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Planning for emergence:

Confronting rule-based and design-based urban development

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Abstract

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Increasing urban populations, climate changes, financial instability, global conflicts, depletion of resources, and increasing land consumption all contribute to the complex and unpredictable urban challenges we are facing today. A compact urban form is promoted by global and local policies, and research has shown the benefits of dense and diverse properties for their capacity to provide complex responses to complex challenges. However, more focused studies on the urban processes involved in generating such qualities are lacking. The present thesis looks into the properties of urban density and diversity through the lens of complex adaptive systems theory, the goal being to understand how different planning approaches produce different outcomes. The research is carried out in two phases, with the first phase focusing on studies of density and diversity both as quantifiable form variables and as qualitative perceptions. The difference in density and diversity outcomes between 'rule-based' and 'design-based' planning approaches are studied both quantitatively and qualitatively, using a building footprints analysis as well as a geo-location-based perception survey. The second phase pursues the topic further in an attempt to understand how 'emergence' can be created in unbuilt sites by applying a 'rule-based' planning system. The thesis outlines some of the adaptable qualities of 'rule-based' systems, which seem to generate similar outcomes regarding compact city properties, as evidenced in 'emergent' urban forms. The present findings provide a better understanding of the extent to which different types of planning systems and approaches do or do not result in compact cities.

Keywords: compact city, urban resilience, rule-based approach, design-based approach, planning by coding, density, diversity, emergent urban form

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Chapter 1.
Introduction

1.1 Global and local urban challenges

UN Habitat's projection (UN Habitat, 2014) foresees continuous growth of populations world-wide, with an increase of 1.18 billion between 2014 and 2030, and of 2.31 billion by 2050. Even in the more developed regions, the population is projected to grow by 30 million by the year 2030. The same report also predicts a 1.18 billion increase in population size in urban areas by 2030 world-wide, and in developed countries an increase of 70 million. According to this prognosis, most of the new population will live in urban settings, and there will be continuous urban population growth and rural population decline. The OECD (2012) expects population growth of about 439,000 in Sweden by 2020. Statistics Sweden also forecasts a 1.5 million increase in the total population by 2040 (Statistics Sweden, 2012).

Parallel to the population growth, there is increased land consumption per capita. According to the World Bank (Rode et al., 2014), the world-wide population increased by 5% during 1990-2000, while the urban built-up area increased by 30% during the same period. In sample cities in the developing world, the population was estimated to have grown by 20% while the built-up urban area increased by 40%. This increasing land consumption per capita, as urban populations increase, risks resulting in urban sprawl and is a concern from the perspective of biodiversity and natural land preservation (OECD, 2012).

In the larger cities in Sweden, the ratio of demand and supply for housing units is unbalanced. Gothenburg, the case city chosen in the present thesis, has seen an average increase in the population of 6,473 annually between 2009 and 2012, and an average annual housing production of 1,570 new units during the same period (City of Gothenburg, 2015). In 2015, the waiting time from the beginning of a search for a place to live to a housing contract was 1,393.5 days, which is more than 160 days longer than the waiting time in 2014 (Boplats, 2015). This insufficient supply of housing has been accompanied by a steep increase in real-estate prices, much exceeding that of the consumer price index and creating financial insecurity and unpredictability (KI, 2014).
Geographical segregation of ethnic groups is also a concern in Gothenburg. Statistics show that 68.3% of all Swedish citizens in Gothenburg were born in Sweden with one or both parents born in Sweden, the others are inhabitants with a so-called 'utländsk bakgrund,' meaning foreign background (City of Gothenburg, 2015). The city is generally divided into areas to the South and West with mostly non-immigrants and areas to the North and East where the population of people with a foreign background exceeds 80% of the total population in some districts (City of Gothenburg, 2015). These North/East city districts were created during the Million Program period, and are identified as problem areas ridden with problems of segregation (Lilja & Pemer, 2010).

The abovementioned challenges in Gothenburg are coupled with extreme weather events caused by global climate change, which include increased average temperature with extreme heat waves, increasing sea level, droughts and floods (Coumou & Rahmstorf, 2012). In Gothenburg, the sea level is expected to rise 70cm above the current level by the year 2100 (Bergström, 2012). This entails increased flood risks around the central district, including the newly planned urban regeneration areas along the Northern rim of the Göta River. Measures to prevent future flooding need to be taken by the city, either as a form of storm barrier or as long dikes along the banks of the river, which will have new impacts on existing urban conditions.

The City of Gothenburg acknowledges the need for development strategies to cope with the population increase and housing shortage, social segregation issues, and better accessibility to various services; the city has proposed an interlinked city and presented the compact city as an ideal urban type (Gothenburg City Council, 2014*a*). Rivercity Gothenburg addresses the issues of social exclusion, climate change, and changed economy through a vision of the connected city, reinforcement of the urban center, and embracement of water, and also proposes a compact connected city to promote diversity and sustainability (Rivercity Gothenburg, 2012).
The reports from major building companies in Sweden recognize the same need; Skanska, and Sweco (Göteborg 2070, 2015) as well as NCC (NCC, 2015) also argue for the positive value of the compact urban form. Statistics from NCC (2015) show citizen preferences for densifying the city core by adding more residential units and recreational sites. The survey shows the need for available affordable housing and to simplify restrictive building regulations as well as municipal provision of land for construction. These visions of a compact city are supported by European Union Regional policy documents (European Commission, 2011), and further by the OECD (2012) and UN Habitat's recent literature reviews (2014), indicating that a compact and diverse city structure has positive effects on citizen health, the economy, efficient use of resources, and preservation of the natural landscape.

Despite all of these arguments for the compact city model, the research is contradictory regarding both what the qualities of the compact city are (Neuman, 2005; Roberts, 2007) and how they can be achieved (Churchman, 1999; Jenks, 2008; Williams, 2004; Manaugh & Kreider, 2013). The present thesis therefore seeks to understand what the properties of the compact city actually are and to study how different types of urban planning systems and approaches succeed in delivering such properties. It explores compact city properties, such as density and diversity, as elements of urban resilience, and applies a complex adaptive systems perspective to better understand how such resilience may be facilitated. The thesis looks into two planning approaches, the 'rule-based' and the 'design-based', and specifically into three planning types that are used in practice: planning by design, planning by coding, and planning by development control. It is hoped that the findings will provide a better understanding of the extent to which different types of planning approaches do or do not result in compact cities.

Chapter 2.
‘a compact city’ or
‘THE COMPACT CITY’?

2.1 The compact city, its paradox and the implementability of guidelines

2.1.1 The compact city policies

Global and local policies advocate the compact city as a solution to urban challenges (UN, 2011; 2014; 2015; EU Commission; 1990; 2011; OECD, 2012; Rivercity Gothenburg, 2012; Gothenburg City Council, 2014*a*). The policies denote it as a type of urban structure that is both dense and diverse, and that has a highly networked infrastructure (UN, 2015; OECD, 2012; EU Commission, 2011). The faster rate of land consumption in comparison to the population growth requires smaller housing units, mobility and reduced administration costs, etc. (OECD, 2012), all of which justify such policies. Additionally, the OECD (2012) suggests that the compact city is a 'sustainable' solution to urban development, claiming that compact city policies will result in lowered CO_2 emissions and reduced energy consumption in transportation, on the metropolitan as well as on the neighborhood scale, in conservation of farmlands and biodiversity, in reduction of infrastructure cost and, finally, in an increase in labor productivity (OECD, 2012). These urban qualities are argued to promote citizen health, resource efficiency, social cohesion, and a better economy (UN Habitat, 2011; 2014; 2015). The EU commission also argues that the density and proximity, as well as the choices available in the compact urban structure enable social, cultural, and political dynamics (EU Commission, 1990). These global policies are reflected in the local policies for urban development. The City of Gothenburg promotes a compact city for walkability, potential for diverse services and trade, accessibility to public transportation, and a feeling of security and attractivity; it plans to develop strategic nodes distributed throughout the city to achieve the compact city aim (Gothenburg City Council, 2014a). Rivercity Gothenburg is a municipal vision for urban waterfront regeneration which complies with the City of Gothenburg's broader scope. It aims to create vibrant urban space built on the principles of the compact city to activate the central core of the city and to connect the city across the river (Rivercity Gothenburg, 2012). It claims that, by doing so, it will create conditions for a diverse range of services, workplaces, culture and recreation.

2.1.2 Policy recommendations for a compact city

Then what is a compact city, exactly?

UN Habitat (2015) provided urban and spatial panning and design goals with a compact city aim, including urban compactness, mixed-use development, and social mix goals. Employing this policy guideline, it provides definitions of the concepts used in the planning aims. The report defines 'urban compactness' as a characteristic of urban form (shape, density, and land use) that reduces the over-exploitation of natural resources and increases economies of agglomeration, which has benefits for residents in terms of proximity. Urban compactness is measured in terms of density of the built area and population as well as the concentration of urban functions. The UN Habitat further provides a definition for mixed land use, which is explained as promoting a variety of compatible land uses and functions and as providing a cross-section of residential, commercial and community infrastructure in neighborhoods while reducing the demand for commuter travel. It also offers a definition of 'social mix' as the presence of residents with different backgrounds and income levels in the same neighborhood. A social mix is suggested to be achieved by availability of different housing options in terms of price ranges, tenure type and typologies, and the availability of a diverse range of jobs in the area (UN Habitat, 2015).

A recent OECD policy paper also lists the characteristics of a compact city as dense and proximate development patterns, urban areas that are linked by public transport systems, and accessibility to local services and jobs. In this policy paper, the 'compact city' definition is also heavily related to 'mix-use' (OECD, 2012).

To elaborate these policy guidelines, UN Habitat offers a set of concrete instructions (UN Habitat, 2014);

> *1. Adequate space for streets and an efficient street network*
> The street network should encompass at least 30 per cent of the land with at least 18 km of street length per square kilometer.
> *2. High density*
> At least 15,000 people per km; that is, 150 people/ha or 61 people/acre.
> *3. Mixed land-use*
> At least 40 per cent of the floor space is allocated for economic use in any neighborhood.
> *4. Social mix*
> The availability of houses in different price ranges and tenure types in any given neighborhood to accommodate different incomes; 20 to 50 per cent of the residential floor area is distributed to low-cost housing, and each tenure type should be no more than 50 per cent of the total.
> *5. Limited land-use specialization*
> To limit single function blocks or neighborhoods, single function blocks should cover less than 10 per cent of any neighborhood.

2.1.3 Research on compact city qualities: Agglomeration effects

More is different. (Anderson, 1972)

These compact city policies are substantiated by research on, e.g., how urban form is related to qualities of the compact city, such as density and diversity. The advantages of the compact city for urban qualities have been delineated in studies on walkability (Badland et al., 2012; Choi & SAYYAR, 2012; Oyeyemi et al., 2013; Eom & Cho, 2015), access to and use of public transportation (Rode et al., 2014; Frank & Pivo, 1994), reduced use of resources, reduced carbon emission, decreased ecological footprint per capita (Newman, 2006; Dodman, 2009), and increased social cohesion (Mardiah, 2015; Burton, 2001).

One way of understanding compact city qualities is the agglomeration effect, which is often used by economists and refers to the benefits generated when firms and people locate in proximity to one another in cities and industrial clusters (Glaeser, 2010). One research approach studying the benefits derived from urban density and diversity argues for the importance of the agglomeration properties of compact cities. The agglomeration of diverse individual agents in proximity with each other is seen to facilitate a complex network among the agents, which is claimed to supply fertile ground for knowledge spillover, propagation of information, and higher frequency of inventions, as evidenced by the number of patents (Bettencourt, 2013; Carlino, 2007). This, in turn, further supports provision of smaller-scale business opportunities, and finally generates better economic output in the cities (Quigley, 1998; Glaeser, 2011; Bristow, 2010).

The advantages of agglomeration of diverse knowledge bases and backgrounds have also been seen in experiments. In one experiment, a group of individuals with diverse backgrounds and another group with a homogenous background were given a problem-solving task. The group with diverse backgrounds had a mixed level of proficiency for the task given, while the group with a homogenous background shared a higher level of proficiency. In this experiment, the group with diverse backgrounds performed better and scored higher on problem-solving than the other group did, despite the diverse-background group's lower combined proficiency level for the task relative to the other group (Hong & Page, 2004). The authors suggest that the synergies between individuals with diverse sets of knowledge and heuristics were the mechanism underlying the superior performance of the group of mixed-proficiency-level individuals with different backgrounds. In another study on the relationship between innovations and agglomeration in compact city settings, three qualities stood out as contributing to creativity (Kanter, 1988):

1. Proximity to the source: density resulting in proximity to users
2. 'Kaleidoscopic thinking' (Kanter, 1988, p.175): diversity and cross-fertilization of ideas
3. Structural integration: communications network

The positive link between creativity and problem-solving, on the one hand, and diversity in urban scale, on the other, is evidenced by the finding that exponential diversification of business types and their novelty are in direct relation to city size, independent of the city's historical or geographical setting (Youn et al., 2016). This mechanism has been observed in results showing a systematic extra increase in socio-economic output such as economic productivity (GDP, personal income, wages, etc.) per capita by ~15% with each doubling of the population of a city, irrespective of the initial size of the city, the time or the nation in question (Bettencourt, 2010). This increase of non-linear complex interactions between agents – both through sub-dividing and through combinatorial processes – clearly indicate how unfolding collective human potential is contingent on urban qualities promoting agglomeration of diverse agents, i.e. density and diversity (Bettencourt, 2010). Here, the agent is understood as an 'autonomous agent' defined as 'a system situated within and a part of an environment that senses that environment and acts on it, over time, in pursuit of its own agenda and so as to effect what it senses in the future' (Franklin & Graesser, 1996, p. 5). Without delving further into theories of 'agency,' 'actor,' and 'agent,' 'agent' and 'actor' can be distinguished by the level of motivation of interest, differentiated by the self-interest of an agent and the socially represented interest of an actor (Frimer, Schaefer, & Oakes, 2014). However in the present thesis, agents acting on their own self-interest, such as individual citizens or a group of citizens, and actors acting upon socially represented moral interest, such as environmental agencies, are lumped together, because the scope of the present research does not include probing into the inter-relation of those two concepts or the power hierarchies between them. The present thesis assumes that both actors and agents react to the environment based on their own perception of the environment, and act based on their own agenda, be it selfish or moral.

The benefits of urban agglomeration of diverse elements, such as in mixed-use-oriented neighborhoods, also include better walkability, with more residents walking to various locations within the community (Eom et al., 2015; Rogers et al., 2014). This, in turn, results in heightened trust in neighbors and residents who are more involved in community events and meetings, thus contributing to social capital and social networks (Rogers et al., 2014). Both higher population density and greater spatial diversity concerning where people live show a strong relationship to shortened commuting distances (Boussauw, Neutens, & Witlox, 2012), highlighting yet another benefit of urban agglomeration.

2.1.4 The compact city paradox

The agglomeration qualities evolving from urban density and diversity, seem to contribute to enough complexity so that we all benefit from the interactions, interdisciplinary/inter-functionary combinations, and spontaneously emerging new trajectories of thought and innovation (Kanter, 1988; Youn et al., 2016). However, how complexity, as a concept, is defined differs from discipline to discipline and from one author to another. Most in accordance with the beneficial qualities of complexity in an urban context would seem to be the evolutionary sciences' explanation of organisms' evolution through mutations as a process of increased information, thus enhancing the complexity (Adami, 2002). A complex system can then be defined as a system in which many diverse interacting units or 'agents' create a collective whole in the form of emergent behavior that is greater than the sum of its individual parts (Page, 2011). It can be seen as a system of interacting parts that display emergent behavior (Newman, 2011; Page, 2011), where increased diversity contributes to more complexity (Page, 2011). Borrowing Page's categories of diversity, in the present case diversity of variation can be further subdivided as 'mutation,' 'inversion,' 'recombination,' 'transfer,' and 'representational diversity' (Page, 2011, p. 55). These diversity categories partly overlap with the characteristic ways in which a compact city delivers agglomeration properties, such as mutation of business types through divisionary and combinatory processes (Bettencourt, 2010; Youn et al., 2016), knowledge transfer and spillover (Bettencourt, 2013; Glaeser, 2010), and representational diversity of services, functions, and businesses (Quigley, 1998; Bristow, 2010). This kind of complexity created by diversity is has been observed to provide complex responses to complex and unpredictable challenges (Holland, 1992; Ahern, 2011).

However, these studies on the advantages of a compact city have been contested or thought to be inconclusive in other studies on the compact city as an urban form, especially in relation to urban density. The findings of these studies show weak correlations between high-density urban structure and reduced carbon emission (Heinonen & Junnila, 2011), negative perceptions of crowding and psychological health (Haigh, Ng Chok, & Harris, 2011), lowered neighborhood satisfaction (Bramley & Power, 2009), higher consumption rate including consumer goods and energy (Heinonen & Junnila, 2011), and higher ecological footprint (Gugger & Kerschbaumer, 2013) in high-density neighborhoods. Because there is an abundance of contradictory results on the advantages and disadvantages of the impact of urban compaction (Jenks et al., 1996), we are left with yet another wicked problem (Neuman, 2005; Roberts, 2007): the paradox of the compact city.

The contrasting study results have been recognized as a consequence of the lack of a clear definition of the compact city (Neuman, 2005). Some argue that the studies in question might indicate the effects of challenges that are inherent to urbanization in general, not to the compact city per se (Glaeser, 2011). In his book, 'Triumph of the city,' Glaeser contends, 'Cities do not make people poor; they attract poor people. The flow of less advantaged people into cities from Rio to Rotterdam demonstrates urban strength, not weakness' (2011, p. 9). Based on surveys of residents' perceptions of crowding conducted in various areas with a similar population density, one study suggests that the negative perceptions of high-density residential areas may be caused by poor design (Kearney, 2006). As an example, designs with less direct views into the neighbor's apartment could decrease such negative perceptions. Another study of the effects of urban structure on carbon consumption in metropolitan areas in Finland showed negative results concerning the links between density and reduced carbon consumption (Heinonen & Junnila, 2011). However, in this study, it is noticeable that all of the case study cities had a population density of fewer than 3,000 inhabitants per km^2, which is significantly below the density of 15,000 persons/km^2 for a compact city recommended by UN Habitat. Similarly, in a study claiming that compact cities have a higher ecological footprint (Gugger & Kerschbaumer, 2013), using a report on ecological footprint per capita in London compared to the rest of the UK (Best Foot Forward, 2002), there seems to be a lack of consideration of the population migration rate to London, consisting of visitors or commuters, during workdays. This shortcoming was even specified in the methods chapter in the report from City Limits, on which the research was based. All in all, it seems uncertain whether all claims regarding the shortcomings of the compact city are always valid. It seems feasible to argue that the interactive qualities between agents – citizens, businesses, various organizations, etc. – owing to the proximity of diverse agents bring about the positive outcomes (Kanter, 1988; Youn et al., 2016, Quigley, 1998; Bristow, 2010; Newman, 2011; Bettencourt, 2010; Bettencourt, 2013; Glaeser, 2010), while the 'compactness' factor of urban density brings about divisive claims as to its advantages (Heinonen & Junnila, 2011; Gugger & Kerschbaumer, 2013; Kearney, 2006; Jenks et al., 1996; Bramley & Power, 2009; Haigh, Ng Chok, & Harris, 2011).

2.1.5 The problematics of chasing 'THE COMPACT CITY' ideal: process vs. form = chicken or egg

The consensus in global policy regarding the benefits of urban compactness paired with the contradictory scientific findings leaves us with the 'compact city' as a paradox or a wicked problem. Neuman (2005) argues that this is due to the lack of definition of the compact city, which causes us to look at any kind of seemingly dense urban form as a compact city, thus giving us contradictory results.

The policy guidelines suggested by UN Habitat (2014) provide some specific implementable parameters for density and diversity. However, concerning implementation these attempts to apply pre-determined goal-oriented parameters of density and diversity are problematic in several ways. The methods used to measure urban density and mixed-use (diversity of urban functions) are not consistent, and in some cases inefficient (Churchman, 1999; Manaugh & Kreider, 2013). Density is measured using different methods in different regions, for instance, some regions measure density as units of people in a given area (population density), others use units of dwellings in a given area (residential density), and the areas used to measure such density also vary, such as hectares, square kilometers, acres, etc. The net and gross density concept is also understood and measured differently depending on the region and culture (Churchman, 1999). The concept of 'sustainability' factors regarding density also varies between local cultures, for instance, some cultures might consider sustainability in terms of ample living space, privacy, and outdoor space to raise a family (Roberts, 2007). In already compact developing nations, where the population density is already high – i.e. Jakarta with 14,084 persons/km^2, or Calcutta with 23,487 persons/km^2 – implementation of compact city policies may be rather superfluous (Williams, 2004; Bardhan, Kurisu, & Hanaki, 2015). The heterogeneity of sprawl indexes (Lee, Kurisu, An, & Hanaki, 2015), and density indexes in different regions (Churchman, 1999; Manaugh & Kreider, 2013) complicates enforcement of implementable global guidelines and the reliability of comparative studies on sprawl and density. Another aspect further complicating the matter of the compact city is the lack of common criteria for defining different kinds of land use, such as what should be considered a commercial activity, what should be included as institutional functionality, and what proportions of different functions should be achieved for an area to be considered mixed-use (Manaugh & Kreider, 2013).

As seen in this chapter, drafting a compact city as a normative urban form regarding its properties of density and diversity is a difficult endeavor, which may not prove to be relevant as regards global implementation. A city 'formation' is rather a process involving complex interactions between diverse factors found in urban systems, between 'built, economic, governance, natural, and social environments' (Roberts, 2007, p. 726); it is constantly adjusting itself (Neuman, 2005), and should be seen as a process, not only as a city form (Neuman, 2005). In his article 'The Compact City Fallacy,' Neuman (2005) disproves the compact city as a concept of sustainable urban form, on the ground that it relies heavily on the 'form,' and he claims that 'the main principle of sustainability, process, is more critical than form—compact or otherwise—in attaining a more sustainable city' (p. 12).

2.1.6 The compact city as an outcome of a complex urban processes

'life cannot be made, but only generated by a process' (Alexander, 1979, p.174).

'Persistent problem are complex (multiple causes and consequences, their reach stretches beyond a wide range of societal domains and scale levels, and they are deeply embedded in our societal structures and institutions), uncertain (they have no ready-made solutions, and it is hardly ever possible to reduce the degree of uncertainty by acquiring more knowledge, since every attempt at finding a solution only ends up changing the way the problem is perceived), difficult to manage (a large number of actors with diverse interest are involved and each tries to influence the other. These actors are relatively autonomous and operate at different scale levels) and hard to grasp (difficult to interpret, ill-structured and susceptible to powerful dynamics in their surroundings)' (Rotman, 2005, p. 7-8).

The problem of reducing the complexities found in a dense and diverse urban structure to a specific normative urban form with pre-determined density and diversity parameters seems to be representative of much of the contradictory research on 'THE compact city' as the 'solution' to assumed existing urban challenges (Neuman, 2005; Alexander, 1969). The problem arises when we reflect on the parameters that seem to define a compact city by reducing the complexity found in urban systems to only a certain number of interacting categories, such as density and diversity. Urban resilience is sought after to better deal with vulnerable urban conditions (Davoudi et al., 2012) and with urban challenges that are increasing in complexity and unpredictability (Homer-Dixon, 2011; Davoudi et al., 2012); in this connection, the compact city is promoted as a way to achieve urban resilience (Neuman, 2005). However, if we choose a seemingly resilient urban structure, investigate the level of density and diversity of that urban structure, and then design a new city with the same values of density and diversity found in the resilient city, will the resulting urban systems then perform resiliently as a proposed compact city? Or is it rather the layers of processual relations that have been created during the formation of such density and diversity that actually result in the resilience? Here, the key qualities of a compact city – density and diversity – can be seen as prerequisites for urban resilience, because they provide enough complexity for urban components to further diversify and generate novelty through combinatorial relationships and their assemblage processes (Bettencourt, 2013; Bristow, 2010). Still, this seems like a chicken-or-egg problem, as it is a question of whether the complex processes arise due to density and diversity alone, or whether the density and diversity also are outcomes of complex processes. As resilience is a matter of urban behavior over time, it might be beneficial to look at the processes that spawn these complex qualities instead of just applying a simplistic and categorical analysis of 'what a compact city is' and 'how it should be,' thus reducing complexity to only a number of values for global implementation (Neuman, 2005).

2.1.7 Urban resilience and adaptability

According to Gunderson and Holling (2002), resilience is defined as the capacity of a system to not only bounce back to its previous state after a shock, but also to extend beyond the previous state which was vulnerable to the shock, and to emerge with an optimized state through adaptive behavior and self-modification (see Diagram 1).

In an urban economics perspective, the necessary elements of a 'resilient place' are characterized as (Bristow, 2010, p. 156):

1. 'Diversity (as opposed to uniformity) in the number of "species" of business, institutions, sources of energy, food, and means of making a living'
2. Capacity to re-organize through networking and information sharing
3. Emphasis on small-scale activities and businesses in the local context that can adapt
4. Mutual access to local assets, capacities, resources and localized production, trading and exchange

In this view, resilience is thought to be achieved by the process of adaptation through individuated processes. This means that achieving resilience is oriented away from the expectation of defining the value of a sustained state of being (dense and diverse), assuming a constant level of performance capacity (reduced ecological footprint, reduced use of cars, etc.).

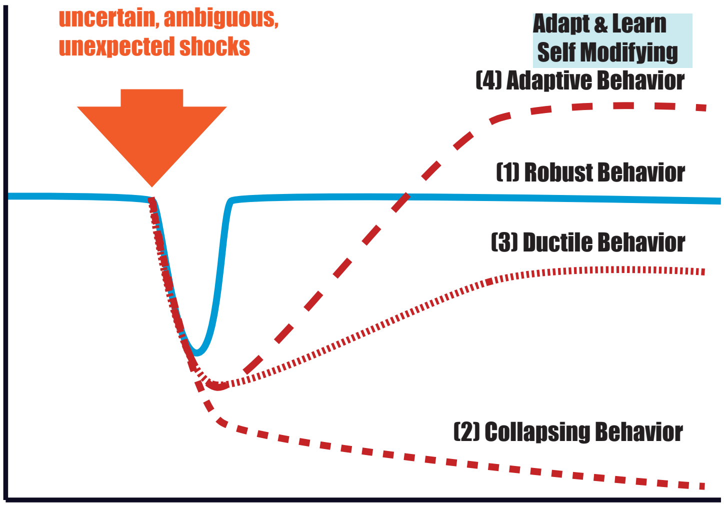

Diagram 1. Resilience through adaptive behavior

Diagram is modified from the lecture 'Urban infrastructure systems facing disruptions - how to make them fault-tolerant' on the 11th November, 2014 in Singapore at ETH Center, as part of IDEA League doctoral school - Urban systems and sustainability: Making urban systems adaptive and resilient, by Dr. Hans Rudolph Heinimann from Future Resilient Systems, ETH, Switzerland.

The positive properties of the compact city are derived from the spontaneous (incremental) adaptive qualities that arise through agglomeration (density), diversity of agents (interactions) and diversity of networks (Bettencourt, 2013; Glaeser, 2011). These incremental adaptive behaviors of diversity of actors and agents, and their interactions embedded in a compact city, can be assumed to give rise to the continuously emerging optimal state for the here and now, thus providing resilience in an adaptive transformative sense (Bettencourt, 2013; Glaeser, 2011; Quigley, 1998). As an example, fewer cars may be driven when there are higher rental prices in denser cities, due to the high proportion of income spent on paying rent, leading to more walking, and in turn perhaps leading to more business opportunities on the street level. We can also speculate that sinking fuel prices might encourage the purchase of personal vehicles, leading to migration of new car owners to suburbia, increasing the housing demand in those areas, thus resulting in increased property prices and further chain reactions. Such continuous adaptations by agents constitute the emerging phenomena of continuing transformative processes (Bettencourt, 2013) – phenomena that continuously shape urban forms so that new contexts unceasingly emerge. How, then, do we 'plan' for continuous urban transformation? The present thesis embraces the concept of transformability through adaptive processes as the foundation of planning for urban resilience, where the dynamics of resilience involve both processes and emergence (Almedom, 2013).

2.1.8 Compact city, emergence and self-organization

In an urban context, any existing or planned urban structure can be said to have 'emerged' or to be 'emerging.' From the point of view of resilience, then, how do we distinguish 'emergence' that retains the adaptive qualities needed for resilience from 'emergence' that does not? From a complexity perspective, for a complex system to exhibit 'emergent' qualities, the following components are necessary: large agglomeration of interacting individuals (density, network), each one exhibiting some sort of nonlinear dynamics (diversity) (Chialvo, 2010) to create a 'spontaneous order' or 'emergence' (Page, 2011; Bristow, 2010). The spontaneous order or emergence that is needed for resilience can be observed in diversity-oriented cities with smaller-scale activities and businesses that have shown their resilience to external economic shock by self-organizing and adapting (spontaneous order), compared to single-industry-oriented cities, where the downfall of the primary industry would render the city fragile (Bristow, 2010).

Thus, emergence is recognized as a process of constantly unfolding a novel adapted state through incremental transformation based on complex interactions. Then, if we are looking for a resilient urban structure, could we study urban structures that manifest resilient characteristics by adaptive incremental changes in urban functions, i.e., through processes of continuous emergence or grown out of 'a complex web of causes and effects, its inter-related parts interwoven through time' (Batty & Marshall, 2012, p.24)? Traditional urban development of the pre-reductionist planning era, i.e. before modernist planning, has been argued to fit the prescribed definition of emergent qualities (Batty & Marshall, 2012; Scheurer, 2007). Such development processes allowed buildings to be deliberately designed to accommodate changes over time, unlike the reductionist perfectionism that instead invested in function-specific spaces that cannot readily facilitate other future functions (Scheurer, 2007). Traditional urbanism, such as that seen in European historical cores, thus shows urban compactness with an embedded diversity of functions, while modernistic urban cores show compactness with monolithic single function concentrations, without the diversity that contributes to complexity, as seen in modern cities in the US (Jenks et al., 1996). In this sense, traditional urban development can be seen as emerged urban form that hosts a variety of characteristics that make it resilient through density and diversity.

Chapter 3.
Study objectives and research questions

3.1 Knowledge gap

The problem of contrasting studies on the benefits of the compact city seems to stem from focusing on the form of the urban structure as a solution package, which is to be analyzed using density and diversity parameters, without much consideration of the involved adaptation processes that are just as important (Alexander, 1965; Neuman, 2005; Hofstad, 2012), while other studies focusing on urban complexity examine how to create bottom-up approaches to incorporate complexity, however with little concern for the built structure outcome (van Diepen &Voogd, 2001). Consequently, there would seem to be a lack of studies connecting desirable urban qualities in terms of density and diversity – and the resulting resilience – with planning approaches that may lead to such qualities.

3.2 Study aims and research questions

The overarching aim of the entire PhD project is therefore to understand how the outcomes of different planning approaches are produced, with a focus on compact city qualities (density and diversity) that lead to resilience.

In the first phase of the research process, two detailed questions were formulated.

> RQ1: How does the physical outcome differ regarding compact city characteristics depending on different planning approaches?
> RQ2: What are the perceptual differences regarding compact city characteristics depending on different planning approaches?

During the design phase of the research addressing question 2, a third research question was generated regarding methodological development.

> RQ3: What survey tool can be developed to support dialogue processes intended to facilitate an understanding of citizen perceptions of the built environment from a street-level perspective?

The first question thus focuses on quantifiable form variables regarding density and diversity, and the second question on qualitative perceptions of density and diversity. The third question focuses on methodological development for collection of citizen perception data.

While investigating the first two questions, and corroborated by the findings from the research related to these questions, a second knowledge gap was identified. Because there seems to be a strong positive relationship between the outcome of a particular type of planning approach (the rule-based approach) and urban density and diversity, it is interesting to pursue the topic further to try to understand how we can create 'emergence' in unbuilt sites by applying the 'rule-based' planning approach. This generated a second set of research questions for the entire PhD project:

> RQ4: What compact city qualities regarding density and diversity are developed if the rule-based approach is applied top-down?
> RQ5: What compact city qualities regarding density and diversity are developed if the rules in the rule-based approach emerges from the bottom-up?

During the design phase of the research for Question 4 and 5, an additional research question was generated regarding the methodological development:

> RQ6: What methodology can be developed to include non-expert citizens without the knowledge of mainstream urban planning tools, in collaboration on urban designs, from the street-level where the urban conditions actually exist?

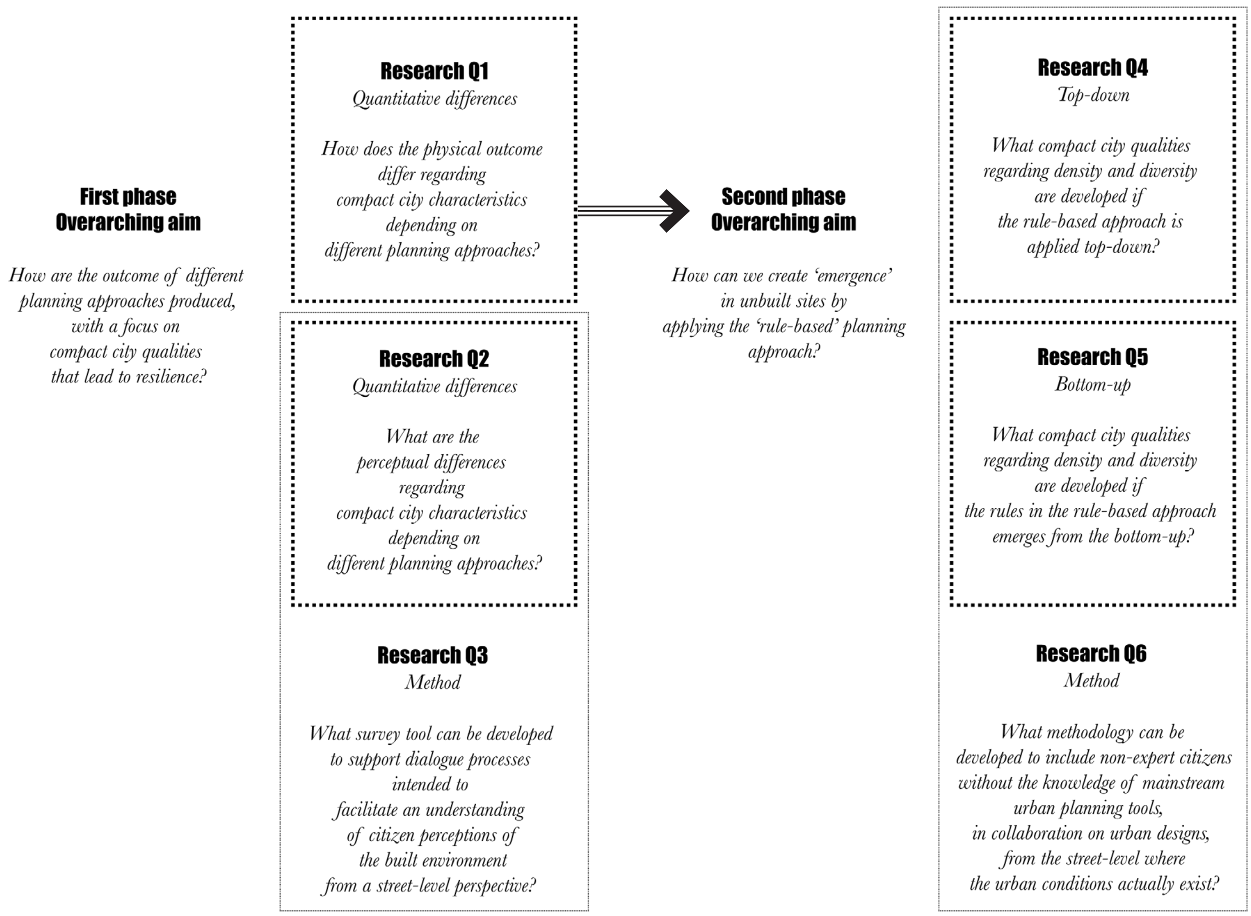

Diagram 2. Research phases and questions

These are the research questions addressed in the entire PhD project. Even if all questions are dealt with in this licentiate thesis, the second phase research questions (2, 4 and 5) are only partially addressed, without full results and conclusions.

Chapter 4. Theoretical/analytical framework

4.1 Cities as complex adaptive systems

Hu and collaborators have shown that after a spoonful of ants is dropped into water, the blob of insects transforms into a pancake-like raft through a simple process: each ant walks randomly on the surface of the blob until it hits the water's edge. "An individual ant can't know how big the raft is, where it is in the raft and what other ants are doing," Hu said. "The only communication goes on at the edge of the structure — that's where the structure grows." (From an interview with David Hu and collaborators at the Georgia Institute of Technology on the architecture of ants)

4.1.1 Definitions of Complex adaptive systems

The concepts discussed in the 'compact city' chapter – resilience, adaptability and emergence – are often used in the context of complex systems sciences. If we go beyond defining a city as a complex system and recognize it as a complex adaptive system (CAS), interesting relationships emerge between cities and urban qualities that can bring out potential resilient properties, which are in accordance with the characteristics of CAS that make a system resilient (Ahern, 2011). As discussed above, a resilient system is constituted by its underlying characteristics as a self-organizing system that builds and increases the capacity for learning and adaptation (Carpenter et al., 2001). The benefits of a compact city are derived from the complexity created by the density, diversity and networking that provide the foundation for the emergence of incremental adaptive transformations. The characteristics that are thought to contribute to urban resilience can be better understood through CAS theory.

Complex Adaptive Systems (CAS) refers to a field of study and resultant conceptual framework for natural and artificial systems that defy reductionist (top-down) investigation. Such systems are generally defined as being composed of populations of adaptive agents whose interactions result in complex non-linear dynamics, the results of which are emergent system phenomena (BrownLee, 2007).

According to Holland (1992), the characteristics of CAS that generate such emergent aggregate behavior are:

Evolution/adaptation
The system is changed and reorganized by its component parts adapting themselves to the problems posed by their surroundings. Holland (1992) gives an example of a thermostat that turns itself on or off to adapt to changing temperature so to achieve a certain climate condition. In the case of CAS, the system is composed of these individual components (thermostats) adapting individually (turning on or off) to deal with the changing conditions (climate).
Aggregate behavior/Emergence

'Complex adaptive systems also exhibit an aggregate behavior that is not simply derived from the actions of the parts' (Holland, 1992, p. 19). The aggregate behavior emerges from the interactions of the parts, and can be observed in the economic activities of individual parts creating flows of demand and supply, in an immune system distinguishing itself from other bodies, in an ecosystem's overall food web or in the patterns of flow of energy and materials.

Anticipation

An individual part's anticipation changes the existing conditions. For instance, anticipation of an oil shortage can impact oil prices. Even if the anticipated event did not occur (i.e., the expected oil crisis did not happen), the surrounding conditions (i.e., oil prices) have already changed (i.e., increased), causing the individual parts (i.e., car owners) to adapt (i.e., selling their cars) to the new condition (i.e., increased oil price).

Individual parts continuously revise the rules for interaction

Each part perpetually finds itself in novel surroundings, given the changing behavior of the other parts. As seen with the thermostat that turns itself on or off, this action taken by the thermostat can impact other components of the surroundings, for instance a humidifier that changes its behavior and rules to adapt to the new condition posed by the thermostat's actions.

Regarding models of CAS, Holland (1992) emphasizes the absence of a single controlling mechanism. Rather, CAS operates with many distributed, interacting parts, that are governed by their own rules, each outcome of the individual parts inducing the actions of other parts. He claims that '[t]he resulting rule-based structure becomes grist for the evolutionary procedures that enable the system to adapt to its surroundings' (Holland, 1992, p. 22).

A similar characterization of CAS from an urban planning perspective has been drawn up by Sanders (2008), who outlines the qualities of CAS as follows.

Diversity among the components

Heterogeneous parts or "agents" are the sources of novelty in the system. The natural selection processes within agent groups ensure the ongoing evolution, regeneration, and adaptation of the system.

Nonlinear interactions

Widespread information flow and feedback loops interact in a nonlinear complex pattern.

Self-organization

Self-organization results from attractors in the system. This happens through adaptation to changes in the larger environment and to changes in other agents.

Local information processing

Information is locally processed through interactions among autonomous agents. Typically, agents "see" only their part of the system and act locally without any global control.

Emergence

Emergence exhibits unpredictable global behavior or patterns through spontaneous emergence of order from local systems' interactions.

Adaptation

A system is open and responsive to changes to the larger environment or context and to other agents in the system, continuously processing, learning, and incorporating new information.

Organization across multiple scales

Agents in the system are organized into groups or hierarchies of diverse layers, which influence how the system evolves over time.

Sensitivity to changes in initial conditions

Small changes in the system can create major results at some point in the future.

Non-equilibrium

Most interesting behavior/creativity is found at the "edge of chaos." Healthy systems operate in a dynamic state somewhere between the extremes of order
and disorder, making it easier for them to adapt to changing conditions.

Best understood by observing the behavior—activities, processes, adaptation—of the whole system over time

Qualitative descriptions and understanding versus quantitative descriptions alone (modified from Sanders, 2008, p. 276).

These two sets of lists provide a basic understanding of the mechanisms of the CAS, which can be summarized as a system that adapts itself through diversity of individual components/parts/agents that behave according to their own rules and adaptive strategies without a central controlling mechanism and through non-linear interactions, actions rendered by anticipations, and various layers of self-organization. This results in a spontaneous emergent state that shifts between non-equilibrium states which continue to adapt and unfold as a novel state. Holland (1992) compares such a system's ability to adapt and avoid collapse through complexity to the immune system, where highly mobile antibodies continuously repel and destroy antigens using infinite varieties of forms. He claims that to deal with ever-changing infinitely variable challenges, the system simply cannot generate a list of challenges, instead it needs to adapt and change continuously.

4.1.2 Implications of CAS theory in an urban planning context

Applied to an urban context, CAS can be understood as urban systems that owing to the dynamic and adaptive interaction processes of microscopic agents – i.e., an urban agent buying a shop and turning it into a restaurant, selling a car and taking collective transportation, changing a route to work, moving with the family to the suburbs, etc. – emerge as constantly changing macroscopic urban patterns. This results in a city that is unintentional, that is incrementally created by rational decisions made for rational reasons by individual actors and agents (Manesh & Tadi, 2011; Rowley, 1996). Here, the constantly changing emergent actions made 'by' micro-agents are motivated by these agents' rational choices based on changes in surrounding conditions or anticipation of such conditions, and/or on other agents changing their activities (Holland, 1992). Emergent actions thus differ from top-down, centrally controlled implementation of assumed rationalized reasons 'for' the macroscopic structure to 'act on' the micro-agents. The rational decision of an agent to buy a car and move to the suburbs while the price of fuel is low differs from centrally planned intentionally expanded suburbs that are rationalized to de-densify congested central urban cores. Micro-agents' actions, both individual or as groups, are based on their individual rational reasons and these actions are not based on any assumed knowledge of their full consequences to the macroscopic pattern (BrownLee, 2007). A simple example of CAS in an urban context is seen in a case study done in a residential area of Barcelona. The study presents a case in which spontaneous introduction of a new building adjacent to an old building (individual action) with sub-standard insulation and building materials provided shading, creating less solar reflection on the old building's facade, thus reducing the energy consumption for cooling of it, i.e. an emergent phenomenon (Manesh & Tabi, 2011).

4.1.3 Planning for resilience in complex adaptive urban systems

With increasing awareness of the inadequacy of relying solely on the sustainability concept (Ahern, 2011; Benson & Craig, 2014) to deal with unpredictable challenges, such as climate change and depletion of resources, more attention is being paid to the concept of resilience (Ahern, 2011). The sustainability goal has been argued to have failed to deliver the predicted behavior changes toward increased sustainability, and damage to the environment is continuous (Benson & Craig, 2014). It is argued that the problem of the sustainability concept is the assumption that we can possess knowledge about certain desirable states of ecological and social systems, and that we have the capacity to maintain a stationary equilibrium, i.e. durable, stable and 'fail-safe' urban forms and conditions (Benson & Craig, 2014; Ahern, 2011). From the point of view of CAS, this results in a paradoxical question: 'How can a static landscape condition be sustainable in a context of unpredictable disturbance and change?' (Ahern, 2011, p. 341-342).

Ahern, in his article 'From fail-safe to safe-to-fail: sustainability and resilience in the new urban world' (2011, p. 341-343), points to rare use of adaptive planning or management in urban planning and design contexts and emphasizes the importance of reducing the risk of failure through the use of 'safe-to-fail' design strategies. He suggests the following strategies for building urban resilience:

Multifunctionality
Given the increasingly limited spaces within compact city settings, multi-functionality can be achieved by combining functions, stacking or time shifting. He argues that multi-functionality enables spatial and economical efficiency, and that it can support response diversity in the functions provided.

Redundancy and modularization
Providing multiple components with the same, similar or backup functions will spread risks across time, geographical areas, and multiple systems. This prevents system collapse when a centrally distributed function, service or infrastructure fails to respond to a certain disturbance, with back-up functions and services provided by a distributed or decentralized system. A resilient system needs to prepare for system failure; it is a system that is 'safe-to-

fail.'

(Bio- and Social) diversity

This refers to the diversity of species within functional groups that have different responses to disturbance and stress. He argues using an example of response diversity applied to urban bio-physical systems with low impact development practices such as permeable pavement and urban tree canopy, each of which reduce the amount of storm drainage infrastructure during heavy rainfall, thus enhancing the overall resilience capacity of the system. Likewise, a higher level of economic and social diversity will provide more complex response diversity to adapt to change and socio-economic disturbances.

Multi-scale networks and connectivity

Connectivity is a critical parameter of a function's performance, and lack of connectivity is often a primary cause of that function's failure. Complex networks build resilience capacity through redundant circuitry that maintains functional connectivity even after network disturbances. Functions that operate on multiple scales need multi-scale connectivity. This is especially important in multi-scale connectivity with built urban form and the surrounding blue-green networks, for biodiversity, hydrological processes, climatic modification, and other enhanced urban qualities.

Adaptive planning and design

For adaptive planning and design, experts and planners assess how a policy or project will influence particular landscape processes or functions, and implemented planning policies or design become 'experiments' from which experts, professionals, and decision-makers may gain new knowledge through monitoring and analysis.

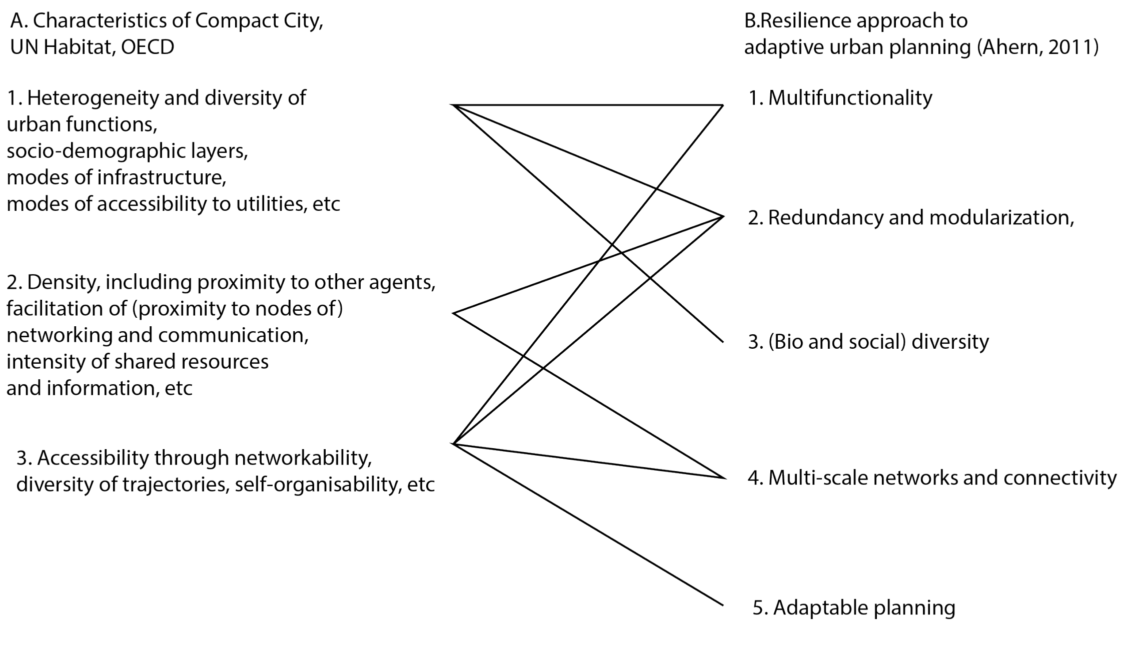

Diagram 3. Resilience approach and compact city (Appendix 3/Paper1)

Ahern (2011) argues that a new culture of innovation, monitoring and assessment of plans is necessary if we are to plan for resilience. He proposes that the 21st century's inevitable rapid changes and replacements of infrastructure and expanding urbanization are opportunities to redirect and reconceive processes of urbanization, transforming them into processes of capacitating resilience.

Another approach to adaptive planning is the 'swarm planning' approach coined by Rob Roggema (2012). Based on the layer approach of Frieling et al. (1998) and complexity principles, he suggests a swarm planning framework:

The whole, and the parts

This is a two-level planning approach. On the whole system level, intervention is carried out strategically so that the whole can be best influenced, such as by targeting interventions to the most networked nodes. The second level applies to the individual parts, such as a road or a building, which can be given capacities that enhance the self-organizing capacity depending on the environment. Roggema gives an example of a house by a lake that can be built with a base that can float. Both these levels are thought to determine the adaptive capacity of the entire system.

5 spatial layers of individual components

Urban components are not contained within the same 'time-rhythm' and spatial scale. A tree is less changeable than a café terrace, for instance. Roggema argues if we connect elements that are similar in such dynamics, and intervene accordingly, we can enhance, predict, and facilitate the transformations. These five spatial-temporal layers are:

Layer 1 *Network:* Country, region with time horizon of 100 years (related to the 'whole')
Layer 2 *Focal points:* Region with 20 years (related to the 'whole')
Layer 3 *Unplanned space:* City, neighborhood with 1 year (related to 'parts')
Layer 4 *Resources:* Continent, country with 1,000 years (related to 'parts')
Layer 5 *Emergent occupation:* Public space, neighborhood with 5 years (related to 'parts')

Non-linear processes

Roggema argues that non-linear processes emerge between these spatial-temporal layers, and that each of those processes contributes to adaptation of the system. The nodes that provide a tipping point, where a system changes from one state to the next adapted state, can be identified as the strategic node where intervention can be carried out to allow for other components' self-organized adaptivity.

Two planning processes

One way is to start planning from the slowest changing elements, such as natural resources. The planning decision will form the basis for the second slowest changing element, such as the networks, and then the nodes, and leave the remaining space unplanned. A second way is to start from an analysis of the first layer, the networks. With the analysis as a base, most important nodes are identified for strategic intervention. When the nodes are intervened in strategically, areas around the nodes are left unplanned, to allow the impact of intervention to emerge. When the patterns emerge in the fifth layer, this can be added to further planning.

Both Ahern's 'safe-to-fail' (Ahern, 2011) and Roggema's swarm planning scenarios (Roggema, 2012) acknowledge the value of adaptability for the resilience of urban systems. Ahern provides qualities that need to be contained within a resilient system, and Roggema provides concrete step-by-step implementation strategies for adaptable planning. These two approaches outlining the characteristics of components and layered strategies in relation to spatial-temporal dimensions can therefore provide composite insights into what might constitute an adaptable urban planning process. However, both approaches rely on experts' interventions, assessments, and consultations to allow for the adaptive emergence of smaller-scale activities, through transdisciplinary collaborative efforts, with an indication of incremental development potentials (Ahern, 2011; Roggema, 2012). Two questions require more exploration: What kinds of tools should be used by the experts and planners for such interventions, and who should the appointed experts be?

4.1.4 Purposeful complexity

The definition of CAS from the natural sciences rejects the centrality or top-down hierarchy of decision-making (Holland, 1992). Instead it emphasizes the role of generative rules that are continuously revised by individual components. The macro-structure that is based on these rules and that is the backbone of evolutionary procedures enables the system to adapt to its surroundings (Holland, 1992). Lansing (2003) explains some of these 'rules', and the mechanisms of components and networks within the system operated by the 'rules', by describing an experiment conducted by Kauffman (1995) in 1960's. Here, N number of bulbs were connected to K number of other bulbs, where each bulb is either turned on or off. In this experiment, the bulbs were turned on or off as a reaction to the connected adjacent bulbs being turned on or off. The results indicated the threshold between chaotic, static and complex behavior that arose from the interaction of the bulbs depending on the number assigned to N and K. Too few connections gave a static result, which ended with all of the lights being turned off, while too many connections produced the chaotic behavior of blinking lights, while the threshold between too little and too many, in this experiment K=3, produced a kind of complex periodic result. Langton (1990, cited in Lansing, 2003) uses this relationship between the rules and complex adaptive behavior in his classification of cellular automata to generate the emergence of complex behavior on the 'edge of chaos.' While these kinds of simulations give predictive indications of the effect of rules on the complexity of artificial relationships, he then asks how it would work in a system where individual agents have individual reactive abilities based on their foresights and anticipations, like those that occur in socio-ecological and socio-economical constructions such as cities?

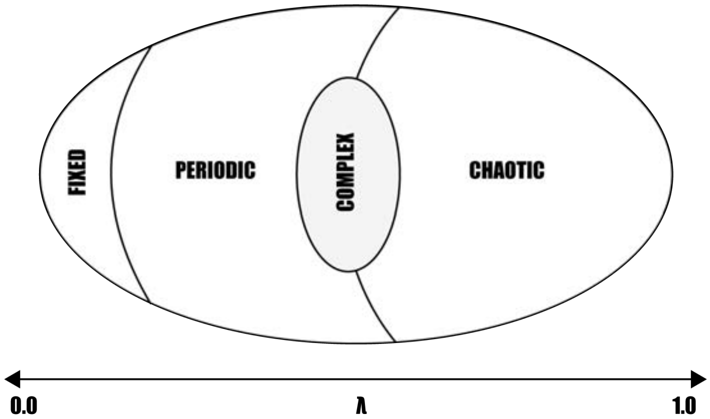

Diagram 4. Langton's classification of cellular automata. Langton found that compex behavior emerges between classes ll and lll, at the edge of chaos (Langton, 1990) - (Diagram modified from Lansing, 2003)

Bettencourt et al. (2010) observe that the 'scaling laws for cities show systematic effects of spatial densification, temporal acceleration and socioeconomic diversification' (Bettencourt et al., 2010, p. 6). The possible universality of the population scale dependency of extra increase in inventions, economic productivity, land price adjustments, and infrastructural spatial increase per capita discussed above (Bettencourt et al., 2010), the so-called '15% rule,' seems to show the potential relationship between the increased number of diverse components in proximity and the increased urban complexity. He further argues that, 'population size is not so much a causal force, but rather a proxy aggregate variable that denotes a set of diverse socio-economic mechanisms that derive advantages from the co-location and intense interaction of people' (Bettencourt et al., 2010, p. 6). In the next section, I will examine what the rules might be and how they could be used in an urban context where agents are the individuated adaptive forces behind the changes. In particular, I will examine some approaches to dealing with this complex matter in relation to the need for superimposed forces on individuals concerning their environmental behavior (van Diepen and Voogd, 2001; Bettencourt, 2014).

4.2 The 'rule' for evolutionary procedures in an urban context

'Finally, every one of these complex, self-organizing, adaptive systems possesses a kinf of dynamism that makes them qualitatively different from static objects such as computer chips or snowflakes, which are merely complicated. Complex systems are spontaneous, more disorderly,…… very simple dynamical rules can give rise to extraordinary intricate behavior.' (Tetlow, 2007, p. 51)

Bettencourt (2014) sees cities as complex social networking systems with incrementally developed infrastructures, within which the potentiality of social networks increases due to shortened distances between agents. He explains the systemic adaptation that takes place through individual choices regarding mode of transfer and decreased size of living space, due to economic constraints brought on by higher real estate costs as density grows, thus contributing spontaneously, though unwittingly, to environmental benefits. He argues that these benefits are more significant when a city increases opportunities for division and coordination of labor, thus increasing the complexity. Within this conceptual framework of what a city is, he proposes that basic rules should be applied at a local level rather than by experts carrying out planning. Such rules should, for example, reflect general constraints imposed for environmental reasons. This would entail, he argues, that heterogeneous agents are allowed to make decisions and choices based on their specific knowledge and information, provided their decisions do not cross others making similar decisions and as long as they stay within the rules.

Similar to Bettencourt's view on urban planning, Marshall (2012) points to the difficulty of planning this kind of urban complexity, i.e. how to intervene, and organize, the large open system without having full knowledge of the whole system or of the full consequences of the planning activities (Marshall, 2012). As supporters of the complexity and redundancy found in traditional, 'unplanned' cities that are still functional, Batty and Marshall (2012) argue that the challenge is to devise a kind of plan or a design which creates that kind of functional complexity (Batty & Marshall, 2012). In this connection, Marshall identifies three types of urban planning aimed at providing the complexity found in traditionally emerged cities (Marshall, 2012):

> *Planning by design*
> This concerns masterplanning, urban design, or outlines of design, with a preconceived conception of the finished state of a specific whole entity. The design here can range from a building, a road, a park, to a neighborhood, or an entire district. The question he asks is: Even though it is inevitable to involve design processes (whatever the scale) how can design (whatever the scale) deliver functional complexity that is associated with an open-ended, adaptive system of independent parts?
>
> *Planning by coding*
> Planning can be achieved through use of codes to specify generic components or the relationships of building blocks. This is a non-site-specific planning type. It can be prescriptive or proscriptive, depending on the level of control. Codes can be used in zoning ordinances, or they can also control design elements, such as the height of buildings, use of materials, or type of streets. The use of codes can be generative, including specification of how elements can be put together to generate aggregate urban form. Codes are generally established by public authorities, though variation in code-setters, such as individual developers, is also possible.
>
> *Planning by development control*
> Planning by development control enables public authorities to exert influence on what may or may not be built by approving or rejecting specific designs or layouts proposed by private individuals or masterplanners. This can be seen as 'artificial selection' rather than the 'natural selection' of market forces. This type is often used in conjunction with the 'Planning by design' type.

Marshall (2012) also suggests that combining the three planning types in appropriate portions can generate sufficient complexity to give rise to a form of emergent urbanism which can also ensure that the public interests are addressed.

4.2.1 Planning by coding: distinguishing between the codes and the 'codes'

In his book 'Urban Coding and Planning,' Marshall (2011) distinguishes 'coding' and 'planning by design' in terms of what the coding does rather than the form of the code. He argues that while 'planning by design' by nature refers to a finite product in a specific location and target date, regardless of the form it takes, either illustrated or written, coding, on the other hand, provides a generic type of urban component, rules or standards that are applicable over time and in different geographic locations more generally. The coding 'provides a framework within which individual designers can work' (Marshall, 2011, p. 230), even though it can also be prescriptive and constraining. However, codes such as 'height limit' still allow variations that can be determined by the designers. Marshall further differentiates 'codes' and codes. He explains that even though a design or illustration of a plan can be codified according to the plans for future implementation of the design, similar to the codes found in Swedish detailed plans (see Image 1), in Marshall's view, the characteristics of such codes, including embedded site specificity, single project orientedness and reference to a specific design, place them in the category of 'planning by design,' and not 'planning by coding.'

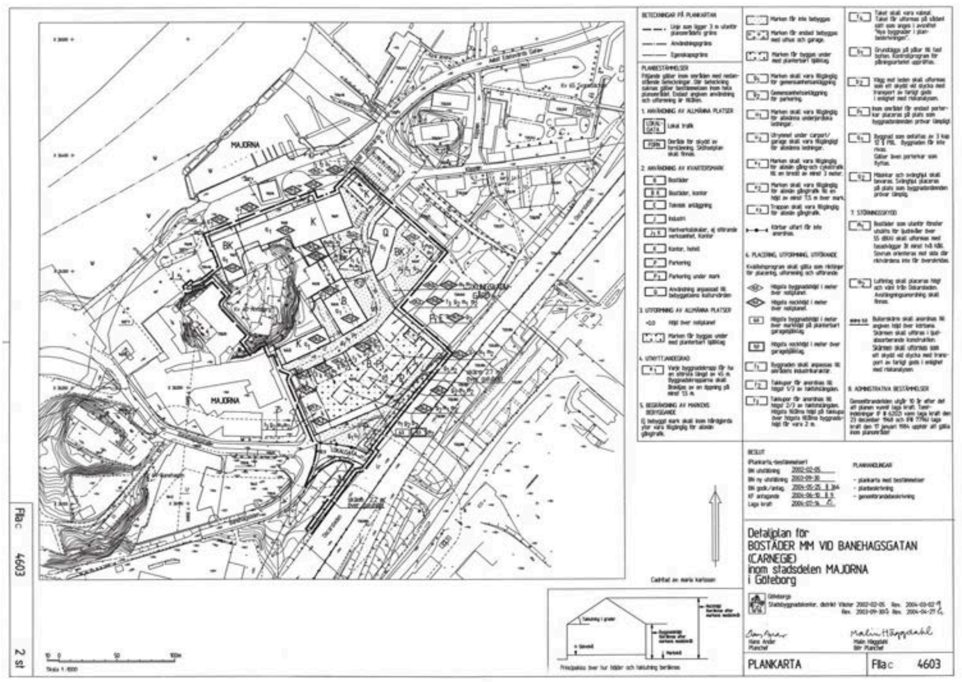

Image 1. Detailplan of residential area in Banehagsgatan, Majorna in Gothenburg

The detailplan shows the illustrative, retrospective codification based on the plan design.

4.2.2 What kind of codes?

'In the European tradition, the great landowners of the city, together with the collective interests of small landowners of the city, together with the collective interests of small landowners, have powerfully influenced the city's form. This why the legal codes governing and recording landownership are one of the earliest and most constant of written urban memory-structure' (Shane, 2005, p. 25).

To get a better understanding of how coding works, it is helpful to look at some examples of its use in urban planning, both past and present.

Pre-modernist urban codes

The early French urban codes essentially dictated the building lines and heights, sets of architectural principles, and administration procedures so as to exert overall control (Kropf, 2011). 'Regulations for the Place Royale included a height limit of 8 toises (about 16 metres), requirements for an arcaded ground floor with four arches on each parcel, four windows on each floor above, vertically aligned, and the specification of stone for the ground floor arcade and brick for the walls' (Chartier, 1994, p.138 quoted in Kropf, 2011).

Neo-traditionalist urban codes: New Urbanist 'Smart growth code'

As an opposing movement to the modernist prescriptive Euclidian zoning system in the US (Duany & Talen, 2001), the new urbanists advocate 'neo-traditionalist,' 'design-based' strategies to develop compact urban form, taking the model urban form from that which existed before the WWII (Bohl, 2000). New urbanist so-called 'transect' zoning encourages transitional zoning between the urban core and rural areas, with dedicated built objects and various building type guidelines suited to the zones (Duany & Talen, 2001).

Codes that concern neighboring conditions: Transfer of development rights in New York City

Parcels of land that are not fully exploited are presented with an option of selling the remaining airspace to the adjacent neighbor to use on their parcels, materializing the potential built space on their parcel on top of that of neighbors who would like to increase the height of their buildings (Lehnerer et al., 2013). As an example, the owner of a parcel in Midtown Manhattan that has been developed to the allowable limits gazes with envy and irritation at its neighbor, whose land is far from having been filled in to the maximum permissible degree. The owner of this underutilized parcel has the right to cash in at any time by filling in his unused airspace with office levels. At a certain level of economic pressure, and given high land prices, this is not a bad idea.

Design grammar- CityEngine: Simulative design tool

CityEngine is a 'Computer Generated Architecture' computing script that generates designs in a procedural way. Initial imported geometry and the bounding box are transformed by the user through the processes defined within the script. The process map tests various queries from the initial shapes through user selections to the final design. Depending on the assigned density and mix of use, a set of fitting typologies is chosen through 'grammar rules,' then additionally, building and floor heights and width are set based on the building functions (Schirmer & Kawagishi, 2011).

These four examples show the generative character of 'codes,' in contrast to the codes used for codification of a specific design or plan. Each example shows components/building blocks (i.e., number of arches, heights, an unbuilt building volume, and density) and how they can be assembled (i.e., every panel on arched ground floor is put together with 4 arches, building types are put together according to zoning, an unused building volume can be put together on another neighboring property). In these examples, the macro-pattern is controlled by the assigned rules, delineating the components and restrictions, where individual agents can determine how the components may be put together and make choices between the combinatorial varieties, based their needs. The following quote from Alexander's Timeless Way of Building (Alexander, 1979, p. 165), including an analogy in which 'codes' are likened to the genetic codes of a flower, may provide good summary of the concept of generative 'codes' in 'Planning by coding.'

'*What makes a flower whole, at the same time that all its cells are more or less autonomous is the genetic code, which guides the process of the individual parts, and makes a whole of them…. Each part (cell) is free to adapt locally to its own processes, and is helped in this process by the genetic code which guides its growth. Yet at the same time, this same code contains features which guarantee that the slow adaptation of the individual parts is not merely anarchic, and individual, but that each part simultaneously helps to create those larger parts, systems, and patterns which are needed for the whole' (Alexander, 1979, p. 165)*

4.2.3 Code–based, Rule-based and Design-based

The terms 'code-based' and 'rule-based' seem to be used interchangeably in the urban research literature (all of the examples provided above use the term 'rule,' except for the first example, where the term used for the particular set of rules was 'codes'). However, as clarified by Marshall (2011), the term code can also be used in the sense of codified design details, such as in detail plans, which is not meant to convey the same meaning of code as used in planning by coding (Marshall, 2011). The terminologies used in CAS show a preference for using the term 'rules' for the underlying generative framework of the CAS system. As observed in New Urbanist planning mechanisms, and as indicated by Marshall (2011), planning by coding, planning by design and planning by development control can be used simultaneously depending on the needs and aims of the planning context. In this case, the presence or absence of primary generic codes pre-imposed globally on the site will determine whether or not the approach is rule-based, independent of the diversity of over-laid planning approaches.

In the present thesis, the use of term 'code' refers only to the generative 'code' as in planning by coding. The term 'rule-based' planning approach is used based on the above argument, i.e. generative, non-site or project specific. This approach guides the emergence of macrosopic pattern where microscopic agents can individually act upon their own decisions under the set restrictions ('codes'), solely through 'planning by coding', or in conjunction with 'planning by development control', and/or 'planning by design'. An approach that primarily guides its planning processes through either 'planning by design' or 'planning by development control,' where there is an absence of embedded generative 'codes' generally applied to the site, is seen as a 'design-based' planning approach.

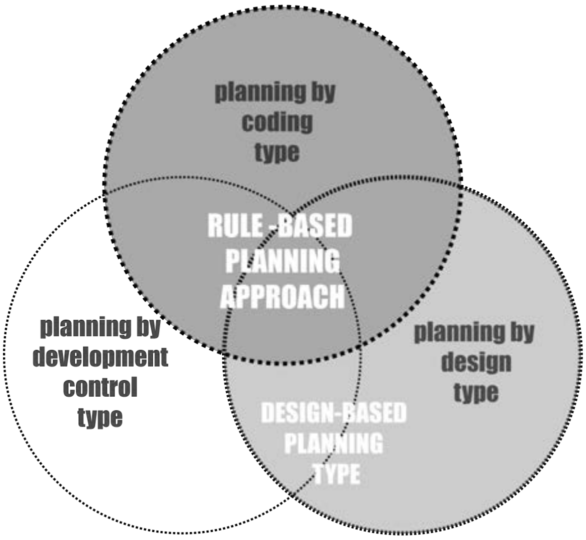

Diagram 5. Planning approaches.
Rule-based and Design-based approaches, in this thesis, are defined by the use of plannning types. Rule-based approach is composed of mechanisms related to 'planning by coding', with or without the combination of either one of- or both 'planning by design', and 'planning by development control'. Design-based approach, on the other hand, is defined as an approach, composed of either 'planning by design' with-, or without 'planning by development control'.

4.2.4 Summary of scope

The present thesis uses complex adaptive systems (CAS) as a theoretical framework to investigate the resilience of urban form as an outcome of different planning approaches. The compact urban form seems to have qualities that can deliver resilient characteristics through the emergent complex dynamics enabled by the adaptive actions of individual agents, and this seems to provide the complex responses necessary for addressing complex challenges. Adaptive urban planning has also been given weight in the discussion on urban resilience, although the tools for such planning require further assessment. Within the urban planning perspective, three planning types have been outlined: 'planning by design', 'planning by coding', and 'planning by development control'. The planning approaches under study have been defined as 'rule-based' and 'design-based' (see Chapter 4.2.3). Of particular interest is the 'rule-based' approach, which incorporates the 'planning by coding' type for its implementation of adaptability, allowing multiple undetermined variations within a delineated boundary defined by the codes. This approach seems to allow for the emergence of continuously adapted novel conditions. Emergence can also be observed at multiple scale levels. For instance, a suburban area can be seen as an individual component that has emerged within a regional urban system. However, in the present thesis, I will be looking into the scale of emergence contained within an urban intensification perspective, focusing on the level of 'neighborhood' or smaller urban districts.

Chapter 5.
Methods

5.1 Research as a bifurcation process

The overarching research aim was to understand how the outcomes of different planning approaches were produced within different urban systems, with a focus on compact city qualities (density and diversity) that lead to resilience. The research process was designed as a phasing of research activities, where one research question leads to another (see Diagram 6).

The first phase of the research aims at assessing the outcome of different planning approaches in relation to the compact city characteristics by addressing three research questions:

> RQ1: How does the physical outcome differ regarding compact city characteristics depending on different planning approaches?
> RQ2: What are the perceptual differences regarding compact city characteristics depending on different planning approaches?
> RQ3: What survey tool can be developed to support dialogue processes intended to facilitate an understanding of citizen perceptions of the built environment from a street-level perspective?

This phase of the research was divided into three parts.
Phase 1a: Corresponds to research questions 1 and 2.
To better understand alternative planning systems to the current mainstream system in Sweden – the 'design-based' approach – a study of a 'rule-based' approach was carried out, using a literature study of a Japanese planning system and urban land use system as the research method (Appendices 1 & 2).

Phase 1b: Corresponds to research question 1.
To address research question 1, a study was carried out to examine the outcomes of different planning approaches in terms of compact city characteristics (density, diversity of building scales and distribution of building scales). This study used building footprint analysis of 'emergent compact urban form', 'designed dispersed urban form', and 'designed compact urban form' in both Gothenburg and Tokyo (Appendix 3/Paper 1).

Phase 1c: Corresponds to research questions 2 and 3.
To address research question 2, regarding the qualitative differences in citizens' perceptions of the outcomes of different planning approaches, a new tool was developed to collect the perception data. This tool was developed using a mobile web app to capture perceptions of 'emergent compact urban form' and 'designed compact urban form' in Gothenburg (Urban CoMapper). (Appendices 4 & 5).

The overarching research topic of the second research phase was formulated based on partial results collected from the studies during the first phase: To better understand the consequent qualities of density and diversity when the 'rule-based' approach was applied to current development areas in Gothenburg. This focus resulted in a new set of research questions related to implementation of the 'rule-based' approach. The first question is from a top-down implementation of rules perspective and the second question is from bottom-up implementation of rules perspective. The final research question is about development of methods in support of both research question 4 and 5.

> RQ4: What compact city qualities regarding density and diversity are developed if the rule-based approach is applied top-down?
> RQ5: What compact city qualities regarding density and diversity are developed if the rules in the rule-based approach emerges from the bottom-up?
> RQ6: What methodology can be developed to include non-expert citizens without the knowledge of mainstream urban planning tools, in collaboration on urban designs, from the street-level where the urban conditions actually exist?

This phase of the research was divided into two parts.

Phase 2a: Corresponds to research question 4.

To define the top-down implemented rules through which compact city qualities would be achieved, a pilot study was conducted. This study used a survey, which was carried out to capture citizens' priorities concerning choice of residence in relation to compact city qualities (Appendix 6/Paper 2 and appendix 7).

Phase 2b: Corresponds to research questions 4,5 and 6.

To address research question 4,5 and 6, a concept for a collaborative urban design tool was developed, aimed at using augmented reality technologies. Such a digital app seeks to facilitate experimentation on how rules can be implemented in study sites, both pre-set top-down rules and bottom-up rules generated through collaboration processes (Appendices 8 & 9).

Details of the applied methods can be found in the summaries in Chapter 6 and in the respective appendices.

Chapter 6.
Results

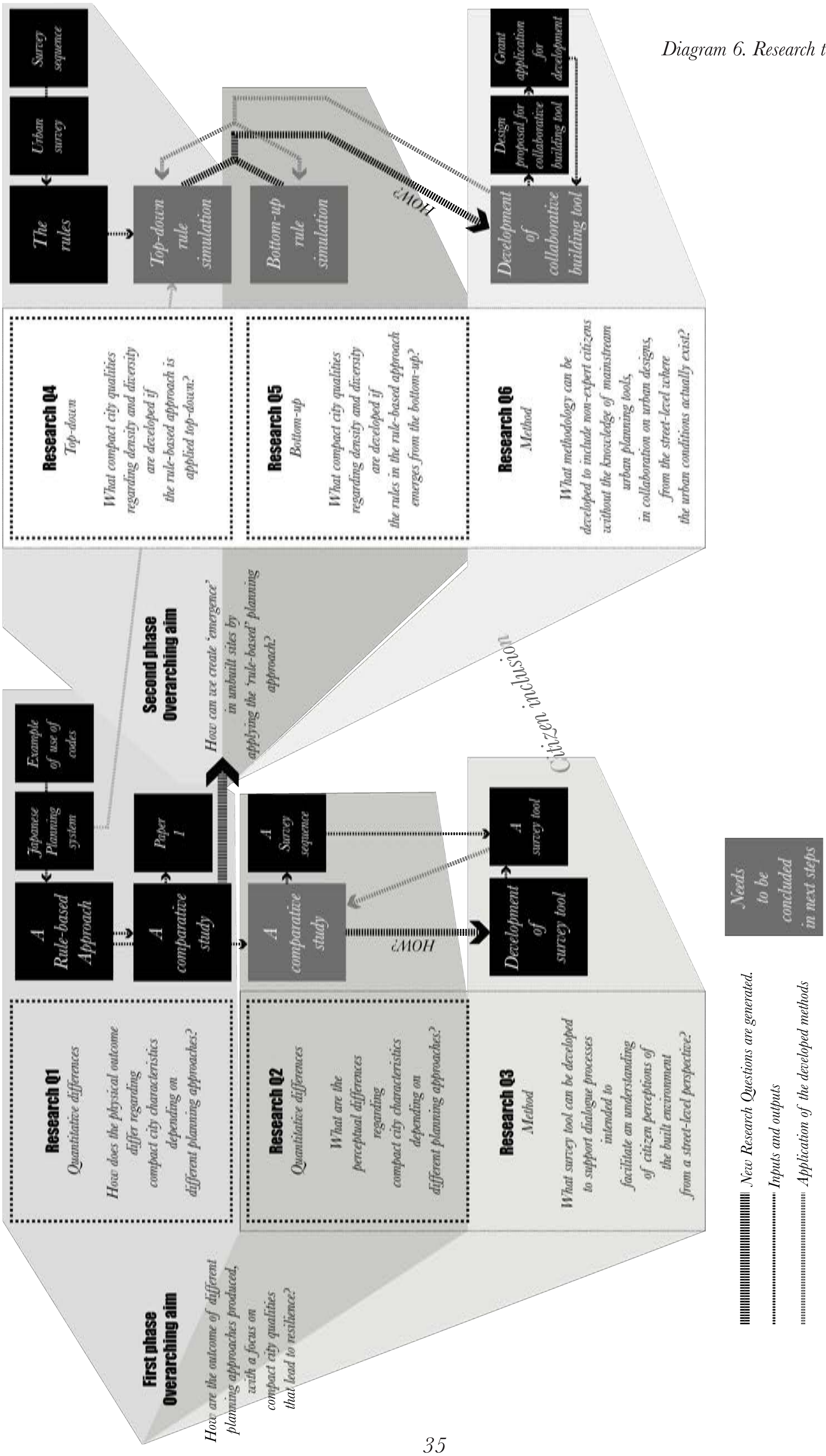

Diagram 6. Research trajectory

This chapter outlines a short summary of each appendix. Because the research is still ongoing, not all of the initiated explorations have generated full results. The complete results of all of the research projects developed during the second phase will be presented in the PhD dissertation that will follow the present licentiate thesis.

Phases		RQs	Appendices	Format	Appendix No.
1	a	1, 2	*Japanese planning system summary*	*Booklet*	*1*
		1, 2	*Example process of planning on site in Tokyo*	*Documentation*	*2*
	b	1	*Compact cities are complex, intense and diverse but: Can we design such emergent urban properties?*	*Paper 1: Accepted for publication in Urban Planning 1(1), 2016, Cogitatio*	*3*
	c	2, 3	*Urban CoMapper App*	*Mobile web-app*	*4*
		2, 3	*Urban CoMapper survey sequences and screenshots*	*Documentation*	*5*
2	a	4	*Identifying relevant design elements of compact city for portside residential areas*	*Paper 2: Manuscript*	*6*
		4	*Waterfront urban survey questionnaire - Documentation, addresses*	*Documentation*	*7*
	b	4, 5, 6	*Urban CoBuilder proposal*	*Documentation*	*8*
		4, 5, 6	*Urban CoBuilder grant application*	*Funding Application*	*9*

Table 1. Research phases, research questions and output

6.1 Japanese planning system summary (Appendices 1 & 2)

Corresponds to research question 1and 2.

The first set of research questions stimulated a process of identifying the existing urban planningsystem that could represent the ‘rule-based’ planning system, and deeper research into the mechanisms of those rules. As implied in a previous chapter, use of ‘codes’ in a rule-based planning approach are seen as generative and as potentializing emergence, thus prompting resilient urban structure. However, as criticized, some of the ‘codes,’ for instance, zoning ordinances practiced in the US, are seen as prescriptive, as seen in Euclidean zoning practice dividing up the urban fabric into single uses, and as a kind of reductionist approach to urban planning. To avoid a rule-based system that implements such debilitating ‘codes’ with respect to complexity perspectives, cities that apply proscriptive codes, or prescriptive (and) accumulative zoning ordinances as their ‘codes’ were prioritized. As a parallel trajectory for identifying a suitable case study city, cities with higher density and diversity and exhibiting a functioning compact city typology were sought after. Finally, the Japanese planning system was chosen as case of a ‘rule-based’ system with compact city qualities. The Japanese planning system employs inherently mixed-use, prescriptive and cumulative zoning ordinances, in conjunction with a set of ‘codes’ in the ‘Building Standard law’ that serve as additional guidance.

During 2013, a four-month-long research exchange took place with Tokyo University, under the supervision of Professor Hideki Koizumi from the urban engineering department, who provided an introduction to Japanese planning systems, mechanisms of rule-based approaches, and land-readjustment planning. Also during Professor Koizumi’s supervision, designed urban areas with a reductionist approach – so-called New Towns in Tokyo peripheries and their urban problems based on an inability to adapt to changing demographical conditions – were identified that could be used in the comparative studies addressing research question 1.

Two books about the Japanese planning system – *Urban Planning Systems in Japan* and *Urban Land Use Planning Systems in Japan* – have been summarized in a booklet. A sample case study of the design processes underlying implementation of the rules has been outlined, from the processes of site analysis through the zoning codes and design implementation of the code from the Building Standard laws.

6.2 Compact cities are complex, intense and diverse but: Can we design such emergent urban properties? (Appendix 3)

Corresponds to research question 1.

This paper investigates research question 1. The compact city has been promoted as a response to urban challenges by global, and local policies. While the benefits of compact city qualities, such as diversity and density, are evidenced in some studies, others contest by showing the detrimental effects of these qualities. Examining the planning processes that generate the beneficial qualities of a compact city, instead of focusing on the globally implementable parameters of density and diversity that prescribe a compact city, might be needed. This study investigates the urban qualities regarding the compact city properties of density and diversity of built scales.

Three indicators of compact city qualities – density, diversity of scale and distribution of diverse scales of built objects – were assessed through analysis of building footprints. The assessment was applied to the urban forms (the urban fabric) – emergent compact urban form (Type 1), designed dispersed urban form (Type 2), and designed compact urban form (Type 3) – to understand to what extent they result in dense and diverse urban properties. Both emergent compact urban form and designed compact urban form are expected to deliver some degree of density and diversity, while designed dispersed urban form can be seen as a control indicator used for comparison purposes.

The above three urban forms were selected in Gothenburg and Tokyo to allow comparison of the differences within and across socio-cultural and historical contexts.

In both cities, according to the building footprint analysis, the lowest density was found in the Type 2 areas, then Type 3 and the highest in Type 1. In Tokyo, Type 1 and Type 3 areas showed similar density, and in Gothenburg, the number of building units was similar between Type 1 and Type 3. The comparisons between the two cities showed that the highest and lowest density clusters were found in Gothenburg, while Tokyo had more even distribution of density between the types. Gothenburg also showed a higher number of unbuilt urban cells. In the building footprint scale distribution comparisons, smaller-scale buildings were found more frequently in Tokyo across all urban types. When examining the proportions of building footprint scales found in each of the cities, a gradual decrease in the proportions of smaller-scale buildings from Type 1 to Type 3 and then to Type 2 was seen in both cities.

The results showed that either density or diversity could be engineered through design, as shown in urban intensification contexts within both systems. However, none of the Type 3 study areas fulfilled both criteria. Delivery of demographic diversity also could be seen as an issue, with Type 3 areas of both cities displaying higher-than-average rental fees. The large-scale masterplanning of the large-scale affected area, even when incorporating phasing strategies and multiple actor involvement in planning processes, could be the reason for the lack of compact city characteristics resulting from incremental emergence.

6.3 Urban CoMapper - Compact mixed city (Appendices 4 and 5)

Corresponds to research question 2 and 3. In this study, the result is focused on research question 3.

The aim of creating compact urban form that is promoted by glocal policies is found in the programs and visions of urban intensification projects in Gothenburg. These projects involve active inclusion of multiple actors and stakeholders, with phasing strategies through collaborative planning of these areas. The physical urban outcome of these intensification projects showed both density and diversity properties different from those of emerged urban areas. While the emergent compact urban form properties seem to be more optimized for the beneficial qualities of urban resilience, as shown in previous studies, such as the agglomeration effect and adaptability through density and diversity, we lack knowledge about citizen perceptions of these urban forms, between the emerged compact urban form and the designed urban form with a compact city orientation, in relation to the qualities of density and diversity.

In order to conduct a citizen perception survey, a mobile-device field data collection tool was developed as a mobile web app. This tool deploys geo-location technology and GPS navigation installed on smartphones to conduct real-time, on-site perception survey mapping. The app uses open-source technologies and data, and utilizes open-source libraries with permissive licenses. The beta web app for Urban CoMapper-compact and mix city was produced; it can be found on a web-link. The beta web app (which was hosted at http://216.66.81.48:8080/urbaniaWebApp/density) was tested in a beta app test workshop with a test group in Gothenburg to examine the functionalities of the app, usability, and the limitations of perception survey workshop protocols, so that modifications can be made for the future workshop addressing to RQ2.

The explanation of how to use the tool was perceived as rather simple, but the sequences of the survey process and the survey criteria, regarding zoning of the area, were somewhat too complicated for the participants. The user interface for mapping the perception of density and diversity and the perception of negativity or positivity seems to be graphically simple enough for participants to use it intuitively. The GPS's delayed response was problematic, though not so great a concern that it could not be solved on site. The distance between the cells seemed somewhat too short to provide different perceptions of the site immediately.

The tool could be modified to shorten the survey processes. The participants' categorization of perceived zoning was too complicated and irrelevant given their misunderstanding of the terminology used. Also it seemed irrelevant to assess perceived zoning between the ranges of 100 meters. The study sites also need to be scaled down considerably. The problem of distinguishing the view 'from' the surveyed standing point and the view 'of' the surveyed point needs to be resolved.

6.4 Identifying relevant design elements of the compact city for portside residential areas (Appendices 6 and 7)

Corresponds to research question 4.

With compact city guidelines, glocal policies promote citizen participation during planning processes, the aim being to better reflect the local context and citizen needs. We have identified a shortcoming in previous compact city studies regarding citizen prioritization and consensus regarding compact city qualities. The paper addresses the lack of research on citizens' perceived priorities regarding compact city properties, and the lack of knowledge about the consensus between citizens concerning the terminology used in compact city promotion in policy guidelines.

The study involved conducting a web-based survey to identify citizens' priorities in choosing residences in waterfront areas in relation to the compact city qualities, using prioritization ranking and trade-off ranking methods. And open-ended questions, followed by a ranking and trade-off survey, asked the participants to define the terms used in the survey, such as 'nature,' and 'living close to X.' To understand prioritization of compact city qualities in a broader spectrum of socio-cultural and socio-economical contexts, the survey was distributed in Gothenburg and Guangzhou, the district Nansha, during April and May, 2015, to a total of 112 participants. The questionnaire can be found in Appendix 7.

The ranking overview of criteria for choice of residence showed that closeness to public transportation was the most important factor for choice of residence, followed by amount of rent. In this overview, closeness to nature, population density and visual qualities were considered rather unimportant. The trade-off survey showed unwillingness to trade off 'closeness to public transport' and 'closeness to utilities' for flood prevention installations. 'The size of the apartment' and higher population density were the factors that could be traded.
The citizens' definitions of 'nature' showed great variation in their perceptions, ranging from urban elements, such as trees on streets, recreational areas, to wild nature, such as the sea, whereas the second majority related to more wild nature, such as the 'forest' or 'sea.' The distance to X survey showed acceptable distances to work, transportation, and nature found within a maximum distance of 20 minutes on foot.

The survey result showing the prioritized concern for affordability over other urban qualities, such as distance to nature or urban visual qualities, reveals a shortcoming in current urban planning of high-end urban regeneration areas. The wide range of perceptions of the semantic meanings of terms often used in compact city policies for citizen consensus also points out some of the language-use issues associated with citizen participation. However, this survey shows a consistent level of priorities regarding certain urban qualities and preferred distance to urban elements, and these points need to be taken up and measures need to be taken to incorporate these priorities into the future planning of urban regeneration areas.

6.5 Development of Urban CoBuilder (Appendices 8 and 9)

Corresponds to research question 4,5 and 6. In this study, the result is focused on research question 6.

Previous studies on urban qualities as outcomes of 'rule-based,' and 'design-based' planning approaches have shown some differences regarding the compact city qualities, such as density and diversity, that are promoted by numerous glocal urban policies. In these studies, rule-based planning approaches seemed to deliver the compact city qualities that provide the benefits of emergent, adaptable capabilities. The provision of platforms that allow individual agents to act upon their own adaptive decisions, based on changes in urban conditions either caused by exogenous factors or by other agents' actions, seems to deliver the resilient characteristics seen in complex adaptive systems. I have identified a lack of knowledge concerning urban quality outcomes in relation to the 'rule-based' planning approach implemented in Gothenburg. In previous studies, the investigated 'rule-based' approaches have implemented top-down rules, and here we are interested in exploring both top-down and bottom-up rule implementation.

The concept of a mobile application for a collaborative urban design tool using Augmented Reality technologies was outlined and presented to Adlerberska stiftelsen in 2014. (Accepted application and design proposal can be found in Appendices 8 & 9).

This tool uses augmented reality technology to enable more information on space-time relevant citizen perceptions of existing urban conditions – information that is of use to participating collaborative citizens as builders of the affected built environment. The chosen study sites are to be demarcated using a 5 meter (w) x 5 meter (l) grid, and the participants are given a set of building cubes of 5 meter (w) x 5 meter (l) x 3meter (h) with varying functions – i.e. residential, commercial, services, culture, offices – that can be placed or stacked on the grids. The top-down rules can determine the number of playable cubes and the proportions of the functions given to a participant, the assignment of buildable cells in the grid, adjacent functions' stack-ability or placement (e.g., on top of a residential cube, a cultural function cube cannot be stacked), height restrictions, etc. With implementation of the bottom-up rules, a random change in rules can be determined by the participants sporadically during the process. In this regard, the rules are to be modified, if it benefits a participant. For instance, an increase in the height of the stacked cubes can be decided on the basis of, e.g., availability of the land space or locating a green space around the building. The concept also entails the possible implementation of rules that allow participants to modify each others' cube placements, by randomly giving a participant a chance to modify someone else's design during the process.

Chapter 7.
Discussion

Emerged urban areas, such as urban historical cores, often exhibit compact city characteristics that seem to be in accordance with the emergent complexity (density and diversity) necessary to achieve adaptable resilient cities (Jenks et al. 1996; Batty et al., 2004; Bettencourt, 2010; Scheurer, 2007; Batty & Marshall, 2012). Given the policies claiming that the compact city is a sustainable urban form (EU Commission, 1990, 2011; UN Habitat, 2011, 2014, 2015; OECD, 2012), initiatives to plan for such an urban form have been on the agenda for many cities, including Gothenburg (City of Gothenburg, 2014*a*; Rivercity Gothenburg, 2012). In Gothenburg, these initiatives often include two planning types as underlying mechanisms – 'planning by design' in conjunction with a 'planning by development control' – in the present thesis are conjointly labeled a design-based approach. Similar to the debate on the validity of 'sustainability' (Benson & Craig, 2014), such a top-down planning approach can be questioned, since it demands that we can have absolute knowledge regarding what parameters constitute a compact city (Neuman, 2005).

However, urban systems have also been studied as complex adaptive systems, and if we accept that they are such systems, then it is not the parameters that are the most interesting, but instead the processes leading to optimized urban forms regarding qualities such as density and diversity. However, even though the compact city seems to deliver the adaptive qualities of resilient systems through its density and diversity (Bettencourt, 2013; Glaeser, 2011; Quigley, 1998; Bettencourt, 2013; Carlino, 2007) at one point in time, this may just be a temporary state in ongoing resilient adaptive processes. Through such processes, we may eventually arrive in a non-compact urban form as an outcome of continuous adaptation. For instance, with continuous development of information technologies where the proximity of agents and access to information are not based on physical distance, the adaptive process may continue toward less compact urban forms, but still carry the resilience with it into the next century. If we consider the fact that the future is laden with unpredictable challenges and conditions, the resilient processes that allow adaptation become highly interesting. In the following sections, I will discuss the results of the studies (Chapter 7.1 – 7.4) and relate them to earlier research on different planning approaches, planning systems and urban forms (Chapter 7.5 –7.6).

7.1 'Codes' used in the Japanese Rule-based approach

To better understand alternative planning approaches to the current mainstream approach in Sweden – the 'design-based' approach – a study of a 'rule-based' approach was carried out (Appendix 1, and 2). The Japanese planning system relies heavily on the urban land use planning system, developed in 1919 (see Appendix 1). This system was established to support efficient urban activities and high quality urban environments by giving a set of rules concerning type of land use, such as residential, commercial, business and industrial uses (see Appendices 1 & 2). The system operates using an 'area division system,' where 'urbanization promotion areas (UPA)' and 'urbanization control areas (UCA),' e.g., demarcation of green belt, are divided and assessed by periodic reviews every five years, in conjunction with occasional reviews if they are needed. Land use zoning is conjointly used as an operating mechanism in UPA. This zoning system includes

12 wider categories of zones, with special land use districts (see Appendices 1& 2). The land use zones can be understood as a coding system, where set proportions of maximum floor area ratios and maximum building coverage ratios can be further combined to create unique variation within a given zone (see Appendix 2). If these zoning codes provide a sort of macroscopic pattern of the city, the building codes provided by the Building Standard law (see Appendix 1) – with 'slant plane restrictions,' 'restriction on floor-area ratio according to the width of the adjoining road,' and 'shadow restrictions' – will enable site-specific adaptation depending on the neighboring context, such as adjacent road width, distance to the site boundary, and in relation to solar angles (see Appendix 2). The consequently emergent outcomes based on the individual agents' adaptations or actions in relation to the local surrounding condition, without knowledge of the full consequences of these actions, are one of the properties required for CAS (Holland, 1992).

7.2 Compact city characteristics as a result of different planning approaches

Different planning approaches were studied in Gothenburg and Tokyo regarding compact city characteristics by using building footprint analysis (see Appendix 3/Paper l). The study showed that either density or diversity could be engineered through 'design by planning' in urban intensification contexts in both cities but that no such area could fulfill both criteria. The pre-masterplanning of the large-scale affected area, even when incorporating phasing strategies and multiple actor involvement in planning processes, could be the reason for the lack of compact city characteristics derived from incremental emergence.

One of the differences between the emergent compact urban form and the designed compact urban form was the building footprint scales. In both cities, representing the 'rule-based' planning approach and the 'design-based' planning approach, the proportion of smaller-scale buildings was found to be higher in emergent areas (see Figure 10 in Appendix 3/Paper 1). When comparing the results within the cities, they seemed to indicate that, in Tokyo, density could be engineered toward the emergent compact city type through design and that, in Gothenburg, building unit quantity could be engineered to some degree. The accumulation of smaller building units in close proximity in the emergent compact form is especially evident in the outcomes of the 'rule-based' approach. This might be understood as providing urban resilience, in the same way as resilience is seen from an economy perspective, provided by the diverse smaller businesses in proximity (Bristow, 2010). Such processes can be part of what Holling (2001) describes as a two-layer system: one system that operates with a slower and larger scale of adaptive cycles that secure, e.g., long-term environmental goals from top down, and one system with faster and smaller scale cycles that invigorate the system. In the small scale system, a set of small critical processes create and maintain the self-organization and small-scale buildings provide fast cycles of urban adaptation.

7.3 Urban CoMapper: Development of tools for bottom-up citizen inclusion

New tools to include citizens in the urban planning discourses were apparent during the studies addressing questions of citizen perception and inclusion of citizens in a collaborative planning approach. As a result, two types of tools were developed. The mobile web app Urban CoMapper (Appendix 4 & 5), was developed to capture perceptions of emergent compact urban form, and the designed compact urban form. Another tool using augmented reality technologies, Urban CoBuilder (Appendix 8 & 9), was developed for collaborative urban design simulation purposes.

The workshop held to test the usability/interactivity and functionality of the CoMapper tool provided valuable information on necessary modifications of the tool to simplify the mapping process. First, the participants' categorization of perceived zoning was both too complicated and irrelevant, given that they had misunderstood the terminology used, such as what is implied by 'residential zone' or 'commercial zone.' Moreover, it seemed irrelevant to assess perceived zoning within a range of 100 meters. The biggest problem was distinguishing the view 'from' the surveyed standing point and the view 'of' the surveyed location. When the participants held the device and looked around the site, they were perceiving what they saw in the distance, rather than the immediate surrounding site. This issue needs to be resolved through various tests, or better survey protocols, instructing them where to look. Another future approach could be to include the distance involved in assessing perceptions of built environments and to adjust the distance between the cells. It was concluded that the app can be developed to become a helpful tool in assessing perception. However, the problems with view points, simplified instructions, and distances between the cells need to be solved before a test with a larger group can be conducted to address research question 2.

7.4 Rules to create a compact city

To define what kind of urban qualities should be turned into top-down rules to create a compact city, a pilot study was conducted. This study used a survey to capture citizens' priorities concerning choice of residence in relation to compact city urban qualities (see Appendices 6, & 7). The survey results showed that, as opposed to visual characteristics or closeness to nature, level of affordability was one of the highest ranked priorities in the survey. This indicates some lack of accordance with current urban intensification area planning, where the average rental fees tend to be higher than the average for the city. As we have discussed in Appendix 3, 'designed compact urban form' areas in both cities showed certain characteristics of a compact city (i.e., density or diversity) but only one of the characteristics, not both simultaneously. Assessments of potential socio-economical diversity in these areas were made by looking further into the affordability. The average rent fee was higher than the average for the city. If we assume that compact city benefits are generated through the complexity delivered by density/proximity of diverse agents (Hong & Page, 2004; Bettencourt, 2011; Glaeser, 2011), then this may result in demographical segregation of certain economically viable groups of residents. It is rather common for residential units in a newly built neighborhood to be rather costly to rent or purchase, at least initially. However, the issue is the size of the affected site with higher rent levels. If the newly built units are spread out and sporadically or incrementally developed within a neighborhood, such economy-based segregation of demographics between the neighborhoods could be reduced. Thus, if we wish to design and plan for diversity 'within' a neighborhood, rather than creating an assemblage of diverse neighborhoods (even though this is also necessary), understanding the scale of a neighborhood could facilitate realization of such diversity-oriented neighborhoods.

UN Habitat (2014) defines a sustainable neighborhood as being characterized by vibrant street life, walkability with provision of industrial, administrative, and commercial services through mixed land use, and affordability of services, housing by promoting proximity and reducing costs, and building services for a diverse group of users (UN Habitat, 2014). The survey in Appendix 6 delineates the preferred distances to transportation, to nature, and to work. The results might provide some perspective on how far citizens are willing to walk to various destinations that might define a neighborhood. According to the survey distributed in 2015 (see Appendix 7), the responses to the question on the meaning of living close to nature, work or public transportation range between 5 – 15 minutes, which means a walking distance of 500 meters to 1 km. This distance range, where the participants prefer to have a transportation node, work and urban nature elements, is within the boundary of a compact city neighborhood for a walkable, lively streetscape (UN Habitat, 2014), defined as having things within a 15-minute walking range (Sastry, Pebley, & Zonta, 2002).

7.5 Smaller-scale urban regeneration in different planning approaches

The overarching aim of the thesis was to understand how the the outcomes of different planning appraoches are produced, with a focus on compact city qualities (density and diversity) that lead to resilience. Resilience is seen as a property that is derived from complex interactions between the diverse agents in proximity, where constantly adapting emergent state is generated throughout different scale levels. In urban context, the emergent urban form seemed to show the compact city characteristics with diverse and smaller scale agents (bulidings), compared to the designed compact urban form (see Appendix 3/Paper 1). The outcomes of the rule-based approach and the design-based approach also showed similar pattern of differences observed between the emergent urban form and the designed urban form, regarding the diversity and scale. Here in the following chapters, I will summarise some of the differences of mechanisms between the two approaches related to planning of compact city in urban regeneration context and see where the potentials lie in creating platform for citizen inclusion in the processes of developing the urban form.

7.5.1 Emergence

a. Design-based

Examining the construction masterplan of Eriksberg regeneration area (see Image 2), we can

Image 2.
Masterplan of West Eriksberg, provided by Västra Eriksberg

募集概要

物件概要	地区名	新宿区新宿六丁目						
	所在	東京都新宿区新宿六丁目						
	画地記号	画地A	画地B	画地C	画地D	画地E	画地F	画地G
	地番	312番1	321番11	329番4	315番28	1363番9	1370番1	1367番1
	譲渡面積（公簿）	95.73 ㎡	211.28 ㎡	75.83 ㎡	257.91 ㎡	103.03 ㎡	84.23 ㎡	137.16 ㎡
	用途地域	商業地域	第二種住居地域	第二種住居地域	第二種住居地域	第二種住居地域	商業地域	商業地域
	建ぺい率/容積率（指定）	80/600	60/400	60/400	60/400	60/400	80/700	80/700
	交通状況	都営地下鉄大江戸線及び東京メトロ副都心線「東新宿」駅徒歩１分から５分						
譲渡に係る手続き	募集要領配布方法	《配布期間》 平成24年10月10日（水）から平成24年11月7日（水）まで 土曜日及び日曜日を除く毎日午前９時30分から正午まで及び午後１時から午後５時まで 《配布場所》 〒163-1313 東京都新宿区西新宿六丁目５番１号新宿アイランドタワー13階 独立行政法人都市再生機構東日本都市再生本部 企画部アセット管理チーム						
	申込方法	機構所定の申込書及び必要書類を画地毎に作成の上、下記により画地毎にお申込みください。なお、申込みに当たっては、募集要領を十分御確認ください。 《申込受付期間》 平成24年11月6日（火）及び平成24年11月7日（水） 《申込受付場所》 〒163-1313 東京都新宿区西新宿六丁目５番１号新宿アイランドタワー13階 独立行政法人都市再生機構東日本都市再生本部 企画部アセット管理チーム						
	譲受人の決定方法	画地毎に上記申込みを行った方による競争入札を行い、開札の結果、機構が予め定めた価格以上の最高額入札者の方で、機構の定める資格基準を満たした方を譲受人として決定します。						
	開札日	平成24年11月8日（木）						
	譲渡契約・引渡し予定時期	平成24年11月下旬						
お問い合わせ先		〒163-1313 東京都新宿区西新宿六丁目５番１号新宿アイランドタワー13階 独立行政法人都市再生機構東日本都市再生本部 企画部アセット管理チーム （電話）03-5323-0418						

Image 3. Shinjuku auction information on parcels, and important dates, Urban Renaissance Agency, Japan, 2013. The process started in October 10th, and the the bid was awarded at the ned of Nov same year.

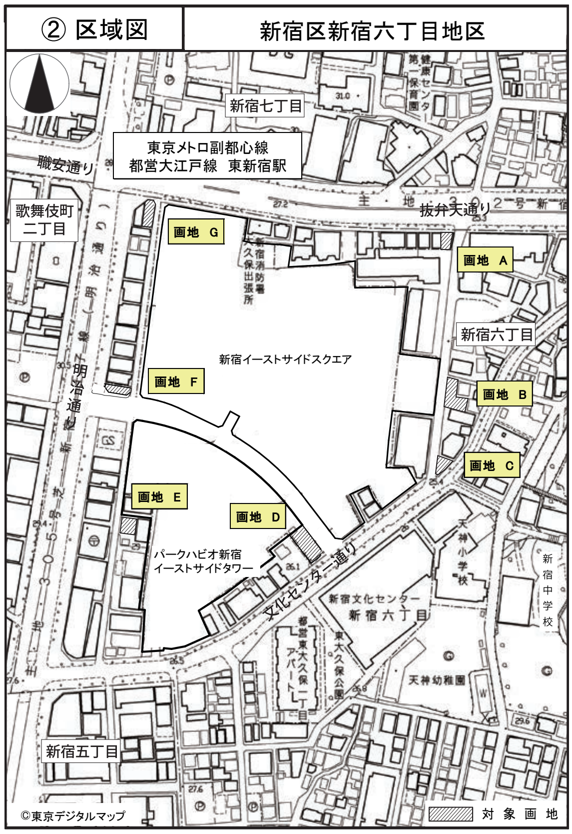

Image 4.
Shinjuku auction information. Urban Renaissance Agency, Japan, 2013 Shows the location of auctioned parcels.

observe the phasing strategy and multiple actor involvement. The construction phases last from 2008 to 2019, with a duration of 11 years in a somewhat mixed chronology within sporadically placed construction years. In this design-based approach, with rigorous detailed masterplanning indicating future locations, building designs, and construction due dates, we might consider that this designed incrementality, through phasing and multiple actor involvement (Gothenburg City Council, 2014*b*), is not aimed at 'emergence' through adaptability. 'Emergence' is recognized as a process of constantly unfolding a novel adapted stated through incremental transformation based on complex interactions, creating resilience through the processes 'growing out of a complex web of cause and effects, its inter-related parts interwoven through time' (Batti & Marshall, 2012, p. 24). In this sense, with a fully designed masterplan in place, it might lack the true 'incrementality' needed for adaptation beyond chronological 'incrementality.' There is a critical need for interdisciplinary/inter-functional combinations, and spontaneously emerging new trajectories of thought and innovation (Kanter, 1988; Youn et al., 2016); self-organization in various levels (Sanders, 2008; Holling, 2001); and non-equilibrium (Sanders, 2008) that to actually bring forth the resilience of a compact city. The research results presented in the present thesis indicate that this will not emerge through masterplanning based on predicted future outcomes. As Alexander (1965) claims, design cannot embrace the present complexity, due to human rationalization and compartmentalization thought processes,. Although 'planning by design' is necessary on a certain level, for instance for a house or a table (Marshall, 2012), to embrace the complexity present in urban development perspective it is necessary to rethink the scale of intervention. One way to deal with the scale of designed masterplan implementation can be seen in Tokyo, even if it was unintentional. Here, district improvement plans need the consent of 90% of residents to enact these detailed plans, and due to the difficult of generating this level of consent, the projects are often confined to very small parcels (Sorensen, 2002, p. 266-268).

b. Rule-based

The Urban Renaissance Agency, formally, Japan Housing Agency established in 1955, is a public agency merged with the Japan Regional Development Corporation in 1974, the Land Development Corporation in 1975, the Housing and Urban Development Corporation in 1981, and the Urban Development Corporation in 1999 (see Appendix 1). This public agency deals with extensive urban issues of regeneration, management of the housing environment, disaster area redevelopment, and development of suburban areas. The agency offers urban regeneration sites for sale through public auctions (see Image 3). The site parcels are sold individually with new zoning rules implemented to the site (see Image 3 & 4). The public notice for recruitment includes information on the auctioned parcels with a parcel size, in this case, ranging from 75.83 m2 to 257.91m2, with allowed zoning usage types: commercial and category 2 residential zones. The FAR and BCR are also specified in each parcel. This permits flexibility of agents' decisions on the usage of parcels, even though the 'codes' assigned to the parcels restrict certain unforeseen developments. These rules are the mechanisms used to control the macroscopic urban pattern with some level of predictability, at the same time serving as a basis for the flexible individual decisions of microscopic agents (Marshall, 2011). For instance, the category 2 residential zone permits residential buildings, as well as shops, offices, hotel buildings and karaoke booths of a certain scale (see Appendix 2). This inherently mixed land use zoning, coupled with the absence of detailed legally binding masterplans (see Appendix 1), creates quasi-infinite variable outcomes through actions taken by individual agents and based on their own rational choices, within the given rules and codes – all of which results in the macro-urban pattern.

7.5.2 Smaller living space to trade for compact urban form

a. Viability

Comparing the population density of the districts where emergent compact areas are located in both cities, we find 5,739 persons per km2 in Gothenburg (Gothenburg City, 2013), and 13,457 persons per km2 in Tokyo (www.demographia.com, 2005). If we compare the density of building footprints of the two study sites, Tokyo Type 1 has 25% built up area, and Gothenburg 31% built up area (see Appendix 3). With its higher population density, lower density of built up area, and higher proportion of smaller-scale buildings, how does Tokyo contain its population? Comparing bird's eye-view photos of both areas, we can clearly observe higher quantity of individual building units and parcels, and small parcels where new construction is ongoing, in Tokyo Type 1 area (see Figure 13 in Appendix 3). We can also count the number of buildings; 968 in Tokyo compared to 164 of Gothenburg (see Figure 10 & 12 in Appendix 3). The building heights in Tokyo vary greatly depending on the zoning assigned to the areas, however, the zoning parcels are segmented into small-scale parcels. How can a less built up area with smaller-scale buildings contain such a high population density? Given a lack of data on average living space per capita in the cities, the following can be assumed: 1. Diversity of building types and varying heights allow for taller building types in which the population can be contained; 2. Mixed smaller-scale types of rental units are provided.

b. Willingness

The survey presented in the manuscript entitled 'Identifying relevant design elements of compact city for portside residential areas' (Appendix 6) listed affordability as one of the highest priorities in choice of residence, and apartment size was given lower priority and readily traded for flood prevention operations. These priorities of affordability in the central waterfront urban regeneration areas, and the willingness to trade for a smaller apartment, shows a potential inclination toward achieving compact city properties, with social diversity through provision of affordable smaller housing within the neighborhood (UN Habitat, 2014). The larger land consumption per increased population due to sprawl (OECD, 2012) is a concern. And densely developed smaller living units contribute to a possible decrease in land consumption in built up urban areas per capita as the urban population increases.

7.5.3 So should we try a 'rule-based' approach in Gothenburg?: Urban CoBuilder

As shown in the 'rule-based' approach in Tokyo, where the codes are assigned top down through development control, the system could adjust the size of developable individual parcels, and assign zoning codes, depending on the urban conditions and future needs (see Appendices 1 & 2, Chapter 7.5.1b), and assigned codes allowed individual agents to react to existing conditions and make decisions that granted flexibility within restricted parameters (see Appendix 2). The causal relationship between the rule-based approach and the density and diversity properties shown in Appendix 3 – with higher population density, contained within smaller built up areas consisting of a higher quantity of smaller-scale building units – is not clear. However, in this present study, it was under the rule-based approach where the density and diversity urban properties were evidenced. This chapter concludes by discussing the potential of exploring this issue further by employing the rule-based approach in the planning site in Gothenburg, using the Urban Cobuilder tool, which is under development (see Appendices 8 & 9). The tool is expected to simulate spontaneous order (Page, 2011) that might emerge through individual agents (citizens) interactions with the built environment, through a process of adapting to new conditions that are generated by other agents (Holland, 1992), i.e. a new taller building next to one agents site. If the rules are implemented top-down, the agents' actions are restricted, and in this case, the rules would be set based on the aim of creating the compact city. With bottom-up generated rules, agents are reacting to changing conditions by changing the rules sporadically, in randomly chosen intervalls. The street-level interaction with the built environment, even though, it's only augmented, might further provide some insight into intuitively reacting to built environment and changing the condition (adaptation on site through action), versus planning or designing from top-down perspective.

7.6 Reflections on the methodologies

Regarding the study of density and diversity properties of urban sites in Paper 1 (Appendix 3), the method for measuring such elements lacks a 3-dimensional (3D) perspective on the density and diversity of the built environment, as well as on diversity in the form of urban functions. Both the 3D perspective and the functional diversity (mixed-use) included in the analysis would be valuable in determining, in more depth, the differences in terms of urban outcome between the planning approaches. Also, research on the historiographical incremental changes that have taken place, in both cities – such as changes in property ownerships or business types, and sub-division or merger of properties – could provide an incremental time perspective and an assessment of the speed of adaptability, especially during times of financial crisis. However, with further development, the methodology developed for building footprint analysis, i.e. raster image analysis and the vector polygon counting mechanism using open-source web-based maps, might facilitate this type of urban analysis of distant sites when documentation and data are not readily available.

Paper 2 (Appendix 6) comprised a complex procedure for designing the survey and distributing the survey in two regions on the globe: Gothenburg and Guangzhou. The survey provided genuine knowledge of how terminology we often use in urban planning aims and in descriptions of urban qualities can be perceived differently by different individuals. However, the survey could be modified further to narrow the scope to more concrete implementable design elements in small-scale urban regeneration sites. Given the difficulty in achieving consensus when participants have diverse objectives and perceptions as to what they are agreeing on, it would be valuable to develop urban surveys that limit such shortcomings through either word choice or re-designed choice parameters, thus improving the survey's performance. In the survey of tradeoffs between urban elements – for instance, between apartment size and closeness to nature – using a threshold of given values where the trade off is either acceptable or not would further improve the survey.

Image 5.
Baugespann. Example from Schönbühlring in Lucerne, Switzerland. (Retrived from https://commons.wikimedia.org/wiki/File:Sch%C3%B6nb%C3%BChlring_in_Luzern.jpg

Image 6.
Urban Cobuilder proposal for Masthugget, Gothenburg (see Appendix 8)

The development of Urban CoMapper and Urban CoBuilder was an attempt to devise a strategy to include non-expert citizens in urban planning or design during the dialogue processes. Proposed urban developments are often illustrated or made into scale models, or presented as development plans. However, '….simulation cannot replace a personal or real interaction, that is to say, a 1:1 experience of the critical object in urban space' –in virtual urban simulations– (Lehnerer et al., 2009, p. 126). Lehnerer further provides an example of 1:1 scale real-time and space simulation: the 'Baugespann (structural mockup)' (see Image 5) used in Switzerland and stipulated by law. Each new building project needs to be rendered beforehand depicting the actual dimension of new building projects, from a new window to a new skyscraper. 'Baugespann' democratizes citizen participation by allowing people to vote for or against based on the visualized outcome of a building project, using easy-to-grasp changes that are perceived directly on site. The tools Urban CoMapper and Urban CoBuilder (see Image 6) are both expected to facilitate visualization of projects and the consequences that are integrated into existing conditions for citizens not trained in deciphering plan drawings or 3D models, or any other measures using a medium to abstract urban conditions into a representation.

Chapter 8. Conclusions

If every person who makes an individual house, at the same time follows these larger patterns, step by step, and does whatever he can with the layout and placing of his house to help create these larger patterns too, then the town slowly gets its structure from the incremental aggregation of their individual acts (Alexander, 1979, p. 191).

8.1 Summary

In the present Licentiate thesis, a series of investigations have been carried out, each one leading to the next in an attempt to contribute to the overarching aim of the entire PhD project. The research aim was to try to understand how the outcomes of different planning approaches are produced, with a focus on the compact city qualities (density and diversity) leading to resilience.

The investigation was conducted to evaluate the physical/quantitative outcomes of different planning approaches regarding compact city characteristics (Appendix 3), and it devised a tool to explore the perceptual/qualitative outcome of these differences (Appendices 4 & 5). To better understand different types of urban planning approaches, we have selected the Japanese 'rule-based' planning approach (Appendices 1 & 2) as a comparative approach to the 'design-based' planning approach of Gothenburg. This has resulted in a second set of research questions asking what the outcome of a 'rule-based' approach would be in the Gothenburg context, through both top-down and bottom-up implementation of the rules. This would entail stand-alone planning by coding if the rules are generated bottom-up, and combination of planning by coding and planning by development control if the rules are set top-down, such as seen in the case of Tokyo.

During the final phase of these investigations, a key issue became what citizens' priorities are regarding compact city qualities: Which elements or qualities do they prioritize and which would they rather trade off? (Appendix 6 & 7). This was done to try to understand whether the designed compact city would deliver what citizens prioritize and to investigate whether there is a potential to use the survey as a consensus mechanism in defining the top-down rules for the second phase of the research. On a parallel track, a collaborative urban planning tool has been designed to explore the outcomes of bottom-up implementation of the 'rule-based' approach in Gothenburg (Appendices 8 & 9).

8.2 Conclusions based on the research questions and limiting factors

Paper 1 (Appendix 3) provided new perspectives on the lack of incrementality in designed urban intensification areas, especially regarding the lack of a spatial-temporal aspect of incrementality to ensure adaptability. This factor seemed to be a key issue in delivering sufficient complexity within a design-based planning approach, where urban intensification and regeneration sites are often designed on a larger scale. In a design-based approach, it was apparent that the top-down planning hierarchy, with detailed masterplanning through collaboration of consortiums, increased the rigidity of the urban structure, with pre-planned and pre-designed buildings on sites, even though its aim was to create some kind of incrementality through phasing. This study showed clearly how different parameters – such as timing, density, building scale diversity and planning operation modes, either centrally designed or decentralized – affect large-scale urban regeneration outcomes.

The Urban CoMapper app (Appendix 4), even though the investigation is still in progress, showed its potential as a mobile collaborative mapping tool that can document citizens' perceptions of urban space within the existing surrounding site context: acoustic conditions (such as traffic noise), urban dynamics (such as flows of people), and weather conditions, and other sensory perceptions of the built environment. For instance, if a perceived high-density area is also affected by constant traffic noises, the perception of perceived density might score negatively; likewise, if a perceived low-density area is rather unkempt and unattractive, it might also score negatively.

In Paper 2 (Appendix 6), identification of some citizen priorities regarding residential choice was carried out using explorative survey methods, both ranking the importance of, and trade-offs between, different urban qualities. The identified importance of affordability and the distance to public transportation and workplaces clearly indicated the factors that need to be considered in either the design of, or established rules for, a future compact city. The preferred distances to urban elements, such as to traffic nodes, nature and work, could be outlined. Perceptions of the semantic meaning of various terms denoting urban elements or qualities of the compact city seemed to differ widely, and this needs to be addressed when developing citizen participation platforms.

8.3 Future research

Given the identified benefits of the rule-based approach, where micro-agents are allowed to take a course of adaptive actions within a certain defined boundary (the 'codes') that controls a kind of anticipation of a macroscopic pattern, it would be meaningful to experiment further with this concept in the Gothenburg context. If we anticipate compact city qualities when using top-down implementation of the rules, what would we expect the developed qualities generated by individual agents to be? And if there is no such anticipation, only a certain existing context, how could the rules be changed through the collective interactions and adaptive actions of individual agents? Would this create a compact urban pattern with embedded complexity and resilience?

The Urban CoMapper app needs to be improved by incorporating user feedback, e.g. by removing a part of the questionnaire to redefine the zoning categories (see Appendix 5), and by concentrating the survey area on smaller parcels. Workshops need to be carried out and a comparative study needs to be performed to understand the perceptual differences between emergent urban form and designed-with-compact-city-orientation urban form, regarding perception of density, diversity and meaning.

The collaborative building tool in development, the Urban CoBuilder, uses augmented reality technology. This is done to test whether the outcomes of taking an action from a literal bottom-up perspective – from the street level with perceptual availability of the existing urban context – differ from the outcomes of top-down planning, where the existing urban context is abstracted through a medium as a kind of model, photos, and/or a set of illustrative texts or drawings. The Urban CoBuilder project also expects to bring the surveyed priorities (see Appendix 6) into the design of the top-down rules, which will be implemented during the collaborative planning sessions. The rules generated bottom-up are expected to respond to the changing site conditions during the planning sessions, through participants' own revisions of rules. This might provide insights into what the differences are depending on the method of rule implementation, and whether either the surveyed citizen priorities, such as distance to certain elements or affordability, would be contested or realized through any such implementations.

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Appendices

Appendix 1:
Japanese Planning System

1. Urban Planning systems in Japan

This is a summary of Urban Planning Systems in Japan (2nd. edition) published by Japan International Cooperation Agency in cooperation with Ministry of Land, Infrastructure and Transport in March, 2007. The tables and the diagrams provided in the booklets are modified from the original book.

A. 1968 Revised City Planning Law- legal framework of current Japanese urban planning

A-1 Background of 1968 Amendment:

1. 1960's rapid large-scale population concentration to urban areas
2. Sporadic fringe development encroached on farm and forest lands
3. Formation of poor quality urban areas, lacking in public facilities and infrastructure
4. Environmental degradation, lacking in proper separation of industrial zone and residential zone
5. Failure to develop sufficient infrastructure for rapid motorization

A-2 Objectives of 1968 Amendment:

1. Land use plans with legal power
2. Supply of building lots in new urban areas
3. Land Development Permission system-regulation and guidance of land use
4. Clarification of cost sharing between Public and Private sector on public facilities-promotion of public facilities development
5. Transfer of regulating powers of CPL to local governments- introduction of a democratic process

A-3 Substance of 1968 Law

1. City Planning Area	Area where CPL is applied. Not limited to boundaries of administrative division.
2. Policies on Improvement, Development, Conservation	Policies on the CPA (the future image of the city) are explained in a. Text b. Drawing(scale of 1:10,000)Not limited to boundaries of administrative division. Designation of a. Urbanization Promotion Area b. Urbanization Control Area
3. Urbanization Promotion Area(UPA) and Urbanization Control Area(UCA)	Prohibition of Building development in UCA Urban Planning Tax only levied in UPA Urban Development Project implemented in UPA
4. Zones and Districts	Land Use Zoning as a basis for regulation of land use and building form. Exceptions such as allocation of schools, hospitals, libraries, markets are dealt in City Planning of public facilities, nor in Land use Zoning. Regulations are not as strict as in some other countries. Compatible land use are allowed. Construction to conform with Land Use Zoning requirements according to the Building Standard Law.
5. Land Development Permission System	Formation of planned urbanized areas, requires building lot developments above certain size to be approved by local governments.
6. City Planning of Public Facilities	City Planning decides public facility areas. Building activities restricted in public facility areas approved sites, except for removable buildings. (The restriction may extend over several decades without compensation)

7. City Planning in Urban Development Project

Authorization given to public sectors to implement urban area development regardless intention of landowners.

It is composed of:

a. Land readjustment Project
b. Urban Redevelopment Project
c. New Residential Area Development Project
(Each projects are guided by separate laws)

8. Authorizing Body of City Planning and Decision Procedures

a) Authorizing Body of City Planning
Prefectures(Major or regional plans) and municipalities (others) decide City Planning.

b) Procedures for Regulatory City Planning
City Planning Decision Regulations restricts the rights of private property and necessitates democratic procedures such as l) public hearings, ll) public review of plans, lll) holding of City Planning Council are provided.

l) Public Hearing : Reflects the opinions of the residents in affected ideas concerning Alterations of the UPA, review of arterial roads

ll) Public Review of City Plans : City plans open to public for 2 weeks and requests public opinion

lll) City Planning Council : It's made up of a Prefecture, a Municipality, an independent committee

lV)Validation of Minister : Important matters such as trunk road more than 4 lanes with width of 18m or more requires Minister's validation.

A-4 Subsequent amendments of the 1968 City Planning Law

With eased concentration to Metropolitan areas in the 80's, redevelopment of urbanized areas, mitigation of environmental problems, revitalization of urban centres were main focus for amendments.

1. 1980 District Plan	Buildings and public facilities are decided in detail for specific areas in conjunction with the City Plan's main framework
2. 1988 Special District Plan for Redevelopment	Conversion of warehouses and factories by relaxed Land Use Zones- New land use provided by developers 2002 revision - Redevelopment Promotion District within District Plan
3. 1992 Taxation on Farmland as Urban Land use and Productive Greenery District	Promotes conversion of farmland within UPA to urban land use by increasing the tax rate of farmland.
4. 2000 Quasi City Planning Area and Public Participation	Imposes land use regulations with a District Plan to be proposed by a public participation system to municipality in areas where mixture of land use should be regulated but not necessary(a positive measure)
5. 2000 Strengthening of Master Plan for City Planning Area	Policies on Improvement, Development, Conservation is applied to the City Planning Areas. Municipal Master Plan system is established - municipality's vision, issues and policies in detail.
6. 2004 Landscape District	To realize better landscape, regulation of design, color,etc. of buildings are established.
7. 2006 Strengthening Regulations on Large-Scale Visitor-Attracting Facilities	Shopping complexes, theaters, etc.... with floor area of more than 10,000sqm are limited to some Land Use Zones.

C. City Planning Area, Quasi City Planning Area and City Planning Master Plan

1. City Planning Area	Designated macroscopically irrespective of administrative borders.	City Planning in CPA:
	a. Area needing Improved, developed and conserved as a unity with a core built-up area of a city, a town or village of certain scale. b. Area that needs to be developed and/or conserved as a new residential or industrial city.	a. Area Division b. Land Use Zoning c. Urban Facilities and Urban Development Projects d. Master Plan for CPA(policies on Improvement, Development, Conservation) must be determined.
2. Quasi-City Planning Area	Designated by prefecture government in the areas where future Improvement, Development, Conservation might be difficult due to disorderly development activities if land use regulation is not imposed.	
3. Master Plan for City Planning Area (Policies on Improvement, Development and Conservation)	Basic policy of City Planning specified by Prefecture government in all CPA as Guideline for City Planning for a 20-year planning period.	a. Target of City Planning b. If adopt Area Division, then policy of Area Division(UPA/UCA) c. Policy regarding Land Use, Urban Facilities and Urban Development Projects.
4. Municipal Master Plan(Basic Policies of City Planning in Cities, Towns and Villages)	Specified by each municipal government : Formulated in accordance with the Master Plan for City Planning Area Determines policies and visions to tackle local issues, urban facilities more in detail	

D. Urbanization Promotion Area(UPA) and Urbanization Control Area(UCA) System

1. Aim	Determines the size and shape of future urban area a. Efficient development of urban facilities b. Prevention of uncontrolled development in forest and farmlands adjoining existing built-up areas.	
2. Current Situation of Area Division System	Not applicable to all CPA Formally decided by national government, now decided on prefecture level Mandatory for metropolitan areas(295 CPA out of 1,271, March 2005)	Population has been controlled and urban sprawl no longer is an issue in Japan
3. Structure	a. l. UPA and ll. UCA	l. UPA : Built-up areas or areas prioritized for development in planned manner within a 10-year period. ll. UCA : Urbanization should be restrained.
4. Surveys Relating to City Planning	Despite that it complies 10 year planning objective, prefectures are obliged to conduct Basic City Planning Surveys every 5 years.	Covers current and future prospects on; population, industry, land use, transportation
5. Basic Principles in the Decision of Area Division	a. UPA to be integrated with Transport Network Plan and relevant public facilities planning b. Securing Planned Urbanization ensuring through Land Readjustment Projects on areas newly incorporated to UPA c. Coordination with Agricultural Administration in determining the conservation of agricultural land to secure good quality farmland	

E. Zones and Districts

1. Outline of the System	Land Use Zoning: regulates the use, density and form of buildings in guiding land use. Designated by City Planning.	Control of buildings : Building Confirmation(permit system) Content of the building design : Building Standard Law
	a. Land Use Zones : Designated in all UPA b. Special Land Use Districts : Complements Land use zones in specific areas c. Special Land Use Restriction Zones : Restrictions outside of UCA d. Efficient Land Utilization Districts, Fire Protection Zones, etc...: According to the particular objectives in specific areas	
1.1.1 Land Use Zones : 12 types of zoning	Provides land use control a. To ensure adequate environment for respective land use, also to promote effective economic activities b. Regulates relationship between building sites and protects favorable living environments.	Main methods of control : a. Building Coverage Ratio(BCR) b. Floor-Area Ratio(FAR) c. Shade restriction d. Height control e. Set back from boundary
1.1.2 Practice of Land Use Control Regulation in the Land Use Zones(LUZ)	LUZ is a means to control land use, not a plan. a. Implementation of LUZ to a UPA converted from UCA: l. Initial phase enforces tighter regulations such as Category 1 Exclusively Low-rise Residential Zone ll. Next phase will alter to allow looser regulation such as Neighborhood Commercial Zone after the planned urban area development is complete. b. Implementation of LUZ for areas with urbanization with mixed land use: l. Stricter regulation restricting urban activities are not realistic. ll. Looser regulations are enforced such as quasi-industrial zone.	

2.1 Other Land Use Zoning

2.1.1 Special Land Use Districts	Tightening or loosening of existing use by overlapping an exiting LUZ with municipal ordinances in specific areas.	Application EX: Areas where special traditional local industries and residential uses are intermingled, quasi-industrial zone is designated and in addition, a special industry zone is designated to protect the exclusive local industries.
2.1.2 Efficient Land Utilization Districts	To promote hight utilization of land, max/min FAR, Max BCR, Min building area,etc. are specified. In case of overlapping with LUZ, formal prevails.	Application EX: Small subdivided building lot in center of city can benefit by small scale buildings(pencil buildings). To prevent this, ELUD is designated with minimum buildable site to encourage joint use of building sites.
2.1.3 Special Land Use Restriction Zone	Areas (outside of UCA) without designated LUZ, need restrictions on certain building types to prevent uncontrolled construction that hampers living environment.	Application EX: SLURZ can prevent Large-scale shopping complex, hotel, recreation facilities that attract large number of people overloading the public facilities. Factories, Pachinko parlour, karaoke boxes can be restricted to ensure favorable living environment.
2.1.4 Fire Protection Zones	Fire resistant structures along the arterial roads to keep as fire escape.	

F. The City Planning of Public Facilities : to be decided by City Planning

1. Types of Public Facilities	a. Transport facilities; roads, urban rail transit system, car parks, automobile terminals, etc..... b. Public spaces; parks, open spaces, plazas, etc.... c. Utilities; water, sewerage, electricity/&gas, etc.... d. Waterways; rivers, canals, etc..... e. Education and cultural facilities; schools, libraries, research facilities, etc..... f. Medical and social welfare facilities; hospitals, day care centers, etc.....	Includes facilities under jurisdiction of Ministry of Land, Infrastructure and Transport, and other ministries, developed by public and private sector.
2. Effects of City Planning decision on Public Facilities	a. Building activities can be restricted where public facilities are decided (City Planning Restriction) b. Land Expropriation Law c. Land owners decided land use plan in accordance with the facility plans	
3. Substance of City Planning Restriction	Building construction are not allowed in principle except for the cases of, a. Building no more than 2 storeys high without basement b. Main structure is simple; wood, iron frame, concrete blocks	Concerned land owners should comply for public interest without the need for compensation.
4. Characteristics in City Planning Decision of Public Facilities (Example of Roads)	a. Principle : Transport facility plans are prepared to manage traffic forecast based on land use for the following 20 years.	
	b. Roads Subject for City Planning Decision	l. Main Arterial Roads : regional, intercity ll. Arterial Roads : Major intra-urban traffic between city and adjacent areas lll. Sub-Arterial Roads : Traffic to/from the arterial roads. Vll. Access Roads(Local Roads) : Roads forming the urban block, direct access to/from building sites.

	c. City Planning Decision in Existing Urban Areas	March 2005, 34,600km out of planned 73,900km in existing built-up areas has been completed.
	d. Interface with Land Use Planning Coordination between land use planning and traffic planning	Location, road width, etc..... are designated with current and future land use condition of the area in consideration through Urban Redevelopment Projects, etc.....
5. The Situation of Decision of Public Facilities in City Planning	Roads, Parks, Sewage system are decided as public facilities in City Planning, and should be developed in UPA.	Table 6-2 completion of planned works

G. District Planning

1. Outline

District Plan System aims at detail planning for building and neighboring public facilities and access roads, etc.... in specific areas.

a. Subject Area for Planning : Space of daily living that can't be regulated within City Planning framework, e.g. LUZ, planning of public facilities, etc....
b. Objective : Formation and maintenance of high quality living environment, aesthetic urban scaping.
c. Legal Position of the System : Regulation of the intermediate areas that interface between individual building control(Building Standard Law) and Land Development System (City Planning Law).

Hierarchy of Planning System

Entire City
City Planning Framework
    Land Use Zones
    Public Facilities Planning
    Urban Development Projects
	Entire city for planning and control

Intermediate Areas
Detailed Land Use Plan System
    Small Scale Urban Facilities
    Restriction of use, Shape,
    Design of Buildings
    Structure of Fence
    Conservation of Trees
	Specified area for planning and control

Individual Sites
Individual Building Control according to Building Standard Law
    Structure
    Form
	Individual site for control

2. Background of the System

Guideline to lead small-scale developments that does not require application under the Land Development Permission System.(As with German B-Plan: It is obliged to follow the detail plans)

Shift of interest from income increase and efficiency to formulation of pleasing living environment.

3. Characteristics of the System

a. Decision Procedures	Procedures set by each municipality. Opinions of land owners are more relevant in formulating the district plan.
b. Contents for Decision	l. Designing of Buildings, ll. Structure of fences of houses, lll. The location of access roads, etc....
c. Enforcement Method	Enforcement of regulations is guaranteed. Reporting of plans to the mayor who may recommend alteration
b. Current Practices	Residential areas through Land Readjustment Projects Difficult in urban sprawl area to obtain consensus

H. Utilization of various kinds of District Plans according to Purposes : District Plan System has various patterns of regulation depending on cases

1. Redevelopment Promotion District	To attract projects in under-utilized areas or certain scale, deregulations and changes or land-use regulations are implemented.
2. Large-scale Store Development Promotion District	Easing the land-use for large scale shopping facilities. Should be integrated with infrastructural planning.
3. Public Facilities Development Promotion-type	For underutilized area due to the lack of public facilities.
4. Urban Housing Development Promotion-type	To promote inner-city habitation, FAR are eased to attract housing projects in inner city areas.
5. Building Shapes Coordinating-type	To create orderly urban landscape and to provide certain width to roads. Setback and height regulations are strengthened.
6. Disaster Prevention Block improvement District Plan	Determines public facilities development and restrictions on buildings for the purpose of disaster prevention.
7. Other Variations	FAR Transfer-Type, Efficient Land Utilization-type, Roadside District Plan, Rural District Plan

I. Urban Development Projects System:
For public sector to be able to carry out development projects regardless of landowner's will for public interest

1. Background of the System	a. Needs to Enhance Land Use Efficiency: to promote housing in rural UPAs and high-rise residential buildings in central areas as well as to provide sufficient parks roads to old factory sites, etc..... b. Fractionated Landownership: To implement development projects in the areas with fractionated land ownership to prevent urban sprawl. c. Efficient Development of Roads Decided in City Planning: Part of the benefits gained by urban development projects are allotted to road constructions.
2. Type of Urban Development Project System	a. Land Readjustment Project System (1954): Re-plotting Measure in existing built-up areas with urban sprawl in progress. Provides the landowners with equivalent land after the project and it's compulsory. Development of public facilities and building lots. b. Urban Redevelopment Project System (1969): Right conversion measures involve transferring rights on land and building to the equivalent one on the floor of newly constructed buildings in the project area. This is also compulsory. c. New Residential Area Development Project System (1963): The system uses land expropriation measures for development of larger scale residential area development in suburban areas of large cities. Started used in the 60's and 70's.

3. Restrictions of Personal Rights in Urban Development Project System	a. Building constructions and levelling of land is restricted once the Development Project is determined. Restrictions are same as determined for areas designated for city planning for Public Facilities. b. When the project implementation plans and conversion of land rights are approved, al the building activities are subject to governor's permission. c. Project implementing bodies are, local governments and public corporations. Status of public corporation and project executing authority are given to cooperatives formed by landowners for Land Readjustment and Urban Redevelopment Projects.
4. Characteristics of Urban Development Projects Designated in the City Planning	a. Specific and practical mechanism of transfer of rights. 'Re-plotting' vs. 'transfer of rights'. Cooperative composed of landowners can be formed to implement Urban Development Projects instead of public bodies. b. Infrastructure Development by Development Benefit All or part of increment values of land by lot developments can be allocated for public facility developments.

J. Land Development Permission System

1. Outline	a. Developers must apply for permission from prefecture government for development of certain scale. b. If the plans satisfy the permission standards, project is permitted. c. In UCA, Plan should be consistent with the criteria of the location.	Scale where permission is necessary: l. City Planning Area A. UPA: 1,000m2 or more B. UCA: All projects C. Area without division: 3,000m2 or more ll. Quasi City Planning Area : 3,000 m2 or more lll. Other Area : 10,000m2 or more
2. Development Standards (Technical Standards) Local government might change the standards if necessary	a. Aim of the standards	l. Proper Location of public facilities; parks, roads, schools ll. Structural safety; foundation, retaining walls.. lll. Environmental quality control vl. Water and sewer system design control
	b. Detail specifications on roads and parks	l. Roads in the plan area should be connected with 9meters or wider road. Intra-circulation roads should have min. 6m in width with two-way access. ll. Total area of open space should be min. 3% of plan area.
3. Permission Criteria in UCA	Development of facilities for agriculture, fishery and forestry.	
4. Development Issue between Developers and Public Facility Managers	a. Construction or improvement of access roads b. Compulsory development of educational facilities c. Development and conservation of parks and open spaces	
5. Cost Sharing of Public Facility Development	a. UPA	l. Public Sector: Arterial roads, sewerage, large-scale parks ll. Private Sector: Access roads, drainage system, small parks designed for residents within the project area
	b. UCA	l. Public Sector: None ll. Private Sector: All public facilities
6. Issues of Piecemeal Development	To avoid cost of public facility development and to shorten project period, developers tend to engage in smaller projects falling below the requisite for Land Development Permission System. Local governments are allowed to lower the min. area requisite to 300m2 for LDP to avoid uncontrolled small-scale developments.	

K. Procedure for City Planning

1. Deciding Body of City Planning

	a. Area Division	b. Land Use Zones	c. Public Facilities: l.Roads	c. Public Facilities: ll. Parks and Open Space	c. Public Facilities: lll. Sewage	d. Urban Development Projects: l. Land Readjust-ment Project	d. Urban Development Projects: ll. Urban Redevelop-ment Project	e. District Plan
l. Prefecture	All	Tokyo, Osaka Nagoya	National-, prefecture Roads, Express-way Municipal Roads (4 lanes or more)	National Parks, Parks larger than 10 ha	Watershed-wide Sewerage system	More than 50 ha	More than 3 ha	None
ll. Municipality	None	Outside of Metropolis	Municipal Roads (less than 4 lanes)	Other parks and open spaces	Public sewerage system	Less than 50 ha	Less than 3 ha	All

2. Intervention of the National Government:

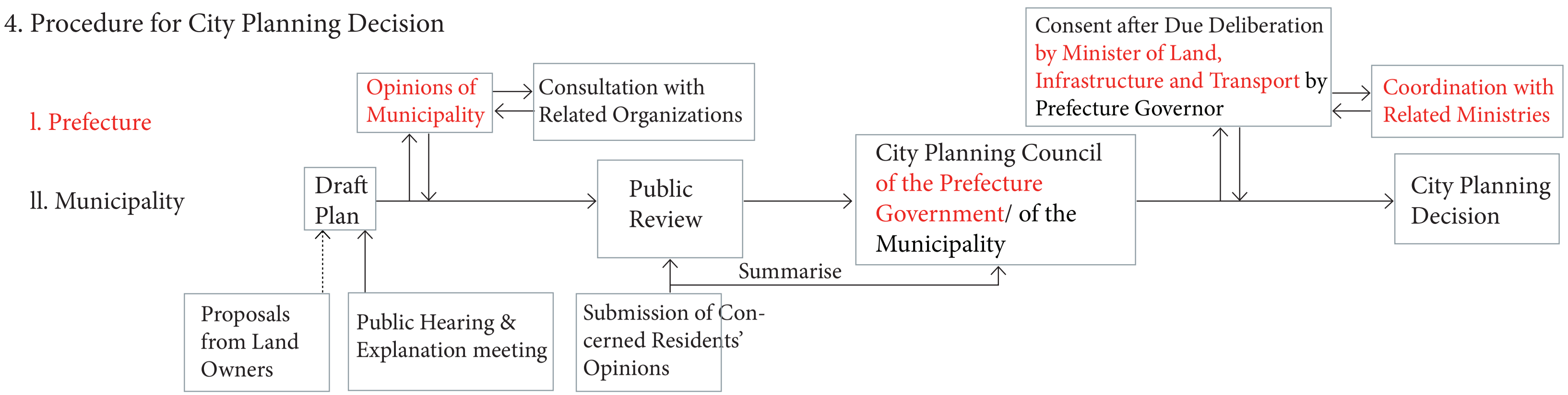
Consent after due deliverance by Minister of Land, infrastructure and Tansport

a. Area Division of UPA and UCA in City Planning Area
b. Large-scale public facilities
c. Large-scale Land Readjustment Projects(larger than 50 ha), Urban Redevelopment Projects(larger than 3 ha)
d. Land Use Zones in cities with pop. 300,000 or more)

3. Consensus Building in City Planning procedure

a. Public Hearing and Explanation Meetings
b. Public Review and Feedback from the Public
c. City Planning Council of Local Government
d. Coordination with Related Agencies

4. Procedure for City Planning Decision



L. Project Approved in City Planning

1. Outline : A system for Projects Decided in City Planning to be realised

Procedure of Plan Implementation for City Planning Projects

Plan Decision (Public Facility Development and/or Urban Development Projects →	Project Validation →	Administrative Action to Implement Project
a. Development activities of land for housing and building construction are restricted. b. Neither land purchase nor actual construction takes place.	a. Vested right is given to a developer to purchase land b. Landowners within project area shall have the right to inverse possession of their property	a. Demolition of existing structure for the purpose of implementation becomes possible b. Compulsory Land Expropriation possible

2. Implementing Body	a. In principle, City Planning Projects are executed by municipalities after approval by the prefectures. b. All Urban Development Projects are implemented as City Planning Projects under the City Planning Law.	
3. Effects of Project Validation	a. Implementing body have rights as;	l. Exercise of Compulsory Land Expropriation ll. In project area, development activities are prohibited. lll. When property within project area are conveyed to another party, the implementing body has first rights to purchase at the same price as third party
4. Administrative Enforcement of Project Law	The procedures and system of proper rights conversion are specified in Project Laws	
	a. Land Readjustment Project (Land Readjustment Law)	l. Restriction of constructing structures which may obstruct execution of projects. ll. Relocation and removal of buildings which obstruct lll. Compulsory transfer of rights on real estate vl. Account settlement upon re-plotting
	b. Urban Redevelopment project(Urban Renewal Law)	l. Restriction of constructing structures which may obstruct execution of projects ll. Compulsory transfer of rights on real estate lll. Account settlement upon the rights-conversion

2. Urban Land Use Planning System in Japan

This is a summary of Urban Land Use Planning System in Japan (2nd. edition) published by Japan International Cooperation Agency in cooperation with Ministry of Land, Infrastructure and Transport in March, 2007. The tables and the diagrams provided in the booklets are modified from the original book.

A. Structure of Urban Land Use Planning System

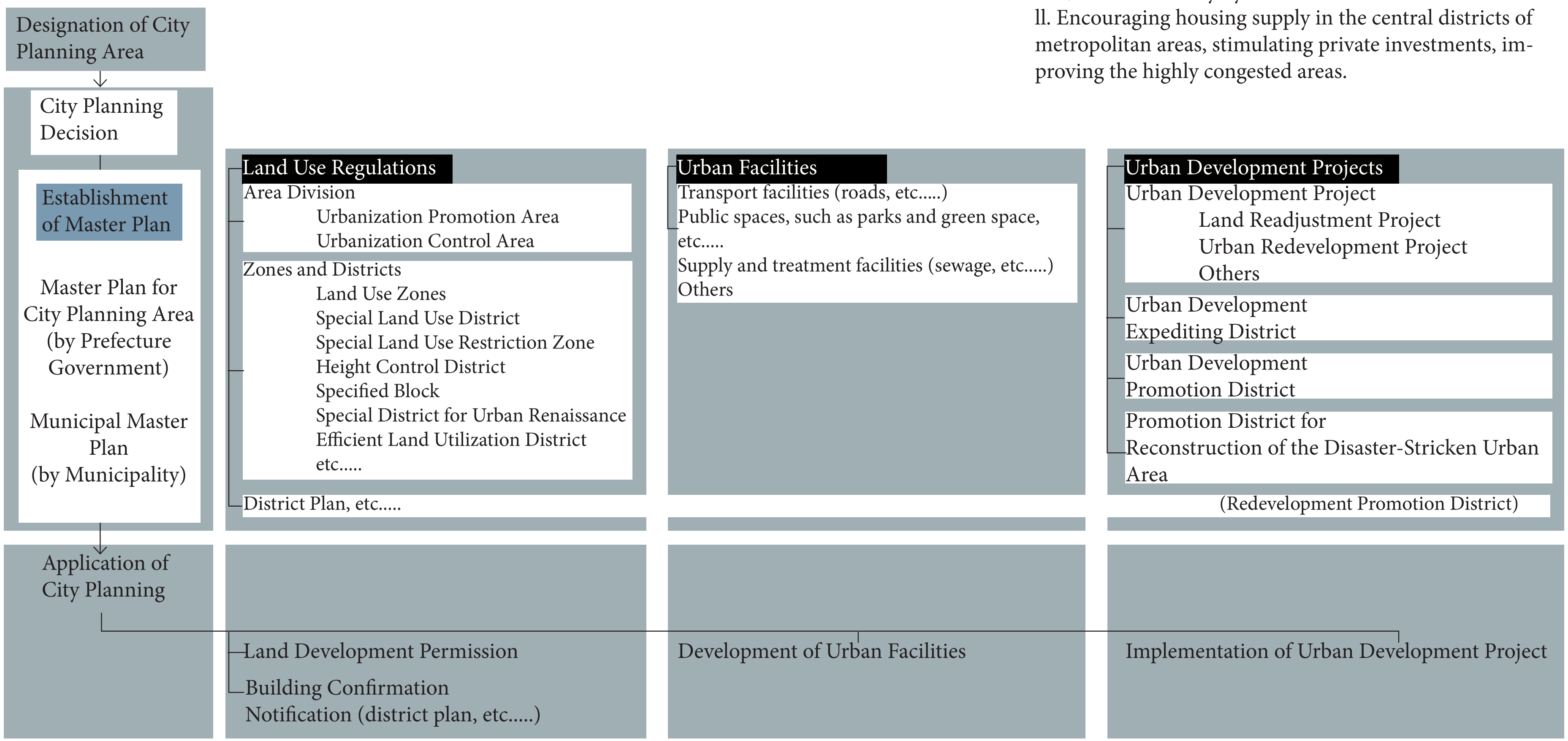
1. Characteristics	a. Categories of zoning	l. Area Division into Urbanization Promotion Area(UPA) and Urbanization Control Area(UCA) ll. Land Use Zones with 12 categories lll. Additional zoning categories vl. District Plan
	b. Enforcement Measures	l. Land development Permission: Controls conversion and physical transformation of the 'land' ll. Building Confirmation: Controls density, use, height and so forth of each building lll. Land Development Permission works in restriction of development in Urbanization Control Area. vl. Building Confirmation ensures various codes on buildings such as, Land Use Zones regulations v. Administrative recommendation is used for District Plan
	c. Land Ownership	l. Each lot is small and formless with many owners in a small district. ll. Land Readjustment Projects and the Urban Redevelopment Project play great role in planning.
	d. Differences from European system	l. Land use regulation,urban development and building construction is NOT controlled by Law, but controlled as area where land use zoning is designated through planning procedure. ll. Development is originally controlled by the Law and planning judges weather to permit or not. lll. European system: 'No development without planning' vl. Japanese system: ' No regulation without planning'

B. Components of Urban Land Use Planning

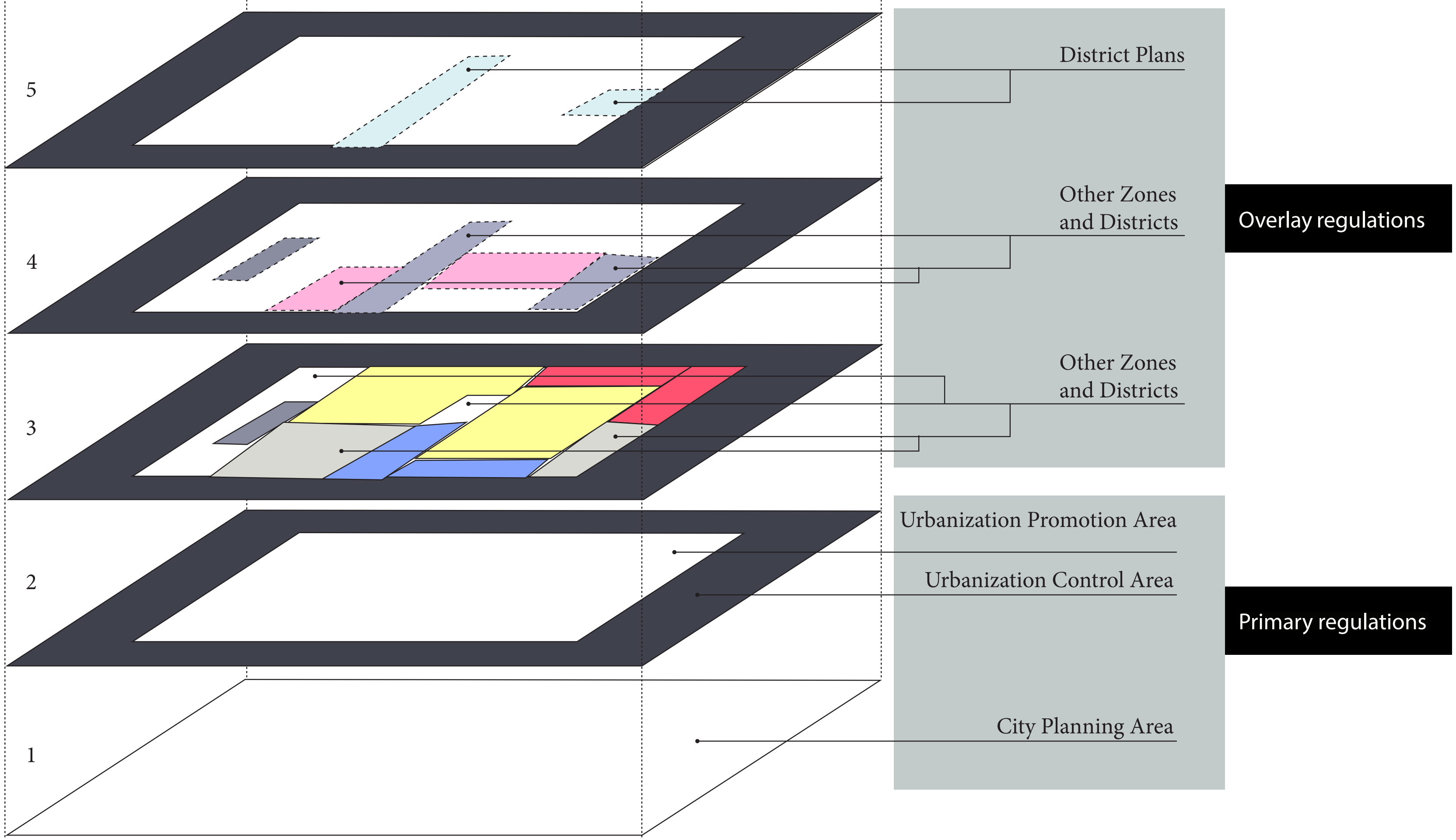
1. Aim	a. Establish order in land use in cities. b. Efficiency of activities or people and industries. c. To Protect quality of environment d. To create proper townscape e. BY APPLICATION OF REGULATORY MEASURES ON LAND DEVELOPMENT AND BUILDING CONSTRUCTIONS.	
2. Components	a. Visionary part: 'Master Plan'/'Comprehensive Plan'	l. Describes the basic policy of planning, ideal formation or urban areas, strategies for realization with current problems and future prospects in consideration ll. Japanese visionary part is insufficient and lacks specific directions in strategies.
	b. Regulatory part: 'Land Use Regulations'/'Zoning Codes'	l. Enforces regulations on each landowner and developer to implement the plan. ll. Complex due to expansion to cope up-to-date urban issues, such as; · Prevention of urban sprawl · Appropriate allocation of functional areas(resi dential, commercial,etc.) to accommodate shifting needs from industry based economy to service-based. · Promotion of efficient land use in city centers due to increased land price and disaster prevention
2. Scope of Urban Land Use Planning	a. Basic Land Use Master Plan is based on National Land Use Planning Law	
	b. Classifies land into five areas	l. Urban Area ll. Agricultural Area lll. Forest Area vl. Natural Parks v. Natural Conservation Area
	c. Urban Land User Planning is implemented in City Planning Area (a quarter of the national land area: 100,000km^2)	City Planning Area includes; l. Built-up areas (20-25% of City Planning Area) ll. Surrounding farmlands and forests lands that are protected from urbanization

3. Structure of Urban Land Use Regulation System

a. Area Division: Urbanization Promotion Areas(UPAs) and Urbanization Control Areas(UCAs)	l. Aim is to prevent urban sprawl, and efficient public investment.
b. Land Use Zones and Other Additional Zoning	l. Land Use Zone controls; use, density, height and shape of buildings. ll. UPA subject to be classified into 12 categories of LUZ. lll. Other zoning; Special Land Use Districts, Fire Protection Zones, Scenic Districts, Historic Townscape Preservation Districts, etc.....
c. The District Plan	l. 'Detail planning' system applied to areas of several hectars, initiated mostly by residents and land owners. ll. Encouraging housing supply in the central districts of metropolitan areas, stimulating private investments, improving the highly congested areas.



Structure of Urban Land Use Regulation System (the Principle Pattern)



C. Enforcement of Urban Land Use Regulations

1. Measures : Land and buildings are treated separately in real-estate market in Japan.	a. Land Development Permission	l. City Planning Law ll. Local governments reviews
	b. Building Confirmation	l. City Planning Law ll. Building Standard Law
2. Decision making in planning	Administrative bodies of; a. Municipal (75%) b. Prefecture (25%) c. Some Prefecture issues need consent from Ministry of Land, Infrastructure and Transport(15%)	
3. the Visionary Part of Urban Land Use Planning: Masterplan	a. Policy on Improvement, Devlopment and Conservation in the City Planning Area (Article 6-2 of the City Planning Law): · Masterplan document on planning policy is decided by Prefecture. ·Population framework provides basis for expan sion of UPA.	Subjects included are; l. Basic principles of city planning ll. Visions on land use lll. Urban development and redevelpment lv. Transportation systems v. Conservation of natural environment and public space vl. Development of Sewage and river systems vll. Development of other public facilities vlll. Urban area improvement programs lx. Prevention of pollution and improvement of environ ment x. Urban disaster prevention xl. Housing supply, etc.....
	b. Municipal Master Plan (Article 18-2 of the City Planning Law): ·Other type of visionary masterplan formed by Municipality ·Do not have sufficient power ·Encourages participation of residents	
	c. Policy directions of District Plan (Article 12-4 of the City Planning Law): Policy direction on improvement, development or conservation ·Goals of the district plan ·Direction on land use ·Direction on district facilities improvement ·Direction on buildings and structures improve ment	l. Urban Renewal Program: Trial on the visionary part of the City Planning (stipulated by Urban Renewal Law of 1980) ll. Urban Renewal Program is obligatory in 21 major cities

D. Characteristics of Urban Land Use Regulations

1. Contents	a. Basic regulatory measures for controlling land use with buildings b. Specific contents of regulation are in the Building Standard Law(not City Planning Law) c. Passive nature of Land Use Zones d. Utilization of land is at the disposal of land owners' right as the basic right of property.	l. Purpose of Building Standard Law : 'To safeguard the life, health, and property of people by providing the minimum standards concerning the site construction, equipment, and the use of buildings...,'-Article 1, City Planning Law ll. Passivity of LUZ can be observed: ex. Category1 Exclusively Low-rise Residential District 'to protect quality of living environment concerning low-rise housing' instead of 'making it'
2. Characteristics	a. Impartiality b. Minimum restriction c. Predictability	
3. Changes in the Urban Land Use Regulation System	a. Recent years, the system had to be modified deregulatory in response to improvement of the District Plan. b. Basic Land Act, 1988 : Guiding principles on the utilization of land: To safeguard public welfare during 'bubble era' Land Utilization promotion District was established on areas larger than 5,000m² where land is not utilized.	l. District Plan is originally modelled from Germany's Bebauungs Plan. ll. Land Use Zones system set minimum standards of buildings, while, District Plan, more procedural requirements are specified to incorporate landowners' demands.

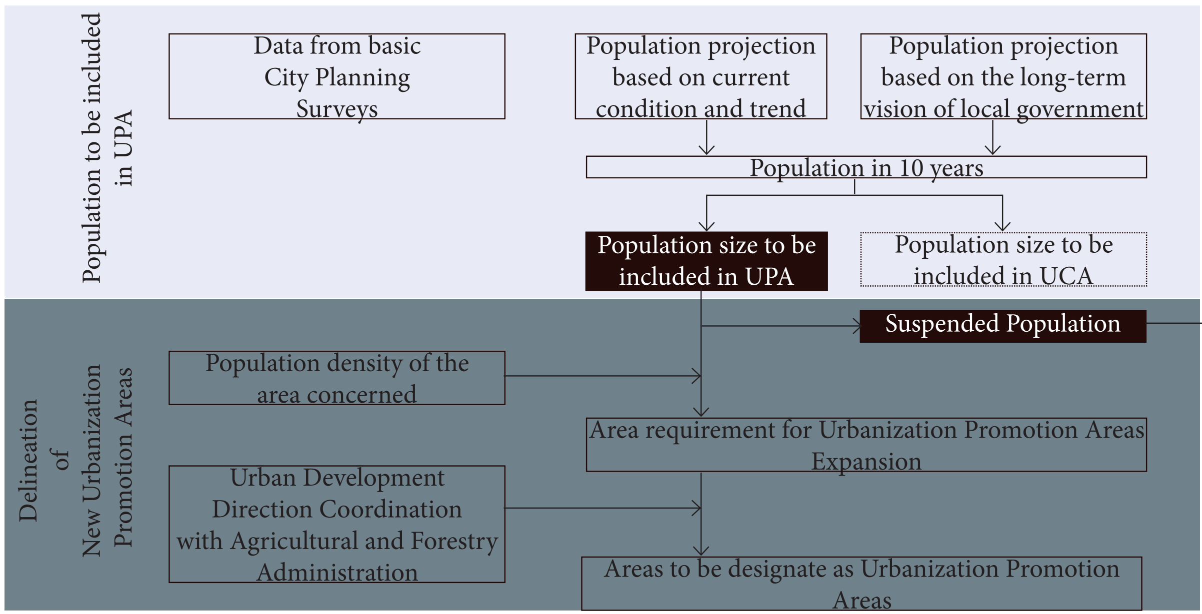
E. Controlling Urbanization

1. Preventing Disorderly Urbanization	a. The Area Division into UPA and UCA from 1968	l. To prevent urban sprawl caused by rapid population increase
	b. UPA	l. Farm land within UPA might be converted. ll. Public investments on infrastructure, facilities prioritised lll. Actively promoted vl. All areas of UPA is converted by Land Use Zones designation
	c. UCA	l. Urban development prohibited. ll. Public investments on infrastructure, facilities not carried out.
	d. Area Division	l. Periodically reviewed based on Basic City Planning Surveys and prospects on residential and industrial demand.
	e. 'Suspended Population'	l. Planning to control disorderly development and consensus building on expansion of UPAs.
2. The Purpose of the Area Division System	a. To avoid public financial burden	l. Prevent urban sprawl ll. Control shapes and sizes of land use allocation
	b. Efficient public investment	l. Concentrating public investments to UPA
	c. To induce private investments	l. Housing supply, retail and industrial development into UPA.
	d. To create functional urban form	l. Land Use Zones must be designated in whole area of UPA.
3. Background: Negative Impact of Urban Sprawl	a. Demolishes systematic approach of planning and development of infrastructure. b. Inefficient public investment c. Negatively affects agricultural activities due to fragmented urban developments in farm lands. d. Deterioration of green environment and inefficiency in public transportation.	
	e. Rapid and massive move to urban areas created urban sprawl during 60's and 70's.	The answer to the sprawl came as differentiation of UPAs and UCAs in 1968.

4. The Area Division System : City Planning Area into UPAs and UCAs	a. UPA : 'Areas that are already urbanized and prioritized for development within 10 years or so'	l. Public investments are promoted ll. Must be covered with Land Use Zone, regulating; Uses Density Shapes of buildings, etc.....
	b. UCA: 'Areas where urbanization should be restricted'	
	c. Area Division does not cover ALL CPA.	About 28% of the CPA that adopted Area Division is the UPA(as of 2005)
	d. Divisions are decided by Prefecture and validated by MLIT(Ministry of Land, Infrastructure and Transport) according to the Law.	
5. Development Permit	a. Purposes of development permit	l. Ensure quality for building site; safety of ground, road access and circulation, drainage and sewage, preservation of topsoil and trees, parks and greeneries. public facilities, etc..... (by City Planning Law) ll. To restrict urban development in UCA.
	b. Development permissions in UCA	l. 'Item 10-a': Until 2006, Developments over 20 ha. in UCA are permitted with the reason that the largeness of scale renders it as non- urban sprawl causing development type. ll. '43-1-6' : Until 2000, Confirmation of Original building lots
	c. Coordination with farmland policies	l.1969 : Improvement of Agricultural Promotion Area, overlaps with UCA, Non-agricultural activities are prohibited
6. Method of Designating the Area Division	a. Since the amendment of City Planning Law in 1968, within a few years, cities with more than 100,000 residents implemented Area Division. b. Every 5 years, Basic City Planning Survey is done by prefectures, which determines eventual expansion or reduction of UPAs.	

a. Step1: The ten-year population projection	l. Population projection within UPA: Existing density in the UPA Trend of population growth Trend of population increase caused by housing supply within newly developed areas ll. Population projection within UCA Natural population growth Housing construction on existing lot lll. Population increase not absorbed in UPA or UCA due to existing conditions- expansion amount of UPA UPA expansion=Exccess population x Current pop. density of entire residential area in target CPA
b. Step2: Selection of actual locations of UPA	Factors considered; l. Policy direction on urban development ll. Conservation area for farmland and natural environment lll. Prospect of urban infrastructural development

Process of Adjusting Urbanization Promotion Areas



Suspended population : An amount of population increase which needs to be allocated through expansion of the UPS, but this increase is not valid for UPA expansion during the time of periodic revision.

F. Allocated Suspended Population

1. Allocated Suspended Population	Spatial allocation has been determined. Ex. Land Readjustment Project is being developed but consensus is not sufficient at the time, thus the projected area is suspended as a UCA.	
2. General Suspended Population	a. Prevents uncontrolled private development b. Dynamic planning process with flexible operation to pursue a comprehensive development project. c. Comprehensive planning, such as, Land Readjustment Projects, New Residential Area Development Projects, industrial Area Development Projects should be implemented to prevent piece-meal development in UPA.	
3. Problems Related to Farmland in the UPA		
4. Evaluation of the Area Division System	a. Criticism for the excessive restriction of land owner's right. b. Large gap of land availability between UPA and UCA: inducing sense of unfairness among owners. c. Loopholes d. Land price speculations	
	e. With lower pressure to urbanize, controversial arguments are being developed. f. Amendment of Law in 2000, the obligation to decide Area Division was repealed except 3 metropolitan regions and large cities, but only a few prefectures abolished Divison System so far.	2 arguments: l. Deregulation policy: Urges strict regulations like UCA be abolished if the necessity isn't present. ll. Environmental management policy: Advocates importance of environment, landscape beauty, etc.....
	g. Large scale shopping centers has been constructed at the outskirts or suburban, and in 2006, commercial buildings of more than 10,000m² has been banned in areas with except in Commercial Zone..	'Compact city' policy prevails.

G. Zoning Regulations in Urban Areas

1. The Land Use Zones	a. Controls land use in built-up areas as basic zoning. b. All UPAs are covered. c. LUZ are shown as colour codes. d. LUZ has 12 categories.	l. 7 Residential categories (4/7 are exclusive) ll. 2 Commercial categories lll. 3 Industrial categories(1/3 is exclusive)
	e. Designates regulations	l. Building coverage ll. Floor area ratio
	f. Building Standard Law	BSL stipulates Max. height of the buildings by setting slant plane restrictions from l. Adjacent roads ll. Neighboring sites
2. Objectives	a. Prevent problems caused by mingle of uses b. Provide guidelines for allocations and rational density in zones according to future vision to ensure efficiency in urban activities.	
3. History of Land Use Zone System	a. Introduced in 1919 by City Planning Law and Urban Area Building Law b. First zoning system contained; Residential zone, Commercial zone and Industrial zone. c. In the 70's categories increased to 8 by introducing exclusive zones. d. 1992, further division of zones into current 12.	l. 1919, aimed to coordinate infrastructural development with private development. ll. 1970's amendment further divided industrial zones by FAR of working area. Use categories subdivided into a gradation of quality level of residential environment. lll. 1992 amendment's reclassification intends to restrict office and commercial areas within residential zones, with sky-rocketed price and demand for office spaces during the time which hollowed out the residential zone.
	e. Density regulation with FAR introduced in 1963. Before 1963, density was controlled by BCR and height restriction.	This gave flexibility in building design as well as providing solution in controlling traffic congestion.

4. Method of Designating Land Use Zones	a. Periodic review of LUZ based on Basic City Planning Surveys that cover City Planning Areas. b. Must be impartial. c. Modification is necessary when special planning within City Planning Framework, such as District Plan, is formulated. d. Lands with same conditions should be regulated equally.	l. 1919, aimed to coordinate infrastructural development with private development. ll. 1970's amendment further divided industrial zones by FAR of working area. Use categories subdivided into a gradation of quality level of residential environment. lll. 1992 amendment's reclassification intends to restrict office and commercial areas within residential zones, with sky-rocketed price and demand for office spaces during the time which hollowed out the residential zone.
	e. Density regulation with FAR introduced in 1963. Before 1963, density was controlled by BCR and height restriction.	This gave flexibility in building design as well as providing solution in controlling traffic congestion.
5. Procedure of periodic review of LUZ	a. Basic City Planning Survey examine current land use by local government. For commercial and office uses, forecast study is conducted.	1/2500 scale map is colour coded to show l.use, ll. number of floors
	b. Previous to revision, policy is authorised by City Planning Council for allocation of zones.	Classifies, CBD, sub-core areas to be developed as high-density built-up areas. 'Policies on Improvement, Development and Conservation'
	c. Land Use Review Guidelines compiled by Local government	Should contain detailed criteria for the judgement of modification of zones and its allocation.
	d. Draft revision of Land Use Zones. Needs not be implemented immediately to sustain stability and may further be modified after citizen opinions with legal procedure of public review and hearing	
	e. Spot revision not based on periodic revision needs to be justified. ex. Expansion of arterial road, implementation of District Plan, etc....	
6. Land Use Zones and the Building Standard Law : 'The paired Laws'	a. Building Confirmation process for building application are confirmed by Building Officials in local government or the private building inspectors from private companies based on the Building Standard Law.	Land Use Zone determines; l. Area ll. Category lll. Lot coverage vl. FAR vll. Minimum lot size Building Standard Law supplements with; l. Allowable use of buildings ll. Specific method of height calculation lll. Reduction of FAR, where applicable vl. Shadow Restrictions

	b. The system is not a mechanism intended to lead to a desirable use of land. Instead, the BSL ensures minimum standard of buildings, and LUZ protects minimum acceptable urban environments.	The height regulation are called 'slant-plane regulation': The height limit is higher inner core of the lot. The buildings need only to follow the regulations. The design within the 3D allowed space, 'birdcage' or 'building envelope' are completely free.
	c. The Land Use Zone : Allocates uses and densities in the city with positive intentions and defines principle characteristic of each district.	LUZ Specifies; use regulation, density regulation, lot coverage regulation and slant-plane regulation to avoid negative external impacts.
7. Other Zoning Regulations : Adopted to modify the use regulations in the Land use Zones.	a. Special Land Use Districts	l. Special Industrial District ll. Educational District
	b. Height Control District	
	c. Efficient Land Urbanization District d. Fire Protection Zone, Quasi Fire Protection Zone e. Parking Place Development District f. Port District g. Productive Greenery District h. Historic Townscape Preservation District	Promotes high density land use
8. Shadow Restriction	a. Introduced in 1976. b. Mechanism of Shadow Restriction: Shade caused by med-high-rise building to neighboring lots, the shading time between 8a.m and 4 p.m. measured at the height of 4 m(Category I, II and Exclusively Low-rise Residential Zone, the height 1.5m) on the day of the winter solstice must be longer than certain standard in proportion to the distance from the land boundaries.	

H. Promotion of Efficient Land Utilization

1. Efficient land Utilization and Urban Renewal	a. 'Efficient Land Utilization' by demolishing congested wooden structure in the metropolitan area and constructing high-rise buildings, providing effective open spaces in the lots. b. Incentive system as deregulation to induce forms of high-rise buildings, with contribution to improve urban quality with plaza or side walk constructions.	
	c. Urban Renewal Policy: Subject to City Planning decision , stipulated by Urban Renewal Law	l. Urban Renewal Program: Specific master plan focusing on urban renewal ll. Efficient Land Utilization District: Regulatory system with incentives lll. Urban Redevelopment Project: Enforcement measure with compulsory execution power by law.
	d. Redevelopment Promotion District: Converting abandoned sites to high-density mixed-use development area. e. Special District for Urban Renaissance: Introduced in 2002, available only in specific areas designated by National Government.	
2. The concept of Efficient Land Utilization	a. Consolidating small lots into a large lot, with fire-resistant high-rise-building and open spaces within the lot.	Traditional urban structure from Edo period(17th-19th) of narrow streets and low-rise wooden frame structure buildings
	b. To prevent wide-spreading fires. c. To relieve the limitation of intensity of land-use in densely congested areas.	
	d. Solutions that overcomes the problems;	l. Sufficient level of road widths, parks and squares ll. Relatively large site and buildings with fire-resistant structures lll. Public open spaces, plaza and sidewalks with amenities, are provided within the building lot.
	a. Extra FAR if the project contributes to improved urban environment, providing public open space	Initially introduced in New York as 'incentive zoning'
	b. Specified Block system by City Planning Law	Defines max. FAR, max. height, setback. Extra FAR is given with provision of public space
	c. Comprehensive Building Design permission system by Building Standard Law-simpler application	Upon application from developer, the local authority grants extra FAR on improved urban qualities

	d. District Plan with Floor-are Ratio by Use	Incentives for the residents for cooperating with the District Plan development.
4. Urban Renewal Policy Structure	Urban Renewal Law systematically implements policies to renew existing built-up areas of large cities and to promote a rational, sound and efficient use of land.	Measures for execution; l. Effective Land Utilization District ll. District Plan Systems as regulatory incentive measures lll. Urban Redevelopment Project

The Scheme of the Urban Renewal Law

Master Plan		
Urban Renewal Program	· Urban Area Designated by Item (Built-up areas where urban renewal is required) ·District Designated by Item (Districts where Integrated and comprehensive redevelopment is promoted)	
Regulation and Guidance		
Efficient Land Utilization District	· Restriction on inefficient land use; FAR bonus for incentives	
Redevelopment Promotion District designated in District Plan	· Drastic change of land use intensity in large-scale idle land, give incentive by raising FAR to induce comprehensive redevelopment projects with requirements on urban infrastructure development and high-quality design of the site.	
Projects		
Type 1 Urban Redevelopment Project	· Low-rate of the number of fire-resistant buildings · Property right exchange	Efficient Land Utilization Zones Redevelopment Promotion District Special District for Urban Renaissance
Type 2 Urban Redevelopment Project	· Area of urgent improvement for fire-disaster prevention · Eminent domain	

Regulation and Incentives in Efficient Land Utilization Districts

Maximum FAR	FAR more than the Land Use Zones regulation can be designated(incentive)
Minimum FAR	Prohibit low-density uses
Maximum BCR	Create sufficient open spaces
Setbacks	Provide Plaza or sidewalk that is open to the public
Minimum Building Area	Prohibit small-scale buildings

5. Urban Redevelopment Project	a. An active method of implementing intensive land use.	Implemented through the process of the City Planning with the power of execution granted by law.
	b. Special tax measures on property right exchange	Cost for research, design, and implementation is subsidized by the public sector.
	c. Only available in 3 areas; Efficient Land Utilization Districts, the Redevelopment Promotion Districts, and the Special Districts for Urban Renaissance	Additionally required conditions; l. Percentage of wooden structure is high enough for impaired spatial health and fire safety ll. FAR is too low for optimal potential utilization
6. Redevelopment Promotion District in District Plan	a. Redevelopment of large-vacant site to high-density use area with mixed-use complexes.	l. Land Use deregulation ll. Infrastructural developments
	b. Tries to use the 'Private Sector Vitality'	Encourage public-private sector partnership: Public sector deregulates, Private sector developed infrastructure
	c. RPD is viewed as conditional zoning. 'Conditional Planning System'	Ex: An industrial zone would have FAR 200%, with fulfilling the condition of development of public facilities, the FAR of 600% will be granted for the commercial or office use.

7. Special District for Urban Renaissance	a. A Further incentive system through legislation of the Special Law for Urban Renaissance from 2002. b. Short-term goal to get through post-bubble recession.	
	c. Scheme of Special District for Urban Renaissance in two parts;	l. Planning proposal by private developer: Private developers suggest a flexible district planning without the need to follow existing regulations. If the local government agrees, the City Planning Decision procedure need to be authorized within 6 months. ll. Deregulation on planning: Flexibility in use of regulations, and the 6 months legal deadline.
8. Transfer of FAR	a. For pursuit of high-density or preservation of land marks, FAR can be transferred between sites.	
	b. Conditions where the transfer of FAR are allowed.	l. Case when two or more buildings are regarded as built on the same site ll. Two or more buildings are planned subject to one integrated planning; · Specified Blocks consisting of two adjacent blocks covered by one planning strategy · District Plan for attaining the allocated density within the district ·The Special FAR Application Zone which is an exceptional measure of the Land Use Zones system

I. The District Plan

1. Characteristics	a. A statutory tool for comprehensive and detailed planning on a district scale. On average 10 ha, but ranges from 1-100ha.	
	b. Purposes;	l. Comprehensive planning on district scale ll. Participatory or collaborative planning with land owners and residents.
	c. Consists of a policy direction meaning a visionary part. d. Regulatory items are selectively used; density, setback, height, etc..... e. District Facilities are enforced in the Land Development Permission process. f. District Plan regulations are overlaid on primary zoning regulations, such as Land Use Zones or UCA.	
2. District-scale Approach vs. Town-scale Approach	a. District plan is a detailed and deliberate planning on District-scale Approach. b. Town-scale approach of Land Use Zones or Arterial Road Network Planning can't control the details or building designs or characteristics of district.	
3. Components of District Plan: 'Comprehensive but flexible approach'	a. Tools of District Plan	l. Structure of the documents: a visionary part called, 'Policy Direction' and regulatory part 'District Improvement Plan' ll. Variety of regulatory items
	b. 'Policy Direction' : Describes planning policy, future images or strategies without affecting legal rights to land sues.	Documents include; l. 'Goals of the plan': purpose of plan ll. 'Direction of land use' lll.'Direction of district facilities': Small roads, parks and open spaces vl. 'Direction of buildings': setbacks to enlarge spaces for pedestrian and design policy for landscaping
	c. 'District Improvement Plan' :	l. 'Locations of district facilities' : Uses documents with description of widths and length of roads and area of greenery and maps indicate the location. ll. 'Regulations on Building Design': Intended to control design of the buildings based on characteristics of district.
	d. Regulatory Items	Limitations of usage, min/max height, shape or exterior design, prohibition of certain walls, etc.....

4. Participation Framework	a. Responsibility of Municipal administration.	Drafting of plans done by, l. Municipal administration ll. Developers lll. Land owners, residents
	b. Municipal ordinances	l. Drafting procedure includes delegating the draft of collected opinions or relevant actors. ll. Selected regulatory items can be issued as municipal ordinances after the plan is determined.
	c. Participatory planning process	l. 'Through the 'request procedure' or 'Planning proposal procedure' ll. 'Building Agreement' : Private contract among its members. Bottom-up approach but not biding for all land owners, while District Plan is legally enforced.
5. Progress of District Plan System	a. District planning was introduced in 1980, influence grossly by German planning system, 'B-Plan'(Bebaunungs Plan), which enables 'planning regulation' as if building shapes were actually built.	District Plan system resembles the German system, while the Land Use Zoning system resembles the French system.
	b. Difficulties on legal aspects lied in relationship between District Plan and Land Use Zones, 'Tailor made' vs. 'Ready made' rules.	District plan was legislated as an additional regulation overlaid on the Land Use Zones and should not undermine the latter.
	c. In 1988, 'Redevelopment Promotion District in the District Plan', gave way to undermine the minimum requirements of Land Use Zones with District Plan based on different condition of infrastructures.	
	d. Theory of Equitable change of regulation.	1991, 'Urban Housing Development Promotion-type' was passed and in 1993, 'Building Shapes Coordinating-type' has been approved, which maybe repeal the slat line regulation by introducing setback line and height limits.
	e. Through adjustments and regulatory innovations, District Plan system was able to contribute to accelerating effective land use conversion from vacant industrial lands to high-density, mixed-use developments.	

J. Variations of the District Plan

District Plans

Type	Sub-type	Description
District Plan	Urban Housing Development Promotion-type	To supply residential units within commercial areas in central business districts, higher FAR is permitted for residential use
District Plan	Public Facilities Development Promotion-type	To guide efficient land use by offering two FARs. When a road is planned to be built, the higher FAR is designated.
District Plan	Floor-Area Ratio Transfer-type	To rationalize land use designation, FAR on existing Land Use Districts are finely allocated to subdivided districts.
District Plan	Building Shapes Coordinating-type	To align buildings along a road by front-setback and maximum height regulations, elimination of slant-plane regulation and application requirement of FAR according to the width of the front road of the building site.
District Plan	Efficient Land Utilization-type	To promote efficient land utilization securing open space, FAR is increased according to performance of public facilities.
District Plan	Redevelopment Promotion District	The plan guides a comprehensive redevelopment project with the excellent urban design. In case of the drastic land use conversion from abandoned factory sites or railway yards to high density mixed land use, the district is given FAR incentives on condition that constructing required urban facilities and others.
District Plan	Large scale Store Development Promotion District	The enable certain kinds of development such as large scale retail store with over 10,000 square meters in floor area.
Rural District Plan		For existing residential areas with unique characteristics of rural region in the UCA, the plan shall be prepared to guarantee good quality residential environment which is harmonized with farming conditions and for appropriate allocation of land use
Roadside District Plan		Along corridors of major arterial roads, where noise level from traffic is high, the plan shall be prepared to prevent noise pollution from traffic and to promote appropriate and rational land use.
Disaster Prevention Block Improvement District Plan		In the area where small wooden houses clusters close together with high density, the plan shall be prepared to improve vulnerable condition in case of earthquake by developing evacuation roads with more than 6 meters in width and with fire resistant buildings along the sides of the roads.

K. Recent Topics

1. Landscaping	a. Beauty District b. Historic Townscape Preservation District c. Scenic District d. Landscape Law	
2. Planning Proposal in the Statutory Process	a. Master plan is made as a public decision providing land use regulations and authorizing infrastructures. b. After initial planning, focus shifts to management of the plan including its amendment	
	c. Encourages private initiative as part of amending resolutions.	Requests of land owners, residents, private developers and non-profit organizations are discussed openly and officially to make planning more dynamic and participative.
	d. City Planning Law was amended to add provisions on statutory procedure in the planning proposals of the private sector, since 2002.	l. With 2/3 concurrence of affected private developers, land owners to amend the plan, he proposal is submitted. ll. Planning authorities should make a prompt decision weather to begin the process of amendment or not. lll. In the case of rejection, authorities need to report to and discuss with City Planning Committee the decision and the reasons for it before notifying the applicants.
3. Controlling Large-Scale Retail Stores	a. 2006, to control the sprawling of large-scale retail establishments, City Planning Law and the Building Standard Law were amended.	Buildings with more than 10,000 square meters in floor area are allowed only in l. Commercial Zone, ll. Neighborbood Commercial Zone and Quasi-Industrial Zone.
	b. Background l. 1974 - end of 1980's Administrative intervention to protect small busi nesses in town centers ll. 1990 - Deregulation as National Policy, caused increased number of large retail complexes	
	lll. 1998 - Implementation of three Laws	l. 'the Town Center Revitalization Law' : Financial support framework ll. ' Large Scale Retail Store Location Law' : Requires environmental impact assessment of areas around the site, minimum number of parking lots, noise prevention, garbage storage lll. Amendment of 'City Planning Law' : Land use regulation system to give flexibility to Special Use District
	lV. 2006 - With the failure of control, strengthening land use regulation, and amendment of 'City Planning Law' was implemented.	

4. Recognition

a. Large retail establishments will continue spreading out in the suburbs even with decreases in the population, resulting; l. hollowing out Town centers, ll. Inefficient public investments for infrastructure and management cost
b. Land use regulations to control large stores should be introduced by a national law for attracting large numbers of people to the municipality conflicts the interests for controlling such establishments

Appendix 2:
Example process of planning on site in Tokyo

The materials used in this appendix has been modified and reworked from the analysis materials made by the author during work at Albert Abut Architecture in Tokyo

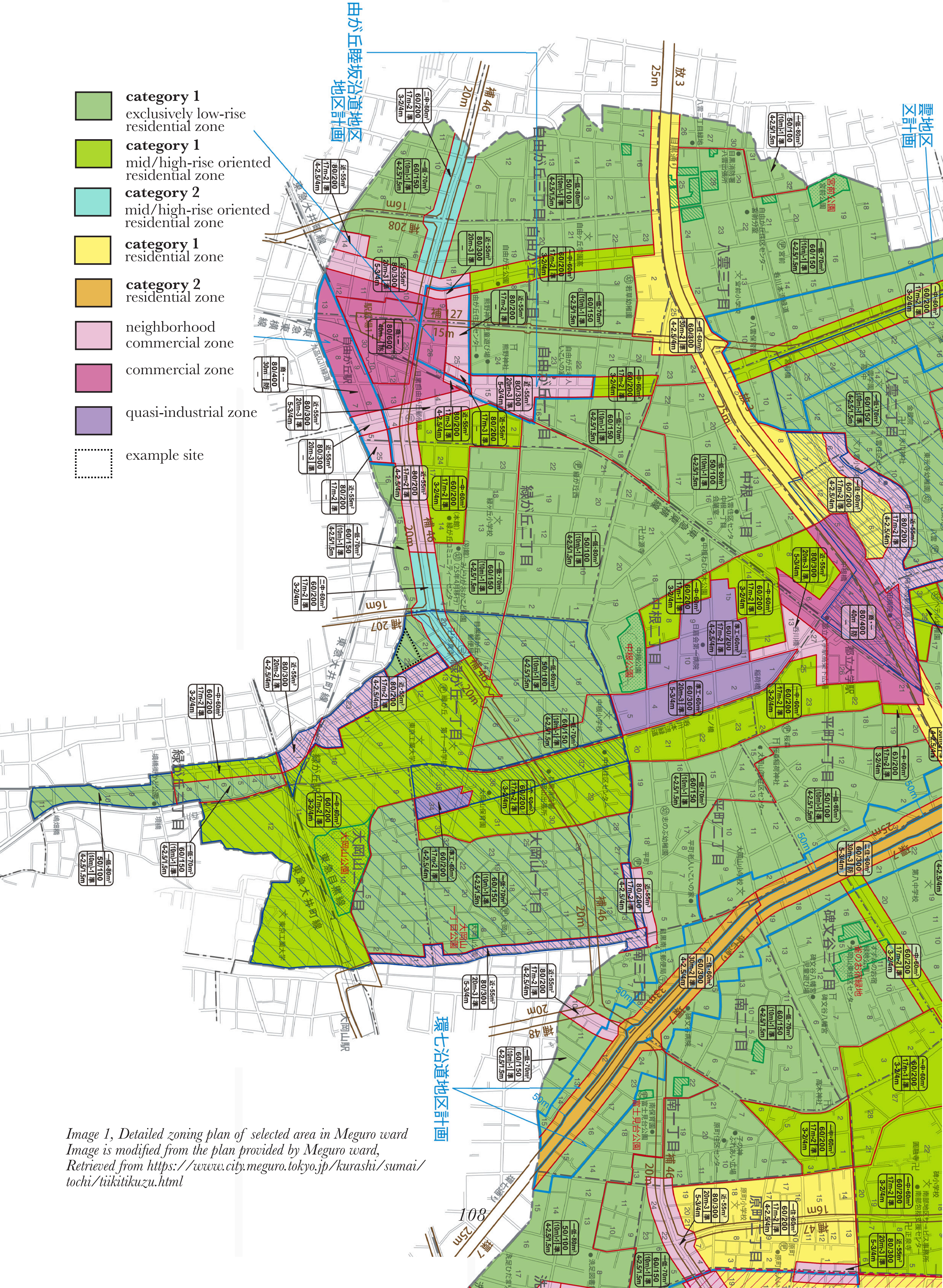


Image 1, Detailed zoning plan of selected area in Meguro ward
Image is modified from the plan provided by Meguro ward,
Retrieved from https://www.city.meguro.tokyo.jp/kurashi/sumai/tochi/tiikitikuzu.html

1 example site

2 **category 1** exclusively low-rise residential zone

The example site belongs to category 1 exclusively low-rise residential zone, and below tables show the buiding types that can be built according to the land-use zoning, and the floor area ratio and building coverage ratio that are applicable.

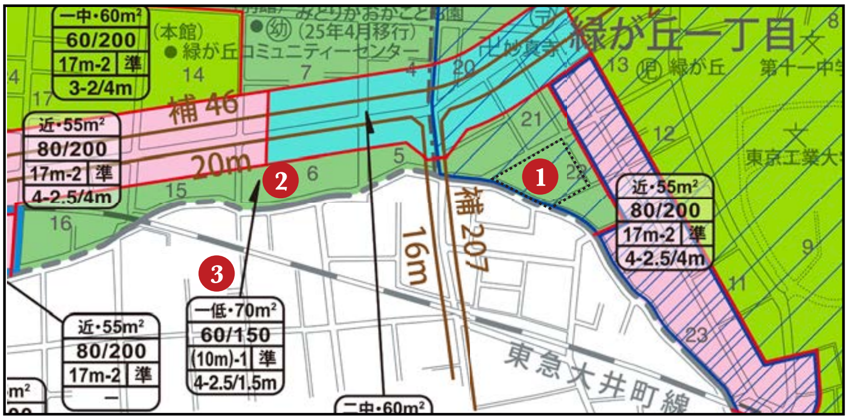


Image 2, Detailed zoning plan of selected area in Meguro ward
Image is modified from the plan provided by Meguro ward,
Retrieved from https://www.city.meguro.tokyo.jp/kurashi/sumai/tochi/tiikitikuzu.html

Table 1, Buildings that can be or cannot be built in different land-use zones.

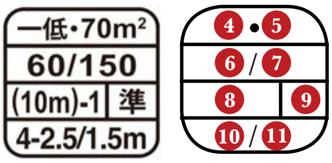
Land-use zones / Examples of buildings	1 low Res.Z.	2 low Res.Z.	1 med Res.Z.	2 med Res.Z.	1 Res.Z.	2 Res.Z.	Quasi Res.Z.	Neigh.Com.Z.	Com.Z.	Quasiind.Z.	Ind.Z.	Ex. Ind.Z.
Houses												■
Schools											■	■
Shrine, Church, Clinic												
Hospital, University	■	■									■	■
Store (150m² Max.)	■											△
Store (500m² Max.)	■	■										△
Office, Store, etc.	■	■	■	△	△							
Hotel	■	■	■	■	△						■	■
Karaoke box	■	■	■	■	■							
Independent garage	■	■										
Warehouse	■	■	■	■	■	■						
Theater	■	■	■	■	■	■	△	△			■	■
Auto repair shop	■	■	■	■	■	■	△	△				
Factory with some possibility of danger or environmental degradation	■	■	■	■	■	■	■	■	■			
Factory with strong possibility of danger or environmental degradation	■	■	■	■	■	■	■	■	■	■		

Can be built | ■ Usually cannot be built | △ Can be built under some conditions

Table 2, Allowable values of floor area ratio, and building coverage ratio

Land-use zones	Floor Area Ratio (%)	Building Coverage Ratio (%)
1 low Res.Z.	50,60,80,100,150,200	30, 40, 50, 60
2 low Res.Z.	50,60,80,100,150,200	30, 40, 50, 60
1 med Res.Z.	100, 150, 200, 300, 400, 500	30, 40, 50, 60
2 med Res.Z.	100, 150, 200, 300, 400, 500	30, 40, 50, 60
1 Res.Z.	100, 150, 200, 300, 400, 500	50, 60, 80
2 Res.Z.	100, 150, 200, 300, 400, 500	50, 60, 80
Quasi Res.Z.	100, 150, 200, 300, 400, 500	50, 60, 80
Neigh.Com.Z.	100, 150, 200, 300, 400, 500	60, 80
Com.Z.	200, 300, 400.....1300	80
Quasiind.Z.	100, 150, 200, 300, 400, 500	50, 60, 80
Ind.Z.	100, 150, 200, 300, 400	50, 60
Ex. Ind.Z.	100, 150, 200, 300, 400	30, 40, 50, 60
Undesignated	50, 80, 100, 200, 300, 400	30, 40, 50, 60, 70

3 *Image 3, Zoning code specific to the example site.*



4 *Land-use zone*
5 *Minimun size of the parcel*
6 *Building coverage ratio*
7 *Floor area ratio*
8 *Height restriction*
9 *Type of fire protection area*
10 *Shadow control*
11 *Shadow measurement height*

1. Allowed building types regarding functions are specified according to land-use zoning (see Table 1). This accumulative and mixed zoning allows different functions under certain sizes, even in the most restrictive area, such as category 1 exclusively low-rise residential areas.

2. More specific zoning codes, are assigned to smaller parcels, indicating the allowed minimum size of the parcel (see # 5), floor area ratio and the buiding coverage ratio (see # 6, and 7), height restrictions (see # 8), and fireprotection level (see # 9), shadow control restriction (see # 10), and where the shadow length is measured from the ground (see # 11).

3. The building shape is affected especially by # 6, 7, 8, 10, and 11.

4. Additionally, setback distance rules, and slant ratio rules affect the building shape.

Step 1

1

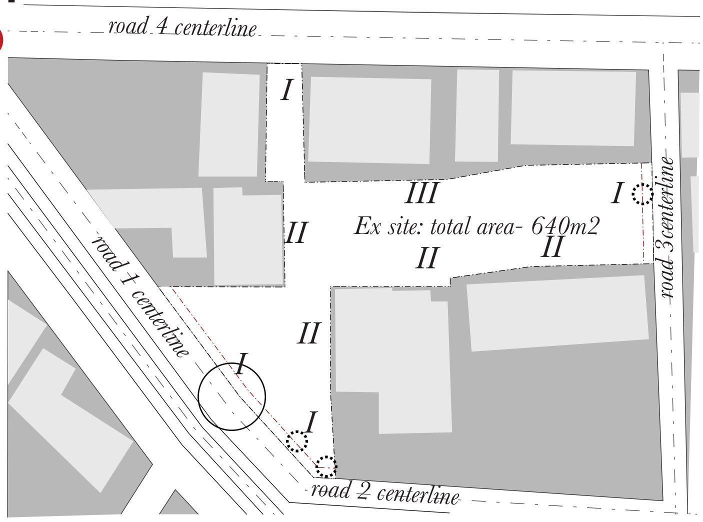


Image 3, Site area and setback lines

setback lines rule

If the adjacent road is less than 4 meters wide, the setback line should be drawn so that the road width is 4 meters wide.
The road 1,2, and 3 are less than 4 meters wide, thus setback line was drawn.

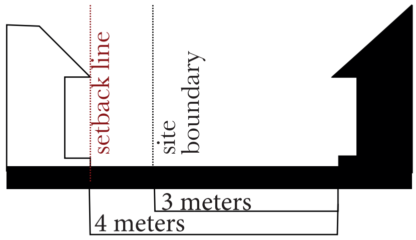


Image 4, Setback line

1meter setback lines sets the new building 4 meters apart from the other side of the road

Step 2

8 *Height restriction*

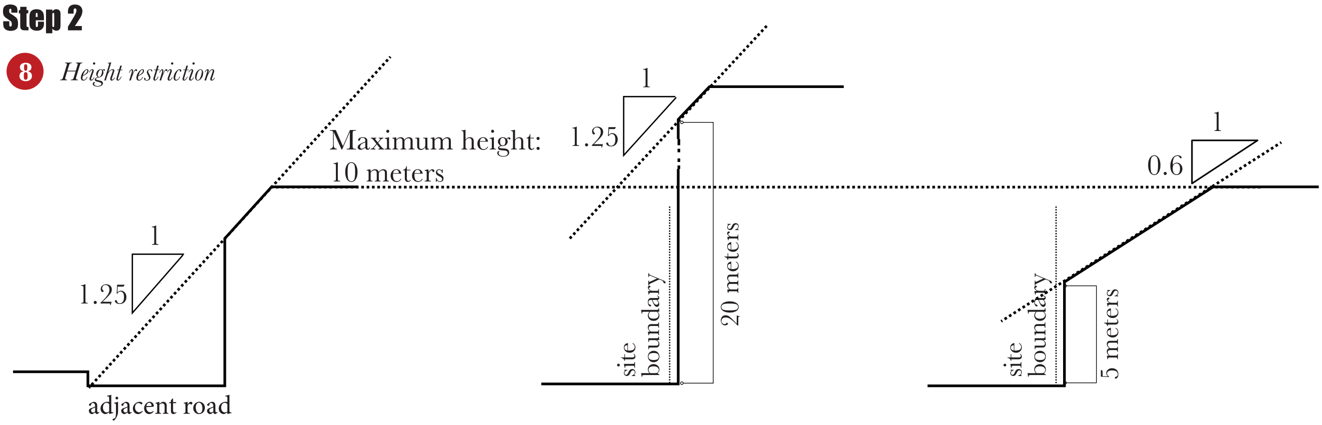


Image 6,
I: slant rule
based on the adjacent road

Image 7,
II: slant rule
based on the adjacent site

Image 8,
III: slant rule
based on the north side of the site

Height restriction is specified in the zoning code. On this site the specified height restrition is 10 meters.
The 3 slant rules can be applied to the site. These are examples of the slant calculations based on category 1 residential zones.

Step 3

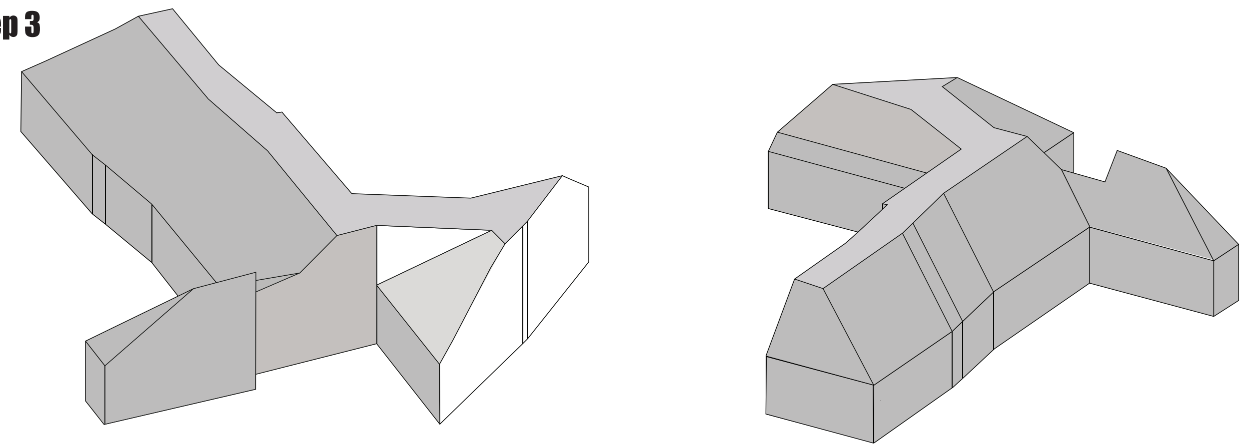


Image 9, These images show the maximum building volume that can be put into the site according to all the slant rules, and the height restriction applied.

Step 4

10 *Shadow control*

11 *Shadow measurement height*

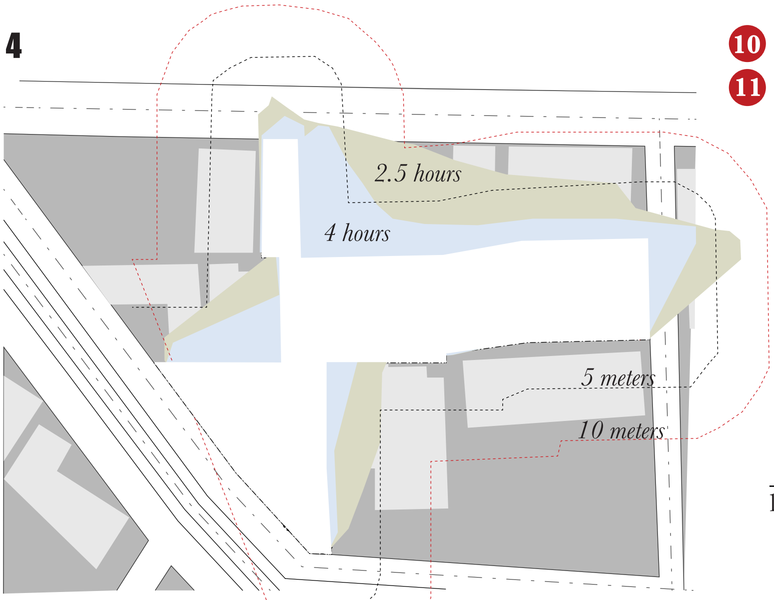


Image 10, Shadow control

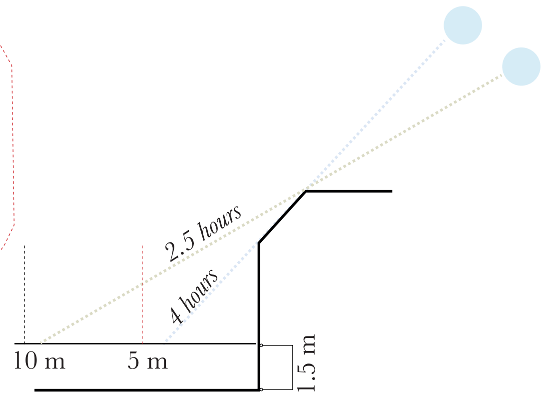
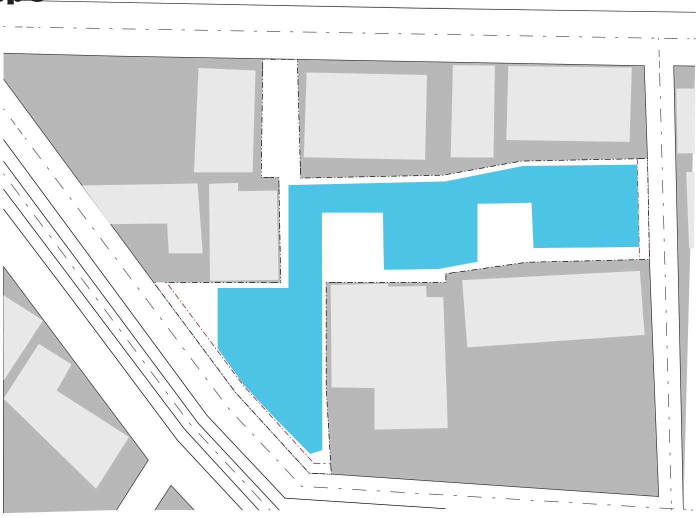


Image 11, How the surface of the shadow area is measured

According to the zoning code assigned to the site, the shadow from the site boundary to 5 meter outwards are allowed for 4 hours of shadow time, while up until 10 meters 2.5 hours daily shadow time is allowed. The area where it's affected by the shadow are measured at 1.5 meters from the ground.

Step 5



6 *Building coverage ratio*

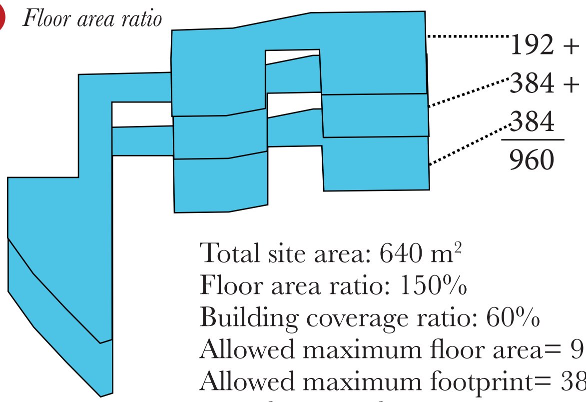
Building coverage ratio:

For the example site the allowed maximum building coverage ratio is 60 percent. The total site area is 640 m^2, thus 60% of the site area would be 384 m^2. The light blue area shows 60 % area after the setback lines are drawn.

Image 12, Building footprint according to building coverage ratio and the slant rule numbers are shown

Step 6

7 *Floor area ratio*



Total site area: 640 m^2
Floor area ratio: 150%
Building coverage ratio: 60%
Allowed maximum floor area= 960m^2
Allowed maximum footprint= 384m^2
960m^2= 384 m^2x 2.5 floors

Image 13, Floors

For the example site the allowed maximum floor area ratio was 150 percent. The total site area is 640 m^2 and the building coverage area, 384 m^2. 150% if 640m^2 is 960 m^2. 960m^2 would be 250 % of the building coverage area, which would be additional 1 whole floor and a half sized floor.

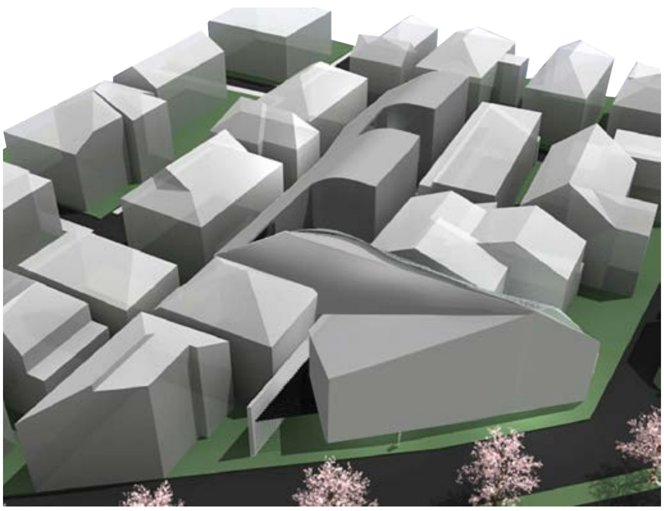


Image 14, Preliminary maximum volume placed on site.

Appendix 3: Compact cities are complex, intense and diverse but: Can we design such emergent urban properties?

Paper 1/Accepted for publication in Urban Planning 1(1), 2016, Cogitatio

Compact cities are complex, intense and diverse but: Can we design such emergent urban properties?

Abstract:
Compact cities are promoted by global and local policies in response to environmental, economic and social challenges. It is argued that increased density and diversity of urban functions and demographics deliver the expected positive outcomes. 'Emerged' urban areas developed incrementally seem to exhibit such characteristics, acquired through adaptation by multiple actors over time and space. Today, 'design-based' planning approaches aim to create the same characteristics here and now. An example is the City of Gothenburg, Sweden, which strives to involve multiple actors to 'design' urban density and mixed use, but with unsatisfactory outcomes. There is reason to investigate in what way current planning approaches need modifications to better translate policy intentions into urban reality. The paper studied which type of planning approach appears to best deliver the desired urban characteristics. Two cities are studied, Gothenburg and Tokyo. Today, these cities operate under different main planning paradigms. Tokyo applies a rule-based approach and Gothenburg a design-based approach. Five urban areas were studied in each city, representing outcomes of three strategic planning approaches that have been applied historically in both cities: 1) emergent compact urban form; 2) designed dispersed urban form; and 3) designed compact urban form. Planning outcomes in the form of density, building scales and diversity were analysed to understand if such properties of density and diversity is best achieved by a specific planning approach. The results showed that different planning approaches deliver very different outcomes when it comes to these qualities. To better support ambitions for compact cities in Gothenburg, the prevailing mix of 'planning by design' and 'planning by developmental control' needs to be complemented by a third planning strategy of 'planning by coding' or 'rule-based planning'. This is critical to capacitate urban planning to accommodate parameters, such as timing, density, building scale diversity, and decentralization of planning and design activities to multiple actors.

Keywords: Compact city, Density, Diversity, Urban resilience, Urban adaptability, Emergent urban form, Rule-based planning

1. Introduction

1.1 Compact city policies

Global and European policies on urban development promote the 'compact city' concept as a response to challenges, such as climate change, environmental issues, economic development, social cohesion and attractivity. A number of recent UN-Habitat reports and policy papers argue that compact city structures have positive effects on citizen health, economy, resource efficiency, social cohesion and cultural dynamics (UN Habitat, 2011; 2014; 2015) and that low population density is the most environmentally harmful urban form in both mono-centric and polycentric urban structures (UN Habitat, 2011).

The same line of arguments is picked up by European Union policy documents, arguing that a compact and diverse city structure has positive effects on citizen health, economy and efficient use of resources (European Commission, 2011), and that cultural, social and political dynamics are promoted by the density, proximity and diverse choices available in compact cities (European Commission, 1990). The OECD, claims that compact city policies will result in lowered CO^2 emissions and reduced energy consumption in transportation, not only on the metropolitan scale but also on the neighbourhood scale, as well as in conservation of farmlands and biodiversity, and in reduction of infrastructure cost and increase of labour productivity (OECD, 2012).

In Sweden, the City of Gothenburg's visions and policies are developed along the same lines, promoting dense and mixed land use urban patterns to reduce socioeconomic segregation and increase liveability, e.g. in the Rivercity Gothenburg Vision (Gothenburg City Council, 2012) and the Development Strategy Gothenburg 2035 (Planning and Building Committee of Gothenburg, 2014).

1.2 The compact city paradox

As we can see, urban development policies at all levels favour dense and diverse urban patterns. Such policies are supported by the proponents of the agglomeration effects (e.g. Glaeser, 2011) rendered by the proximity of diverse urban components, leading to mixed land use, diversity of demographics and diversity of scales. It is claimed that such qualities provide better economic output (Quigley, 1998) and higher invention rates by providing fertile ground for knowledge spillover (Carlino et al., 2007; Glaeser, 2011), reduce energy use through employment density (Mindali et al., 2004), and alleviate social segregation (Burton, 2001). It is also argued that dense and diverse urban patterns are more resilient forms of urban structure, providing a redundancy of functions (Bettencourt & West, 2010), networkability and response-diversity to disturbances (Glaeser, 2011; Offenhuber & Ratti, 2014; Bristow, 2010).

However, compact city policies are also contested in research. It is argued that neighbourhood density might impact negatively on neighbourhood satisfaction (Bramley & Power, 2009), sense of attachment and sense of quality of public utilities (Dempsey et al., 2012), and crowdedness and psychological health (Haigh, Ng Chok, & Harris, 2011). Furthermore, critics of 'Compact city' argue against the concept, highlighting the bigger income gaps, increased ecological footprint due to higher consumption (Heinonen & Junnila, 2011), decreased living space for low income groups and accessibility issues to green space and nature areas (Burton, 2001). Still, negative social problems related to density may be due to the characteristics of the urban areas where poverty is concentrated, rather than to the urban form itself (Bramley & Power, 2009). Increased consumption rates and larger income gaps might be linked to the incidents of accumulation of wealthy population as well as low income population in dense urban areas, not to the urban form itself (Glaeser, 2011). Since crowding is a problem of perception of urban space, this may partly be due to a design problem and not intrinsically linked to urban compactness (Kearney, 2006).

The correlation between urban problems and urban form is thus unclear. There is a risk that generic problems of urbanization are criticized as being problems of compact cities. As Edward Glaeser puts it: 'Cities do not make people poor; they attract poor people. The flow of less advantaged people into cities from Rio to Rotterdam demonstrates urban strength, not weakness.' (Glaeser, 2011, p.9).

One explanation of the contradictory findings is the persistent lack of clear definitions for what a compact city actually is (Neuman, 2005). The classifications listed in UN-Habitat's and other policy papers are general, and do not provide concrete guidelines for global implementation. Even if several attempts have been made to establish 'compact city' or 'sprawl' indexes, the heterogeneity of the concepts of density (Churchman, 1999; Manaugh & Kreider, 2013), and diversity (Manaugh & Kreider, 2013), and prevalence of different indexes (Lee, Kurisu, An, & Hanaki, 2015) is a problem for the practical implementation of policy. Another explanation is that positive properties of compact cities are found in research on urban economics (Bettencourt, 2013; Glaeser, 2011) while research showing negative effects focus on psychological impacts (Haigh, Ng Chok, & Harris, 2011), lowered satisfaction (Bramley & Power, 2009), and higher consumption rates (Heinonen & Junnila, 2011).

Due to such inconsistencies in research, there is a risk that the notion 'compact city', ends up as a 'boundary object' similar to concepts such as 'resilience' (Wilkinson, 2011) and 'sustainable development' (Muraca and Voget-Kleschin, 2011), vague enough to justify any type of urban development (Leffers, 2015). However, seeing the notion 'compact city' as a boundary object also shifts the focus towards urban transformation as process (Brand and Jax, 2007). Leaving the critique offered by Neuman regarding the benefits of more compact cities aside for the moment, his argument that 'form is both the structure that shapes process and the structure that emerges from a process' (Neuman 2005, p. 22) merits further consideration. If form 'is an outcome of evolution' (Neuman, 2005, p. 23), then the arrangement of how to carry out planning in ways that support and guide such an evolutionary process becomes a key issue. Assuming that dense and diverse urban patterns may be beneficial, we need to understand more regarding what types of planning approaches can best promote such properties. There is a need to focus planning evaluation on the implementation of plans, not least in the context of the growing interest in urban form as the spatial concretization of urban sustainability (Oliveira & Pinho, 2010). This paper therefore aims to contribute to such evaluation efforts by responding to the question:

1. What are the differences in outcome of different planning approaches in relation to urban characteristics, such as density and diversity?

Note that this study will only deliver a partial answer to this question, due to the limitation of the conducted study. The following section introduces the understanding of cities as complex systems which will be used as the theoretical underpinning for the study. Thereafter, the methods used to gather and analyse data are described and the two case cities are introduced. The next section presents the results from the study. Finally, the results are discussed and some conclusions are presented.

2. Cities as emerging complex systems

The challenges facing cities are increasingly more complex due to the dispersion of power, the divergence of agents, increasing information flows and channels, and prevailing globalization processes (Homer-Dixon, 2011). This complex urban condition is continuously exacerbated by the unpredictability of internal and external factors, such as climate change, sudden demographic changes and financial crisis (Davoudi et al., 2012).

Resilience studies pay particular attention to the problematic of unpredictability, although with a variety of interpretation of the meaning and application of the term (Chelleri & Olazabal 2012). In the urban context, evolutionary resilience appears appropriate (Davoudi et al., 2012), denoting the ability of a system, not only to bounce back from events causing a shock through robust behaviour, but also to adapt and learn from the past behaviours to surpass the previous state by extending its capacity (Gunderson & Holling, 2002). Such an evolutionary and adaptive view of resilience emphasizes characteristics of discontinuous change, chaos and order, self-organization, and nonlinear system behaviour (Gunderson & Holling, 2002).

Self-organising in conjunction with nonlinear system behaviour might increase an urban system's capacity for adapting and learning through complex interactions of the rational behaviour of individual, 'micro' agents to adapt to changes, collectively rendering a 'macro' adaptive urban emergence that is unintentional (Manesh & Tadi, 2011; Rowley, 1994).

Such emerging complexity is seen as beneficial compared to simplification, as it increases (Marshall, 2012):

1. Perceptual richness, where humans fare better psychologically in complex environment
2. Functional capacity through properties such as hierarchy, flexibility, redundancy and specialization of different parts
3. Synergy, where entirety is greater than the sum of the parts.

When compared to the guidelines found in global policy on urban development, the evolutionary resilience approach to urban planning seems to deliver the outlined characteristics of compact cities. This is achieved through system properties, such as multi-functionality, redundancy and modularization, biodiversity and social diversity, multi-scale networks and connectivity, and adaptable planning (see Figure 1).

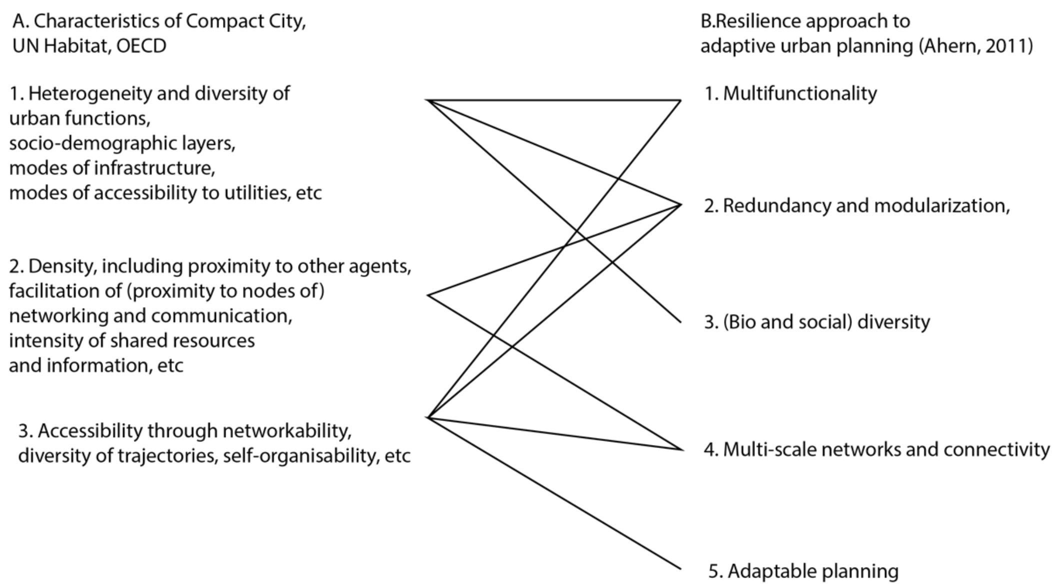


Figure 1. Policy characteristics of compact cities with properties delivered by a resilience approach to urban planning. Based on UN-Habitat (2014), OECD (2012) and Ahern (2011).

Resilient urban properties that relate to increased diversity, networks and increased number of agents through density and proximity are often seen in emergent urban areas that have developed incrementally through time, such as European medieval cities (Marshall, 2012; Jan Scheurer, 2007), certain districts of Asian mega cities and various informal settlements, for example Dharavi in Mumbai (Echanove et al., 2013).

Emergent systems are defined as systems with simpler higher order behaviour that arise from underlying complex interactions; similar to cells emerging from interactions of atoms, society emerges from interactions of people (Page, 2011). Such micro-agent interactions and adaptations at the individual networking level continually create new emergence and increase the robustness of the whole system (Alexander, 1965; Bettencourt 2013). Also, an urban fabric created by multiple actor layers, incrementally with diversity of building types, scales and functions, is often seen as having attributes of more intense and livelier street lives (Jacobs, 1961; Eom & Cho, 2015; Merlino, 2011).

In contrast, modernistic planning has focused on idealized plans developed top-down to deliver perfection at the moment of creation, based on control systems correcting 'problems of yesterday' with a 'conventional toolkit' (Taylor, 2005, p.157; cited in Davoudi et al., 2012; Batty & Marshall, 2012). This planning approach has been criticized for creating simplified and rationalized urban forms out of diverse agendas, including reduced density and separation of urban functions (Alexander, 1965; Marshall, 2012). Alexander (1965) argued that 'planning' cannot reproduce the complex characteristics of urban forms and interactions that have developed incrementally and interactively. Still, attempts have been made to emulate compact city characteristics in post-modern contexts, i.e. diversity of functions and density. Typically, this has been done by trying to shape emergent characteristics or forms through site specific designs (Neuman, 2005; Marshall, 2012). However, Marshall (2012) points to the difficulty of planning the kind of urban complexity that are seen in traditional emergent urban forms, through intervention and organizing. Large open systems, such as urban systems, are impossible to plan without having the full knowledge on consequences of such interventions, which evidently is impossible (Marshall, 2012). Marshall & Batty (2012), instead, argue that the challenge is to devise the sort of plan or design which create the desired functional complexity. Here, Marshall (2012) identifies three planning types that, when combined into a system of planning types, can promote urban complexity:

1. Planning by design: Master planning, urban design, or outlines of design, with a preconceived conception of the finished state of a specific whole entity.
2. Planning by coding: Use of generative codes to define generic components or relationships of building blocks. Non site specific. The use can be generative with specification of how elements can be put together to generate aggregate urban form.
3. Planning by development control: Enabling public authorities' influences on what is allowed to be built or not by approving or rejecting specific designs or layouts proposed by private individuals or master planners.

Marshall describes the role of the 'code' in 'planning by coding', as a generative code that 'provides a framework within which individual designers can work' (2011, p. 230). Here, the use of codes for recording landownership in European traditional urbanism have been noted 'as of the earliest and most constant form of written urban memory-structure' (Shane, 2005, p.25).

Table 1. Four outcomes of two main planning types. Adapted after Marshall (2012).

Approach / Form	*Planning by coding*	*Planning by design*
Low density and diversity	A. • Functional simplicity • Continuous adaptation	C. • Functional separation • Ready-made neighbourhoods
High density and diversity	B. • Functional complexity • Continuous adaptation	D. • Simulated complexity • No adaptive capacity

To sum up, four main outcomes of planning can be distinguished that are helpful for analysing how different planning types relate to the processes of developing dense and diverse urban patterns (see Table 1):

A. *Emergent dispersed urban form:* Planning by coding with no compact city ambitions leads to sprawling patterns and uniform uses. Although continuous adaptation takes place, low diversity decreases the capacity to quickly evolve into new emerged states.
B. *Emergent compact urban form:* Planning by coding aiming at high density and diversity facilitates incremental and individual micro interactions through time and space by multiple actors. Since emergence is continual and diversity is high, such urban systems have the possibilities to change and adapt to create new emerged states.
C. *Designed dispersed urban form:* Planning by design, where rationalization and simplification create compartmentalized urban patterns. Typical for modernistic and top-down planned urban systems, these plans are often executed through large-scale site interventions with long-term projections into the future.
D. *Designed compact urban form*: Planning by design − often in combination with planning by development control − are often applied in new initiatives to emulate emergent compact city characteristics. They are initiated top-down and focuses on functional diversity, density as well as on diversity of property ownerships. As designed urban systems, they often include large site areas and incrementality is negligible.

Of these four planning outcomes, C and D are the most relevant for analysing initiatives to produce more compact cities, while outcome B is relevant to include in any analysis due to the persisting legacy into current days of the modernistic approach to urban planning and development.

3. Method

According to UN-Habitat (2015), density is measured in terms of the density of built areas and population, and of the concentration of urban functions. When it comes to diversity, both mixed land use and social mix are included. Mixed land use is defined as a variety of compatible land uses and functions and provision of a cross-section of residential, commercial and community infrastructure in neighbourhoods. Social mix is defined as the presence of residents from different backgrounds and income levels in the same neighborhood, and suggested to be achieved by availability of different housing options in terms of price ranges, tenure type and building types, and the availability of diversity of jobs in the proximity (UN Habitat, 2015).

However, as urban planning takes place in open systems with many purposeful parts (i.e., people and organizations pursuing their interests), it is difficult to link planning activities to any outcomes in the urban reality (Laurian et al., 2010). Therefore, this study has chosen two highly institutionalized planning systems – in Sweden and Japan – to increase the likelihood that planning has in fact affected the urban reality. Three indicators for compact city urban form were used for assessment of dense and diverse built environment: the density of built objects, the scales of built objects and the distribution of the diversity of the built objects. Data on these indicators were developed through analysis of building footprints. Analysis of building footprints is evidently insufficient for representing the wide spectrum of qualities to be found in, or realized through, the compact city. However, building footprints represent the building coverage ratio of a site and can indicate both street level density and diversity in the form of urban grain sizes and rhythm, diversity of building types, and diversity of urban parcel distribution. As an example, the size of individual plots of land play a role for promoting subsidiarity in decision making to better satisfy local needs (Hoffmann-Axthelm, 1993, 1996; cited in Scheurer, 2007). Nevertheless, a remaining limitation is that building footprints never can include building volume and related intensity of land use, a weakness common to any analysis solely based on land use.

The assessment was applied to three different kinds of planning outcomes (urban fabrics) resulting from two types of planning approaches as seen in Table 1 above. These were 'emergent compact urban form' achieved through planning by coding, 'designed dispersed urban form' achieved through planning by design, and 'designed compact urban form' achieved through planning by design in combination with planning by development control. Both 'emergent compact urban form' and 'designed compact urban form' are expected to deliver some degree of density and diversity while 'designed dispersed urban form' is seen as a control indicator for comparison purposes.

As case material, we selected urban fabrics corresponding to the abovementioned three planning outcomes in one city, where the socio-cultural and historical context is similar. The result is then compared to similar urban fabrics in another city with other contextual relationships. The expectation was that identifying similarities and disparities within a city and between both cities would give insights into how density and diversity in more absolute terms are influenced by what planning approach has been applied. The study thus analysed three housing areas in Gothenburg and Tokyo, respectively, chosen to represent:

1. Emergent compact urban form (Type 1): An inner city urban fabric evolved through time by multiple actors' interactions
2. Designed dispersed urban form (Type 2): A modernist urban fabric from 1960-1970's where the ideology was clearly to separate and create separation between the functions and to give uniform characteristics and standards
3. Designed compact urban form (Type 3): An inner city urban fabric where density and diversity has been designed by a number of developers simultaneously

The two cities are evidently incomparable both in scale and in sociocultural, political and historical contexts. However, in this study, the comparison is done regarding relative proportions of density and diversity across the urban areas.

3.1. Gothenburg and Tokyo

The city of Gothenburg has 544,261 in population and 1,209 persons/km^2 in population density (Gothenburg City Council, 2015).

In Gothenburg, as in many other European cities, much of the development has been planned top-down by planners and architects through large-scale developments. However, the small city core developed before the 19th century has been left largely untouched. The period from 1961-1980 has produced 42% of the building stock constructed from 1931 until 2014 (Statistics Sweden, 2015). The city districts created during the Million Program period are identified as problem areas ridden with segregation issues (Lilja och Pemer, 2010).

Today, the City of Gothenburg is in dire need to increase the number of housing and to reduce socio-spatial segregation. The lack of housing and a constant increase of the population leads to a waiting period, counting from start of the search to a rental contract, reaching almost 4 years (Boplats, 2014). The persistent socio-economical spatial segregation coupled with a division into 'immigrant' and 'native Swedish' populations is also highly problematic (Lilja och Pemer, 2010). The integration is slow paced and the quality of urban life standard is very much inferior in the Million Program areas where the immigrating population consist of up to 80% of the total population (Gothenburg city council, 2013).

As a response to these problematic issues, Gothenburg is currently adopting a strategy based on involvement of multiple actors, e.g. by employing a diversity of firms to 'design' new urban areas with mixed tenancy types and functions (Gothenburg City Council, 2012; 2014). Although this strategy needs to be assessed further after a longer time period, it has so far been criticised for failure to produce the desired compact dense and mixed urban areas, especially with controversial issues concerning gentrification (Thörn, 2013).

Tokyo houses more than 13 million people (Tokyo Metropolitan Government, 2012). Its 23 central special wards have a population of 9.2 million and a density of 14,818 persons/km^2.

Most of the urban areas of Tokyo has emerged through continuous incremental adaptation over time. The post WWII land reform, where 1,918,000 hectares land was force-purchased from 2,341,000 landlords and sold to 4,748,000 tenants significantly reduced the size of the holdings. This led to piecemeal developments with rather un-organized individual development initiatives and composite mix of building types (Kawagoe, 1999). The city is seemingly chaotic with a rather formless urban structure due to its piecemeal lots developments on narrow streets, but it still keeps the traditional urban patterns quite intact. According to a study on residential class segregation, Tokyo demonstrates low class segregations based on occupation distribution, providing juxtaposition of demographics. (Fujita & Hill, 2012).

3.2. Study Areas

The ten study areas in Gothenburg and Tokyo (see Figure 2) were chosen according to the applied planning approaches and include:

Type 1: Emergent compact urban form, evolved incrementally by multiple actors through time and space
A) Gothenburg Central area: Two areas developed from the 17th century representing one of the oldest neighbourhoods in the city.

> 1) Inom Vallgraven: Until 1864, when the city extended southwards, this area was the core of Gothenburg and still is a very central area of the city (Stadshem, 2015), with a population of 3,917 (Gothenburg City, 2014).
>
> 2) Järntorget/Haga: Previously developed with small wooden houses where port workers resided. Larger buildings were built densely in the area from around the 1840's when industry started attracting larger number of workers (Stadshem, 2015). The population is 5,718 (Gothenburg City, 2014).

B) Tokyo Central areas: Two mixed neighbourhoods with diverse functions located in the central districts of Tokyo, selected to represent typical urban patterns found in the central areas of the Tokyo metropolis. Both areas have been developed since the Edo period from 1600's.

> 1) Nishiazabu: Located in Minato ward, in central Tokyo, with a population of 10,523 (Minato city, 2012).
>
> 2) Ebisu: Situated in Shibuya ward, also located in central Tokyo, with population of 13,019 (Shibuya city, 2010).

Type 2: Designed dispersed urban form, reductionist and top-down

C) Gothenburg Million Program Area. The 'Million Program' refers to a Swedish public housing program operated between 1965-1974 to deliver one million housing units (NE, 2015).

1) Hjällbo: Among the 7,273 residents, around 60% are born outside of Sweden. 15% are foreign citizens and 45% have Swedish citizenship. Statistics show a persistently higher percentage of population on social security benefits in the district, on average 8-10% from 2000-2007, compared to a 1-2% average in Gothenburg during that period. (TILLIT, 2012)

D) Tokyo New Town areas, referring to satellite districts developed around major cities by the Japan Housing Corporation to provide modern affordable apartments to the mass of workers migrating to the cities during the 1960's. The features of the New Towns were to emulate Western and modern ideal living with greenery and parks (Yokohari et al., 2006). Both New Towns in this study face challenges due to decreasing population in the areas (Japantimes, 2013, Ducom, 2008).

1) Chiba New Town: This suburb was developed from 1969 and onwards and contains a population of approx. 143,300 people (Chiba Prefecture Government, 2013).

2) Tama New Town: The development took place from the mid 60's until the mid 80's comprising 3,000-5,000 dwellings (Tama city, 2013).

Type 3: Designed compact urban form, diversity-oriented to emulate emergent characteristics

E) Gothenburg Waterfront: Two areas on the North of the Göta river represent ongoing urban intensification projects developed by the municipal agency, Älvstranden Development Ltd.

1) Kvillebäcken: 2,000 new apartments and offices/commercial functions are recently finalized, where seven firms were hired to design designated sites with a mix of tenancy types and functions in incremental development stages.

2) Eriksberg: 2,200 housing in different forms and tenure types are to be built on a disused shipyard from 2006 to 2019. A consortium of six construction firms and the municipal agency is involved in the planning and development of this area.

F) Tokyo Central area:

1) Roppongi Hills: Tokyo metropolis' response to a compact city within the central special wards. This urban intensification project was constructed by Mori building corporation and was completed in 2003. The complex with total floor space of 724,000 m^2 contains offices, commercial activities, residential units and cultural activities.

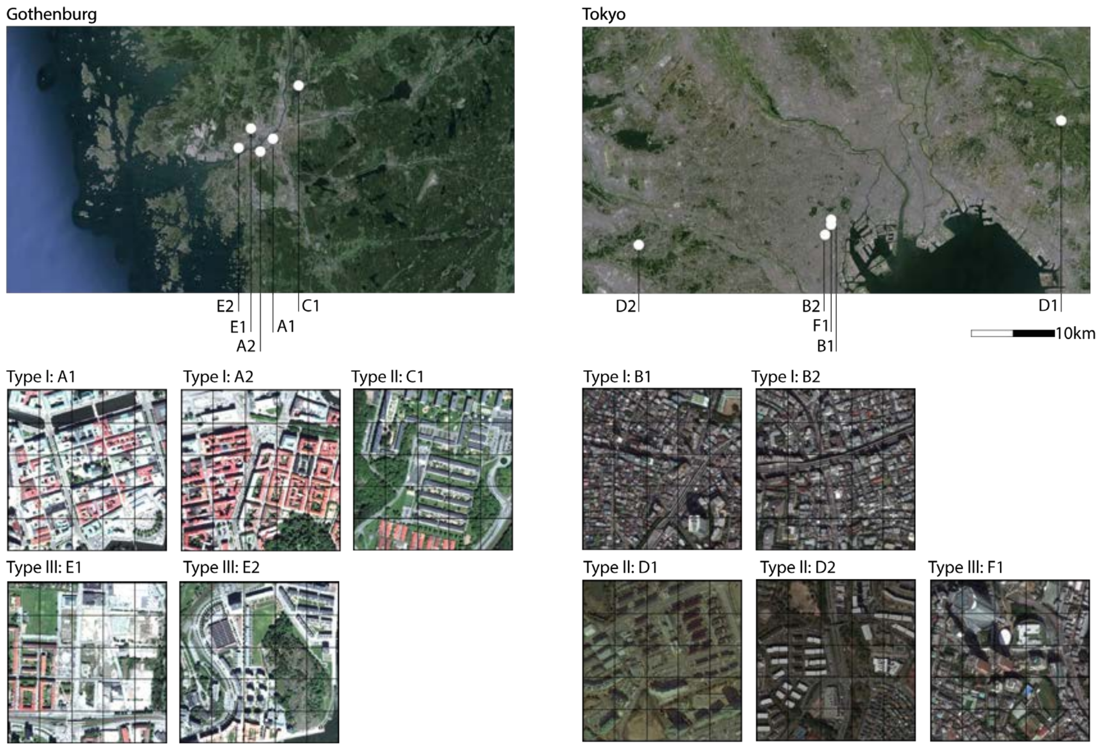


Figure 2. The ten study areas in Gothenburg and Tokyo

3.3. Analytical tools

Each chosen study area was overlaid with a grid of 25 cells measuring 100 by 100 meters, thus covering 10,000 m² each. The cells were numbered from 1 to 25 starting shown in image 4 in Figure 3. Each cell was analysed individually. Applying the analysis on cells provided results based on a continuous urban fabric, i.e. not based on project sites. The reason for implementing this approach was to gain understanding of the areas as continuous space, including transitional points between different quarters, blocks or projected sites, encompassing urban patterns from various time periods.

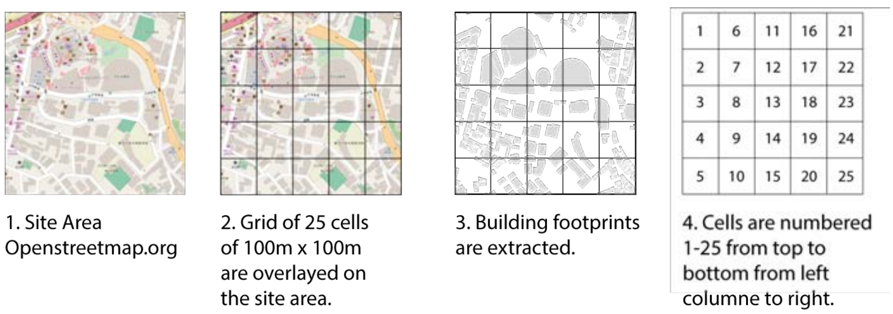


Figure 3. Process of analysis of building footprints in site areas with grids

The subsequent analysis of density and mixed use was based on three indicators: the density of built objects; the scale of building footprints; and the distribution and diversity of building footprints.

3.3.1. The density of built objects

The building footprints were used as indicator for density. The study of the built environment was done through analysis of open source maps retrieved from openstreetmap.org. The assessment of density was performed by analysing the raster image pixel counting. The vector shapes, which identify the borders of buildings, were separated from the rest of the information, such as roads, paths and site boundaries (see image 3 in Figure 3). This gave a gross density including public and private streets as well as unbuilt surfaces. Then the colour scale of the vector polygons representing building footprint was reduced to black, i.e. with red(R), green(G) and blue(B) in the RGB scale reduced to 0%. Through this measure, the density of BCR could be derived as 100-RGB %=x% where 'RGB' is the remaining space excluding the building footprints.

3.3.2. The scale and distribution and diversity of building footprints: Phase 1

The assessment of scale was done by measuring the size of the footprint of each building. To do this, the vector polygons representing the building footprints of the study areas were imported to the Adobe Illustrator software and consequently, a vector analysis script, 'SelectPathBySize.jsx' was executed for the analysis scales of built objects.

1. The script analysed areas smaller (or in 'f' below identical or bigger) than a certain surface area. The parameters of the building footprint areas used for the calculation were:

   a. smaller than 300 m²
   b. smaller than 750 m²
   c. smaller than 1,500 m²
   d. smaller than 2,250 m²
   e. smaller than 3,000 m²
   f. bigger than 3,000 m²

Each identified built object for a scale was removed and color-coded (see Figure 4), leaving only those larger than the values already analyzed to be assessed further. The built objects larger than 3,000 m² were grouped together without further subdivision.

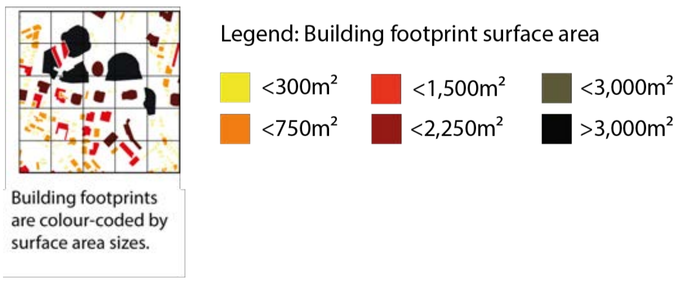


Figure 4. Analysis process of scale proportions – Phase 1

3.3.3. The scale and distribution/diversity of building footprints: Phase 2

Subsequently, each cell with the categorically color-coded vector polygons were imported to the Adobe Photoshop software as separate layers and analysed with a histogram function to calculate the number of pixels of the combined area of a given scale object within a cell. The proportion of each building scale was then derived in relation to the total number of pixels in each cell. (see Figure 5)

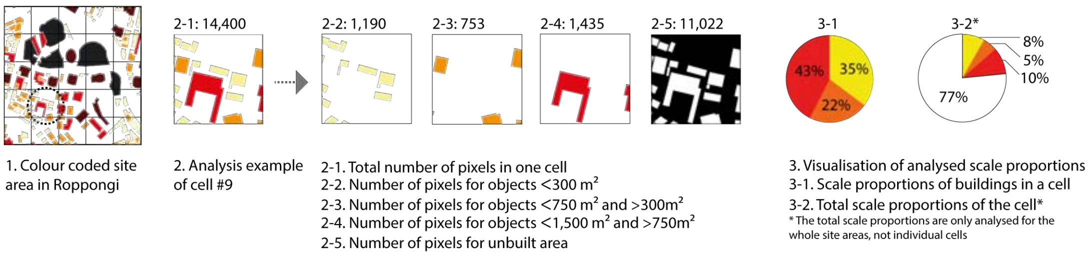


Figure 5. Analysis process of scale proportions – Phase 2

4. Results

Below, the results of the analysis of density, scale and distribution/diversity of building footprints are presented.

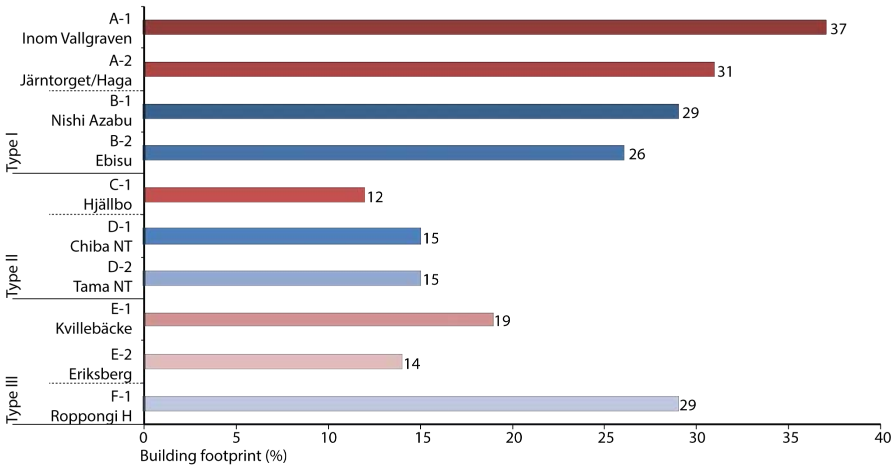


Figure 6. Graph over building foot print densities in the ten study areas. The horizontal axis shows the density as a percentage of the total area.

Figure 6 illustrates the analysis of the density of built objects. It shows the building coverage ratio in the ten study areas in Gothenburg and Tokyo. It showed the highest density of 37% and 31% in type 1 and the lowest, 12% in type 2 and low density, 19% and 14% in type 3 in Gothenburg. In Tokyo, the study areas in type 1 and 3 showed similar density, 29%, 26% and respectively, 29%, while both areas in type 2 showed the lowest density of 15%.

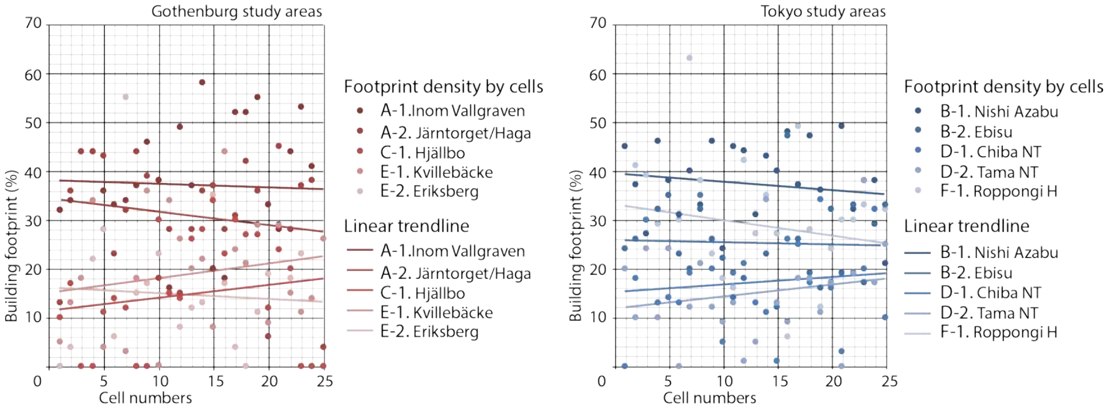


Figure 7. Graphs showing the distribution of the density of each cell in the study areas.

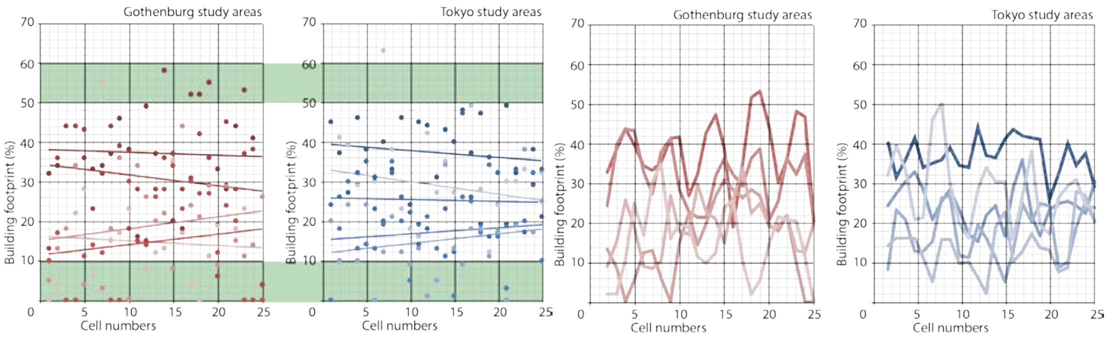


Figure 8. Four graphs showing the distribution of density trends in both cities. The images to the left show the median level density while the images to the right show the general pattern of density distribution between the cells.

The median values of density of the two cities showed that both the highest and the lowest density clusters were found in Gothenburg (in the 50%-60% and 0%-10% spectra), while the distribution was more evenly clustered in Tokyo (between 10%-40%) (see Figures 7 and 8). It was also notable that the number unbuilt neighbourhood areas represented by cell on 0% axis were much higher in Gothenburg.

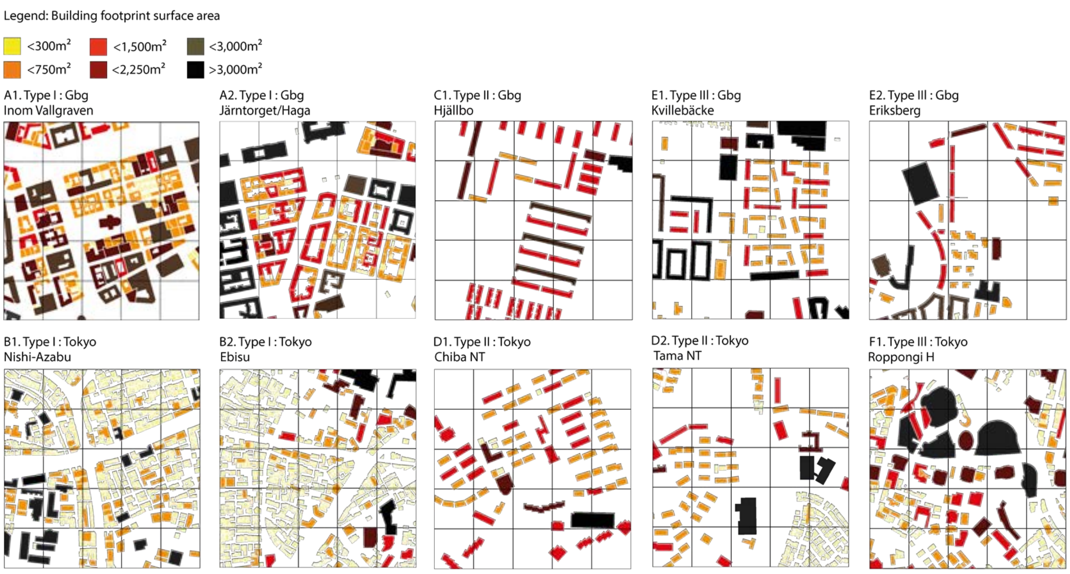


Figure 9. Building footprints in the ten study areas color-coded according to their scale; first phase of

analysis

Figure 9 illustrates the first phase of analysing the scale and distribution/diversity of building footprints. With the colour coding it facilitates the visualisation of the variation of building types and the street patterns.

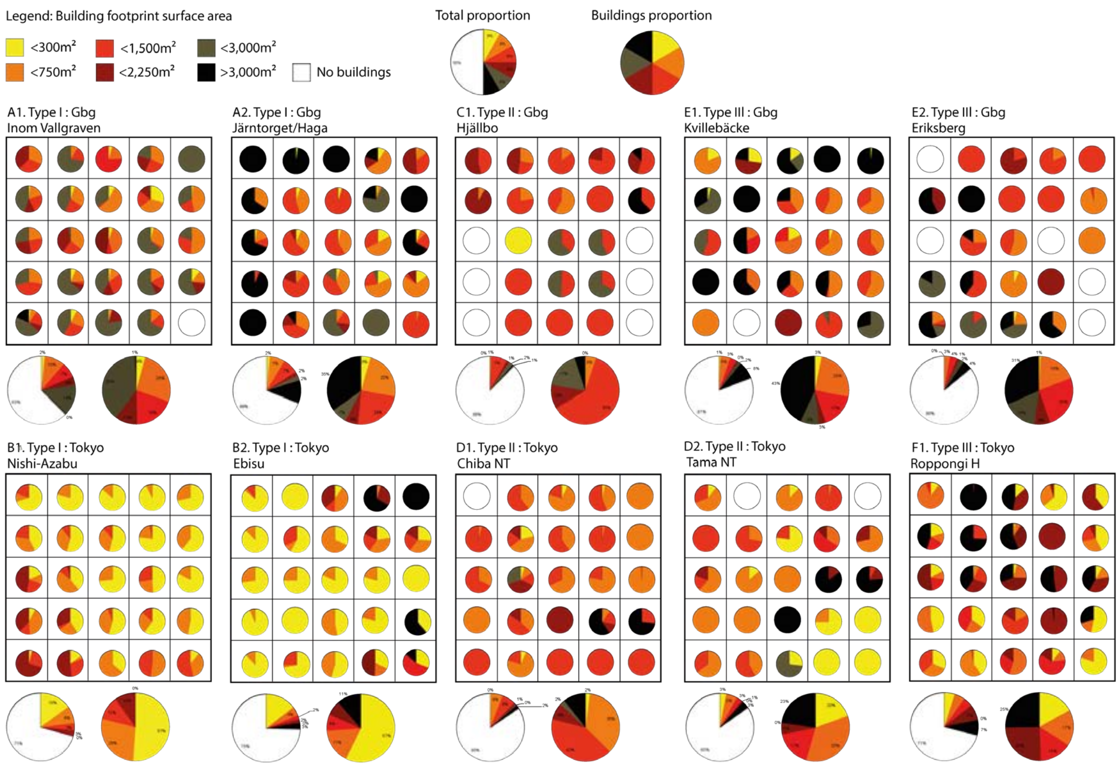


Figure 10. Diagrams showing the scale distributions of building footprints as well as the total proportions including unbuilt surfaces for each cell in the ten study areas; second phase of analysis

The second phase of analysing scale and distribution/diversity of building footprints is illustrated in Figure 10, showing the differences between Gothenburg and Tokyo in terms of scale distribution of the building footprints. Smaller scale buildings were much more frequent in Tokyo for all urban types. Building footprints of under 750 m² consisted of 32% and 24% of all buildings in Tokyo, while in Gothenburg the percentages for those scales were 4% and 22%, respectively.

However, looking at the proportions between the types within the same cities, we observed a gradual decrease of smaller scale buildings from Type 1, and to Type 3, and then to Type 2. Also, more vacant lots are observed in Type 2 in both cities.

5. Discussion

The graphs on density analysis of the study sites showed generally higher density in Type 1 areas in both cities. Gothenburg showed even higher density in those areas than Tokyo. The designed compact city areas of Type 3 in Gothenburg showed much lower density, which was rather similar to that of modernist designed Type 2 areas of

Tokyo. The study of the median levels of density showed a much more even distribution of density in overall Tokyo, with a more consistently clustered density distribution throughout (see Figure 8). In Gothenburg, the highs and lows of the density were greater, with urban areas varying significantly from larger unbuilt sites to extremely dense sites. Type 1 Gothenburg areas showed much higher density than that of any other Type in both cities. Also here, extreme highs and lows were observed, compared to the more contained distribution of the Tokyo sites (see Figure 11).

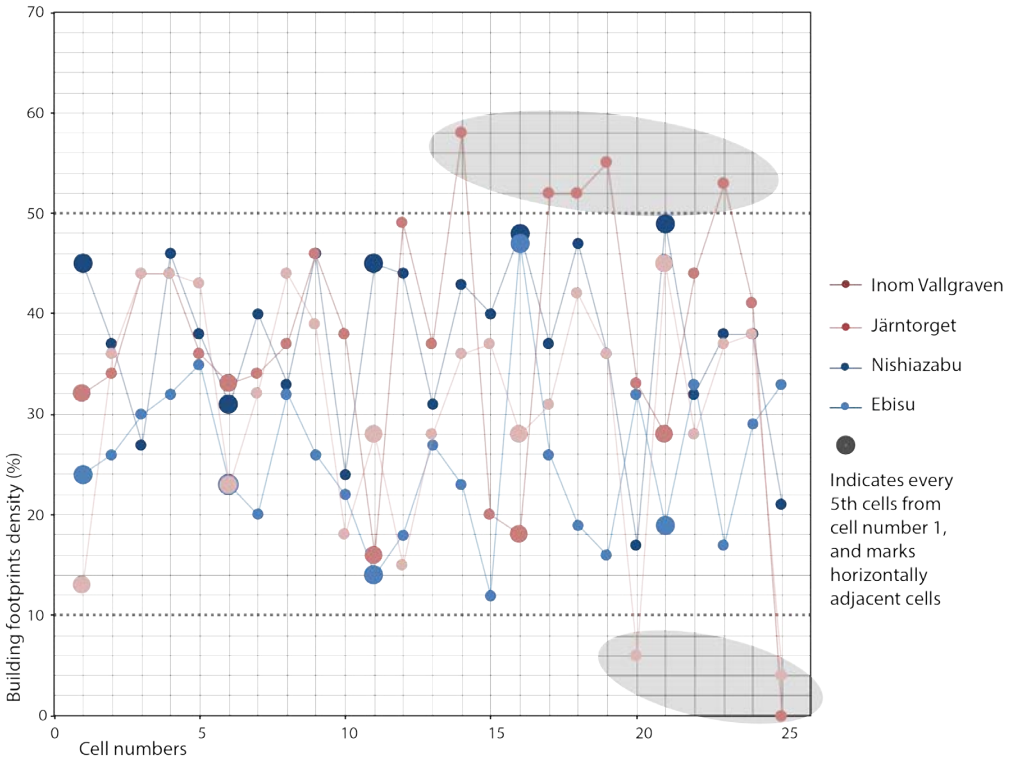


Figure 11. Graph showing the density of each cell in all four Type 1 areas. Highs and lows in Gothenburg are shaded grey.

When looking at the the scale and distribution/diversity of building footprints across the study areas, including streets and unbuilt surfaces, the building shapes and configuration of Gothenburg's Type 3 areas exhibited resemblance to the reductionist oriented Type 2 areas of both cities, rather than the intended compact city type seen in Gothenburg Type 1 areas (See Figure 9).

However, when looking at distribution/diversity of just the building footprints, the results told a somewhat different story (see Figure 12). A comparison of the scales of building objects within each city showed an increasing scale from Type 1 to Type 2 and then to Type 3. Also, the relative number of buildings found in respective study area was highest in Type 1 areas and lowest in Type 2 areas in both cities, while Type 3 areas remained in-between. However, assuming that the whole Type 3 areas would be developed in the same manner as the individual intensification projects, Gothenburg's Type 3 actually started to resemble Type 1, while in Tokyo, this adjusted value of Type 3 resembled that of Type 2 areas (See Figure 12). The density and mixed-use oriented design approach in Tokyo (Type 3) had thus resulted in a lower quantity of buildings in a dense composition, emulating the density of Type 1 but the building scale and distribution of Type 2. In Gothenburg, it was unclear if the densities or building scales exhibited any characteristics similar to the emerged urban form of Type 1. The slight increase of density was rather insignificant. However, the increase of the number of buildings found in the two Type 3 areas, almost to the level found in Type 1 areas, seemed to indicate some of the characteristics found in Type 1.

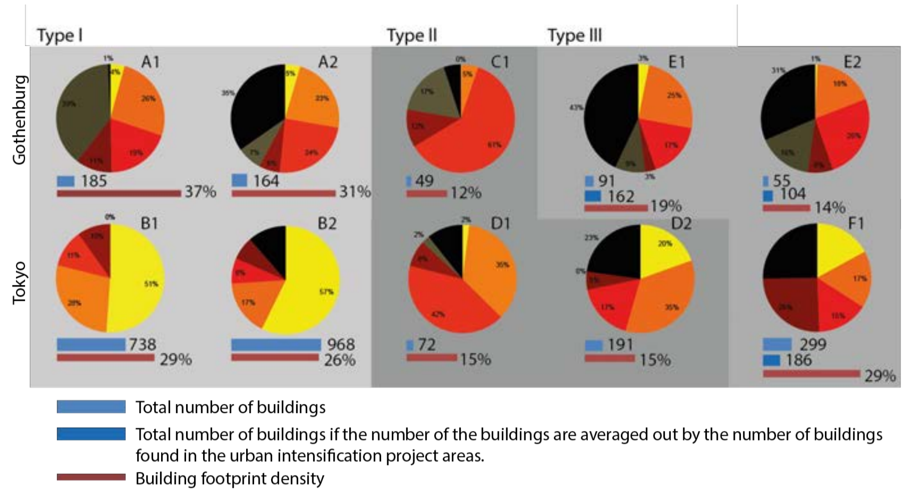


Figure 12. Comparisons of scale distributions of the building footprints in the two cities. Numbers of buildings found in each study area is shown. As a comparison, for Type 3 the figure also shows the projected number of buildings as if the whole study area would have contained the same number of buildings as the intensification development sites. The percentage of building footprint density is provided for reference.

Furthermore, it might be speculated that wider roads and existence of larger public areas are contributing factors to the variation of density in Gothenburg seen in Figure 11. A quick tracking of visible parking spaces in two of the areas in Gothenburg and Tokyo showed larger parking spaces distributed less evenly in the Gothenburg Type 1 area (see Figure 13).

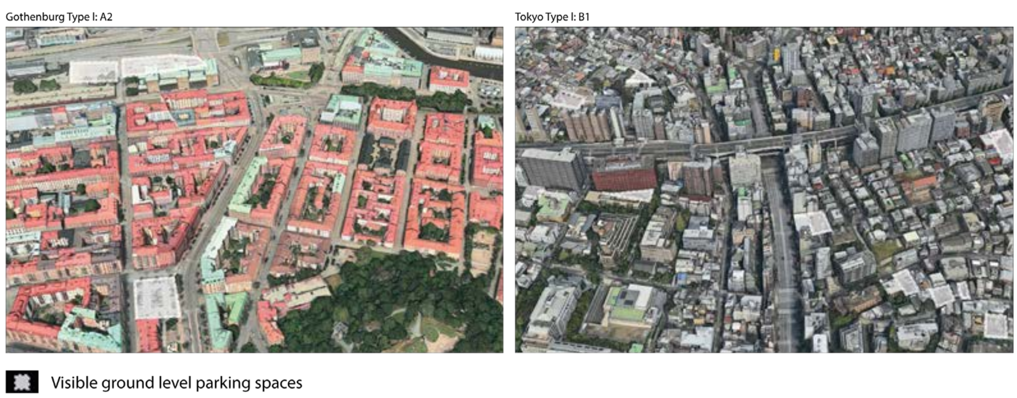


Figure 13. The bird's eye-view of Type 1 study areas in both cities with marked ground level spaces designated for parking

It is not surprising that the results showed reduced density and less diversity in areas designed with the reductionist approach (Type 2) compared to the areas designed with a density and diversity oriented approach (Type 3) in both cities. However, the observation that areas designed compact city areas in ongoing urban intensification programs in Gothenburg have a density that was closer to that of the suburban Million Program area than to the density of the city core seems more remarkable. This might be due to the fact that these intensification plans were subjected to a waterfront development where the 'Compact city' motto is immediately followed by a 'Close to green areas' motto (Gothenburg city, 2012). To confirm this assumption, an additional analysis was carried out, focusing only on the project development areas, thus disregarding previously existing green areas and surrounding housing areas (see Figure 14). When the result was compared to the total scale distribution and density of the study areas, it displayed slightly increased density. However, the building scale distributions in the newly built intensification areas were much simplified, resulting in less diversity of scales compared to what was found in the total areas. This seemed to indicate that while the density efforts emulated Type 1 areas, the scale distribution followed the pattern observed in Type 2 areas.

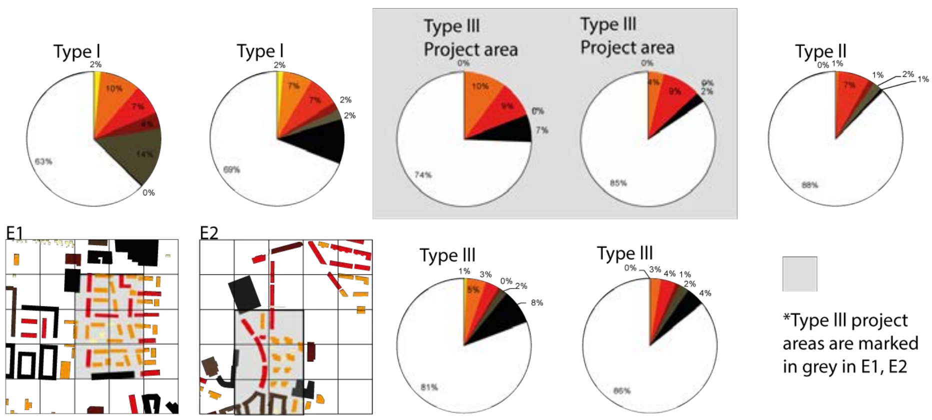


Figure 14. Proportions of scale distributions of building footprints of Type 3 areas in Gothenburg re-analysed focusing only on the newly developed parts of the study area.

For Tokyo, the results showed designed compact city of Type 3 actually displaying an overall density similar to the Type 1 areas. Once again, we singled out the Roppongi Hills project area and re-analysed the density and the scale distribution and compared the results with the total study area and also to the other areas studied in Tokyo (see Figure 15). The extended analysis showed that also in this case, the project area had an increased density. However, it also showed a reduced proportion of smaller scale buildings, resulting in less buildings with footprints of under 1,500 m² than in both Type 1, Type 2, and the rest of the Type 3 area. The secondary analysis of the Type 3 areas in both cities seemed to indicate that an increase of the density was possible to engineer through urban design, while the design of diversity of building scales was not.

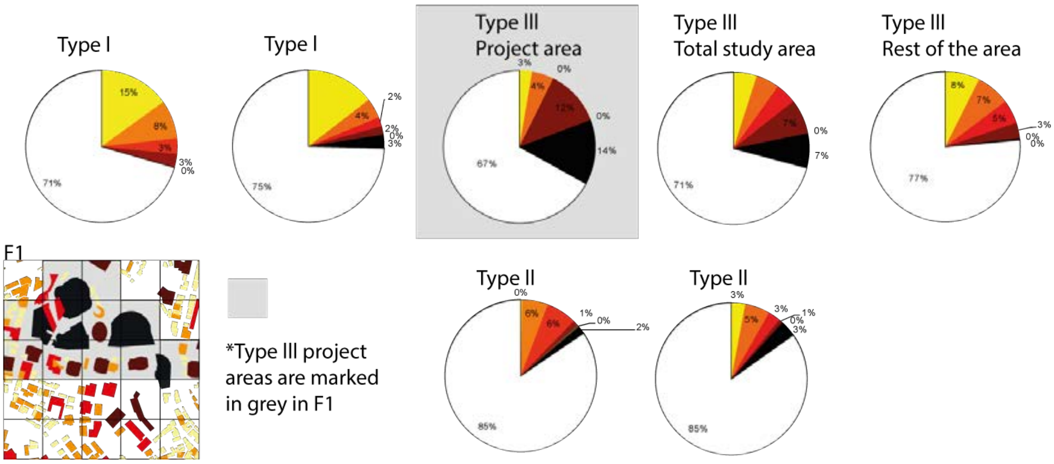


Figure 15. Re-analysis of the Type 3 area in Tokyo. The overall Roppongi area is divided into the Roppongi Hills project area and the surrounding area.

To sum up the findings on density and diversity, it was only in Gothenburg that density distinguished Type 1 from Type 3. An increase of building scales and uniformity of scale distribution was observed in Type 3 areas in both cities. The analysis of quantity of built objects was showed contrasting results in the Type 3 in both cities. However, higher density, a higher quantity of small-scale built objects and a more even distribution between the scales seemed to indicate the presence of a kind of compact city form in Type 3 areas in both cities, compared to Type 2 areas.

If we apply Ahern's (2011) resilience characteristics shown in Figure 1, increased density and number of built objects potentially indicate the required multiplicity of elements and components required for redundancy and modularization. Benefits of multiple, diverse agents for resilient and adaptive urban systems have been pointed out by many researchers (Quigley, 1998; Bettencourt, 2013; Glaeser, 2011; Bettencourt & West, 2010), and the characteristics of the emerged Type 1 seem to concur with those characteristics, if we consider a parcel as an individual agent (Hoffmann-Axthelm, 1993, 1996; cited in Scheurer, 2007). For Type 3 this is less obvious. An emergent system could be regarded as a processes of incremental adaptivity by diverse agent's self-modification, and interaction, and the characteristics of emergent urban form is the outcome of this processes. Even though the urban intensification projects in Gothenburg waterfronts, represented by the two Type 3 study areas Kvillebäcken and Eriksberg, aim to implement incremental development strategies with varying phases of construction assigned to multiple actors, Figure 16 shows that this incrementality is designed already during the initial master planning process.

Figure 16. Images show the information regarding the phasing of the project development

The images in Figure 16 also show how the planned diversity of employed design firms and of urban functions is designed already at this early stage. A certain degree of density and variety of scales may possibly be emulated in planning processes if the parameters are set to achieve such characteristics. However, it seems that true diversity of scales as consequences of emergent design processes through adaptation and incremental development is not delivered by pre-designed incrementality with a pre-assigned and controlled diversity.

One critique of the Kvillebäcken and Eriksberg areas in Gothenburg concerns the high rents and purchase fees in the project areas. The average rent per m² per year in Gothenburg for a one room apartment is 1,251 SEK (Statistics Sweden, 2015), while the lower rent scale for a one room apartment is 2,101sek per m² and year in Kvillebäcken (Kjellberg, 2015). The rent in Roppongi Hills residence is also much higher than the average of the same ward, costing 7,480 JPY per m² (Moriliving, 2015) compared to the 4,409 JPY average (REINS, 2015). Newly built apartments being expensive is not a new phenomenon. However, when large neighbourhoods are solely composed of costly new apartments, any diversity of the socio-economic demography can hardly be achieved. Kvillebäcken is especially criticized for negative gentrification, not least since the development of the site involved the removal of existing buildings and activities (Thörn, 2013). In this case, an incremental 'adaptive process' through time and space could proven to contribute more to the resilient characteristics of urban form rather than what was achieved through the pre-designed and pre-determined processes only mimicking incrementality (Neuman, 2005; Alexander, 1965).

In comparison with Gothenburg, the Type 1 study areas with emergent urban form in Tokyo showed slightly lower but more uniform rates of density, with higher proportion of smaller buildings and overall quantity of buildings (see Figures 8 and 10). The distribution of this type is prevalent in the overall Tokyo metropolitan area. It is interesting to discuss whether the less problematic class segregation issues observed in Tokyo (Fujita & Hill, 2012) might relate to these urban-form characteristics. It is speculated that contributing urban form factors might be a well-networked public transportation, renewability of aged buildings and housing stocks, smaller scale real-estate development, and less strict land use which create micro pattern of land-use with mixed functions (Fujita & Hill, 2012). Presumably, such patterns of multi-functionality, redundancy, modularization and diversity (Ahern, 2011) can be seen to increase socioeconomic resilience to the benefit of less affluent citizens.

Tokyo is operating under an overarching 'rule-based' planning approach with a highly mixed accumulative zoning, where building standard laws are consistent to 'planning by coding' (Marshall, 2012). The implementation of the zoning codes is top-down, thus indicating, also the 'planning by development control'. Compared to Type 2, shaped through 'planning by design', and Type 3, delivered through 'planning by development control', and 'planning by design', the question weather 'planning by coding' generates more emergent behaviour with incremental adaptive changes as seen in Type 1 needs to be further studied. Also, our understanding of how Tokyo's rule-based planning approach – and its outcomes – came into being would be further strengthened from understanding more about how the historical background of urban development processes in Tokyo plays into this. First, the lack of centralized planning can be explained by the post WW II situation. After the destruction of the city structure during the war and the great Kanto earthquake, a prevailing lack of resources resulted in a lack of centralized planning, leaving the city to be reconstructed by citizen efforts, neighbourhood by neighbourhood, mimicking structures existing before the destruction (Hein, 2010, Okata & Murayama, 2011). Second, land reform policy of post WWII forced agricultural landlords to sell land to smaller farmers, resulting in piecemeal land divisions with a diversity of smaller scale independent actors (Kawagoe, 1999). Third, as railways were constructed the areas were developed around each station, so that the next station could be expanded with the capital gains from the real-estate development, incrementally expanding the city station by station (Okata & Murayama, 2011).

6. Conclusions

This paper sets out to answer the question:

1. What are the differences in outcome of different planning approaches in relation to urban characteristics, such as density and diversity?

We have shown how different planning approaches seem to deliver very different outcomes when it comes density and diversity of built objects. While the process of Type 3 development (designed compact urban form) to some extent emulates Type 1 (emergent compact urban form), some of the differences seem to be critical to the detriment of Type 3 planning:

1. The time factor. By completely eliminating the existing building stocks and activities on site, as was done in the Kvillebäcken area, the planners also eliminated the time factor, leading to a total lack of incrementality and with no remaining population to engage in post-destruction piecemeal reconstruction.
2. The lack of diversity of building scales and absence of smaller estate patterns. Even with the efforts to involve multiple design and development companies to create diversity, the uniformity of overall scale still remains. Also, higher costs in larger scale development projects seems to contribute to a less diverse mix of socio-economical demographics.
3. Employment of a top-down planning hierarchy. The main planning body analyses and draws up a form plan, which is then approved by the city council. Multi-actor participation is only served through designing individual buildings assigned to them centrally, through 'planning by design' and 'development control' (Marshall, 2012).

Here this study might be able to contribute in relation to the how planning is carried out in Gothenburg, currently mixing 'planning by design' with 'planning by developmental control' (Marshall, 2012). We have shown how parameters, such as timing, density, building scale diversity, and decentralization of planning and design activities to multiple actors are critical factors also in large scale development projects, for example in brown-field regeneration or urban infill areas. Although these parameters need to be studied more in-depth, with consideration to the local context for understanding the optimal level of timing, density and building scale in site areas. The 'planning by coding' (Marshall, 2012) strategy, with 'generative' rules, seems to offer a promising third path also in Swedish urban regeneration for density and mixed use, as seen with the rule-based approach in Japan. Consequently, feasibility studies for implementation of 'planning by coding' or rule-based planning strategies should be carried out to support incrementality whenever possible.

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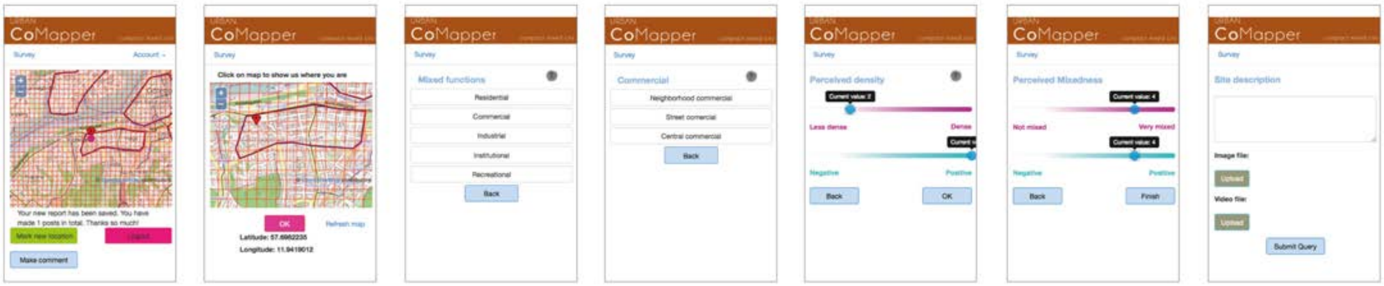
Appendix 4: Urban CoMapper - Compact mixed city

Mobile web-app



URBAN
CoMapper
Survey
Account
Your new report has been saved. You have made 1 posts in total. Thanks so much!
Mark new location
Make comment
Click on map to show us where you are
OK
Refresh map
Latitude:
Longitude:
Mixed functions
Residential
Commercial
Industrial
Institutional
Recreational
Back
Commercial
Neighborhood commercial
Street comercial
Central commercial
Perceived density
Less dense
Dense
Negative
Positive
Perceived Mixedness
Not mixed
Very mixed
Finish
Site description
Image file:
Upload
Video file:
Submit Query

Appendix 5:
Urban CoMapper - Compact survery sequences

Urban CoMapper survey sequences

1. Participants registered with basic information regarding age and affiliation
2. Participants clicks 'OK' on the welcome screen.
3. Map of overall area including all study sites is shown with the grid over-layed. Participants can either 1. Mark a new location, 2. Make a comment, or 3. Logout.
4. By clicking on 'Mark New location', zoomed in map with exact location of the participant is shown. Participant confirms that the location is correct.
5. Participant marks the perceived density of the space.
6. Participants marks the perceived negativity or positivity level regarding the density of the site.
7. Participants chose a perceived zone between; 1. Residential, 2. Commercial, 3. Industrial, 4. Institutional, 5. Recreational.
8. Upon choosing the perceived zones, participants further choses the subcategory of the zone.
9. Residential; a. Mostly residential, b. Very residential
10. Commercial; a. neighbourhood commercial, b. Street commercial, c. Central commercial
11. Industrial; a. Mostly industrial, b. Industrial
12. Institutional; a. Hospitals, b. Schools, c. Administrative
13. Recreational; a. Parks, b. Museums, c. Sports
14. Participants are then to chose a perceived level of mixedness from value between 1-5, with 5 as highest value.
15. Participants are then to chose a perceived negativity or positivity regarding the perceived mixedness
16. Participants are guided back to the screen 3. Participants can either 1. Mark a new location, 2. Make a comment, or 3. Logout and finish the survey.
17. If the participants chose to mark a new location, then the sequences from 4-11 are repeated.
18. If the participants chose to make a comment, then participants can input text description of the site, or motivation for the perception level inputted through the survey, and upload a photography of the site.
19. Participants can either chose to mark a new location or log out.

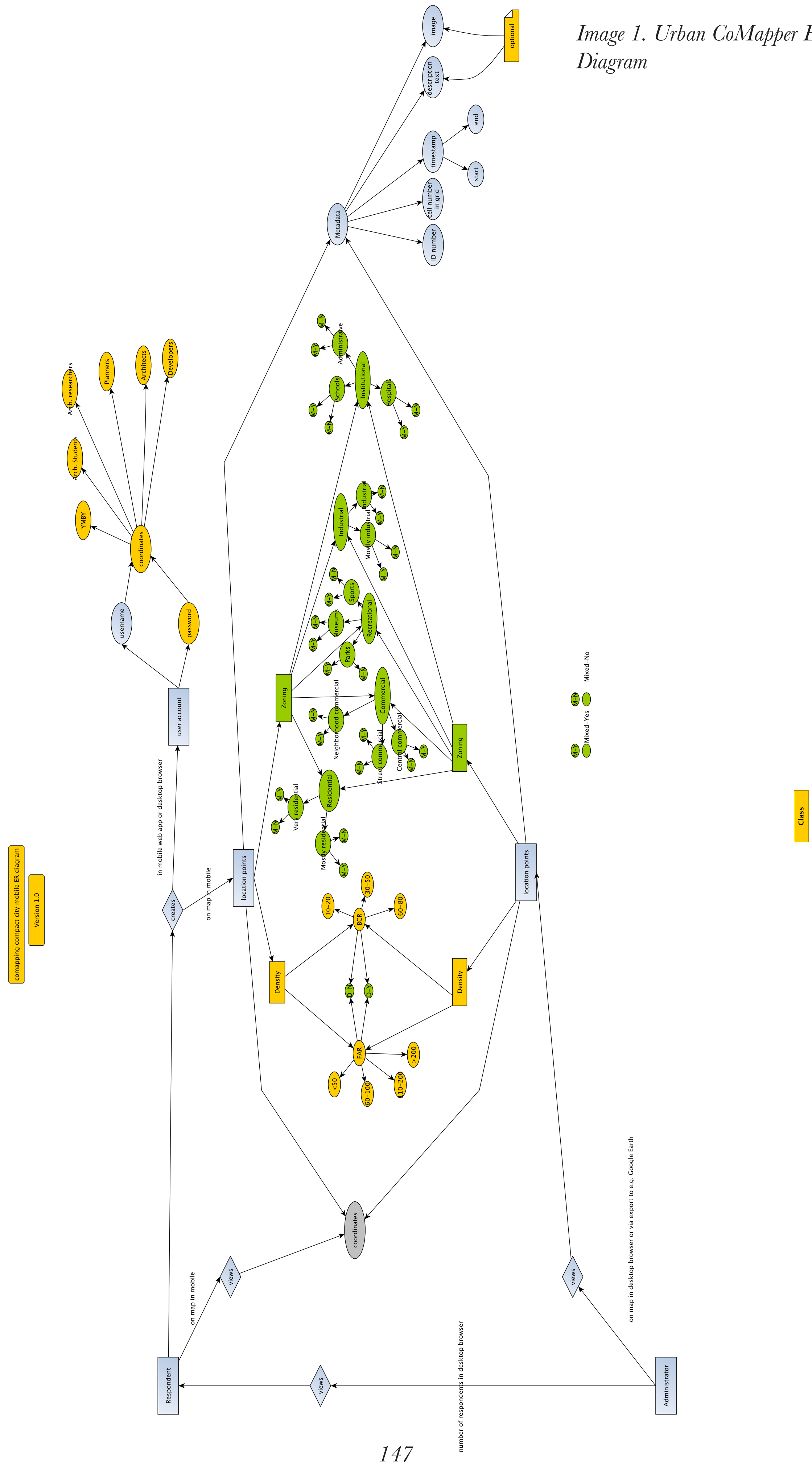


Image 1. Urban CoMapper ER Diagram

Appendix 6:
Identifying relevant design elements of the compact city for portside residential areas

Journal paper manuscript

Identifying relevant design elements for compact city design of portside residential areas

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Abstract (Teresa)

Today, global policies emphasize the importance of compact city models for the resilient urban future. Especially, considering increasing complexities in urban matters, unpredictability of the future outcomes, as well as the increasing population density in urban areas, it is of utmost importance to include citizens perceptions in urban planning and into the design process of compact cities.

With an empirical research approach, we survey citizens of two large portside residential areas to identify and prioritize urban design elements. The survey was distributed in the two cities of Gothenburg, Sweden and Nansha, China. Both facing new development plans on the waterfront areas to test if local contexts apply in general citizen priorities. The survey reveals citizen priorities of design elements and also discrepancies of perception on terminologies used.

Keywords: public perception, citizen participation, waterfront residential areas, compact city

1. Is compact city a solution to unpredictable, complex urban challenges?

1.1 Compact city policies

Cities globally are faced by various unpredictable, and complex challenges, such as climate changes, resources depletion, population migration due to global conflicts, and economical instabilities. Waterfront cities, are challenged by additional issues, due to rising water levels, increased flooding, and often with land-reclamation issues. Some of the development plans for waterfront areas are tied to brownfield regeneration or urban regeneration plans, either on ex-shipyards or adjacent to an existing or planned shipyards. In urban regeneration or intensification context, waterfront development need to consider the resiliency of the place, in consideration to both environmental and climate issues; flooding, rise of water levels, extreme weather conditions, and the social sustainability issues. In response to the future unpredictable disturbances, global and local policies (UN Habitat, 2011; 2013; 2014; 2015, European Commission, 1990; 2011, OECD, 2012) propose 'Compact City' as the necessary resilient future urban form.

The various policy guidelines summarises the desirable characteristics of compact city as follows (UN Habitat, OECD);

1. Diversity of: of urban functions, socio-demographic layers, modes of infrastructure, modes of accessibility to utilities, etc.
2. Density: including proximity to other agents, facilitation of networking and communication, intensity of shared resources and information, etc
3. Accessibility through: networkability, diversity of trajectories, self-organisability

Some of the terms used in the characterization of 'Compact City' are defined as (UN Habitat, OECD);

1. Compactness: Measurable in terms of density of built areas, population, and the concentration of urban functions.
2. Mixed use: Variety of compatible land uses and functions, provision of a cross-section of residential, commercial and community infrastructure in neighborhoods.
3. Social-mix: presence of residents from different backgrounds and income levels in the same neighbourhood

Based on these guidelines, UN Habitat (2014) recently published an additional directives concerning the parameters of compact city with more concrete values which are encouraged to be implemented in urban planning and design.

1. *Adequate space for streets and an efficient street network*
   The street network should encompass at least 30 per cent of the land with at least 18 km of street length per square kilometer.
2. *High density*
   At least 15,000 people per km; that is, 150 people/ha or 61 people/acre.
3. *Mixed land-use*
   At least 40 per cent of the floor space is allocated for economic use in any neighbourhood.
4. *Social mix*
   The availability of houses in different price ranges and tenure types in any given neighbourhood to accommodate different incomes; 20 to 50 per cent of the residential floor area is distributed to low cost
   housing, and each tenure type should be no more than 50 per cent of the total.
5. *Limited land-use specialization*
   To limit single function blocks or neighbourhoods; single function blocks
   should cover less than 10 per cent of any neighbourhood.

1.2 Compact city paradoxes

However, even with these guidelines, the consensus on what a 'Compact city' is, is still under debate, due to global implementability issues relating to local urban context (Katie Williams, 2007, Bardhan, Kurisu, & Hanaki, 2015), multiplicity of existing indexes (Lee, Kurisu, An, & Hanaki, 2015), and even the feasibility or the meaningfulness of defining a compact city as urban form (Neuman, 2005).

The proponents of 'Compact city' highlights the benefits of increased economic productivity (Quigley, 1998; Glaeser, 2011; Bettencourt, 2013), social cohesion (Bramley & Power,2009), reduced fuel consumption, reduction in energy use as well as reduced depletion of nature land areas (Mindali, Raveh, & Salomon, 2004; Chatterjee, & Hunt, 2007). Furthermore, compact and mixed type urban typology is promoted as being more resilient (Offenhuber & Ratti, 2014; Ahern, 2011), due to its capacity to provide redundancy of functions and infrastructural choices, capacity to network resulting from agglomeration of agents and proximity, providing complex response diversity to disturbances (Glaeser, 2011; Bettencourt

& West, 2010; Quigley, 1998). Studies also show diversity of business types and sizes as cities increase in population, showing how the accumulated complexity trigger further diversity and novelty of activities, eventually increasing the economic capacity of the city (Youn &, Bettencourt, 2016). However, other studies showing negative impact of urban compactness argue that density lowers the neighbourhood satisfaction (Bramley & Power, 2009), sense of community attachment and worsened quality of public utilities (Dempsey et al., 2012), induces perception of crowdedness, and thus worsened psychological health (Haigh, Ng Chok, & Harris, 2011). Others also highlight the bigger income gaps, higher consumption rate in the dense cities (Heinonen & Junnila, 2011), decreased living spaces and accessibility to green spaces (Burton, 2001). However, it is also contemplated that the negative impact of dense urban forms might be derived from the urban design problems, independent of the density value (Kearney, 2006). In his argument, a change of sightline towards neighbouring building can induce different perceptions of crowding (ibid.). Some even argue that the income gap and concentration of impoverished groups might be caused by accumulation of wealth and migration of low income people towards the bigger cities which offer more job opportunities (Bramley & Power, 2009; Glaeser, 2011). The results on benefits of compact city is vastly contradicting, and this might be due to the vague definition of compact city (Neuman, 2006) and might be due to the vagueness or diversity of definition of density (Azra,).

Upon examination, most of the positive aspects of compact city described above, originates from the embedded complexity inherent in 'compact city' setting due to proximity/density and the diversity/mix-use (Bettencourt, 2010; Glaeser, 2011). As Neuman noted in his 'Compact city fallacy' (2006), the problematic of compact city might come from the efforts to define an urban form as a solution, adopting the same criticized approach of reductionism, rather than focusing on the processes which generates such characteristics or complexity. In the next chapter, we will examine some of the planning approaches that concern the complexity perspective.

2. Compact city through urban planning processes

2.1 Spatial agency: Citizen participation and consensus

These compact city policies are often carried out through urban intensification projects with compact urban development visions and in most cases, citizens live in and around these areas are directly affected. In addition, these urban policies are jointly promoted with policies stating that the public should be involved in creating more resilient urban conditions and work in intensification projects (UN Habitat, 2015; EU commission, 1988; 2008). Both EU commission's and UN Habitat's policy papers on governance emphasizes the importance of enabling the participation of public and citizens in decision making and in the making of their environment. The listed methods for implementation include, transparency of information, support for participation, public education and efficient use of information and communication technologies (ICTs) to offer new opportunities for democratic mobilization (ibid.).

Spatial agency is a concept that the agency of planning and organizing the built space should be given to the users (Awan, Schneider, & Till, 2011). It incorporates the thematic such as complex systems in urban planning approaches by gradually handing over the agency and power to the individual agents. The introduction of the bottom-up hierarchy in planning processes through communicative/collaborative approaches is thought to improve self organizing and networking by the agents through negotiations, assessments, and consultation (Healey, 1999; Innes, 2010). In this perspective, identification of the agents and the relationships between them come into focus, so that the handing-over processes can be best realized in various forms that accord with the socio-cultural conditions of the locations(Awan, Schneider, & Till, 2011) . These planning approaches to 'include' the public have given rise to various public participation methods, such as communicative planning (Healey, 1999) or collaborative rationality (Innes, 2010) by understanding the general consensus between the agents. However, these methods were also criticized for its lack of possibilities to include the 'future generations' into the discourses, and the impact on environment by the decisions of individuals and institutions, even with the prevailing consensus of concerns for the environment (van Diepen & Voogd, 2001). Also criticised is the lack of implementation strategies to fully hand over the agencies within the existing top-down hierarchical processes (Healey, 1999, Schneider et al., 2009). Inevitability of superimposed policy rules, especially concerning environmental issues as an added layer could supply more resilience to these approaches (Bettencourt, 2013; van Diepen & Voogd, 2001). Nevertheless,, these initiatives to create consensus still provide vast information on the properties and the capacity of the agents and the relationships between the agents. Simply, with the current planning system's obstacles to design a new urban areas solely based on this collaborative methods, without the city's master planning or top-down rules in implementation, it is meaningful to investigate whether existing participation methods (in this case, during consultation processes) can be improved, until gradually, more influence can be performed by the citizens.

2.2 Citizen perceptions research and dilemmas

To gain insight into citizen's consensus in urban context, such as in a form of 'satisfaction' and to include citizen perspectives on planning matters, the citizen perceptions on urban planning have been researched methodologically, especially regarding, the perception of density, safety, walkability issues within the disciplines of environmental psychology and urban geography. The complexity of such research starts from the lack of consensus on definitions of urban terms that are generally used in urban surveys. For instance, relationship between the urban density, and neighborhood satisfaction, perception of safety, citizen health have been a focus of recent urban researches, especially with the guiding policies steering towards compact city solutions. However, there is lack of consensus on definitions of 'density' (Arza, 1999; Boyko, 2011) as well as 'neighborhood' (Dempsey, 2009), the two common terminologies used for assessing citizen's urban perception.

Then the complication continues as to HOW to quantify the 'perception' of values. Various studies from criminal psychology with vast amount of researches on discrepancies between the 'Perception', and 'Conception'. Causality/correlation problematic (Oyeyemi et al. 2012, Saelens et al. 2003, Leslie et al. 2005) also generates different results on researches on perceived qualities and behavioral consequences, ie. 'Do we choose to live in a walkable city because we do not have a car, or do we not own a car because we already live in a walkable city?' Also the survey methodologies have certain problematic. Text based surveys might not portray the perception or the perceived information without participants conceptualizing it first (Bonaiuto, 2003, Salesses, 2013, Schroeder, 1983, Oyeyemi et al., 2013,) and image based surveys also face dilemmas with its limits to represent the 3D space that is a physical built environment. (Schroeder, 1983, Salesses, 2013, Quercia et al., 2014) In addition to that, the socio-cultural differences even within a confined geographical regions (Oyeyemi et al., 2013, Arvidsson et al., 2012) can portray differences of perception of the same urban areas, thus rendering the consecutive actions taken in the built environment vary.

2.3 Residential area design elements, perceived quality and compact city

In terms of the residential development, numbers of studies make their efforts in the discussion of the quality of the residential area. There emerge a number of similar terms applied in urban environmental studies related to residential environment, such as urban environmental quality, livability, quality of life, quality of place, residential-perception and satisfaction, sustainability, etc. (Van Kamp et al., 2003). Van Kamp et al. (2003) through the research of relationship between environmental quality and quality of life, suggest that the quality of the residential area is determined by residents' living perception, expectation, evaluation, and satisfaction in terms of the environment of residential communities, and the relationships between residents and environment formed through residential planning and design (Van Kamp et al., 2003).

Carp et al. identify six clusters of the 20 factors that could be interpreted meaningfully as dimensions of residential environmental quality. The factors include noise, esthetics, neighbors, safety, mobility, and annoyances. In addition, Mithell argues that quality of life components include health, physical environment, natural resources, goods and services, security, personal and community development (Van Kamp et al., 2003, as cited in Mithell, 2000, 2001). More broadly, the domains of human livability and environmental quality involve lifestyle, culture, community, safety/security, natural environment, natural resources, built environment, public services accessibility, economy, health, and personal characteristics (Van Kamp et al., 2003).

Through matrix analysis and case study applications, it has also been suggested that connection and character are the most important quality with respect to physical form, and "the top physical form criteria include: a walkable community, outdoor amenities, lots of seating, barrier free, and open space areas in residential areas" (Smith et al., 1997).

The View of greenery and close proximity to green space are argued to be beneficial to human health through various mechanisms such as reducing stress and satisfying the innate human attraction to nature (Jackson, 2003). On the scale of neighborhood, social capital appears to be the critical issue to human health and the links between social capital and green space has been proved. In addition, there are debates about whether high residential density, land mixed-use, and gridded street patterns could actually maximize social contact and physical exercise. Meanwhile, other components of neighborhood design related to human health and welfare include the presence of public buildings, landmarks, and conductive walkways (Jackson, 2003).

In a research by Kearney. A. R.(2006), on impact of density and green space on neighborhood satisfaction shows how the urban design elements such as community shared space, nearby nature, the view and distances interactively play a role in satisfaction of inhabitants. For instance, the negative perception on neighborhood density did not depend on the density per se, but on the presence or absence of view to natural elements, such as trees or nature. Reducing the direct view to the neighboring buildings also contributed in reduced negative perception on density matters. While the use of semi-developed shared space, such as playground or ball-field contributed more to sense of community compared to the shared nature areas, the access to both types of spaces contributed to the positive perception of neighborhood, disregarding the distance to the nature itself.

The design elements listed above including; nature, shared spaces, public amenities, economy, aesthetics, and design parameters, such as ; a view to, distance to, access to, affordability to need to satisfy both psychological(sense of belonging, sense of community) and physical(health, mobility) wellbeing. Identification of the citizen preferences of these relevant design elements and the parameters, in combination with the insights into the individual definitions of value terms of the citizens, it might help clarify the relevancy of certain manipulable planning design parameters in port city waterfront residential area planning and designs.

The identification of citizen preferences on such implementable design elements, especially regarding the use of ICTs offer various opportunities to understand the inhabitants and their demands as well as to build consensus among them. The dynamics of the relationships and the demands of the inhabitants in relationship to the built environment can be extracted.

As noted in the previous chapter, the consensus on what kind of city citizens want does not directly interpret to what the citizens do for which motivations (van Diepen & Voogd, 2001). Relating to the design elements concerning the 'Compact city' qualities, both density and mix-use have contradicting research results on perception studies, even though the concept of the terminology, such as density vary (Arza, 1999; Boyko, 2011).

3. Study objectives: Citizen prioritisation between the compact city quality as design elements.

There is a lack of understanding the citizen priorities in the choices of residences regarding the compact city qualities in portside waterfront cities; even though, the visual qualities and green housing can be seen as important factor in idealised design elements, underlying priorities regarding what is the most important factor in choosing to live in such area can vary. As van Diepen and Voogd indicate human greed as motivation for the choices, when it comes to individual decisions, if the compact city qualities can be an attractor to an urban area is unclear. If the qualities of compact city is an attractive factor for the choice of residence, then identifying which compact city quality could be prioritized might render meaningfulness.

The lack of consensus on the terminologies used in description of compact city qualities, such as density, mix-use, accessibility to public transportation and/or to utilities can be problematic in the urban perception surveys. This issue needs to be addressed in this research of citizen prioritisation.

As UN Habitat's guideline of compact city provide measures and parameters that should be implemented globally, for sustainable urban development, it would also be meaningful, if the research can provide some insight into differences of citizen prioritization in diverse local contexts.

Here we have chosen the 'perception' and the 'priorities' of the agents/stakeholders relating to the future built environment in portside city intensification areas as our research boundary. The preferences and prioritisation in relation to the elements of design based on the 'compact city' qualities, and the semantic consensus of the terms, through this comparative study aims to contribute further understanding of citizen perception and compact city qualities.

The present survey format takes consideration of this complex problematic and combines it with open-end questions on individual definitions of perceived concepts of design elements and values. The designed survey format attempts to validate the consistency of chosen preferences as well as to validate if the choice of values and parameters concur between the agents.

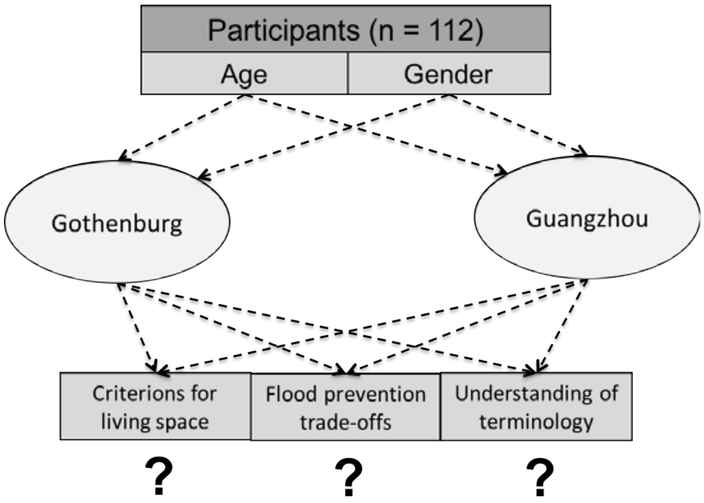
1. The citizen's preferences of endogenous and exogenous elements and values that can be implemented for port city waterfront residential planning are identified by a quantitative approach in form of an online survey. Therefore, prioritization of most important decision factors by citizens and identification of individual definitions of those factors were performed in this interdisciplinary collaboration.
    a. The endogenous relationship tests the qualifying properties such as individual definitions relating to the other agents, i.e. density, nature, mix-use.
    b. The exogenous relationship studies include the climate changes and flood risks, infrastructural relationships (Manesha et al., 2011) with focus to waterfront urban development for new residential areas.

2. The paper also explores the validity of urban surveys as a citizen participation tool. If the consensus can be articulated for certain aspects of planning priorities and if the consensus are achieved, whether, it's meaningful and clear, so that it can be implemented in planning processes.

3. Research Design

The research focuses on identifying citizens' priorities in choosing the residential spaces in waterfront areas. Their perception of built environment is estimated through analyzing the priorities of design elements and conditions that are perceived to be more important. This in turn allows an understanding of the needs and drawbacks of the yet unbuilt living spaces that are currently in development.

The survey simplifies definitions of the questioned values, such as 'density' or 'mixed', but rather than providing a preconceived definition of such values, it invites the participants to define the terms on their own understanding. This method provides a meaningful insight into the terms used in urban research and urban dialogues with the citizens as well as how they are perceived and understood:



Aiming also a broader spectrum of cultural differences, the survey was distributed in two different cities (and countries) with different socio-cultural, political and economical conditions, with one common factor that both cities focus on development of waterfront residential projects. The aim of this comparative research is to understand, if there is a major difference in citizen perception of their priorities of certain built environment. The final modified surveys were re-distributed from the 28th April until the 7th May in both locations, Gothenburg and Guangzhou, Nansha area.

4. Investigation areas

Among the cities by waterfront, two port city cases are specified: Gothenburg, Sweden, and Guangzhou, China to look into individual challenges as well as generic challenges as waterfront cities.

4.1 Gothenburg, Sweden

Gothenburg is the second most populous city in Sweden on the west coast approximately 400 km from Stockholm, 200km from Copenhagen and 300km from Oslo. Being on the west coast with the biggest port in Scandinavia, with activities with 25 % of all Swedish transport passing through, Gothenburg was a major point for shipyard industry of the region. However, with the subsequent downsizing of the shipyard after economic crisis starting from 2000, and final closing of all shipyard activities in the 2014, this ex-industrial area has been on the major agenda for the Göteborg City planning office. The city centers its urban intensification strategies around this waterfront area redevelopment plans to convert closed down port/industry activity brownfield into a new vibrant city area where the connection between the CBD and the cultural commercial hub across the river is achieved by both visual and functional ties. The Älvstranden Utveckling (Gothenburg City Council, 2012) focuses on creating ‘compact and mix city’ which functions as testbed for various planning strategies. The policy documents for development of this area emphasizes sustainable social development where various types both in the aspects of ownership and building types and functions are mixed. The vision and the objectives laid out by the city council is clear, however, as it is always a complex mix of citizens who will occupy the space, the test of survey methodology in regards to this new area development is highly relevant.

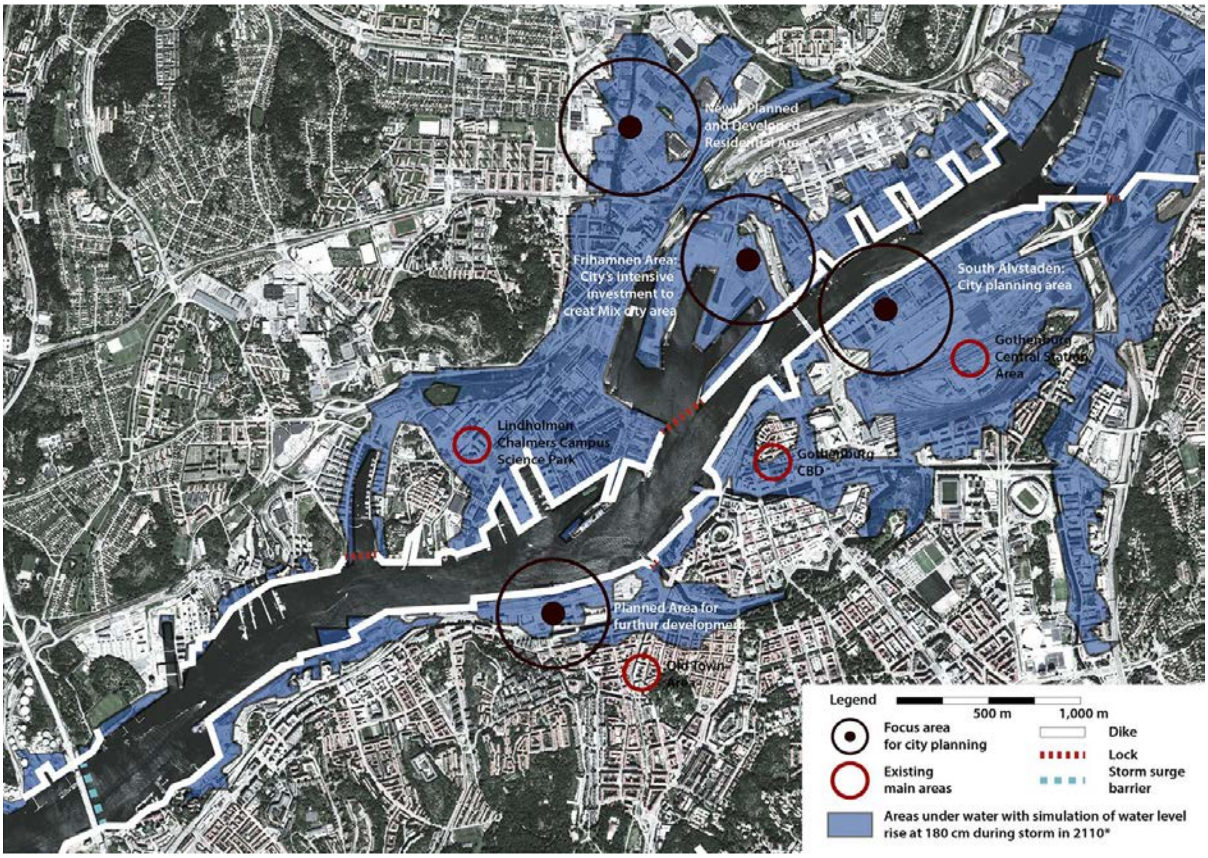


Image 1: The image shows the prognosis areas for flood and the planning areas at the waterfront in Gothenburg.

With the city investing its efforts in reviving the waterfront areas in the central Gothenburg, from the perspectives of climate changes and unavoidable measures the city needs to take, it is apparent that the efforts should be guided towards the impact of such measures being played in urban planning (source missing).

4.2 *Guangzhou, China*

Due to the advantage location, Guangzhou has been an important port city for China’s external trade industry, and Nansha district became the most important port area of Guangzhou. At present, Guangzhou Port is the 3rd largest port in China, whose cargo handling capacity ranks as the fifth among the ports over the world. It is also the main material distribution center and the largest hub port for international trade in Pearl River Delta area (PRD), or even in the south China. At the end of 2014, Guangdong free trade area (within Nansha area) was designated by the central government as large as 60 km^2, comprised of seven sub-parcels, ranging from 3 km^2 to 15 km^2. In addition, the sum coverage of land for port, transportation, duty-free logistics and processing zone has exceeded half proportion. Located at south of Guangzhou and near the mouth of Pearl River, Nansha district is 50km away from city center of Guangzhou. As the geometric center of the Pan-Pearl River Delta, is serving as the intersectional region between the Pearl River basin and the ocean. And Nansha district is located 38 sea miles from Hong Kong and 41 sea miles from Macau. As the geometric center of the Pearl River Delta, Nansha harbor district is a critical node connecting the city clusters along the two banks of the Pearl River. According to the sixth population national census data, the amount population of Nansha district ranges at second last in Guangzhou. The population density is 493 person/km^2, which could not satisfy the aim of being a new urban area. In addition, the population distribution is uneven within the Nansha district, especially that the population densities of surrounding towns are higher than Nansha. As a future portside city, Nansha is planned to housing 1 million urban people and to cover 100 km^2 urban construction areas by 2025, and then the Nansha district should have become a new large city.

Both cities (Gothenburg and Guangzhou) are therefore relevant case studies for our research question. We tried to let the population identify important factors for choosing a place to live, in order to generate new planning insights for regions like Nansha or Gothenburg.

5. Methodology

In this section, the questionnaire instrument is outlined. A first remark addresses the online survey instrument with subsections. Further the sample of participants with a first statistical overview follows.

5.1 Survey

The online survey was divided into five main parts.

Demographic variables: the first section included questions about demographic data as well as information about the period of time living in the city and if the participants are original from the city.

City and living information: The second part dealt more specific with the personal factors, which can influence the choice of an apartment/house. First, the closeness to the (next) city center is questioned. Then, the participants were encouraged to estimate the current apartment size. Further, participants were requested to rank different factors in order of personal importance: Apartment size (a), Amount of rent (b), Population density (c), Closeness to public transportation (d), Closeness to nature (e), Vicinity to utilities (f), Visual qualities (g), Closeness to work (h) and environmental quality (i).

City scenarios: In the third section, two city scenarios were introduced in order to help the participants envision the questioned areas of Gothenburg Frihamnen, Sweden and Nansha New District, China. The participants were asked to choose a personal importance level for different groups of design element factors: general characteristics (e.g. size of apartment), outdoor environmental quality (e.g. air quality) and indoor environmental quality (e.g. ventilation) in form of a 6-point Likert scale (1 = not important at all, 6 = very important):

How important are the given factors for you?		
General characteristics	**Outdoor environmental quality**	**Indoor environmental quality**
• Size of apartment	• Thermal comfort	• Orientation
• Closeness to nature	• Acoustic quality	• Acoustic quality
• Closeness to public & commercial utilities	• Visual quality	• Ventilation
• Amount of rent	• Air quality	
• Population density	• Lightning	
• Closeness to public transportation		
• Living close to work		
• Safe surroundings		

Table x: Item example of general, outdoor and indoor factors from questionnaire.

Preferences: The fourth section questions the personal preferences of design factors in relation to climate change and flood prevention measures. Here the participants were invited to decide, whether or not, they would trade of factors of personal importance (see second section) in order to implement measures, that need to be taken for flood control.

The last part of the survey encouraged participants to give feedback and comments to several topics like living close to nature and/or work, living close to public transport, the understanding of population density or definition of a "mix city". A feedback and opinion section with the topic "Urban areas" closed the survey.

5.2 Participants

A total of N=112 participants took part in this survey with an age range of 20 to 69 years (M=32.2; SD=10.2). With 42,6% men (N=46) and 57,4% women (N=62) the gender distribution was slightly asymmetrical. The participants can be divided in two main groups: I. citizens of Gothenburg (N=52, 46,4%) and II. citizens of Guangzhou (N=60, 53,6%). In the first city-group (CG Gothenburg) are 62,0% women (N=31) and 38,0% men (N=19). Mostly, the participants are not originally from the city (76,9%). A total of 35,9% lives in Gothenburg since more than 10 years, 23,1% are living there since 5-10 years, 15,4% since 3-5 years, 17,9% for 1-3 years and only 7,7% are living there less than 1 year.

In the second city-group (CG Guangzhou) are 52,6% women (N=30) and 47,4% men (N=27). The participants of this group are also mostly not originally from the city (74,1%). In total, only 4,8% lives more than 10 years in Guangzhou, 42,9% are living there since 5-10 years, 28,6% since 3-5 years, 16,7% for 1-3 years and 7,1% for less since 1 year.

6. Results

Due to the exploratory approach, the focus was set on a detailed description of the residential areas, learning about important factors and identify them as design elements for urban design planning. Further, we report definitions, benefits and barriers that are related to urban systems and urban life.

6.1 Decision factors for living

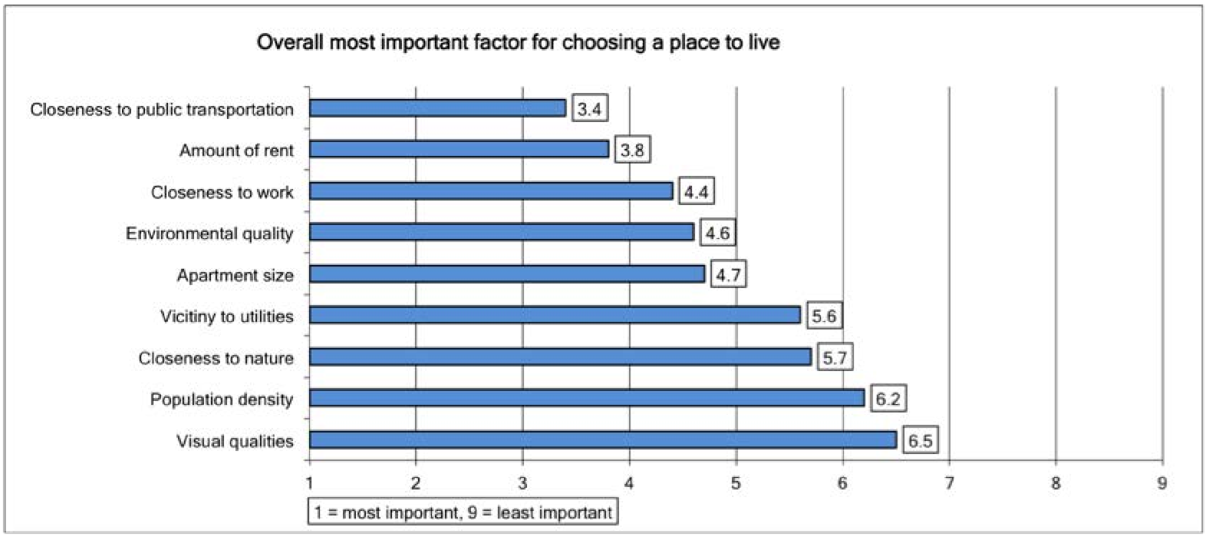


Figure 1: Ranking overview of key criterions for living space, N=112 (1 = most important for decision making, 9 = least important for decision making).

The overall statistics show, that closeness to public transportation is the most important factor, that people keep in mind when they choose a place to live (M=3.4, SD=1.8). The amount of rent (M=3.8, SD=2.4) and the closeness to work (M=4.4, SD=2.9) are also factors of high importance, shown by the mean values. In contrast, closeness to nature (M=5.7, SD=2.4), population density (M=6.2, SD=2.0) and especially visual qualities (e.g. a great view from the apartment) seem to be rather not important (M=6.5, SD=2.4).

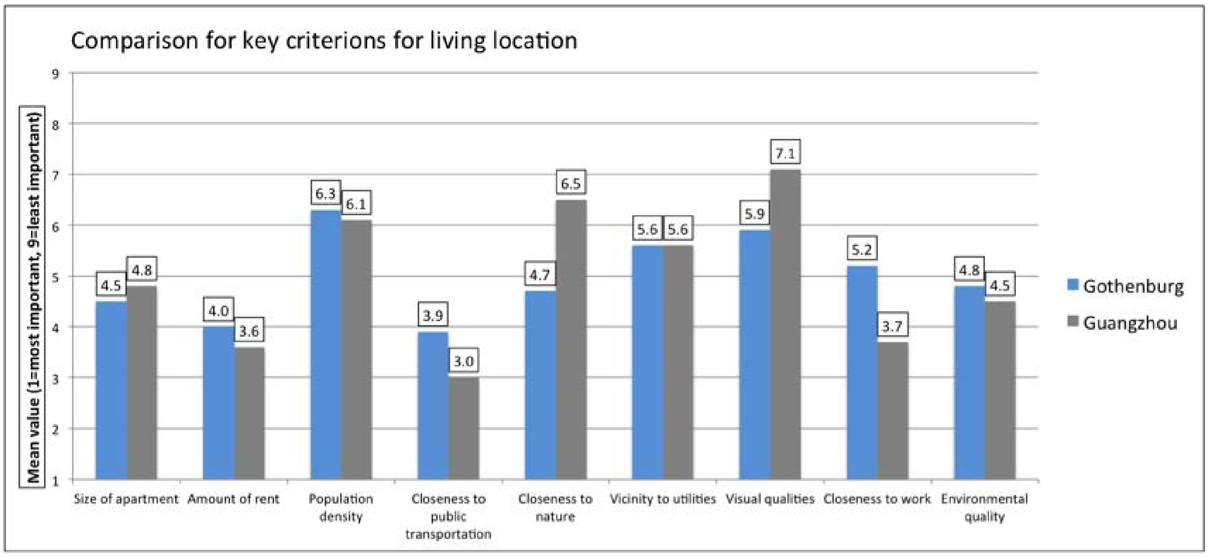


Figure 2: Comparison of the key criterions for living space by city-groups Gothenburg and Guangzhou.

The comparison of both city-groups shows, that closeness to public transportation is even more important for Guangzhou participants (M=3.0, SD=1.7) than for Gothenburg participants (M=3.9, SD=1.8), although it is the most important factor for both groups. Another difference can be seen with closeness to work, again, this factor is more important for Guangzhou participants (M=3.7, SD=2.8) as to Gothenburg participants (M=5.2, SD=2.7).

6.2 Flood prevention trade-offs

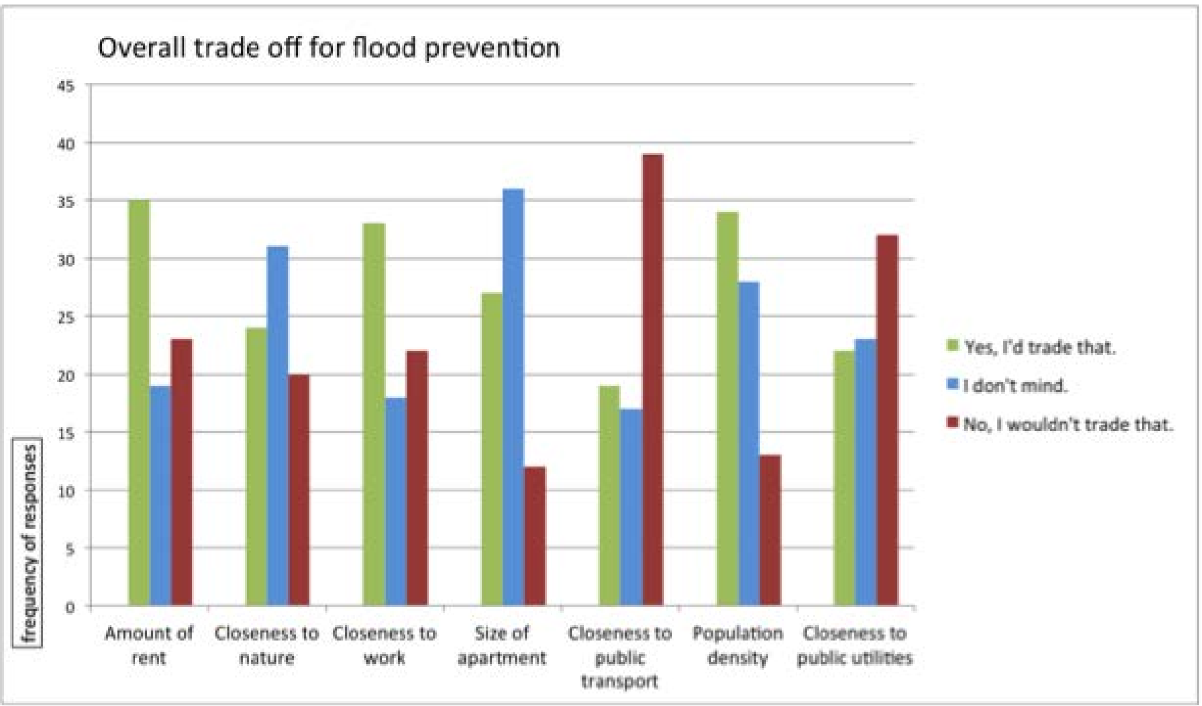


Figure 3: Frequencies of responses, if the given factors would be traded for the needed flood prevention.

As can be seen in Figure 3, the most important factor “closeness to public transport” is also the one, which shows the highest disagree, whether that would be traded for flood prevention (N=39). Also the closeness to public utilities has a high disagree rating (N=32). Interestingly, the amount of rent (N=35), the population density (N=34) and the closeness to work (N=33) are the factors, which would be traded for flood prevention. To identify, if this could be a cultural difference, the trade offs will be compared by the two cities groups:

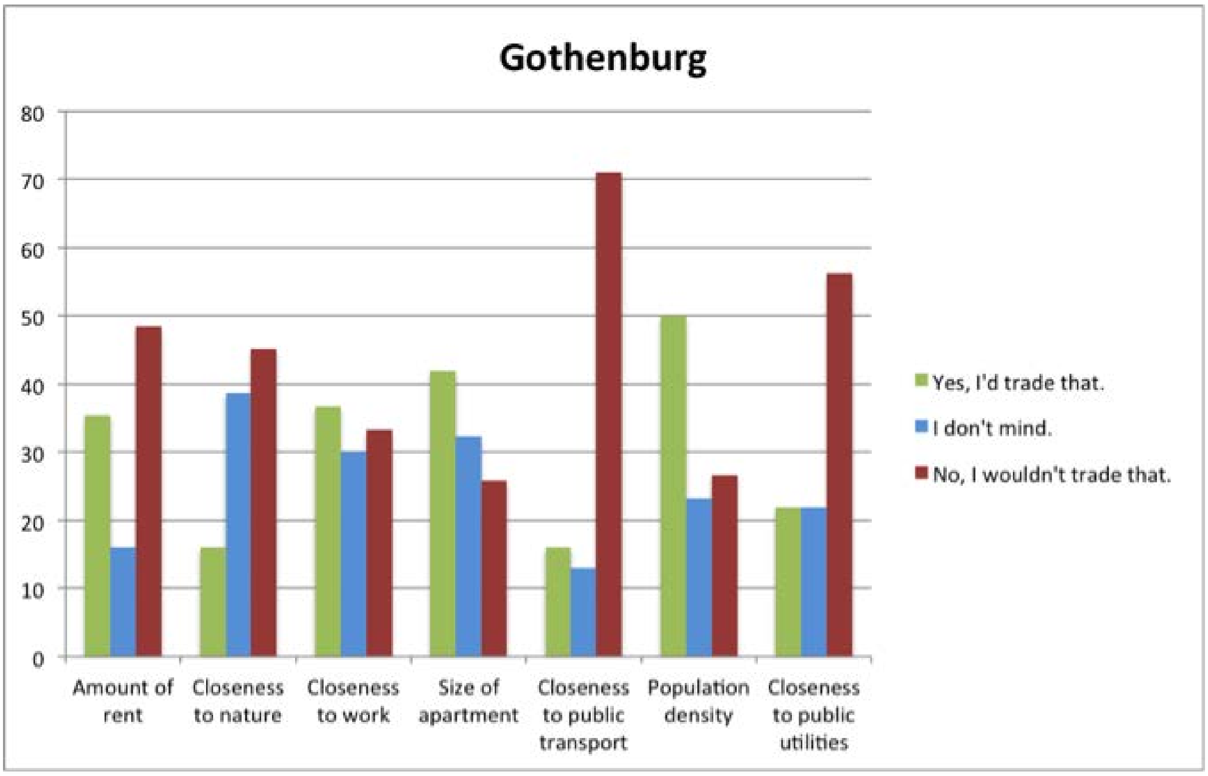


Figure 4: Trade off decisions of Gothenburg citizens (in %).

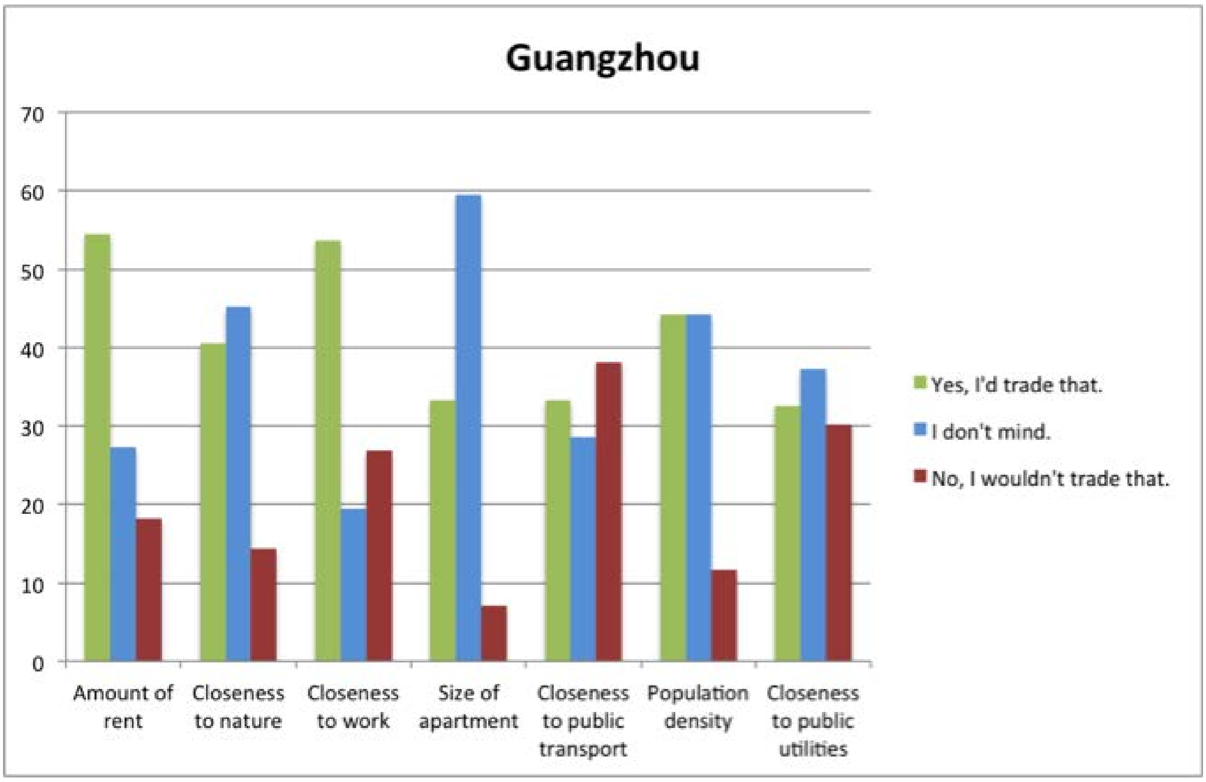


Figure 5: Trade off decisions of Guangzhou citizens (in %).

Both Guangzhou and Gothenburg participants' priorities show the unwillingness to trade off public transport and the vicinity to utilities and the similar pattern of willingness to trade-off the size of the apartment or a higher population density. The intermediate factors regarding the amount of rent, the closeness to work and the closeness to nature were varying between the two cultures clearly indicating the priorities of ‘close to nature’ being significantly higher in Gothenburg than in Guangzhou.

6.3 Types of flood prevention

The survey for the Gothenburg citizens on the preferences of flood prevention measures, the choice ‘Redirect planning focus areas to exclude waterfront areas’ gained significant preference over the two measures that are being considered in planning initiatives. Second place of preferences shows the ‘Dikes’ over ‘Barriers’.

Question: Which alternative sounds more attractive to you?						
		First Choice		Second Choice		Third Choice
Barriers		N=17		N=31		N=32
Dikes		N=22		N=37		N=21
Redirect planning focus areas to exclude waterfront areas		N=41		N=12		N=27

Table 1: Survey question result of alternatives for flood prevention.

6.4 Terminologies defined by the participants and its significance

The qualitative part of the survey covered questions explicitly asking the participants to describe the values and priorities questioned in the survey with own terminologies. This was important for understanding how participants interpret the concepts used in the survey. Urban perception is often a very complex subject in which the used concepts are often interpreted subjectively. The research focuses on a quantification of citizens’ perception on urban qualities, which might benefit from this result. All participants were invited to define the following qualities and characteristics: proximity, nature, mix-city definition and density. Further, an analysis of the results is presented:

a. What does it mean to live close to nature?

A total of 37% of the participants associated nature with urban parks or recreational areas, while 14% associated the same element with larger scale nature, such as forest or the sea. A small number of participants associated ‘living in the suburbs’ as ‘living close to nature’. An appropriate period of time to reach a nature location was also questioned. Here, a maximum of 10 minutes by feet was the most given answer. The scope of nature ranged from a garden in a house to street trees to larger scale natural reserves.

b. What does it mean to live close to work?

74% estimated 30 minutes as an acceptable distance to work, among which when given the mode of transport defined bike-ride or public transport as main means. Respondents who responded with walking distance defined 10-15 minutes walk as acceptable.

c. What does it mean to live close to public transport?

46% of the respondents responded that less than 5 minute walk to the public transport meant close to public transportation. The maximum time given by the participants was 20 minutes walk. Also indications on the waiting time, and connections showed perception of the infrastructural availability as the meaning of living close to public transport.

d. What do you think means 'Mix city'?
53% of respondents responded with 'Functional mix', while 12% responded with 'Mix of diverse demographics'. The answers included mix of architectural style, materiality and also the density as a form of measure for the mix.

e. What do you think means 'Dense city'?
40% of respondents associated density with 'Population'; a sizeable proportion of respondents responding with 'Population' also described 'Enough number of population to sustain a mix-functional city'. 15% listed various urban/architectural typologies to describe dense city. Among all the respondents 28% used the concept of 'Mix' in the answers. Feeling of crowdedness and negative connotations were also present (10%).

7. Discussions

The survey results show very clearly and consistently that the vicinity to public transportation is a highest priority in both cultures (See fig.1, 2). This is confirmed also through the trade-off survey where the participants are asked to trade-off values for flood prevention measures, cities need to take (See fig.3). Here also shows the unwillingness to trade off the distance to public transportation, and the distance to utilities indicating the importance of infrastructural availability. The amount of rent, and the closeness to work, the next prioritised factors also confirm the implementability of compact city qualities into the unbuilt areas, if lowered cost can be achieved, either through smaller dwelling units, or by unconventional methods.
It is also shown that with the infrastructural availability is ranked highest in the priorities in both cultures, the semantic understanding of this value is also concurrent between the respondents, unlike the vastly diverging responses for the consensus of what is 'living close to nature', which is ambivalent priority for both cultures. With the specifics from the open-end questionnaire, this survey result regarding the distance to public transportation and work has high probability of being implemented during the planning processes as design parameters.

The cultural differences that is shown in the survey is the consistency of importance of 'nature' vs. 'work' which shows the priorities of living close to nature in Gothenburg and the priorities of living close to work in Guangzhou in both choice of residence preferences and trade off priorities (See fig.2, 3). When considering the extreme discrepancies of varying degrees of definition of nature provided with the answers to question 'living close to nature', this can be looked into further in later researches.

The responses regarding the distance to nature, public transportation and work shows that when asked these questions, more precise distance is given as answers for distance to public transportation and work, while the answers pointed out the definition of 'Nature' by answering ' It means living close to… 1. park, or 2. Forest.' in contrast to the answers given for public transportation, as ' It means reaching public transportation in 5 minutes on foot.' The varying degrees of consensus on the meaning might affect the outcome of the survey result greatly, especially regarding definition of nature, the scope of range included from street trees to open sea. In this regard, the survey results of priorities become ambiguous. (see, supplemented documents)

The concept of Mixed-ness and Density were showing interesting connection to each other. Mix-use and Dense city were in general perceived as interconnected. Perception of density was explained as a mix-use urban areas and vice versa. Architectural descriptions and the density of populations and diversity were also being used in both concepts. This gives a picture of inter-relatedness of the two perceived concepts. However, in general, the concepts of 'Mix city' were regarded more positively than the perception of 'Dense city'. The term 'Compact' was also used for description of 'Dense city' with more positive connotations.

8. Conclusions and Outlook

The research is not dealing with the implementation strategies. Once the design element of citizen preferences are identified, it is not given that the solution can be simplified due to some of the priorities in the research indicating contradicting values. For instance, the case of trade off for the flood prevention measures on Gothenburg cases indicate, the amount of rent can be traded off, while amount of the rent ranks as second most important element in choosing the residences (compare Figures 1, 3). The survey result, even with lacking statistical coherences on all the priorities, the general guidelines for the top and the bottom priorities are still clear, providing a general picture of preferences and design possibilities to accommodate them. The result of the survey actually indicates useful design elements and defines design parameters.

Furthermore, it shows that some of the defined priorities can actually be implemented as design elements for planners and architects and this survey could act as a citizen participation form when given specific questions which has general consensus of the meaning of the values asked.

The semantic understanding of the terminologies show the lack of consensus, stipulating more efforts are needed in building a common understanding of the design terminologies between the stakeholders/agents.

In case of Gothenburg, the preference of 'Redirecting the planning initiatives from the waterfront area' over other flood prevention methods preferences indicates interesting views on the city's development planning proposals of the waterfront areas and where the efforts on urban planning issues are directed for the next 4 decades. The future work may include the experiments with different kinds of survey methodologies to see if the results on the citizen perception vary between the methods and to improve the performance of survey.

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[1] *SMHI: Swedish Meteorological and Hydrological Institute*

[2] *Sweco: Swedish consulting company in the fields of construction, architecture and environmental engineering. http://www.sweco.se/sv/Sweden/*

Appendix 7:
Waterfront urban survey questionnaire

IDEA League 2015 - Urban Systems and Sustainability

Welcome!

Identification of important factors for designing port side residential areas

Dear participants,
nowadays the majority of the world's population lives in urban spaces (United Nations 2012). In the context of urban planning and urban development, divergent demands of different stakeholders of the living space "city" have to be taken into account. Planning, implementation and maintanence of such areas require an integrative method and insights of all active parties of a city (such as architects, urban planners, citizens, politicans, mobility managers etc.).

On behalf of the IDEA League, a focused network of leading European universities of science and technology, we formed an interdisciplinary research group. The current project GAG aims the priorization and identification of factors for designing urban residential port-side areas. Therefore your participation is an important step towards understanding the needs and desires of urban residents. With this questionnaire, we hope to gain such insights to confirm and prioritize factors for urban planning for each party.

All information will be treated confidentially and anonymously (data protection).

Please take the survey and give us your opinions. Also feel free to answer questions regarding your opinions as texts and your opinions on the survey format.

Thank you for participating and for your time!

Hye Kyung Lim (Chalmers University, Sweden)
Xia Sheng (SCUT, China)
Teresa Schmidt (RWTH Aachen University, Germany)

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IDEA League 2015 - Urban Systems and Sustainability

Part 1: General information

1. Please state your age:

2. State your gender, please:

- ○ Female
- ○ Male

3. Please indicate your highest degree:

- ☐ No diploma
- ☐ Vocational training
- ☐ Secondary modern school qualification
- ☐ Higher education entrance
- ☐ High school diploma
- ☐ University degree
- ☐ Other

4. What is your employment status?

- ☐ Student
- ☐ Parental or sick leave
- ☐ Temporary employment / Part time job
- ☐ Pensioner
- ☐ Permanent job
- ☐ Currently unemployed / Seeking work

5. What is your current occupation?

6. In which city do you live?

- ○ Guangzhou (Asia)
- ○ Gothenburg (Europe)
- ○ Aachen (Europe)

7. Are you originally from the city?

- ○ Yes.
- ○ No.

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8. If you are not originally from the city, how long have you lived in the city?

- ◯ Less than 1 year.
- ◯ 1-3 years.
- ◯ 3-5 years.
- ◯ 5-10 years.
- ◯ More than 10 years.

9. What are you reasons for moving to your current city?

- ☐ Work / Study
- ☐ Social relations (Family, Partner)
- ☐ Reputation of the city
- ☐ Location of the city
- ☐ Extras of the city (e.g. closeness to water)

10.

What is your current living situation? At this moment, I live ...

- ◯ ... alone.
- ◯ ... in a shared apartment.
- ◯ ... with a partner.
- ◯ ... with a partner and kids.
- ◯ ... with my parents.
- ◯ ... with my parents and siblings.
- ◯ ... in a multigenerational house (e.g. grandparents and parents).

11. How many persons live in your apartment/house?

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Part 2: City and living information

12.

How close to the city center do you live?

- "I live ____ minutes by public transport." *(Please enter in numbers.)*

13. Which size has your current apartment/house? *(Please indicate in square meters.)*

14. Which factor is the most important for you to choose a place to live? *(1 is most important.)*

- Apartment size
- Amount of rent
- Population density
- Closeness to public transportation
- Closeness to nature
- Vicitiny to utilities
- Visual qualities
- Closeness to work
- Environmental quality

15.

Do you own a vehicle and do you use it for commuting to work/ school? *(Vehicle means any type of personal vehicle, e.g. bicycles, bikes, cars.)*

- Yes, I own a vehicle and I use it to commute.
- Yes, I own a vehicle, but I do not use it to commute.
- No, I do not own a vehicle, but I commute.
- No, I do not own a vehicle and I do not commute.

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16. If yes, what type of vehicle do you own?

- ○ Car
- ○ Motorcycle
- ○ Bicycle
- ○ Other (please state)

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Guangzhou & Gothenburg

For all Gothenburg citizens:

Gothenburg Frihamnen is a hotspot for testbed of urban planning strategies within 'Vision Älvstaden' expanding the Central Gothenburg area across the water. This vision includes 1,000 new housings and 1,000 working spaces to be built by 2021 with Compact and Mixed city as attractive element.

We would like to understand which factors are important for you, if you would like to move to this attractive water front residential area. Please help us understand which factors are important for you!

For Nansha new area citizens:

Nansha New District is a state level development area as 'special economic and services zone' in Pearl river delta connecting Guangzhou metropolitan areas and Shenzhen to Hong Kong and Macao. This area is projected to attract high-tech industries and research centers as well as new residential areas and commercial activities. In designing residential areas in this growing region of South East China, we would like to understand what kind of factors should be considered for architectural and urban planning processes.

Please, let us know, which factors are important for you personally, so we can incorporate your opinion as design elements for future planning of this exciting new area!

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Part 3: Factors for urban design

* 17. How important are the given factors for you?
Please make your decision in every line for general characteristics:

	not important at all	not important	rather not important	rather important	important	very important
Size of apartment	○	○	○	○	○	○
Closeness to nature	○	○	○	○	○	○
Closeness to public & commercial utilities (e.g. school, hospital, shop)	○	○	○	○	○	○
Amount of rent	○	○	○	○	○	○
Population density	○	○	○	○	○	○
Closeness to public transportation	○	○	○	○	○	○
Living close to work	○	○	○	○	○	○
Safe surroundings	○	○	○	○	○	○

* 18. How important are the given factors for you?
Please make your decision in every line for outdoor environmental quality:

	not important at all	not important	rather not important	rather important	important	very important
Thermal comfort	○	○	○	○	○	○
Acoustic quality	○	○	○	○	○	○
Visual quality	○	○	○	○	○	○
Air quality	○	○	○	○	○	○
Lightning	○	○	○	○	○	○

* 19. How important are the given factors for you?
Please make your decision in every line for indoor environmental quality:

	not important at all	not important	rather not important	rather important	important	very important
Orientation	○	○	○	○	○	○
Acoustic quality	○	○	○	○	○	○
Ventilation	○	○	○	○	○	○

Part 4: Identifying importance of possible design factors

The following questions ask which factor is more important for your choice when you are choosing your home. Compare the factor at the left at the blue bar (A) to the factors listed on the right (B). Select the factors that are more important than the factor in the left side of the bar.

This means ‘closeness to nature’, ‘size of apartment’ and ‘closeness to public' is more important than ‘amount of rent’.

(A)	(B) closeness to nature	closeness to work	size of apartment	cl
amount of rent	V	☐	V	

20. Which factor is more important for you?

	closeness to nature	closeness to work	size of apartment	closeness to public transport	population density	closeness to public utilities	visual qualities
amount of rent	☐	☐	☐	☐	☐	☐	☐

21. Which factor is more important for you?

	closeness to work	size of apartment	closeness to public transport	population density	closeness to public utilities	visual qualities
closeness to nature	☐	☐	☐	☐	☐	☐

22. Which factor is more important for you?

	size of apartment	closeness to public transport	population density	closeness to public utilities	visual qualities
closeness to work	☐	☐	☐	☐	☐

23. Which factor is more important for you?

	closeness to public transportation	population density	closeness to public utilities	visual qualities
size of apartment	☐	☐	☐	☐

24. Which factor is more important for you?

	population density	closeness to public utilities	visual qualities
closeness to public transport	☐	☐	☐

25. Which factor is more important for you?

	closeness to public utilities	visual qualities
population density	☐	☐

26. Which factor is more important for you?

	visual qualities
closeness to public utilities	☐

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Extra part 6: Flooding

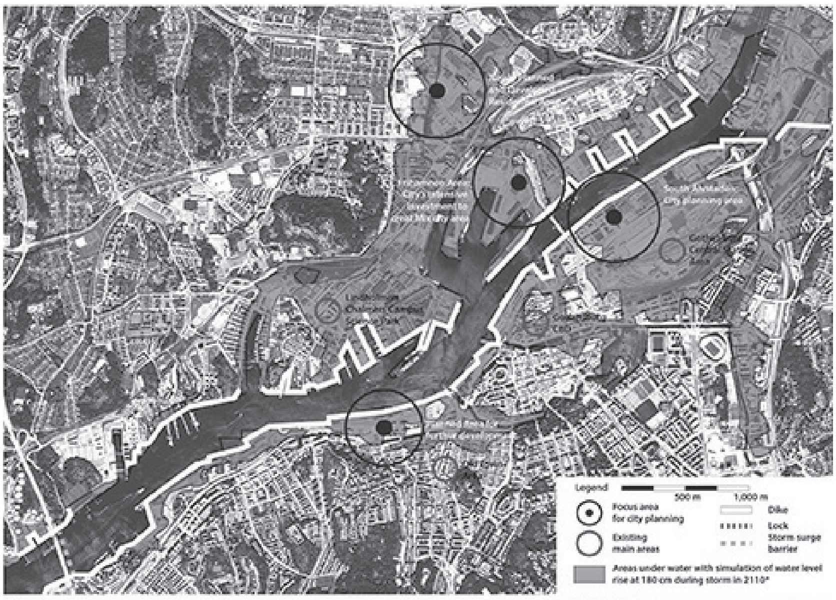
This section should be answered from people, who are living in / near a city with flooding challenges or can imagine living near such an area.

With various researches into climate change pointing out towards future possibilities for sea level rise with frequent flooding occurring by the year 2100, e.g. Gothenburg city needs to take into account various flood prevention methods. The focus of city planning efforts is mostly spent on the waterfront areas where the prognosis shows would suffer most from the flooding. Stop investing in the future disaster prone areas, such as Kvillebäcken, Frihamnen, Södra Älvstaden and Lindholmen, or changing the focus planning areas is not a realistic option.
The two options studied by Sweco for Gothenburg city as alternatives include storm surge barriers i Kungälv and by the Älvborgsbron, or 17.6 km dikes with a number of water locks (sluss).

This inevitably will affect future urban planning of the area. Considering the risk of natural disasters, here we would like to understand which factors you prioritized as more important in conjunction to the flood prevention initiatives.

The following images show:

1. Re-direct planning: The composite diagram of flood prevention measures and 2110 prognosis for flood affected areas.
2. Dike: An Example of super levees: Tokyos' 14.5 km long and 10 meter high super dike.
3. Barrier: The image of "The Maeslant Barrier" in Rotterdam.



27. Which alternative sounds more attractive to you? *(1 is best.)*

- Barriers
- Dikes
- Re-direct planning focus areas to exclude waterfront areas

28. Which of the factors could you trade off in exchange to the measures need to be taken for flood prevention?

	Yes, I'd trade that.	I don't mind.	No, I wouldn't trade that.
Amount of rent	◯	◯	◯
Closeness to nature	◯	◯	◯
Closeness to work	◯	◯	◯
Size of apartment	◯	◯	◯
Closeness to public transport	◯	◯	◯
Population density	◯	◯	◯
Closeness to public utilities	◯	◯	◯

29. Which of the following factors could be compromised (a poorer quality, but no trade off) for flood prevention?

	Yes, this could be compromised.	No, this should not be compromised.
Amount of rent	◯	◯
Closeness to nature	◯	◯
Closeness to work	◯	◯
Size of apartment	◯	◯
Closeness to public transport	◯	◯
Population density	◯	◯
Closeness to public utilites	◯	◯

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Part 5: Feedback and ideas

30.

How would you define the given factors?
Question example: What means "living close to nature" for you?
Answer example: It means to live near a park area (min. 2ha) and to be able to reach that in a five minutes walk.

Describe and / or give us an example of a city area you think fits your definition, if possible.

Living close to nature

Living close to work

Living close to public transport

What do you think is a low population density?

What do you think means a ‘Mix city’?

What do you think means a ‘Dense city’?

31. Thank you so far for your participation - you are a great help!

At this point we will ask you for your opinion about the topic "urban areas". What factors are important for you, when you are choosing a place to live?

32. What should urban planners keep in mind, when they plan a new water front residential area?

33. Do you think this survey can include any other factors?

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Finish

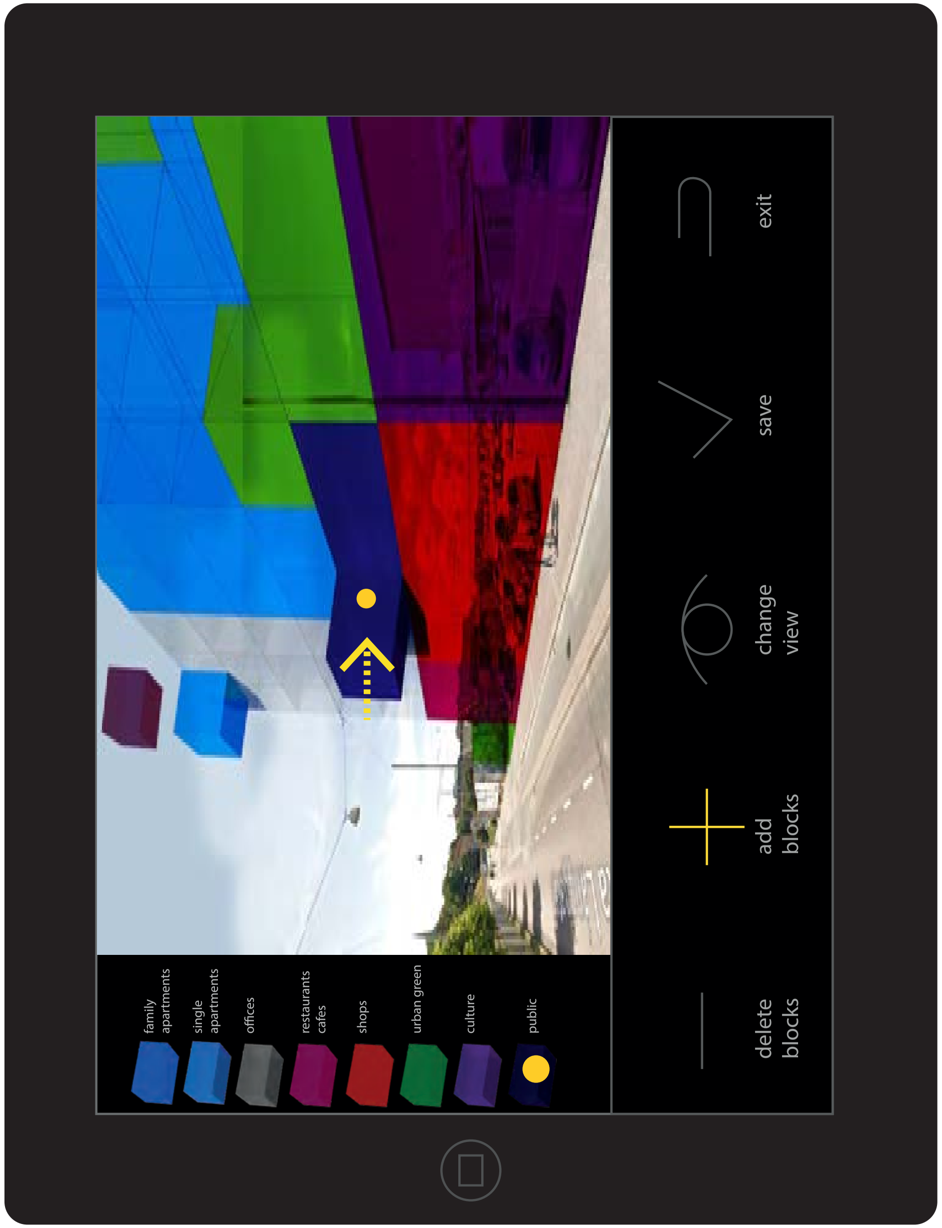
Thank you very much for your participation! You're the best!

Appendix 8:
Urban CoBuilder proposal

Urban CoBuilder

This is preliminary proposal for development of tool for project Masthugget.
Let’s do it!

Contact: Kyung@chalmers.se
Hye Kyung Lim
2014-04-23



Urban CoBuilder

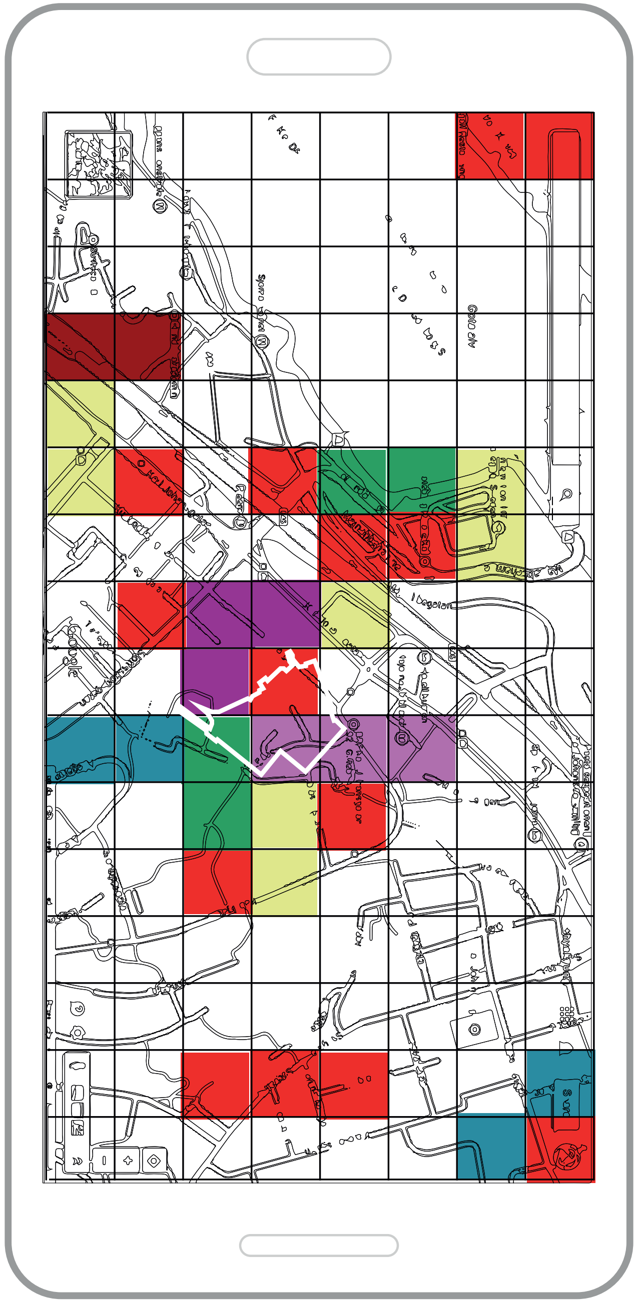
Introduction

Tablet based urban survey/Design tool

Collaborative 3D mappingand building strategy for survey of citizen wants and needs in site designs
Communication's tool between the city and citizen
Sizeable grid for area based survey
Real-time and in-place survey rather than post-constructed perception of a place

Augmented Reality allows users to view the site from human perspective through camera, while placing simple functional cubes based on preset grid sizes.

Suitable for smaller scale sites. Here is an example/illustration using Masthugget project area.



Urban CoMapper

Background-Preceding tool

Smart phone based urban survey tool
Collaborative mapping strategy for survey of citizen perception of urban quality
Communication's tool between the city and citizen
Sizeable grid for area based survey
Real-time and in-place survey rather than post-constructed perception of a place

Geofencing notifies users where the survey boundaries are.
Versatile tool for various urban researches where the citizen perception and input
needs to be mapped.

Workshop experiments are scheduled for the first prototypes of the tool; 1. Compact Dense City, 2. Urban Green Potential

A

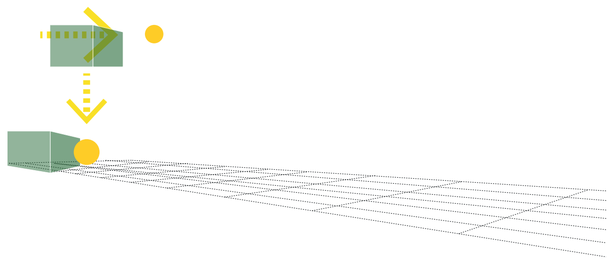
GPS and geodata based: Apps Junaio, Layar
This is a location-based gizmo that uses the phone's viewfinder and Nokia Maps to give you a 3D what's-what view of your neighbourhood. Hold your phone up so the camera can see where you are, and the app will immediately overlay your street-view with virtual signs to the best places to eat, drink, sightsee, or shop.
(http://conversations.nokia.com/2013/01/13/for-real-the-amazing-story-of-augmented-reality/)

B

The 2013 IKEA Catalog app featured an augmented reality viewer that visualized furniture in 3-D and served related video and digital content to readers

C

GPS Penguin Navi : HAKUHODO Tokyo/doAR designed an augmented reality GPS system with Junaio featuring penguins that lead the way to the aquarium.
The penguins walk and move exactly like real penguins.
It was the first motion captured technology applied to penguins.
(http://junaio.wordpress.com/2013/07/01/penguin-navi/)

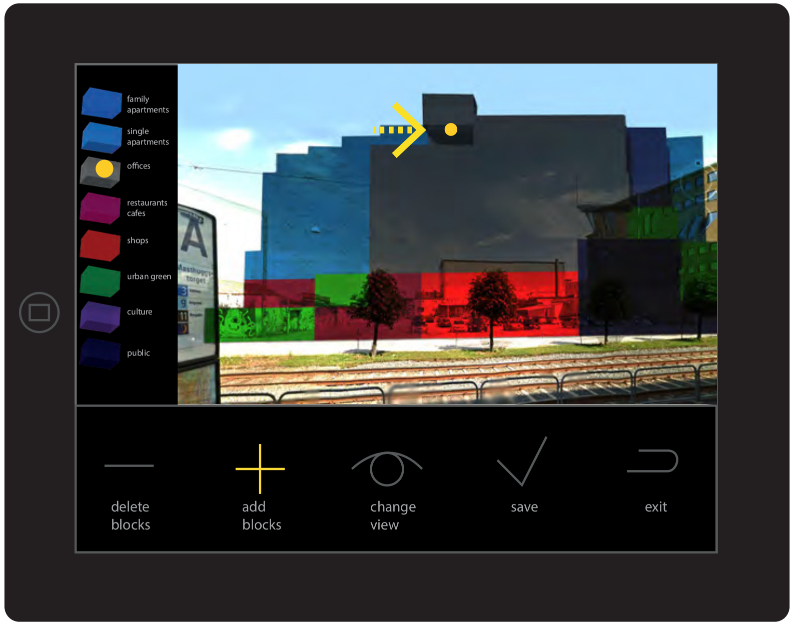


Urban CoBuilder

Concept

From Urban Comapper which enables various urban survey research to be projected in a collaborative mapping settings, Urban Cobuilder takes the collaborative design strategies, grid system in a 3D mapping setting with Augmented Reality and 3D object tracking on tablets.

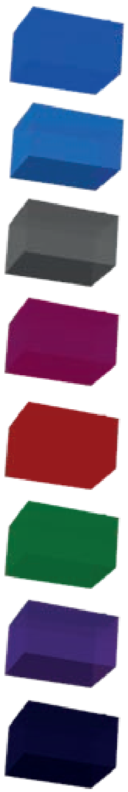
With pre-set-able project area, grid sizes, various urban functions to be used as design modules, Urban CoBuilder provides co-creative environment where the citizens can directly participate in creating mixed, dense, green urban structure where possible.



Urban CoBuilder

components
APP/USE

B Stackable Modular cubes with urban functions:
Height 3m
Width/Length 5m each or 10 m each



family apartments

single apartments

offices

restaurants cafes

shops

urban green

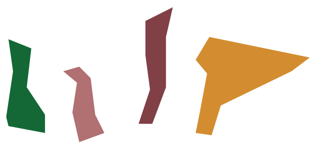
culture

public

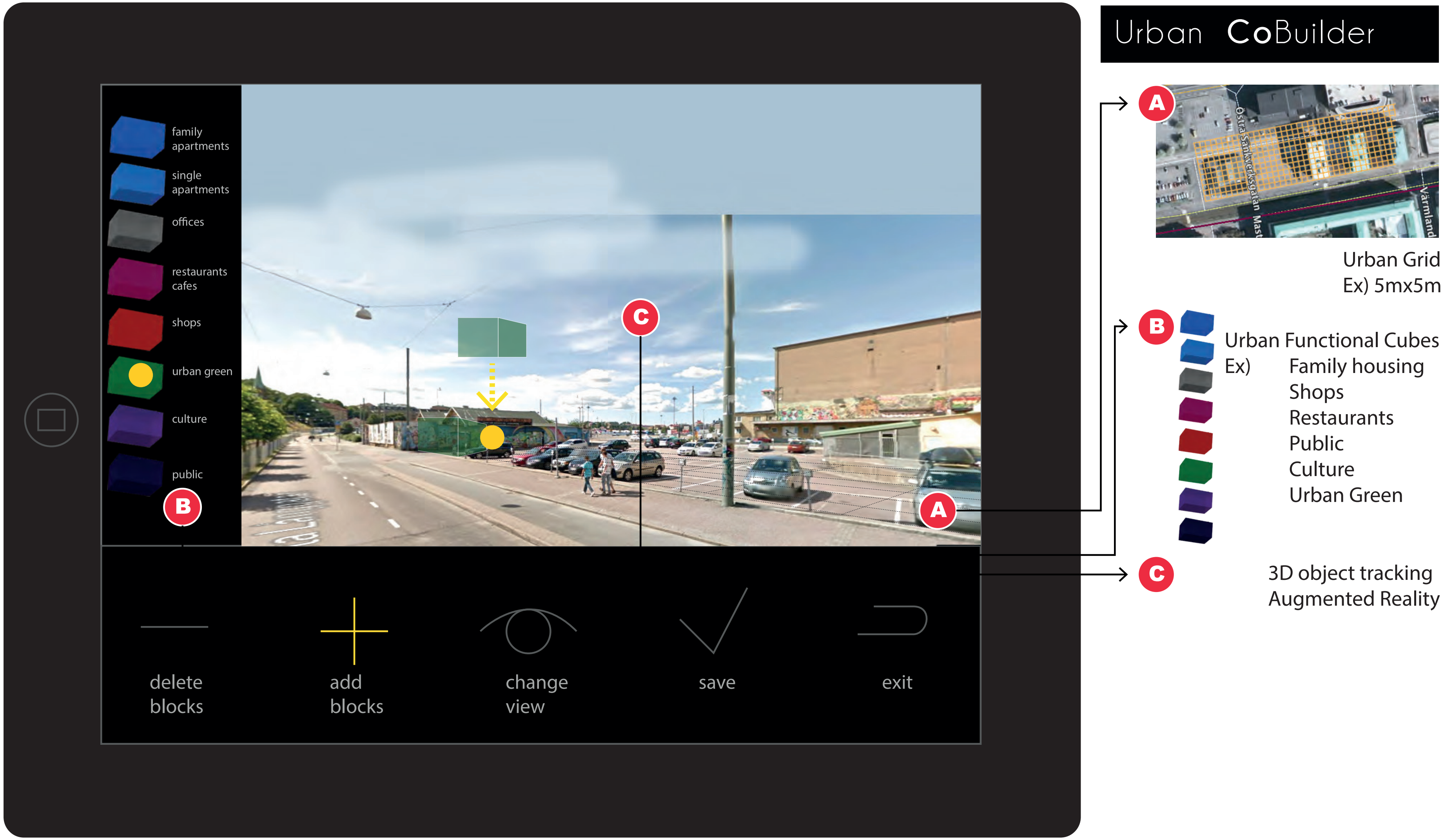
A GPS BASED??
3D GRID?

C SITE

d



Citizens and Ideas:
WHAT DO THEY WANT?

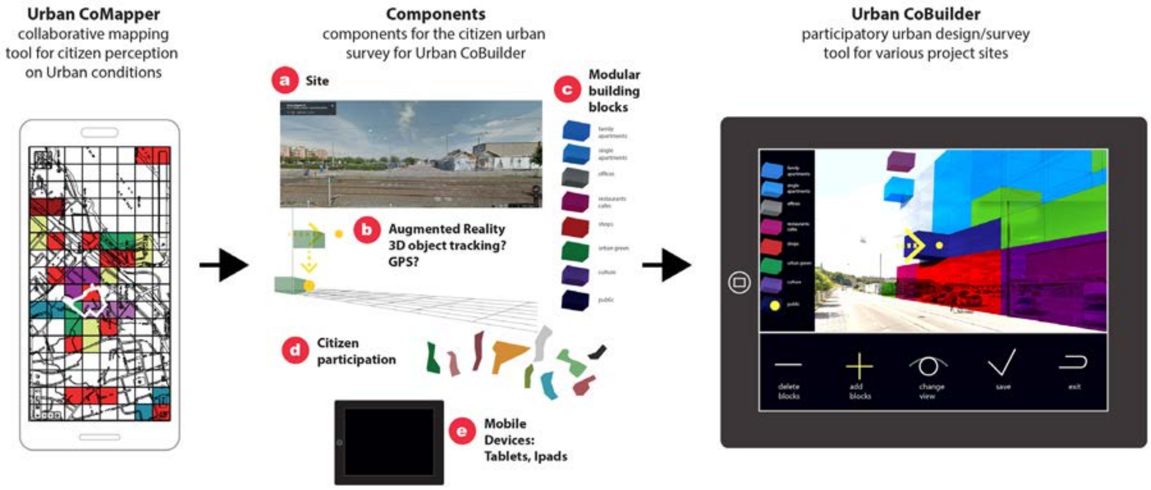

Urban CoBuilder
A
Urban Grid
Ex) 5mx5m
B
Urban Functional Cubes
Ex) Family housing
Shops
Restaurants
Public
Culture
Urban Green
C
3D object tracking
Augmented Reality
family apartments
single apartments
offices
restaurants cafes
shops
urban green
culture
public
delete blocks
add blocks
change view
save
exit
Värmland
Östra Sankverksgatan
Mast

Appendix 9:
Urban CoBuilder grant application

Application granted

Description of the purpose for application for the Adlerbertska scholarship
For Urban CoBuilder

Lim Hye Kyung
PhD Candidate, Department of Architecture
Chalmers University of Technology
Email: kyung@chalmers.se
Mobile: 073-9972 915



1. Identified research gap and the background - Interpretation of Designs as Rules

A. Research gap

In the 2011 FORMAS[1] Report on Urban Sustainable Development, which highlights a knowledge gap in understanding connections between the city inhabitant and built environment. The report states that there is an unquestionable link between built environment and living conditions by which 'man', by acting in and appropriating the built environment, is also its co-creator. [2]

With this report on the current research gap and spatial agency as an underpinning theory, a collaborative mapping tool has been developed for citizen perception survey on various urban conditions and abstract qual-

1 Forskningsrådet för miljö, areella näringar och samhällsbyggande

2 2011 Formas Report, State of the Art Sustainable Urban Development in Sweden, p37

ities with project title, '*Urban CoMapper©*[3]*: Collaborative Citizen Perception Mapping For The Sustainable Compact And Green City'*[4].

B. Background

a. PhD Thesis

The PhD thesis *Mechanisms and Outcomes of 'Rule based' and 'Design based' planning systems*[5], while working with the thematic around sustainable compact and mixed city, investigates various approaches to interpret and inter-change between the outcomes of the systems by first looking into the designed forms, buildings and urban typologies and derive more abstract values resulting from the forms, in particular density and mixed-use. The tool is used in creating the connection between the form and the value in the context of citizen perception.

b. The Urban CoMapper© and Urbania©

The *Urban CoMapper©* is designed with initial funding of 100,000 SEK from Adlerbertska Stiftelsen from 2013, as a trans- and inter- disciplinary efforts between two PhD Candidates from Department of Architecture, at Chalmers University of Technology and IT consultants.[6] The tool was designed as the next step application for the web-based urban survey tool, *Urbania©*[7].

The tool is designed as a comprehensive urban survey system that uses collaborative mapping as a core method for surveying citizen perception of urban qualities relating to built environment, and as a result, functions as a platform for communication between the citizens and the city experts/planners. This tool uses various Geo-technologies to effectively tag the location of the participants and the surroundings. The difference between the available tools in the market, as well as with *Urbania©* is that, the concept of measuring the citizen perception of built environment has been taken more seriously, as this tool differs in the location and time of the survey from the other tools. While the web-based tools use various methods to understand the perception of built environment, it is done in retrospective perspective of what had been perceived and thus cannot be the measurement of *Perception* of the space. While the surveys done with web-based tools are based on the 2-dimensional space of the *images or the maps* on the computer screen and the users' memory of perception, with tool Urban CoMapper, it is done in 3-dimensional space at the location of survey object and in real-time.

3 The term *'Urban CoMapper©'* has been coined and created by the two research authors: Hye Kyung Lim and Anna Maria Orru.

4 The project originates from two PhD projects docked at the Chalmers University of Technology, and Mistra Urban Futures research institute in Gothenburg. Each researcher is also docking their investigations in two alternating Swedish cities; Gothenburg and Stockholm.

5 PhD thesis docked at the Department of Architecture, Chalmers University of Technology of Lim Hye Kyung

6 A series of workshops have been conducted with collaborators. The first took place on 2014.05.25 with a pilot test for the first version of the app. The second took place 20140615 where a number of diverse audiences were invited, including urban farmers, city inhabitants and city professionals, to test the app.

7 Urbania© is an inter-active web-based feedback and survey tool using Google map and it is being developed at the Mistra Urban Futures. The tool is already being tested for Trafikverket, Göteborg Stad and in various test researches within the Mistra Urban Futures.

The beta tool is to be tested in various workshops starting June 2014. The conference presentation at IGU, Poznan[8] and academic papers are planned to be produced with the conclusions from the workshops.

2. Spatial Agency as underpinning theory and research questions- Interpretation of Rules as Designs

A. Spatial Agency

Spatial agency necessitates an alternative way of looking at how buildings and cities can be produced.[9] In this mode, the agency of a given space is gradually handed over to participating city inhabitants from the initially engaged experts, which renders an empowerment of the space to the local inhabitant.

As the next step, expanding the concept from the collaborative mapping tool as a systematic platform for communications between the involved parties in urban planning in a macro scale, investigating citizen perception and input regarding the already built environment, now we are looking into the un-built environment in a more micro scale.

B. Research Questions

The questions then are how do we hand over the agency to the citizens? How do we understand what the citizens want and how do the citizens inform the experts their needs and wants without neither underlying city planning knowledge nor the appropriate tools? Can the citizens perceive and understand urban planning with bird's eye-view from plans and maps as the planners do? Or is there a way to directly design in a simplistic communicable way at the site, perceiving at the same moment the resulting outcome of their own design input? How do we create a connection between their visions and immediate space of built urban environment?

3. Methodology and implementation:
Urban CoBuilder: Tool development concepts and outcome

A. Trans-disciplinary collaboration

This tool is planned to be developed with trans-disciplinary collaboration between interactive designers, IT consultants and researchers from both Department of Architecture and Department of Applied IT (HCI)[10]. The use of GPS based Augmented reality[11] with 3D objects placing and tracking is the basis for the tool framework.

8 Urban Geography Commission, Poznan 2014 - Annual Conference of the IGU Urban Commission, from 11th Aug -14th Aug 2014

9 http://www.spatialagency.net/

10 Alexandru Dancu is a PhD student at the Computer-Science Research School, Chalmers University of Technology. He gained his MSc. in Embedded Computing System with the thesis project at University of Southampton, UK. His BSc. degree was in Computer-Science with the thesis project at School of Computing, National University of Singapore.
HCI stands for Human Computer Interaction

11 Augmented reality (AR) is a live direct or indirect view of a physical, real-world environment whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data. (Wikipedia)

B. Tools in the market

There are various tools in the market using Augmented reality in urban scale with 3D object placements based on GPS location trackers for advertisement purposes. A good example for this application is Nokia City Lense, which is an augmented reality software that gives dynamic information about users' surroundings.[12]

Other augmented reality tools including 3D objects use 3D object tracking based on a target and derives the location and the direction/distance of the object from the target itself. This can be seen in free 2014 IKEA Catalogue App[13], where the users can place 3D furniture in their living den. But for the tool to be adaptable and as generic as possible, use of GPS to track the location of the virtual 3D modules are pursued rather than target based location systems.

C. The concept

This tool is designed for tablets and Ipads due to the screen size necessary for the usability of this CoBuilder tool. The users are given multiple choices of modular boxes, each representing various urban functions, such as, a restaurant, a café, a book store, a single apartment or a family apartment, or even an urban garden. The sizes of the 3D cubes can vary according to the project sites and programs.

D. Implementation

Given an example of Masthugget Urban Project, creating the link between Järntorget and Stigbergstorget through the waterfront, the 3D modular cubes can include functions that can be found at the project site surroundings, or the missing but needed functions. For instance, cubes representing, commercial activities, cultural activities and urban gardens would be more appropriate choices rather than the family housing stacks due to noises from highways. The cubes could be 1 floor of 100m2 area unit and stackable up to 6-7 floors, depending on the program.

The track-ability and the stack-ability of the multiple 3D objects can give users direct interaction with the built environment and the *potentiality* of the environment as they design the site. The connection between these two elements can create valuable interaction and perspective regarding understanding of real scales. The collected data and the vision of citizens then can be analysed as 3D mapping, on the street level as well as on the vertical axis, and can provide valuable information for further development potential of the project sites.

The case studies and workshops with the tool in various problem sites, including aforementioned Järnvågen, Masthugget and the conclusions will be disseminated in a form of academic papers and PhD thesis as well as in a form of presentations at conferences.

4. The connection to the Sustainable Development and knowledge production

In creating a *Sustainable Compact and Mixed City,* this tool can contribute to understanding how the citizens perceive their needs and wants when it comes to co-creating their environment in a more tangible and real form. This methodology can also create a further applications connecting the Augmented reality and Virtual reality technologies into urban planning and for provision of public services, including information systems regarding public transportations or public amenities and an embedded element in infrastructure as navigation system.

Gothenburg is a city that is growing rapidly and with massive potential for progressive urban planning due to

12 http://alternativeto.net/software/nokia-city-lens/

13 http://www.gizmag.com/ikea-augmented-reality-catalog-app/28703/

large-scale underdeveloped ex-industry sites and the waterfront[14] in the centrally located areas. With strong emphasis on IT sector and knowledge production[15] it gives opportunities for collaborations between diverse experts and researchers in urban planning and computational sciences and in interactive designs. This collaboration can create urban research tools that are embedded in urban planning systems, integrating citizen participation and communication as an inseparable part in the urban planning process.

5. The budget and timeline for project

The preliminary budget for starting the project is estimated to be 100,000- 150,000 SEK. The funding sought here is 100,000SEK. The rest of the cost will be sought at Mistra Urban Futures[16] and other external sources. The budget will cover the fees for IT consultancy and the preliminary estimates are as follows. The Grant from Adlerbertska Stiftelsen is planned to pay for the initial analysis, project management cost and the user-interface design.

Fee calculations table[17]

	Hours	SEK/hour	
Requirements analysis (R)	60	1 100 kr	66 000 kr 66 000kr
User Interface design (U)	40	400 kr	16 000 kr
Project management (P)	40	1 100 kr	44 000 kr
Total	140		126 000 kr 165 000 kr

6. Project timeline

2014-06: Preliminary time planning and pre-study and analysis
2014-08: Initial case study meetings for Masthugget Urban Development Project
2014-10: Start of the development of Urban CoBuilder: Initial analysis consultancy
2014-12: Draft of tool development plan

2015-01: Development of tool
2015-04: Beta test tool
2015-05: Workshops and modification of the tool
2015-06: Tool launch and workshops on site
2015-10-: Dissemination of conclusion through academic paper and conferences

14 http://alvstranden.com/hem/

15 FACTS AND FIGURES FOR THE GÖTEBORG REGION, *The Region of Sustainable Growth Report,* from Business Region Göteborg, 2008

16 Mistra Urban Futures — Centre for sustainable urban development
http://www.mistraurbanfutures.se/english/startpage.4.15c2317a1266994794c8000596.html

17 Fee calculations are based on the cost analysis for the development of Urban CoMapper tool with the Consultancy firms Changemaker AB and Milestones AB from Gothenburg from 2013-2014.