas*. So, the new Ottoman culture transformed Istanbul into a *showpiece of Islamic architecture*, and architecture is a reflection of culture. On the other hand, some remarkable pieces of Byzantine art did remain and were eventually transformed (the Hagia Sophia became a mosque), and other churches were also replaced by mosques. The

Photo 1. Historic peninsula, a world heritage site. Sultan Ahmet-Mosque (front), Hagia Sophia-Museum, Bosphor. Golden Horn left side. View northward to the Bosphor. Source: Keskin Color, 1985 (compare Fig. 1, 2).

Photo 2. Inside the Great Bazaar, a centre of shopping and tourism, 1992 (compare Fig. 2). Up to 1950 a centre of retail and wholesale as well as traditional handicraft.

Ottomans (whose former headquarters were at Bursa and Edirne) ruled in Istanbul from 1453 until 1918 and *Istanbul again became a global city*. Not only as the centre of Sunna-Muslims (Osmanic Caliphate 1517–1924) but also because of its military power (besiegement of Vienna 1683), at least up to the 18th century.

The change from the Byzantine to the Ottoman period is characterised by a remarkable *continuity of the locations* of urban functions. The acropolis became the sultan's stronghold with barracks and fortifications, and with a palace, the modern museum Topkapi. The main road at the peninsula's ridge is today the same as in Byzantine times, it connects the former emperor's quarters with the market area. This market area was the Roman-Greek *Forum*, where nearby the *Great Bazaar* (Photo 2) was founded. Even the residential areas and the harbour site at the Golden Horn/Chrysoceras/Halic were retained at the same location.

The *traditional CBD* kept its monocentric urban status up to the period of westernisation and modernisation during the 19th century. The sultan left Topkapi to his palace Dolmabahce at the Bosphor and new quarters were taken up at Pera (see chapter 3). The monocentric commercial functions remained until the late 1950s. Starting around 1970, the historic centre was given new *touristic functions* as well as developing shopping facilities – primarily for people from the socialist states in Eastern Europe. A world heritage site from 1985, the traditional core is nowadays a cornerstone of the Turkish identity and a vital part of Istanbul's economy. Revitalisation (Gezici & Kerimoglŭ 2010, Bütüner 2006, Ozus & Dokmeci 2005) and gentrification (Ergun 2004) have accompanied those new functions.

3. Fragmented CBDs in 1900: Early modernisation and bipolarity

During the 19th century (up to 1900) the city grew rapidly as the following data show: 1826 - 360,000, 1856 - 450,000, 1885 - 874,000 – and 1897 over 1 million inhabitants. In that time Istanbul was inhabitated by a *multi-ethnic society*. Muslims were just in the majority (52%), Armenians and Greeks were 16% each and 4.5% were Jews. Additionally, 13% of the population (1897) were counted as foreigners (not Ottoman citizens), most of them being Europeans from different countries, mostly businessmen. In the decades before 1900 the political and economic relations of the Ottoman Empire to Europe had been reinforced. A *general modernisation* in urban form, mechanisation and industrialisation took place in the capital. Politically, the Ottomans lost their influence in south-eastern Europe (the Balkans), but the European empires had been interested in keeping up relations with the government at Istanbul – for intensive economic reasons. At the same time, and similar to big cities in Europe, town planning and modern urban infrastructure (building technology, electricity, mobility) occurred. A "*European" part of Istanbul* arose at Pera (Photo 3), a plateau north of the Golden Horn, connected with the Galata Bridge by an *underground cableway tunnel*, the first in Europe. The railway connection to Europe was constructed by 1873 and nearby another modern CBD grew up between the railway station *Sirceçi* and the area surrounding the *Galata bridge* (see Fig. 2, shaped like a dumb-bell).

A bipolar city structure was a fact in 1900. How did the structures in the traditional centre look like and *why did the city move toward the Pera hills*?

At first, the traditional core between Topkapi and the Bazaar area (Fig. 1, 2) was the powerful centre of the *state's administration*: the Ministries of Finance, Interior, External

Affairs (Sublime Porte) and War (today: Istanbul University) had been located here in modern buildings. The big Bazaar area nearby covered numerous workshops, similar to the coastline at the Golden Horn. On the northern side of the Horn, and this is necessary to mention now, the quarter of *Galata* is unlike the other city areas. This quarter with its Mediterranean stone buildings was mostly inhabited by Europeans, and by Greeks and Armenians for centuries. The location of Galata and the neighbouring Pera were highly valued by France, the United Kingdom, the German Reich and Russia when they located their embassies there. Pera *became the hot spot for the modern and urban lifestyle* in Istanbul before World War I. Its centre, the *Istiklal Caddesi*, was a high level shopping area and *Istanbul's first modern CBD*. Located between the *Tunnel* and the *Taksim*-Place, its topographical position is significant for the location of the following urban centres.

Photo 3. Istiklal Cad. at Pera 2010. Westernised CBD of Ottoman Istanbul around 1900 (Grand Rue de Pera, compare Fig. 2). Renewed nowadays after blight till 1990.

By 1900, there was a bipolarity of the city centre and three different CBD areas were also distinguishable (see Fig. 2). One of them is the *traditional core* with governmental functions and the famous mosques: *Ottoman-Islamic identity* – surrounded by traditional urban work space. Remote from that, at the Pera plateau, a *segregated westernised society* had an everyday life similar to that in a European city. These residential, shopping and entertainment areas were one part of Istanbul's modern city. The other area was the CBD complex *on both sides of the Galata bridge*. Similar to the function of the bridge as a hinge, this CBD complex links the administrative core near Topkapi and the westernised core by the CBDs functions: a modern *economical administration* with banking and insurance offices, the main post office, with harbour facilities and the main railway station.

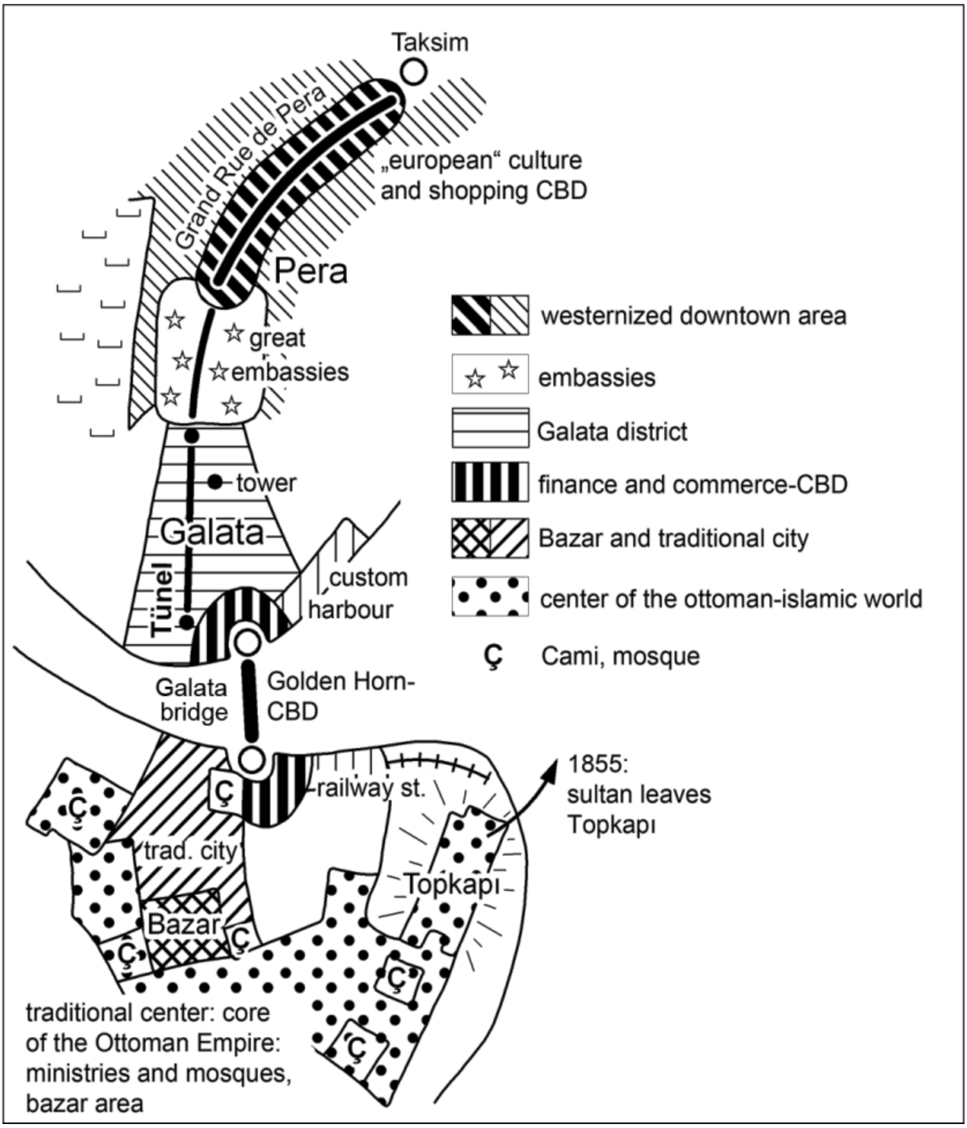

Fig. 2. Fragmentation at 1900: traditional core and two modern CBDs. Modern functions at new locations – the movement of CBDs starts. Draft: M. Seger.

The built up area of Istanbul did now (1900) cover both sides of the Golden Horn and also the area east of the Bosporus: Aside the old bridgehead of Üsküdar Kadiköy became important. In Kadiköy, today Istanbul's Anatolian centre, the head station of the Bagdad-railway was built.

4. Rising to a world city again: 1950 – 2000

The end of World War I (1918) was at the same time the end of the Ottoman dynasty, analogous the fate of the Habsburgs (in Austro-Hungary) and Wilhelm II at Berlin. For Istanbul the time that followed was extremely hard. When Kemal Pasha, a cavalry officer and leader of nationalist young men (who complained about the decline of Turkey) got the leadership of the post-Ottoman country, he decided upon Ankara as the new state capital. Turkey was a very undeveloped country in that time and the decision was correct, in respect to enforce modernisation in the Asiatic hinterland.

But for Istanbul the decision meant losing its international reputation with the embassies and other international organisations moving to Ankara. Another significant blow was the exchange of population between Turkey and Greece in the early 1920s, repeated in part in the 1950s: Istanbul lost most of its Greek and Armenian population. This seriously held back the city's development for decades and turned it to a (mostly) monoethnic society. After a stagnant period (1920–1945), this situation was the starting point of the development after WW II, which is characterised as *a period of rapid growth, a changing urban structure* and *take-off phases* as shown in Fig. 3. For the corresponding spatial development see Fig. 4.

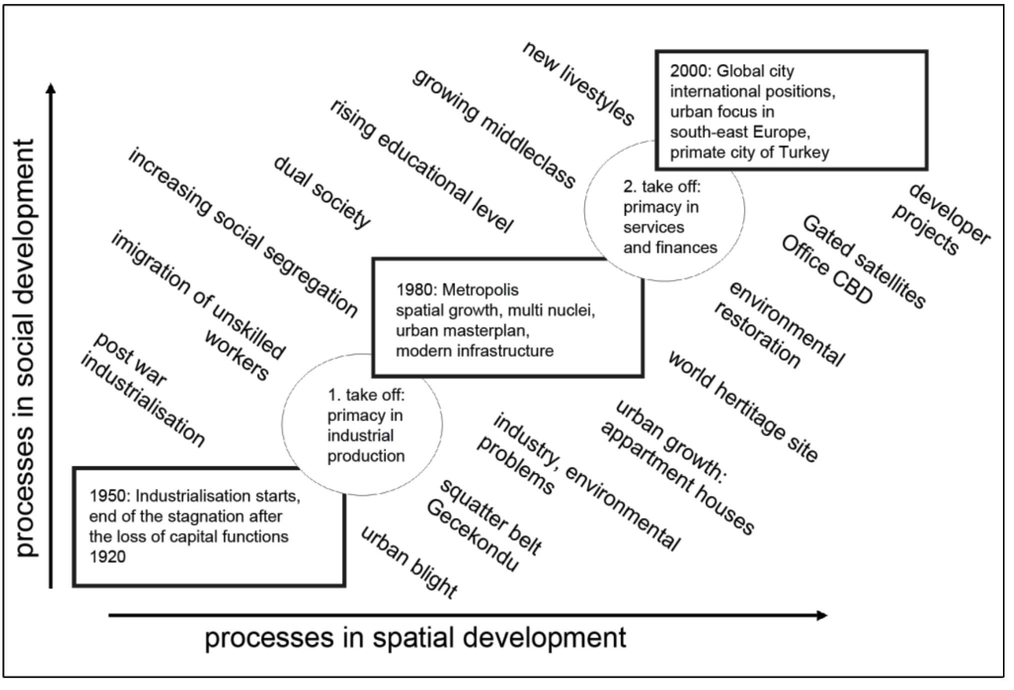

Fig. 3. Steps to a global city: the spatial change and social development of Istanbul 1950-2000. Three stages of urban development and two phases of "take off". Concept: M. Seger.

In the decades between 1950 and 1970, Istanbul's growth was driven by an intensive industrialisation, especially in the following branches: textile, leather, clothes, chemical goods and machinery. A city of 1.2 million inhabitants in 1950, this number rose to 1.9 million in 1960 and to 3 million in 1970. The growth of the population was dominantly caused by migration, mostly unskilled and from Anatolia. The industry was located west of the peninsula, at the Golden Horn and on the Asiatic bridgehead of the city. The migrants built their squatter homes in general near to the factory sites, so called *Gecekondu* – meaning 'built over night'. A ring of *squatter areas* characterised the fringe of the city, its new inner parts dominated by apartment blocks. The direction of the growth at that time is documented in Fig. 4 and the fragmentation of the *shape of the city in three main parts* (Penisula, north of Golden Horn, bridgehead in the east) produced several subcentres. Up to 1985 (1985: 5,8 mio. inhabitants) new industrial areas were founded and the crowded situation made it necessary to remove most of the industries out of the city - the start of *environment protection*.

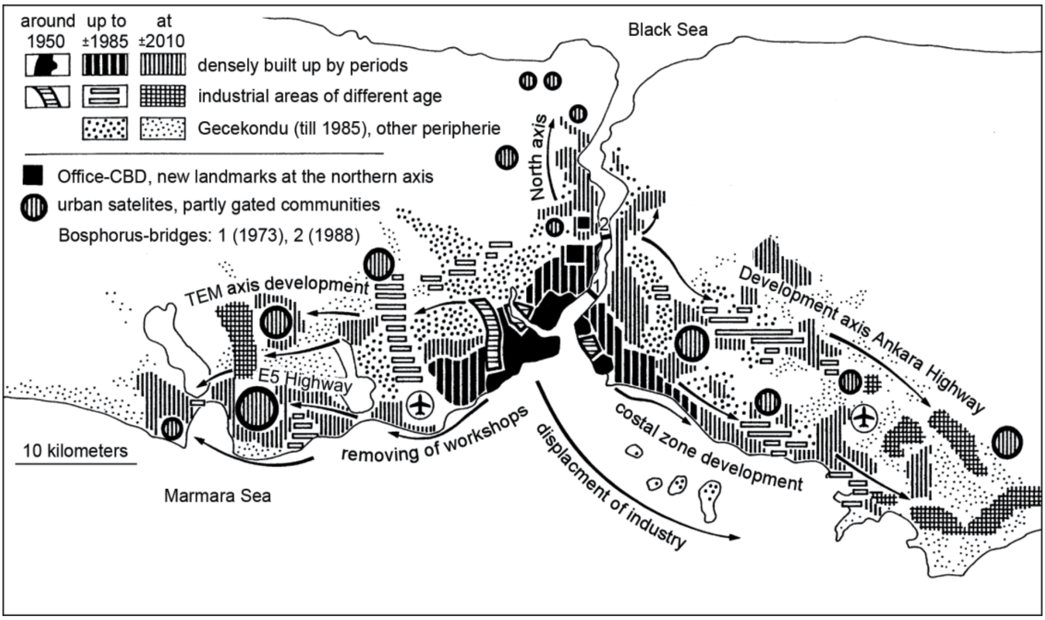

Fig. 4. Changes in the urban form of Istanbul 1950-2010: ribbon development at the seaside, growth and fragmentation, satellites and displacement of industry, belt of Gecekondu, later upgrading. Draft M. Seger.

The *CBD areas* (Fig. 1) underwent the following changes in the period 1950–1970:

- At the *traditional core*, the Bazaar lost parts of its wholesale functions – but obtained new customers from the socialist satellite states. A Bazaar-mantle area (the Laleli district) arose with textile shops and hotels for those people as well as for western tourists. So the historic peninsula started to turn to new functions.
- Governmental institutions left the old city and the Golden Horn-CBD. That areas lost their former position and turned nearly to an inner city slum.
- Also the Tunnel-to-Taksim boulevard *Istiklal Caddesi* showed a heavy blight phenomena.
- An area of *expensive consumer* goods (Photo 4) grew north of Taksim square, see the *triangle* in Fig. 1 and the symbol "S" for the district's name Şişli. The shops there are the

consequent reaction to the demand from a growing upper middle class only at Şişli and north of that area.

- Even though not a part of the CBD "chain", one should not forget the centre of the *Trans-Bosporus-Istanbul*, the Kadiköy CBD (see Fig. 1).

The *industrialisation* brought Istanbul back to the prime position among Turkey's cities and even before the fall of the iron curtain (1989) tremendous numbers of tourists from the so-called *socialist states* did their shopping tours in Istanbul. It was the time of *luggage trade* with the wholesale of western products at cheap prices. The low prices of Turkish goods are related to low wages for the working people in comparison to central Europe.

Photo 4. Road and shops in Şişli's Golden Triangle near the Osmanbey metro station. Founded in the 1970s, the area has become the most fashionable shopping district nowadays, 2010, "S" in Fig. 1.

5. Recent development: Northern part of the city's backbone – specialised CBDs in a globalising metropolis

Starting between 1980 and 1990 a *second take-off* of the city's size, structure and position took place in Istanbul (see Fig. 3). The result nowadays is a booming metropolis (Güvenc 2010), a *city too big to fail* (Urban Age, 2009), with more than 13 million inhabitants in the metropolitan areas (the district Istanbul). The basic power for this development is Istanbul's *primary city function*, which can be demonstrated as follows: 86% of Turkey's headquarters are located in Istanbul and half of the 500 great industrial estates. The city shares 35% of the state's commercial and service activities and contributes 43% to Turkey's tax revenues. Most of the foreign banking institutions in Turkey and most of the private universities are located in the city. More than half of Turkey's exports and imports take place in Istanbul and about 7.6 million tourists and shoppers from abroad (2009 approximately, 22% of Turkey's tourism) visited Istanbul. The relation *services:industry* in the formal sector is 62:38 (Istanbul Chamber of Commerce 2009). Istanbul is still a goods producing city, beneath the growth of the financial sector and related variables (which indicates a post-industrial and globalised structure). The revenues of the relevant employees rose and a new middleclass has now been created. Their new lifestyle is oriented on real estate as well as on consumer attitudes: 60 shopping malls were built in Istanbul between 2000 and 2005.

What does this mean in relation to *CBD development* within the last decade? At first, the tremendous growth of the metropolis is fragmented by different functions and levels.

The dominant new CBD structures are located in the middle part of the metropolis, *continuing the CBD chain with a north bound axis*; see Fig. 1. The region north of the "triangle" in Şişli is characterised by four facts:

- the area near the Bosphor is favoured as an expensive residential zone (see Fig. 1, Photo 5),

Photo 5. Konus-Hypermarket and Apartment-complex, Levent. Globalised aspects of architecture and lifestyle, "L" in Fig. 1.

- high ranking governmental institutions (Istanbul Technical University, Military Academy) and sports grounds mark the edge of the city near Maslak (M) and Levent (L),
- the accessibility of the whole area is excellent due to *two motorways* which connect the European and the Asian part of the town (Photo 6); Bosphorus-bridges: 1973, 1988.
- the CBDs from Maslak to Taksim square (M, T in Fig. 1) are connected by Istanbul's only underground (Metro) line, a prolongation to the historic peninsula is under construction.

Within that *Taksim to Maslak axis* the most recent CBD developments have taken place. Important to notice is the *spatial disaggregation* of the different types of new services. The financial CBD is spatially isolated from the city's shopping areas. The huge buildings signalize another proximity: that one to the *global financial market*. The financial sector created the office clusters at Levent (L) and Maslak (M) (Photo 7) and consumer services are concentrated at the "*triangle*" in Şişli (S).

Photo 6. At the crossroads: central motorway (left to right) crosses the main axis of the CBD chain, dominant building: Tat tower, Levent left, behind. Gayrettepe 2010, "G" in Fig. 1.

6. Conclusion: Chain of CBDs revisited

Summarising the different functions of the *chain of CBDs in Istanbul* – as shown in Fig. 1 – one can detect globalised and at least transnational aspects in each of them, as pointed out in the following.

Traditional core, world heritage site

Starting with the *traditional core,* it should be mentioned that this has been designated a UNESCO *world heritage site since 1985*. Istanbul's *brand awareness* is strongly related to the shape of the historic city which turned into a global touristic attraction. Characterised by Photos 1, 2.

Banking and Finance CBD

At the other end of the *backbone of the metropolis,* clusters of *skyscrapers* at *Levent and Maslak* are the metaphors for the city's powerful financial sector, post-modern and globalised at the same time. Their silhouettes contrast with those of the Ottoman minarets and the city's logo attempts to combine that. Vertical gated communities (apartment towers) and exclusive hypermarkets (e.g. Konus, leave Metro at Levent) are mixed with the office towers in that CBD area. Documented by Photos 6-7.

Photo 7. Maslak from south, Büyükdere Cad. Office towers right, vertical gated city left. Northern end of the chain of CBDs, "M" in Fig. 1.

Prime Shopping CBD

The ultimate hub for shopping and entertainment – now called the *golden triangle* - is a district in Şişli (S in Fig. 1). Clothing outlets, international brands as well haute couture can be found in the narrow lanes of Nişantaşi and Teşvikiye (Photo 4), the location of the city's *new creative class* (leave Metro at Osmanbey). It is remarkable that shopkeepers, formerly located near the touristic overcrowded Bazaar area are now moving to Nişantaşi with its upper class and international customers. Both the financial quarter and the "golden triangle" enlarge the imagination of Istanbul: they are *new post-modern locations*, spatially remote from the waterfront city at the Bosphor and the Golden Horn.

Fin de Siècle - CBD rediscovered

Proceeding southward, the space between the "golden triangle" and the traditional core is not at all an empty place. The fashionable CBD of 1900 south of the Taksim square (T), downgraded up to the 1970s, is now revitalised and a *city of pedestrian avenues* (Photo 3). The surrounding flourishes now as an entertainment quarter with different types of restaurants.

Galata bridge and the Golden Horn – the focal point of different intersections

Photo 8. At the Galata bridge 2010. Golden Horn, Focus of Istanbul's "multiple intersections". Suleimaniye mosque in the background.

Coming down from the Pera plateau through Galata to the Golden Horn and to the Galata bridge, with the view to the mosques and their minarets, and surrounded by different noises and senses of smell one is entering another world. A permanent motion of people, vessels and cars creates an imagination: the *Golden Horn area*, this is the city's core for the common people.

At this busy waterfront with its socially and economically different functions (Photo 8) ends the presentation of Istanbul's chain of CBDs. At the waterfront on feels as though at a crossroads. Between Europe and Asia, ancient sites and modern quarters, between social levels, and between past and future. Away from the shoreline and on the way to the Asian bridgehead one can watch the skyline and the *chain of CBD* landmarks. Maybe that's Istanbul's secret: to be close to ancient times and simultaneously part of a global network.

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Part 4

Spatial Analysis and Urban Development

11

Two Ways of New Towns Development: A Tale of Two Cities

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1. Introduction

New Towns, or Planned Communities, are cities in which all aspects of development are determined before construction begins. Eichler and Kaplan (1967) and Griffin (1974) have defined "new community" as a large development, generally over 1000 hectares (2500 acres) that has a comprehensive and mixed-use design conforming to a single master plan and a socially diverse population. The most self-contained are also called "new towns". The related term, refers to a community that seeks to produce a range of valuable social, environmental, and economic benefits than more conventional, less comprehensively planned developments are likely to achieve. Such communities have been proposed as creative alternatives to conventional developments for many years and in many countries. New Towns are generally thought of as being of two types: 'independent', if they contain employment for their own residents and 'satellite[1]' if a substantial number of residents commute to another metropolis.

Development of New Towns is expensive, particularly the provision of their infrastructure. Despite a high level of subsidy from central government and often regional authorities as well, the new towns remain heavily in debt, a problem exacerbated by the currently much reduced rates of demographic and economic growth.

The slow pace at which land is being acquired and premises are being occupied increases the burden of repaying the loans contracted to finance development. Additional financial difficulties have arisen over the running of the new towns' services, due to the present relatively small local tax income, which is available to support them.

Similarly, certain of the amenities originally provided were designed in the expectation of much larger populations and reflected the government's expressed wish to create new communities, which were fully equipped from the outset, a policy that implicitly recognised that there might be initial operational difficulties. Thus, while the services may be desirable, they represent a particular problem to finance.

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[1] Some authors use the term satellite for new towns that are self-contained but whose residents use some of the facilities of nearby cities.

The idea of New Towns had begun in Europe, specifically in United Kingdom and afterwards in France and United States following more or less the direction of E. Howard in his book “Garden cities of tomorrow” (1902). There are cities that are created because of a political-administrative decision[2]. Those new cities are urban spaces where people can life, work and spare its free time. Howard town-planning conception is the planning of the city as a space assigned to houses, commerce, culture and industrial areas. All of this reconcile with the environment protection. Most of these new cities were understood as big city clearing, for that reason, the ideal of inhabitants is 250.000. But, one of the most frequent reasons for wanting new towns, as Alonso (1969) have said, is that they will be planned.

The development of New Towns in US differs from the European model. The main difference is the management and the financing. In United States, financing is private or public-private partnership and in Europe is public. In Europe central governments sponsored new town development but in US they were sponsored by private real-estate developers. Compare to Europe American new towns were less directed by national social policy. Distribution of the city is also different, in US in the heart of the city there is “the loop”[3] where is located offices, shops and hotels and people lives in suburbs, in that case the car is part of the city. The administrative structure of New Towns in US varies, sometimes it is dependent of other cities and, other New Towns have their own government.

This chapter first outlines how New Towns were developed in Europe and in United States explaining the differences between the two ways of development. Later on, we show the case study of two cities. Those cities are The Woodlands (Texas, US) that belong to US model and Tres Cantos (Madrid, Spain) that fit in the European model of New Town development.

2. New towns in Europe and in USA

It has been Ebenezer Howard the pioneer of New Towns planning. In 1898, Howard publishes his book “Tomorrow: a peaceful path to real reform”. Even though he wrote that book, his most famous one is “Garden cities of tomorrow” (1902). We can see his concept of New town represented with his idea of the three magnets (figure 1).

Howard was so worried about migration from countryside to the cities; both ways of life are totally different. Cities attract people form villages but it spread them in a spontaneous and disorganised way and this make appear suburbs. For that reason Howard said that it must be created a new way of life that take advantage of both worlds. It has to be a town that combines city dynamism and rural beauty. City offers more employment, higher wages and entertainment but also has higher prices, overcrowding and long trips. For that reason, Howard proposes a mix of both worlds, a place where people can live and work in a beautiful environment. His urban conception is city planning where houses, commerce and cultural centres coexist with industry and countryside. The garden city is not a suburb it is integration between rural and urban.

New towns are previously planned and it is determinate where it is going to be infrastructures, economic activity (industry and commerce) and social services (education,

[2] We are not talking about dormitory towns.

[3] Ernest W. Burgess *The growth of the city: an introduction to a research project.*

health and leisure). Citizens have the opportunity to participate in city governance and influence on political decisions during city creation.

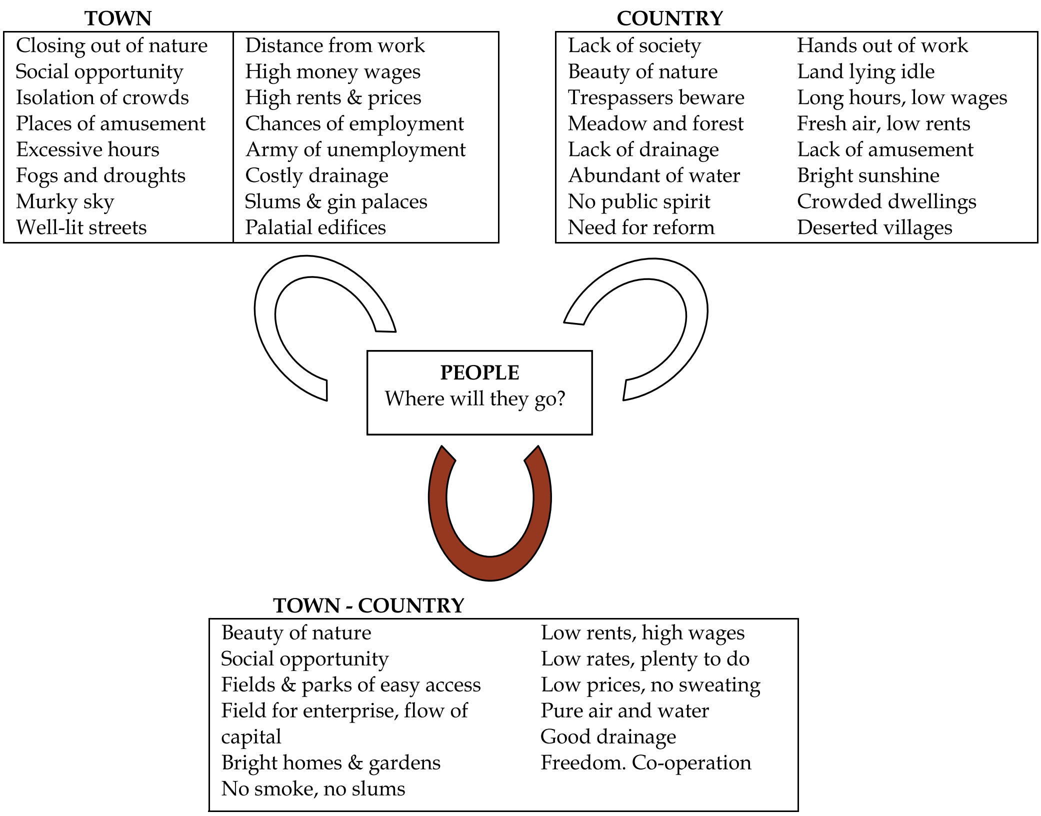


Fig. 1. Howard's three magnets

In recent years, the role of the State has been change. We pass from an old administration where government has the control of supply public services to a New Public Management (NPM) reform (Hood, 1991) where the public-private partnerships (PPP) have appear and developed. This reform has been grounded in institutional economic theory. Several studies have examined public-private partnerships involving concessions, leases or management contracts for the provision of utilities, education or health care from such differing theoretical perspectives as transaction cost economics (Crocker and Masten, 1996; Huet and Saussier, 2003), or agency theory (Guasch, Laffont and Straub, 2003). The development of partnerships with the private sector has emerged as a key element in implementing public policies and programs.

However, we have gone one-step ahead and citizens get involved in public decisions and manage some public services. Government may be seen as providing public goods and services as a result of market failure, but sometimes government do not deliver those goods either. Buchanan in 1979 has said that government failures occur when government is inefficient in the production of public goods. In such cases, private agents can provide services on their own or with the support of the public sector. In planned communities in

US, where private companies have developed a town, developers take over a significant number of roles traditionally played by government. They build roads, streets, sewage system, and provide other services normally associated with government.

Foldvary (1994) says that in cities where government provides goods and collect taxes the owners of the land are free riders, but in New Towns, where goods are provided by the site owner or by an association, free riders vanish because users pay for the services they get. We must add that since private companies develop New towns in US, they have planning and governance structures that differ from those of regular towns. Developers perform a quasi-governmental role: developing the initial and ongoing master plan, administering private development controls, setting up neighbourhood associations to maintain common areas, working to attract employers and retailers, and initiating the formation of local and specialized governments. Public goods provided by private communities include the public good of governance itself. This model is common to most of the New Towns in United States.

Proper functioning of any municipality requires community infrastructure ranging from parks, schools, museums, hospitals, libraries, and police and fire stations to water and sewage systems. A good master plan integrates these facilities into the community in a useful and aesthetic way. The elements of such a plan are varied and complex. Members of the community, government and business must come together in a cooperative way to determine both the current needs of the area and the demands of anticipated and desired growth. A well thought out and executed plan will help to ensure the well-being of residents, attract business, stimulate job creation and bring about a pleasing community in which to live and work.

Who should be involved in policymaking and implementation is a core question in public policy and public management. Feldman (2007) explain three models that describe relationships between actors in the policymaking process: the political oversight, expertise and direct public participation models. The first model describes the relationship between the politician and the public manager (Harris, 1964; Wood and Waterman, 1991). The public elects politicians and makes its wishes known through elections. The primary concern is how to make sure that public managers fulfill those mandates (Calvert et al., 1987; McNollgast et al., 1999). In the expertise model (Fiedrich, 1935; Rourke, 1986), certified knowledge is provided by skilled individuals, many of whom hold positions in government agencies, but some of whom may work as university teachers or in other research and training organizations. In this model, experts provide information to politicians who actually make policy.

The third model is based in the planning discipline and includes people directly impacted by planning practices (Arnstein, 1971; Burke, 1968). In this model, public managers create opportunities for public participation, deliberation and decision making (Box, 1998; Heifetz & Sinder, 1990). Public participation is thought to enhance the quality of the public policy process.

In this chapter, we will see through the cases that citizen involvement is important even if funding comes from a private company (US model) or from the Government (European model). In both cases, we will find what I call an "involvement community", where people and organizations are involved in a process of making and implementing policy during the development of the New town and after it. In the US model there are no politicians and political parties that can take policy decisions depending on their ideology or can have electoral or party motivations. Developed through the case study, the theory of an involvement community follows from the actions citizens take in the pursuit of specific goals. In the Spanish case only in the first period before the New town becomes independent community associations are heavily involved after that appear political parties.

Osborne and Gaebler (1992) discuss how community members can add special knowledge and experience. They quote John McKnight of Northwestern University, who feels that communities, since they are closer to their problems, are better able to understand and address them. Defining community is difficult because people live and work in different locations, often crossing jurisdictional boundaries, but a sense of belonging, as several theorists have emphasized, provides a reason for action (Etzioni, 2004; Sandel, 1998; Taylor, 1989) and organization. This kind of organizational process is important because community members have key information needed to implement plans and public policy.

Involvement is the product of identification with and a feeling of belonging to a place where one lives peacefully. People want to give back to their community, and for that reason, they volunteer to be elected as representatives of their villages or neighbourhoods. According to Steven Ames (1998) a community can better understand the values of its citizens and use them as a basis for planning by identifying the trends and forces that affect the community, articulating a vision to guide short-term decisions and long-term initiatives, and developing tools to achieve its vision.

In US model, the developer is not alone in providing public goods or government; neighbours elect the community association's board of directors, which represents them. The association, in turn, provides some public goods. In such a town, local government control involves economic development, population settlement and environmental protection. The private company that builds the town lays down some rules, or covenants, based in contract law. The regulation set up by either a strong homeowner's association or a contracting company may be quite extensive and detailed. Rules may determine what colors you can paint the exterior of your home, the maximum length your grass can be or what exactly you can put in your front yard for display purposes. Restrictions may also exist on building additions, adding a front or back deck or a shed in the backyard. Potential buyers do well to ask about fees laws and stipulations. Membership in the homeowner's association, with fees and participation in meetings, may also be required.

In the European model as developer is the State he is the one that provides public goods. Neighbours only take part after the development of the New town when they start to life on it. They create associations to solve different problems that appear or to demand services that they start to need as transportation, schools or health centres. They also get involved in the segregation of the New town creating a political party and becoming part of the governance of the city that they belong. This makes them take part of political decisions and from inside ask for their city segregation. Cook (1975) notes that citizen participation can legitimize a programme or an action. To legitimize can often mean the difference between success and failure of community efforts. Delegate decisions to others, normally politicians will not always be in the best interest of those for that reason sometimes it is important citizen involvement.

2.1 European model

England and later on France were the promoters of New towns and urban development in Europe. Also at the end of nineteen century, Cerdà with his urban extension in Barcelona (Spain) and Arturo Soria with his idea of the linear city are pioneers in urban development. For that reason, we are going to talk about England and France as European models.

As we have said it has been Ebenezer Howard the pioneer of New Towns planning. In 1898, Howard publishes his book "Tomorrow: a peaceful path to real reform". Even though he wrote that book, his most famous one is "Garden cities of tomorrow" (1902).

In 1889 Howard and other people created the Garden City Association in England. The Garden Cities and Town Planning Association had defined a garden city as "a town designed for healthy living and industry of a size that makes possible a full measure of social life but not larger, surrounded by a rural belt; the whole of the land being in public ownership, or held in trust for the community".

In 1902 some executive register the first firm "Garden city pioneer company" that acquires some land located 55 km north of London (1.546 Hes.) and they started building in 1903 the first city following Howard model, this city was Letchworth. Actually, it has 33.000 inhabitants. Welwyn garden city (also located north of London) was built in 1920 and is the second new town in England. Those two new towns were built without public support; they received money from private firms and investors.

From the economic crisis in 1929, it began the necessity of finding a regional policy more coherent that distributes industry in a rational way. For that reason, they start to think again in the garden city. They start to think that it should be created a national urban planning and in 1937, they created Barlow Commission that published the report called: "Report of the Royal Commission on the Distribution of the Industrial Population". Barrow did not recommended New Towns but he said that it should be a good idea to establish a new territorial planning where industry, commerce and population could life together in harmony.

However, New towns in England have its big significance after Second World War and it is related to city and social reconstruction. During this period it has been built almost 4 million houses because during war were destroyed a lot of them. As a first time public administration built almost all the houses but they did it without any planning, they did not follow Howard's theory.

These promotions were carrying out by local authorities and private firms. However, it was after the II World War when New Towns, in UK, have started their development and become more closely related with the concept of national regional policy. New Towns started to belong to a planning strategy in the United Kingdom. Even if it does not exists a unique model they are, understand to clear big cities or to be the centre of a region in order to arrange a territorial division or revitalize a depraved zone. In 1946 appears New Towns Act, this Law with some adjustments (consecutive laws in 1959, 1965, 1968, 1976 and 1981) is still in force and constitute the legal basis of the actual program of new towns. Legally, the Secretary of State decides location of a new town. They created a public corporation that has the function of developing the new town. Once the area is designate, this corporation buys the land (also if they need to expropriate the land), design the distribution of the residential, the commercial and the industrial areas, the basic infrastructures (water, telephone, light, roads, etc.). The finance of the corporation is public and its funds come from the National Loans Fund. Those loans have a return of at least 50 years and an interest rate fixed in the moment of concession. They return the loan with revenues from sells and rents. In France and Spain, they follow this model with small variations, as we will see.

New towns committee estimates that ideal city size might be between 30.000 and 50.000 inhabitants even thought some New towns had almost 250.000. Their dream was that citizens in New towns or at least most of them could work in the same city avoiding commuting. In 1946, enacted “New Town Act” this law suffers some modifications in 1959, 1965, 1968 and 1976 and is the law that establishes the rules of New towns. This law is considered the most complete not only in England but also in other European countries. In England a New town localization is decide by the Secretary of Estate together with the local authority. They create a public corporation for any New town built. Once they designated the area, this corporation starts to act; it buys the land and plan where commerce, industry and houses must be. It is who built all the infrastructures (water supplies, electricity, roads, etc.). Its funding is public and money might be sanction by the Parliament. It comes from the “National Loans Fund”. In none of those New towns in England they have succeeded with the ideal concept because in all the cases more than half of population work out of the city and some of them have more than 250.000 inhabitants or less than 3.000 and have become suburbs of the main city.

If we look at France they have a similar urban planning program of New towns, it is called “Nouvelles villes”. Central government made the decision of building, location and funding of the New town. There are only two differences from the English model, the first one is that in France there is no corporation and there are different authorities that have the competence on the New town. For building a New town, they create an agency called “Etablissement Public d’Amenegement” (EPA). A board of directors manages the public organization that is composed by seven members of local administrations (town halls and regions) and for seven from central administration. For that reason, there are usually conflicts between central and local administrations. The second one is that EPA sells the land to private firms and those built houses, industries and commerce but always under EPA’s supervision.

As in the English case those New towns became employment generators although this employment mostly belongs to service sector particularly commerce and offices. We have to say that most of those New towns are not self-sufficient but as they have good quality and quantity of services, they have become an attraction for middle class citizens.

2.2 United states model

In the early history of America, Planned Communities were quite common. Jamestowne, Philadelphia, Williamsburg, Annapolis and Washington, D.C., are examples of this trend. The subsequent development of the United States, however, made planned cities both impractical and unpopular. It was not until the twentieth century that the New Town idea was revived. New Towns in US had appeared in the 1920’s from the Regional Planning Association of America. Following the example of British Garden Cities, Radburn, New Jersey, was begun in 1929. It was built in order to give houses to low income workers. It was followed by government sponsored "greenbelt" towns: Greenhills, Ohio; Greendale, Wisconsin; and Greenbelt, Maryland. The economic crisis and the II World War paralyse the construction of new towns. After World War II, Park Forest, Illinois joined the list of

American New Towns. The current era of New Town development began in 1962 with the creation of Reston, Virginia. The "new community" movement of the 1960s and 1970s attempted a grand experiment in housing. It inspired the construction of innovative communities that were designed to counter suburbia's cultural conformity, social isolation, ugliness, and environmental problems. This richly documented book examines the results of those experiments in three of the most successful new communities: Irvine Ranch in Southern California, Columbia in Maryland, and The Woodlands in the suburbs of Houston, Texas. Since that time at least thirty-eight planned communities have been developed throughout the United States. The Federal New Communities Program of the U.S. Department of Housing and Urban Development (1970-1983) sponsored thirteen of these communities.

One of the arguments of creating a new town is the creation of an attractive living environment, with a well planned housing and spatial organization. Sometimes new towns represent speculative ventures for private enterprises. It is said that more successful experiences tend to have occur in countries where the government provides long term subsides. Modern Planned Communities provide housing for a variety of income levels and allow the residents to participate in the governance of the city. There are two ways of qualification a New Town: 'independent', if they contain the employment of their own residents and 'satellite[4]' if there is a substantial amount of residents that commute to other metropolis.

The Woodlands was chosen one of the thirteen communities to be affected by the 1968 New Communities Act (Housing and Urban Development Title IV) as the site of a new planned community. The act, amended in 1970, provided $18 million of a total $294 million in federal loan guarantees for new towns. The Woodlands is a company-run town

In this paper, I have adapted the third model to a case where a public manager is replaced by a private committee to produce what I call an "involvement community", where people and organizations are involved in a process of making and implementing policy. There are no politicians and political parties that can take policy decisions depending on their ideology or can have electoral or party motivations. Developed through the case study, the theory of an involvement community follows from the actions citizens take in the pursuit of specific goals.

Osborne and Gaebler (1992) discuss how community members can add special knowledge and experience. They quote John McKnight of Northwestern University, who feels that communities, since they are closer to their problems, are better able to understand and address them. Defining community is difficult because people live and work in different locations, often crossing jurisdictional boundaries, but a sense of belonging, as several theorists have emphasized, provides a reason for action (Etzioni, 2004; Sandel, 1998; Taylor, 1989) and organization. This kind of organizational process is important because community members have key information needed to implement plans and public policy.

Involvement is the product of identification with and a feeling of belonging to a place where one lives peacefully. People want to give back to their community, and for that reason, they volunteer to be elected as representatives of their villages or neighbourhoods. According to

[4] Some authors use the term satellite also for those new towns which are self-contained but whose residents use some of the facilities of the cities nearby.

Steven Ames (1998) a community can better understand the values of its citizens and use them as a basis for planning by identifying the trends and forces that affect the community, articulating a vision to guide short-term decisions and long-term initiatives, and developing tools to achieve its vision.

In my model, the developer is not alone in providing public goods or government; neighbours elect the community association's board of directors, which represents them. The association, in turn, provides some public goods. In such a town, local government control involves economic development, population settlement and environmental protection. The private company that builds the town lays down some rules, or covenants, based in contract law. The regulation set up by either a strong homeowner's association or a contracting company may be quite extensive and detailed. Rules may determine what colors you can paint the exterior of your home, the maximum length your grass can be or what exactly you can put in your front yard for display purposes. Restrictions may also exist on building additions, adding a front or back deck or a shed in the backyard. Potential buyers do well to ask about fees laws and stipulations. Membership in the home owner's association, with fees and participation in meetings, may also be required.

The company and the associations also collects an assessment from residents to fund the public services provide by them.

3. Case sutdies

3.1 The woodlands

The Woodlands is located in the extraterritorial jurisdiction of Houston within Montgomery County in Texas. The Woodlands was built in a partnership between Mitchell Energy & Development Corporation and the US Department of Housing and Urban Development (HUD). It was one of the thirteen Title VII new towns developments that received federal loan guarantees in the early 1970s. In the early 1960's George Mitchell, wildcatter, oil and real estate entrepreneur, got the idea of a master planned community that would include as many jobs as homes. He thought that the new community might be near a major city benefit from transport and have ample land for future growth. In 1964 they purchase the first land in Montgomery County but it was on September of 1972 when the construction of The Woodlands began. When opened, The Woodlands consisted of a few families living in Settlers Corner, a conference center and country club, the Information Center, The Warf shopping area, 19 model homes, 50 apartments, three office buildings and several recreational amenities. The principal activities of the Mitchell Energy and Development Corporation[5] are the exploration for and production of natural gas, natural gas liquids, crude oil and condensate, operation of natural gas gathering systems and marketing of natural gas through purchase and resale activities. The Company owns or operates approximately 9,100 miles of natural gas gathering systems which are located in Texas. Gas services accounted for 68% of 2000 revenues and exploration and production, 32%. After 1955 the firm began to diversify into real estate. When George Mitchell became president, he formed Mitchell Development of the Southwest; in 1971 the business was renamed Mitchell Energy and Development Corporation. In 1974 the firm opened the Woodlands, as we have

[5] A major independent producer.

said a 25,000-acre planned community twenty-seven miles north of downtown Houston, built under a federal incentive program to encourage urban developments.

The Woodlands is located within the extraterritorial jurisdiction of Houston, Texas and has a population equal to the 33rd largest city in Texas (more than 85.000 inhabitants).

As an unincorporated area[6] it operates independently of city government. Approximately 3.000 acres extend into unincorporated Harris County, 160 acres are located inside the corporate limits of the city of Shenandoah, and some 375 acres are located in the city of Conroe (see map 1). Several villages comprise the Woodlands. Each is its own small town, with shopping centers, community organizations, schools, recreational facilities and healthcare. The villages are East Shore, Town Center (primarily a commercial development), Sterling Ridge, Carlton Woods (a gated community), Creekside Park, Alden Bridge, Cochran's Crossing, Indian Springs, College Park, Panther Creek and Grogan's Mill (see map 2).

Initially, it was considered as a "residential community" (Cervero, 1995) but with 46 per cent of its population employed within the Woodlands, it must now be considered an "independent" new town.

The Woodlands master plan was based on three basic goals (Levisohn, 1985): The first one was to build a community where people would pay ultimate respect to the land and living things from the start (ecological balance), where people could live with the greatest freedom (Human development) and achieve a reasonable return on investment (Economic profitability). The Woodlands philosophy was based on:

1. Good land use planning
2. Environmentally sensitive development
3. Economic, social and racial integration

Economically, The Woodlands was the most successful new town of its generation. What started as a planned residential community has been transformed into an incipient city with enough economic development to participate in and influence regional planning and policy.

For the first ten years the developer controlled the community, and the Woodlands Community Association (WCA) was the sole venue for resident involvement, but in August 1992, two more associations were created. Now three associations, described in figure 1, make up the governance structure (table 3) of The Woodlands. These associations are non-profit corporations managed by board of directors, and they provide public services to residents and property owners.

Individuals who acquire a property in The Woodlands become members of either the WCA or TWA for as long as they hold title. Similarly, commercial owners belong to WCOA. Volunteers make up the boards of directors of the three associations. The Woodlands Community Service Corporation (WCSC), known also as the Community Associations of The Woodlands, performs administrative, managerial and operational services required by the three associations. The associations are structured to serve citizens. Each year residents and property owners in each village elect members to their respective association's board of directors. Associations are funded from assessments and borrowing[7].

[6] A region of land is unincorporated if it is not a part of any municipality.
[7] Some from federal and state grants.

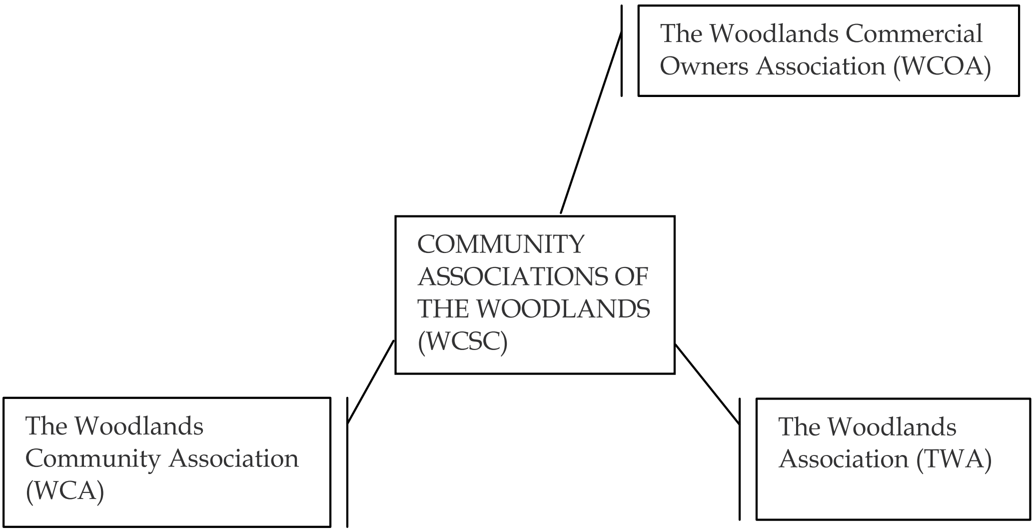


Fig. 2. Community Associations of The Woodlands

The Community Associations of The Woodlands, is a private, not-for-profit corporation, created in 1992. The company delivers staff services to The Woodlands Community Association, Inc., The Woodlands Association, Inc. and The Woodlands Commercial Owners Association, Inc. It is one of the largest private, non-profit governments in the US.

On the associations' behalf, The Community Associations of The Woodlands provides, or contracts for others to provide, services including police and fire protection, garbage and recycling collection, parks and pathway maintenance, streetscape maintenance, covenant enforcement and recreation programming for existing and future community associations in The Woodlands. These organizations contract with The Woodlands Community Service Corp. (WCSC) for staff services.

As we have said residents become members of a community association once they purchase a property in The Woodlands. Almost all residential and commercial property owners and residents in The Woodlands are members of one of these associations. Those associations are (Figure 2):

- The Woodlands Community Association, Inc. (WCA) is the community association for residents and property owners in the villages of Grogan's Mill, Panther Creek, Cochran's Crossing and Indian Springs (east of Falconwing Drive). A board of directors composed of 12 representatives elected from the villages and one member appointed by the developer (Woodlands Development Company) governs the WCA[8]. This volunteer board of directors has final authority over budget, financial and policy issues.
- The Woodlands Association, Inc. (TWA) is the community association for residents and property owners in the villages of Alden Bridge, Sterling Ridge, Carlton Woods, Indian

[8] The Covenants allow the board to be made up of a combination of community-elected individuals and individuals appointed by The Woodlands Operating Company, L.P.

Springs (west of Falconwing Drive) and the neighborhood of Harper's Landing in the village of College Park. It has a ten-member board, four elected by the owners and residents of the villages and six appointed by the development company.

- The Woodlands Commercial Owners Association, Inc. (WCOA) serves commercial owners across the Woodlands. Its board of directors has five members, four appointed by the developer and one elected by commercial owners. Around 1.300 companies, ranging from small retail stores to international headquarters buildings, employ approximately 46 per cent of employed residents.

Villages in the Woodlands also elect representatives to their respective village Associations. These village associations are unofficial and have non-specified responsibilities, they act as civic clubs organizing different events and serving as intermediaries between village citizens and the associations (TWA and WCA).

Most public services are provided by private agents through community and neighbourhood associations, but there are a few services that are provided by public agents such as Municipal Utility Districts (MUD), the Montgomery County and San Jacinto River Authority as we can see in table 1. Each of these entities operates independently although they maintain a system of coordination. Services are provided by municipalities only in those portions of The Woodlands within the corporate limits of Shenandoah and Conroe (approximately 5% of the land). The Environmental Services Department monitors the contract with Waste Management of Texas, Inc., a private waste company, to provide an integrated residential solid waste management system for The Woodlands.

Only three out of seven of the public goods providers' are public agencies, those are MUDs, Montgomery County and San Jacinto. The Woodlands Development Company (TWDC) also takes responsibility for constructing much of the initial infrastructure and cost-shares in the development of new parks and amenities in areas currently under development. In that case, public and private sectors complement each other in providing services to the public.

There are also associations and Residential Design Review Committees (RDRC) for each village that promote village events, maintain the integrity of homes and neighbourhoods, and assist in the coordination of community governance. They also evaluate violations of established standards and seek constructive resolutions of these matters. The committee may review all changes and improvements in a property. Each one has 3 to 5 members[9] elected by residents and owners of the village for a one-year period.

Funding

The funds necessary to provide these services come from assessments charged to residents based on the area in which they live and the value of their home.

Almost all property owners in The Woodlands are subject to The Woodlands Covenants and pay annual assessments to support the community services provided by their association. This assessment fee is mandatory and each community association board of directors sets the assessment rate during the annual budget approval process.

[9] Those members do not receive any compensation for this position.

Agent	Provider	Service
Private	**Community Associations**	• Fire protection • Emergency medical services • Park and recreation services • Deed restriction enforcement • Solid waste collection and recycling • Neighbourhood environmental • Watch program
	Town Center Improvement District (TCID)	• Economic development • Business stimulation • Visitor services • Supplemental law enforcement funding and services in Town Center and related area • Recreation
	The Woodlands Development Company (TWDC)	• Street/Right –of-way construction/Maintenance • Covenant/Deed restriction enforcement • Building Plan Review/Building permits (limited) • Streetscape maintenance • Traffic management • Transportation management & Planning • Economic development
	The Woodlands Road Utility District (RUD)	• Finances and constructs major thoroughfare improvements
Public	**Twelve MUD**[10]	• Retail water • Wastewater and drainage services
	Montgomery County	• Law enforcement and criminal justice services • Social services[11] • Road and bridge maintenance • Traffic management • Emergency medical services (Montgomery County Hospital district[12]) • Roadside drainage channel maintenance • Library service • Courts • Mosquito control
	San Jacinto River Authority[13]	• Wholesale water supply • Wastewater collection and treatment services • Stormwater detention operations

Table 1. Public Services' providers

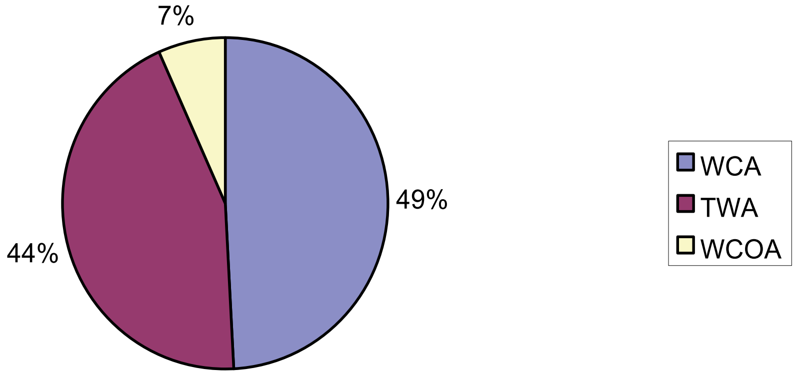
[10] Municipal Utility Districts.
[11] They only make small monetary contributions to agencies that provided these services.
[12] Separate from Montgomery County Government.
[13] They sell to MUDs all that services.

The annual assessment fees are based on the property's assessed value determined by the Montgomery County Central Appraisal District, which is responsible for determining the value of all property in the county. If the property assessment does not yet reflect the value of a completed building, the association will estimate a value for the property as of September 1 for assessment purposes. The assessed value of the property is noted on the annual assessment statement, mailed in late November each year. Assessment fees are levied on all residential and commercial properties in The Woodlands on which covenants have been imposed. The fee is calculated using the assessed value of the property and the annual assessment rate approved by the board. Payment of the annual assessment fee is the property owner's responsibility.

Table 2 shows the assessments that citizens pay to the association to which they belong.

	WCA	TWA	WCOA
Assessment Rate	$0,455	$0,49	$0,39

Table 2. Assessment Rate by Associations, 2006 (per $100 property valuation).

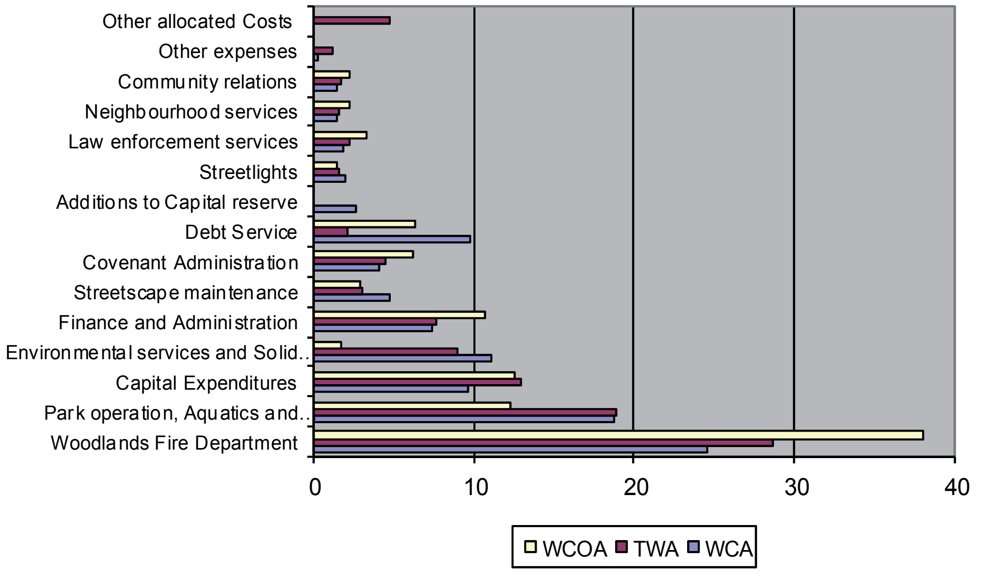


Source: Self elaborated from data of The Woodlands Community Association, Inc.

Fig. 3. Total of Funds by Association, 2006 (%)

As we can see in figure 2 WCA and TWA get the 93 per cent of the total fund and only a 7 per cent is for the Commercial Association. This is to be expected, because there are more neighbours than shops or firms.

The Woodlands Fire Department is funded through the associations from property assessments and, in part, by the Town Center Improvement District. Community Associations of The Woodlands (CATW) provides municipal-type services that are funded through annual assessments paid by property owners.



Source: Self elaborated from data of The Woodlands Community Association, Inc.

Fig. 4. Uses of Funds, Community Associations 2006 (%)

<table>
<tr><th></th><th>County</th><th>TCID[14]</th><th>MUD[15]s</th><th colspan="3">Associations</th></tr>
<tr><td>Financing</td><td>Property taxes</td><td>Sales & Hotel occupancy taxes</td><td>Property taxes & water & sewer fees</td><td colspan="3">Assessments and Fees</td></tr>
<tr><td rowspan="2">Mana-gement</td><td rowspan="2">Elected Commissi-oners Court & administra-tive staff</td><td rowspan="2">Elected/appointed TCID Board & administrative staff</td><td rowspan="2">Elected/appointed MUD directors & administrative staff of the JPA[16]</td><td>13 Elected/appointed WCA directors</td><td>10 Elected/appointed TWA directors</td><td>5 Elected/appointed WCOA directors</td></tr>
<tr><td colspan="3">Directors and administrative staff of the Community Associations of The Woodlands</td></tr>
<tr><td>Services</td><td>Law Enforcement, Street maintenance, Public health, Animal control, Library, Drainage, Facility maintenance and other basic County services</td><td>Economic Development Program, Infrastructure Debt financing & Enhanced Law Enforcement</td><td>Water, Sewer and Drainage services</td><td colspan="3">Fire protection, park operations, aquatics and recreation, environmental services and residential trash and recycling, streetscape maintenance, covenant administration and streetlighting</td></tr>
</table>

Table 3. Current Governance structure

[14] Town Center Improvement District.
[15] Municipal Utility District.
[16] Joint Powers Agency.

Services funded by assessment dollars include also emergency medical service, additional sheriff's deputies, residential design review and covenant enforcement, The Woodlands Watch Programs, streetscape maintenance, streetlights, residential trash removal and recycling, recreational programs, and environmental and recycling education. Community-wide facilities provided and maintained by the associations' assessment funds are: parks, swimming pools, athletic fields and courts, pathways, Lake Woodlands, a recreation center and recreational vehicle storage.

3.2 Tres cantos

During the 50's and 60's in Spain it was a lot of migration between countryside and cities and jointly with the natural increase of population there was a need of new houses mostly in the principal cities, one of them was Madrid. Metropolitan area of Madrid was growing a lot and in a disorganized way. One of the problems was the legal difficulty of new urban land creation. In 1970, the "Decreto-Ley 7/1970" of June 27th about Urgent Urban Actions (ACTUR[17]) tried to solve those problems. ACTUR has three objectives:

1. Supply housing demand in big cities specially Madrid and Barcelona.
2. Introduce modifications to the Land Law to speed up land expropriations.
3. Create land reserve for community equipments and activities.

With this Law ("Decreto-Ley") starts New town's creation in Spain. They want to build self-sufficient towns as it was in England and France. In that case, the National Institute of Housing selected the zone, expropriated the land and fund New town construction. This project was so ambitious and disconnected from Spanish reality that central Administration was not able to face up its costs. Under this Law it was expected to build eight New Towns (table 3):

City name	Region	Area (Has.)	Population
Tres Cantos	Madrid	1.690	144.000
Riera de Caldas	Barcelona	1.472	132.000
Sabadell-Tarrassa	Barcelona	1.675	148.000
Martorell	Barcelona	1.861	165.000
Vilanova	Valencia	1.330	-
La Cartuja	Sevilla	887	78.000
Puente de Santiago	Zaragoza	665	94.500
Rio de San Pedro	Cádiz	1.593	141.300

Source: Fernando de Terán.

Table 4. Areas defined as ACTUR

The only one that has become a real New town is Tres Cantos. The others seven or have not been developed or have become suburbs as Puente de Santiago in Zaragoza or has restructured as Cartuja in Sevilla that become the area of the Universal Exposition in 1992.

[17] Actuaciones Urbanísticas Urgentes (ACTUR).

Tres Cantos is located in the Autonomous Community of Madrid, 22 km north of the capital city Madrid and was born as a New Town from a political decision. It is not a traditional city because it was not developed from geographic, historic or any other way that normally develops a Spanish city. It was a political-administrative decision that developed this city. It is not a dormitory town because actually residents work and live in the city and receive workers from villages that are close to it. As we have said Tres Cantos was born under the law called "Decreto-Ley" of June 27th of 1970 that regulated what it was called as Urgent Urbanity Action. They initiated the project in 1971, it was supposed to be constructed 36000 homes with an industrial area and all the services that a city will need. They decide to establish Tres Cantos on rural land ceded by the city of Colmenar Viejo. Residential occupation began from 1982 and in 1991; it was incorporated as a separate municipality, the newest in all Spain.

They choose this location because it was close to Madrid (map 3) and the land was flat and inexpensive. They created a public firm (with central administration funds) that following the English and French experience build and manage the city.

In 1971 Housing Department, pass the demarcation of the urban actuation Area of Tres Cantos. It has an area of 1.691 Has. that belong to two municipalities Colmenar Viejo (1.381 Has.) and Madrid (310 Has.). It has an exceptional situation as we have said is too closed to Madrid and it has a natural environment (map 4).

In order to manage ACTUR they created in 1976 a public firm called "Tres Cantos S.A (TCSA)". It has the financial participation of National Institute of Development (INUR[18]) (57,6 per cent), Regional Council of Madrid (22,4 per cent) and Saving Bank of Madrid (20 per cent). In 1991 the funding becomes public and funding belongs to Housing Institute of Madrid (84,4 per cent) and to Autonomous community of Madrid (15,6 per cent). TCSA is a unique experience in Spain because combine public functions as it is was a Town Hall and private selling land or building social equipment.

When they start to build houses as it not was private initiative, central administration decide to build houses through cooperatives and between 1978 and 1985, they built 4.842 houses. In 1982, Tres Cantos has 50 inhabitants.

In 1986 began the second period of house building, at this period there is a mix of construction between cooperatives (1.964 houses) and private firms (2.984 houses). In ten years, Tres Cantos increased its population to 22.000 inhabitants and actually (2011) it has 41.343 inhabitants.

During the first period neighbours create associations to solve different problems that appear or to demand services that they start to need as transportation, schools or health centres. However, the biggest problem during this initial period was the administrative dependence of Colmenar Viejo Town Hall. Since 1987, neighbours had political representations at Colmenar Viejo administration. Those representatives had obtained the approval of Tres Cantos segregation of Colmenar Viejo. In March of 1991, Tres Cantos become an independent municipality. It is the number 179 municipality of the Autonomous Community of Madrid. Two months later, they celebrated the first local elections and it won one political party created by neighbours called Tres Cantos United ("Tres Cantos Unido", TCU). Since now there have been other political parties running the Town Hall.

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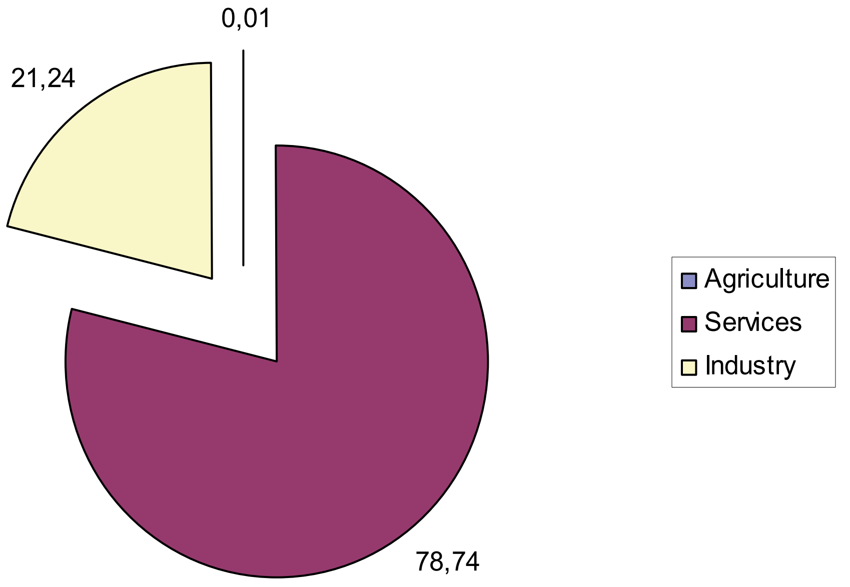
[18] Instituto Nacional de Urbanización.



Source: Self elaborated from National Institute of Statistic

Fig. 5. Percentage of different sectors in GDP.

The Gross Domestic Product per capita is 68.840€ and as we can see in figure 4 most comes from service sector. It comes to the city 30.000 workers from others municipalities close to Tres Cantos to work in. This economic development is due to its localization. It is really close to Madrid and highways. It also has train transportation and a good accessibility to Barajas airport in Madrid.

We can say that Tres Cantos is has become a good example of New Town as Howard definition because it is a self-sufficient city with a sustainable environment, industry, commerce and houses.

4. Conclusions

We often have seen New Towns as solution for the problems of housing cost, social integration or urban growth. Most of these New towns are planned in order to clear big cities and for this reason, most of them are close to them. The successful ones are those that do not end as suburbs of the big city. As we could see in our examples none of them end as a suburb, they have become independent cities where between 30 and 40 per cent of population work in the New Town.

Like all New Towns, The Woodlands and Tres Cantos began as "satellite" towns, but in time they grew and became "independent". The Woodlands is an unincorporated town that operates independently of city government. Its three Associations provide municipal-type services to residents. Tres Cantos is an independent municipality with its own local government. They are also a model for planned development and environmental protection; The Woodlands is one of the greenest communities in the country (5.000 acres of green space).

As we have said one of the main differences between European and US model is the funding. We know that New town development is expensive, particularly the provision of their infrastructures. In Europe, central or local government provides those infrastructures and in US is the private developer who provides them. For that reason in US some of the New towns failed or remain heavily in debt and in Europe only failed the ones that administration do not have money due to economic crisis.

The Woodlands case study can help us understand how a private government can provide public goods and recognize that certain groups or individuals can be involved in the governance of a city. Such an involvement community is a unique form of governance, and The Woodlands is the only community in United States governed by private associations. In particular, the processes of partnership creation and empowerment have reinforced the idea that a community can diminish the power of a developer in the development of a new town in ways that have implications for the community's future governance and growth.

The Woodlands also holds lessons for governments and private developers as they seek to create sustainable environments and community involvement governance. This style of governance, in the end, reflects the characters and personalities of the family members living in the community. Also, there is no existence of political parties that can have electoral or party motivations.

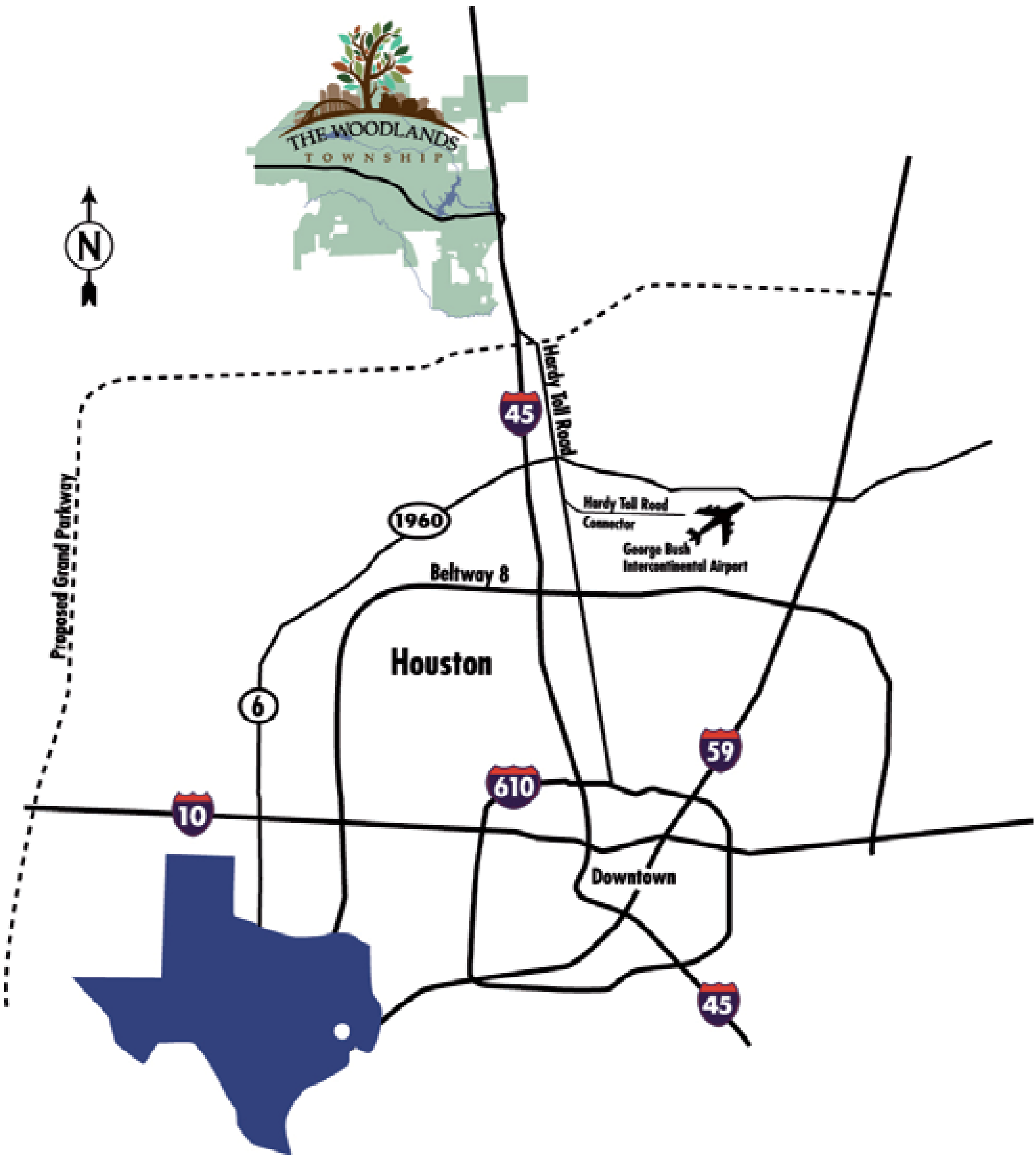
The case of The Woodlands provides a caution against the new towns where the developer dominates decision-making. By encouraging a system of involvement, the developer of The Woodlands has made it possible for residents to determine their own future. Already experienced in running most of the affairs of the project, citizens are well positioned to choose the best way to preserve and develop their community. As I have said it has been the most successful new town of its generation and it has been transformed into an incipient city with enough economic development to participate in and influence regional planning and policy. It remains to be seen whether New Towns are a good planning or policy instrument for the future.

Tres Cantos has followed English and French planning model. In that case the developer was a public firm called "Tres Cantos S.A" and the funding it was also from public administrations. It is a good example for housing cooperatives because in the first period of building the city houses were built by a cooperative. This way of constructions through cooperatives appears during periods of economic crisis. In the first period of developing Tres Cantos it was an economic crisis in Spain.

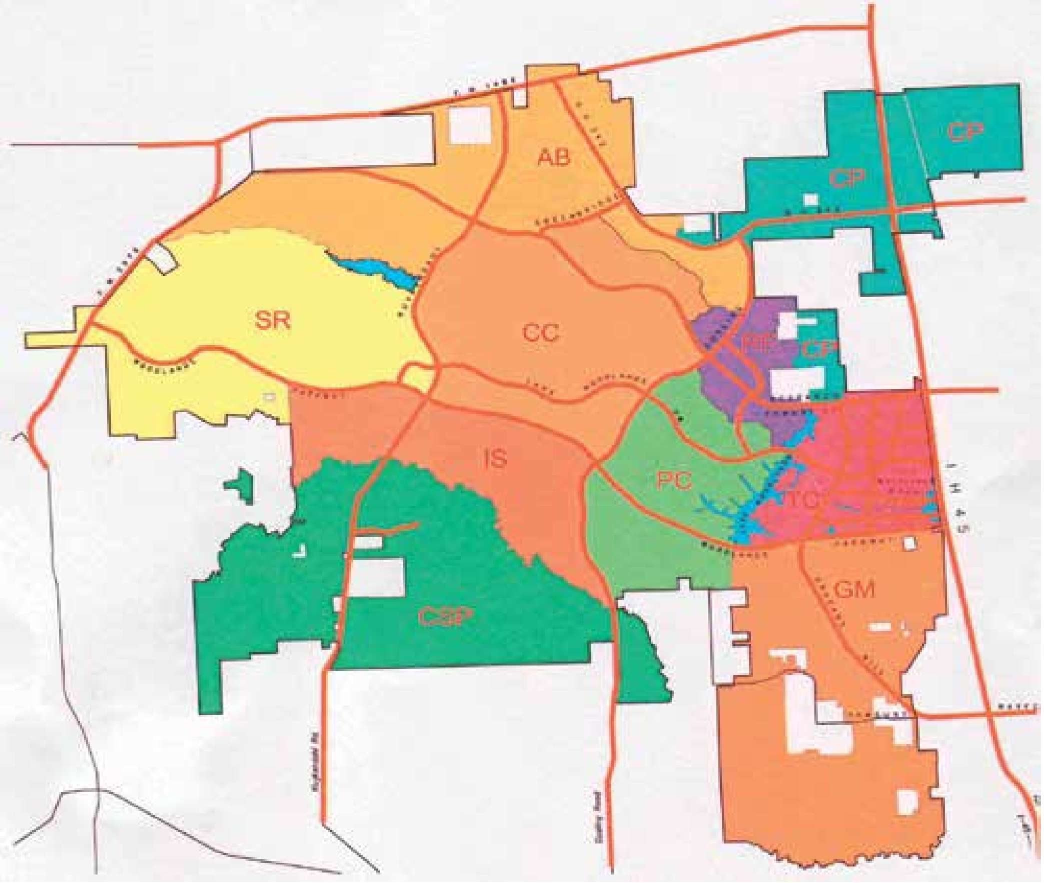
Tres Cantos is located in a sustainable environment with a good transportation network and it is so close to a big city as Madrid. In addition, it has a young demographic structure. This makes that its economic activity is characterize by a high participation of woman in the labour market. It has also high-qualified worker and government employees. Its unemployment rate is low due to its high occupation rate and because it has many young people studying.

As the in case of The Woodlands, Tres Cantos neighbour's associations have a lot of influence in the development and segregation of the New town from the city close to it. Nevertheless, in Tres Cantos, the government of the town is elected in public elections and it has the same composition as the rest of municipalities in Spain. However, in The Woodlands they have a private government composed by a board of directors.

5. Annexes

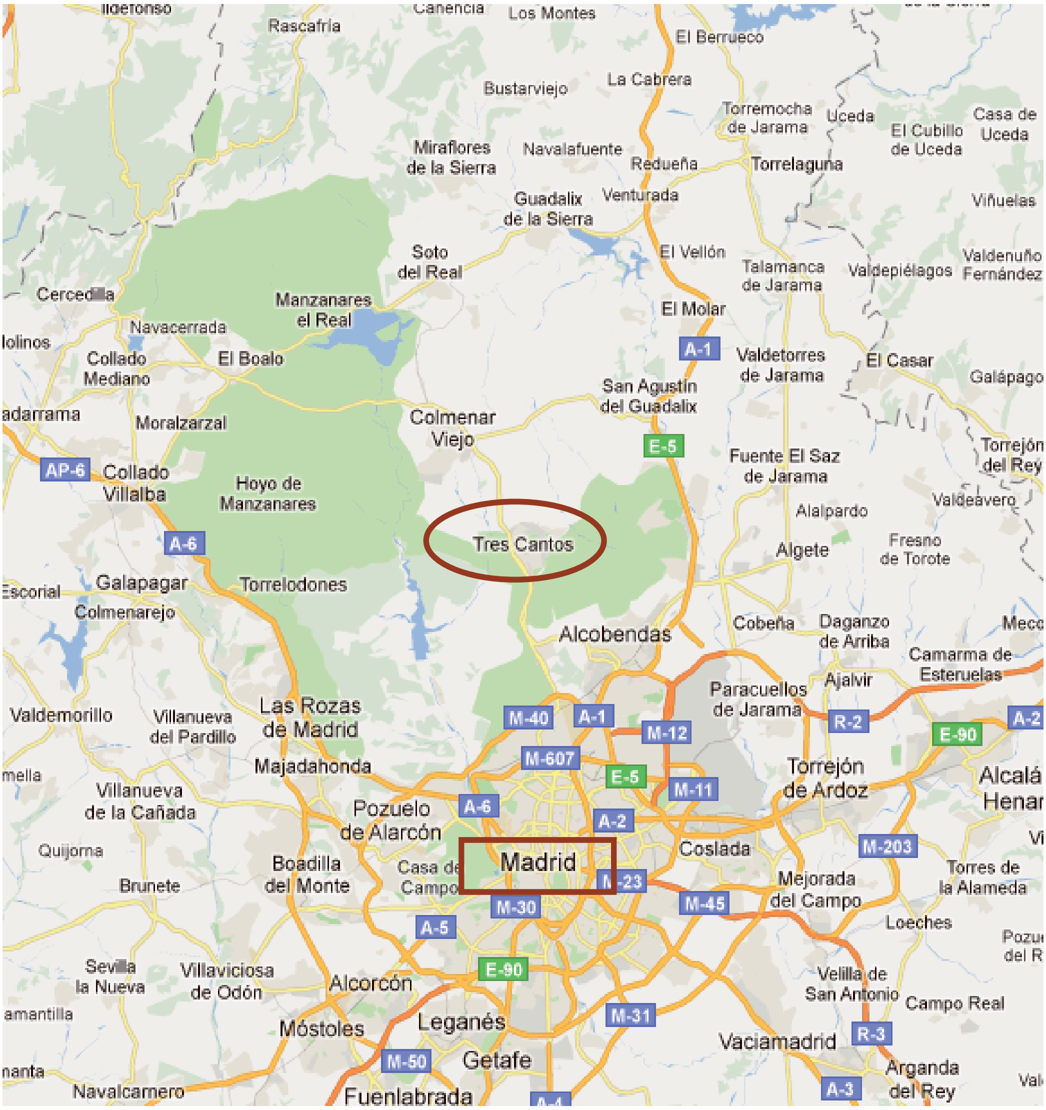


Map 1. The Woodlands' location



AB: Village of Alden Bridge; CC: Village of Cochran's Crossing; CP: Village of College Park; CSP: Village of Creekside Park; GM: Village of Grogan's Mill; IS: Village of Indian Springs; PC: Village of Panther Creek; SR: Village of Sterling Ridge; TC: Town Center; RF: Reasearch Forest

Map 2. The Woodlands' villages



Map 3. Tres Cantos' location

Map 4. Tres Cantos

6. Acknowledgment

I will like to thank to Mr. Joel Deretchin, vice president of public affairs of The Woodlands Development Company (TWDC), for his useful information, his patient and his kindness.

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12

An Evaluation of Distribution and Quantity of Parks in Istanbul

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1. Introduction

Some researchers have pointed out that the availability of accessible and attractive green areas is an integral part of the urban quality of life (Herzele and Wiedmann, 2003). Others maintain that the provision of green areas improves the urban environment, contributes to public health, increases the quality of life and provides amenities to residents in the form of recreational benefits (Wu and Plantinga, 2003). For instance, green areas can sequester carbon dioxide emissions and produce oxygen (Jo, 2002); purify air and water, regulate micro climate, reduce noise (Bolund and Hunhammer, 1999); (Hanamaen et al., 2003); protect soil and water (Pauleit and Duhmer, 2000); absorb rainwater and pollutants (Connine et al., 2004) and mitigate urban heat island effect (Rudie and Dewers, 1984; Stanners and Bourdeau 1995; Simpson and McPherson 1996; Bonan, 2000).

Some have pointed out that the benefits of parks are not just environmental but also recreational, aesthetic and emotional (Kaplan and Kaplan, 1989; Savard et al., 2000); (Ong, 2003); (Gobster and Westphal, 2004; Jim, 2006a). Furthermore, public parks can have a statistically significant effect on the sale price of nearby houses (Benson et al., 1998; Tyrvainen, 1997). Most Istanbul residents generally view parks as recreational areas and the paucity of these areas have led to the severe overcrowding of available green areas on weekends and holidays (Aksoy, 2011).

Linking the quantified and spatially explicit urban green area pattern with an economic model, such as the hedonic price model combined with property characters can help clarify the relationship between green areas and economic values (Geoghegan, 2002; Morancho, 2003). In the future, it is expected that the social and spatial implications of new lifestyles, values, attitudes to nature and sustainability will even lead to higher demands for urban green area (Thompson, 2002). This situation has also been observed in Istanbul as residents have begun to demand more green areas and parks set aside for their use.

Although intrusion into forests is officially forbidden, developers enticed by high profit have often succeeded in obtaining needed permits and most of those who have moved to the periphery are in search of green and tranquil places of residence despite the high cost of living (Dokmeci and Berkoz, 2000).

Residential invasion of green areas in the periphery of the cities is not only a phenomenon in Istanbul as it has also occurred in other countries. In the US, suburban expansion is converting forests, agricultural land, and wetlands into built environments beyond the edges of urbanized areas at an alarming and increasing pace (Gillham, 2002; Robinson et al., 2005). In addition, Canada (Rothblatt, 1994) and the United Kingdom also suffer from the loss of forests, agricultural lands, and green areas to urban expansion.

Rapid urbanization, together with an increase in leisure time, has resulted in the public's greater awareness regarding the amount and quality of nearby green areas (Shultz and King, 2001; Geoghegan et al., 1997). In order to deal with the problems of urban expansion and to answer the recreational, hygienic and aesthetic needs of people, the preservation and development of green areas are central issues (Turner, 2005). Several studies have investigated access to park and recreational facilities in the fields of planning, geography and leisure studies (Gobster, 1995; Talen and Anselin, 1998). (Cho and Choi's paper 2005) was based on the investigation of equity of public parks distribution by using GIS method. (Li et al., 2005) propose a comprehensive concept for planning urban green areas based on ecological principles and its implication is illustrated in Beijing, China and (Jim and Chen 2003) in Nanjing city, China. The increasing number of studies on green areas in China illustrate that fast economic and social changes in recent years have brought massive expansion, redevelopment and restructuring of cities and these changes offer cities the opportunity to improve environmental quality through urban green areas.

Comprehensive planning of park areas in cities is required to improve our ability to relate land use patterns to environmental characteristics. This is essential for understanding urban green area systems and cannot be done effectively without first quantifying spatial patterns in local areas.

The review of the literature illustrates that most of the studies at hand have been carried out on developed countries. Despite this, more recently a number of studies on the evaluation of green areas in developing countries have gained momentum, such as the studies by (Oduwaye, 1998) for Nigeria, (Oguz 2000) for Ankara (Turkey), (Li et al., 2005) for Beijing (China), (Jim and Chen 2003) for Nanjing city (China), (Jim and Chen 2006) for Guangzhou (China) and Kong and Nakagoshi (2006) for Jinan (China).

In the Istanbul case, the balanced spatial distribution of parks with respect to population has become a public concern that involves many factors. For example, in Istanbul there has been an overall decrease in green areas and this has had a negative effect as environmental pollution is on the increase and settlements built in rain catchment areas have led to disastrous floods in some areas of the city, such as Alibeyköy.

The present paper evaluates the distribution of parks in Istanbul by considering the different characteristics of the city's districts. A regression analysis has been used in order to analyze the spatial distribution of parks with respect to the characteristics of districts such as population, income, planned development ratio of districts and distance to the Central Business District (CBD)

2. Materials and methods

Istanbul, the largest city of Turkey with a population of 10 million (2000) ranks as the country's most important socio-economic and cultural center. Istanbul is also an important tourism center due to its historical background as the capital of three empires and thanks to its natural amenities. The long historical background of Istanbul not only enriches its urban structure but also its renowned green areas by starting from Roman times and continuing through Byzantium and Ottoman times (Maguire, 2000; Melling, 1819).

Despite all of its positive attributes, Istanbul's tremendous population growth after 1950s, due to rural migration, has negatively affected its socio-economic and cultural life as well as its physical structure and green areas. In 1975, the unit park area per person was 0.3 m^2/person, slowly increasing to 1.1 m^2/person in 2004 due to modern housing development to some extent in recent years. This figure is much lower than legislative requirements for unit park area ratio of 2 m^2/person within the legislative requirements for the general green areas which is 10 m^2/ person and should therefore be increased (Aksoy et al., 2007).

While in some districts green areas have been used to locate new public facilities such as schools or mosques under the pressure of population increase, some other districts have been demanding the preservation of the existing green area, in addition to demanding new park areas. Further investigation of the relationships between the unit park area ratio and the characteristics of districts are explained.

Despite these important roles of green areas for the quality of urban life in Istanbul, aggressive entrepreneurs have built modern housing complexes in forest areas in the periphery of city and other green areas have been invaded by squatters, all resulting in a park/ person ratio that is even lower in the second ring than it is in the core and the first ring (Table 1).

Years	Core	I Ring	II Ring
1975	0.8	0.2	0.14
1980	0.95	0.22	0.22
1985	1.76	0.25	0.09
1990	2.84	0.87	0.30
1995	3.19	1.42	0.61
2004	3.39	1.76	0.88

Table 1. Unit Park Area Ratio (m^2/person) values according to Concentric Rings

First the study area is analyzed according to the concentric rings with respect to population and green area distribution and then regression analyses with respect to the characteristics of the districts are provided.

For the regression analysis green areas per person is taken a dependent variable and income, population, planning ratio, distance to the CBD, education are taken as independent variables. The number of, and information about, the green areas have been obtained from reports and in situ measurements prepared and taken by the Greater Municipality of Istanbul and the Office of Parks and Gardens. Arcview 3.2 Software (Herzele and Wiedemann, 2003) has provided successful results in Mapping and Geographical Information Systems works.

Data for the analyses were obtained by satellite image analysis checked with extensive field research and implemented on the GIS Maps by comparisons with the master plan.

A spatial analysis can serve as a starting point for an evaluation of the distribution of green areas with respect to population needs. As (Jim, 2004) has suggested, variations in land use and urban development patterns have generated green areas of different geometry, distribution and composition. To this regard, the quantification of green area patterns is a prerequisite to understanding green area spatial distribution and green area changes overtime. The hypothesis in this study is that education and income have a positive impact on green areas of the districts. Most of the squatter areas have very low unit park ratios due to the fact that their development was random and without planning.

In order to understand the reasons for different patterns of park distribution in different districts, we must first investigate the interaction between socio-economic and planning forces in different districts as they are already taken into consideration by other studies (Alberti, 1999; Kline, 2006). The spatial distribution of green areas has been investigated in two stages. First, the spatial distribution of unit park area has been investigated over time according to the districts and concentric zones of the city.

3. Results and discussion

The results illustrate that there is a wide width between the lowest and the highest unit park area ratio of districts.

The spatial distribution of parks has been analyzed according to Istanbul's concentric rings. The core area is taken to be the area stretching 3000 m. from the centre, which corresponds to the old Central Business District (CBD); the first ring is from 3000 m. to 12000 m, which covers the area occupied by the city in the 1950s before heavy rural migration started; the second ring is taken as the peripheral area beyond the first ring (Dökmeci et al., 2007)

While the core area was home to 6% of the total population in 1985, this percentage decreased to 3% in 2000 due to suburbanization and the functional transformation of some of the buildings from residential to business utilization.

A similar trend was observed in the first ring where in 1985 the population ratio of this zone was 51%, decreasing to 30% in 2000. On the other hand, the population ratio of the second ring witnessed a sharp increase from 43% to 67% in 2000. This population increase in the periphery caused the expansion of the city at the expense of the green areas.

The investigation of the spatial distribution of unit park areas per person according to the rings and their growth rates illustrates different patterns (Table 1). While in 1975 the unit park area ratio was 0.8 m^2/person in the core area (Eminönü and Beyoğlu), it increased to 3.39 m^2 in 2004 due to population decrease as a result of suburbanization, the functional transformation from housing to business, and the Municipality's creation of green areas in these districts.

The same ratio was 0.19 m^2/person in the first ring in 1975 increasing to1.76 m^2/person in 2004. In the second ring, the same ratio was 0.14 m^2/person in 1975 and it increased to 0.95 m^2/person in 2004 due to provision of green areas in the recent modern housing projects according to the legal requirements in both zones. Thus, during the rapid urbanization process after 1975, park areas increased at a slower pace at the metropolitan level.

At the same time, there was a determined effort to preserve public or private green areas along the shore lines of Bosphorus and the historically world wide famous image of Bosphorus was conserved (Lamartine, 1897). Moreover, during the restructuring process of the 1980s, in order to increase green areas in the existing urban structure, warehouses and manufacturing plants along the Golden Horn shores were relocated and new park areas were created. Also, land was reclaimed from the sea along the Marmara Sea coast and new park areas were created, thus increasing amenities on the shore lines.

The spatial distribution of unit park areas according to the districts between 1995-2004 has been investigated and the results are illustrated in Figure 1. Among the districts, Eminonu has the highest ratio, 10.6 m²/person. This can be explained by the opening of some of the large gardens of the Topkapı Palace to public use and the utilization of the Byzantine Hippodrome as a park area, a utilization that actually began in the 1880s as a result of the Westernization movement (Celik, 1993).

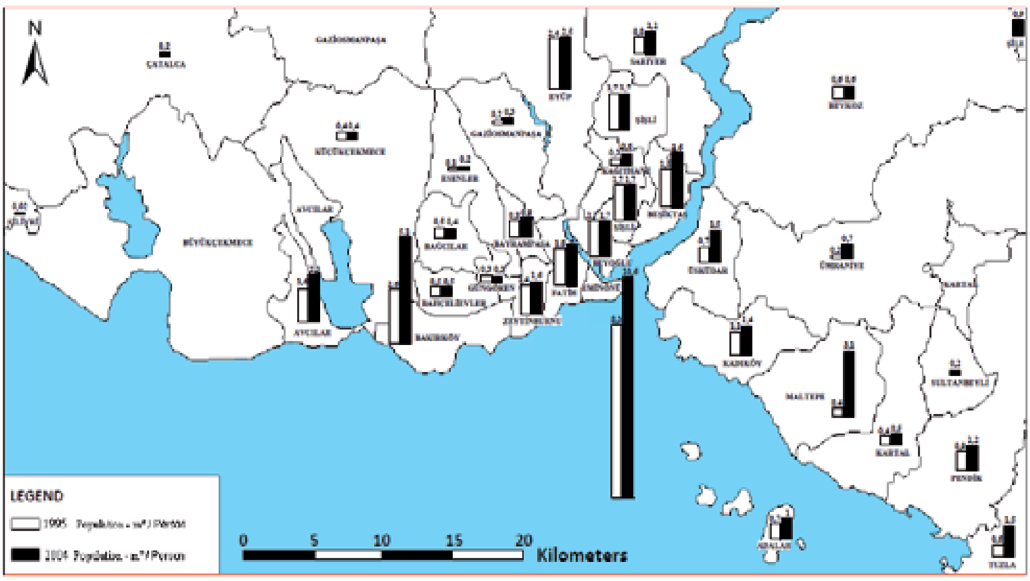

Fig. 1. Spatial Distribution of Unit Park Areas Between (1995-2004) in Istanbul

The second highest ratio (5,1 m²/person) belongs to Bakırköy, a district located in the periphery. The fact that it enjoys larger park areas than most of the other districts can be explained by its historical background as a recreation/excursion area of Istanbul during the Ottoman Empire period.

While the majority of squatter districts such as Esenler and Sultanbeyli (0,2 m²/person) and Güngören and Gaziosmanpaşa (0,3 m²/person), have lower park person ratios due to their limited budget to develop park areas there are also exceptions to this, such as Avcılar (2, 3 m²/person) and Maltepe (3,1 m²/person). On the other hand, some of the high income districts have lower park person ratios such as Kadıköy (1,4 m²/person) and Sarıyer (1,1 m²/person). At the same time some other districts, such as Silivri and Çatalca, are included in the lowest park per person ratio group due to the fact that they have only recently been included within the boundaries of the expanding Metropolitan area (Table 2).

DISTRICT	1975 (State Institute of Statistics)			2004 (T.R. Office of Turkish Statistics of the Office of the Prime Minister)		
	POPULATION	SURFACE AREA		POPULATION	SURFACE AREA	
		Surface (m^2)	m^2/ person		Surface (m^2)	m^2/ person
ADALAR	-	-	-	17806	17710	1
AVCILAR	-	-	-	236885	553.000	2,3
BAĞCILAR	-	-	-	558653	250210	0,4
BAHÇELİEVLER	-	-	-	464903	227.915	0,5
BAKIRKÖY	200942	26200	0,1	192000	972255	5,1
BAYRAMPAŞA	-	-	-	246646	211740	0,9
BEŞİKTAŞ	174931	19360	0,1	190139	501545	2,6
BEYKOZ	76804	13850	0,2	213203	117440	0,6
BEYOĞLU	230532	62000	0,3	235733	401715	1,7
EMİNÖNÜ	122885	237440	1,9	55180	583330	10,6
ESENLER	-	-	-	394423	97290	0,2
EYÜP	95486	6400	0,06	253252	627245	2,5
FATİH	504127	51150	0,1	407991	805525	2
G.O.PAŞA	97118	-	-	754790	240670	0,3
GÜNGÖREN	-	-	-	269939	93785	0,3
KADIKÖY	354957	51600	0,1	653000	895160	1,4
KAĞITHANE	-	-	-	344547	213020	0,6
KARTAL	-	-	-	417034	217020	0,5
K. ÇEKMECE	-	-	-	589139	244895	0,4
MALTEPE	-	-	-	356568	1.109.945	3,1
PENDİK	-	-	-	388940	484630	1,2
SARIYER	79329	24000	0,3	241234	259605	1,1
ŞİŞLİ	270577	135800	0,5	270582	473220	1,7
TUZLA	-	-	-	124037	190655	1,5
ÜMRANİYE	-	-	-	626312	463165	0,7
ÜSKÜDAR	202957	60800	0,3	501804	746700	1,5
ZEYTİNBURNU	123548	9150	0,07	241825	383690	1,6
BÜYÜKÇEKMECE	-	-	-	396937	-	-
ÇATALCA	-			82149	13220	0,2
SULTANBEYLİ				175771	42500	0,2
ŞİLE				32923	30000	0,9
SİLİVRİ				107486	2590	0,02
İSTANBUL	**2534193**	**697750**	**0,3**	**10041831**	**1147139**	**1,1**

Table 2. Unit Park Area Ratio (m^2/person) values according to District

Secondly, a regression analysis has been used to determine the relationships between the unit park area ratio and the demographic, socio-economic and physical characteristics of the districts (Table 3).

R^2 = 0.693			
Adjusted R^2 = 0.645	F=14.655	Sig.=.000	
Variables	Beta	t	Sig.
(Constant)		2.385	.025
Population	-.445	-3.433	.002
Income	-.113	-.594	.557
Planning ratio	.450	2.761	.010
Distance to the CBD	-.473	-3.157	.004
N= 31 districts			
Dependent variable: unit park ratio (m^2/ person)			

Table 3. Regression Results

In the analysis, the park area/per person ratio has been taken as a dependent variable and population, distance to the Central Business District (CBD), income and planned development ratio of the districts have been taken as independent variables.

According to the results of the regression analysis the significant values include population figures, the distance to the Central Business District (CBD and whether the district had planned development. However, income per capita has not been found to be significant, despite the expectations that higher income people have more power to influence the municipal governments to provide necessary green areas in their districts according to the legislative requirements. There is actually a negative relationship between the population and the unit park area ratio of the districts which means that as the population increases the unit park area ratio decreases as it is expected due to higher construction pressure in the more populated districts. Also, there is a negative relationship between the unit park ratio and distance to the Central Business District (CBD) for as the distance increases, the unit park area ratio decreases. This can be explained by the existence of large unplanned squatter areas in the periphery of Istanbul.

There is a positive relationship between the planned area ratio and the unit park area ratio as it is expected that as the planned area ratio increases, unit park area ratio increases also. Thus, restructuring of the squatter areas in the periphery of Istanbul which is currently underway and the creation of new park areas such as in Başakşehir, will not only provide economic benefits to the owners and municipalities but will also help to improve the hygienic and aesthetic conditions by creating new park areas. This expectation has already been supported by previous studies (Bourassa, 1992; Bourassa et al., 2005; Jim and Chen, 2006c). At the same time, improving the participation of all stakeholders and better coordination of planning institutions is crucial for the successful development of green areas according to the needs of people.

4. Conclusions

Rapid urbanization and the expansion of Istanbul have caused continual restructuring and changes in land-use at the expense of green areas. Although recent housing projects fulfill necessary green area requirements, this only helps to increase a small amount of the unit park area ratio at the metropolitan level. The spatial distribution of green areas varies according to the different characteristics of districts. Yet gaining an understanding of the changes in green areas has been hindered by a lack of systematic analysis. The purpose of this paper is to provide some insights into the spatial distribution of green areas in Istanbul and changes that have occurred overtime. The relationships between the characteristics of districts and provision of parks have been investigated to understand how the interaction between socio-economic and planning forces vary overtime and space in different districts. This study can provide a comprehensive background for the planning of a green area framework and it pinpoints the need for the development of new park areas. The major originality of the research lies in the attempt to span a bridge between legislative requirements of green area and planning practice under the pressure of real estate pressures.

While the historical Central Business District (CBD) has the highest unit park area ratio due to the palace gardens and the use of the Hippodrome square as a public park, squatter areas in the periphery have very low unit park area ratios since they are not planned developments according to legislative requirements.

According to the results of the study, population, distance to the Central Business District (CBD) and planning ratio of the districts have an effect on the unit park ratio per person of the districts. However, despite prior expectations, no relationships between income per capita and the unit park area ratio of the districts were determined. This can be explained by the fact that high density construction is being used to respond to the higher demand for higher income neighborhoods.

Population rates and distance to the Central Business District (CBD) have a negative effect which means that as the population and distance to the Central Business District (CBD), increase, unit park area decreases. This phenomenon is due to the large numbers of squatter settlements in these areas. On the other hand, there is a positive relationship between the unit park area of the districts and the planning ratio, as it is expected. This means that as the ratio of planned areas in the districts increases, so will unit park area per person. Thus, it is necessary to improve the existing unit park area ratio, especially in the peripheral districts and to support the restructuring of squatter areas in the periphery by improving urban planning standards. The analysis as it is developed here enables the calculation of necessary green areas by linking it to demographic data.

Thus, the analysis illustrates that wide discrepancies exist among the districts with respect to unit park area ratios. This situation should be corrected during the ongoing restructuring process of squatter areas.

The model and results presented here have important implications for the development of planning policies. They can be useful for landscape and urban planners. Developing and understanding the dynamic spatial patterns of green areas can improve our ability to assess and create future planning scenarios by combining appropriate spatial models.

There is a widespread public support for green area provision at the metropolitan level with the condition that the land and budget are available in the districts of local level. At the same time, efforts to limit urban expansion should also be considered in the case of Istanbul.

Further research is suggested by increasing the number of variables as in (Herzele and Wiedemann, 2003), by using time-series analysis, by making lost-benefit an analysis suitable to the socio-economic conditions of Istanbul and by taking into consideration different types of green areas for the development of a more comprehensive ecological system for the Istanbul Metropolitan Area as in (Jim and Chen, 2003).

Finally, developing an understanding of the dynamic spatial patterns of green areas and their interactions with urban environment can improve our ability to assess and create future planning scenarios by combining appropriate spatial models, such as the Cellular Automata model, which gives the opportunity to investigate internal impact of different land uses.

The results of the study can be especially useful for the recent metropolitan planning process of Istanbul and for the restructuring of squatter areas by increasing green areas per person as in (Jim & Chen, 2006). Moreover, previous studies illustrate that creating parks in undeveloped areas before they are subject to development pressures will reduce leapfrogging development (Turner, 2005).

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13

Cooperative Development and Land Use Planning Dynamics in Sub-Saharan Africa: A Quest for Socio Solidarity Economy and Partnership in Sustainable Urban Development

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1. Introduction

Urbanisation is the key factor underpinning and catalysing changes in land use, land transactions, increased rural-urban immigration, cooperative development and the overall poverty increase in Cities of Sub-Saharan Africa (SSA). The increase of urban population leads to changes in the life style of the people, where land used for farming is changed into different land uses including housing and institutional development. The changing life style demand people to think more on how to get finance to sustain their life and living styles in urban areas, and therefore financial and agricultural cooperatives becomes a fundamental demand in urban development. The need for development of these cooperatives is encouraged due to life changes caused by among other reasons urbanisation processes leading and catalysing people into forming associations and voluntary pressure groups as room for manoeuvre, which ultimately help them to access different financial betterments from financial institutions to improve their income levels. Paradoxically, rural dwellers make use of goods and services including money remittances in terms of money flows from urban settings.

The rural and urban inhabitants both depend on agricultural activities, in which case the success in marketing of agricultural products whereby improved productivity depends much on group organisation in the form of cooperatives, mainly Agriculture Cooperatives. In this respect agriculture land use allocation for farming becomes an essential ingredient for enhancing farmers' productivity in both urban and rural settings. However, there exists a strong relationship, which seems not to be clearly known between cooperative development principles and values with land use planning in the fight against poverty in Africa especially SSA. Thus, discussing urban development is inseparable from rural development context in view of the synergy of urbanisation processes, particularly when one wants to understand access to the city economy, in terms of capital outsourcing from relatives and friends, labour and exchange of goods and services, and strong communication action. These are common features, which triggers the transformation needs of cooperative development and land use planning in urban development agenda in both developed and developing countries.

In both countries of the world stated above, Tanzania inclusive, cooperatives have traversed two stages namely state control and liberalization (Bottelberge, P *et al*, 2010). The former, cooperatives were created by government as part of their populistnationalist strategies for nation building, rather than by people's own common interests and motivation or by market demands. Such strategies were often enthusiastically supported by international donors who preferred to work through governments (Hofstede, G., 1994). From the early nineties, cooperatives entered the era of liberalization, which required them to be run on business principles and in line with the evolving market economy. The questions of analyzing member based assets including land as mortgage was a driving feature in both financial and agriculture cooperative in this era. The understanding cooperatives and land use planning nexus in empowering member based in accessing financial resources as well as improving ecological environment in both urban and rural setting was and still a demand in our communities. Betts *et all*.,(2002) support by showing the potential of community involvement in management of forest land and urban environment. The authors indicate that private forest land owner, can utilize cooperative ecosystem based management guidelines to own land property. Cooperative are found to be less growth oriented but use natural resources inputs more efficiently and therefore makes members come out of poverty in poor resource areas (Booth,D.,E, 1995; Delveltere *et al*., 2008)

The SSA countries in which we work exhibit a wide range of social and political systems, stages of economic evolution and cultural legacies. Yet in each, the need for collective action to address shared problems is evident, particularly in rural and resource-poor areas.

However, by organizing cooperatives and participatory land use planning approaches, farmers and entrepreneurs can mobilize capital, pool knowledge, achieve economies of scale and foster vertical integration. They can create greater leverage in the marketplace and policy arena, attract business service providers and more efficiently link to urban and export markets. Such disciplined groups not only catalyze local economic growth, they may serve as a vehicle for more equitable community land use planning and improve members income and level of productivity in the city economy. Likewise, they develop human capital, encourage the participation of women and youth in development activities including farmers' decision making, fostering democracy and entrepreneurship for organizational and membership development within the social solidarity economy context.

In pursuing factors for sustainable urban development agenda, the question of cooperative development and land use planning linkage therefore are essentials. However, towards enhancing city's productivity and attraction of foreign investment, understanding social solidarity economy is inevitable. The social solidarity economy in this context refers to collective practices that contribute to building a more just and egalitarian world hence contributing to sustainable development. The practice grows in a global perspective, by linking economy to society, local to global, labour to investment, and production, consumption and the environment. Thus, it becomes an engine for development and plays an increasingly important role in meeting needs that are not adequately addressed by the public or private economy. The social solidarity economy is one of the responses to the current economic crises in addressing city development challenges. Both land use planning and cooperative enterprises therefore are key players and require partnership in strengthening the social solidarity economy in a locality or for overall country productivity. They have both economic and social characteristics. The economic characteristics entail how do they operate efficiently and attain profit to cover operating costs as well as operate at low or economic costs. In view of social characteristics, all of them must involve people in its operations, must be competitive in the market economy, and have adequate capital investment from the membership. In addition, both land use planning and cooperative development experiences consistent conflicts, thus demanding that they are managed democratically, transparently and with inclusiveness of stakeholders in planning to decision making.

Cooperatives in this context refers to social and economic organisation or association formed by people voluntarily who agree to come together on the basis of equality and equity to undertake an economic activity in order to achieve their goal (ICA 2001; Kashuliza *et al,* 1999). These people have common felt need, which among others make them come together. However, before a cooperative society/enterprise is formed, certain things must occur including: there must be people with common need/problem; the need and desire to solve that problem; association of people with a common bond coming together discuss how to solve the problem and an agreement/consensus on how to solve the problem. The key cooperative principles includes: Voluntary, which entails no force, willing and freedom to join: Equality, which entails non exploitative, existence of democracy and equal voting rights and lastly equity, which entails equitable share, capital contribution and sharing of risks and profits (Bottelberge *et al,* 2010; Faustine, 2001; Chambo, 2010)

In supporting the above, land use planning refers to a process of determining equitable and efficient use of land through proper allocation to ensure proper sitting of the building and other land uses including farming (Magigi *et al*, 2009). It considers the principles of social, economy, land use compatibility, accessibility, aesthetic value, livability, safety and technology of efficient use of land to increase city and residents' productivity. It considers also minimisation of land use conflicts to enhance city Direct Foreign Investment (DFI) and productivity which has direct connection with social solidarity economy. The process of land use planning initiation requires voluntary action of members, participation, democracy in decision making, equal sharing of costs, involvement of different stakeholders and enjoyment of the plan outputs. The planning output is the land use plan, which once registered may help a member within a neighbourhood or cooperative member to use it as a collateral to access financial mortgages after the land has been formally granted right of occupancy. Thus, dealing with urban development, where poverty is on the increase in African cities, land use planning and cooperative development can not be avoided and can be integrated as a viable option for poverty reduction in African cities including Moshi in Tanzania.

2. Study approach

A descriptive research design has been adapted for this study, which was complemented by exploratory devise to capture elements that relate to knowledge and opinions of relevant actors in land use planning processes and cooperative development context. Himo Savings and Credit Cooperative Society (SACCOS) and Himo community led land use planning project were taken as case studies in Moshi Rural District Council. A list of SACCOS, urban farming association groups and informal settlements involved in land use planning project in Moshi were obtained and used as sample frame in selection of the study areas. Qualitative and quantitative data were collected from both primary and secondary data sources, where a total of 292 respondents were involved in this study (Table 1). The study employed qualitative data collection approach with periodic use of quantitative data gathered to enable the use of information from different sources for the purpose of triangulation. The mix of qualitative and quantitative data collection approach was preferred so as to enhance the search for different types of information from diverse sources to capture the existing relationships, partnership, values and contribution of land use planning and cooperative development in poverty reduction effort in urban development agenda.

2.1 Study area description and selection

The study area was Himo settlement in Kilimanjaro region, particularly, Kitotoloni Village and Himo Savings Cooperative Society. The villages and Himo SACCOS are located on the foot of Mount Kilimanjaro between 2,500 and 3,000 meters above sea level. River Saghana and Whona, traverses the settlement, which are Pangani drainage basin tributaries. It is located about 30 kilometers from Moshi urban centre with a population of 18,872 people, of which 10,024 are females and the rest are men (Ward Population Census Report, 2008). The area receives mean rainfall between 800 mm and 1,400 mm; sometimes reaching up to 1,600 mm. Mean daily temperature is 10–12 centigrade while annual range of temperature is 4–6 centigrade. The present size of household farm ranges from 1 acre to 2 acres (as per Ward data from August 2008). Other households have less than 1 acre (48%). Most of all household expenditures are expected to come from this small piece of land. The average size of the household is seven people, which indicates increasing future land problems in the township.

Existence of unsolved land use planning conflicts of landholders against the council remained undetermined by the court of law for many years. Existence of land property mortgage/collateral conflicts within Himo SACCOS, land tenure conflicts, unorganized farming practices are some of the remarkable factors used for selection of the study cases. Urban planners *inter alia,* were and still are totally stuck and unable to regulate land use change in the entire territory under the customary land tenure system within the township dominant by farming. This has resulted in conflicts and confrontations of local authorities and landholders, which appear revealing the interests, real rationalities, notions, values and ethics underlying the actor's decisions and actions in land development. In addition, landholders in Himo organized a protest to struggle to seek space in the formal planning system to influence decisions, which negatively affected their lives. On the other hand, Himo SACCOS organized an Auction for selling a member based housing property for loan recovery, which both increase conflicts and therefore the cases might clarify the factors underpinning the poor performance of land use planning and cooperative development in social solidarity economy within Sub-Saharan African Cities. The selection of the case did not mean that other factors found rational were not considered, but the one proposed provided a profound for indepth case exploration and therefore others cases were taken and reflected in the study context.

A number of respondents who participated in providing data and information for this study are depicted in Table 1.

Participant's Category	**Kitotoloni Village**		**Himo SACCOS**		**Farmers association group members**		**Total Respondents**
	Men	Women	Men	Women	Men	Women	
Respondents	90	10	15	7	20	30	172
Informants	5	4	6	5	2	3	25
FGDs	14	5	12	8	3	4	46
Interviews	3	2	11	10	2	4	32
In-depth Interviews	6	4	3	2	1	1	17
Total	**118**	**25**	**47**	**32**	**28**	**42**	**292**

Source: Field Data (2010-March 2011)

Table 1. Number and Location of respondents in the case study

3. Results, discussion and synthesis

3.1 Factors for the growth of Himo settlement

Himo is an area which is transforming from agricultural land use to urban area. Formally Himo was initially a sisal estate known as Voi estate established in 1929 and in 1940s. It then pooled people from various parts of Tanzania as well as other countries such as Kenya and Burundi. The services located to serve the estates and job in sisal cutting attracted people to live in the area. From late 1970s to the late 1990s, Himo became a centre of a thriving smuggling trade across the border exchanging agricultural produce from Tanzania for manufactured goods from Kenya. As a matter of fact this contributed to the rapid growth of Himo town especially in the 1970s and 1980s. This also facilitated construction activities and therefore increased land use changes and needs beyond planned development including service provision.

Inadequate formal provisions of surveyed and serviced plots, decreasing urban farming land in the city of Moshi Municipality and limiting residents to sustain their livelihoods have catalyzed the growth of Himo settlement. The growth of Moshi Municipality has been diverted to these small townships. A report obtained from the planning office during field work showed that from 1998 to 2002, 1,368 plot applications were received, and out of these a total of 415 applicants (30%) were from Moshi Municipality. In August 2008, more than 3,500 people were looking for land as applicants. This shows that the growth of Moshi town is to some extent being diverted to small townships surrounding it. Consequently, proper land use allocations through involving land use planning becomes an essential mission for the local authority to effect and accommodate various changes.

3.2 Essence and emergence of Himo SACCOS and land use planning projects

3.2.1 Himo SACCOS

Changes of Himo settlement into Township led to decreasing land for farming on the one hand which on the other hand motivated people to get organized into groups including formation of Savings and Credit Societies to access financial resources to enable them have a voice on their land. Himo SACCOS which loans funds Himo Settlement dwellers was established in year 2006. It was born out of the desire of the Lutheran Church believers who were motivated by the Uchumi Commercial Bank, to form such an organization to fight against poverty in the neighborhood as well as checking down loss of farm land as the area changed its status from a Village to a Township. A total of 37 members were founders as a result of motivation provided by Clergy of the Lutheran Church. It operated as a pre-cooperative group for almost a year. In March 2007, the Himo Savings and Credit Cooperative Society was registered with registration No. KLR 687 and started operations as mandated by Cooperative Society Act of 2003 of Tanzania.

3.2.2 Factors for success and challenges of HIMO SACCOS

Training

Members and leaders of Himo SACCOS received training from various institutions outside and internally. These institutions include Cooperative Department of Moshi Municipality, from Banks and regular internal trainings offered by SACCOS to members by leaders who were already trained. The Cooperative Department offered seven training session to leaders and members from the year 2007 to June 2011. The type of training offered includes cooperative leadership entrepreneurship and rights and duties of members and leaders. CRDB and Uchumi Commercial Banks offered two trainings on effective use of Loan, recovery systems and entrepreneurship. Four trainings in these areas had been offered to members and leaders. This seems to be done if and only if there is an offer for a loan from these banks on demand basis. Internal training is done by leaders to members. This training type is offered on regular basis to keep the members informed of their obligations for organizational development. What is observed is that the training and education aspect is not given much weight. It is not taken to mean the preparation of the human resource for serving the SACCOS. This discussion shows Commercial Banks that have ties with the SACCOS should reduce the lending interest rate as it increases the cost in terms of the borrowings to the members. As well, they should give the requested loans on time.

Legal, policy awareness and gender considerations

The study found out that the Himo SACCOS has been adhering to the legal requirements. One indicator noted includes keeping copies of the Cooperative Policy; Cooperative Societies Act; The Cooperative Societies Rules; and their own internally developed by-Laws. However, it appears that though these are kept in SACCOS' custody, yet many of the members are unaware of them (inclusive of the Board Members). It is only the Loan Officer and the Cashier who make effective use of them. This is detrimental to the progress of the cooperative, which seems to be common to such organizations.

Himo SACCOS experiences gender balance in terms of membership, but with regard to leadership position, gender imbalances exists. The organization has a total of 289 members, of which 121 are female and the rest are men. The table below indicates the gender imbalances existing within the organization operations.

Organ	Position	Sex
1. The Board	Chairperson	Male
	Ass. Chairperson	Male
	Secretary	Male
	Assistant Secretary	Male
2. Supervisory Committee	3 Members	All Male
3. Management	Manager	Male
	Loan Officer	Male
4. Loan Committee	3 Members	2 Male, 1 Female

Table 2. Organizational structure

From the table above, one can rightly deduce and infer that there is a problem with regard to women participation in leadership positions at Himo SACCOS. There are only three women out of twelve leaders forming the Board and this is because it is a legal prescription. In the management there is only one lady cashier. The trainees tried to find out the reasons for such a problem, it came to their notice that basically two reasons are behind this problem. First, women are not ready to compete. This is much more motivated by cowardice and fear to stand before men. And the other reason is much connected with much concentration in other economic activities and reproductive functions. Women are worried that if they become leaders they won't participate effectively in other personal activities. The SACCOS administration is highly encouraged to make sure that women are also included in the leadership positions. It is not enough that they are members only. The study established that women are hesitant to join leadership position due to the nature of the Chagga society where male dominates. However, they should know their right of becoming leaders. Education will provide education and increase women awareness and understanding of their rights, including land property ownership.

Effective mechanism of financial inspection and Auditing

According to informants, inspection and auditing are normally done annually to ensure transparency in the use of public funds. The inspection was found to be done by the Municipal Council Cooperative department officers and auditing by a government auditing parastatal organization known as Co-opeative Audit and Supervision Corporation (COASCO). The two institutions normally examine Financial statements and based on Income and Expenditure of the SACCOS and give feedback report as supervisory report by Co-operative Officers and Management Audit and Annual Audit Report by COASCO Director General who is mandated to do so. However, it was strangely observed that inadequate funds hinder timely audit work. For example until June 2011, the financial report for the year 2009 and 2010 were not audited. This may lead to increasingly misuse of public funds through swindling of money which can lead to decline of SACCOS activities. It is likely this may discourage members to contribute to their organization and therefore decrease their income levels, levels of productivity and reduced faith in those in leadership position.

Non-compliance with the law, principles & values

Three Annual General Meetings are required as per Himo SACCOS bye-laws. Inspection and auditing of organization funds have to be done annually. Experience shows that there has been a departure from implementing the rules. The numbers of meetings were not exactly the number prescribed in the society Bylaws. It appears that leaders of this organization shun away from questioning by members especially on the use of members funds. Further, it was observed that, the issue of Auditing and Inspection are not given much serious attention by the SACCOS, the Cooperative Department and COASCO. Here we recommend that the Board, which is the organ responsible for running of the society, to make sure that the Bylaws are adhered to and the three meetings are held. This is for the sake of making the society alive and allowing members to get an opportunity to make their contributions for better running of the society to their advantage. Revising and transforming the Cooperative Societies Act and its better implementation seems to be a an enormous demand.

3.2.3 Government based interventions in land use planning process

In view of land use planning project in the neighborhood, Himo District Council as a local authority initiated this project immediately after the area had been declared to be township in 1986 and consequently extension of the boundary was compulsory. When the planning boundaries for Himo Township were established in 1986, some villages which were registered, under the Village and Ujamaa Registration Act of 1975 in Tanzania, were engulfed into the planning area. Prior to this plan these villages had administrative authorities and the land allocation and control vested with Village Authorities who were entitled to decide about land questions including subdivision and allocation. Kitotoloni village is among the ones engulfed into the planning area. During preparation of land use plan project for this area, there was no explanation on how the villagers would be incorporated into urban fabric, including compensation for their land. Most landholders resisted land use planning and have continued parceling land for selling or allocation to their families and clans. They are also erecting permanent buildings despite the instructions given by the district council to stop doing so. People used to access land in the settlement by different mean as presented in Table 3 below.

Means of acquisition	Men	Women	Total	Percentage
Inheritance	132	10	142	88.8
Gift	0	1	1	0.6
Buying	13	4	17	10.6
Total	145	15	160	100
Percentage	90.6	9.4	100	

Source: Field Data (2008)

Table 3. Land Acquisition at Kitotoloni Village

Results presented in Table 2 show that 142 (88.8%) of property owners got land through inheritance, one person got land from his former employer as a gift (0.6%), and 10.6% bought parcels of land from original settlers and occupation of land by virtue of absence of landlords was not recorded in the area. This has a connotation that land occupiers at Kitotoloni village are strongly attached to customary land tenure system, which is one type of land declared as per Urban Planning Act of 2006, it has to be futile. Women (9.4%) compared to men (90.6%) are seen to be the least involved in property acquisition. This could be caused by patriarchal dominance in accessing property and ownership rights in African families including Chagga community in Kilimanjaro Region, Tanzania.

In view to such land use developments for the township, the villagers protested against the planning intervention. This protest manifested itself as a conflict, which led into residents appealing in the court of law, seeking help for their land that has been changed from agricultural to residential use. The court of law has issued a stop order to planning and surveying of plots until when a consensus will be reached. The conflict has become an obstacle to the council's attempts to regulate land use change in Himo Township, especially in Kitotoloni village that has been included in the township boundaries.

However, in the discussion with landholders (88% of the total respondents), they said that they are not opposing their farms to be part of urban area, however they were unhappy about the decision because of uncertainty about their lives in the changing social and economic setting in an urban environment. Government officials promised that each landholder whose land will be taken would be given first priority in allocation of new plots and be compensated in the process of land use planning and allocations. The landholders were not satisfied with this promise as they knew that once an area has been declared an urban area, the use of land will change to housing, institutions, and other uses. They also were aware that parceling the land into residential plots will cause change of traditional farm boundaries of individual land holdings. What they did not know is how they will survive in a township environment, as they already experienced that certain laws and regulations in towns prohibit activities such as free grazing, growing of crops such as maize and bananas. This restriction was perceived as a constraint in starting a cooperative that will or may help to market their products profitably and subsequently alleviate poverty. Most land occupiers depend totally on land for their sustenance. In addition, landholders know that once their land has been turned into an urban, they will not have freedom of using it as they desire. In this area, land is used by the owner and children to secure their livelihoods. This necessitated some of them joining Himo SACCOS to cope with urban life

3.3 Leadership and governance

Himo SACCOS has three tier type of leadership with different mandates as per their constitutional set up. This structure comprises of SACCOS' members, Board members and Supervisory Committee. Board members are elected by members during the Annual General Meeting (AGM). Members are supposed to make decisions during the Annual General Meeting where their voices are expected to be heard. The supervisory committee which comprises Manager, loan officer and Cashier who performs daily activities of the organisation. The supervisory committee officials are also members but in most cases are employed by SACCOS based on their area of expertise. The structure seems to be commendable but there is a problem in regard of the AGM. According to the interviewees, the Board is not complying with the by-laws because the number of meetings supposed to be held annually is not met as previously explained. In addition, knowledge on land and house mortgages observed are not clearly known to enable them understanding both formal and informal properties, which can be mortgaged by members to the cooperative society.

By June 2011, Himo SACCOS had 289 members, of which 121 are females and 168 are males. Members of this organization are involved in different activities which enable them to recover the cost of loan once borrowed. These activities include small-scale business persons, crop farming and animal husbandry. The organization is open for any member to join provided she/he is living in Himo neighborhood as guided by the organization bye-laws.

There are categorically two types of members observed during this study. They include the founder members and ordinary members. The founder members are the ones who brought the society into life and the ordinary members are the ones who have been registered day to day upon meeting certain criteria. According to **Rule 10** of the SACCOS' by-laws, ordinary members can be admitted if she/he has met the following conditions; first, if she/he has attained the age of 15 years and above; if she/he is of sound mind; if she/he has fully paid up shares (i.e. 10 shares @ TShs 5,000/=). There are other more requirements related to the behavioural aspect of a person. One important thing noted is that, one cannot become a member if she/he does not reside within the Ward of Makuyuni that is made of three villages of *Himo, Makuyuni and Lotima*.

Himo SACCOS had a capital meriting to Tanzania[1] Shillings 70 Millions (i.e. 47,000 USD) by June 2011 from Tanzania Shillings 37,000 (i.e. 25 USD) in the year 2006 when it started. The main sources of funds include loans from Banks, member entry fees and selling of pass books. Other sources include selling the constitutions to members and income resulting from penalties imposed on members who delays loans recovery. Reluctance of leaders for change including barring chances to youth to lead the organization was observed to be a key challenge. The Founder leaders, it was observed, they take the organization to be their property and are reluctant to allow any changes which seems to jeopardize their leadership, a situation which deters development of the organization. It was also noted that these leaders do not want to transform to new leadership style and adapting to technology nor preparing for adaptation and acquiring new skills required to enhance organizational performance. In fact this observation is part of the contribution to current conflict in the cooperative. One may wonder how the founders are always re-elected in the Annual General Meeting. This appears to follow personal integrity, popularity and convincing power, which puts away the youth who aspire to contest but lacks those characteristics to win the votes.

Some conditions are set to ensure the amount of penalty on a member is recovered as a way of disciplining members by the organisation. For a member who delays loan repayment between 1 to 14 days after planned period, she/he is supposed to pay 2% of the total loan received. Likely, for a member who delays repayment between 15 and 30 days has to pay extra payment of 4% of the total amount borrowed. These conditions were made and agreed by members themselves during their Annual General meetings. The enforcement of these conditions enabled the organization to increase its income and therefore its economy. In addition, a total of TShs. 280 Million loan, from Uchumi Bank (100m) and CRDB Bank (180m), were borrowed by the organization with 16% interest. Loans from Uchumi Bank were recovered successful until year 2009 from the base year 2006. Loan from CRDB until June 2011, was not fully recovered by the organization. What has been observed and perceived by members is that loans from banks make them poorer. It is important if the source of income can be internal sources rather than depending on bank loans which charges high interest rate.

In view of land use planning, key players include local authority and landholders who were denied right to be part of decision making process in formalizing land rights in township authority through involvement in land use planning, cadastral survey and being granted right of occupancy, culminating in unnecessary land use conflicts. Some of the conflicts are related to re-negotiation of the customary land ownership in the face of the ignored right of the landholders, in view of social and political changes. The undermining of indigenous

[1] I USD was equivalent to 1500Tshs by June 2011

tenure arrangements in Himo has resulted in conflicts, which manifest in physical clashes between customary and statutory rights in the process of land use planning. Under the current Land Policy of 1995 in Tanzania one may have access to land through either a granted right of occupancy or by customary right of occupancy. Whereas the former is issued by the head of state or his authorized subordinates, under the later system the law deems customary land owners as lawful occupiers (the deemed right of occupancy). However, since colonial times up to the present, the courts have undermined the ''deemed right of occupancy'' under which customary land tenure is based, and upheld the superiority of documentary evidence, title deeds, certificates of occupancy and all the paraphernalia of granted rights of occupancy. This can be critically interpreted that, the courts are of the opinion that customary right of occupancy is inferior to the granted right of occupancy once the settlement expands. This puts more questions, as to how the customary land right will be respected as a way of gaining status which shall enable the urban poor to access financial sources to enable them contribute towards national growth and poverty reduction efforts especially among cooperative members and SACCOS' management?

3.4 Cooperative development and land use planning disputes

3.4.1 Dispute settlement mechanisms for Himo SACCOS

Remarkable mechanism appears to have been established by Himo SACCOS in resolving disputes. Common disputes observed are connected with the Loan Repayments. When members fail to repay is when things starts to come to a collision course. The established processes include;

i. Serve a notice to a member. Some conditions are set on how to execute this. From 1-30 days, the member is called by phone and be informed the need to recover the loan. From 31-60, the member is served a letter explaining to pay as a follow-up. From 61-90 days this is recorded as bad debt;
ii. Second step is physical follow-up. In this regards physical visit of the member's business unit is made. If found is informed and is requested to voluntarily come and repay back the loan with penalties,
iii. Thirdly, if the member is not able to come and repay at the society, attachment and realization of the Securities is declared and auctioneers are contacted and involved;
iv. The search for the Guarantor is committed and letter and physical visit is done. In this respect when they fail the Auctioneers take the reading role.

In the whole process, nowhere the court of law is being involved. This seems to be detrimental for the cooperative organization development in terms of ensuring cost recovery once the member borrows. This also happens in land use planning process, as no where the court can be involved in the process of land use planning unless there is a conflict between subordinates. This act as a disincentive to community and or association members who are motivated and joined together to improve their settlement and income levels of their residents and therefore improve township productivity.

3.4.2 Conflicts related to selling member properties within Himo SACCOS

One of the conditions for accessing a loan from Himo SACCOS and other cooperatives in Tanzania and elsewhere include being an active member who contribute shares, pay fees, actively participates in the business of the organization, attend meetings and share ideas on the development of the organization. The member also must have some guarantors who know him/her in terms of properties he/she owns. These properties may be sold as payback once the member fails to recover the loan. The common properties which most of the cooperative members use as mortgage include land, house and other material goods such as vehicles. Once the member request for a loan is accepted, the loan agreement is drawn and signed by both parties.

The nature of the conflict occurred in Himo SACCOS is between the organization and one member, Mr. Emmanuel. S. Mvungi, who entered a loan repayment agreement in which he mortgaged his house. The appellant borrowed a total of Tsh.5, 000,000 million (3340 USD) from the Himo SACCOS on 12th May 2009 for two years recovery period agreement. The condition set for loan recovery was to adhere on monthly repayment schedule. The appellant after receiving the loan he did not respond to any loan repayment as agreed in the contract. The organization management reminded him in various occasions by both orally and written notices. He either ignored and/or refused to payback the money.

On 4th April 2010, after serving three notices to the member, the Himo SACCOS contacted Visionary Auction Mart Broker popularly known as Majembe Auction Mart to help the organization to recover the cost. The Broker sent two notices of 14 days and later of 30 days. These attempts of the Broker to serve the notices fell on deaf ears and the member did neither appear nor respond to these notices. While the Majembe Auction Mart prepared to go to sell the mortgaged house as by law to recover the loan borrowed, they received an ex-parte interim order No.96 of 2010 dated 15th of June, 2010 restricting the action to be taken from *The District Land and Housing Tribunal of Kilimanjaro at Moshi.*

The member after filing the case in the District Land Tribunal, prayed for not auctioning the mortgaged house to settle the loan amount instead he requested for more to pay slowly as he gets the money. In this respect no explanation was given where and how he spent the money received from the Himo SACCOS. The Himo SACCOS was in favour of interest of justice to see that the loan is repaid back so that the organization can be able to assist and extend the loan to other needy people rather than leaving the money with the applicant who is not ready on his volition to pay back the loan. The total amount to be covered included loan 5,545,200 with penalty addition and for Broker fee amounted to TShs 554,020 excluding other costs payable such as Transport fee which merit to TShs 15,000/=. Up to June 2011, the case still under the District Land and Housing Tribunal in Moshi waiting for decision to be made for the parties.

The study shows that the Housing property, which is mortgaged as collateral was constructed on informal land which is owned under customary land tenure. The informal land property owned under customary law in practice has less value when compared to the formal right of occupancy recognized in legal framework. The market value of this mortgaged house on informal land determined by the broker could have been more valuable if land use planning was carried land registered. Likely, training on land laws to cooperative leaders and members was lacking to enable member knowledge on issues of land and housing property mortgages and its implications once opted to use as collateral for financial access. Training in property rights and collateral determination can be an important vehicle for enhancing cooperative development. However, capital accumulation through member contribution seems to be an important element to enhance sustainability of the microfinance institution to ensure it makes profit. The borrowing from Banks is a disincentive for ensuring cooperative development and sustainability so as to make surplus one of the reasons being high interest rate and numerous exorbitant fees of banks.

3.4.3 Nature and sources of land use change, land tenure conflicts based on land use planning process in the neighbourhoods

Urban planning process among other things, aims to ensure equitable utilization of land, increase city productivity and creating a livable and safe city. The process involves production of land use plan as an output to guide urban development and investment processes through having planned neighbourhoods. The process involves land use planning, cadastral survey, and infrastructure provision and land registration. The formal granted rights of occupancy ensure land safety and security for landholders who want to use the property to access financial benefits. The land planning process in Himo settlement encountered various challenges and conflicts, which deterred its effectiveness as explained hereunder.

Inclusion of village areas into planning boundaries

When the planning boundaries for Himo township were established in 1986, some villages which were registered, under the Village and Ujamaa Villages Registration Act of 1975 in Tanzania, were engulfed into the planning area. Prior to this plan these villages had administrative authorities and the land allocation and control vested with Village Authorities who were entitled to decide about land questions including subdivision and allocation. Kitotoloni villagers are among the ones engulfed into the planning area. Given that during preparation of layout plans for this area, there was no explanation on how the villagers would be incorporated into urban fabric, including compensation for their land, most landholders resisted land use planning process and have continued parceling land for selling or allocation to their families and clans. They are also erecting permanent buildings despite the instructions given by the District Council to stop doing so.

Protest against expansion of boundaries of the planning area

The villagers protested against the planning intervention. This protest manifested itself as a conflict, which led into residents appealing in the court of law, seeking help for their land that has been changed from agricultural to residential. The court of law has issued stop order from planning and surveying of plots till when consensus will be reached. The conflict has become an obstacle to the council's attempts to regulate land use change in Himo township fringes, especially in Kitotoloni village that have been included in the township boundaries.

The ''fear'' of getting urbanized

In the discussions with landholders (88% of the total respondents), they said that they are not opposing their farms to be part of urban area, however they were unhappy about the decision because of uncertainty about their lives in the changing social and economic setting of an urban environment. Government officials promised that each landholder whose land will be taken would be given first priority in allocation of new plots and be compensated. The landholders were not satisfied with this promise as they knew that once an area has been declared an urban area, the use of land will change to housing, institutions, and other uses. They also knew that parceling the land into residential plots will cause change of traditional farm boundaries of individual land holdings. What they did not know is how they will survive in a town environment, as they already experienced that certain laws and regulations in town prohibit activities such as free grazing, growing of crops such as maize and bananas. Most of land occupiers depend totally on land for their sustenance. Therefore they know once their land has been turned to urban, they will not have freedom of using it as they desire. In this area, land is used by the owner and children to secure their livelihoods.

The system of compensation suggested by the lands officers and other leaders was not acceptable by most of landholders. The system was that, when the area has already been planned and surveyed, landholders will be given one plot in every acre one possessed. This means that those with one acre will get one plot, those with two acres two plots and those with piece of land which is less than an acre will also be given one plot. However this system didn't specify the size of plots which will be offered. By any means these plots wouldn't be able to support livelihood of these people. Worse enough is that some of the landholders whom their land was planned and surveyed didn't get even a single plot within that piece of land they have possessed. This land was allocated to other persons and when they went to complain they were told that they would be allocated another plot in another area.

One resident whose farm was subdivided into plots didn't get a plot there, instead he was shown a new plot near a quarrying area where he wouldn't be able to practice agriculture as he was used. In his former farm he had planted vegetables and trees of different varieties, and if it was the matter of being given a plot he was supposed to be given first priority. Neither compensation in cash was discussed nor on other properties as promised. One landholder remarks:

> *''This arrangement of taking our farms is like some one who has taken your shirt, then he torn it into pieces, then he just gives back to you a collar, will this collar be enough to cover my whole body? From this land I am getting food, I am getting money to settle school fees for my children and other expenditures. Today you are asking me to leave? It is quite impossible, I will kill any one who will happen to take my land and I will also commit suicide''.*

The corroboration statement was also confirmed by other landholders in Himo settlement. This revealed that landholders had been more or less ignored in the course of preparing the layout plan. Most of the landholders asserted that they had heard about layout planning for the area but they had neither participated in the process nor had the opportunity to air their views. Understandably, the interviewed landholders expressed bitter reservations about the intentions of the Ministry responsible for Lands and Human Settlements and Development to prepare layout plans without involving and considering landholders' rights.

Interviewed landholders (88%) perceived the attempted planning intervention as a threat to expropriate their land. Trust and relationship between the landholders and the local government (especially the district council) are weak and may probably further decline. The majority of those who had been allocated land in newly planned areas in Himo include influential people like businessmen, politicians, middle and upper class public servants, and retired civil servants. This implies that land in the periphery is increasingly being colonized by people who command some form of power, through a conspiracy theory. One landholder remarks:

".I do not know where these people want us to go. Look, the beacon, had been amounted here separating the main house and a cowshed. Surveyors came to my home and told me that my farm plot has been reduced and therefore I have to find somewhere else to erect a cowshed because the existing one has fallen into somebody's plot".

This implies that there were no proper updating of base maps to plot existing property rights and interests on the basis of which a plan would be prepared.

Conflicts' arising from the state's undermining of indigenous Tenure arrangements

Some of the conflicts are related to re-negotiation of the customary land ownership in the face of the ignored right of the landholders, in view of social and political changes. The undermining of indigenous tenure arrangements in Himo has resulted in conflicts, which manifest in the clashes between customary and statutory rights. Under the current Land Policy of 1995 in Tanzania one may have access to land through either the granted right of occupancy or by customary right of occupancy. Whereas the former is issued by the head of state or his authorized subordinates, under the later system the law deems customary land owners as lawful occupiers (the deemed right of occupancy). However, since colonial times up to the present the courts have undermined the "deemed right of occupancy" under which customary land tenure is based, and upheld the superiority of documentary evidence, title deeds, certificates of occupancy and all the paraphernalia of granted rights of occupancy. This can be critical interpreted that the courts is of the opinion that customary right of occupancy is inferior to the granted right of occupancy once the settlement expanded. This puts more question, how the customary land right will gain status for enabling the urban poor to access financial betterment towards national growth and poverty reduction efforts?

Conflicts during cadastral survey processes

A major conflict, which confronted the surveyor, was the discrepancy between the proposed plot boundaries and actual plot boundaries on the ground. The plot subdivision plan disregarded individual property boundaries and a lot of development had taken place since, contrary to the plan. The planners had not recorded this important aspect of land development during the mapping exercise, because they did not consider land value to be an important issue. The mapping exercise did however not take into account individual property rights, suggesting that such rights did not matter to the planners, although they did to those holding such rights.

The first attempt of surveying plots in the area faced strong resistance from landholders, who teamed up led by their chairman. Many of them didn't know if their land had been planned. This resistance caused the surveyors and land officers to report the issue at Himo Police Station so that they can be guarded. From that day the surveying of plots was done under supervision of the police. Landholders who continued to resist were caught and taken into jail. Some people who are said to have close relationship with land officers had their farms surveyed and given title deeds. Therefore during surveying of plots these farms were not included. This act caused complains as some peoples' land was taken while others were not.

3.4.4 Community coping strategies, resources and powers to respond on formal land use change

Once the landholders teamed up to fight against their rights on using their land, a total of 2300 U$ was contributed to facilitate their move. A total of 25% of the contributors were female households, which shows the importance of gender consideration in land use planning. The action of landholders appears to build strength to act against the government and therefore be able to file their case in the court as explained hereunder.

Opening of cases in the court of law

When people saw that surveying of plots was going on they teamed up and went into the court and filed a case opposing their land being surveyed without their involvement. The plaintiffs were villagers of Kitotoloni the defandant was the district council. In their allegation they said, Kitotoloni village was registered in 1976 as village No. KM/KIJ 334. It had otherwise existed as a village before independence. It owes its origin from land allocations made to parents and grand parents of the plaintiffs by the Chief (Mangi) of Kilema for which each grantee paid customary fee called ''upata''. At the time of allocation the area was forest and bush land. In order to put into use the grantees had to clear the forest and bush and remove stumps, with a lot of efforts and at cost. In supporting the foregoing one landholder states:

> *''We were surprised to seeing people coming with their cameras [meaning theodolite] into our land forcing us to move out''.*

The court went ahead and issued a stop order of surveying and issuing plots. The district council was directed to discuss with the landholders to reach consensus before the exercise resumes. In responding to the court decision, the local authority called for a meeting. In this meeting the landholders wanted to know what exactly the District Council wanted to achieve by expanding the town towards this area. They wanted to be enlightened on how the landholders will benefit from the town's expansion. The question appears to be a common community felt problem that made them work together to defend their customary land right of occupancy.

In addition, it appears that if the benefits of land use planning procedures and allocations could have been clearly explained to landholders by the local authority, eventually there would have been no problem of this magnitude. The fear, inter alia, was striking landholders' minds because they knew that urban regulations prescribe how land should be used and developed, according to certain standards. Until July, 2011, the struggle was still in vain and continued to brew.

3.4.5 Roles of different actors in land use planning

Stakeholders involved and their linkages with various stakeholders involved in the land use planning, implementation and arbitration of land disputes in Himo settlement are numerous.

Ten cell leaders, committee members and landholders:

These stakeholders have been involved in land subdivision and transactions, transfer of land rights, and conflict resolution. Eventually there are land conflicts in Himo relating to farm boundaries, use of canal water, blockage of footpaths and even double selling of the same plot. While Himo is changing from rural to urban, buildings worth millions of shillings have been erected. This suggests that investors, including landholders, have confidence in the informal institutions, which have facilitated property transactions and are safeguarding individual rights as a social solidarity economy. These buildings are being erected in the area which has been declared to be a planning area ripe for urban development.

Central Government (MLHSD), Local government (District Council), Ward and Sub-Ward administration, Sub-ward development committees, policy and Courts of law.

These institutions are among others responsible for land use plan preparation; follow up on the different land use plans in the area, policy formulation and enforcement including Ministry responsible for planning and local government. Other responsibilities include conflict management related to land development in the country mitigated by police and the courts of law. The performance of these institutions is shaped by social and physical contexts, but the observed outcomes are also influenced by the formal system. A land dispute, which could be solved by a local institution, in short time can take several months or years when this issue is handled with the courts of law. This institutional characteristic in practice appears discouraging local communities to engage in land use planning and subsequently conflicts arise.

3.5 Urban farming, land use planning and cooperative nexus and emerging challenges

Implementing land use planning requires contribution and partnership in terms of cost sharing. The costs here involves payment for consultancy services, labour, materials and those leaders who will be making follow-up in land use plan approval procedure. All these costs are community shared and require commitment and transparence in its use. In regard to co-operatives, the organizations in most cases aim at cost minimization. The members try their level best to ensure that costs are at lowest and equal opportunities are given to members. This forms a similarity when trying to link land use planning process and cooperative development and sustainability when the question of cost is at the central focus of all the two in mutuality and friendly manner. However, decisions in both fields are taken in collaboratively though the initiation differs as per policy and guidelines in place in Tanzania and other Sub-Saharan African Countries.

Urban land use planning is guided by Urban Planning Act of 2007 and Land use Planning Act of 2006. These legal instruments exclude urban farming as it requires attention in its management. However, the case study shows people get organized and use peri-urban areas for subsistence farming. Gardening and household yards are common. Vegetables farming in plots and off-plots were also noted to be dominant. These activities were found to be conducted in unplanned and un-serviced land, where it becomes cheaply undertaken by the government once land is needed for public development or for any land use alternative development including housing or other investment needs. A group of farmers who had formed an association for using irrigation system were negatively affected as the land they used to farm was taken by government for public interest.

In fact, once someone's lands is taken, she/he drifts to lower levels of poverty since the property she/he depends on has been taken. In addition, cooperatives associations in forms of SACCOS found difficulties to establish the value of unplanned land and with no title deeds. Likely, group associations found that after land deprivation they declined economically and found themselves poorer and the shifting to peri-urban and rural areas became an apparent feature. However, urbanisation process is accompanied with expansion of the city boundary, which engulfs peri-urban land, resulting into decreasing land used for farming. Lack of land designated for cooperative development in urban planning practise is hindering cooperative effectiveness and their level of productivity. Increasing interaction of smallholder farmers and

Savings and Credit Cooperative organisations guarantee members' access to the city economy, in terms of capital outsourcing from relatives and friends, labour and exchange of goods and services, and strong communication action are common features, that triggers the transformation need of cooperative development and land use planning change in urban development. Thus, guiding urban development through proper land use planning is essential to ensure the increased urban investment, making a social justice city and therefore reduce poverty among urban residents to implement the urban development agenda.

4. Synthesis and concluding statements

The SSA countries in which we work exhibit a wide range of social and political systems, stages of economic evolution and cultural legacies. Yet in each, the need for collective action to address shared problems is evident, particularly in rural and resource-poor areas.

However, by organizing cooperatives and participatory land use planning approaches, farmers and entrepreneurs can mobilize capital, pool knowledge, achieve economies of scale and foster vertical integration. They can create greater leverage in the marketplace and policy arena, attract business service providers and more efficiently link to urban and export markets. Such disciplined groups not only catalyze local economic growth, they may serve as a vehicle for more equitable community land use planning and improve members income and level of productivity in the city economy. Likewise, they develop human capital, encourage the participation of women and youth in development activities including farmers' decision making, fostering democracy and entrepreneurship for organizational and membership development within the social solidarity economy context.

Whether working with legally registered agricultural and financial cooperatives, community-based enterprises and private limited companies, financial institutions such as Banks seems they do not promote one standard model for enhanced cooperative development. Banks are interested in profit making and giving loans which they know later you will reimburse at high interest rate and impose exorbitant fees indiscriminately. The approach for enhancing cooperatives is to build on existing structures and to promote diversity and choice within itself. In this regard diagnostic tools for assessing the capacity and seriousness of existing cooperatives to serve the interests of their members in an effective, accountable and transparent manner are in high demand. Along with participatory subsector analysis, institutional mapping and competitiveness analysis tools, by engaging stakeholders in devising plans that address cooperative weaknesses and constraints.

To ensure cooperative sustainability, accountability, service orientation and surplus generation, members must contribute and monitor the progress of their group. There is a need for developing participatory methods and procedures in policy and legal context to allow group members to assess management, participation, organization, planning, economic performance, technical operations, financial operations and growth in both sectors of cooperative and community based initiated land use planning process. Some range of instruments–including memoranda of understanding, protocols, contracts and franchise agreements–to protect members from abuses of power and to discourage irresponsible groups from bringing the organizations into disrepute, can be adopted.

Community organized groups in their involvement in land use planning and cooperative development allows small-business owners and farmers to compete in the marketplace.

There is therefore a need to strengthen the capacity of such groups to expand their trading options by scaling up production and applying quality-control standards. To this end, groups are assisted in accessing essential technical services, linking to higher-value markets, forming business alliances and advocating for a favorable regulatory environment for improved city productivity.

The potential for large-scale impact embodied in agriculture and financial cooperatives justifies the long-term commitment of resources required to build effective, independent and financially sustainable member organizations. As organizations mature, they generally expand their operations–diversifying products and services, branching into new geographic areas and addressing social concerns such as illiteracy, gender inequity or HIV/AIDS. Cooperatives play a significant role in nurturing the next generation of community leaders, and, with their extensive member networks, they are ideal vehicles for transferring knowledge, challenging social perceptions and poverty reduction tools.

In democratically run, member-owned organizations, smallholder farmers and small-scale business owners learn participatory decision making and develop ways to resolve conflicts. They enables members to demand accountability of elected leaders, present their views in public, claim ownership of the local political process, and on a daily basis they demonstrate the values of transparency and accountability.

The study shows that local community participation is important towards enabling residents in urban centers to come together and fight for their right of securing tenure system for improving small scale farmers' productivity as a response to food insecurity. However, linkages, synergy and partnerships in view to participation process and contribution of different resources appears to be an important ingredient in enhancing local community involvement in securing land tenure and therefore safeguard urban environment. Roles of different actors including the central government, local government and other planning and development institutions need to be clear and therefore contributory to enabling local community initiated project such as land use planning, cadastral survey and land registration to be implemented effectively and efficiently. This may be the case in most Sub Saharan African countries, where the need for having planned and secured formal landownership to residents is high in urban development agenda.

The economic characteristics entail how do they operate efficiently and attain high profit to cover operating costs as well as operate at low economic costs. In view of the social characteristics, all of them must involve people in its operations, must be competitive in the market economy, must have adequate capital investment from the membership and finally must be managed democratically, which shows the role of land use planning and cooperative development in improving city productivity.

The future outlook of cooperative and land use planning process should be based on community-centred and market-driven approach. Member-owned groups should increase their members' incomes, either directly, for example through bulk input purchases and collective marketing, or indirectly, such as through policy and advocacy initiatives. Members are motivated to participate in group activities because of profits and or benefits they obtain as a result of their engagement in the sector.

To move in the right direction, the Government may also prepare a transparent strategy for rebuilding the co-operative movement involving other interested parties like NGOs and other sympathizers of co-operative enterprise. The tendency of the Government to dominate the co-operatives as in the past should be avoided, but will play a key facilitation role. The heart of the strategy should be a pro-poor participatory co-operative development and modernization education programs that may be drawn on the positive lessons of the wide range of participatory approach based pilot projects. This may bring fundamental change of attitudes and approaches of particularly the government policy makers and other interested stakeholders including extension officers, Co-operative support institutions, co-operative movement and other sectors in the economy. Likely they will succeed to introduce appropriate changes of the mindsets and governance practices. The study concludes that towards enhancing social-solidarity economy for improved livelihoods of members within city's neighborhoods or within cooperative associations, private-public partnership (PPP) may be an important combination to be considered in urban development. If the linkages and partnerships are not well created and addressed in policy and institutional settings, it may be difficult to retrofit and may enhance urban poverty in Sub-Saharan African cities and rural settings.

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14

The Evolution and Spatial Dynamics of Coastal Cities in Greece

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1. Introduction

The procedure of human evolution has been always connected with the concepts of space and time. Communities that existed in the same chronological period in different geographic locations, such as communities that existed in the same geographic location at different eras, present various patterns of development. This statement indicates, on one hand, the significance of the spatial parameter to the Economic and Regional Analysis and, on the other hand, the directions that the Economic Research should be oriented to, in order to provide more complete outcomes. From the amount of spatial attributes that a geographic location may possess, the present article deals with the coastal one. Coastal areas have played diachronically a leading role to the development of human civilization, ought to their geographical characteristics, focused on to the seaside location , which provides many transportation advantages, such as development of ports (Li, 2003), commodity (trade development) (Cori, 1999) and also environmental advantages, such as mild climate and natural beauty (Yeung, 2001). The purpose of this chapter is to study the evolution and the spatial dynamics of coastal cities, through a spatial, statistical and regional analytic approach, in order to recognize and to interpret the patterns that describe this evolution, under the regional economic and policy perspective.

In particular, the chapter focuses on the case of Greek coastal cities (Polyzos et al., 2011), as it follows. First of all, this choice is considered by the authors to be a challenge, since the case of Greek coastal cities lies under the individuality of not presenting extended population coverage, agglomeration or demographic mega phenomena. This fact differentiates the performance of the Greek coastal system from other cases' and sets an inverse scaling transformation to the until now research findings of this field (Yeung, 2001; Sheng Han and Yan, 1999; Li, 2003; Sekovski et al., 2011). Secondly, the case of studying a recent Greek spatial and economic system is particularly up to date, by the time that Greece is currently being subjected to an economic crisis (considered from many to be an introducing crisis to the European economic system), fact that is expected to reveal some vital axes in order to comprehend the developmental potentials of the Country. Another reason is the authors' Greek parentage, which sets the Greek case to be a familiar research field. Finally, although the research on coastal cities' dynamics presents an efficient scientific matter (Miller & Auyong, 1991; Cori, 1999; Yeung, 2001; Li, 2003), so in Global as in

Mediterranean scale, the analogue Greek research can be characterized springtime, fact that sets the utility of this chapter to be considered introducing.

1.1 Definitions and conceptual framework

The concept of "coastal city" includes two semantic components, at first the significance of "coastal" and secondly the concept of "city". Consequently, a single definition of a coastal city cannot be easily derived, since it suggests a synthetic notion, which depends on the concessions that regard the corresponding components (Sekovski et al., 2011). The coastal component refers to a residential entity's spatial attribute, which depends on the distance and the elevation that this entity possess from the sea. This definition contains, a priori, a degree of subjectivity that is based on the conventions held each time (Klein et al., 2003). In international level, coastal regions suggest a 40-mile wide zone from the coastline (Cori, 1999), but this definition lacks from spatial rigidity. Regarding Greece, the elevation parameter does not suggest a concern, because Greek coastal morphology does not present, in the majority of instances, precipitate and inaccessible shapes, so as the most of the coastal city formations have direct projections to the seaside. The distance parameter was studied for Greece in the past and concluded to a classification (Kiousopoulos, 2008), under which coastal areas can be divided into three (3) categories: (a) the spatial units that have direct contact with the sea (are littoral), (b) spatial units that lack direct contact but are adjacent to littoral (having an easy access to the sea) and (c) these spatial units which are deprived of any contact with the sea.

As far as it concerns the conceptual component of "cities", similar problems of subjectivity arise. In the international literature, there is an inconsistency about the volume of the population threshold that classifies a (coastal) city to be considered "megacity". Some suggestive values for this threshold are recorded to be 1, 8, and 10 million inhabitants (Cross, 2001). Regarding the Greek case, the urban units of "Athens" and "Thessaloniki" fulfill the population criteria of the first mentioned threshold value, so as to be considered "megacities". In the present study "Athens" and "Thessaloniki" are not defined as megacities, so as the component cities of these units can be examined separately, ought to the limited scale effect of Greece.

This acceptance was held due to the previous megacity threshold argument and due to the fact that, if it is considered that these two Greek city clusters of "Athens" and "Thessaloniki" as urban units, then the coastal cities number, with a significant population coverage, is considerably being reduced. Furthermore, the criteria of defining residential units as "cities" are respectively fuzzy. This subjectivity is managed in international and national levels through conventional acts, such as laws. According to the United Nations' perspective for large scale cities, the term "megacities" regards urban agglomerations with at least 10 million inhabitants (Sekovski et al., 2011). In the Greek legislation status, the corresponding conventional act that defines Greek cities and provides a city sizing discrimination is the Act 3643/2006.

1.2 History

The developmental dynamics of coastal cities became significant at the period that urbanization trends appeared, with a result to rearrange the spatial population distribution status (Roberts, 1989). Urbanization suggested the phenomenon of abandoning the rural areas and settling in cities, under the prospect of exploiting better employment opportunities (Long et al., 2009) and, in general, higher level of life quality, ought to population's agglomeration acts (O' Sullivan, 2003). When urbanization came into prominence (Roberts, 1989; O' Sullivan, 2003), which was placed in the last century (Li, 2003)and presented its peak the period from 1960s to 1980s (Cohen, 2004; Satterthwaite, 2005 (Sekovski et al., 2011)), global population distribution altered and led to the formation of significant urban concentrations, mainly into places that were benefited from environmental, mineral sources, transportation and geographical privileges. These dense residential entities were transformed to cities and further to megacities, consisting considerable population vertices of the universal urban network.

The most rapid urbanization process has been conducted mostly at the past century, so as to be considered, (in this rapid scale) also known as "urban sprawl" (Sekovski et al., 2011), a historical event. In 1900, not more than the 14% of the world's population lived in urban centers, whereas in 2000, it is estimated that more than the 50% of the world's population lived in one of at least 16–17 world's biggest megacities, each having population over 10 million people, with the majority of these to occur in the developing world (Li, 2003). Today, the phenomenon of urbanization is still present, in different or transformed patterns, but it is significantly lower (Sekovski et al., 2011). Because of this procedure, coastal areas suggested attractive destinations for the acts of colonization. At the modern meta-urbanization period, the urban centers were saturated, regarding population density, and another act of population shifting occurred and favored the coastal cities development. These demographic pressures detonated through the act of locomotion from a dense city to a rarer, under the terms of acquiring better life quality (Cori, 1999). Furthermore, these pressures, in conjunction with the consequent continuous need for expansion of urban cores (Beriatos & Papageorgiou, 2010), usually took place through a city's projection along its coastal forehead (Cori, 1999), which rendered the evolution of coastal cities to be considered a multivariable spatial phenomenon.

Greece is a country that is characterized by high coastal concentration and it is estimated that almost the 57% of the country's population live in coastal areas (Polyzos et al., 2011). This considerable coastal concentration oughts its existence to the urbanization procedure, as also to meta-urbanization peripheral shifting. The demographic pressures, observed at the modern meta-urbanization period, were detonated through the act of locomotion from a dense city to a rarer, under the terms of acquiring life quality (Cori, 1999). These detonation trends constituted a parameter in the Hellenic seaside towns' development, during the period 1961 – 2001.

1.3 Spatial characteristics

The developmental significance of coastal areas is strongly correlated with the seaside location. The adjacency of coastal areas to the sea, suggests an attribute that provides a set of advantages to the residential units, which are placed near the sea. The most important facilities that coastal areas provide and direct to respective economical opportunities are transportation (Li, 2003), commodity (Cori, 1999) environmental and cultural (Yeung, 2001; Sekovski et al., 2011), supply and touristic (Sekovski et al., 2011).

In the majority of the cases, when a coastal residential unit reaches the critical population threshold, the coastal urban concentration leads to the formation of harbors (Polyzos, 2011; Sekovski et al., 2011). Since harbors exist in most coastal cities, maritime transport and the related economic accessory facilities are particularly significant factors for their development. The harbor-based economies of coastal cities, suggest an engine of economic growth, which can be expressed in variable ways, such as composition of employment centers, attraction of investment and trade and creation of production and market places for commodities and consumption (Li, 2003). Of course, the seaside location privilege diachronically entailed the risk of attacks in the history, such as piracies (Birnie, 1987; Anderson, 1995). Today coastal cities suggest a vital source of income for national economies (Li, 2003), fact that is obviously observed even in the case of Greece (Polyzos et al., 2011).

The environmental facile of coastal cities, suggests also a powerful developmental axis. Many coastal cities are located and being developed at places where additional (to seaside) physical facilities, energy source and raw material deposits exist (Decker et al., 2002), factors that are supposed to be essential for the reinforcement of the coastal city's economy. For example, the existence of water supplies and arable lands consist considerable criteria for the location of cities in general. Many coastal cities were either located (when possible) near to river endings, where potable and irrigation water supplies are plentiful so as their hydro-energy exploitation is more accessible. The deltaic end of the Greek "Evros" river represents a characteristic paradigm for the coastal city of "Alexandroupolis" environmental vantage. Regarding raw material deposits, the coastal city of "Kavala" in Greece, which is located in a geographic position plenty of marble deposits, suggest an indicant example. Environmental amenities of coastal cities also operate as an axis of cultural development and education, as an absorbent mechanism of surplus rural population, as well as the nursery for civic spirit and social harmony (Li, 2003). History of Greece can indicate various paradigms of coastal cities (suggestively at regions of "Attica", "Ionian Islands", "Crete", "Dodekanisa" etc.) that consisted cultural centers and cores of science and arts development.

The touristic facility constitutes a fundamental developmental factor to coastal cities and this statement seems to be more significant in the case of Greece, by the time that the country posses a coastline greater than 10.000 km (Cori, 1999). Nowadays, the coastal cities dynamics are mainly directed by the developmental axis of touristic utilization (Cori, 1999; Miller & Auyong, 1991), revealing a considerable amount of profitable potentials for the economy of a country. The touristic development, considered as a respond variable, on depends on other economic variables, such as the increase of peoples' leisure time (at least in developed countries), the communication and transportation improvement (Sekovski et al., 2011), the environmental, cultural and coastal attraction etc., which suggest motivations and render coastal areas to comprise obvious spatial destinations for the conduction of the touristic procedure.

The concept of coastal tourism includes, in its definition, the full range of tourism, leisure, and recreationally oriented activities that take place in the coastal zone and in the offshore coastal waters (Hall, 2001). Coastal tourism is considered one of the faster evolving forms of contemporary tourism, and, in the case of Greece, it seems to be the most promising developmental potential that the country should exploit, in order to overpass its modern economic problems. Moreover, considering the above in a larger scale framework, Greece and, secondary, Croatia suggests the leading countries in a possible process of west-east shifting of international tourism within the Mediterranean area (Cori, 1999). Greece, in order to take advantage of its liberal touristic dynamics, should coordinate the potentialities of its archeological and artistic heritage with the traditional sea-sun-shore appeal, investing on its small islands, as recommended by Agenda 21, through a combined procedure of economic development with environmental solicitude (Cori, 1999).

This chapter is organized as it follows; section 2 presents the study area and the available data in the case study of Greek coastal cities, section 3 describes the research methods taken under consideration to model the case, section 4 presents the results and the evaluation and, finally, in section 5 some conclusions are given.

2. Methodological approach

2.1 Systemic methodology

The initial approach, into the analysis of coastal cities developmental performance, was based on a systemic point of view. The term "systemic" has a wide conceptual range and refers to this class of methodologies that aspires to model, on a theoretical basis, the structural components of the study object and to describe its operations, under the perspective that it suggests a subsystem of a wider systemic environment. In the case of this paper, the study object refers to a manifold of chosen Greek coastal cities, which are distributed over the geographic area of Greece and suggest a spatial system. The total of coastal cities is grouped, by a geographical division, into administrative clusters, which suggest the Greek prefectures, as defined before the act of "Kallikratis" (Act 3852/2010). Consequently, the spatial units that are studied in this paper refer, on one hand, to each coastal city (spatial monad) and, on the other hand, to the pre-"Kallikrateian" Greek prefectures (spatial units consisting groups of spatial monads).

The theoretic framework of the systemic approach was inspired from the Drivers-Pressures-State-Impacts-Responses (DPSIR) model (Sekovski et al., 2011). The DPSIR model suggests a chain framework of (the five title) concepts that describe, on a step (discrete) way, the input-output mechanism of a socio-economic phenomenon with its geographic dimensions. Given a short description, the Drivers (motivation of acts) lead to pressures on the geographical system, pressures that result to a state (balance status). The conducted operations, targeting to achieve the balance, may have environmental and economic impacts on the wider including system. Finally, the Responses present a set of societal and policy makers' prioritizations, in order to reduce the undesired impacts and, in general, to improve the performance of the system. The schematic framework of the DPSIR model, adopted to the case of Greek coastal cities and to the needs of this study, is presented at figure 1.

2.2 Analytic approach

The analytic approach suggests a supplementary or further analysis of the systemic modeling, which was presented above. It targets to describe, under a quantitative perspective, the parts that synthesize the study system and to quantify the systemic mechanisms. Regarding the case of Greek coastal cities, the quantitative tools that are used for the research derive from the scientific sectors of Spatial Analysis, Regional Economics and Statistics. The analytic tools, which are used in this study, regard some common Spatial Analytic (Mitchell, 2005), Regional Econometric (Polyzos, 2011; Tsiotas and Polyzos, 2011) and Statistical measures (Blalock, 1972; Hays, 1981; Norusis, 2004) and are described briefly below.

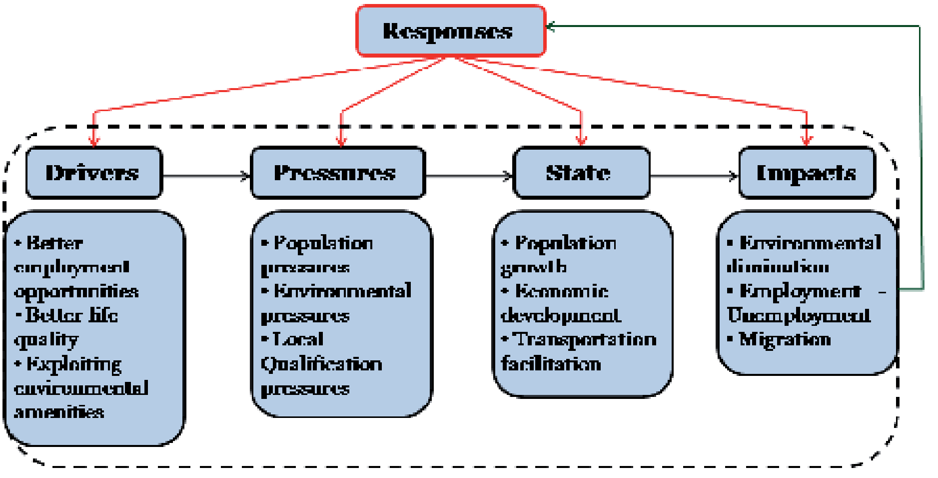

Fig. 1. The DPSIR framework scheme for the case of Greek coastal cities

2.2.1 Spatial analytic tools

The Weighted Mean Center (WMC) (Mitchell, 2005) suggests a plane point that has coordinates (x, y) the average calculation of the coordinates of all the features in the study area, as shown at relation (1), where x_i, y_i is the symbolism of the coordinates and w_i of the weights of a point I (Polyzos et al., 2011).

$$WMC = (\bar{X}, \bar{Y}) \left| \bar{X} = \frac{\sum_{i=1}^{n} w_i \cdot x_i}{\sum_{i=1}^{n} w_i}, \bar{Y} = \frac{\sum_{i=1}^{n} w_i \cdot y_i}{\sum_{i=1}^{n} w_i} \right. \qquad (1)$$

WMC is a useful measure for tracking changes in a spatial distribution or for comparing the distributions of different types of features. In this study WMC is used to compare the spatial distributions of the Greek coastal cities appearance for the decades 1961 up to 2001. The WMC's shifting suggests a five step trail (WMC1961, WMC1971, WMC1981, WMC1991, WMC2001,) and is expected to reveal the demographic transformation and the potentials of the coastal cities in Greece.

Central Feature (CF) tool identifies the most centrally located feature in a point, line, or polygon feature class. Distances from each feature to every other feature in the dataset are calculated (weighted) and summed (Mitchell, 2005). The mathematical formula of the central feature is related to the closeness centrality formula (Wang et al., 2011) and is shown at relation (2). The use of this tool is expected to disclose the most vital Greek coastal city in terms of population and centrality (Polyzos et al., 2011).

$$CF = c \in \{c_1,...,c_n\} \left| \min \left(dc_i = \frac{\sum_{i=1}^{n} w_i \cdot \sum_{j=1, i \neq j}^{n} dc_{ij}}{w_i} \right), i = 1,...,n \right. \quad (2)$$

2.2.2 Regional econometric tools

The Theil index constitutes a statistic function for inequality measurement analysis. The index appertains in the entropy measures family and has a comparative utility. The index's mathematical formula is shown at equation (3) (Tsiotas and Polyzos, 2011).

$$T = \frac{1}{n} \sum_{i=1}^{n} \frac{x_i}{\mu} \cdot \ln \frac{x_i}{\mu} \quad (3)$$

whereas x_i stands for the arithmetic value of the observation *i* for the characteristic (variable) *X* (*i*=1,…,*n*), *lnx* is the napierian logarithmic function and μ the mean of the *n* observations x_i (i=1,…,n). Theil index ranges into the interval $0 \leq T \leq \ln n$ (Polyzos, 2011). The Theil index is considered useful in order to reveal the cities that presented the greatest variations in their chronological evolution.

2.2.3 Statistical tools

At the following analysis the statistical methods of bivariate correlations and one-sample T-test are used. The bivariate correlations procedure (Norusis, 2004) computes Pearson's correlation coefficient with their significance levels. The linear correlation formula is a measure of linear association that measures the level, in which two variables are related. The mathematic formula of Pearson's Bivariate Correlations is shown at relation (4),

$$r = \frac{Cov(X,Y)}{\sqrt{Var(X) \cdot Var(Y)}} \quad (4)$$

Where, *Cov*(*X*,*Y*) stands for the covariance of the variables *X*, *Y* and *Var*(*X*), *Var*(*Y*) for the respective variations.

The one-sample T-test procedure (Blalock, 1972; Hays, 1981; Norusis, 2004) tests whether the mean of a single variable differs from a specified theoretic value. The procedure tests the difference between the sample mean and the known or hypothesized value and specifies the level of confidence for the difference. This test is hence used to compare the means between two samples, the coastal and the terrestrial, by assuming that the hypothesized value of the test regards the mean value of the second sample.

The purpose of this test in the case of Greek coastal cities is to compare some characteristics that appear in the coastal and the terrestrial prefectures and to draw conclusions. The mathematic formula of the t-test statistical function is expressed by the ratio $t = \frac{D}{S_D}$ where $D = \overline{X}_1 - \overline{X}_2$ is the difference of the two means (coastal and terrestrial) and S_D is the standard error of the difference. The one-sample T-test process was considered easier to apply than the corresponding ANOVA, which is also commonly used to compare sample means since the samples are compared in pairs. The constraint of the T-test method and the rest common linear ones assumes that the data is normally distributed, especially with respect to skewness. Consequently, outlying values should be carefully checked and the use of boxplots is applied in order to manage these cases.

3. The case of Greek coastal cities

3.1 Study area and data

The research deals with these cities of the Greek territory (terrestrial and island), which present a population over 5.000 inhabitants, according to the official censuses held the decades 1961-2001. The threshold of the 5.000 inhabitants was selected arbitrarily (Polyzos et al., 2011), taking under consideration the Act 3643/2006 that regards the classification of Greek cities sizing. This Greek cities population filtering was applied sequentially, in every census' data (1961, 1971, 1981, 1991 and 2001), so the available data may differ beyond decades. The cities that presented lower population volume than the threshold were truncated, even though they may were examined in a previous sampling set. This truncation procedure is expected to present, in some occasions, abrupt alternations, but also to reveal more obvious results. Regarding the selection criteria of the study object volume the amount of cities that surpass the population threshold of 5.000 inhabitants and, simultaneously, have direct contact with the sea or have an easy access to the sea were chosen to suggest the sample manifold.

3.2 Population pressure

One of the most significant factors that can elect considerable information for the spatial characteristics and dynamics of coastal cities in Greece is the demographic parameter. The population shifting and, in general, the demographic transformation, which are being observed diachronically, suggest an indicative variable of a place's developmental trends. Worldwide an amount of 70% of the world's population (percentage that suggests, in terms of absolute numbers, a population between 3.8 and 4.5 billion) are considered to live in the coastal zone (Cori, 1999; Li, 2003). The coastal zone is generally defined as a 40-mile wide belt from the coastline (Cori, 1999), but this definition varies and depends fromeach case's scale.

Moreover, it is estimated that up to the year 2015 there will be 36 mega-cities (with population over 10 million inhabitants), from which 30 will occur in the developing countries and 22 in Asia (Li, 2003). In global scale, Algeria and, especially, Greece suggest two characteristic cases of countries that appear considerable coastal density, where most main urban agglomerations are situated at (or near) the coast. In Mediterranean level, the coastal population presents double density than in the rest terrestrial areas. Nevertheless, the future estimations, for the coastal inhabitation of the Mediterranean countries, suggest that coastal population density will probably not grow much further in France, Italy and Greece.

The present study works with the decennial data of the period 1961-2001, which is available from the corresponding censuses. After applying the threshold filtering (criterion) to the coastal cities manifold, the available decennial sub-manifolds of the Greek coastal cities are presented as pie charts, for the corresponding coastal cities, to the map of figure 2. During the study period, the Greek urban population coverage changed 29,5%, from 56,21% in 1961 to 72,79% in 2001. This fact implies, firstly, the structural changes that the Greek economic model was subjected (the meanwhile period) to, which suggests the country's transposition from the agricultural-based economy model (primary sector) to the services provision economy model (tertiary sector).

Secondly, the meanwhile urban growth can be related to the phenomenon of agglomeration that benefited the two Hellenic metropolitan cities, "Athens" and "Thessaloniki", with respect to the trends observed in the wider Mediterranean level (Cori, 1999). The growing Greek coastal cities coverage of the total country's population in 1961 reaches a coverage of 16,42%, whereas in 2001 this percentage extended to 19,43%. The map of figure 2 also depicts the geographical distribution of the Greek coastal cities population growth. This map is considered useful in the level that it illustrates some geographical formations (or clusters) of this population growth. It seems worth telling that the greatest coastal concentrations in the Greek territory appear into places that do not present morphology of open (non-curved) coast lines, but in those which are attributed with physical protection. This fact comes to an agreement with the previous historical placement.

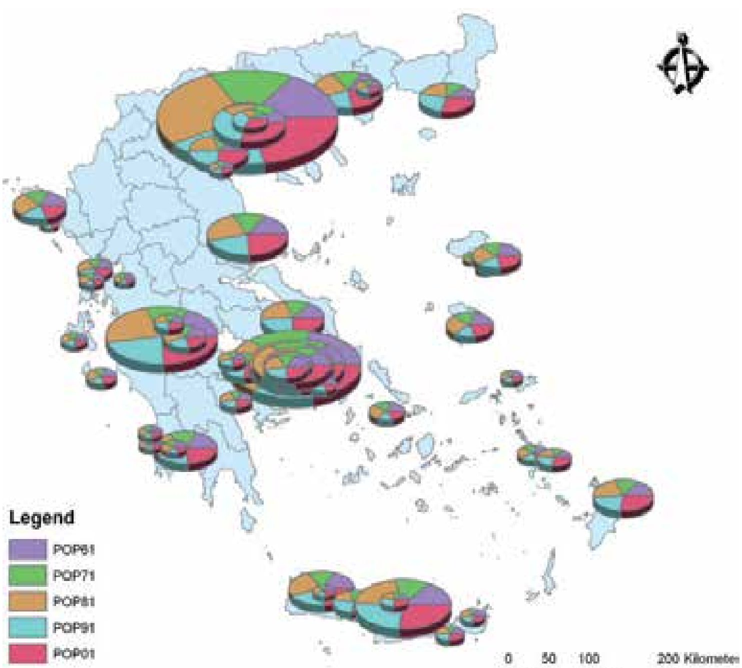

Fig. 2. Comparative pie charts of the coastal cities population distribution for the period 1961-2001.

Figure 3 maps the spatial locations of the Greek Geographical Mean Center (GMC) and the group of Weighted Mean Centers (WMC), which were calculated for the period 1961-2001. This map also depicts the geographical locations of the two Greek metropolitan cities

"Athens" and "Thessaloniki". The comparison of the locations between GMC and the group of WMC (GWMC) can acquire demographic interpretation, since the only difference between the two respective mathematical formulas calculations regards the consideration of the weights. In other words, the consideration of the population weights in the GMC formula turns the second into the WMC and the spatial distance of GMC and WMC suggests a macroscopic transformation (shifting), ought to the demographic parameter. This shifting is expected to reveal the demographic spatial trends of the Greek coastal cities for the period 1961-2001.

The horizontal shifting of the GMC to the GWMC to the East side can get two justifications. Firstly, the fact that the Eastern seaside forehead of Greece is greater than the Western suggests a geographic inequality, which is reasonably illustrated by the attraction of the GWMC to the East. Secondly, this horizontal shifting seems to follow the direction of the location of Athens that presents the greatest urban formation in Greece, having population over 5.000.000 inhabitants. The vertical shifting of the GMC to the GWMC reveals the tractive behaviour of "Athens" to the GWMC. Nevertheless the vertical shifting is considered shorter in length than the horizontal, ought to the fact that the anti-diametric location of the second greater, in population ranking, Greek city, "Thessaloniki", plays a makeweight role to this spatial attraction.

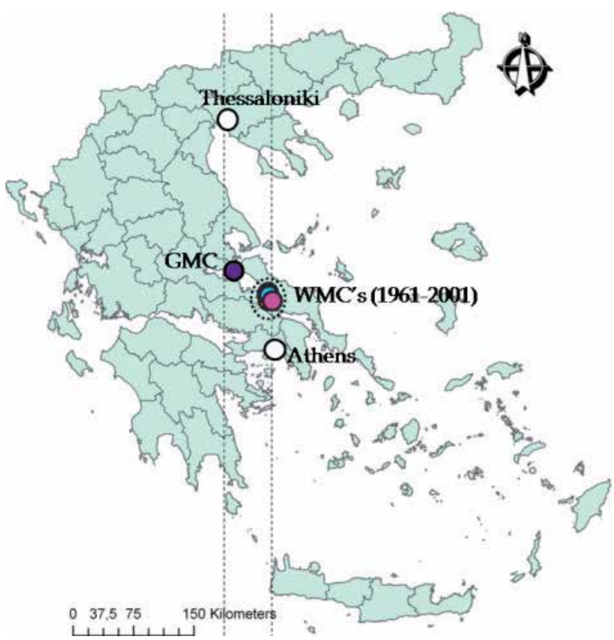

Fig. 3. Map displaying the locations of the Greek Geographical Mean Center (GMC) and the group of Weighted Mean Centers (WMC), for the period 1961-2001.

Moreover, the existent data can be further edited so as to form the diagrams of figure 4, which present the National Greek and Coastal population, after applying a summation to the population data of decennial samples (populations of cities that overpass the threshold criterion). These diagrams illustrate the decennial population growth distributions, calculated under the basis of considering (or not) the case of Athens. In both cases, it can be observed that the Greek coastal cities population presents a growing decennial procedure, almost under a linear attitude, but this growth seems to be inconsistent to the respective performance of the National population's evolution. This observation indicates, on one hand, the fact that the capital city of Athens benefited the majority of this period's (1961-2001) population growth and, on the other hand, the fact that the Greek coastal inhabitation process stood indifferent to the eruptive urbanization phenomena of the period 1960-1980.

It is probably remarkable to focus on the inverse performance of the population growth that is observed in the period of 1971 (figure 4). At that time, the National population increased, in opposition to the National population without Athens, which was decreased. This difference between National population and National population without Athens, indicates, obviously, that the provincial population shifted towards the metropolitan city of Athens, verifying the existing urbanization theories (Roberts, 1989; O' Sullivan, 2003; Sekovski et al., 2011). Nevertheless, the coastal population of this period, despite the fact that it does not suggest an immiscibly urban topology, has grown up, on a contrary to the current National provincial impoverishment. This systemic inconsistency reveals a latent population growth mechanism for coastal areas that presents an indifferent behavior to the National urbanization trends, which were recorded the decades 1971-1981.

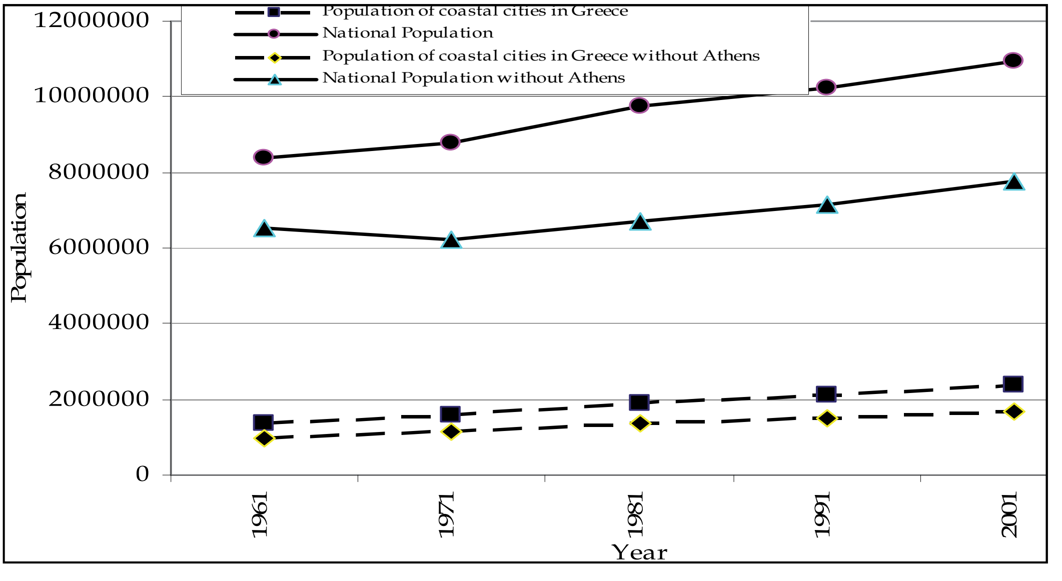

Fig. 4. Comparative diagrams of National Greek and Coastal population, including and not including the case of Athens.

A further quantitative approach of the population pressure of Greek coastal cities regards the study of the coastal population density performance. The concept of population density is a general measure that indicates the intense of inhabitance that a spatial unit presents. A common unit expression for this measure is given in inhabitants per square kilometer (inhabitants/km^2) (Cori, 1999), but for the purpose of this study the measure is modified and used as coastal population density. The notion of coastal population density is defined, for the present study, as the percentage of the coastal city population to the total urban population by the ratio $CPD_i = \frac{CP_i}{TP_i}$, where CP_i is the coastal population of prefecture i and TP_i is the total urban population of prefecture i, regarding the amount of cities that surpass the population threshold of 5.000 inhabitants.

The calculation process of the CPD for each Greek coastal prefecture and for every decennial data produces the bar plots of figure 5, which indicate the prefectures that experienced the greatest coastal population density at the period 1961-2001. The bar plot of figure 5 is composed by five components, in respect to the decennial coastal data. This component division leads to the classification (for the data period) of the coastal cities densities into five corresponding ordinal categories, from 1 up to 5 (minimum to maximum significance). The 5th category (describes densities into the interval 4-5) includes the prefectures that present very dense coastal inhabitation and, consequently, the fundamental developmental parameter for them seems to be exclusively the coastal attribute. Such prefectures are mainly

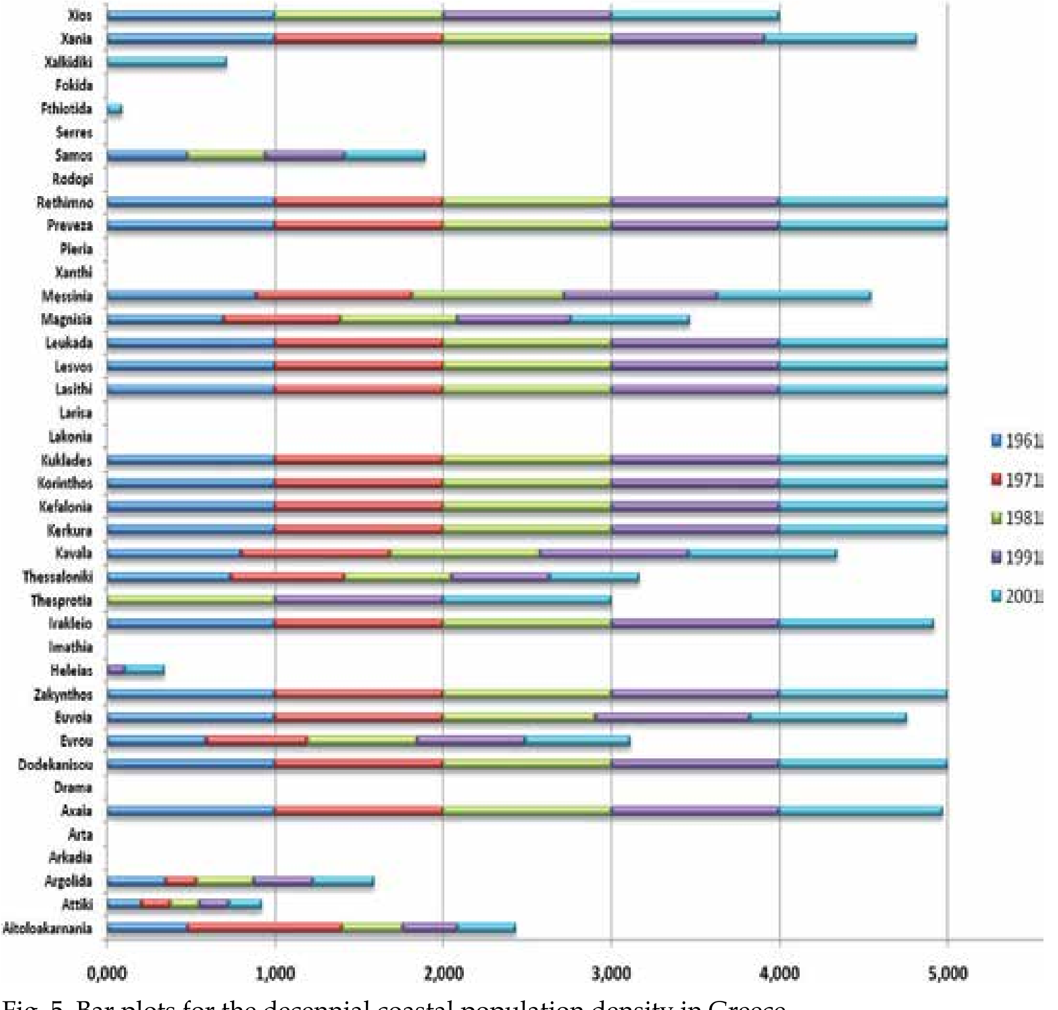

Fig. 5. Bar plots for the decennial coastal population density in Greece.

islands and are the prefectures of "Xania" (island/Crete Region), "Rethymno" (island/Crete Region), "Preveza" (non island/West Greece), "Messinia" (non island/Peloponnesus), "Leukada" (island/Ionian islands), "Lesvos" (island/East Aegean), "Lasithi" (island/Crete Region), "Kuklades" (island/Central Aegean), "Korinthia" (non island/Peloponnesus), "Kefallinia" (island/Ionian Islands), "Kerkura" (island/Ionian Islands), "Kavala" (non island/Northern East Greece), "Irakleio" (island/Crete Region), "Zakinthos" (island/Ionian Islands), "Euvoiaa" (island/Central Greece), "Dodekanisos" (island/East Aegean) and "Achaia" (non island/Peloponnesus).

The calculated results of the figure 5 can form a map, so as to demonstrate the spatial (geographical) distribution of the corresponding coastal population densities. Such a map is presented at figure 6. The measuring subject in this map regards the mean coastal population density that the Greek prefectures presented, during the period 1961-2001. The prefectures that are exclusively terrestrial and do not present a coastal part are excluded from the map illustration.

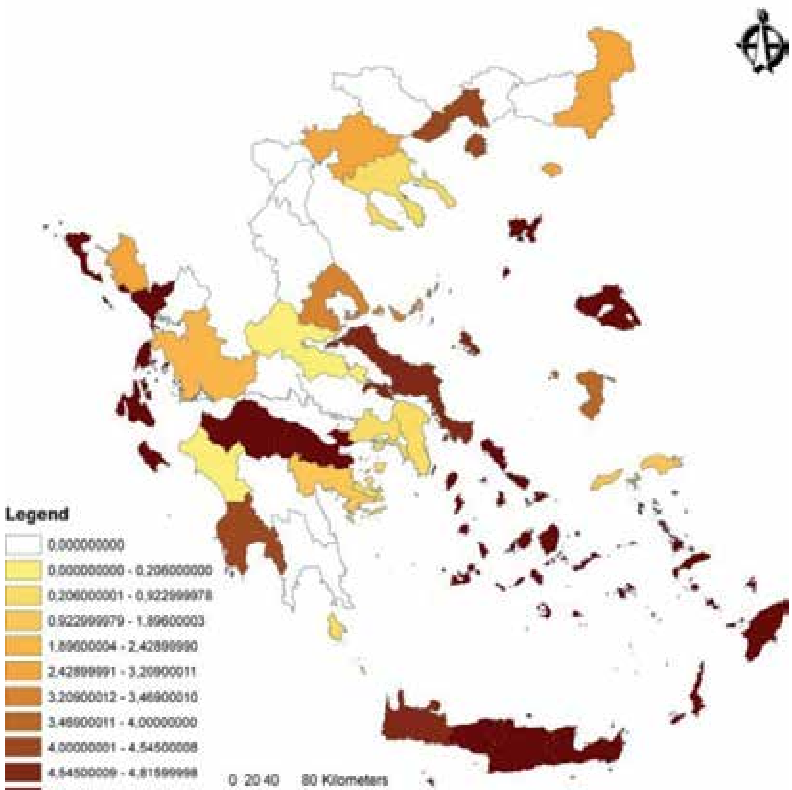

Fig. 6. Mean Population density of coastal prefectures in Greece

The spatial distribution of the mean coastal population density in Greece (per prefecture) depicts a further status of population growth clusters, which can probably reveal some developmental cores for the country. As it can be observed from the map, diachronically (referring to the period 1961-2001) the most dense, in population, coastal prefectures in

Greece appear to lie under a grouped structure that is distributed to all geographical directions. At the West Greece this cluster forms an arc that includes the "Ionian" islands and the prefecture of "Preveza". One of the fundamental economic axes that can justify these prefectures dense population is probably the maritime commercial and transportation activities of these prefectures, in conjunction with the fact that their geographical position provides an easy access to Italy.

In the Region of Peloponnesus, the dense coastal prefectures cluster forms two cores. The first is located at the prefecture of "Messinia" and the other figures a dipole of the prefectures "Achaia-Korinthia". The prefecture of "Messinia" always presented a strong agricultural economy and, considering the fact that this place lacks of a significant commercial harbour, it can be assumed that probably the intense coastal inhabitation of this prefecture has rural motivations and trends, ought to environmental amenities of such areas. The dipole "Achaia-Korinthia" probably oughts its density to its component prefectures strategic significance in transportations. The prefecture of "Achaia" has a great (for the Greek state) harbour and the one of "Korinthia" suggests a connection (the only before the year 2005) or the region of Peloponnesus with the prefecture of "Athens" and the rest terrestrial Greece.

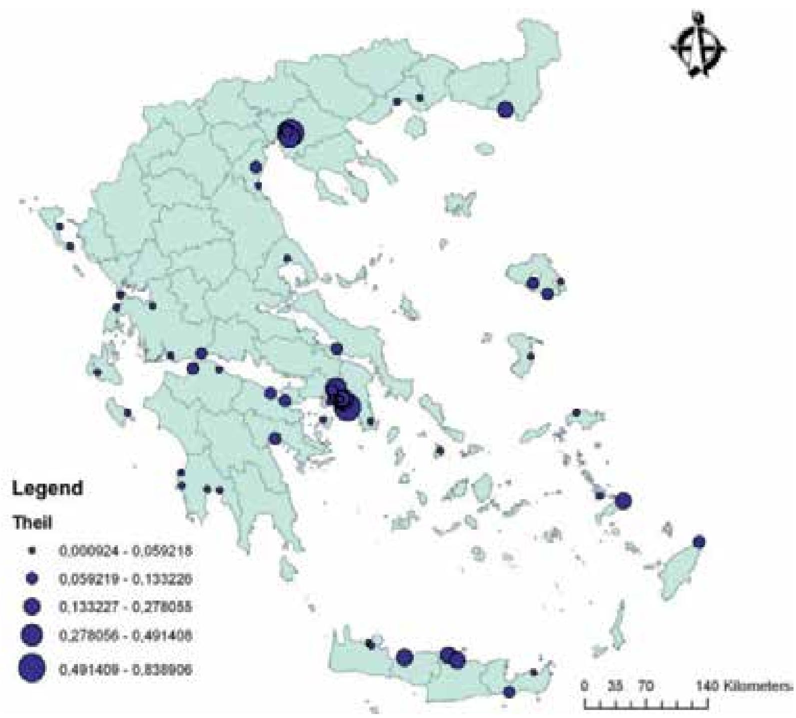

Fig. 7. Spatial distribution of the coastal cities Theil index for the period 1961-2001.

The rest clusters are located in the Northern Greece at the prefecture of Kavala (with considerable mineral wealth), in the central Greece at the prefecture of Evoia (closeness to Athens) and in the Aegean at the prefectures of "Lesvos" (sailing and agricultural based economy, as also closeness to Turkey), at the region of "Kyklades" (touristic, sailing, agricultural and mineral based economy), at the region of "Dodekanisa" (touristic, sailing, agricultural and cultural heritage economy) and at the region of Crete (agricultural, touristic, sailing and cultural heritage economy).

A further analysis on the population pressure can be applied with the use of the Theil index. The calculation of the Theil index provides results that reveal the cities, which presented the greatest variations in their chronological evolution, as shown in figure 7.

Figure 7 illustrates these cities, which throughout the study period (1961-2001) presented the most abrupt changes in their population. This map reveals the strong fluctuations (positive in the majority as presented earlier) of the city clusters of "Athens" and "Thessaloniki" that are characterized of the most intense meanwhile conurbations. A second cluster of cities of medium to notable variations is comprised of the cities of the province, the most significant of which are located in the prefectures of the region of Crete, in the islands of Southern Aegean and the Northern East Greece. Finally, a third cluster of cities of the terrestrial central body of Greece is formed (the so called developmental axis "S"), where the capital cities of the respective prefectures present relatively abrupt changes of their population sizes (Polyzos et al., 2011).

3.3 Local qualification pressure

Tourism suggests a fundamental developmental axis for Greece, ought to its elongated coastline, which is greater than 10.000km (Cori, 1999), to its sunshine weather and to its thousands of islands that have various morphologies. The seaside location of Greek coastal cities provides intuitive documentation for the economic base of these cities, indicating that both these cities and their respective prefectures present specialization in touristic activities and services. The purpose of this section aspires to request quantitative evidence that justifies this empirical approach and to proceed to a further analysis on the productivity orientation of the Greek coastal cities. The available data regard the calculation results of the Local Qualification Index of the Greek prefectures, referring to the economic sectors of agricultural, manufacture, construction and touristic productivity for the year 2006 (Polyzos, 2011), can produce the box plots of figure 8. The data is further categorized, for the purpose of this study, to non coastal and coastal groups so as to produce box plots that can be submitted to comparison.

The box plot diagrams of figure 9 sketches out the distributions of the LQ index (per sector) for the coastal and non coastal cases. The Agriculture box plots indicate a slightly better (presenting higher values) performance of the Greek terrestrial prefectures, in comparison with the coastal. This performance seems reasonable if considering the terrestrial ease in transportation, maintenance, and support, regarding the agricultural equipment. The question of the significance of difference over the performance between coastal and non coastal prefectures will be answered at the following T-tests.

The Manufacture box plots reveal a relationship between the coastal and non coastal prefectures that is not easy to come into obvious conclusions. Perhaps the only safe information, which can be derived from this diagram, derives from the observation that the non coastal box plot presents a more narrow distribution than the coastal and less number of outlier values. This higher concentration of the non coastal manufacture distribution displays a better overall performance for the non costal case, but this conclusion cannot be justified rigorously. A similar unclear picture also describes the case of Constructions. The mean values of the box plots seem to lie under a condition of significant equality, but the non coastal prefectures distribution present a positive asymmetry, fact that indicates a stronger agricultural sectorial performance than the coastal case.

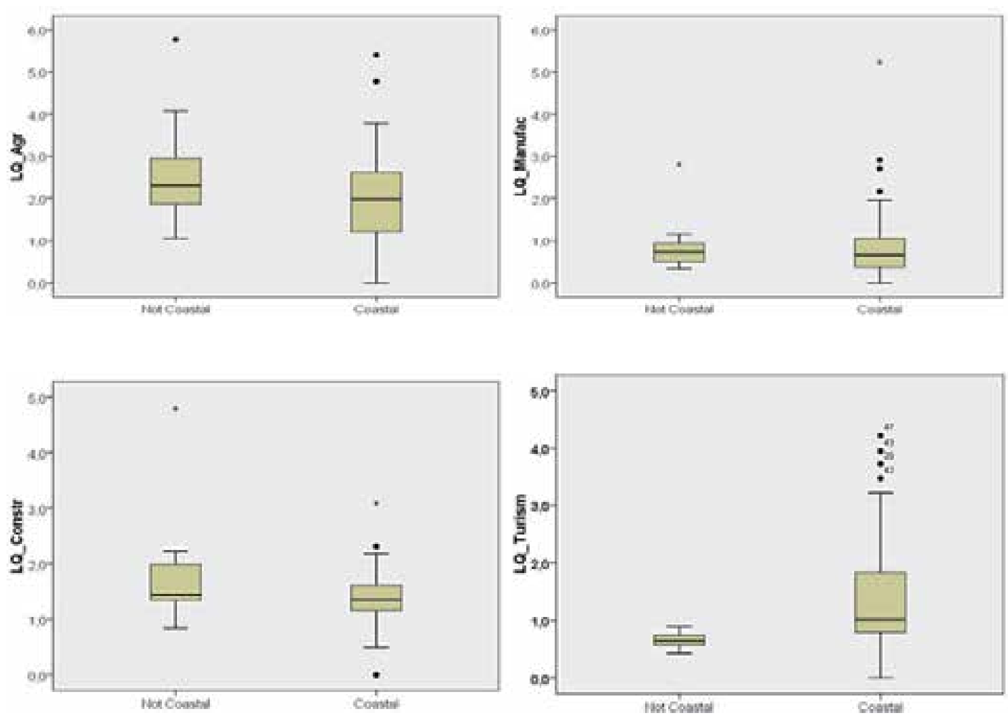

Fig. 8. Box plots of the Local Qualification Index for coastal and non coastal prefectures (data of year 2006).

Finally, the Tourism diagrams present a clearer picture that indicates the difference between coastal and non coastal prefectures about their touristic productivity performance. Coastal cities reveal an obvious higher mean value than the non coastal, as long as a wider distribution with a positive asymmetry, factors that indicate higher touristic economical potentials of the coastal cities, for the majority of cases. The appearance of the non coastal prefectures is presented very shrink, fact that denotes the limited touristic potentials of the terrestrial Greek regions. In order to obtain answers to the question of equality, between the means of coastal and non costal prefectures, a T-test was applied for each sector case, under the conditions that they were described at the methodology section. The results of the T-tests are shown at table 1, where the symbol X in the $LQ(X)$ symbolism refers to an abbreviation coding A≡agricultural, M≡manufacture, C≡construction and T≡touristic. Also the C and NC symbols regard to the coastal and non coastal classes.

	LQA_NC = 2.62					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the	
LQA_C	-3,057	42	0,004	-0,6060	-1,006	-0,2060
	LQA_NC = 2.62					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the	
LQM_C	0,285	42	0,777	0,0407	-0,247	0,3290
	LQA_NC = 2.62					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the	
LQC_C	-5,291	42	0,000	-0,4567	-0,630	-0,2825
	LQA_NC = 2.62					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the	
LQT_C	4,749	42	0,000	0,7427	0,427	1,0584

Table 1. T-test results for the comparison of the means between coastal and non coastal samples for the Local Qualification Index.

The test results, presented in table 1, exclude the cases of Agriculture, Constructions and Tourism Local Qualification to present equal mean values. Moreover, the negative edge values of the confidence intervals in the Agriculture and Constructions cases conclude that there is a significance negative difference between the coastal and non coastal case (diff=LQX_C-LQX_NC). Consequently, in the Agriculture and in the Constructions cases the coastal prefectures present smaller developmental dynamics. Oppositional, in the Tourism case, the advance of coastal prefectures performance is obvious, even through a single graphic observation. The T-test table results indicate that the case of Manufacture can, statistically, justify equality between coastal and non coastal mean values. Nevertheless, the performances on Manufactures between coastal and not coastal cases cannot be considered the same due to the ranges of their distributions.

In order to proceed to a further analysis, to provide supplementary evidence and to validate the previous discussion results, the Binomial Correlations were calculated between the mean coastal population density and the Local Qualification Indices values. The correlation results are presented at table 2.

From the results of table 2 only the correlation between the mean coastal population density and the Tourism LQ appear a considerable value that is also significant. The other correlation results do not present worthy information, except perhaps the one that can be mined from the correlation signals. The signal interpretation of the table 3 reveals the fact that the mean coastal population density and the rest LQ indices are negative correlated. This result provides an essential documentation to assert that coastal prefectures are privileged to benefit higher potentials in tourism.

		mean_D	LQ_Agr	LQ_Manufac	LQ_Constr
mean_D	Pearson Correl.	1	-0,319*	-0,103	-0,048
	Sig. (2-tailed)		0,019	0,461	0,730
	N	54	54	54	54
LQ_Agr	Pearson Correl.	-0,319*	1	0,043	0,081
	Sig. (2-tailed)	0,019		0,758	0,562
	N	54	54	54	54
LQ_Manufac	Pearson Correl.	-0,103	0,043	1	0,090
	Sig. (2-tailed)	0,461	0,758		0,516
	N	54	54	54	54
LQ_Constr	Pearson Correl.	-0,048	0,081	0,090	1
	Sig. (2-tailed)	0,730	0,562	0,516	
	N	54	54	54	54
LQ_Turism	Pearson Correl.	**0,608****	-0,204	-0,321*	0,037
	Sig. (2-tailed)	0,000	0,138	0,018	0,789
	N	54	54	54	54

Table 2. Binomial correlation results between the mean coastal population density and the Local Qualification Indices values.

3.4 Coastal cities prosperity

A similar procedure to the Local Qualification analysis is applied at the following, in order to provide an answer to the question if the Level of Prosperity in coastal prefectures can be considered greater than the terrestrial ones. The available data of this case regard the calculation results of the Index of Wealth for the prefectures of Greece, for the year 2006, as presented by Polyzos (2011). The analytic process is composed by the same with the previous analysis steps. Firstly, the data available are presented graphically to the box plots of figure 9, in order to provide some information for the distribution, and, secondly, the mean values of the box plots are tested for statistical significance equality.

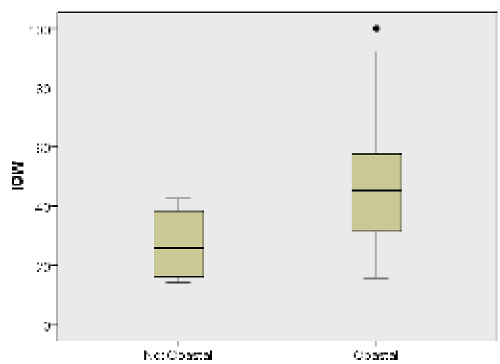

Fig. 9. Box plots of the Index of Prosperity for coastal and non coastal prefectures (data of year 2006).

The correlation between the mean coastal population density and the index of wealth was calculated, but found neither to be considerable in value (0,482) nor to statistical significance. A single observation of the box plots of figure 9 seems to be adequate to indicate the inequality in the level of wealth that benefits the coastal prefectures. The application of the comparing means procedure provides documentation to the visual comparison results of figure 9. The mean comparison results are presented in table 3.

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the	
IOW_C	13,103	42	0,000	48,642	41,151	56,134
IOW_T	8,224	10	0,000	27,375	19,958	34,792

Table 3. T-test results for the comparison of the means between the coastal and non coastal samples for the Index of Wealth in Greece.

Table 3 indicates, in quantitative terms, the significant inequality between the coastal and non coastal case of the Index of Wealth in Greece. The edge values of the confidence intervals do not have covering areas, fact that suggests their inequality. Consequently, the obvious inequality of means $\mu_{IOW\_C}>\mu_{IOW\_NC} \Leftrightarrow 48{,}6>27{,}4$ can provide the essential documentation to conclude that the Greek coastal prefectures enjoy greater wealth than the terrestrial ones.

4. Conclusions

This chapter dealt with the population transformation of Greek coastal cities, held during the last 50 years. Coastal cities over 5.000 citizens were studied, by using spatial, econometric and statistic measures and models. During the study period, the Greek urban population coverage changed in an amount of 29,5%, from 56,21% (presented in 1961) to 72,79% (in 2001). By observing the trends in the Mediterranean level (Cori, 1999), a similar transposition in the demographic status can be concluded. Urban population of coastal countries presented an amount of 50% growth during the period 1950-2005, percentage which is higher in comparison with the corresponding Greek, probably due to significant urbanization rates of South Mediterranean countries and Turkey. The growing Greek coastal cities cover the 16,42% of the total country's population in 1961, whereas in 2001 they reached to represent approximately 2.100.000 inhabitants, with a coverage of 19,43% in total population. The augmentative trends appear to be strong during the first two decades of the study period, but they diminish from 1981 and forward. This fact implies, firstly, the structural changes that the Greek economic model was subjected (the meanwhile period) to, which suggests the country's transposition from the agricultural-based economy model (primary sector) to the services provision economy model (tertiary sector). Secondly, the meanwhile urban growth can be related to the phenomenon of agglomeration that benefited the two Hellenic metropolitan cities, "*Athens*" and "*Thessaloniki*".

One of the general conclusions, which was extracted by this study, verified the general demographic transformation that the Greek cities (in general) were subjected to and moved from the phase of intense urbanization (during the decades of 60's and 70's, where the centers of the Metropolitan cities of "*Athens*" and "*Thessaloniki*" grown) to the phase of suburbanization (in the decade of 1980's and after, where the suburban zones of the two metropolitan Hellenic cities expanded). The above transformation also affected the Greek coastal cities and moved their status into a new balance, described by the strengthening of mainly the "*Attica*" prefecture's cities-satellites, which suggests the phenomenon of counter-urbanization and secondly the south-eastern insular regions of Greece.

Nevertheless, the non-metropolitan coastal population growth procedure in Greece seems to stay indifferent to the eruptive urbanization phenomena of the period 1960-1980, presenting an equable increase. This observation leads to the conclusion that the Greek coastal population growth suggests a product of a mature chronicle augmentative process. This state of maturity implies the result that coastal infrastructures, which were constructed in order to host the population augmentative process, were obviously developed through a natural, unpressured and unbiased procedure, in comparison with the intense metropolitan urbanization cases (which led to an unscheduled and without plan construction of these cities). Consequently, the infrastructure of coastal areas are, more probable, supposed to present a receptor of investments and of further developmental acts, so as to provide a developmental bus for the country's economical crisis management.

Regarding the Local Qualification dynamics, Greek coastal cities present better developmental performance than the terrestrial ones in the Tourism case, lower in Agriculture and in the Constructions and statistically equal in the Manufacture case. The Tourism case performance seems to be expected, since Greece is a country with a vast amount of coast lines, a significant maritime environment, a sunshine weather and a voluminous amount of islands (with various morphologies), parameters which suggest attractors of touristic development. On the other hand, this obvious ascendancy of the coastal tourism elects questions about the unexploited field of development that the forest and agro tourism activities can provide to the national economy. However, the coastal case of tourism, although it consists the fundamental axis of touristic Greek development, it has to be further subjected to standardized procedures and policies, as also to scheduled orientation through education, in order to suggest the dominant developmental tool, which may be able to recover the country from the economic crisis. The cases of Agriculture and Constructions do not perform in coastal prefectures better than in terrestrial, ought, firstly, to the lack of arable areas and to transportation ease and facilities. The equal performance of coastal and terrestrial prefectures in Manufactures elects the creativity potentials of the Greek nation that it appears to be adaptable to geographical specifications.

On the other hand, the overall level of wealth in coastal prefectures resulted to be higher than the terrestrial ones. This conclusion seems critical for the decision making policy consideration, especially during the current period of crisis that Greece is subjected to. On one hand, through a microscopic perspective, this result reveals some directions for the citizens, in order to request better employment and living conditions and, on the other hand, through a macroscopic perspective, it should motivate the terrestrial economic development (such as agro tourism for example), without impoverish the healthier coastal.

It is commonly accepted that the long-lasting neglect of the regional perspective is able to create economically, social and environmental problems, which may decrease any positive result that is achieved until now and is reflected to the improvement of certain macroeconomic national sizes. For this reason, a total re-planning of regional policy should be practised in Greece, combined with actions that will totally alternate the territorial balances.

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Cities are growing as never before and nowadays, it is estimated that at least 50% of the world's population lives in urban areas. This trend is expected to continue and simultaneously the problems in urban areas are anticipated to have an increase. Urbanization constitutes a complex process involving problems with social, economic, environmental and spatial dimensions that need appropriate solutions. This book highlights some of these problems and discusses possible solutions in terms of organisation, planning and management. The purpose of the book is to present selected chapters, of great importance for understanding the urban development issues, written by renowned authors in this scientific field. All the chapters have been thoroughly reviewed and they cover some basic aspects concerning urban sustainability, urban sprawl, urban planning, urban environment, housing and land uses. The editor gratefully acknowledges the assistance of Dr Marius Minea in reviewing two chapters.

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