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Rationale of Smart High-rise Regulations

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1 ABSTRACT

Through systematic analysis of the evolvement of high-rise regulations in European and American cities, this paper attempts to summarize some rationale in hope of setting a theoretical foundation for smart high-rise regulation. The study suggests that the development of high-rise regulations are driven by the economic, environmental, and social impact of high-rises on surrounding neighborhoods. Some concluding key points consist of; 1) high-rise regulations should be context specific; 2) high-rise regulations should comprehensively consider the impact and interaction of high-rises on the surrounding environment; 3) high-rise regulations should encourage the development of high-rise clusters rather than individual high-rises, in order to effectively increase density, and facilitate urban growth and renewal; 4) high-rise regulations should emphasize on creating a vibrant inner city rather than shaping urban morphology; 5) high-rise regulations should give more attention to the street level rather than traditional top-level of high-rises; 6) high-rise regulations should be scientifically formulated by the use of data processing technology such as GIS. The goal of smart high-rise regulations is to create a sense of belonging for residents, a unique urban experience, and an interactive neighborhood environment.

2 INTRODUCTION

High-rises are striking buildings that can be seen from far away, thus attract a great deal of attention. Huxtable enthusiastically praised high-rise as “not only the building of the century, also the single work of architecture that can be studied as the embodiment and expression of much that makes the century what it is... No other building type incorporates so many forces of the modern world, or has been so expressive of changing belief systems and so responsive to changing tastes and practices... The tall building probes our collective psyche as it probes the sky”. (Huxtable, 1984) McNeill claims the high-rise as “an extremely complex spatial phenomenon”, (McNeill, 2005) which resonates with Fazlur Khan’s argument, “designing high-rise structures is as much an engineering challenge as it is a social and political concern” (Khan, 1965). This study aims to explore the rationale of regulations that restrict or direct high-rise development from multifaceted perspectives, in hope of providing some theoretical basis for policy making in terms of permitting or rejecting high-rise projects. Studying the rationale of high-rise regulations requires a thorough comprehension of what specific features should be taken into consideration, in other words, establishing logical qualifiers to justify high-rise construction. Previous research have provided examples of some of these features such as land-use, density, visibility, urban experience, inner city revitalization, cultural preservation, and so forth. In order to identify the key features of high-rise regulations, it is helpful to look back to understand how high-rise is planned and designed, and how it has evolved historically. Even for a single proposed high-rise project, various stakeholders engage in complex interplay in order to satisfy each other’s optimal interests. This interplay of political powers in high-rise development originated as early as 1916 in the context of the New York City Zoning Ordinance, one of the milestone legislations in the U.S. In commercial real estate development, zoning “pits the individualism of American capitalism against deeply rooted notions of communal public good”. (Poindexter, 1998) It is the planner’s obligation to systematically analyze the benefit related to all stakeholders as well as the impact of high-rises on the surrounding social and physical environment. In order to more objectively and inclusively study the rationale of high-rise regulations, the past experience from the high-rise development must be reviewed and scrutinized. Retrospect to the historical evolvement of high-rise regulations in European and American cities, this paper attempts to summarize some rationale in hope of setting a firm theoretical foundation for smart high-rise regulation. Since a substantial amount of the world’s tallest buildings are located outside the western world, some scholars argue that “in debates over the future of urban form, existing western-biased theories and models are of questionable relevance” (McNeill, 2005). Nevertheless, a) high-rise regulations were originated from Europe and North America, and have been evolved and improved over the longest period; b) most systematic research on high-rise regulations, especially from theoretical perspective, are contributed by European and American scholars.

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3 CONCEPTS AND MISUNDERSTANDINGS

Urban economics theories suggest that low-density development comes with additional cost such as the cost of infrastructure to support dispersed urban regions, the cost of housing for lower paid workers, and the cost of energy consumption from private automobile. In light of these costs, high-rise development was proposed in order to achieve the ideal sustainable and compact urban form. Particularly, the goals of high-rise development were to reduce residents' dependency on the automobile, encourage active transportation and use of public transport, and reduce energy consumption through shared amenities. Along with these goals came questions and skepticism of the high-rise proposal such as: how high of a building could be defined as "high-rise"? Will high-rise development lead to higher density and growth of land value? Under what circumstances will the sustainable use of transport be supported by high-rises?

3.1 How high is high-rise?

It is difficult to set standards for the height of buildings that can be deemed "high-rise" since the concept of "high" is not only place-specific, but also time-specific. For example, a building classified as "high-rise" in the 1920s could be regarded as "mid-rise" by today's standards. The standard for defining a building as "high-rise" also varies internationally. For instance, only one building within the Europe Union was listed as one of the top 100 tallest buildings in the world. The Shard of London was listed as the 87th tallest building, according to The Skyscraper Center of CTBUH (Council on Tall Buildings and Urban Habitat). As a relative term, the different standards of "high-rise" lead to the diverse policies that regulate building height and locations worldwide. In addition, the definition of height needs to be standardized and presented clearly since height can be measured in many different ways: architectural height, floor-to-ceiling height, floor-to-floor height, and so forth.

3.2 High-rise = high density?

High-rise development is widely considered as the most effective way to achieve urban densification. However, is that true in every case? To answer the question of whether or not high-rise construction necessarily leads to high density, Zandbelt illustrated the relationship between high-rise and high density though the cases of Bergpolderflat and Montevideo in Rotterdam (Zandbelt, 2012). The block where Bergpolderflat is located has a lower Floor Space Index than its surrounding blocks. As the tallest residential tower in the Netherlands at the time, the base of Montevideo takes up almost five times as much space as the tower itself. Therefore, height is not always positively associated with density. Based on empirical research of height and density, Zandbelt further concluded that, "the base of the building must be much larger than the tower on top of it" and "only the cluster of high-rises have a degree of density" (Zandbelt, 2012). With respect to the higher density of workplace associated with the cluster of high-rise office buildings, Christopher Alexander and others proved that high-rise structures do not necessarily accommodate higher residential density due to tower separation rules (Alexander, 1977).

3.3 Does high-rise generate high land value?

The price of land is not simply determined by the amount of construction, but by the complex content of the structure, purpose and value of the projects, as well as the micro and macro-economic environments. High-rise building construction and maintenance costs are more expensive than those of low-rise buildings. In the Netherlands, the feasibility of high-rise is strongly supported by low-rise revenues. Homogeneous-looking high-rise projects could be heavy financial burdens for developers especially when the market is saturated. In addition to costs, vacancy rate is another issue that should be taken into consideration. Whether or not the project could get governmental commitment should be comprehensively considered prior to the construction of high-rise projects. Ghost towns in China exemplified this issue quite well. Without the services and facilities the tenants expect to experience along with a declining job market, the high residential buildings in Ordos, Kangbashi, and other Chinese cities had high vacancy rates and were a heavy financial burden for developers (Donald, 2012).

3.4 Environmental performance of high-rises; good or bad?

Based on the research of Van den Dobbelsteen, Colaleo, and others, the energy consumption of high-rises could be high when considering all the transport and service required to support high-rises functioning well (Van den Dobbelsteen et al, 2007). More materials than necessary, such as concrete, are required to be used

to deepen the foundation of high-rises (Colaleo, 2003). However, the expected service life and use of space should not be ignored when assessing environmental performance of high-rises. Mixed and intensive use of the surface favors high-rises, as tall buildings allow us to avoid excessive spatial claims outside the city. Newman and Kenworthy's research demonstrated that dense development through high-rises could support sustainable use of transport, for instance, significant reduction of gasoline consumption (Newman & Kenworthy, 1989 & 2001). High-rise buildings could considerably facilitate dense development in order to pursue a sustainable lifestyle. However, it is noteworthy that high-rise does not necessarily lead to high density. The impact of high-rises on the quality of the surrounding environment and daily life of residents should be taken into consideration. High-rises could block views, light, and sunshine, while the channel between tall buildings could increase wind velocity, which would increase the difficulties for pedestrians or cyclists, thus impeding the initiation of green transportation.

4 INCENTIVES, ARCHETYPES, AND USES OF HIGH-RISE DEVELOPMENT

4.1 Incentives of high-rise development

Markus Appenzeller argued that it was the, "scarcity of land, technological advance, and ego of investors and architects" that jointly triggered the mass high-rise development in Chicago (Appenzeller, 2012). Today, the incentives of high-rise development have become more complex, as Oral Buyukozturk categorized as, "scarcity of land in urban areas; increasing demand for business and residential space; economic growth; technological advancements; innovations in structural systems; desire for aesthetics in urban settings; concept of city skyline; cultural significance and prestige; human aspiration to build higher" (Buyukozturk, 2004). Despite the change in incentives associated with high-rise development over time, the essential motivations for high-rise development have remained similar. Due to differences in culture and demographics, high-rise developments in North America, Europe, East Asia, and the Persian Gulf have been stimulated by various combinations of the aforementioned incentives.

4.2 Three archetypes and the evolution

To understand why high-rise development in different regions is so distinct, it is important to realize that high-rise buildings are rooted in and have evolved through different urban culture. According to Appenzeller, European high-rises are characterized as iconic and have been placed in key locations such as churches and palaces over centuries. In contrast, American high-rises are presented in the form of agglomeration of skyscrapers, typically occupying one or more city blocks, such as those comprising the collective silhouette of New York City (Appenzeller, 2012). Le Corbusier advocated a third type of high-rise that contained a mix of uses in one tower. Appenzeller categorized these three types of high-rises as the American high-rise, an aggregation of skyscrapers; the European high-rise, an independent iconic tower; and the inventions of Le Corbusier (Appenzeller, 2012). Based on this classification, he further analyzed the evolution of the three archetypes around the world over the past 70 years. For example, with its unparalleled height, the Burj Khalifa was solitarily erected from a "barely existing urban culture" in the Persian Gulf, as a representative mutation of the European high-rise (Appenzeller, 2012). Interestingly, it also serves as a mixed-use tower with the intention of lifting the public accessible space into the sky. In East Asia, with a long existing urban culture and enormous demographic pressure, the high-rise become an unavoidable option. Though mixed-use high-rises agglomerate together into building complexes, the iconic project can be observed as well. The collective hybrid is regarded as the combination of all three archetypes of high-rises. In order to cater to the desire of a growing number of people moving back to center cities, all three types of high-rise development have been proposed and constructed in Europe. Representative examples include La Défense in Paris, De Rotterdam complex in The Netherlands, and the central business district around Liverpool Street Station in London. Numerous examples of high-rise development around the world have demonstrated that an individual skyscraper does not necessarily lead to a compact urban form, however, composition of high-rises may do so.

4.3 The uses of high-rises

What are the use of high-rise buildings? Originated from the tall office buildings in Chicago and New York City, a substantial number of today's high-rises are apartment blocks, hotels, and mixed use complex. It is not unusual to see skyscrapers for residential use worldwide, especially in East Asia. The high-rise

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apartments can "range from cramped, cheaply constructed forms of social housing to luxury condominiums" (McNeill, 2005). Besides tall office buildings and apartment complex, many high-rises are occupied by hotels, including some world-famous high-end brands such as the Ritz-Carlton, with their lofty aerial perspectives as a commercial selling point. McNeill argues that there is "a growing tendency among developers and policy-makers to favor mixed-use developments, where office, hotel and residential uses are shared within one building". (McNeill, 2005)

5 EUROPEAN APPROACHES TO HIGH-RISE REGULATIONS

5.1 Motivations of high-rise development in Europe

Unlike American or Asian cities, high-rise development in Europe was not "driven by comprehensive building height policies, but was a by-product of mass social housing delivered after the Second World War" (Nicolaou, 2012). Many high-rises in Europe are in the form of individual landmarks located in urban centers. The demand for high-rise development in Europe was primarily stimulated by, according to Nicolaou, "developing an international image with commercial demands and increase urban density in consistent with the policies on sustainability" (Nicolaou, 2012). The challenges experienced by planning authorities were reflected in ensuring the feasibility of high-rises, and integrating the scale and particularities of the planned high-rise projects within the existing environment.

5.2 Collective effect of high-rise development – the debate

High-rise supporters passionately praise the prominent benefits driven by high-rise development, including the intensification of space and expansion of infrastructural capacity, global positioning and branding, positive change of urban morphology, and catalytic rejuvenation of economic base. Opponents of high-rise development provide their reasons for confining high-rise construction such as inefficiency of energy performance, expensive rental and maintenance costs, lack of development flexibility, restraining vitality and activity inside of the building rather than encouraging them outside, detrimental psychological impact of nonhuman scale, and cold blank walls from tall buildings. Thus, it is difficult to measure the collective effect of high-rise development. For instance, expansion of infrastructural capacity might bring congestion, and the fact that judgment of urban image is quite subjective based on individual perspectives rather than objective and clear.

McNeill's systematically analysis of the impact of high-rises provides a holistic view. In terms of the positive effect of high-rise development, on the one hand, high-rises allow "the kind of logistical access required to sustain urban clusters, and often house some of the 'light institutions' deemed significant to the functioning of the contemporary economy, which has been central to the relaxation of planning controls on tall buildings" (McNeill, 2005). On the other hand, "contemporary high-rises selectively connect together the most favored users and places, both within and between cities" (McNeill, 2005). From the perspective of the social impact of high-rises, "these buildings have tiny footplates but huge aggregate impacts on the city or metropolitan area". (McNeill, 2005) Speaking of the role high-rises played on urban morphology, McNeill argues that the invention and growth of high-rises since last century have caused some perceived damage to the existing skylines of many cities. However, as mentioned before, this is really a subjective matter based on individual perceptions.

5.3 The characteristics of high-rise regulations in Europe

Unfortunately, very few authorities have established mature strategies or tested high-rise policies. Since the 1960s and 1970s, construction of tall buildings in Europe was driven by housing policy and public sector reconstruction programs. Many high-rise projects at the time failed due to lack of comprehensive market analysis and effective approaches of management in regard to high-rise development. Contemporary high-rise developments are driven by private sector demand for higher density and profit. High-rise regulations are composed of relatively weak policies and very little "post occupancy" evaluation research (Nicolaou, 2012). The change of high-rise development in Europe is also reflected in the change of geographic location. Tall commercial buildings are mostly proposed in urban centers, while tall residential buildings are proposed everywhere. Nowadays, some commercial high-rises are being proposed in marginal office locations or in small cities and towns. The spatial change of high-rises in Europe is similar to their counterparts in Asia. However, Asian high-rises do not have as many alternatives as the European ones for location selection due

to the tremendous population pressure, while the spatial distribution of European high-rises presents more of a "haphazard nature of demand" (Nicolaou, 2012)

Compared to the sophisticated and comprehensive zoning ordinances and building policies in North America and Asia, high-rise regulations in Europe emerged after the war in a less substantive form of "design prescriptions" (Nicolaou, 2012). A substantial number of policy-makers from European cities viewed high-rise development as isolated insertion rather than comprehensive transformation of urban form. As a result, high-rise projects continue to be assessed without consideration of their adjacent similar projects (Nicolaou, 2012). Yet another issue is the debate of historic preservation and management of high-rise development. High-rise policy research commissioned by the Mayor of London suggested that, it is the cultural value of the city's historic districts that caused the high value of land, in turn with the high demand for larger and taller development. However, Nicolaou argues that the city failed to provide integrated and valid evidence to support high-rise development in the area close to its historic district (Nicolaou, 2012).

The high-rise regulations and policies in Europe can be characterize as more reactive than proactive from a position of "why not" passively adopting policies related to other regions rather than thoroughly understanding "why" high-rise projects should be promoted in order to achieve sustainable growth in the long run (Nicolaou, 2012). The concerns among European policy makers and planners emphasize how to balance the desire of a new city image in order to express economic boom and the impact of high-rise development on existing urban nature, especially when the high-rise projects cause drastic changes in low-rise cities. Nicolaou argued that most skyscrapers in London only meet part of the tenants' expectations such as mixed use and enhanced sense of place (Nicolaou, 2012). Rarely a specific skyscraper could be endorsed as an ideal model that fulfills all expectations of tenants.

5.4 Recent tendencies of high-rise development in Europe

What conclusions can be drawn from high-rise management in Europe? Due to the traditional urban culture, a large number of European high-rises serve as urban icons. Previous research has suggested, for most housing models, density increases with height up to a point of around 20 floors (Nicolaou, 2012). Beyond that, high-rises need to space out in order to achieve similar energy performance. Hence, increasing density on a citywide scale depends on the comprehensive management of building height, rather than incremental consideration of individual building. The role high-rises play in urban renewal remains unclear. Successful urban regeneration seems triggered by high-rise development, usually associated with other significant prerequisites. Either the high-rise project is part of a long-term master plan, or it is endorsed by strong political and public support. Buchanan argued that economic transformation is more related to infrastructure improvement with the help of high-rise development rather than tall buildings themselves, implying that it is the catalytic effect of high-rises that plays a critical role in urban revitalization (Buchanan, 1998).

The branding value of high-rises have changed over time. With the non-innovative "universal" design of high-rises are spread through out the world, architects, planners, and policy makers increasingly concern about their cities losing uniqueness and attractiveness with the development of high-rises. Some cities are shifting their emphasis on high-rise development to public space improvement in order to attract more tenants (Nicolaou, 2012). Efficiency assessment of residential high-rises usually concentrates on estate revenue and occupation rate. However, the failure and demolition of many residential high-rises constructed and commissioned by the public sector in 1970s indicate the significance of comprehensive management and consideration of psychological needs of inhabitants prior to any kind of construction (Nicolaou, 2012). Recent trends of workplace design for modern industries show the preference "towards large floor plates that encourage seamless communication and enhance flexibility for expansion or contraction of operations" (Nicolaou, 2012). Similarly, regulations of residential high-rises should encourage creating communities that facilitate social interaction. McNeill points out that "public access to rooftop bars, restaurants, viewing platforms or gardens is now seen as being an important issue in skyscraper planning permission, although security concerns are often used to thwart this" (McNeill, 2005) Thus, the issue of "access and positioning of the public at various points in the high-rises is often controversial" (McNeill, 2005).

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6 CASE STUDIES OF AMERICAN AND EUROPEAN HIGH-RISE REGULATIONS

6.1 Setback formula and incentive zoning: New York City Zoning Ordinances of 1916 and 1961

In the earliest decades of high-rise development, regulations focused on the characteristics of building itself in terms of the design (e.g. the setbacks), degree of comfort for occupiers (e.g. light, air), and the related economic benefits. Adler discussed the economic advantages of setback principles by calling for some regulation to assure access of light and air to the rooftops, and equally important, to the streets and into the rooms of the lower stories, since "the experience of real estate agents shows that high rentals can be obtained only for well-lighted offices…" (Adler, 1892) However, according to Hoffmann, "there is no reason to believe that the setbacks of high-rises were motivated by any consideration of public street amenities." (Hoffmann, 1970)

It is noteworthy that L. Sullivan pioneered the sociological studies of high-rises by providing the solution of setback principle and analyzing the rationale of setbacks. Sullivan's essay "The High Building Question" (Sullivan, 1891) argues that the rationale of setback is dominated by the interplay of interest and rights of the individual owner of land and public welfare. "A sense of public welfare control the individual owner in terms of his willingness to maximize the rental space by restricting the area as the building progresses upward" (Sullivan, 1891). By further exploring the corresponding behavior of the individual owner based on his human nature, Sullivan highlights the significance of both maintaining public welfare and holding the freedom of thought and action of the individual sacred.

Considerably influenced by the setback principle, the 1916 New York City zoning system emphasizes both land use and bulk restrictions. The system combined three land use districts of housing, commerce, and industrial activities, five height districts, in which buildings could not be higher than a certain multiple of the width of the street (from one to two-and-a-half), and five area districts, with requirements for the minimum size of yards and courts and the maximum percentage of the lot covered (Willis, 1986). The complex interplay of different political powers was reflected in the 1916 zoning ordinance, since it was made of "combined efforts of urban reformers and city planners, allied with wealthy real estate owners who wielded the requisite political clout" (Willis, 1986). Stakeholders include the Committee on Building Heights, the Commission on Building Districts and Restrictions, as well as real estate and business owners. The planners and politicians who wrote the laws were motivated, "not by a vision of an ideal city, but by practical, political, and economic issues of urban reform" (Willis, 1986). The 1916 zoning law aimed to solve primary urban issues of the time including "overbuilding and congestion in lower Manhattan, clash of interests (and classes) on Fifth Avenue, the protection of property rights, and real estate conflicts". (Willis, 1986) Aesthetic value was another subject under consideration. The "setback style" bonus paid specific attention to "creating strong, sculptural massing and the subordination of ornament, and an expression of contemporary American society" (Corbett, 1927). According to Munro, the 1916 zoning ordinance was designed to "help public administration by making it more orderly, diminishing its difficulties, and reducing needless outlays" (Munro, 1931).

Despite the revolutionary enlightenment of the 1916 zoning ordinance on high-rise regulation, criticism was extensively raised for racial hatred and the class bias inherent in the ordinance. To address these predicaments, approaches of government intervention were proposed as decreasing allowable population and building densities through limitation of the expansion of skyscraper districts and more stringent restrictions on the height and bulk of buildings. The 1961 Zoning Resolution followed the approach of incentive zoning, by "setting floor-area ratios (18) and 20% density bonuses for creating public plazas, later extended to other urban amenities" (Weiss, 1992). The allowable population density was reduced while the lot coverage of high-rises was increased in the 1960s compared with the 1916 zoning law. The density bonuses of the 1961 zoning resolution permitted more flexibility in the structure of high-rises in order to accommodate the desire of developers (Weiss, 1992). However, a cost-benefit analysis demonstrated that the benefit from taking advantage of the density bonus is much larger than the cost of plaza construction, forty-eight times, according to Kayden. (Kayden, 1978) This led to the construction boom of taller and bulkier high-rises. The regulations, particularly the issue about density level and governmental intervention, have been discussed and debated ever since. Specific use of density bonus in specific districts was encouraged and added in the 1961 regulation. More restricted and complicated regulations were initiated in many American cities based on the zoning ordinance originated from New York City.

6.2 From incremental to comprehensive regulation – high-rise regulations in London

The approaches of high-rise management applied by cities in the UK and in continental Europe are distinctive (Nicolaou, 2012). Policies in Frankfurt and Paris confined high-rise development projects outside the traditional city center by prescriptive zoning regulations in order to preserve the historic morphology of city center. For example, "La Défense was invented to provide relief from the pressure to construct high-rise buildings in the center of Paris" (Bosselmannn, 2012). Contrastingly, Greater London Authority (GLA) took a very different approach to manage high-rise development by "offering loose zoning ordinances and avoiding restrictive building height regulations" (Nicolaou, 2012). Apart from the considerations of high-rise management similar to other European cities, policy makers in London take into consideration maintaining the city's role as one of the international financial capitals. This explains why the building height restrictions in London are not as stringent as other European cities. Similar to the planning theories, the different regulation patterns adopted by London and Paris or Frankfurt can be categorized as "incremental" (London) and "comprehensive" (Paris or Frankfurt). By allowing high-rise development in London's historic CBD, GLA attempted to present London's economic vitality and cultural diversity through the city's varying skyline. Driven by speculative investment, large numbers of high-rise projects are more individual-based rather than serving as part of some comprehensive master plan, along with constant revision and reposition during the development period. From the beginning of the 2000s, high-rise regulations and policies became more coordinated, but still not as specific or detailed as some other cities in continental Europe or North America. In regards to the administrative process, high-rise regulations were established based on individual projects within each London borough's administrative boundary (Nicolaou, 2012). Building heights in different boroughs were regulated in an uncoordinated fashion. The transformation of London's view management policy from the London Strategic Views Framework to the London View Management Framework shifted emphasis from preservation of the view of central London area and famous landmarks within it (such as St Paul's Cathedral and the Palace of Westminster), to the inclusive organization of high-quality views for the whole city and the experience of the viewers (Nicolaou, 2012). The most recent View Framework considered the respective impact of foreground, middle ground, and background of urban morphology based on the experience of viewers (Nicolaou, 2012). The Supplementary Planning Guidance (SPG) gives further detail on certain policies found in the London Plan. Besides the view management in the City of London, "planning permissions for tall blocks are often only being granted with the barest provision for car parking, putting additional pressure on existing underground links" (McNeill, 2005). This expresses the comprehensive consideration of the relationship between high-rises and the capacity of surrounding infrastructure (e.g. street and underground). The development of high-rise regulations in London indicates the significance of comprehensive intervention in order to avoid arbitrary growth of skyline configuration.

6.3 Visibility management of high-rises in The Hague

In order to support more objective policy-making procedures with respect to the visual impact of high-rises in The Hague, several advanced GIS methods including mapping, scatter plots, and viewsheds were applied to project the growth of building height and assess the visibility of high-rise clusters. During a public hearing, a photo-montaged impression, released by the municipality, falsified the visual impact of the planned high-rises near the Central Station by reducing its actual size. (van der Hoeven & Nijhuis, 2012). The municipality's predicament of maintaining balance between high-rise development and preservation of the integrity of the established skyline is reflected in its effort to hide the actual visual impact of proposed high-rises. The high-rises draw the greatest attention in regard to visibility, thus specific regulations are required to manipulate the visual impact of high-rises. A comprehensive GIS-based viewshed method was applied to analyze the visual impact of high-rise clusters in The Hague (van der Hoeven & Nijhuis, 2012). A number of important influential parameters were selected and measured to improve the accuracy of visual analysis of high-rises such as "the apparent contrast between the high-rise and its background, the angular size of the high-rise, the contrast threshold at the level of luminance, and the meteorological optical range at different weather conditions" (Nicolai, 1971; Duntley, 1948; Middleton, 1952).

6.4 Shifting emphasis on street level and urban experience in Rotterdam

In the 1990s, high-rise policies and visions were initiated in the City of Rotterdam when high-rises were recognized as tools for densification and mixed-use in the inner city, expression of modernity and economic success, as well as significant components of the urban skyline. Nevertheless, without a restricted limit of

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building height, the skyline of the city grew higher but lack of diversity. (Arends, 2012). The development of high-rise regulations of Rotterdam from 1990s to 2010s illustrated the shift from emphasis on the high-rise itself and its role in shaping urban morphology to the contribution of high-rises on creating a vibrant, interaction-friendly inner city. Instead of the conventional focus on the top-level of high-rises, the street level of high-rises was given particular attention to create a desired "city lounge" experience (Arends, 2012). Understanding the impact of high-rises on the street level requires interdisciplinary knowledge. The impact on the street level was measured by the experience of pedestrians. As a result, more transparency and public functions in the lower part of a high-rise were advocated. The limit of 200 meters building height and a flexible maximum floor space in Rotterdam were considered the most economically feasible, as it ensures the sustainable growth of new high-rises while restricting over-full development. Various "sun-spots" have been designed for compensation of shadows cast by high-rises (Arends, 2012).

7 CONCLUSION

This study attempts to contribute to the exploration of accountability of high-rise development. The experience from the development of European and American high-rise regulations are reviewed and analyzed. Some tendencies are noteworthy during the evolution of high-rise regulations. The zoning resolution of New York City initiated the approach of incentive zoning instead of flat building height restrictions. The transformation of London's view management policy shifted emphasis from preservation of the view of landmarks in the central London area to the inclusive organization of high-quality views for the whole city and the experience of the viewers. The development of high-rise regulations of Rotterdam from the 1990s to the 2010s exemplified the shift from emphasis on the role of high-rises in shaping urban morphology to the contribution of high-rises on creating a vibrant, interaction-friendly inner city. Instead of the traditional concentration on the top-level of high-rises, the street level of high-rises was given particular attention to create a "city lounge" experience. Through this study, it becomes clearer that the development of high-rise regulations is driven by incentives as economic, environmental, and social impact of high-rises. Specifically, the economic impact of high-rises continues to serve as a major determinant when assessing the feasibility of high-rise projects. The collective visual impact of high-rise clusters is gaining more attention than those of individual high-rise. Environmental and social influence of high-rises is given more and more considerations, such as creating a sense of belonging, a unique urban experience, and an interactive neighborhood.

The study hopes to offer some inspiration for establishing reasonable qualifiers to justify high-rise development in developing countries as well. Similar to the history of developed countries, urbanization in developing countries was associated with the increase in excessive automobile use and urban sprawl, and the resulting social fragmentation and environmental deterioration. Differentiated from the developed countries, some developing countries face enormous pressure from overpopulated cities. High-rise development was thus proposed and practiced as a solution in order to ease the pressure from these problems. The ideal of a 'universal' high-rise style popularized by the modernist movement have been criticized by architectural theorists, urban planners, and social historians. Instead, for developing countries which adopt high-rises as symbols of national modernization, there is a tendency of the integration of "standardized western production methods with a locally sensitive design vocabulary" in recent years (McNeill, 2005). Accordingly, regulations of high-rises should be more context specific in order to better accommodate vernacular physical and social environment in developing countries. For example, regulations of high-rises in tropical areas might function more effectively by incorporating climate concerns to provide "appropriate environmental solutions to the problem of the high-rise in the tropics" (Papadakēs, 1992). Regulations of high-rises in earthquake-prone areas could pay more attention to issues related to structural safety, disaster prevention and evacuation. Through literature review, the existing studies of high-rises by researchers from developing countries primarily concentrate on technical perspectives such as high-rise structural design (Ding et al, 2014) or building seismic vulnerability (Wu et al, 2013). This study aims to supplement the discussion about high-rise development from theoretical perspective of accountability.

Over one hundred years ago, when high-rises first thrived in American cities, Louis Sullivan envisioned the future form of high-rise cities, boldly ahead of its time. (Sullivan, 1896; Hoffmann, 1970) Through his study and practice in Chicago, he sought for a "true normal type" for all high-rises and believed high-rises need to express "a sentiment of largeness and freedom". (Sullivan, 1896) Echoing with Sullivan's profound insight

of sustainability of high-rises depending on whether it is the living form of utterance, an art “of the people, by the people, and for the people” (Sullivan, 1896), high-rise development should be regarded as an opportunity, not a necessity, that it could only be justified and regulated for the right reasons, and the reasons are ever human-centered. This is the law.

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