

# Case study of mixed-use high-rise location at the Greater Paris scale

C. Saint-Pierre<sup>1,2</sup>, V. Becue<sup>1</sup>, Y. Diab<sup>1</sup>, J. Teller<sup>2</sup>

<sup>1</sup>*Université Paris-Est, Ecole des Ingénieurs de la Ville de Paris, France*

<sup>2</sup>*LEMA, Université de Liège, Belgium*

## Abstract

The phenomenon of urbanization is recognized all around the world: cities are growing, changing, renewing. For over a century, these transformations were possible thanks to numerous technical and technological progresses. Among the characteristic components of urban environment, the vertical construction is experiencing a more or less accepted success, according to the regions, populations or cultures. More present on the North American continent since their birth, and more recently implanted in the Asian countries, towers were for a long while a land and economical result. Today, the stakes have evolved and the towers are well-known for their strong symbol of economic power with a local, global or international influence. Among European cities, Paris is showing less enthusiasm concerning tower construction on its territory and is having trouble to develop high-rise projects. Nevertheless, more and more projects of this kind are proposed – especially in the strategies of the Greater Paris consultation – but they are hardly approved.

This is why it is necessary to question oneself about the means to find a judicious establishment and an adapted program, allowing a good insertion of a tower in the urban fabric, at the building, district or city scale. We first establish a method which relates and analyses typological and contextual criteria, allowing the situation's assessment and the impacts' evolution of a tower project in the sustainable city. These criteria are mainly used as a support of decision making and are consequently useful for the creation of case studies, easier to understand for elected members and citizens, since they clearly expose the issues.

*Keywords: high-rise, mixed-use building, Greater Paris consultancy, mobility, form, function.*

## **1 Introduction**

At the beginning of the 21<sup>st</sup> century, sustainable development and parallels movements are more and more present in minds of public decision-makers, architects and urban planners. Following the growing concerns about the environment and the future of the planet, international conferences, environmental agreements and numerous local acting plans are rising since for few decades. Cities have to face more and more challenges implying various fields concerned with sustainable development. Engineers, sociologists, politics, geographers, architects, urban planners and other actors are working on the possibilities to anticipate and ameliorate evolutions of cities. In the same time, the revival of the debate on high rise buildings in Paris leads us to question their implication in the sustainable city development and see how they could be the solution to present issues.

This article aims at evaluating the coherence of special organization of areas which could be appropriate for high rise buildings in the Parisian area. This objective would let us see if it is possible to understand an urbanized territory with high rise buildings, in analyzing its components as accessibility, centrality, density and mixity. The project's ambition is to give the best recommendations to the different actors, in order to develop projects with success or a development policy that would facilitate vertical urbanism. The objective will be to collect the best conditions to create the emergence of concrete suggestions, as sketches of special development, architectural ideas, implementation process, political and financial strategies, and dynamics to inspire, directly usable for the Greater Paris development.

The first part of the article handles the different elements of the context of this study with the presentation of the Greater Paris Consultancy, the high rise issues in Paris and the major development axis of the new town planning scheme of Paris. Then the selection of criteria inherent to high rise buildings projects is presented in the second part, as well as the method used for the analysis. Finally, a part of the results are developed in a third part, an application of the method to chosen areas of the Greater Paris territory.

## **2 Context**

The study of high rise buildings location was established from several contextual factors. Firstly, the research carried on in the frame of the Greater Paris consultancy which took place during the two last years, raised up questions concerning the future of the Parisian metropolis. Then, high constructions are part of the urbanization phenomenon growing in European and international cities. They supply numerous discussions and debates, more or less animated, especially in Paris where towers were disparaged for a long time. Finally, one of the leading modifications of the town planning scheme of Paris is the improvement of mixed urban areas.

## **2.1 The Greater Paris Consultancy**

Started at the beginning of the year 2008, the Greater Paris Consultancy was composed of ten multidisciplinary teams who worked on two axes: “The metropolis of the 20<sup>th</sup> century, after-Kyoto” and “prospective analysis of the Parisian urban area”. The main themes that represent the major stakes of the metropolis development concerning in particular mobility and transportation, green areas, equipments, business centers, etc.

Several proposition of urban scheme are presented in the results of this consultancy. Some of them are proposing to replace centralism with polycentrism and to multiply urban centers in completing and improving the existing transportation network, and developing the city following a multifunctional vertical and horizontal networking (LIN and Rogers teams). Others emphasize the importance of existing functional links between centers (for example the rhizomes of Porzamparc’s team). Others are proposing to intensify the functional mixity development and to work on renewing districts, to face the urban spreading. They also mention the densification at all scale, varying typologies for multiple uses, especially in the construction of mixed-use high rise buildings (Nouvel and Descartes teams) [1].

Mobility, largely discussed by the ten teams, was for a long time a factor of territory’s transformations but its importance is growing with the stakes of the post-Kyoto City. Transportation development is an essential condition for the functioning of the metropolis. All the teams of the consultancy are proposing a renovation and extension of the actual transportation networks, in particular in making connections between suburban areas [2].

## **2.2 High-rise in Paris**

The first high-rise constructions in Paris were built at the beginning of the 20<sup>th</sup> century. Nevertheless they do not compete with the first American skyscrapers. The debate about height is started by the architect Auguste Perret, and then followed by Le Corbusier in the 1920’s. All the high-rise construction’s propositions stayed at the project state in France and there was no high-rise experimentation as in the United States. In 1925, Le Corbusier established the “Plan Voisin”, a proposition made of a set of towers in the center of Paris.

In the framework of the “Plus Grand Paris Plan” in 1932, several thinking about the planning of Paris and its suburb arose. Back then, the “principe de dalle” (suggested by François Coignet) with a dissociation of the highest street for pedestrians, and the lower street for transportation networks and services for buildings. This principle was applied for the construction of La Defense and the Front de Seine district. In the same development plan, the idea of creation of business center around Paris was justified for reducing city congestions.

In the 1950's – 1960's, the large projects of Paris development were proposed to balance activities throughout the capital, to develop functional mixity in Paris outskirts, to create new urban centers and to clear the center of the city. The approval of the Urban Master Plan in 1967 revived the debate about high rise buildings, justified with new data on the population level, the economic growth and the emergence of industrial service. The high rise limit was removed and some projects were studied (as the Montparnasse tower, La Défense, etc.). Nevertheless, the construction of the Montparnasse tower generated a lot of rejects against towers and the regulation about high rise buildings was again reinforced. This is one example among others which demonstrates that the reject of towers is related to a location problem. Most of the towers are disconnected from their environment, from public space, whereas their scale is not incompatible with the street scale. On the contrary, it is a question of connections [3].

The new zoning map of 1974 clearly defines building height for new urban development areas. The different height level limits currently in force are 25 meters in central zones and surrounding historical sites, 31 meters in intermediate zones, and 37 meters in some outlying district, presented on the following map from the town planning scheme of the city of Paris (Figure 1).

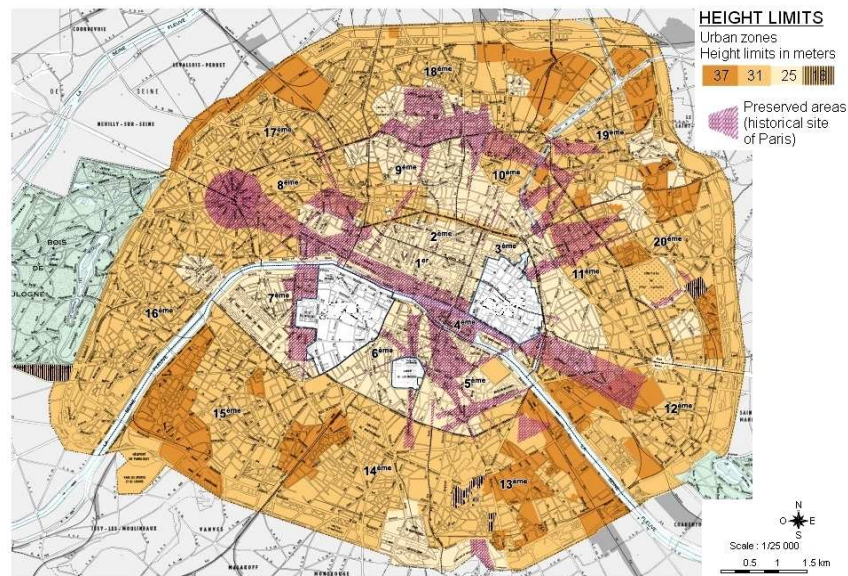


Figure 1: Height limits map of Paris [4]

However, concerning high rise buildings location, different problematic aspects draw a particular attention:

- The green structure in the studied area (covered surfaces or potentially covered by vegetation);

- Discontinuity of urban landscapes;
- Historical and cultural values, specific of these spaces;
- Availability and quality of the built environment;
- New projects of single-function buildings.

Indeed, this phenomenon risks reinforcing a kind of single-functionality, and the worst paradox underlying this concept is a single-function high rise building. Without a sufficient density and variety of functions, we face segregation and concentration of functions, which would be harmful to the urban fabric of the studied sites of the Greater Paris.

If the question of building towers inside Paris stayed unsettled for a long time, the recent projects of urban development (among them the propositions of the Greater Paris Consultancy) including high rise constructions, have indubitably revived the debate. This is especially the case of the 200 meters project of the Triangle tower which will be built in the South of Paris, at the Porte de Versailles. However, a tower cannot be planned without analyzing essential aspects of the territory, as for example mobility or activity studies.

### **2.3 Mixity and mobility**

Since 2006, the new town planning scheme of Paris is effective and focused on three main axes:

- The smartening up of the city in considering historical sites and green spaces;
- The creation of job offers and the establishment of activities;
- The maintenance of social diversity in fighting disparities.

It is obvious to associate transversal themes to these objectives, such as mobility and mixity (social, functional, urban, etc.) [4].

Mobility is essential to establish new activities and to maintain social diversity. Concerning people or information, it is an fundamental component to create connections between the different clusters and let them develop. Moreover, it is one of the major stakes of Parisian metropolis development. Another essential characteristic of mobility is the question of transportation: the use of car and public transportation is a real question about the future of the metropolis, especially with the objectives of the Kyoto commitment.

Mixity is also one of the main factors in the development and rehabilitation of districts. Different existing types of mixity allow supporting the objectives of the new town planning scheme:

- Social mixity and housing mixity are interacting, which help to maintain diversity and fight against inequalities;
- Mixity of urban functions can stimulate jobs creation and activities establishment;
- Mixity of urban morphologies can contribute to the smartening up of the city and to the preservation of historical sites and green spaces.

To succeed a mixed-use high rise building project, it is necessary to think about the co-activity of urban functions in the immediate surroundings and the analysis of the special organization. Moreover, a spontaneous densification, non organized and only based on functional demand, is inadequate and dangerous for local resources. Indeed this development does not evaluate the global impacts of the spatial organization of the city of Paris territory. Therefore, it is possible to state with more arguments the optimum size of buildings since they would host a mix of different various functions. It's a matter of qualifying tower projects in their global evolution while considering new needs of the society [5].

This would allow developers and local actors to accept and think about mixing functions in their projects. We can rightfully question if high rise buildings could contain a cultural space, restaurants, an auditorium, shops, etc. as well as public spaces at the ground floor. The only problem consists in the lack of culture and the shyness of investors. Furthermore, when we compare different urban operations (San Francisco, Chicago, and London), we remark the quality of high rise buildings is when they are not isolated from public space, whereas in Paris they are all single-function high rise buildings [6]. Moreover, to succeed mixity it is necessary to make high rise buildings evolve in time. For example, some floors allocated to social housing should be able to be transformed in high standing apartments. Flexibility is implying certain knowledge of all the existing functions on the city of Paris territory.

Finally, the lack of research on vertical urbanism, the lack of economical and ecological studies on their cost and maintenance, the lack of sociopsychological studies on life in high rise, the lack of comparison between dense districts without towers and districts with groups of towers in Europe, make us to evaluate and propose certain opportunities for areas where high rise buildings could be inserted in Paris [7].

### **3 Identification of inherent criteria and grid analysis**

#### **3.1 High rise building regulations comparison from three cities**

Town planning schemes, building codes and zoning maps of three cities were finely analysed to determine which criterion were the most influent in the construction of high rise buildings. Chicago, San Francisco and London were chosen with historical and cultural justifications.

Chicago is one of the first cities which started the construction of high rise buildings at the end of the 19<sup>th</sup> century. The city is commonly known as the birth place of skyscrapers. After a devastating fire, the reconstruction of the city was an opportunity to redevelop a new planning scheme and regulations were progressively elaborated. The fundamental criteria in the Chicago Building Code are functions and constructions types, listed in tables. All the height and volume limits are based on these tables. Multifunction and mixity are also specified criteria of the Building Code. Recent considerations on energy efficiency were

added to the code and make Chicago one of the first cities to apply these environmental regulations.

Even if San Francisco is a typical American city with its financial district consisting of high rise buildings, it was not as easy to build them since there was a strong movement against towers in the middle of the 20<sup>th</sup> century, fearing a “manhattanization” of San Francisco. Consequently, very strict rules were established concerning height and bulk of buildings. There are charts, tables and maps which precise height and bulk limits in function of the district area and the characteristics of the buildings. Others essential criteria, precious to the city, are the skyline and view quality. Indeed, several plans develop the idea of emphasizing the hills in avoiding podium effects with large scale buildings at the top of the hills, and preferring thin high rise buildings with graduated heights instead (Figure 2). This layout also allows maintenance a good view and light access for more buildings.



Figure 2: Hill shape emphasized vs. podium effect [8]

The particularity of London is its absence of strict regulations about height limits or locations. Nevertheless, all the development plans and general plans are made of policies and guidance that promoters are supposed to follow as much as possible. We can notice that the flexible nature of these policies generate numerous negotiations between local, regional authorities and promoters about large projects. Concerning high rise buildings, one of the most important criteria is the protection of Landmark Viewing Corridors which were established to ensure a view of historical buildings from several places and the emphasize of the skyline (for example the St Paul’s Cathedral or the Westminster Palace). The accent is often focused on the possible increase of attractiveness and dynamism of the area where a high rise building would be located.

A parallel study was carried out on the regulations of the city of Paris to attempt understanding why the situation is a little more complicated when the matter of high rise buildings comes. This is why Paris is appearing in the table of results (Table 1).

### 3.2 Environmental Impact Assessment (EIA)

Environmental Impact Assessments were also analyzed to identify essential criteria taken in account in the construction process of high rise buildings. High rise building EIAs are usually following the same content and the following list of items is presented:

- Functional classification of high rise;
- Location of the project in the regulation context;
- Site analysis (actual territory situation, natural, physical, urban context);
- Impact on the urban environment (skyline, view, bulk, etc.);
- Impact on the natural and physical environment (sunlight, air quality, geology, water, wind, acoustics, climate, etc.);
- Impact on access, circulations, transportations, etc. ;
- Waste management ;
- Energy efficiency;
- District liveliness;
- Construction site management;
- Impact on health;

### 3.3 Identification of inherent criteria

From the analysis of the three cities urban regulations and the EIA items, we noticed that nine criteria were recurring and furthermore related to each others. Indeed there is, for example, a close relation between the form of a building with its energy efficiency or the daylight accessibility, or the urban morphology is having impact at different scales: it would determine the building form and could be part of the skyline of the city. Two criteria seem to be crucial in the process of a high rise construction on the Parisian territory: mobility and activity (function). They create a strong duality, which stands out from the set of criteria. All the links and potential impacts are summarized in the following scheme (Figure 3).

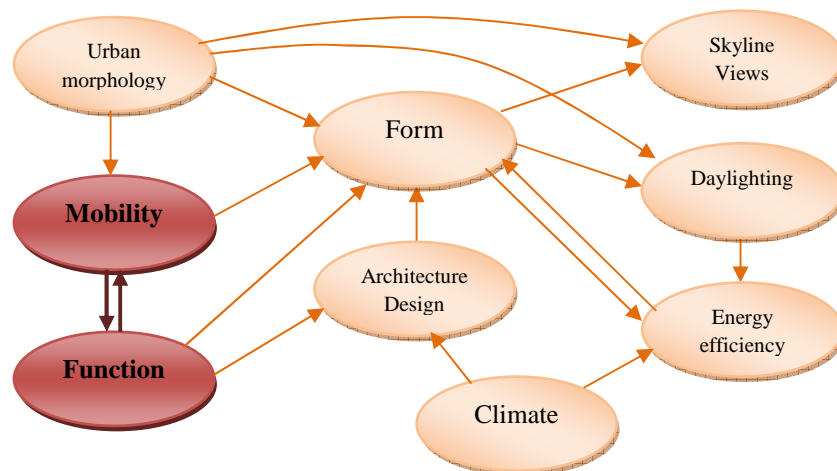


Figure 3: Relations between the nine identified criteria



Table 1: Selected criteria from the two analysis

Criteria	Chicago	San Francisco	London	Paris	
Regulations	Zoning	Chicago Zoning Ordinance	San Francisco Zoning Plan	Unitary Development Plans (UDP)	Plan de zonage (in the PLU of Paris)
	Town Planning Scheme and Urban Plans	Chicago Plan (Burnham 1909) Chicago Building Code	General Plan Downtown Plan Urban Design Plan	London Building Acts Development Plan Unitary Development Plans (UDP) Regional Planning Guidance London Plan (2004)	Construction and Inhabitat Code PLU of Paris (Town Planning Scheme) SDRIF (Regional Planning Scheme) Loi SRU (law for solidarity and urban renewal)
Form	Table of precised heights and surfaces regulations	Height and bulk limits on the zoning map	- No height limit - Each case is individually analysed	Three height limitats: 25m, 31m, 37m (see figure 1) - Aspect ratios (height and bulk ratio)	
Function	- Classification by type and function of buildings - Multifunctionality	Determined on the zoning map			
Architecture Design			Should be related to its surroundings	- Must be related to its surroundings - Existing preserved (historical) areas	
Skyline Views		- Should emphasize the hills shape - Must not block the views (from the hills)	Landmark Viewing Corridor to preserve the view of historical sites and slylines	- Historical axis - Alignment of buildings along the street (Hausmann)	
Morphology	Numerous skyscrapers in the center but also along the lake and in the suburbs	- Skyscrapers in the financial district and in few residential areas - Victorian houses	- High density - Variable type and size of buildings	- Very high density - Medium sized buildings	
Energy	Specific chapter on energy efficiency in the Chicago Building Code	Mentioned in the San Francisco General Plan	Policy specifying the aim of improving and maximizing energy efficiency	- Cannot be part of the law in France - In the PLU only in underlying means	
Daylighting	Mentioned in the chapter on energy efficiency	Related to height and spaces between towers	Largely preferred to artificial lighthing	Related to the street aspect ratio and morphology	
Climate	- Cool weather, near Lake Michigan, micro-climate due to skyscrapers - Called "windy city"	Cooler micro-climate in San Francisco (compared to the Bay Area), but usually nice weather	Mentioned in EIA	Mentioned in EIA	
Mobility	- Good access to high rise buildings - Good transportation network - Mentioned in EIA	- Good transportation network - Mentioned in EIA	- Limited access for vehicle in the center of London - Good transportation network - Criteria of EIA	- Transportation network saturated - One of the major axis of the new PLU - Fundamental criteria in EIA	

Key diagram		very high importance
		average importance
		not having priority
		not mentioned

## 4 Mobility and location strategies

The method is developed with a Geographic Information System (GIS). The territory study consists in describing the most precisely each element of the territory (block or parcel) in giving:

- Its density;
- Its status in official regulations (town planning scheme, master plans, etc.);
- Housing/activities ratio;
- Accessibility with the different transportation means (public transportation, motor vehicles, train, etc.);
- ...

From the collected information, the aim is to identify the most appropriate area to build high rise. There are two possible use of this method: from high rise buildings we know the mobility profile, we are looking for places having an adequate accessibility profile; or from a place we are looking for the right type of high rise to establish. In the first approach, we find a connection between territories descriptions and types of high rise that is to determine the best criterion of accessibility (public transportation or personal vehicles) related to each criterion of mobility (intensity of employees living within a local radius, volume of international transit, etc.).

The method is a decision-making tool of research of similar cases to a reference case (ideal situation). The most adapted technique is the reasoning based on cases (nearest neighbor search algorithm). We suppose we wish to implant a high rise building with equal percentage of housing and offices and some shops at the ground level. This building would consequently have an intense flow of visitors, employees, professional trips, and an average volume of supplies transit (for shops). In calculating the distance (norm-2) between each place and the ideal place, we obtain a map of location of a high rise building in close outskirts (Figure 4).

The method seems to be a good tool of diagnosis and urban planning, which help the decision-maker to considerate the territory accessibility. The implementation of this method to the Parisian area is all the more efficient that it takes in account new techniques: fuzzy logic and a Decision Support System (DSS) gather with a Geographic Information System (GIS).

The prospect evolutions of this tool lie in the learning capacity of the DSS. Indeed, more the system is used to place high rises (with different rates of activity and multifunctionality), more the database is dense. Thus, thresholds used for the description of activities could evolve, as well as the database containing the different types of activities. In optimizing distances and accessibilities with public transportations, we have to prove their viability to car holders.

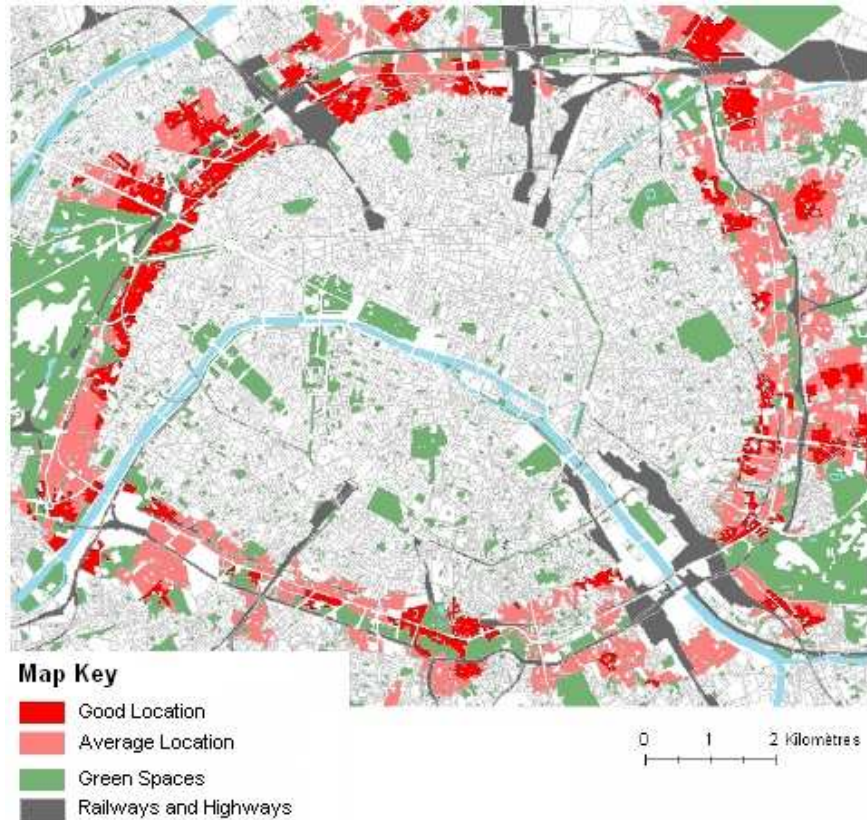


Figure 4: Possible location of a high rise building in close outskirts of Paris

Direct consequences of the reduction of the car dependency are clearly from two kinds:

- An environmental concern, with the reduction of pollutants emissions and the underlying public health interest;
- A concern about general accessibility and unblock the city, which is an economical benefit in term of transportation, but also a recovery of its territory use.

## 5 Conclusion and prospective

Analysing, understanding and reallocate these stakes are essential parts that the method can ensure in combining mobility and multifunctionality, because it identify the territory and activities and then gather them in a same area. This warrant is fundamental for a sustainable and coherent urbanism.

In this project, the method shows a certain duality between mobility and multifunctionality. This kind of policy allows to not only focus on one or the other argument but to develop both frontally.

The first experimentations of this method were applied on districts forming the first outskirts of Paris, at the edge of the Paris beltway. Different sectors of the territory of Paris, judiciously selected, were listed in several categories (profiles) according to their accessibility. This consists in defining a location strategy from different existing criteria and elaborated in the method, crossing the accessibility profile of the place and the mobility profile of the activity to implant. These experimentations aim to demonstrate the capacity of the territory regarding these different districts to establish future high rise buildings. The various sectors are the starting point of new resources and evolutions of areas, on economic as well as social aspects, with the creation of new activities and services, and thanks to the flow of populations induced by this urban development.

In applying this method on these districts, several criteria were used, as the employment ratio (number of employees per area unit), the number of visitors, the parking regulations per activity or distances to a central station, subway or tramway station. Tests of this policy indicate that relocations in adequate areas modify people customs and means of transportation.

Concerning the development of these experimental places with a high economic growth potential, available stocks are globally enough to face the establishment of new activities. The initiation of this method would seem to be an answer to the development of the Parisian metropolis. Further experimentations should be carried out for other districts of Paris or its suburbs, on the territory of the Greater Paris, and with other criteria.

## 6 References

- [1] Le Grand Paris de l'agglomération parisienne, [www.legrandparis.culture.gouv.fr](http://www.legrandparis.culture.gouv.fr)
- [2] Gaudron O. & al, *Lecture des 10 projets du Grand Paris, analyses synthétiques et remarques transversales*, PUCA, 2009.
- [3] Castex J. & Rouyer R., *Les tours à Paris, bilan et prospectives*, APUR, 2003.
- [4] *Plan Local d'Urbanisme de Paris*, Planning Department of the City of Paris, 2006.
- [5] Becue V., *Système d'aide à l'évaluation de la qualité de l'aménagement urbain durable intégrant l'exigence de la mixité des fonctions urbaines*, Thesis, Université de Valenciennes et du Hainaut Cambresis, 2005.
- [6] Ferrier J., *Making of, Pharre et Hypergreen towers*, Archives d'architecture moderne, Ante Prima, 2007.
- [7] Paquot T., *Petit Manifeste pour une écologie existentielle*, Bourin, 2007.
- [8] *San Francisco General Plan*, Planning Department of the City of San Francisco, Municipal Code Corporation, 2008.