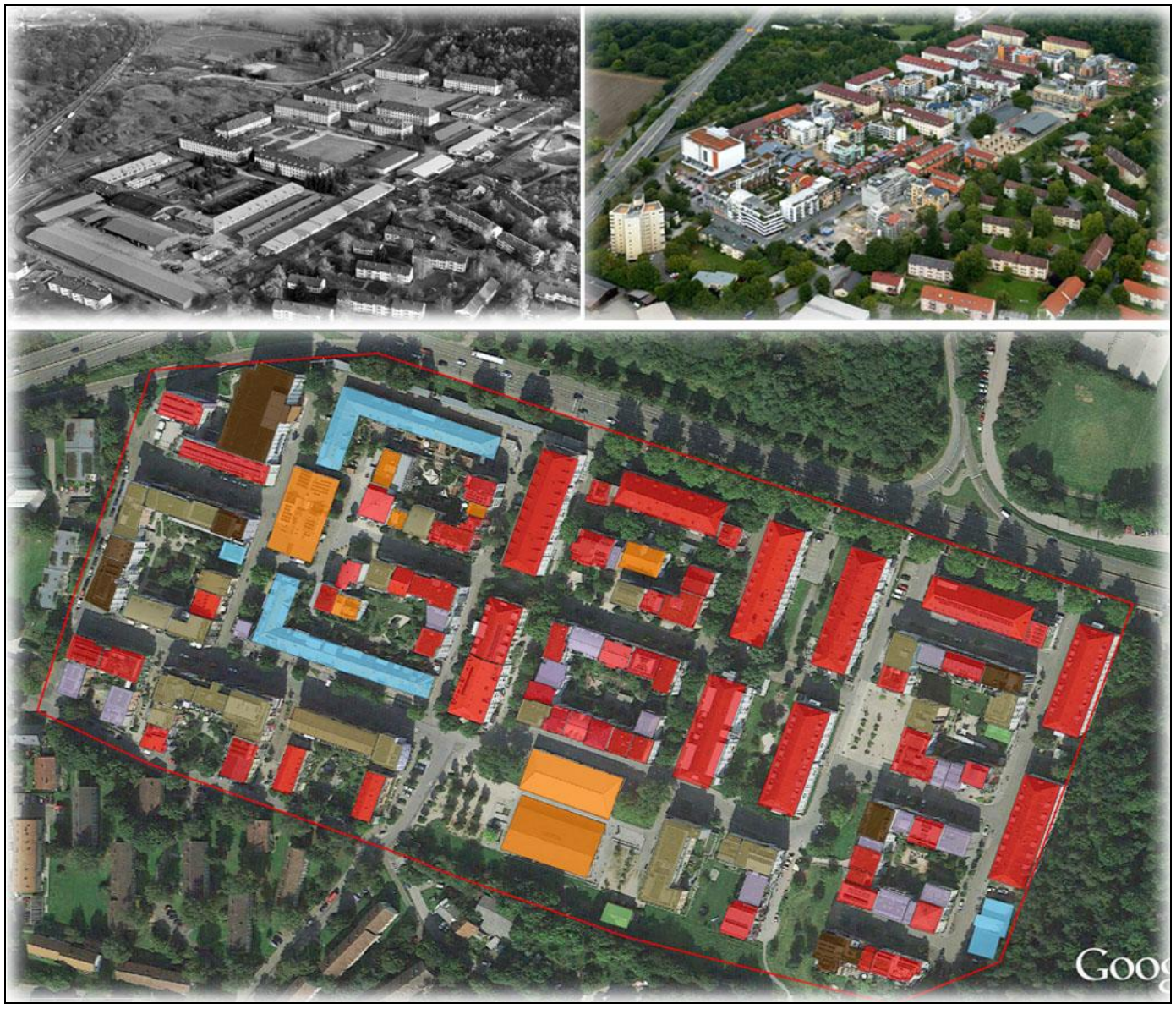
Sustainable Urban Development on Brownfield land in the German state of Baden- Württemberg



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Abstract:

The main aim of this Thesis is to determine whether the French district in Tübingen, broadly regarded as a model of urban sustainability, really is more sustainable than a similar, 'typical' quarter; and to unravel the planning measures that led to the potential differences between the two. In order to achieve this aim, the French district was compared with a similar, but 'typical' district ('Quartier am Turm' in Heidelberg), primary via means of GIS analysis and archival research. A custom-made framework, including 21 indicators divided into 12 sustainability categories, was devised for the comparative analysis.

Results have shown that the French district performs better than the 'typical' district for all 21 indicators used for the comparative analysis; and fares considerably better than the latter in 9 urban sustainability areas (consisting of 16 indicators). These positive results can be explained through the implementation of 7 categories of 'unorthodox' planning measures for the development of the French district.

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Chapter I: Introduction

1.1 Background of the research

The 1987 report "Our common future" of the World Centre for Sustainable Development and the 1992 "Earth Summit" from Rio de Janeiro brought to the fore the concept of Sustainable Development, a vision that attempts to integrate economic development with social and environmental factors (WCED, 1987). The Living planet 2000 report estimates that the state of "the earth's natural ecosystems has declined by about 33%" between 1970 and 2000, while at the same time "the ecological pressure of humanity on the earth has increased by about 50% over the same period" (WWF, 2000 in: Davoudi, Layard, 2001). Therefore McLaren considers that "sustainable development can only be achieved if human capacity is kept within the constraints set by environmental capacity" (McLaren, 1996 in: Davoudi, Layard, 2001). A critical role in altering the state of the environment is played by urban settlements (Newman, 2006). In 1990 42.6% of the world's population lived in cities (Haughton, Hunter, 1994). By 2050 this amount will possibly rise up to 69% (Shen et al., 2012). Despite the fact that" 60% of the world's Gross national product is produced in cities" (Haughton, Hunter, 1994, p.11), each city numbering about 1 million inhabitants consumes on average "625,000 tonnes of water, 2000 tonnes of food and 9500 tonnes of fuel; and generates 500,000 tonnes of waste water, 2000 tonnes of waste solids and 950 tonnes of air pollutants" (ibid., p.11). Additionally, in Western Europe cities seize two percent of usable agriculture land each decade (ibid.). As a result of these figures, searching for sustainable modes to develop urban areas are of utmost importance, especially as studies have shown that "changing the shape, size, residential density, layout, and location of activities in cities can bring energy-demand variations of up to 150%" (ibid., p.13).

Such a search for Sustainable Urban Development (SUD) is of particular importance in Germany, where an average of 130 hectares of Greenfield land were lost to urban sprawl each day at the end of the 1990's (Ganser, Williams, 2007), and this trend suffered only an insignificant reduction since then (Penn-Bressel, 2010). In order to combat such disturbing figures and to reduce the burden of its cities on the environment, the German federal government launched the "30-ha target", a programme aimed at reducing the urban spread on neighboring Greenfield land to 30 hectares per day by 2020 (ibid.), suggesting that new neighborhoods should be developed on Brownfield sites already existing within the cities' boundaries (Thornton et al., 2007). That is possible especially in the context of inner-city former military sites, made available with the retreat of the Allied occupation forces since the end of the Cold War (BICC, 1995). Such land was made available mostly in the Western German States of Rhineland-Palatinate, Hessen, Bavaria and Baden-Württemberg (ibid.).

Nonetheless, despite of the rich literature on sustainable urban development, of the intentions stated by the local authorities through various policy documents in pursuing sustainable urbanism, and of the plethora of new developments marketed as 'sustainable', there are up to date few studies that provide an in-depth analysis and evaluation of such sustainability examples, especially if we take into consideration the scale of an entire neighborhood.

Using as a reference a neighborhood from the state of Baden-Württemberg broadly regarded as an example of sustainable urban development- the French district in Tübingen (Ledwoch, 2012), the main aim of this Thesis is to determine whether this French district really is more sustainable than a similar, 'typical' quarter, and to unravel the planning measures that led to the potential differences between the two.

1.2 Research Questions

In order to achieve the aim of the Thesis, it is necessary to answer a number of research questions, in the following order:

1) *What is the role of Brownfield reconversion as a strategy for sustainable urban development?*

The aim of this research question is to 'set up the scene' for the Thesis, by introducing the reader to the concept of sustainable urban development, and analyzing Brownfield reconversion as a strategy for its implementation at local level. This will be achieved through a desk-study research of relevant literature on sustainable development and Brownfield reconversion, and will be dealt with in the second chapter (Academic context) of this Thesis.

2) *How can planning processes towards sustainable urban development and planning outcomes be evaluated as regards to their sustainability?*

The aim of this research question is to determine the design characteristics a sustainable neighborhood should possess, according to the literature; and to operationalize these traits through a series of indicators that can be used for the comparative analysis of the empirical chapter. This will be achieved through a desk-study research of several important frameworks consisting of strategies for implementing sustainable urban development, and will be addressed in the third chapter (theoretical framework) of this Thesis.

Additionally, a framework aimed at operationalizing the theoretical determinants that influence the redevelopment process of Brownfield land towards sustainable neighborhoods will be devised, in order to 'frame' the exploratory part of this study. This will be based mainly on the analysis of Gilbert et al.'s work in this field, and will also be addressed in the third chapter (theoretical framework) of this Thesis.

3) *What is the policy context for implementing sustainable urban development at the local level in the German state of Baden-Württemberg*?

This research question is focused on analyzing the role of various institutional tiers in promoting SUD and facilitating its implementation. Particular attention will be given to the German planning system and the tools available to the local authorities for implementing sustainable development. This will be achieved through a desk-study research of the relevant documents devised at the German federal level and the Baden-Württemberg institutional level; and will be addressed in the fourth chapter (policy context for sustainable urban development at the local level) of this Thesis.

4) *To what extent is the 'French district' in Tübingen more sustainable than a similar, 'typical' quarter, and which planning measures can account for the potential different results between the two?*

The aim of the central research question of this Thesis is to analyze the sustainability of the French district, by comparing it with a similar, typical quarter (the 'Quartier am Turm' in Heidelberg). The analysis is focused not only on the comparison between the two districts, but also on the planning measures that help explain the differences between them. The comparative analysis will be undertaken mainly via means of GIS software, in the sixth (empirical) chapter of this Thesis.

Additionally, this Thesis will contain an exploratory section, aimed at determining the underlying factors that affected the redevelopment of a former military site (Brownfield land) into a sustainable neighborhood in the case of the French quarter in Tübingen. Given the large amount of research needed for exploring such an aim, it is beyond the scope of this Thesis; however in-depth interviews undertaken with two actors that have an insight into the development process of the French quarter reveal a number of such potential underlying factors. Results from this section are by no means definitive, given the very small number of interviewees; however they are of use in further enhancing the scientific relevance of this Thesis, by underlining the methodological difficulties in studying the development of a neighborhood stretched for over a decade, and by determining a specific area for future research.

1.3 Structure of the Master's Thesis

In order to comprehensively address the research questions, the Thesis will be divided into seven chapters.

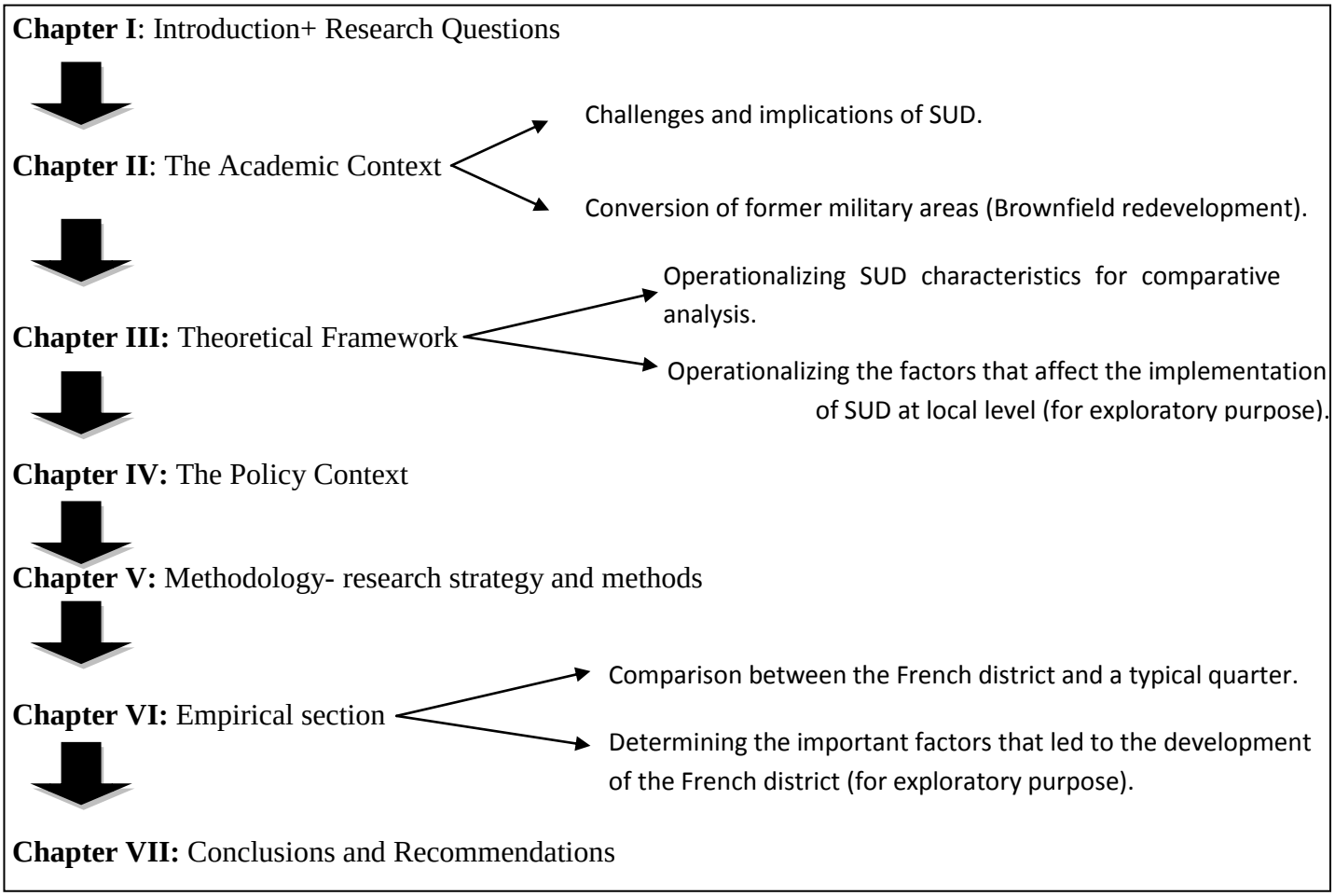

***Figure 1**: Structure of the Master's Thesis*. ***Source:** Author's own, 2013.*

The first chapter represents the introduction of the research, where the general context, aims, research questions, and structure of the Master's Thesis will be presented.

The second chapter represents the academic context for the chosen topic. It is divided into two parts: a literature review on the challenges and implications of SUD; and an analysis of the reconversions of Brownfield land as a SUD strategy.

The third chapter represents the theoretical framework of the Thesis. It is aimed at operationalizing sustainable neighborhood characteristics for the comparative analysis of the empirical chapter, via means of a set of indicators. Furthermore, in view of the exploratory section of this research, a framework consisting of the factors that influence the development of sustainable urban neighborhoods on former Brownfield land will be devised.

The fourth chapter represents the policy context of the research, and will comprise of an evaluation of the role of various institutional tiers in promoting SUD and facilitating its implementation; and of an analysis of the German planning system.

The fifth chapter will address the methodology of the Thesis, analyzing the research strategy and methods. These will be discussed more thoroughly in the next section of this chapter.

The sixth chapter represents the empirical part of this Thesis. Based on the set of indicators that were developed in the methodology chapter, a point-by-point comparison between the French quarter and the 'Quartier am Turm' will be realized, in order to determine in which areas the former really is more sustainable than a traditional quarter. Additionally, based on the second framework devised in the theoretical framework chapter for exploratory purposes, the results of two interviews aimed at determining the main underlying causes that led to the development of the French district, will be brought to the fore.

The seventh chapter will be comprised of the conclusions and recommendations of the Thesis, summarizing the findings, and subtracting some general guidelines, strategies, factors and insights that can affect the future implementation of sustainable urban development at the neighborhood scale on Brownfield land in Germany.

1.4 Research approach

A case study ***research strategy*** is employed for this Thesis. It has been defined as a "strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidences" (Robson, 2002 in: Saunders et al., 2009, p.145). Within a case study research strategy the context plays a significant role, as "the boundaries between the phenomenon being studied and the context within which it is being studied are not clearly evident" (Yin, 2003 in: Saunders et al., 2009, p.146). The case study strategy was chosen because it provides important insights on the implementation process of sustainable urban development concepts for new neighborhood developments on former Brownfield land, and also allows for a "rich understanding of the context of the research" (Morris, Wood, 1991 in: Saunders et al., 2009, p.146), in this case the conversion of a former military site in the German city of Tübingen.

In order to achieve the aim of this Thesis and answer to its research questions, a suitable case-study, based on which an analysis of the implementation of sustainable urban development could be undertaken, had to be chosen. As mentioned before, despite the rich literature on sustainable

urban development, few practical examples, especially if we take the 'scale' factor into consideration, are available as of now. Therefore, I decided to focus my research on the neighborhood scale, which is viewed by some academics as the most appropriate one to implement urban sustainability measures (Carmona, 2001). The neighborhood scale is large and encompassing enough (in comparison with the scale of individual buildings or small-sized quarters) as to integrate all aspects of sustainability- economical, social and environmental- and thus to have a visible impact on the life-style of its inhabitants and on the broader urban environment. At the same time, the neighborhood scale is flexible enough to allow for the application of urban sustainability principles from all three spheres throughout virtually its entire area and for most of the inhabitants, being closest to showcase the way of life of a 'sustainable community' (and the planning measures required to achieve such a life-style).

The chosen case-study - the 'French' district in Tübingen- was selected because it is broadly recognized as a model of sustainable redevelopment of former inner-city Brownfield land, and can be regarded as a valuable example especially in the context of Germany, where many such areas are available for redevelopment. The central research question is aimed at determining the validity of the above-mentioned assumption regarding the French quarter, by comparing it with a similar, but typical development. The findings could prove useful for undertaking future similar developments. Comprehensive details regarding the research approach can be found in the 'Methodology' chapter.

The ***research methods*** will comprise of an analysis of the two quarters via means of a GIS software (Autocad Map 3D, version 2014); of a thorough study of the Tübingen city archives; of a review of policy documents; and of interviews with relevant stakeholders (for the exploratory part of this Thesis).

In order to increase the validity and reliability from the multiple sources of data, the 'triangulation' method will be applied. 'Triangulation' has been described as the "use of different data collection techniques within one study in order to ensure that the data are telling you what you think they are telling you" (Saunders et al., 2009, p.146); in other words comparing the results and answers from the GIS analysis, archival research, and policy documents review, will provide, as much as possible, a comprehensible view on the chosen topic.

To begin with, GIS software will be used for the *point-by-point analysis* of the two quarters; as it represents a powerful, professional tool used by municipalities and specialized companies all over the world for spatial analysis and scenarios (comprehensive details regarding the research methods are provided in the 'Methodology' chapter).

Next, an *archival research* of the Tübingen city archives has been undertaken, and all the existing relevant data on the 'French neighborhood' and its development will be put to use for achieving the aim of this Thesis.

The *in-depth interviews* with Ms. Selina Heinrich from the city development department of the city of Tübingen, and with Ms. Katharina Manderscheid, author of the book "Milieu, Urbanität und Raum" ('Milieu, urban design and space'), which uses the French neighborhood as a case-study for determining the social impact of urban development concepts; will give some insights

on the development process and the factors that led to the development of a sustainable neighborhood in place of the former French military barracks in Tübingen. Given the fact that these insights are not part of the aim of this Thesis, and are based solely on a very limited number of interviews, they will form the exploratory section of this Thesis, aimed at suggesting future research possibilities, and not at giving definitive answers.

Additionally, a study of the *policy documents* for the selected case-studies will allow for a more comprehensive assessment of the two neighborhoods.

1.5 Societal and Scientific Relevance

Societal relevance of the study:

- *Transferability of the findings to future similar developments in Germany, especially given the urban Brownfield context in this country:* the areas (sustainability categories) where a sustainable quarter scores higher compared to a traditional district, and the planning measures behind these outcomes, have the potential to represent a model, a 'standard' for future neighborhoods developed in a similar context to the one of the French district in Tübingen. The results of the analysis from the empirical chapter are highlighted in a 'summarizing framework', which could potentially be regarded as a 'general basis' for developing new sustainable neighborhoods in similar conditions.

- *Highlighting the important planning measures that were implemented for developing a sustainable quarter:* the implementation of these measures was possible by using several innovative tools of the German planning system, and the positive effects of such tools in developing a sustainable quarter might provide a reasoning for adopting some of the aspects of the German planning system (especially the high degree of independence of local authorities) outside of Germany.

- Demonstrating via means of this Thesis that the reconversion of some inner-city Brownfield sites (more specifically former military bases that were not heavily contaminated) represents a potential solution for implementing sustainable urban development principles at a relatively large scale. Such a context is especially relevant in Germany, where quantified-target policies to reduce the urban sprawl are being set; and where the departure of the Allied forces meant that vast quantities of urban areas have become available to the municipalities for redevelopment.

Scientific relevance of the study:

- Reviewing some aspects of the literature on sustainable urban development, and on the redevelopment of Brownfield land as a strategy for implementing it.
- Establishing a link between high tiers policy documents, the German planning system, and the implementation of sustainability measures at the local level; and highlighting the decisive role of the local authorities for implementing sustainable urban development in the studied context.
- Operationalizing sustainable design principles for comparative urban sustainability analysis, via means of a set of indicators that could be used in future research for similar purposes. The two frameworks developed as a result of the analysis from the theoretical chapter represent the main contribution of this Thesis to the body of knowledge on urban sustainability.
- Given the fact that there are no clear benchmarks for urban sustainability at the neighborhood scale, the values for each point of the empirical chapter of this Thesis could provide an initial reference point for evaluating the sustainability of a similar urban area.
- The main research methods (GIS analysis combined with archival research) of this Thesis could represent a model for undertaking similar research in the future, especially if sufficient pre-existing GIS data are not fully available to the researcher.
- The results of the exploratory section could be further explored in a future research, as they are far from being definitive and are based only on a reduced number of interviews. Additionally, the difficulties encountered in contacting knowledgeable actors for the case of the French district (as detailed in the exploratory section), might be of relevance for future researchers interested in a similar topic.

Chapter II: Academic context of the research

The second chapter will represents the academic context for the chosen topic. It is divided into two parts: one dealing with the literature review on the challenges and implications of sustainable urban development; and the other one dealing with the conversions of Brownfield land as a mean of achieving sustainable urban development.

2.1 First part of the academic context

2.1.1 The concept of 'sustainable development'

In this section the various meanings and perception of the 'sustainable development' concept are analyzed, and the applicability of the term for practical use will be examined.

Definition and evolution of the concept:

The energy and oil crisis of the late 70's and early 80's brought to the fore concerns about global pollution, depletion of nonrenewable energy sources and uncontrolled population increase (Robinson J., 2003). Confirming these concerns, The 'Living Planet 2000' report estimates that the state of "the earth's natural ecosystems has declined by about 33%" between 1970 and 2000, while at the time "the ecological pressure of humanity on the earth has increased by about 50% over the same period" (WWF, 2000 in: Davoudi, Layard, 2001). Within this specific context, the term of 'sustainable development' emerged as "an attempt to bridge the gap between environmental concerns about the increasingly evident ecological consequences of human activities and socio-political concerns about human development issues" (ibid., p. 370). Sustainable development has been defined as the "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987, p.8).

The main challenge and allure of sustainable development lies in the fact that it attempts to reconcile two apparently contradictory requirements: the pursuit for economic growth, and the need to preserve the natural environment (Renn, Goble, 1996). Adding to that, Campbell considers that sustainable development can be imagined as a center of a triangle comprised of apparently conflicting goals: economic development, environmental protection, and social equity (Campbell, 1996).

2.1.2 Sustainable development in urban areas

In this section the role that urban settlements have in the degradation of the environment and the important part that such areas might have in achieving the goals of 'sustainable development' are analyzed.

Urban settlements and environmental pollution:

Urban settlements are considered to play a vital role in the debates surrounding 'sustainable development', because of three main reasons: an "increasingly urbanizing world", as detailed in the beginning of first chapter; a concentration of major economic activities, including industrial processes, in urban areas (therefore a high requirement for natural resources and consequently, an important proportion of waste generation); and a high demand for goods and services due to the concentration of much "of the world's middle- and upper-income groups" in urban settlements (McGranahan, Satterthwaite, 2003, p. 244). Thus it is of no wonder that urban areas, "by their very nature as centres of population and economic activity, show high concentrations of pollutants" (CEC, 1990, p. 14).

The sources for most of the environmental pollution stemming from urban settlements are the activities related to the industrial sector, the emanations from motor vehicles, the materials used in the construction sector, and "the burning of fossil fuels for heating or electricity generation" (ibid.). It has been reported that despite the fact that" 60% of the world's Gross national product is produced in cities" (Haughton, Hunter, 1994, p.11), each city numbering about 1 million inhabitants consumes on average "625,000 tonnes of water, 2000 tonnes of food and 9500 tonnes of fuel; and generates 500,000 tonnes of waste water, 2000 tonnes of waste solids and 950 tonnes of air pollutants" (ibid., p.11).

Additionally, in Western Europe cities seize two percent of usable agriculture land each decade (ibid.). As a result of these figures, searching for sustainable modes to develop urban areas in parallel to more 'traditional' environmental measures are of utmost importance, especially as studies have shown that" changing the shape, size, residential density, layout, and location of activities in cities can bring energy-demand variations of up to 150%" (ibid., p.13).

Sustainable urban development:

The concept of sustainable development is seen by some academics as a solution to the contemporary issues of urban development (Berke, 2002), especially as historically, the development of urban settlements has been achieved with the cost of environmental devastation:

"to build cities we have cleared forests, fouled rivers and the air, leveled mountains" (Campbell, 1996, p.2). Therefore, an "urban vision of sustainable development, infused with a belief in social and environmental justice" is seen as desirable (Campbell, 1996, p. 23).

Sustainable urban development relates to the achievement of balance between economic growth, social equity, and environmental protection in the case of urban development policies (Campbell, 1996). More specifically, it has been defined as the designing and building of urban neighborhoods; houses; "recreational, commercial and infrastructure facilities" in such a way as to be "environmentally friendly, socially equitable, economically feasible and participatory empowering" (Niedersächsisches Ministerium für Frauen, Arbeit und Soziales, p.5). Intending to operationalize the definition for "most local applications" and referring strictly to the environmental aspect, Breheny defines sustainable urban development as "the adoption of policies that minimize both local resource consumption and pollutants" (Breheny, 1990 in: Breheny, 1992, p.138). Furthermore, because of "economic, social and environmental considerations, the aim of the sustainable development of urban areas is to reduce urban development on Greenfield land" (Jacoby et al., 2008, p.76).

The first part of this chapter introduced the term 'sustainable development' and related it to the urban context. Furthermore, the important role played by urban settlements in shaping modern life-styles and altering the state of the environment has been analyzed. It clarifies what sustainable development for urban areas means, and defines some broad theoretical ways to achieve it. In conclusion, this section is of use to the purpose of this research, as it defines the broad context in which the implementation of sustainable development in urban areas occurs. A transition from this broad context to the relevant frameworks that serve the main aim of this Thesis will be undertaken in the next chapters.

2.2 Second part of the academic context

2.2.1 The reconversion of Brownfield sites

In this section, the term 'Brownfield' will be defined and its relation with the term sustainable development briefly explained; while the factors that affect or hinder the redevelopment of inner-city Brownfield sites will be analyzed.

A widely accepted principle in the implementation process of sustainable development concepts for the improvement of urban areas is related to the re-use and reconversion of urban Brownfield sites (Grimski, Ferber, 2001). Brownfield land "is any land […] which has previously been used or developed and is not currently fully in use, although it may be partially occupied or utilized. It

may also be vacant, derelict or contaminated. Therefore a Brownfield site is not available for immediate use without intervention" (Alker et al., 2000, p. 64). Brownfield sites are 'mirrors' of past activities performed on them, and opposed to 'virgin' Greenfield areas "often contain a conglomerate of buildings, infrastructures and industrial residues of varying toxicity […]; in addition, Brownfield sites are connected to transportation, communication, power and even social facilities, i.e. infrastructure." (Koll-Schretzenmayr, 1999, p.43).

Re-using Brownfield areas is seen as a strategy capable of having "broader economic, environmental and social benefits" for urban centers (Raco, Henderson, 2006, p.499). More generally, "urban Brownfield development is seen as contributing to compact, sustainable cities" (Adams, 2004 in: Ganser, Williams, 2007, p. 604). The "economic, industrial, agricultural" changes in last decades, coupled with demographic shifts, led to the emergence of a large number of Brownfield sites in most European countries (Ganser, Williams, 2007, p. 603). Thus, the reconversion of Brownfield sites represents a major issue among planning agencies in the European Union; and especially so in Germany and the United Kingdom, where national-level objectives for Brownfield regeneration have been set "with the twin objectives of furthering urban regeneration and reducing Greenfield development" (ibid.).

Often, the emergence of Brownfield land is caused by "economic structural change and the decline of traditional industries" in a specific urban area, which usually lead to unemployment and a general decline in the quality of life of the neighborhoods surrounding the Brownfield sites (Grimski, Ferber, 2001, p. 143). As a consequence, it is believed that the redevelopment of inner-city Brownfield areas will have beneficial effects in mitigating some of the problems of modern cities, "including socio-economic hardship and a rising concern for the maintenance and advancement of environmental quality" (Raco, Henderson, 2006, p. 500). Positive effects of Brownfield redevelopment, such as turning development away from over-congested zones, providing additional employment opportunities inside the city boundaries, reducing urban sprawl and Greenfield development, and enabling a "more compact and energy-efficient urban" life-style, lead to the conclusion, that at least in theory, the conversion of such sites represents a 'win-win' opportunity for all the stakeholders involved (Bagaeen, 2006; Raco, Henderson, 2006).

<u>Factors that affect the redevelopment of inner-city Brownfield land:</u>

The main challenges of redeveloping Brownfield sites is related to the fact that such areas are often 'unviable' from a financial point of view, and usually cannot compete with development alternatives on Greenfield land without public intervention (Thornton et al., 2006, p. 117).

In contrast to Greenfield sites, 'unique assets' often encountered on inner-city Brownfield areas, including here "attractive inner-city locations, parks which once belonged to mansions of entrepreneurs, open space with mature wooded areas on surplus development sites of former

industrial enterprises, and historical monuments of unique beauty", increase the importance of these sites for the urban regeneration process (Koll-Schretzenmayr, 1999, p.43-44).

Despite the fact that a successful rehabilitation of such areas could have long-term beneficial effects on the surrounding neighborhoods or even on the whole city, practical considerations such as "wrong location, legacy of redundant infrastructure, decontamination costs, high rehabilitation costs and reduced real estate value" pose serious issues to local authorities in redeveloping Brownfield land (Thornton et al., 2006, p. 117). Furthermore, the connection to infrastructure, whether sufficient or not, bears important physical and legal consequences; and represents a determining factor that must be taken into account in any Brownfield redevelopment proposal (Koll-Schretzenmayr, 1999).

A variety of other factors can also affect negatively the redevelopment of inner-city Brownfield land, such as "complicated shapes of parcels, ownership claims […], diverse interests by public or private sectors […], a wide range of physical obstacles […], ongoing industrial or non-industrial uses, and [especially] heavy soil contamination" (ibid., p.44). Ownership uncertainties and the existence of some of the factors mentioned above mean that the redevelopment of the entire Brownfield site might not be immediately made available, in contrast to the situation of most Greenfield sites (ibid.).

Nonetheless, despite all of the difficulties and challenges in redeveloping inner-city Brownfield sites, it is considered that "Brownfield redevelopment can produce new forms of equitable development and raise standards of living in deprived communities if projects are embedded in a broader set of mainstream policy measures" (Raco, Henderson, 2006, p.509). In other words, the reconversion of Brownfield sites present within urban boundaries is an important and viable strategy to use in order to pursue the sustainable development of an urban area; however this strategy in itself, without further social and environmental measures that should be embedded in the urban development policies and practices, will not be efficient enough to mark a general, long-term qualitative change in the life of urban inhabitants.

Therefore, "Brownfield development alone cannot tackle the broad range of planning and environmental problems that affect cities and regions" (ibid.); nonetheless it can be considered an important tool for planners in order to achieve the goals of sustainable urban development, if supplemented by further 'sustainability' measures.

The second part of the academic context defines the concept of 'Brownfield land' and analyzes the importance of redeveloping such sites in achieving sustainable urban development. Despite the numerous challenges that such a redevelopment might pose, challenges that were underlined throughout this section, the importance of converting Brownfield sites and the advantages it might bring cannot be underestimated. As such, Brownfield conversion can be considered an important strategy in achieving sustainable urban development. That is even more valid in the case of Germany, due to the high availability of former inner-city military sites as a result of the ending of the Cold War.

Chapter III: Defining frameworks for the assessment of the case-studies

This chapter represents the theoretical framework of the Thesis. It is aimed at operationalizing sustainable development concepts for urban planning; in other words determining the specific characteristics that a sustainable neighborhood should possess, and translating them into sustainability indicators that can be used for a comparative analysis. Furthermore, this chapter is focused on defining a framework constituted from the factors that influence the development of new, sustainable urban neighborhoods. This framework will be used for structuring the interviews that will inform the exploratory section of this study. First however, considerations related to the neighborhood scale for sustainable urban development implementation and evaluation will be tackled.

3.1 The appropriate scale for implementing sustainable urban development

One can find a multitude of examples of sustainable development principles that were implemented in urban areas, however the vast majority of these are represented by individual dwellings or small quarters or groups of houses (that consume a reduced amount of energy or use alternative technologies for electricity/heat generation), or by some specialized municipal services (environmental friendly waste management, or environmental friendly transport systems). However most of these examples, despite their value, are not integrated into wider measures that can change the life-style of the urban population significantly towards a more sustainable future. In other words, individual sustainability measures have little influence on the vast majority of the community and have a reduced impact on the life-style of the inhabitants, and on the broader urban environment. That is all due to the 'scale' factor. Only beyond a certain scale, and only if a certain number of inhabitants and services are involved in trying to lead a 'sustainable life-style', can a palpable effect on people and on the urban environment be felt. Therefore, in the strive to analyze the implementation of sustainable urban development and its effects on communities, life-styles, urban design and surrounding environment, the scale factor is of great importance.

A whole city or metropolis that is entirely 'sustainable', as defined in the literature, is virtually impossible to find in today's world, due to the societal and development factors that shaped modern life-styles, and due to their dependence on a variety of external factors. Therefore, the settlement scale is too broad and large to effectively analyze the implementation of sustainable urban practices; while a scale below the one of the neighborhood level, like "the block, the street and the building" scale (Berke, 2002, p.27) is too narrow, context-dependant, and ultimately bears little importance in view of an entire urban settlement, in order to be considered suitable for assessing the implementation of sustainable urban development principles.

As such, the neighborhood scale has been chosen for analysis in this Thesis; as "the neighborhood, the district, and the corridor are the essential elements of development and redevelopment in the metropolis" (ibid.). The neighborhood scale is viewed by some academics as the most appropriate one to implement urban sustainability measures (Carmona, 2001). The neighborhood scale is large and encompassing enough (in comparison with the scale of individual buildings or small-sized quarters) as to integrate all aspects of sustainability- economical, social and environmental- and thus to have a visible impact on the life-style of its inhabitants and on the broader urban environment. It is therefore appropriate to be used as a starting point in the attempt of reaching a sustainable urban life form.

3.2.1 Analyzing the existing frameworks that were devised for operationalizing urban sustainability characteristics

In this section five frameworks devised by various academics for operationalizing urban sustainability characteristics will be described and evaluated; and used as a basis for a comprehensive theoretical framework that will encompass most of the theoretical characteristics of a sustainable neighborhood. The frameworks analyzed in this section have been chosen because they comprise of urban sustainability characteristics that are valid for the scale of an urban neighborhood; and can therefore be used for the comparative analysis of this study.

<u>The framework of Bashir Kazimee:</u>

Kazimee proposes 25 strategies that ought to be implemented if a neighborhood is to be categorized as 'sustainable', strategies "organized under five primary variables for achieving sustainability: human ecology, energy conservation, land and resource conservation (food and fiber,) air and water quality" (ibid., p.1). The first category, human ecology, relates to "the way people interrelate and use the environment" (ibid., p.3), and the 14 guidelines that fall under this category are divided for the regional, city, neighborhood and individual building level (ibid.). Despite this classification, some strategies that are initially aimed at other scales than the neighborhood one, such as using greenbelts for pollution reduction and climate moderation, using renewable energy sources for heating/cooling or electricity generation, prioritizing "pedestrian and public transit systems" (ibid.), reducing waste generation or reusing and recycling as much material as possible (Kazimee, 2001), are also of importance for the neighborhood scale, as they are present in the frameworks of other authors. Other important strategies from this category include restoring the "natural, cultural, historical […] site characteristics and qualities" (ibid., p.4); developing "neighborhood schools […], activity centers (indoor and outdoor) and services (shared governance, daycare, shopping, recycling, etc.)" (ibid.); providing bike- and walkways; creating ample bicycle parking lots; establishing a sufficient amount of parks and green spaces; "designing for effecting land-use" by providing densities of "at least at least 12-16 dwelling units per acre" (ibid., p.5) (about 30-40 dwelling

units per hectare); minimizing the effect of automobile parking by distributing "parking behind housing or in small, landscaped lots" (ibid.); or inducing traffic calming measures within the neighborhood (Kazimee, 2001). Some other strategies can however considered to be too context-dependant to be used for the comprehensive framework that will be devised, such as building smaller homes with common walls to reduce energy consumption; eliminating or reducing fences for properties in order to "enhance human scale, social activities, surveillance and safety" (ibid., p.5); or developing uniform dwelling clusters "with similar cultural character and life styles" (ibid.). The second category of Kazimee's framework is related to energy savings from buildings, and four useful strategies are described, all revolving around efficient energy design of dwellings through the use of sustainable materials and construction methods; use of renewable energies for heating/cooling purposes; or use of "passive and active solar strategies" (ibid., p.7). Although all these measure apply to individual dwellings and could be difficult to regulate by local authorities, they are essential for the sustainability of a neighborhood and must be included in a comprehensive framework. What authorities could do in this case is to devise a 'Building Code' that emphasizes energy efficiency for dwellings, and develop district heating systems, which are more energy efficient than individual ones. The next category is about 'land and resource conservation', and the main point is revolved around the effectiveness of the recycling process, as a sustainable neighborhood should be equipped for each cluster with recycling centers or composting bins (Kazimee, 2001). Two more strategies are brought to the fore in this section, based on encouraging family farming or gardening and neighborhood products ('localizing the economy'), and organizing workshops, sales, and events to stimulate the 'neighborhood products' (ibid.). The fourth category is dedicated to water conservation, as 'water impoundment areas' such as lakes or water catch basins "reduce downstream flooding, and increase water quality and bio-diversity", while also having aesthetical and recreational values (ibid., p.9). The second strategy of this category relates to using appliances that conserve the use of water, while also emphasizing the importance of harvesting gray water from dwellings to be used "in landscaping and toilet flushing" (ibid.), and accentuating the need to "provide artificial wetland in the site" (ibid.). The last category brings to the fore the importance of air quality as a "critical variable for human and environmental health" (ibid., p.10); and as such developing "greenways and greenbelts" or urban forests increase the 'livability' and 'desirability' of neighborhoods, and help to mitigate urban pollution, thus being of critical importance for sustainable urban development (ibid.).

Kazimee's framework covers many topics related to the implementation of the ecological aspects of sustainable urban development, and can be used as a starting point for developing a comprehensive framework aimed at determining the characteristics of sustainable neighborhoods. Its main drawbacks are the little attention given to urban design strategies and especially the lack of attention given to the social aspect of urban development. There is no emphasis on social equity strategies such as the participation of NGOs or CBOs in the decision-making process, the involvement of affected groups in the implementation phase, or the reduction of social disparity by providing opportunities for different social classes to live in the supposed 'sustainable' neighborhood. As such, Kazimee's framework can be considered one-dimensional as it emphasizes only the environmental aspect of sustainable urban development;

nonetheless for this category it covers most topics. Consequently, as many as 16 of the 25 strategies proposed by Kazimee are of use for a comprehensive framework.

The framework of Douglas Farr:

Farr's framework is also focused on the characteristics that a sustainable neighborhood should possess, emphasizing the ecological aspect of sustainable urban development, by highlighting the importance of green spaces, vegetation and even infrastructure in this regard. Furthermore, he emphasizes the urban design strategies that should be applied for a sustainable neighborhood (Farr, 2008). The former aspect has similar guidelines and strategies as Kazimee's framework, however kept at a broader level; while the latter aspect has a special relevance for this discussion, as it describes five main areas of concern for sustainable neighborhood design (ibid.). First, an "identifiable center and edge to the neighborhood"are required, especially as there is usually a decrease in density from the center to the boundaries of the neighborhood (ibid., p. 10). Furthermore, when designing a neighborhood it should be taken into account that its center should be "within walking distance" from all areas of the respective neighborhood (ibid.). Second, a sustainable neighborhood should be designed as to have a 'walkable size' (ibid.). While most neighborhoods range somewhere "from 16 to 81 hectares", a radius of about 400 meters from the center to the edge of the neighborhood would be appropriate "for creating [a] neighborhood unit that is manageable in size and feels walkable" (ibid.). Third, a "mix of land uses and housing types" would be ideal for a sustainable neighborhood, despite the fact that the percentage of non-residential uses differs greatly between neighborhoods (ibid.). Thus, a variety of functions within the neighborhood that are at walking distance would result in a reduction of the need for car use, and subsequently in a reduction of environmental pollution (ibid.). Fourth, an "integrated network of walkable streets" that are designed in the first place for pedestrian and cycling use, and in the second place for motorized vehicles would lead to a safer and more sustainable environment (ibid., p.11). Traffic calming methods such as limiting the maximum allowed speed through the neighborhood at 30 km/h will also lead to a 'highly walkable environment' (ibid.). Fifth, some of the best sites in the neighborhood should be reserved for 'community purposes' in order to develop on them specific public dwellings or public spaces that will enhance the quality and individuality of the neighborhood (ibid.). Apart from these five areas of action, Farr also mentions some other characteristics of sustainable neighborhoods that are also present in most of the other frameworks, such as the existence of "buildings which do not provide off-street parking", encouraging and organizing 'neighborhood retail' activities, or adopting "strategies to make the most efficient use possible by limited transportation", such as car-sharing (ibid.).

The framework of Farr, despite being more a collection of urban design strategies than a comprehensive scheme, provides some import insights on the design aspects that should be taken into account when assessing sustainable neighborhoods.

The framework of Margrit Hugentobler and Markus Brändle-Ströh:

Hugentobler and Brändle-Ströh devised a conceptual framework for analyzing the sustainability of an urban regeneration project for a neighborhood in Zürich (Hugentobler, Brändle-Ströh, 1997). The aims of their research was to "link ecological sustainability to the psychological, social, economic, and cultural aspects of urban development and planning; to outline the preconditions, contexts, and processes that characterize successful partnerships among the public, private, and non-profit sectors; and to link planning theory with planning practice" (ibid., p. 86). As a result, at first a series of guiding questions were proposed aimed at establishing the possible impacts of an urban development proposal; and more importantly for this discussion, a conceptual framework was developed based on these guiding questions that highlight some important characteristics for a sustainable neighborhood (Hugentobler, Brändle-Ströh, 1997). These characteristics are divided into five categories or 'systems': cultural systems, social systems, human systems, biological systems, and chemical/physical systems (ibid.). The first category, 'cultural systems', encompasses six measures that revolve around the topics of "reclamation/protection of the natural habitat for plants and animals" and "restoring previously existing historical qualities to the urban life space" for the respective development site (ibid., p.96). The second category, 'social systems', is based on the concept of social justice, and is of particular importance for the evaluation of sustainable neighborhoods as it addresses, unlike the previously analyzed frameworks, the social aspect of sustainable urban development. Five characteristics are being listed, three of which are of potential interest for the focus of this study: "increased social interaction in the neighborhoods"; "citizen participation in the planning and implementation process"; and "involvement of all relevant groups affected by the projects" in the decision-making and implementation process (ibid.). The next category, 'human systems', relate to the "satisfaction of basic human needs" (ibid., p.90), as the design of the new development should enhance feelings of safety, opportunities for recreation, aesthetical characteristics of the site, and most important, should provide for a safe environment for children to play in (ibid., p.96). Although some of the characteristics from this category seem somewhat context-dependant and 'subjective', one of the guidelines mentioned here (about the need to create public spaces within the neighborhood that provide opportunities for relaxation) is more easily 'quantifiable', and should be added to a comprehensive framework for the assessment of sustainable neighborhoods. The fourth category, 'biological systems', includes only two brief environmental characteristics of a sustainable neighborhood, namely the preservation of bio-diversity and the "protection of natural habitats" (ibid., p.90). The last category, 'chemical/physical systems' states the importance of reducing pollution by using materials with a high degree of recyclability and by using renewable energy sources as much as possible (ibid.).

The framework of Hugentobler and Brändle-Ströh is important for this discussion because it emphasizes the social aspects that a sustainable neighborhood should possess, however the main drawback of this framework is the fact that all listed characteristics are kept at a very broad level, with little detail being given on the actual measures to implement these characteristics at the neighborhood scale.

The framework of the 'Charter of New Urbanism':

The 'Charter of New Urbanism' consists of 27 urban sustainability principles distributed evenly into three categories: principles for the regional and city level; principles for the neighborhood or district level; and principles for the street or individual dwelling level (Congress of New Urbanism, 2001 in: Berke, 2002). The principles for the first category are of little relevance for this analysis as they are focused on a larger scale; however the last two categories both encompass important guidelines for sustainable neighborhoods. Emphasis is put on the compactness and 'pedestrian-friendly' character of the development; on planning for appropriate densities along transport routes as to make "public transit to become a viable alternative to the automobile"; on designing "interconnected networks of streets […] to encourage walking, reduce the number and length of automobile trips, and conserve energy"; on assuring that a sufficient number of parks or green spaces are present within the neighborhood (ibid., p.27); on allocating important sites for "civic buildings or public gathering places"; and on the "preservation and renewal of historic buildings, districts, and landscapes" (ibid., p.28). One principle stands out in comparison to the other frameworks: the importance of concentrating "civic, institutional, and commercial activity" within the neighborhood in order to reduce pollution by decreasing the need for automobile trips and to allow children to cycle or walk to schools (ibid.).

The framework of the 'Charter of New Urbanism' is important because of the very clear statements of the guidelines, which leave little space for interpretation; however, it lacks a certain amount of depth in detailing some of the presented principles.

The framework of Matthew Carmona:

Carmona's work encompasses a comparison between eleven frameworks aimed at assessing strategies for sustainable urban development from various sources: Breheny, CEC, Evans, URBED, Bentley, Barton, Haughton and Hunter, Rogers, Blowers, Hough and Frey (Carmona, 2001). In order to be able to compare the characteristics of sustainable urban development present in all these frameworks, he divides them into ten distinctive categories; and develops a framework that combines most of the characteristics present in the eleven studied frameworks (ibid.). In this new conceptual framework he classifies sustainability characteristics based on spatial scale, distinguishing between strategies for the individual dwelling, the space (street), the quarters (neighborhood), and the settlement scale (ibid.). The first category, 'stewardship', is comprised of various strategies revolving around the easy maintenance of spaces, around traffic calming solutions, and especially around devising integrated solutions for urban development with all affected stakeholders (ibid.). The second category of the framework is 'resource efficiency' (ibid.). For this category 'typical environmental sustainability' strategies such as "using passive (and active) solar gain technologies", using materials with an reduced 'embodied energy' or which are recyclable, using CHP systems for district heating/cooling, and developing a suitable public transport infrastructure in order to reduce private motorized vehicle use (ibid., p.179) are recommended. The next category, 'diversity and choice', consists of strategies aimed at achieving social inclusion, such as removing "barriers to local accessibility" by impeding the 'privatization' of public properties that would lead to "the effective exclusion from these areas of

significant portions of society" (ibid., p.182), or providing a mixture of different "building types, ages and tenures" (ibid., p.179). The need to provide "mixed uses within buildings" in the neighborhood is also mentioned in this category (ibid.), as well as diminishing the dominance of motorized vehicles in relation to pedestrians or cyclist by designing more 'walkable' and 'bicycle-friendly' streets and spaces (ibid., p.182). The fourth category, 'human needs', is concerned with the safety of the inhabitants "by reducing pedestrian/vehicle conflict" and by "combating crime through space design and management" (ibid., p.180); and with promoting socially-mixed communities through "equity, opportunity […and] participation" (ibid., p.183). The fifth category, 'resilience', also addresses the need for resource conservation; while strategies aimed at constructing durable and flexible (adapted to more than one function) buildings, spaces and infrastructure in order to reduce the need for demolishing, revitalization or conversion, are encouraged (ibid.). The next category is labeled 'pollution reduction', and consists of strategies aimed at reducing "the impact of development on its surroundings", first through 'reduction efforts' like "insulating against noise, ventilating against fumes, designing-out light pollution, designing-in filtration by trees, and investing in public transport whilst (as far as possible) controlling private car-borne travel" (ibid., p.184); and second through the recycling and reusing of waste and materials (ibid.). The seventh category, 'concentration', consists of providing a certain building density "to reduce travel demand, energy use and land-take" (ibid.). The eight category, 'distinctiveness', is concerned with retaining and revitalizing the dwellings, spaces or places that have a particular importance for the respective area in the sense that they provide a sense of identity or 'emotional heritage' to the site (Carmona, 2001). The penultimate category is called 'biotic support' and it emphasizes the importance of "maintaining environmental diversity" by providing sufficient open spaces, respecting natural habitats, and encouraging "greening and display of private gardens" (ibid., p.181). The last category, 'self-sufficiency', is intended to counter the unsustainable effects of globalization, and requires the active participation of stakeholders and residents in the development process; providing the inhabitants with the physical support such as internet availability "to allow home working", or simply "allowing space for local food production in less dense urban areas" (ibid., p.186).

The framework of Matthew Carmona is the most comprehensive of all the frameworks studied in this chapter, as it encompasses a broad range of characteristics for sustainable urban development. It virtually covers most topics presented in the other analyzed schemes; however its main drawback is the fact that all characteristics and recommendations are kept at a very broad level, unlike in some cases in the papers of Kazimee or Farr, which go more into detail about the application of specific urban sustainability strategies. Nonetheless, its value for creating a comprehensive framework that can be used for assessing the sustainability of neighborhoods cannot be underestimated.

3.2.2 A comprehensive framework consisting of the main characteristics that define a sustainable neighborhood

In this section the framework that will be used in the empirical chapter of this Thesis will be defined. It is based on bringing together the main aspects of the five frameworks that were analyzed in the above section, and is comprised of 12 urban sustainability areas that define a sustainable neighborhood, combining elements from the environmental, social, economic and urban design spheres. These characteristics are operationalized for the comparative analysis of the empirical chapter through a set of indicators chosen from the 'White Paper on sustainable urban development indicators' (Lynch et al., 2011). This policy document was preferred for three reasons:

- *It was compiled after a comprehensive research on most urban development indicators used throughout the world;*
- *Contains tables with indicators that are used specifically for the neighborhood scale analysis in various cities;*
- *The indicators are categorized in different sustainability areas, similar to the frameworks analyzed in the preceding section, and are thus easily transferable to the custom framework that is devised in this chapter.*

Most of the indicators that inform the empirical part of this Thesis are derived from the aforementioned White paper, and were extrapolated to match the available data I had about the two neighborhoods. It is important to note that no exact benchmarks for comparing the sustainability of a neighborhood are currently in place (e.g minimum amount of building with solar panels per hectare, for a neighborhood to be considered sustainable). Some benchmarks exist for the scale of an entire city; however they use mostly indicators that are of little use for the neighborhood scale (e.g. public-health related indicators, or overall economic performance indicators), and are subject to many variables resulting from the large diversity of urban settlements. Given this variety, most indicators presented in policy documents come without a benchmark. As such, it is much more viable and precise for the purpose of this study to compare the neighborhood regarded as 'sustainable' to an existing similar, 'traditional' quarter; and derive conclusions directly from this comparison, rather than from a comparison with benchmarks that were not devised for such a scale.

For most of the urban sustainability areas of the framework, more than one indicator was chosen for analysis, in order to give a more precise picture regarding the differences between the two quarters that are being compared. Consequently, the framework that informs the empirical chapter of this Thesis comprises of the following 12 urban sustainability areas and 21 indicators:

	Urban sustainability areas:
a	***The existence of sufficient parks/green spaces within the neighborhood***, in order to reduce the effects of urban pollution, to temperate extreme climatic conditions, to protect biodiversity, and to provide the inhabitants with a variety of recreational possibilities. *Indicators used for the comparative analysis of the two quarters:* 1. Public Green Spaces as a percentage of the total neighborhood area; 2. Surface of Public Green Spaces per hectare (in m^2).
b	***The use of renewable energy sources for heating/cooling or electricity generation***, for example through the employment of solar panels, photovoltaic cells, or geo-thermal systems for dwellings. *Indicators used for the comparative analysis of the two quarters:* 1. Percentage of dwelling units with solar panels relative to the total number of dwellings; 2. Area of households with solar panels per hectare (in m^2).
c	***Giving priority to pedestrian or bicycle transport,*** by providing, bike paths, walkways, specific systems for bicycle parking or by designing 'interconnected networks of streets' that encourage walking within the neighborhood. *Indicators used for the comparative analysis of the two quarters:* 1. Percentage of daily trips undertaken by walking and cycling; 2. Percentage of daily trips undertaken by private motorized vehicles; 3. Proportion between non-motorized and private motorized transport modes.
d	***Providing a minimal dwelling density per hectare***, in order to reduce infrastructure and building costs, and to increase the efficiency of public transport systems. *Indicator used for the comparative analysis of the two quarters:* 1. Gross Floor Area per hectare (in m^2).
e	***Reducing the space 'lost' due to autovehicle parking,*** by distributing "parking behind housing or in small, landscaped lots" (Kazimee B., 2001, p.5). *Indicators used for the comparative analysis of the two quarters:* 1. Average area per hectare dedicated to parking spaces in the district (in m^2); 2. Proportion of the dedicated parking spaces that are located at the edge of the district, relative to the total surface of dedicated parking spaces for the whole district.

	Urban sustainability areas:
f	***The existence of traffic calming measures*** in order to mitigate the negative effects of traffic within the neighborhood (pollution, noise, reduced safety for pedestrians), like 'speed limits, pedestrian refuges, or heavy truck circulation restrictions. *Indicators used for the comparative analysis of the two quarters:* 1. Length of streets that are closed to motorized traffic, relative to the total length of the streets in the district (in m); 2. Length of traffic calmed streets - maximum 30 km/h speed, relative to the total length of the streets in the district (in m).
g	***Further conserving energy through passive design solutions*** for the quarter and for buildings (planting of tree belts and vegetation; building Green roofs and facades). *Indicators used for the comparative analysis of the two quarters:* 1. Average surface per hectare (of built space) of buildings with green roofs (in m^2); 2. "Urban tree canopy average as percentage of total urbanized area" (Lynch et al., 2011, p. 59).
h	***The existence of district heating systems such as CHP*** *('Combined Heat and Power')*, that can support the energy needs of an entire neighborhood from a single source, and are more energy-efficient than individual heating/cooling systems. *Indicator used for the comparative analysis of the two quarters:* 1. Existence of a CHP plant.
i	***The existence of an efficient public transport system*** as a viable and much more environmental-friendly alternative to private motorized vehicles. *Indicators used for the comparative analysis of the two quarters:* 1. Ratio between public transport use and private motorized vehicle use for daily trips; 2. Area within a 100 meter radius from public transport stops relative to the total area of the quarter (in m^2).
j	***The application of the practice to save or rejuvenate specific sites or dwellings within the neighborhood that bear a special signification***, in order to increase the attractiveness and uniqueness of the neighborhood. *Indicators used for the comparative analysis of the two quarters:* 1. Surface of historical dwellings that were preserved from the old function of the site, as a percentage of the total built surface of the district; 2. Surface of historical dwellings that were preserved from the old function of the site, minus the former garrison dwellings of the French quarter, as a percentage of the total built surface of the district.
k	***Create open, flexible spaces within the neighborhood*** that can be used for a variety of activities, and ***'reserve some of the best sites in the neighborhood for community purposes'*** (Farr, 2008, p.12). *Indicator used for the comparative analysis of the two quarters:* 1. Average area per hectare of public, open spaces (in m^2).

l	***Localizing' the economy and providing a mix of land-uses and services within the neighborhood*** in order to increase the attractiveness of the district, and to reduce the need for commuting. *Indicator used for the comparative analysis of the two quarters:* 1. Percentage of available working places per capita.

In this section, an assessment of five frameworks that depict the characteristics of a sustainable neighborhood has been undertaken; and these characteristics were combined in order to create a new framework, based on which the indicators that will be used for the comparative analysis of the empirical chapter were determined.

3.3 Determining the factors that affect the redevelopment of inner-city Brownfield land into sustainable neighborhoods

This section of the theoretical framework chapter will inform the exploratory section of this study. It is aimed at determining the factors that, in theory, are relevant for the sustainable development of an urban district on Brownfield land. Particularly the work of Gilbert et al. will be used as a basis for creating a framework with the above mentioned factors. Despite the fact that it is slightly outdated, their conclusions are directly linked to real-world examples, which give it some degree of empirical validity; and furthermore their framework was devised more or less at the same time with the beginning of the development on French district, making it relevant to the conditions of that time.

Gilbert et al. dedicate an entire book- 'Making cities work: The Role of Local Authorities in the Urban Environment'- to the topic of sustainable urban development, citing positive examples from urban settlements all over the world (Gilbert et al., 1996). Based on such a large number of case-studies, the authors devised a scheme that encompasses the main factors that affect a successful implementation of urban sustainability principles for municipal development. These underlying factors are divided into three categories: 'governance', 'capacity', and 'actions and initiatives to secure sustainability', each comprising of a set of fundamental characteristics (ibid.).

However, given the specifics of the 'French district', namely the fact that it was developed on the site of a former military base made available to German authorities after the end of the Cold War, such a framework would not be complete if the factors that affect Brownfield redevelopment (which includes military bases redevelopment) would not be included. These factors have been derived from the literature review on inner-city Brwonfield redevelopment, summarized in the second chapter of this Thesis.

Reviewing the aforementioned aspects, one can conclude that the following factors affect the successful implementation of sustainable urban (neighborhood) development on Brownfield land:

	Determinants for the redevelopment of inner-city Brownfield land into sustainable districts
	I) Determinants from the 'Governance' category
a	***The ownership of the site*** by the local authorities.
b	***A sustainable urban development vision.***
c	***The authority of the municipality*** over the development process, and over the outcomes.
d	***Integrating solutions from the local communities*** in the policy-making and implementation process in order to gain acceptance and legitimacy.
	I) Determinants from the 'Capacity' category
e	***The existence of adequate financial resources*** for pursuing urban sustainability.
f	***The correlation of the work of specialist*** from different fields.
g	***Raising awareness on the need to pursue sustainability at community level*** through workshops, manuals, commercials and other initiatives.
	II) Determinants from the 'Actions and Initiatives to Secure Sustainability' category
h	***The existence of binding planning tools***, which are used to implement the sustainable character for the district.
i	***Mutual agreements between the municipality and the building cooperatives (private developers)***, that further enhance the sustainability aspect of the district.
	III) Determinants from the specific category of Brownfield (military sites) redevelopment
j	***The attractive location of the site and its degree of connectivity*** to the existing infrastructure.
k	***Cost and time span required to clean-up the former military site.***
l	***Existence of built (or natural) facilities that may enhance the site's attractiveness in view for a potential redevelopment.***
m	***The availability of specific governmental incentives for Brownfield reconversion,*** in order to make the redevelopment of the Brownfield (military) site financially attractive as opposed to Greenfield development.

The above scheme will be used for framing the interviews that inform the exploratory part of this Thesis.

Chapter IV: The policy context

The policy context of this Thesis will deal with the role of the various institutional tiers in promoting SUD (Brownfield/military sites conversion is included here as a strategy for SUD) and facilitating its implementation. Two institutional tiers will be analyzed separately: the German federal level and the institutional level of the state Baden-Württemberg; while special consideration will be given to the role of local authorities within the German planning system.

4.1.1 The federal level of Germany

At the federal level of Germany, two policy documents are of particular relevance for the implementation of sustainable development principles in urban areas: 'Perspectives for Germany- Our strategy for sustainable development', a document released in 2002 that sets the framework for Germany's sustainable development strategy and also defines some guidelines for sustainable urban development (FGG, 2002); and 'Target 30 ha', a policy documents that sets the target of reducing urban spread towards Greenfield land in Germany from 131 ha/day in 1999 to 30 ha/day in 2020 (The Council for Sustainable Development, 2004).

'Perspectives for Germany- Our strategy for sustainable development':

The eight chapter of the Agenda 21 requests all signatory states to prepare a national sustainable development strategy, aimed at balancing economic, social and environmental objectives for the respective countries (Mittler, 2001). Consequently, the document 'Perspectives for Germany' represents an original approach towards sustainable development, as instead of the usual 'three-pillar approach' (economic development, social equity and environmental protection), it is comprised of "four central coordinates: intergenerational equity, quality of life, social cohesion and international responsibility" (ibid., p.167). Based on these coordinates, eight 'action areas' are defined: energy/climate; mobility; agriculture/nutrition; global responsibility […]; demographic change; education; innovation/economy; and land-use" (ibid.). Indicators, aims, and guidelines on how to achieve these aims are given for each of the categories mentioned above, while 'pilot projects' are given as examples of practical implementation of the strategies (ibid.). Based on the advices of the 'German Council of Sustainable Development', sustainable urban development has been proposed as an important category within the German sustainable development strategy (Bachmann, 2008). However, only one section is specifically dedicated to the development of urban areas (FGG, 2002).

Ralf Tils has made a critical assessment of the German sustainable development strategy, based on a series of guidelines and principles specifically elaborated by the OECD and UN for reviewing national sustainable development strategies (Tils, 2007). He concluded that in terms of horizontal integration, "the performance assessment of the German sustainable development strategy […] is mixed so far" (ibid., p.167): the OECD assesses the 'Perspectives for Germany' in a positive manner; while some academics are more critical, emphasizing some policy areas, such as labor market policy, that were not included in the document (ibid.)

In terms of 'vertical integration', the German sustainable development strategy has up to date been poorly rated (Tils, 2007). The German federal system means that the national level cannot impose sustainable development measures on the lower tiers of administration, namely "the state (Länder) and the local (Kommunen) levels", and therefore a successful strategy can only be implemented through vertical cooperation between these three levels (ibid., p.168). The German Länder mostly preferred to focus on their own environmental strategies or Local Agenda 21 projects, nonetheless these are much more limited in scope than an elaborated sustainable development strategy (ibid.).

Another vital aspect for any sustainable development policy document is the participative process, as "broad public participation and partnerships with civil society, private sector and external organizations are understood to be key elements of the sustainable development strategy process" (OECD, 2001 in: Tils, 2007, p.169). Despite some critics on the limited periods for discussion, civil society involvement, or lack of transparency in the elaboration of the strategy, it is generally considered that the 'German Council for Sustainable Development' has fared rather well; and that through it the opinions of civil society actors were taken into considerations, as their "suggestions were actually used to rework the strategy" (OECD, 2006 in: Tils R., 2007, p.169).

In terms of implementation, "national governments are supposed to provide concrete mechanisms that guarantee the implementation of SD in everyday policy-making" (Tils, 2007, p.169), while also linking "long-term visions with short- and medium-term actions" (OECD, 2001 in: Tils, 2007, p.169). Because of this crucial category the German sustainable development strategy is being heavily criticized, as 'Perspectives for Germany' does not make any provisions or requests for the various sectors or ministries on how to "translate the sustainable development strategy into day-to-day operation within their jurisdiction", and even more so it does not provide any "links to budgetary processes" that would make the implementation of the strategy more apparent (Tils, 2007, p.169).

The last category for assessment is related to the 'monitoring and evaluation' of the implementation process, as "clearly defined, realizable objectives and indicators that describe overall sustainable development goals as well as periodic measurement and reporting" are crucial for the achievement of a more sustainable development in practice (OECD, 2001 in: Tils, 2007, p.170). In 'Perspectives for Germany', the goals are set for a specific amount of time, and the indicators used to measure the implementation process of the strategy towards achieving the objectives incorporate a broad variety of areas (FGG, 2002). Although the document "is positively evaluated because it mostly contains quantifiable objectives in addition to its use of indicators" (OECD, 2006 in: Tils R., 2007, p.171); it has been also criticized because "the

relationship between the objectives and indicators is ambiguous", because of the "poor selection of indicators that leads to biases towards positive representation", and because of the "impossibility of measuring identifiable changes" (Tils, 2007, p.170). Thus, opinions on the performance of the German sustainable development strategy in terms of 'monitoring and evaluation' are ambiguous.

To conclude this section, it can be stated that 'Perspectives for Germany' is an ambitious document, designed to combine "various policies as well as policy fields within a new single programmatic concept", however it does not possess the characteristics that would allow it to "unite the conflicting dynamics of adequate problem solutions, administrative practicability and the requirements of overall political success in party democracies such as Germany" (ibid., p.174). In other words, despite its ambitious intentions and objectives, the German sustainable development strategy has had limited influence in practice until now.

The 'Target 30 ha' policy document:

The second important document for sustainable urban development in Germany is the 'target 30 ha', with the intention of reducing urban spread in Germany from 131 ha/day in 1999 to 30 ha/day in 2020 (The Council for Sustainable Development, 2004). Urban sprawl has been traditionally caused by the permissive development policies on Greenfield land, as such areas are usually much cheaper, have fewer legal constraints and are immediately 'developable' in comparison to the redevelopment of inner-city Brownfield sites (Thornton et al., 2006; Koll-Schretzenmayr, 1999; Penn-Bressel, 2010). There are economic, social and environmental motives for reducing development on Greenfield land (The Council for Sustainable Development, 2004), as this activity decreases the regenerative capacity of nature and its capacity for life-support, endangers habitats and species alike, increases pollution due to longer distances, and therefore higher fuel consumption, and contributes to climate change (Penn-Bressel, 2010). Furthermore, unrestricted urban sprawl leads to loss of valuable Greenfield land that could be used for agriculture or for renewable energies (ibid.); and can lead to a separation between social classes, as the poorer communities tend to be left behind in the more underdeveloped urban areas, which in turn leads to lower chances of a brighter future for these disadvantaged groups (ibid.). However, between all these areas, "environmental concerns acted as the strongest driver for the 30 ha target", while the main aims are based on "furthering urban regeneration and reducing Greenfield consumption" (Ganser, Williams, 2007, p. 605).

Factors that affect the achievement of the 'Target 30 ha' objective:

One of the main challenges to achieving the aim is the fact that the 'Target 30 ha' document is first and foremost a 'political postulate', and therefore "the likelihood of achieving these targets, and the potential broader consequences were not assessed in detail before they were set" (ibid.). A crucial element for the achievement of the stated aim is related to the inclusion of the objectives in the German planning system (Ganser, Williams, 2007). Within the German planning context, this can be done by translating the objective based on "proportion of area of each region or local authority; proportion of population; proportion of available Brownfield;

proportion of economic productivity; and, possibly the most refined solution, according to area productivity" (ibid., p. 606). Until now no such method has been agreed upon (ibid.). Furthermore, an efficient monitoring system needs to be set-up in order to measure the practical implementation of the document, however "there are several monitoring deficits at present, specifically time lags in data collection, which make it difficult to trace policy impacts" (ibid., p. 608).

Given the above considerations, and the fact that urban sprawl suffered only an insignificant reduction in the last years (Penn-Bressel, 2010), one can state that the practical relevance of 'Target 30 ha' for achieving the aims of sustainable urban development has been limited.

4.1.2 The institutional level of the state of Baden-Württemberg

Following the Rio Conference of 1992, the state adopted the 'Baden-Württemberg Environmental Plan', which led to the emergence of the 'Sustainability Advisory Board' in 2002, a conglomerate of specialists from various disciplines tasked with aiding the implementation of the 'Environmental Plan' (Weber et al., 2008). Even more important, the state of Baden-Württemberg launched its sustainable development strategy based on " an integrative approach offering a long-term orientation for society, the economy and politics", and trying to involve "representatives from the economy, environmental and nature protection, special interest groups, churches, unions, clubs, municipalities, […and] individual citizens" in implementing this strategy (ibid., p.91). Ambitious mid- and long-term objectives for the sustainable development strategy of Baden-Württemberg were set in February 2012, and aim at reducing CO_2 emissions until 2050 with 90% compared to the 1990 value (already in 2020 a reduction of 25% compared to the 1990 value is expected); at reducing the nuclear energy use to 17% of the total until 2020; at increasing the output of energy from renewable sources from 17% up to 38% in 2020; and at reducing Greenhouse gas emission with 25% until 2020 (Rat für Nachhaltige Entwicklung, 2012). In addition, a reduction of "the per capita energy consumption" with 20% until 2020 is envisaged (Weber et al., 2008, p.92); and "a long-term strategy to combat land consumption" is prepared in order to reverse the negative trend that led to "the double of the average living space per inhabitant […] since 1965", and to the massive spread of "areas for settlements and traffic" on Greenfield land (ibid., p.94). Despite such ambitious goals, negative feedbacks from the economic associations, which described these goals as 'utopic'(Rat für Nachhaltige Entwicklung, 2012), have been received; and it is yet to be seen how, and if, these objectives will be implemented. Furthermore, despite the fact that about one third of all municipalities in Baden-Württemberg considered implementing Local Agenda 21 programmes (Weber et al., 2008); a status report on the 'sustainability' progress in the state dating from 2000 concluded that despite significant successes from an environmental point of view in past decades, the state of Baden-Württemberg still has significant issues to solve regarding the protection of the ozone layer, noise management, soil protection, biodiversity, noise management, energy use and air quality (Renn et al., 2000). This document does not include any social or economic indicators, and seems to be outdated; however, in the absence of another more recent report, one can conclude (following the general trends of the past decade) that despite some possible improvements in the

fields of renewable energy use, fuel efficiency or biodiversity protection, the main environmental issues signaled in the 2000 progress report are still of actuality today. On the specific issue of sustainable urban development, despite the fact that the "sustainable development of towns and regions" is seen as central to any sustainable development progress (Weber et al., 2008, p.91); no integrated or comprehensive strategies on how to achieve urban sustainability have been implemented up to date. Nonetheless, the economic situation of the state, combined with the 'seemingly' political interest for sustainable development and the fact that some urban developments regarded as 'sustainability models' have emerged in the past decade, suggest that the state of Baden-Württemberg is at least in theory a suitable area for the promotion of sustainability.

The first part of the policy context chapter of this Thesis has dealt with the relevant policy documents regarding sustainable urban development at the federal level of Germany, and institutional level of the state Baden-Württemberg. It can be concluded, that despite of the theoretical importance of the studied policy documents, aimed especially at providing guidelines and 'shaping the mind' of relevant stakeholders in urban development, little practical results have been achieved due to them so far. This conclusion is of use for the purpose of the research, as it means that the main factors for developing sustainable neighborhoods on Brownfield land in Germany are to be found at the local level and local actions and initiatives are the main drivers behind such developments, and much less so incentives or policies from higher tiers.

4.2 The role of local authorities within the planning system of Germany

Overview of the German planning system:

The planning system of Germany is a reflection of the vertical separation of administrative powers in Germany, divided between the Federation and the 16 states (Länder) (Turowski, 2002). This separation of powers leads to various differences between the Länder regarding the administrative and planning system, differences that are uncharacteristic for a centralized state (ibid.). Consequently, since Germany's federal administrative system does not allow for an efficient centralized planning framework (Schmidt, 2009); planning in Germany functions according to the 'counter-current' principle based on consensus-building and a "reciprocal influence by federal, state and municipal authorities on each other's proposals" (Schmidt, Buehler, 2007, p. 57). Within this framework, "the primary actors involved […] are the federal government (Bund), the 16 state governments (Länder), the 114 planning regions and the approximately 14,000 municipalities" (BBR, 2000 in: Schmidt, Buehler, 2007, p. 57).

The 'Federal Spatial Planning Act' represents "the key legislative basis for spatial planning in Germany" (Knieling J., Othengrafen F., 2005, p.2), and has the main purpose of ensuring equitable living conditions and opportunities for people all across the country (Schmidt, Buehler, 2007). It delegates the responsibility for achieving this aim to the 16 States (ibid.).

In order to reach this objective, several re-distributive policies were implemented, with the scope of reducing the wealth disparities between richer and poorer Länder; and of revitalizing former mining or heavy industrial areas that are in decline (like the Ruhr and Saar regions), or former East German provinces that lagged behind economically after the reunification (ibid.). Another effort to minimize spatial social disparities was the emergence of a 'central places' system, which creates an 'urban hierarchy' for German cities based on the "services and infrastructure [they provide] to the surrounding regions" and allocates state and federal funds based on the rank of the cities on the 'urban hierarchy' (ibid., p.61).

The role of local authorities within the German planning system:

Although the "German constitution guarantees municipalities the right to independent self-government […], decisions concerning land use, taxation and economic development often do not flow from the immediate jurisdiction, but often must function within a regional, state or national framework" (Schmidt, Buehler, 2007, p.63). Strategic goals and targets are established at higher levels (Turowski, 2002); however "the system is organized around mediation and consensus", and often the goals are set after collaborative discussions that take into account the opinions of members from all tiers of government (Schmidt, Buehler, 2007, p.57). The privilege of local authorities "to determine their own development is enshrined within the German Basic Law", which mentions the fact that "the municipalities shall be guaranteed the right to manage all the affairs of the local community on their own responsibility…" (Article 28 (2) of the German Basic Law in: Schmidt, 2009, p.1911). In other words, local authorities have the privilege "to regulate all matters of public authority (i.e. of local government) concerning the local community" (Turowski, 2002, p.9); however their decisions must be consistent with the strategic framework imposed by the higher institutional tiers (state and federal levels).

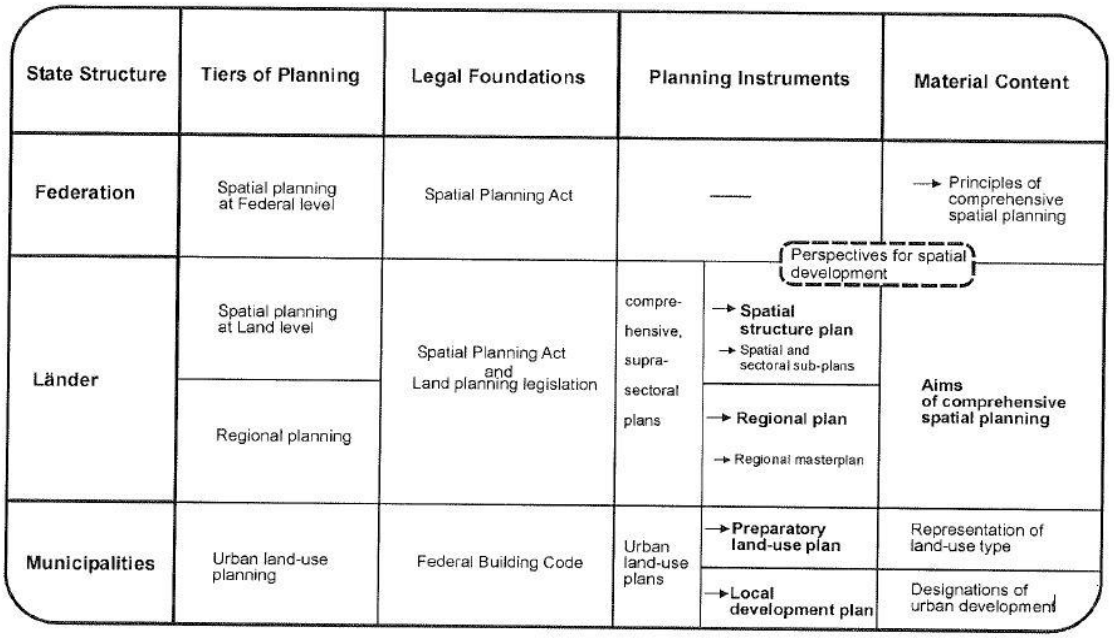

***Figure 2**: The German planning system.* ***Source**: Turowski G., 2002, p.12.*

Income taxes are generally divided between the three main tiers of government, however "municipalities are dependent, to a certain extent, on a local trade tax" (Van den Berg et al., 2006 in: Schmidt, 2009, p. 1911); which leads to competition between neighboring municipalities for investments (Schmidt, 2009). Half of the revenues for German municipalities stem from property taxes (9%) and intergovernmental transfers (41%), while some public services, such as the management of schools are left to the State authorities (ibid., p.63).

Instruments available for the local authorities for influencing urban development:

Regarding spatial planning itself, the federal level of government only establishes broad goals and targets that ought to be attained by the State and local levels (Schmidt, 2009); and as such "the level of responsibility and degree of plan detail increases with lower levels of government" (Schmidt, Buehler, 2007, p. 57). Local level matters account for all public tasks that involve the local community, from "the provision of utilities, local public transport, road construction within the municipal territory, and the entire field of town planning", to "the construction […] of schools, hospitals, cultural and sports facilities" (Turowski, 2002, p. 9). In planning terms, this provision of administrative powers to the local level is called 'municipal planning autonomy' (ibid.). This system accords important privileges and freedoms to local authorities, however it must be mentioned that the German 'Federal Building Code' obliges the local levels of government "to make plans that are vertically and horizontally consistent" (Schmidt, Buehler, 2007, p.57). As such, plans emerged at the local level must be homogeneous with "plans above them" (Schmidt, 2009, p.1912).

Practically, there are two main planning tools available to the German municipalities for regulating urban spatial planning: the preparatory land-use plan ('Flächennutzungsplan' in German), issued at a scale ranging from 1:10000 to 1:20000 (Turowski G., 2002), which "outlines land use and is binding on the administrative authority formulating the Plan" (MLIT official website, 2013); and the detailed land use-plan ('Bebaungsplan' in German, also translated as 'zoning plan' or 'local development plan'), issued at a scale ranging from 1:500 to 1:1000 (Turowski, 2002), which represents "a construction guidance plan that is binding also on the actions of private individuals" (MLIT official website, 2013). Both tools are required to be consistent with the regional master plans developed by the respective State (ibid.), as mentioned before; and must be conform with the 'Landscape plan', the 'Green Structure plan' (both regulating agricultural and Green space land uses), the 'Federal Transit Plan' (regulating important infrastructure) (ibid.), as well as other sectoral plans devised at higher levels for 'special' issues or areas (e.g. 'Protection Areas Act','Highways Act') (Turowski, 2002).

While 'preparatory land-use plans' lay out "in general terms the types of land use prevailing or envisaged for the whole of the municipal territory" (ibid., p.24); the 'detailed land-use plans' represent the "binding force [that] extends not just to public authorities, but to everyone" (ibid.). The latter play an important part regarding the powers of local authorities to control the spatial development of the areas under their jurisdiction , as they represent the legal tool for imposing specific measures stemmed from the local level that can decisively impact the development of an urban area.

This can be achieved through leverages such as the power to "earmark areas of land for specific uses (e.g. residential and commercial use, public purposes)" (ibid.); to impose certain restrictions ("e.g. maximum proportions of plots to be built on, maximum number of storeys"); to attach specific conditions ("e.g. dwellings for certain social groups"); and to oblige constructors to impose "measures of some type to be required before a certain use may be taken up (e.g. noise insulation, planting)" (ibid.). In addition to these tools, municipalities can issue urban policy documents like the 'Framework for Town planning' (Rahmenplan), which contain policy objectives and implementation guidelines for urban development, but are, like the preparatory land-use plans, not "binding on any other parties, nor do [they] establish any direct legal rights" (ibid., p.24).

Although all plans developed at local level have to be consistent with the planning frameworks of the higher institutional tiers, the latter are preoccupied more with setting general guidelines, objectives, and gross land-use functions, and contain little detail on the exact form of imposing measures. This lack of detail gives local authorities considerable leverage regarding the suitable ways for implementing state and federal planning policies, and grants them considerable more freedom (compared to more traditional, centralized 'top-down' planning systems) in implementing their own, local spatial development policies through the binding 'detailed land-use plans' (Bebaungspläne).

Gilbert et al. have expressed the importance of a decentralized planning framework and of allowing and meeting the conditions for local authorities to govern themselves in order to pursue sustainable urban development goals, and in this regard it can be stated that the German administrative and planning system meets the above-mentioned characteristics and can, at least theoretically, provide a good starting point for a more sustainable development of urban settlements.

This statement is strengthened by one further argument: the fact that the German 'Spatial Planning Act' stipulates that "the tasks of comprehensive spatial planning should be performed in accordance with the principles of sustainable spatial development; in other words, that spatial planning should strive to reconcile social and economic demands on land use with the ecological functions of the land, and in so doing achieve a sustainable and balanced structure for the territory as a whole" (Turowski, 2002, p. 13). Consequently, the Federal Building Code requires municipalities "to balance diverging public and private interests and to remove and prevent any deficits in urban development in the interests of safeguarding sustainable urban development and the socially equitable use of the land" (ibid.). The two aforementioned documents mention the importance of sustainable development for urban settlements, and devise a series of general guidelines and categories for achieving this, but specify little further details and provide no binding propositions for regulating the implementation of these guidelines. As such, implementing such concepts for the sustainable development of urban areas remains the responsibility of local authorities, further strengthening their role in relation to sustainable urban development.

Chapter V: Methodology

In this chapter, the methodology chosen for this Thesis will be analyzed.

Despite the rich literature on sustainable urban development, and the intentions stated by the local authorities through various policy documents of pursuing sustainable urbanism, there are up to date very few examples on how this concept can be applied in practice and lead to communities that have a sustainable life-style. The reason for that is the 'scale' factor, which has been analyzed in the beginning of the theoretical framework chapter. The literature on urban sustainability suggests that the neighborhood scale is the most appropriate for implementing urban sustainability measures (Carmona, 2001), as it is large enough to influence the life-style of the people living in the respective area, yet flexible enough to allow for the application of sustainability principles into practice. As such, the neighborhood scale has been deemed as appropriate scale for the scope of this research.

5.1 Context of the research

Once the scale for the research has been defined, it is important to choose a suitable context, which would allow for a focus of the research, and consequently, for the transferability of the findings to future similar developments. Throughout Europe, social and economical shifts in the last decades have led to the availability of a multitude of inner-city Brownfield land rife for redevelopment. One vital aspect of sustainable urban development is related precisely to the redevelopment of such Brownfield land, which leads to a reduction on the need for urban development on Greenfield land and to all the negative consequences that such a sprawl brings (this topic is thoroughly analyzed in the second part of the 'academic context' chapter).

This topic is of particular importance for Germany, where national level objectives for reducing urban sprawl exist, and where the withdrawal of the US troops alone made available (already in the 1995) an amount of land that was "almost the same size as the federal state of Bremen" (BICC, 1995, p.6). This was due to the fact that throughout the Cold War, more than 80% of the 'Western Allies' occupation forces were stationed in Germany, a country with a critical strategic and political importance for the belligerents (ibid.). The end of the Cold War has brought a massive restructuring and reduction of these forces, and as of today only a very small percent of those bases remain active, freeing up a huge amount of land that could be used for development purposes by German municipalities (Jacoby et al., 2008). The available land was sold to the German federal government, to the respective states or to the municipalities themselves,

depending on the case (BICC, 1995); and the presence of some of these sites within city boundaries, sometimes even in central locations, represents an important opportunity for urban rehabilitation (BICC, 1995; Bagaeen, 2006). Given all the above considerations, as well as the fact that I am fluent in German (allowing me to also use literature in German for the scope of this Thesis), I considered Germany to represent the appropriate context for this research.

5.2 Choosing the Case-study for the research

Once the context has been defined, it is important to choose a viable case-study for the research. For the discussion on sustainable urban development, especially the German state Baden-Württemberg draws attention with two neighborhoods that were developed on former military sites, and are broadly regarded as sustainable: Vauban in Freiburg and the 'French' neighborhood in Tübingen. Both can be considered suitable for an urban sustainability research due to their similar context, similar time-period of development and similar inhabitant's number (both were built 'from scratch' on former inner-city military sites that were handed by the departing Allied forces to the German state at the beginning of the 90's, both were developed in similar timeframes- from the middle of the 90's towards the end of the last decade, and both operate within the same political and planning framework of the state of Baden-Württemberg).

However, one striking difference exists between the two cases: the Vauban is almost exclusively a residential neighborhood, whereas the French neighborhood in Tübingen is a 'mixed-use' area, where commercial and residential functions are cleverly embedded together. That is a very important aspect, because a sustainable community needs to provide a certain amount of local jobs, most of the services, and commercial, sport and leisure infrastructure to its inhabitants, in order to reduce the fuel consumption caused by daily motorized trips to other parts of the city. Such an approach would give the neighborhood a higher level of independence compared to a solely-residential neighborhood. Adding to that the fact that the case of Vauban has been intensively studied in the past, while the 'French neighborhood', despite similar achievements in terms of sustainability, received much less attention; I have considered much more suitable to use the latter as the focus for this research. As a consequence of all of the above, the 'French neighborhood' in Tübingen can be regarded as a suitable example for the purpose of this Thesis.

5.3 A suitable example for comparison

In order to evaluate the alleged sustainability of the French district and the efficiency of the 'unorthodox' planning measures used for its development, a comparative analysis with a 'typical' (traditionally-developed) district, which was not marketed as being 'sustainable', is needed. For such a comparison between a quarter that is promoted as a sustainable neighborhood, and a similar case that wasn't given this label, it is required for the two districts to share some similar characteristics: planning framework, size, development period, or distance from city center.

My search was thus limited to the state of Baden-Württemberg, in order to maintain the same planning framework; and to a city at least as large as Tübingen, in order to be able to accommodate the development of a similarly-sized neighborhood. The 'Quartier am Turm in Heidelberg', and the redeveloped 'Smiley-Barracks' in Karlsruhe were the only two cases that fulfilled the aforementioned characteristics. Given the fact that the latter was also marketed as a 'sustainable quarter', and that its development was still ongoing; I chose the 'Quartier am Turm' as a suitable, 'typical' neighborhood, to be used for comparison with the 'sustainable' French district. The two share important similar characteristics:

- The same planning framework (Baden-Württemberg);
- Comparable sizes (13,5 hectares for the Quartier am Turm; and 11,2 for the French district);
- Same distance to city centre (3 kilometers in both cases);
- Similar number of inhabitants (about 2300 for the French district, and 2000 for the Quartier am Turm; although I could not confirm the latter value from official sources);
- The same date for the completion of the development: both were officially finalized in 2007; with the last remaining lots being completed in both quarters in 2010 (although works on Quartier am Turm started in 2001, and on the French quarter about four years earlier);
- Both were redevelopments of inner-city Brownfield land (the French district was a former military garrison, while the 'Quartier am Turm' a former train carriage factory).

Given all the above considerations, the 'Quartier am Turm' in Heidelberg has been selected as the appropriate 'typical' development to be used for a comparative analysis with the 'sustainable' French district.

5.4 Research design

In order to attain the aim of this Thesis and answer the research questions, a combination of three research methods is employed:

a) The use of GIS software for the comparative analysis between the two quarters:

The central research question is aimed at evaluating the sustainability of the French district, by comparing it with a 'typical' quarter. The most appropriate and feasible way of undertaking such a comparison is through the use of GIS software, a powerful, professional tools used for spatial analysis by specialists all over the world (Heywood et al, 2011). This tool allows users to represent graphically, and also quantify the differences between maps, making it ideal for the comparative analysis of this Thesis. GIS software is a far more complex, reliable and powerful tool for storing and analyzing spatial data, compared to the more common spatial analysis based solely on free aerial imagery software. Its main advantage is the fact that it allows users to "view, understand, question, interpret, and visualize data in many ways that reveal relationships, patterns, and trends in the form of maps, globes, reports, and charts" (Infotech website, 2010).

Furthermore, "GIS helps you answer questions and solve problems by looking at your data in a way that is quickly understood and easily shared" (ibid.), as the resulting images (e.g. see maps from the empirical chapter) represent an easy to understand and intuitive insight on the matter at hand. This advantage of GIS software is of importance especially when disseminating information to people from different fields of activity, and to policy- and decision-makers.

However, unlike freeware geospatial programmes, GIS software has three main drawbacks:

- There are a variety of GIS programmes, many operating different from one another, and most require a substantial license fee in order to be used;
- Given the complexity of the software, training is usually needed in order to be able to use it correctly;
- It requires the input of data in specific GIS formats (which is usually very expensive), in order to undertake spatial analysis.

All these issues have been tackled progressively. First of all, the choice of using AutoCAD Map 3D as the suitable GIS software for the purpose of this Thesis was based on two facts: my past experience as an architect, through which I became accustomed with the AutoCAD platform (although Map 3D is a GIS software with a different purpose than the original AutoCAD, they share the same interface and some similar functions); and the fact that I was able to acquire a free, educational license for the purpose of this Thesis (the watermark on the maps from the empirical chapter are a result of this type of license).

Second of all, with the help of teachers from the Cardiff Metropolitan University, I was able to receive GIS training, which helped me to get accustomed with the software; and learn to introduce data and effectuate spatial analysis.

Third of all, GIS data is not for free, and usually amounts for thousands of Euros, given the needs of this Thesis. So the only option was to input manually the data from other sources, a much more time-consuming, but feasible alternative.

The spatial data for the two districts were deducted through the following means:

- Analysis of high-resolution aerial and satellite imagery (using the Google Earth Pro software);
- Analysis of 360 degrees axonometric views of buildings and spaces (Bing Maps 3D, Flash Earth);
- Analysis of various maps and data from the Tübingen and Heidelberg city archives, including the land-use plans for both quarters;
- Using relevant data about the two quarters existing in policy documents and academic journals.

The use of several different sources for data input helps 'triangulate' the information, thus allowing for more precise inputs. Since the accuracy of GIS analysis is determined by the quality of the data that are inserted into the program, this 'triangulation' of data sources helps reduce the

errors that might appear. More detailed information about the type of data and the process of analysis follows in chronological order below:

1) High-resolution base maps for the two quarters were extracted from Google Earth Pro in form of picture images (.jpg), to be used as a base layer in AutoCAD Map 3D. They are 'top-down', 'north-up' views, similar to orthographic plans of architectural drawings.

2) The base images were imported into Map 3D, and were attached to the appropriate coordinate system (wgs84-Zone 32N for Germany) in order to be displayed correctly. Four coordinate points for each image (that were established in Google Earth) were used to calibrate them on the correct position in Map 3D.

3) The base images were scaled in Map 3D to reflect their accurate, real-world dimensions. This was done by comparing the dimensions of several lines (of the base image) from Google Earth to the ones in Map 3D, and adjusting the latter ones accordingly.

4) Once the base map image has been set, the layers used for analysis were created on top of them, using a transparency percentage (between 20-40%, depending on the layer). The following layers were added on top of the base map through a polygon creation method: 'buildings', 'open spaces', 'roads', 'parking lots', 'tree canopies', 'bus stops'. Each layer contains polygons and lines that were drawn on the exact contour of their real-world correspondents (with the help of the high-resolution of the image), thus resulting in accurate areas, perimeters, distances and spatial placement. Once drawn, all layers were exported in the geo-spatial SDF format, to be used for data input and analysis.

5) In order to easily be able to analyze the two quarters on a point-by-point basis, separate files were created for each sustainability category. The SDF files containing the shapes and dimensions of the surfaces were imported, and specific attributes were inserted for each layer. These attributes reflected the information needed for comparing the two districts (established through the 21 indicators used for analysis; see theoretical framework chapter).

Therefore, the 'buildings' layer contains the following information about each building in the two quarters:

- Its total area (measured in square meters);
- Its address;
- Its height (measured in numbers of floors);
- The type of roof (Green roof or regular);
- The existence of solar panels on the building;
- The calculated surface of the green roof, as some dwellings, especially in the 'Quartier am Turm' are only partly covered by Green roofs (in square meters);
- Whether the dwelling had a historical character (and was reconverted) or not.

The 'open spaces' layer contains the following information about each such surface in the two quarters:

- Its area;
- Whether it was private (courtyards); or open to the public;
- Whether it was a Green area or not.
- A generic name given by the title of the surrounding street.

The 'parking lots' layer contains the following information about each parking space in the two quarters:

- Its area;
- Its location relative to the quarter (at the edge, or 'inside');
- A generic name given by the title of the surrounding street.

The 'roads' layer contains the following information about each street in the two quarters:

- Whether it was closed for motorized traffic (pedestrian street) or not;
- Whether it had a speed limit of 50km/h or not;
- Whether it was traffic-calmed (speed limit 30 km/h) or not;
- Its name.

The 'tree canopy' layer contains the following data about each tree in the two quarters:

- The (projected) area of its canopy in summer.

The 'bus stops' layer contains the following information for each public transport stop in the two quarters:

- Its name;
- The public transport lines it serves.

6) Once the data were introduced, the analysis was mainly done through the 'query' function of AutoCAD Map 3D, which allows for the presentation of spatial data based on specific attributes that were manually introduced (e.g. highlighting only the buildings that have a Green roof; or only the streets that are traffic calmed). 'Buffering' is another function of Map 3D used for the comparative analysis of the two quarters; as it allows to highlight a buffer zone at a specific radius from a spatial point (e.g. all buildings within 100 meters radius of a public transport stop). All maps were devised through one of the two aforementioned methods.

7) The last phase comprised of the stylization of the resulting maps, their scaling in the layout tab (scale 1:7500 is used for each map), their export in a PDF format, a supplementary restyling in Photoshop CS5 and the final saving of the image in .jpg format, in order to be imported in MS Word.

b) The input of the data in the GIS software was aided by an ***archival research*** of the Tübingen city archives. The variety of plans, maps, personal pictures, historical and aerial photos and of the supporting documents ('Framework for Town Planning', detailed land-use plan, 'Südstadt' project description) gave an important insight to most of the topics covered for the central research question. Similarly, the detailed land-use plan for the 'Quartier am Turm' was made available by the Heidelberg municipality, and is used to inform some aspects from the empirical chapter of this Thesis.

c) The *in-depth interviews* with Ms. Selina Heinrich from the urban development department of the city of Tübingen and Ms. Katharina Manderscheid, author of the book "Milieu, Urbanität und Raum" ('Milieu, urban design and space'), which uses the French neighborhood as a case-study for determining the social impact of urban development concepts, represent the main method for achieving the aim of the exploratory part of this research. The findings from the interviews gave insights on the development process and the factors that led to the development of a sustainable neighborhood in place of the former French military barracks in Tübingen, however given the limited number of interviews, results cannot be generalized and are far from being definitive (hence the 'exploratory' section of this Thesis).

This chapter has analyzed the methodology of the Thesis, by presenting the context, the reasoning behind choosing the sustainable case-study and the typical example for comparison, and the research methods of the study. The following chapter represents the empirical part of the Thesis.

Chapter VI: The empirical part

This chapter represents the empirical study of this Thesis, which will inform its main research question. The first sections will provide a brief description of the two chosen case-studies, while the main body of the chapter will be comprised of the comparative analysis between them. Additionally, the results of the interviews that inform the exploratory part of this study will be analyzed at the end of this chapter.

6.1 The French district in Tübingen

The city of Tübingen is situated in the South-West of Germany and has a central location within the German state of Baden-Württemberg, approximately 30 km away from the state capital, Stuttgart (Stadt Tübingen, 2005). It has been founded in the fourteenth century on the shores of the river Neckar, which presently divides the city in two parts; and is currently resided by approximately 89,000 inhabitants and 25,000 students (Stadt Tübingen Official Website, 2013).

The present-day '*French neighborhood*' was developed on the place of the former French military garrison situated in the Southern part of the city, and encompasses an area of about 11 hectares, about 3 km away from the city center (Stadt Tübingen, 2005). Today, it is inhabited by about 2300 people and provides workplaces for approximately 750 people. It has received the German Award for City Planning in 2001, and is regarded as a model of sustainable quarter (Stadt Tübingen Official Website, 2013). In 1991, the departure of the garrison provided the Tübingen city council with an important opportunity of developing a former inaccessible part of the town, thus recreating the image of the city and fulfilling the accommodation and workplace needs of Tübingen (Stadt Tübingen, 2005.).

Plans for development:

The idea for the redevelopment of the Southern part of Tübingen was to create a "city of short distances", that would provide residence for 6000-6500 inhabitants, and would ensure about 2000-2500 workplaces for the whole Southern area (ibid., p.4). The main objective was to create a high-density, mixed-used neighborhood, that can function independently of private motorized transport as much as possible, and can attain a high ecological and quality of life standard (Ferber, 2004). The development would be realized successively, through several consecutive development stages, which would stretch for a period of over 10 years (ibid.). In order to ensure the legality of the future development, the entire area was designated as a "mixed-area" ('Mischgebiet') and a paragraph of the German building code ('Paragraph 165 ff') that allows for innovative re-use of urban areas was applied as a planning tool for the new neighborhood (ibid., p.3).

Figure 3: The present day French neighborhood. **Source**: Stadt Tübingen, Grohe, 2012.

The 'Department of Redevelopment Tübingen' ('Stadtsanierungsamt') and the 'Regional development department Baden-Württemberg' ('LEG'), together with a number of other private parties, among them the winner of the city development competition- 'Studio Lehen Drei Stuttgart', were nominated with the responsibility for the implementation of the redevelopment measures (ibid.). The city council was the owner of the lots, and was responsible with the step-by-step decontamination of the areas (ibid.). In order to finance the infrastructure (about 30 millions Deutsch Marks at that time) and reduce prices, the city council sold the lots directly to the future inhabitants instead of contracting real-estate or development companies, which would usually build on the lots and then sell directly to the interested groups, inflating the real prices through this scheme (Kieninger R., Edelmann N., 2004). The future residents created private 'building cooperatives' ('Baugemeinschaften'), which were responsible with the purchase of the lot directly from the city council, without any intermediaries, and with the approval of the construction plans (ibid.). Through this innovative process, not only did the future residents pay a lot less than under normal circumstances (even with 35-40 %), but they also have an important influence on the design and characteristics of the future dwellings, customizing them in order to suit their needs and desires (ibid.).

As such, the municipality launched in 1992 a city development competition for the entire southern area of Tübingen (which includes, besides the French neighborhood, the 'Stuttgarter Strasse' quarter), at which 52 projects were presented (ibid.). The results of the contest were incorporated in the most influential document related to the development of the French neighborhood: the 'Framework for Town Planning' ('Städtebaulicher Rahmenplan') (Ferber, 2004).

The 'framework for town planning' ('Rahmenplan') of the French neighborhood and the adjacent Stuttgarter Strasse was a policy document that emerged in 1994 and included the ideas, proposals and results of the city development contest (Stadt Tübingen, 1994). Despite of the fact that it wasn't a "legally binding document for third parties", it formulates objectives, environmental and social characteristics, development stages and timelines, and some urban design measures (Ferber, 2004, p.2). The guidelines of the 'Rahmenplan' had a significant influence on the development of the neighborhood, as they were used as a "background for creating development plans as well as [for] building measures" (ibid.) The most important tool for the implementation of the objectives and guidelines of the 'Rahmenplan' was the detailed land-use plan of the respective area ('Bebauungsplan'), a legally binding document that regulates the development, construction and infrastructural constraints of the French neighborhood (Stadt Tübingen, 1994).

6.2 The 'Quartier am Turm' in Heidelberg

The city of Heidelberg was founded in the 13th century, and lies in the North-Western part of the German state of Baden-Württemberg, approximately 80 km away from Stuttgart, the state's capital (Heidelberg Official Website, 2013). It is inhabited by almost 150.000 people, among which about 38.000 are students (ibid.).

The present day *'Quartier am Turm'* is a neighborhood of Heidelberg developed on the site of the former Hans Fuchs train carriage factory, which was built in 1861, and was purchased by various international companies (the last owner being the Japanese Furukawa company) over the years (E&K Unternehmensgruppe, 2008). Production ceased in 1995, and the municipality of Heidelberg, taking into account the high real-estate prices in the city (being surpassed in Germany only by the city of München), decided to redevelop the site into a new neighborhood (Müller, 2009). As such, the municipality devised a detailed land-use plan for the spatial development of the area, and sold the site in 2001 to a consortium called 'E & K Quartier am Turm GmbH', which was comprised of several real-estate companies (the largest of them being 'Epple Immobilien') (ibid.). Development lasted until 2007 (although works on 2 remaining lots were finished only in 2010), and resulted in a mixed-use quarter housing approximately 2000 inhabitants and offering about 500 work places (Innen-BW website, 2013). One specific characteristic of the district is related to its pleasant architecture, as an important accent was put on the aesthetics of building's facades, which were inspired by musical themes and by the old, detailed masonry facades of the former train carriage factory (E&K Unternehmensgruppe, 2008).

The 'Quartier am Turm' represents a good case-study for a comparative analysis with the French district, as it was developed in a conventional, 'market-driven' manner; and presents many of the characteristics of a traditional, newly-developed German quarter (further specific details will be provided in the main section of this chapter).

Figure 4: *Collage of pictures of the 'Quartier am Turm'.* ***Source:*** *Innen-Bw website, 2013.*

6.3 Comparative analysis between the French district and the 'Quartier am Turm'

Based on the framework that was developed in the theoretical framework chapter, the following section comprises of 21 indicators classified in 12 urban sustainability categories, which will be used for the comparative analysis of the two districts. The analysis will examine each point of the above-mentioned framework.

a) ***The existence of sufficient parks/green spaces within the neighborhood***.

Their effects are crucial for a sustainable community, as they vastly enhance the quality of life in the surrounding areas; and help reduce the effects of urban pollution, temperate extreme climatic conditions, protect biodiversity, and provide the inhabitants with a variety of recreational possibilities.

In order to operationalize this urban sustainability characteristic, two important indicators are taken into account: the percentage of public green spaces (parks) relative to the total land area of the neighborhood (Lynch et al., 2011); and the amount of green public spaces in the two neighborhoods per hectare.

Figure 5: Wankheimer stream, leading to the wooden areas south of the French neighborhood.
Source: Stadt Tübingen Archives, 2012.

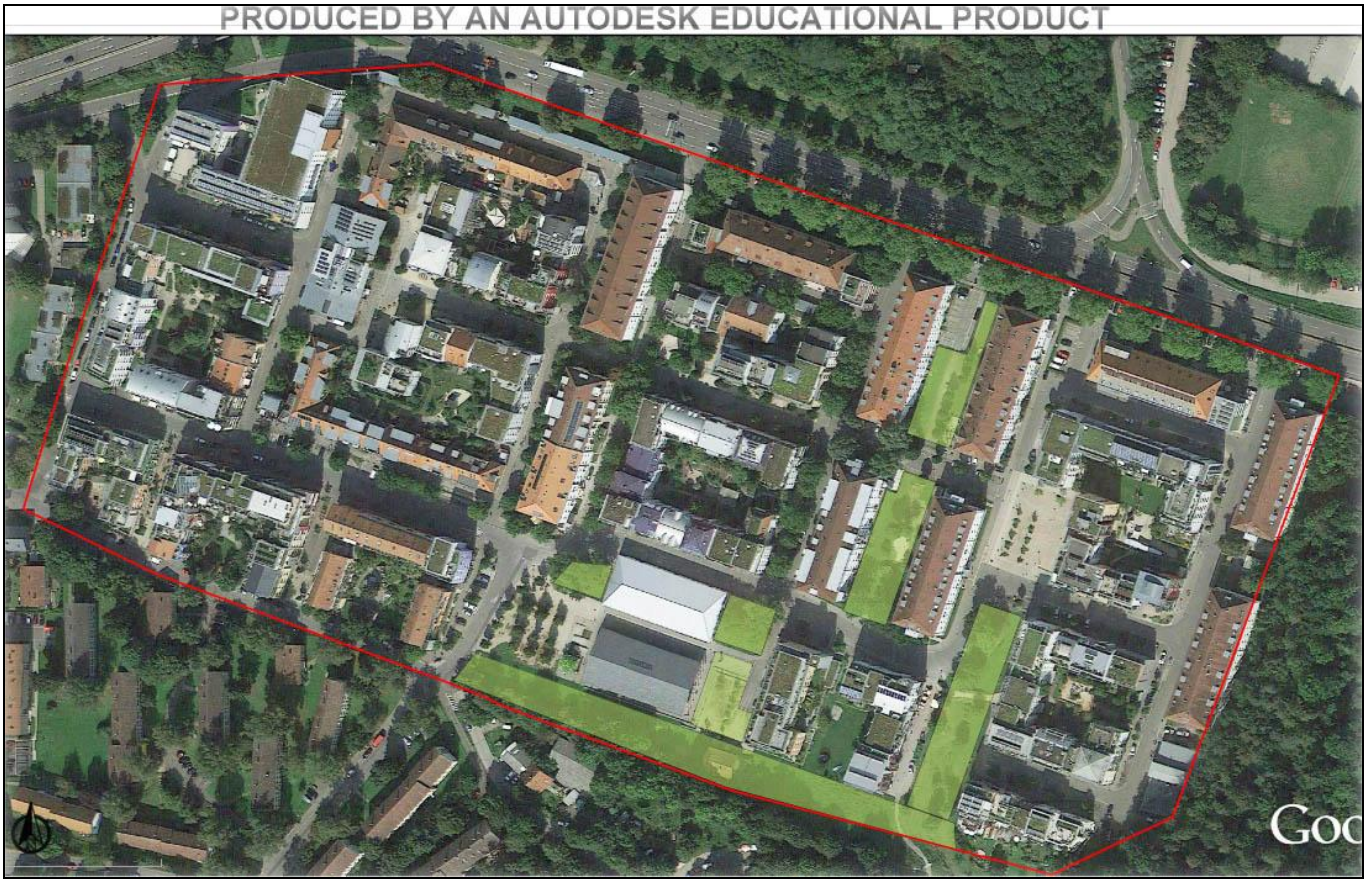

Figure 6: Parks in the French neighborhood. **Source:** Author's own (created in Autocad Map 3D 2014; base map image from Google Earth), 2013.

Legend: Public Green Spaces (Parks) **Initial Scale:** 1:7.500

The public green spaces are divided as follows:

Name:	**Area:**
Eisenhutstrasse/ Wankheimer Taele	3031 m^2
Wankheimer Taele	1545 m^2
Panzerhalle	581 m^2
Ballspielhalle 1	391 m^2
Ballspielhalle 2	207 m^2
Moempelgarder Weg 1	1065 m^2
Moempelgarder Weg 2	815 m^2
Total:	**7635 m^2**

Table 1: Public Green Spaces in the French quarter. **Source:** Author's own, 2013

Figure 7: Parks in the 'Quartier am Turm'. **Source:** Author's own (created in Autocad Map 3D 2014; base map image from Google Earth), 2013.

Legend: Public Green Spaces (Parks) **Initial Scale:** 1:7.500

The public green spaces are divided as follows:

Name:	Area:
Lindenweg 1	1634 m^2
Lindenweg 2	1198 m^2
Lindenweg 3	685 m^2
Lindenweg 4	645 m^2
Rudolf-Hell Strasse	1258 m^2
Wasserturm	484 m^2
Total	**5904 m^2**

Table 2: Public Green Spaces in the 'Quartier am Turm'. **Source:** Author's own, 2013.

Calculations of public green areas in the French quarter reveal that these are occupying a surface of 7635 m^2 out of 110.374 m^2 total surface, which represents 6, 91%. In the case of the 'Quartier am Turm', public green areas occupy 5904 m^2 out of 135.480 m^2 total surface, which represents

4, 35%. These figures lead to the conclusion that public green spaces in the French quarter represent over one and a half time more surface from the total area of the neighborhood in comparison with the traditional quarter.

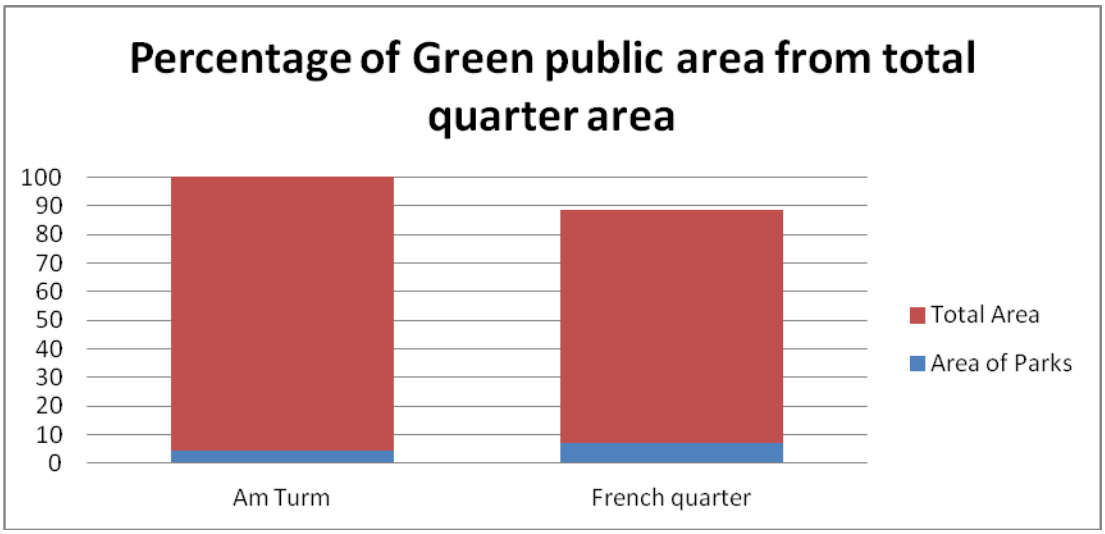

Chart 1: *Public green spaces in the two quarters compared to the respective total area of the* neighborhoods*: 100% represents the total surface of the 'Am Turm' (larger) neighborhood- 135480 m².* ***Source:*** *Author's own, 2013.*

A more intuitive conclusion can be drawn from the comparison of the surface of green areas per hectare in the two quarters. As such, parks in the French quarter amount for an average of 691,7 m^2 per hectare; while in the 'Quartier am Turm' for 435,7 m^2 per hectare.

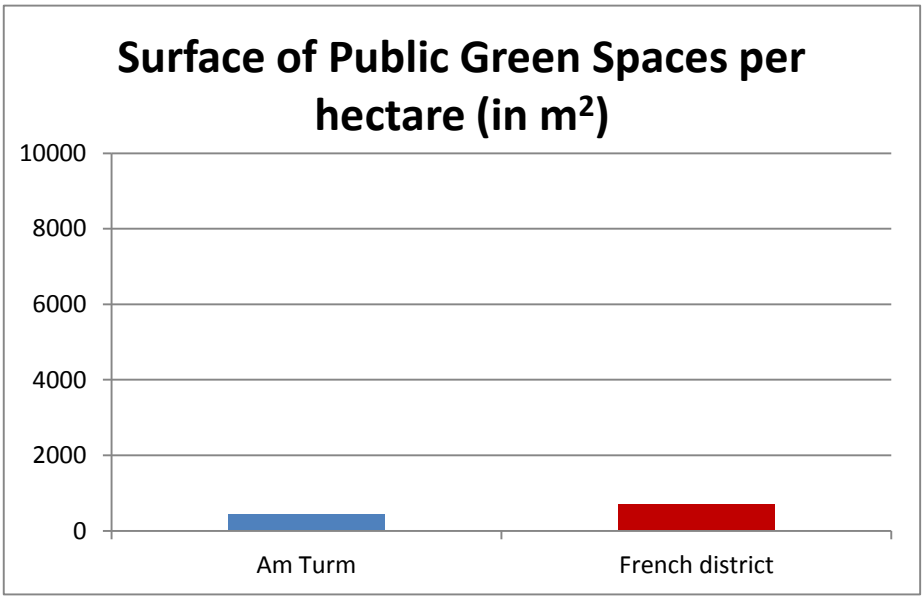

Chart 2: *Surface of Public Green Spaces per hectare (in m^2) in the two quarters.* ***Source:*** *Author's own, 2013.*

That means, that on average per one hectare, public green spaces account for 58,7% more space in the French quarter compared to the traditional neighborhood.

Such a difference can be explained through the examination of the land use plans ('Bebauungsplan-BBP') for the two quarters. Although there are similar considerations in both plans regarding the planting of trees on main streets and the greening of certain types of roofs, the major difference is represented by a proposal of the 'framework for town planning' ('Rahmenplan') for the French quarter; which made recommendations to preserve some areas that were rife for development as green spaces (Stadt Tuebingen, 2004). These proposals referred to the designation of the wooden area in the South of the district, as well as the area surrounding the Wankheimer stream, as 'public green space'. This prohibited development on both lots, and enriched the total area of parks in the quarter with over 50%. The proposals were later adopted in the binding detailed land-use plan ('BBP') (Stadt Tuebingen, 1996), which ensured their legality and application. Furthermore, the 'BBP' obliged the constructors to 'green' at least 40% of all surfaces that aren't built upon (ibid.), a measure which further enhanced the amount of green spaces in the neighborhood.

In conclusion, the fact that the French quarter possesses with almost a third more parks than a traditional neighborhood can be attributed to the importance given to environmental sustainability and quality of life in the 'Rahmenplan', which shaped the modern French neighborhood. These concerns can be traced back to the vision of the man behind the 'Rahmenplan' and the evolution of the French quarter, Mr. Andreas Feldtkeller (Manderscheid, 2013). The role of his vision in the development of the French neighborhood will be further discussed in the exploratory section of this chapter.

b) ***The use of renewable energy sources for heating/cooling or electricity generation***, for example through the employment of solar panels, photovoltaic cells, etc.

Renewable energy systems for dwellings bring important advantages not only to the owner of the household, through the reduction of the need for standard fossil fuel-based energy, and thus of the monthly payments for energy; but also to the surrounding environment, as they are non-pollutant; and under specific circumstances to the wider environment, as they contribute to the reduction in the demand for non-renewable fossil fuel. One main drawback to the use of renewable energy systems is the high initial investment, backed by a lack of favorable natural conditions in some areas (e.g. lack of sun for photovoltaic cells).

The comparison between the two quarters takes the following sustainable urban development indicators into account: the number of dwelling units with solar panels relative to the total number of dwelling units in the quarter (Lynch et al., 2011); and the total ground floor area ('blueprint area') of households with solar panels per hectare.

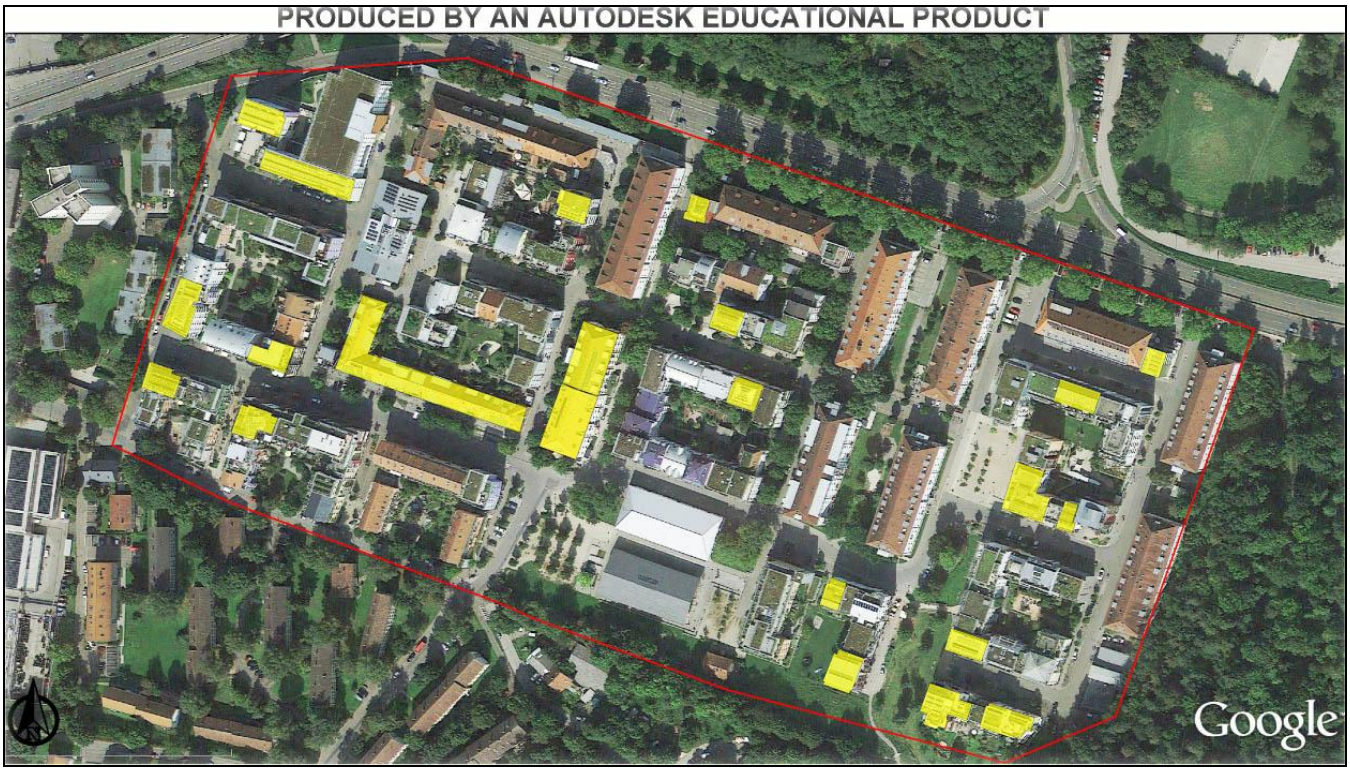

Figure 8: Dwellings with solar panels in the French quarter. **Source:** Author's own (created in Autocad Map 3D 2014; base map image from Google Earth), 2013.

Legend: Dwellings with solar panels. **Initial Scale:** 1:7.500

The following dwellings have a solar technology system installed:

Name:	Ground floor (blueprint) area:
Marienburgerstrasse #1	246 m^2
Franzoesische Allee #1	423 m^2
Marienburgerstrasse #2	296 m^2
Aixer Strasse #1	195 m^2
Aixer Strasse #2	203 m^2
Aixer Strasse #3	220 m^2
Pferdestaellen #1	1390 m^2
Cezanneweg #1	180 m^2
Provenceweg #1	556 m^2
Provenceweg #2	532 m^2
Allee des Chasseurs #1	108 m^2
Franzoesische Allee #2	160 m^2
Franzoesische Allee #3	183 m^2
Aixer Strasse #4	119 m^2
Wankheimer Taele #1	244 m^2
Henriettenweg #1	309 m^2
Henriettenweg #2	261 m^2
Henriettenweg #3	191 m^2
Mirabeauweg #1	390 m^2
Mirabeauweg #2	91 m^2
Mistralweg #1	209 m^2
Mistralweg #2	110 m^2
Total:	**6616 m^2**

Table 3: Dwellings with solar systems in the French quarter. **Source:** Author's own, 2013.

Figure 9: Building with solar panels in the French quarter.

Source: Stadt Tübingen, 2012.

Figure 10: Dwellings with solar panels in the 'Quartier Am Turm'. **Source:** Author's own (created in Autocad Map 3D 2014; base map image from Google Earth), 2013.

Legend: Dwellings with solar panels. **Initial Scale:** 1:7.500

The following dwelling has a solar technology system installed:

Name:	**Ground Floor (Blueprint) Area:**
Heinrich Fuchs Strasse #1	171 m^2
Total:	**171 m^2**

Table 4: Dwellings with solar systems in the 'Quartier am Turm'. **Source:** Author's own, 2013.

Compared to the total number of households in the French quarter, dwellings that have solar technology installed represent 18,8 % (22 dwelling units out of a total of 117). In the 'Quartier am Turm', there is only a single dwelling unit with solar panels out of a total of 143, representing just 0,69 %. That is over 27 times less!

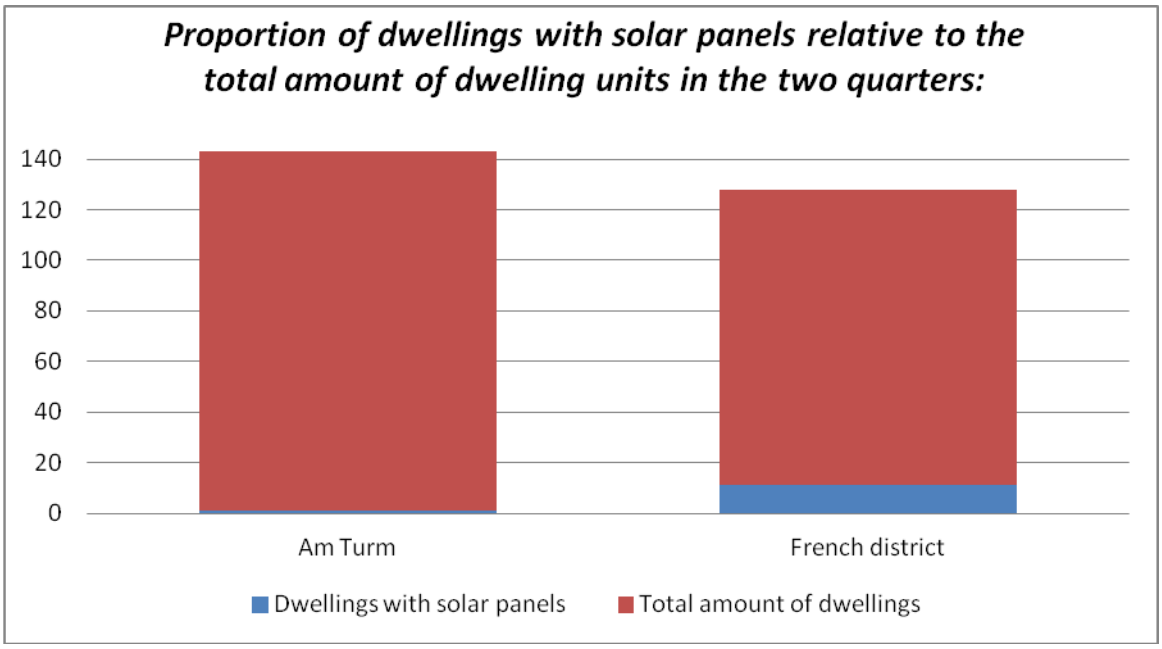

Chart 3: *Proportion of dwellings with solar panels relative to the total amount of dwelling units in the two quarters.* ***Source:*** *Author's own, 2013.*

On average per one hectare of built space, dwellings with solar panels in the French quarter account for 1837,5 m^2 (6.616 m^2 out of 36.005 m^2); while in 'Quartier am Turm' they account for 52,2 m^2 (171 m^2 out of 32.746 m^2). <u>That is over 35 times less!</u>

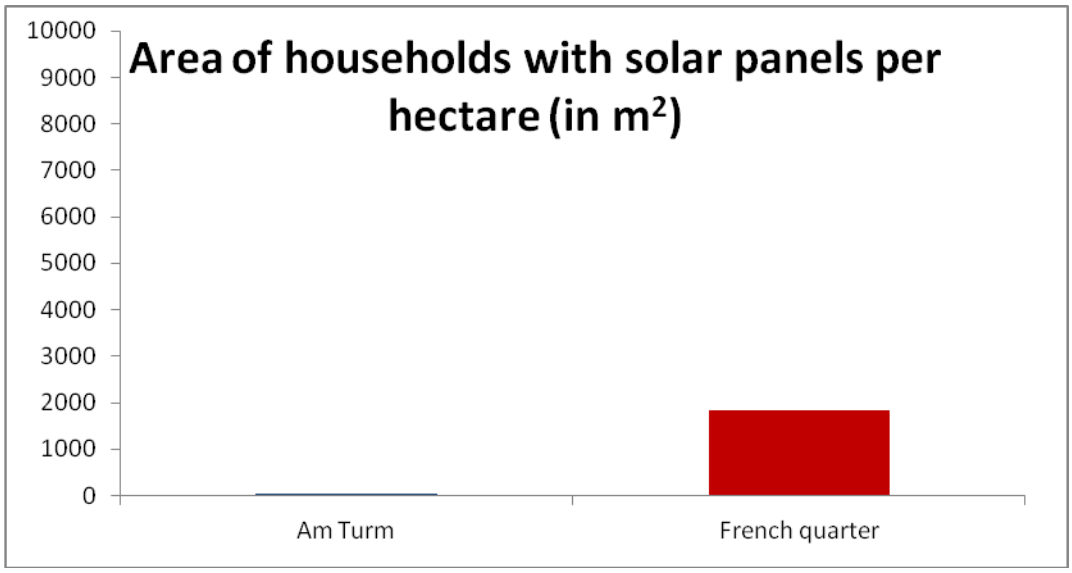

Chart 4: *Area of households with solar panels per hectare (in m^2) in the two quarters.*
Source: *Author's own, 2013.*

Such a big difference cannot be explained through the land-use plans, as in both cases the use of alternative energy sources is recommended, but by no means obligatory. In the case of the French quarter, the use of renewable energy has been encouraged in the 'Rahmenplan' (Stadt Tübingen, 1994); however no further direct actions (e.g. financial incentives) have been taken by the local authorities in this regard. As such, the use of renewable energy systems remains the decision of the private owners or of the private building cooperatives (Kieninger R., Edelmann N., 2004). A similar situation is encountered in the 'Quartier am Turm', where no legal requirements regarding solar systems were enforced, despite of the efforts of the Heidelberg municipality to encourage the use of such technologies (Map Sevice Heidelberg website, 2013).

Figure 11: *Solar roof cadastre for 'Quartier am Turm'. Despite of the fact that more than half of the buildings are suited or well-suited for solar panels, there is currently only a single dwelling unit with such a system installed.* ***Source:*** *Modified version of Map Service Heidelberg Website, 2013.*

The large difference between the two neighborhoods regarding solar energy employment for dwellings can be explained by two factors: first of all, the development of the 'Quartier am Turm' was market-driven, and the obligation to green certain shapes of roofs (as stated in the land-use plan) might have left the private developers with little resources and/or motivation for pursuing solar technologies. Furthermore, the almost complete absence of solar panels in the neighborhood, despite of the fact that construction works finished in 2007, can be regarded as a statement that investments in sustainability measures are much less likely to be pursued by individuals (despite their long-term benefits), in absence of some regulatory provisions.

Second of all, the important number of dwellings with solar panels in the French quarter (given the fact that there is also a significant amount of buildings with green roofs) can be attributed to the 'points allocation system' used by the municipality. The increasing attractiveness of the French quarter meant that a few years after the development began, there were more proposals for buying the lots than actual land; so the municipality devised a system where construction projects with more points would get the lots (Heinrich, 2013). Points were attributed to construction projects, which contained benign environmental and social measures (such as solar panels or specific flats with social rent); and at such the designs that would improve the sustainability of the quarter were selected (ibid.). The municipality could revoke the option for buying a lot if the construction project differed significantly from the initial proposal (ibid.). Consequently, this non market-driven approach seems to have been crucial for the construction of an important number of dwellings with solar technologies in the French quarter.

c) ***Give priority to pedestrian or bicycle transport***, by providing bike paths, walkways, specific systems for bicycle parking, or by designing 'interconnected networks of streets' that encourage walking within the neighborhood.

Encouraging non-motorized transport has been widely regarded in the literature as a crucial characteristic of urban sustainability, as it reduces the consumption of fossil fuel, environmental pollution, and increases the quality of life, safety and attractiveness of a quarter, as well as enhancing the local economy and the opportunities for socialization.

Three indicators are taken into account: the percentage of daily trips undertaken by walking and cycling (non-motorized transport), the percentage of daily trips undertaken by private motorized vehicles, and the proportion between private motorized and non-motorized transport modes within the quarters. Given the fact that there are no available data regarding the first two indicators for the 'Quartier am Turm' itself, existing average data for German cities were used for analysis.

Figure 12: Cycling in the French neighborhood.
Source: Stadt Tübingen, 2012.

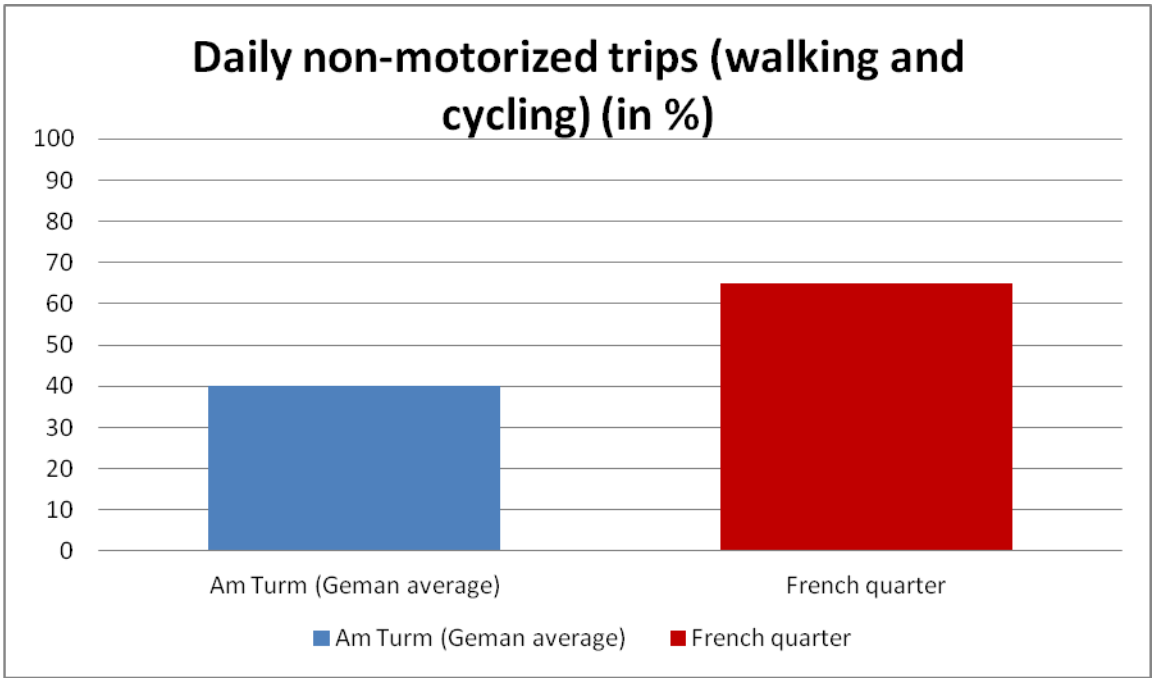

Chart 5: *Percentage of walking and cycling trips. These figures take into account all trips, including internal traffic.* ***Source:*** *Adapted version of Ledwoch, 2012.*

The data available on the daily amount of trips undertaken on foot or by bike (non-motorized transport) reveal that in the French quarter, 65% of all daily trips are non-motorized. The rest is divided between private motorized transport and public transport use (Ledwoch, 2012). Non-motorized transport in the French neighborhood is divided between cycling (60% of non-motorized trips) and walking (40% of non-motorized trips).

The average data for German cities (which will be taken into consideration, since no specific data for 'Quartier am Turm' is available) reveal that non-motorized transport accounts for 40% of all daily trips (ibid.). Out of these 67, 5% are done by walking, and 32, 5 % by cycling.

Consequently, a direct comparison reveals that non-motorized trips are with 62,5% more frequent in the French quarter, compared to traditional neighborhoods.

In regard to daily private auto vehicle use, available data suggest that in the French district, 21% of all daily trips are undertaken by car; while in an average German city, the same transport mode accounts for 40% of all daily trips (ibid.).

Therefore, private vehicle use is almost half as frequent in the French quarter compared to an average German neighborhood.

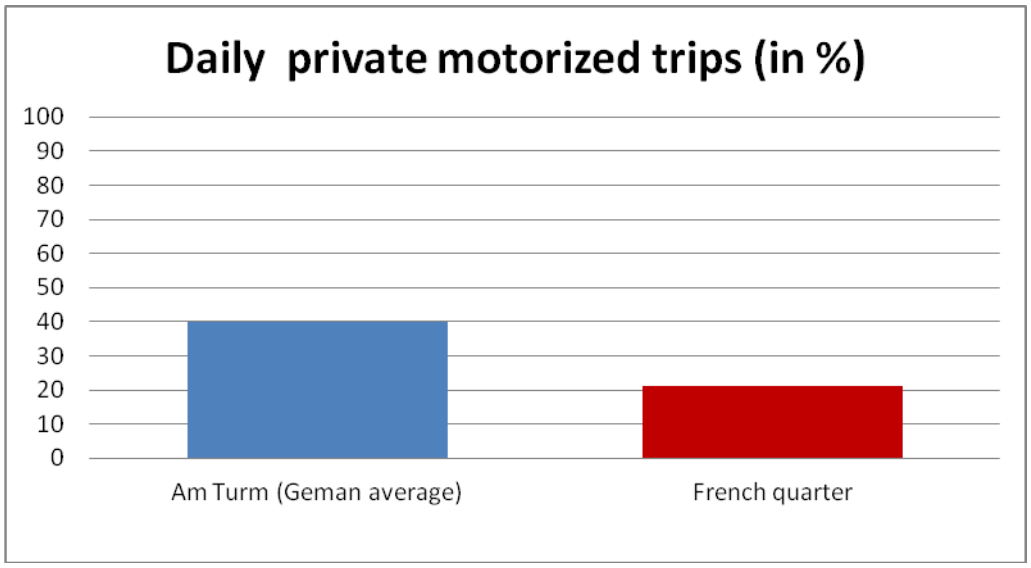

Chart 6: *Percentage of private motorized trips. These figures take into account all trips, including internal traffic.* ***Source:*** *Adapted version of Ledwoch, 2012.*

Regarding the proportion between private motorized and non-motorized trips in the two neighborhoods, results show that in the French quarter, daily trips undertaken with private motorized vehicles represent only a third compared to non-motorized trips in the neighborhood; while in an average German cities this proportion is about equal.

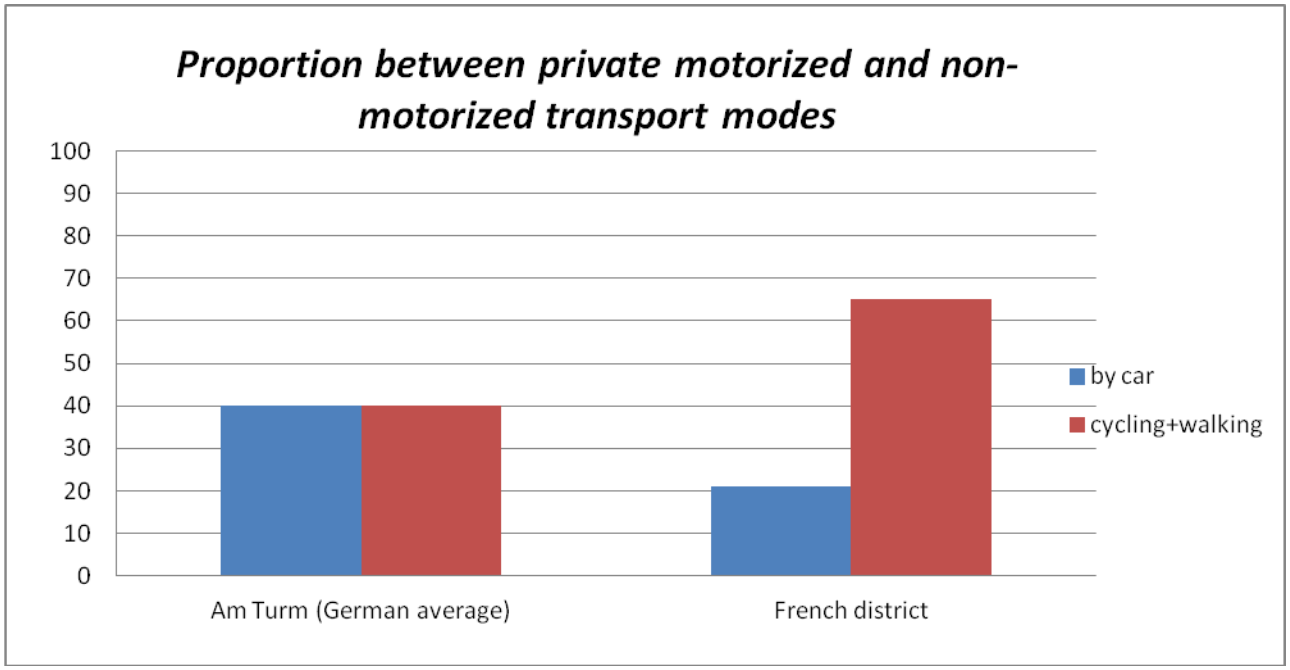

Chart 7: *Proportion between private motorized and non-motorized transport modes. These figures take into account all trips, including internal traffic.* ***Source:*** *Adapted version of Ledwoch, 2012.*

As such, one can conclude that cycling and walking trips combined are three times more frequent than private auto vehicle trips in the French quarter (a ratio of 3:1 compared to private vehicle use); while being equally frequent in an average German neighborhood (a ratio of 1:1).

Such differences between the French district and a traditional quarter can be explained through the adoption of the sustainability recommendation from the 'Rahmennplan' into practice. The motto for the development of the French neighborhood was "A city of short distances" -"Stadt der kurzen Wege" (Stadt Tübingen, 1994, p.31). One of the important aims stated in the 'Rahmenplan' was to plan the new district in such a way, that most daily trips could be done by walking (ibid.). The new development didn't prohibit auto vehicle use; however priority was given to pedestrian walking and subsequently, to non-motorized transport means, such as bicycle transport (Ferber, 2004).

This was achieved through the introduction of a combination of measures, aimed at imposing the priority of non-motorized transport: long-time parking restrictions for all private motorized vehicles on the streets inside of the neighborhood, which obliged all residents to park the cars in specifically built areas at the edge of the district (Stadt Tübingen, 1996); no delimitations between street and sidewalks in order to discourage car usage (ibid.); improving the public transport and supporting a car-sharing company (ibid.); the restriction of building gas stations in the neighborhood, in order to avoid the vehicle congestion towards and from the station (ibid.); speed limits and traffic calming measures on most streets that increase pedestrian safety (Stadt Tübingen, 1994).

In addition to these measures, the urban design of the district consists of high-density constructions, and a mixed-used (residential and commercial) functional structure; where interconnected streets and numerous walking shortcuts further enhance the support for non-motorized transport ways (Ledwoch, 2012).

The reduced traffic within the district also encourages cycling, as a "cycle network was implemented in traffic calming zones […], and Tübingen Südstadt was connected with the Tübinger cycle network in order to give cyclists the possibility to reach the city centre by bike" (Ferber, 2004). Additionally, dedicated parking lots for bicycles have been constructed all over the neighborhood, in order to further encourage cycling trips.

All the aforementioned measures, combined with the provision of a seemingly efficient alternative in public transport and car-sharing company, led to the positive results of the French district regarding this particular urban sustainability characteristic.

d) ***Provide a minimal dwelling density per hectare***, in order to reduce infrastructure and building costs, fossil fuel usage, and increase the efficiency of the public transport systems.

Higher densities and a mix of functions reduce the need for taking longer trips with the car, thus decreasing fuel consumption and environmental pollution; and prevent unnecessary urban sprawl, thus saving more land for agricultural, recreational or environmental use. Furthermore, they increase the efficiency of the public transport system (Stadt Tübingen, 1996); and "help to save infrastructure costs as well as [reducing] the ecological disadvantages resulting from impervious surfaces, such as a higher risk of flooding" (Ledwoch, 2012, p.5).

Although there are various opinions regarding the effects of high density development in relationship to energy consumption, evidences indicate a correlation between urban density and the latter: usually, higher densities correspond to lower energy consumption (Carmona, 2001).

One indicator will be used for the analysis of densities in the two quarters: the Gross Floor Area per hectare in the two quarters, relative to a minimum such surface that must be achieved for a sustainable quarter (Gross Floor Area = the added average surfaces of all floors in a dwelling). This will be realized by adding the ground floor area ('blueprint area') of all dwelling units in the quarter, and multiplying it with the average number of floors calculated from all the buildings of the district. The resulting amount will be divided with the total land area of the neighborhood and give an average Gross Floor Area per hectare, which will be compared with the values extrapolated from the urban sustainability guidelines.

Academics suggested that a minimal acceptable density should be around 60 dwelling units (in case of low-rise residential development) per hectare (Kazimee, 2001). This value is far too broad and inapplicable for infill urban developments; and therefore a Gross Floor Area value per hectare, (which takes into consideration the total area of a building by adding the average surfaces of all floors) is much more precise, and would be more appropriate for a comparison.

First, for comparison, the minimum Gross Floor Area value for a 'sustainable' quarter must be calculated. Reports suggest that in the US, the average size of a dwelling is 201,5 m^2 (CommSec, 2009). The US average dwelling size was selected, and not the German one, because the calculation for the minimum dwelling units per hectare were realized by US academics, based on local data. Multiplying this average value with the suggested value of dwelling units per hectare (60) gives us a total of 12.090 m^2 of Gross Floor Area per hectare as a minimum value of density for a sustainable quarter. Next, the densities of the two quarters will be compared relative to this minimal value.

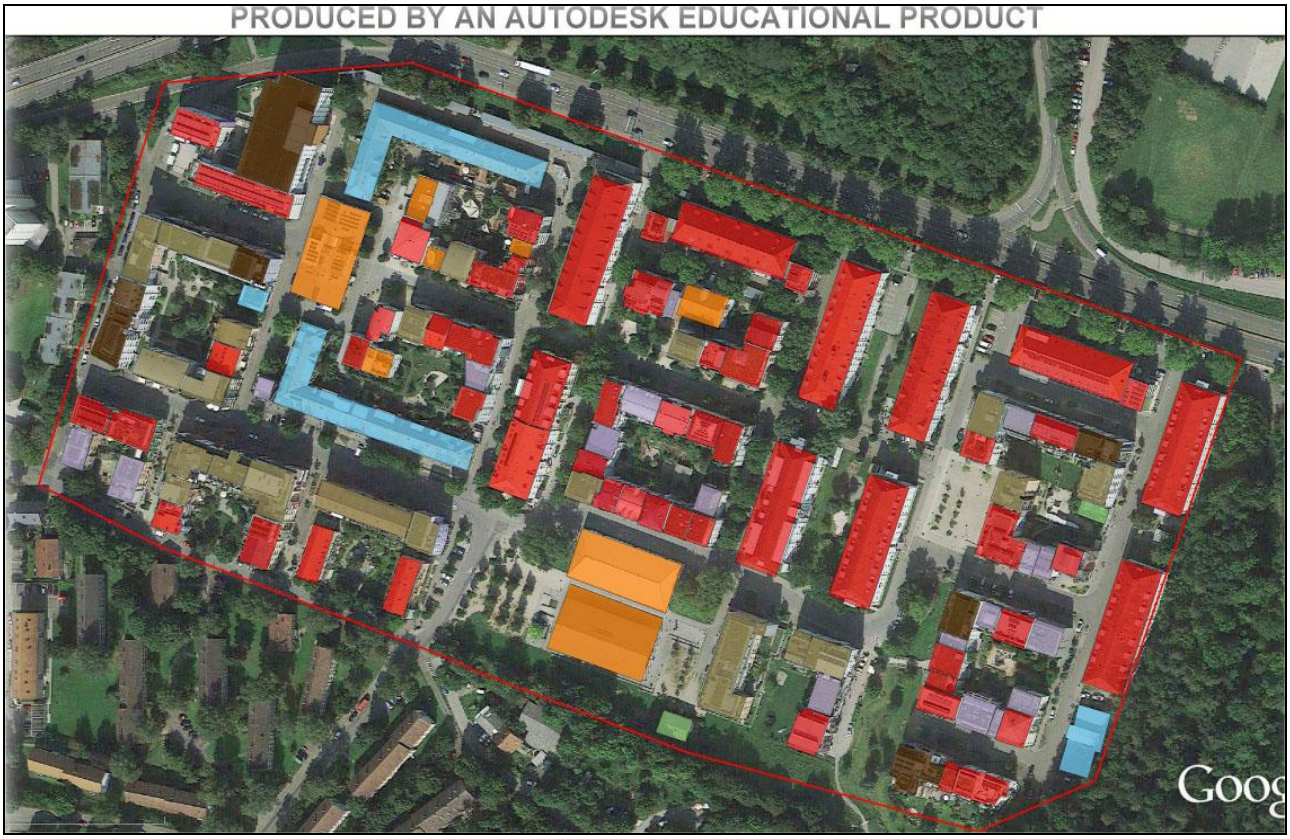

Figure 13: Dwelling's heights in the French quarter. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013. **Initial Scale:** 1:7.500

Legend:

- *Dwellings one floor (Ground floor-G)*
- *Dwellings two floors (G+1)*
- *Dwellings three floors (G+2)*
- *Dwellings four floors (G+3)*
- *Dwellings five floors (G+4)*
- *Dwellings six floors (G+5)*
- *Dwellings seven floors (G+6)*

Figure 14: Drawing of a street front in the French quarter. The joining of dwellings with different styles and heights can be noticed. **Source:** Stadtsanierungsamt Tübingen, 1997, p.16.

Height of dwellings:	**Amount:**
Dwellings with one floor (G)	2
Dwellings with two floors (G+1)	4
Dwellings with three floors (G+2)	8
Dwellings with four floors (G+3)	18
Dwellings with five floors (G+4)	57
Dwellings with six floors (G+5)	21
Dwellings with seven floors (G+6)	7
Total amount of dwelling's floors:	2+8+24+72+285+126+49 = **566**
Total amount of dwelling units:	**117**
Average floor ratio per dwelling:	566/117 = **4,8**
Total 'blueprint' surface of dwellings in the district:	**36.005 m^2**
Average Gross Floor Area of dwellings: (Gross Floor Area = the added average surfaces of all floors in a dwelling)	36.005 x 4,8 = **172.824 m^2**
Average Gross Floor Area per hectare:	172.824 m^2/ 11,0374 ha = **15.658 m^2/ ha**

Table 5: Calculation of Gross Floor area per hectare in the French quarter. **Source:** Author's own, 2013.

Height of dwellings:	**Amount:**
Dwellings with one floor (G)	10
Dwellings with two floors (G+1)	4
Dwellings with three floors (G+2)	48
Dwellings with four floors (G+3)	15
Dwellings with five floors (G+4)	65
Total amount of dwelling's floors:	10+8+144+60+325 = **547**
Total amount of dwelling units:	**143**
Average floor ratio per dwelling:	547/143 = **3,8**
Total 'blueprint' surface of dwellings in the district:	**32.746 m^2**
Average Gross Floor Area of dwellings: (Gross Floor Area = the added average surfaces of all floors in a dwelling)	32.746 x 3,8 = **124.434 m^2**
Average Gross Floor Area per hectare:	124.434 m^2/ 13,548 ha = **9184,6 m^2/ ha**

Table 6: Calculation of Gross Floor Area per hectare in the 'Quartier am Turm' (*see map on next page). **Source:** Author's own, 2013.

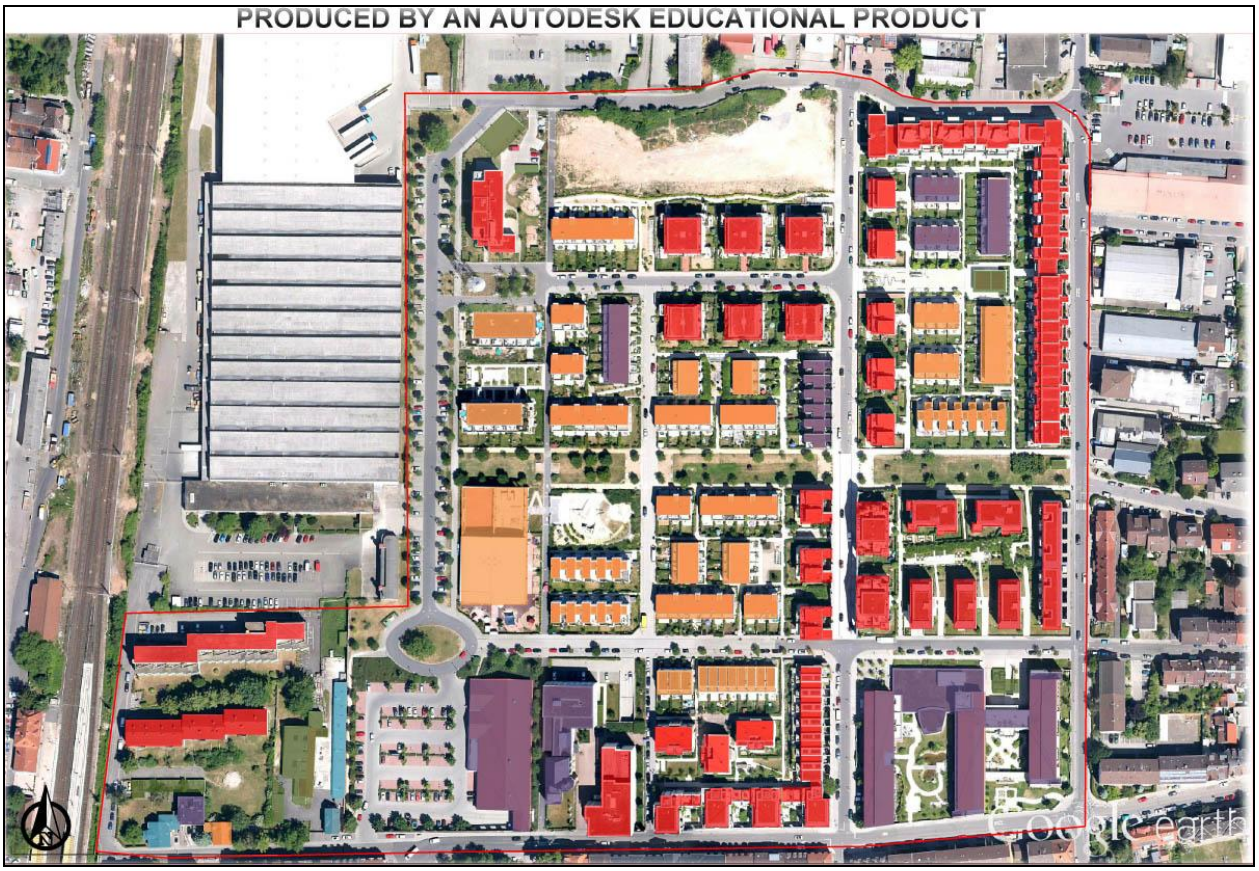

Figure 15: Dwelling's heights in the 'Quartier am Turm'. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013. **Initial Scale:** 1:7.500

Legend:

- *Dwellings one floor (Ground floor-G)*
- *Dwellings two floors (G+1)*
- *Dwellings three floors (G+2)*
- *Dwellings four floors (G+3)*
- *Dwellings five floors (G+4)*

Comparisons between the two quarters reveal the fact that while the French district exceeds the minimum required Gross Floor Area of built spaces per hectare with 29,5% (15.658 m^2/ ha, compared to the required 12.090 m^2/ ha); the 'Quartier am Turm' fails to meet the minimum standard by 31,6% (9184,6 m^2/ ha, compared to the required 12.090 m^2/ ha). Between the two quarters themselves, the French district has a Gross Floor Area per hectare with 70,5% higher than in the case of the traditional neighborhood.

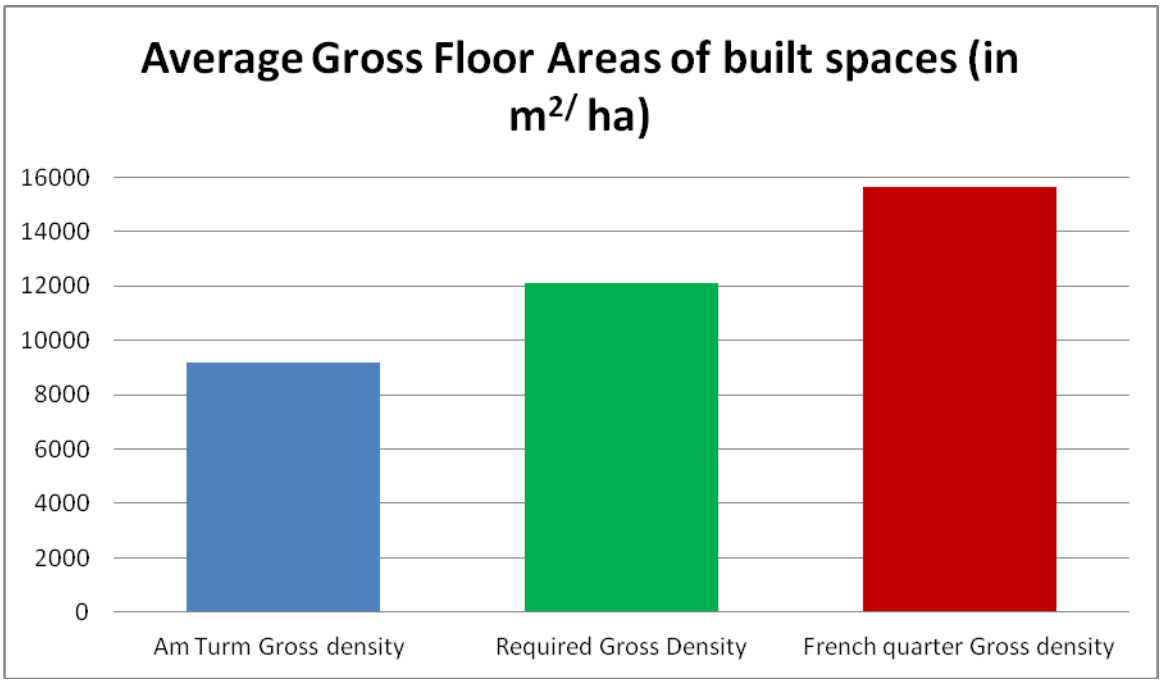

Chart 8: *Gross Floor Areas of the built spaces in the two quarters, compared to a 'sustainability' benchmark.* ***Source:*** *Author's own, 2013.*

These large differences can be explained through the vision of the 'Rahmenplan' of achieving a balance between high-density constructions, which would yield the potential advantages presented in the beginning of this section; and achieving a high quality of life through the provision of sufficient green spaces, safe streets, and local infrastructure (Stadt Tübingen, 1994).

Two planning measures were important for putting this vision into practice: developing public and green spaces concomitantly to the buildings (Ferber, 2004); and most importantly, determining in the land-use plan a 'fixed 'method of construction for most of the buildings that were to be erected in the French district: a height between three and five stories for most new dwellings, and their disposition in a 'perimeter development' consisting of 'enclosed blocks' around inner courtyards (Stadt Tübingen, 1996). This method of construction allows for flexibility, and for a combination of high density living with mixed functionality and green spaces (especially through the added green areas of the resulting inner courtyards).

e) ***Reduce the space 'lost' because of autovehicle parking*** (Kazimee, 2001, p.5).

One of the key aspects of a sustainable neighborhood is its parking concept. This concept plays an important role for any high-density development aiming at sustainability, because of three aspects: first of all, space is scarce in such cases, and an important developable area can be lost to individual parking lots (Kazimee, 2001); second of all, individual parking lots inside such a district would increase motorized traffic exponentially, and would vastly reduce the effectiveness of all other measures aimed at traffic calming and encouraging non-motorized trips; and third of all, increased traffic means a decrease in pedestrian and children safety.

Two indicators will be taken into account for comparison: the average area per hectare dedicated to parking spaces in the district (the less area 'lost' to parking, the better for the sustainability of the quarter); and the proportion of the dedicated parking spaces that are located at the edge of the district, relative to the total surface of dedicated parking spaces for the whole district (in this case, the more parking lots at the edge of the district, the less traffic and 'lost' space to parking inside of the neighborhood itself, which leads to a higher 'sustainability value' of the neighborhood).

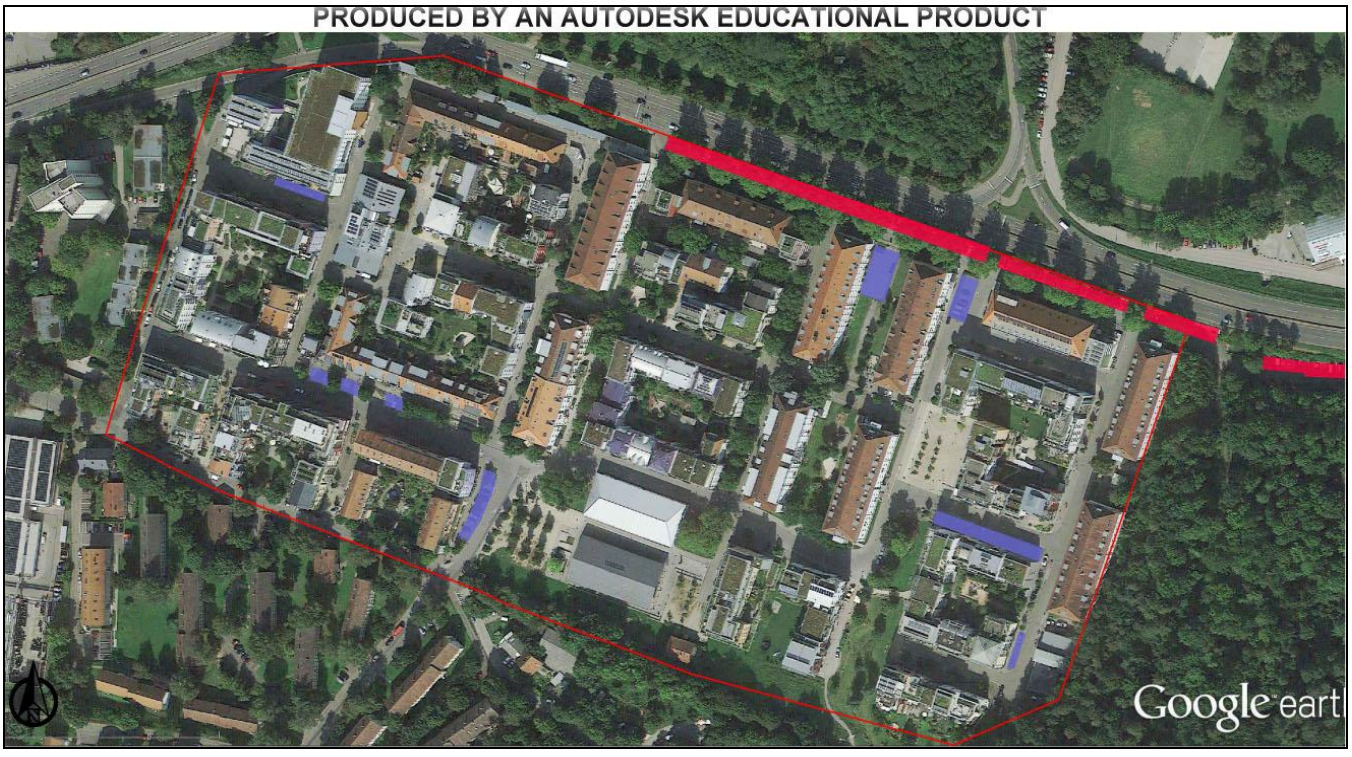

Figure 16: Dedicated parking lots inside the French quarter. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013. **Initial Scale:** 1:7.500.

Legend: Parking lots inside the quarter. Parking lots at edge of quarter.

Name:	**Area:**
Franzoesische Allee	101,5 m^2
Aixer Strasse #1	52,5 m^2
Aixer Strasse #2	52,5 m^2
Aixer Strasse #3	52,5 m^2
Wennfelder Garten	216 m^2
Moempelgarder Weg	311 m^2
Wankheimer Taele	190 m^2
Mirabeauweg	358 m^2
Landkutchersweg	61 m^2
Total:	**1395 m^2**

Table 7: Dedicated parking spaces located inside the French quarter. **Source:** Author's own, 2013.

Name:	**Area:**
Allee des Chasseurs #1	1175 m^2
Allee des Chasseurs #2	369 m^2
Allee des Chasseurs #3	235 m^2
Allee des Chasseurs #4	294 m^2
Total:	**2073 m^2**

Table 8: Dedicated parking lots located at the edge of the French quarter. **Source:** Author's own, 2013.

Figure 17: Automatic Parking House in the French neighborhood.

Source: Tüpedia, 2012.

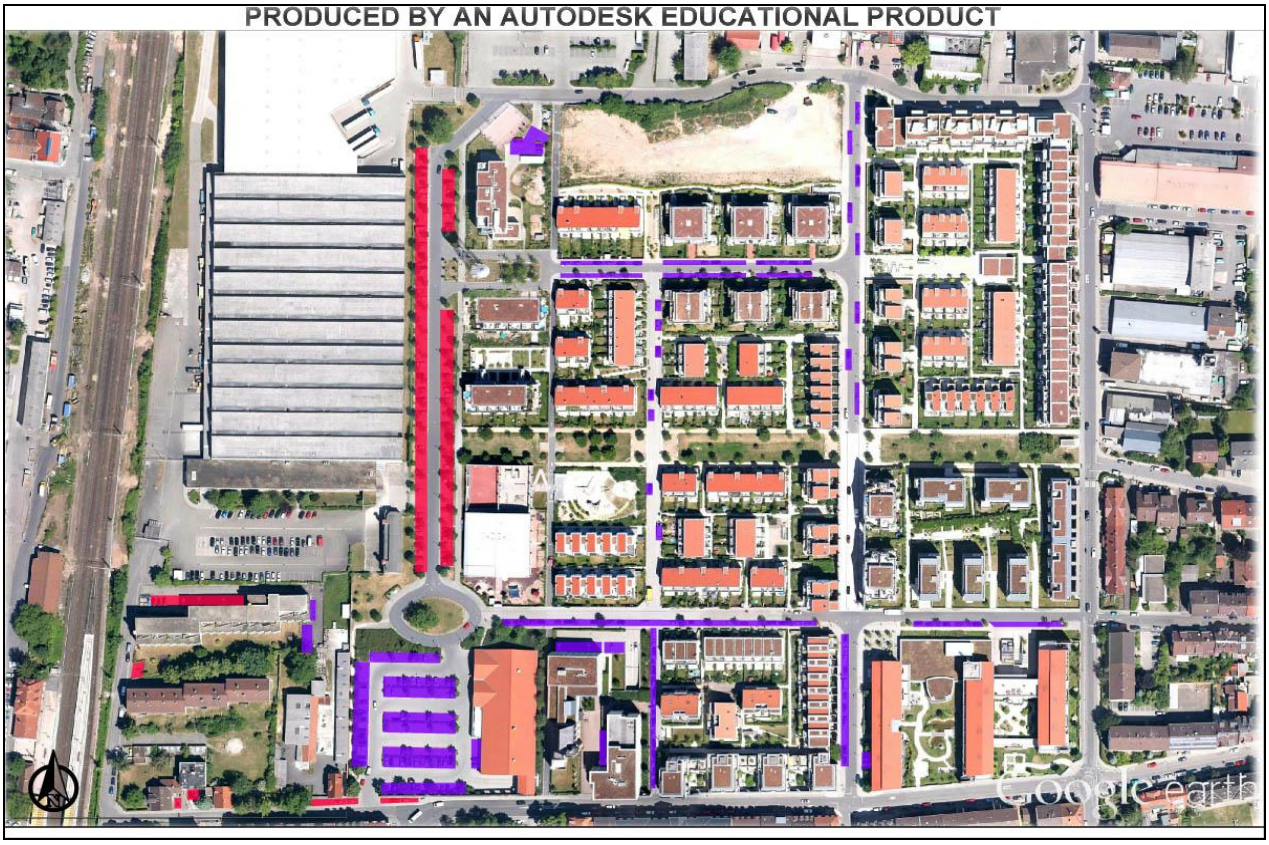

Figure 18: Dedicated parking lots inside the 'Quartier am Turm'. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013. **Initial Scale:** 1:7.500.

Legend: Parking lots inside the quarter. Parking lots at edge of quarter.

Name:	**Area:**
Franz Knuckenberg Strasse (10 lots)	215 m^2
Supermarket Parking (7 lots)	1885 m^2
Helaweg (6 lots)	868 m^2
Georg-Mechterheimer Strasse (6 lots)	484 m^2
Rudolf Hell Strasse (8 lots)	672 m^2
Felix Wankel Strasse (1 lot)	168 m^2
Heinrich Fuchs Strasse (2 lots)	99 m^2
Total:	**4391 m^2**

Table 9: Dedicated parking lots located inside the 'Quartier am Turm'. **Source:** Author's own, 2013.

Name:	**Area:**
Konrad Zuse Strasse (3 lots)	2191 m^2
Heinrich Fuchs Strasse (6 lots)	820 m^2
Total:	**3011 m^2**

Table 10: Dedicated parking lots located at the edge of the 'Quartier am Turm'. **Source:** Author's own, 2013.

On average per one hectare, parking spaces located in the French district account for 126 m^2 (3.468 m^2 out of 110.374 m^2 total surface); while in the 'Quartier am Turm' they account for 324 m^2 (7.402 m^2 from 135.480 m^2 total surface).

That means, that in the traditional quarter, on average per one hectare the space lost for auto vehicle parking is about 2,5 times greater than in the French quarter.

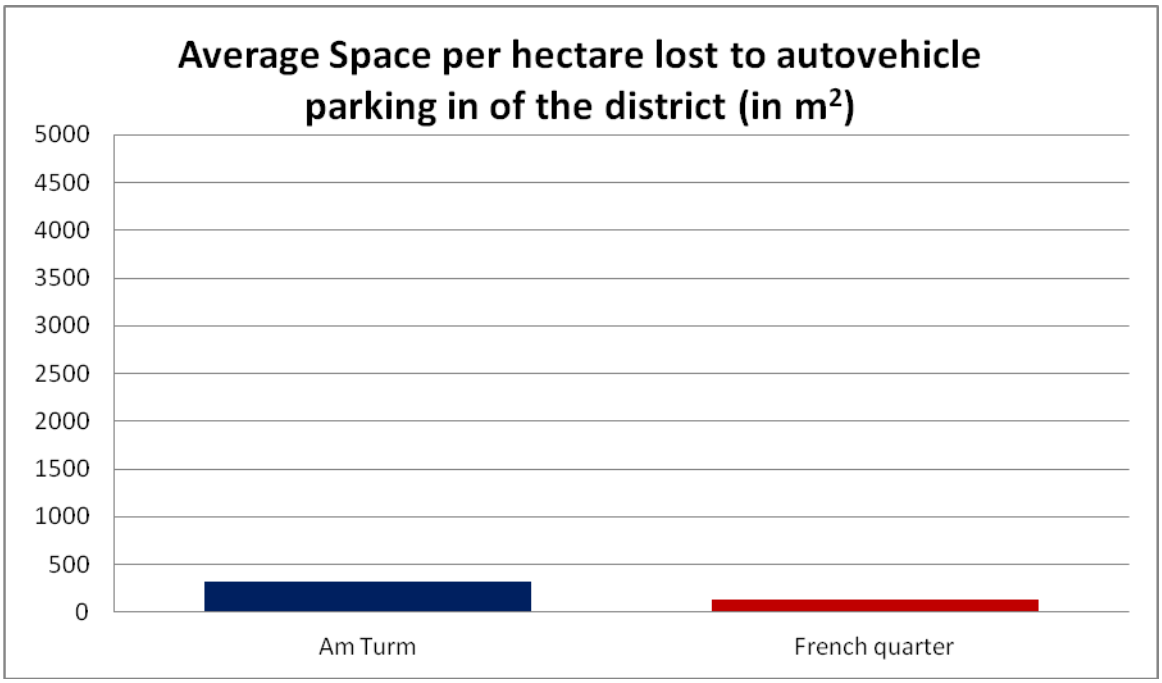

Chart 9: *Average Space per hectare lost to autovehicle parking in of the district (in m^2).* ***Source:*** *Author's own, 2013.*

Concerning the amount of parking spaces located at the edge of the district, relative to the total amount of parking spaces in the neighborhood, the French quarter has a proportion of 59,7% (2073 m^2 of parking lots located at the edge of the quarter, compared to a total amount of 3468 m^2 'lost' to parking lots for the whole French quarter); while the 'Quartier am Turm' has a proportion of 40,6% (3011 m^2 of parking lots located at edge of quarter, compared to 7402 m^2 total amount of parking lots in the 'Quartier am Turm').

That means that there are almost 1,5 times more parking spaces located at the edge of the district in the French quarter, compared to a traditional neighborhood. The higher the proportion between parking lots at the edge at the district and the ones located inside of the district, the better for the sustainability of the quarter; as internal traffic and all its resulting environmental and social effects decrease, and more land becomes available for public and green space development inside of the district (Davoudi, Layard, 2001).

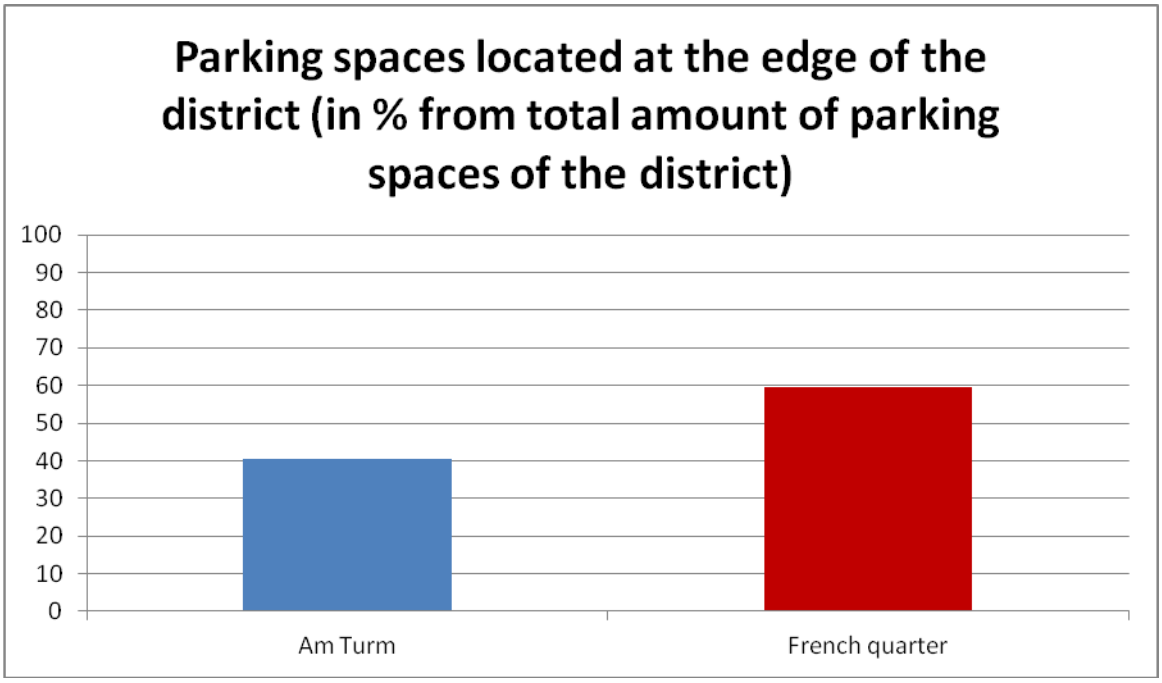

Chart 10: *Parking spaces located at the edge of the district (in % from total amount of parking spaces of the district).* ***Source:*** *Author's own, 2013.*

These significant differences between the two quarters can be explained through the 'alternative parking concept' that was taken in consideration early in the development of the French district, as important measures related to the parking concept of the neighborhood that were originally proposed in the 'Rahmenplan' were fully adopted in the 'BBP' (Stadt Tübingen, 1996). By using "another innovative planning tool being part of German BauNVO (Baunutzungsverordnung) [stating that] the prohibition of parking spaces in building areas could be integrated in the development plan", the local authorities prohibited parking on the streets of the neighborhood, with the exception of some essential delivery vehicles and vehicles for disabled persons (Ferber, 2004, p.4). Cars are only allowed to be parked in special automatic multi-storey parking houses built at the edge of the district (ibid.); while on the streets of the neighborhood only embarking and debarking is allowed (Kieninger R., Edelmann N., 2004). Some short-term parkplaces (for maximum 24 minutes) are also available throughout the district (ibid.).

The parking houses were planned in such a way, that a person has to walk a maximum of 300 meters from any point of the neighborhood to reach a parking house, the same maximum amount of distance that a person has to walk in order to reach a bus stop (Stadt Tübingen, 1996).This solution was adopted in order to save space (through the automatic system of the parking house that uses optimal space) and encourage the use of public transport (Ledwoch, 2012). Furthermore, the city council offers a non-profit 'rent-a-car' service, which leases cars to inhabitants at moderate hourly rates (Ferber, 2004).

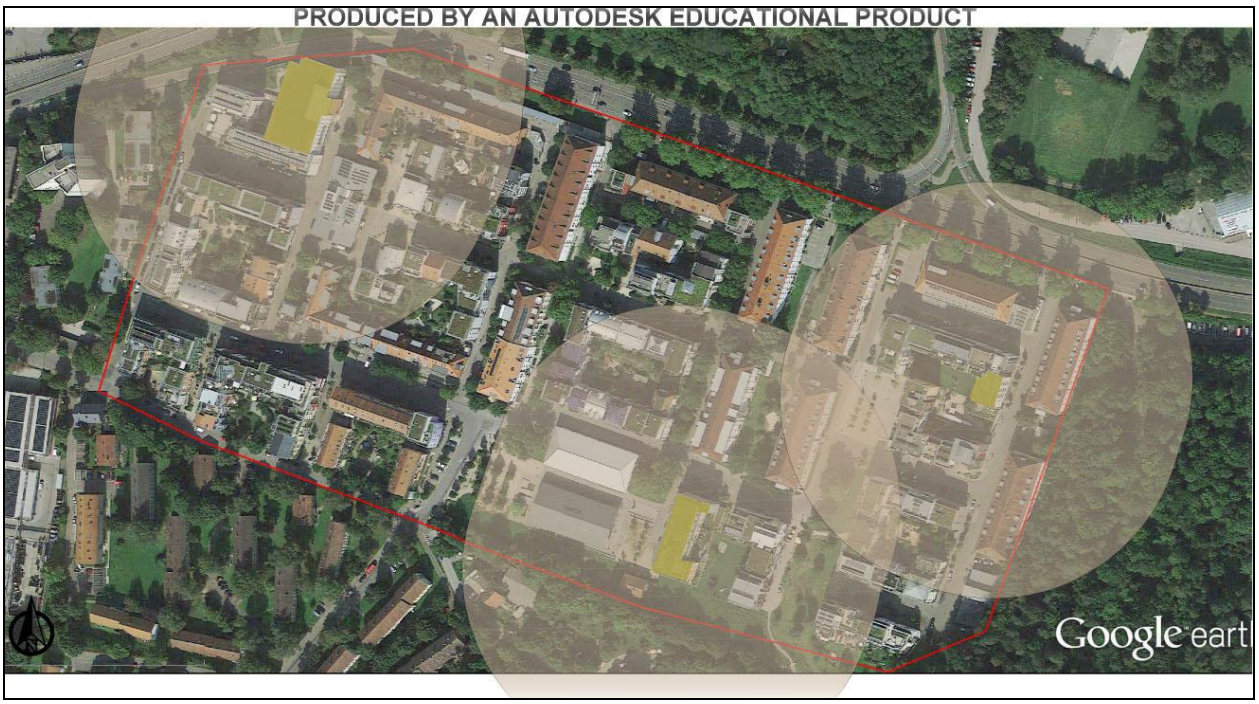

Figure 19: Areas within 100 meters of a parking house in the French quarter. From any point of the neighborhood there is a maximum distance of 300 m to walk to a parking house. This layout allows for the ease of access to parking houses, and encourages alternative transport modes. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013. **Initial Scale:** 1:7.500.

Legend: Parking houses in the French district.

Since such a parking concept is pretty radical compared to traditional expectations, some of the new residents opposed it at first; however after discussions with the local authorities in which the rationality of the concept was explained, they accepted the idea (ibid.).

As a conclusion from all the above, the parking concept is of utmost importance in order to make a shift from private motorized vehicle use to more energy-efficient ways of transport possible. The Tübingen authorities have put a special emphasis on this concept; and their methods of prohibiting parking inside the neighborhood and building automatic parking houses at its edge, doubled with viable non-motorized and public transport alternatives, have influenced decisively the development of the French district into a sustainable neighborhood.

f) ***Introduce traffic calming measures*** in order to mitigate the negative effects of traffic within the neighborhood (pollution, noise, reduced safety for pedestrians), like speed limits, pedestrian refuges, or circulation restrictions.

A reduced traffic inside a neighborhood equates in a safer place for children to play, less pollution and fossil fuel consumption, enhanced attractiveness of sustainable transport modes (cycling, walking), and an overall increase in the quality of life. Two indicators are taken into account for comparison between the two neighborhoods: the added length of streets that are closed to motorized traffic, relative to the total length of the streets from the neighborhood; and the added length of traffic calmed streets (maximum 30 km/h speed), relative to the total length of the streets from the neighborhood.

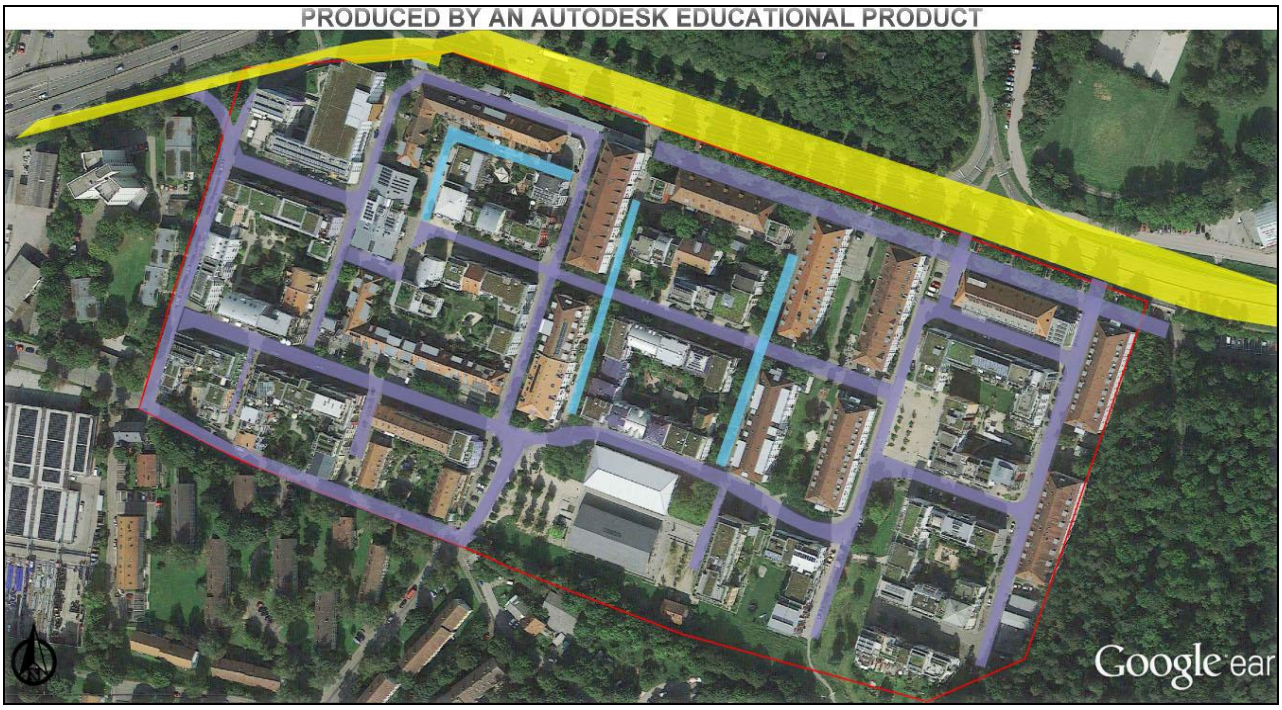

Figure 20: Streets in the French district. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013. **Initial Scale:** 1:7.500.

Legend: Traffic calmed streets (max. 30km/h). Streets closed to motorized traffic.

National Route 27 (max. 50 km/h).

Name:	Length:
Bei den Pferdestaellen (partial)	114 m
Provenceweg	113 m
Moempelgerder Weg	113 m
Total:	**340 m**

Table 11: Streets closed to motorized traffic in the French district. **Source:** Author's own, 2013.

Name:	Length:
Aixer Strasse	484 m
Marienburger Strasse	167 m
Franzoesische Allee	361 m
Allee des Chasseurs	285 m
Wennfelder Garten	52 m
Eisenhutstrasse	190 m
Cezanneweg	155 m
Bei den Pferdestaellen (partial)	244 m
Wankheimer Taele	214 m
Landkutchersweg	284 m
Mistralweg	67 m
Total:	**2503 m**

Table 12: Traffic calmed streets (max. 30km/h) in the French district. **Source:** Author's own, 2013.

Figure 21: Aixer Street, the main axis of transport in the French district. **Source:** Stadt Tübingen, 2012.

Figure 22: Streets in the 'Quartier am Turm'. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013. **Initial Scale:** 1:7.500.

Legend: Traffic calmed streets (max. 30km/h). Streets closed to motorized traffic.

Regular streets (max. 50 km/h).

Name:	**Length:**
Karl von Drais Weg (partial)	256 m
Total:	**256 m**

Table 13: Streets closed to motorized traffic in the 'Quartier am Turm'. **Source:** Author's own, 2013.

Name:	**Length:**
Helaweg (partial)	140 m
Franz Kruckenberg Strasse (partial)	90 m
Rudolf Hell Strasse	255 m
Total:	**485 m**

Table 14: Traffic calmed streets (max. 30km/h) in the 'Quartier am Turm'. **Source:** Author's own, 2013.

In the case of the French district, the added length of the streets that are closed to all motorized traffic represents 11,95 % of the total length of streets in the district (340 meters out of a total of 2843 meters). In the 'Quartier am Turm', it represents 8,39 % of the total length of streets in the district (256 meters out of a total of 3048 meters). Consequently, streets completely closed to motorized traffic in the French quarter have with 42% more length relative to the total compared to the traditional neighborhood.

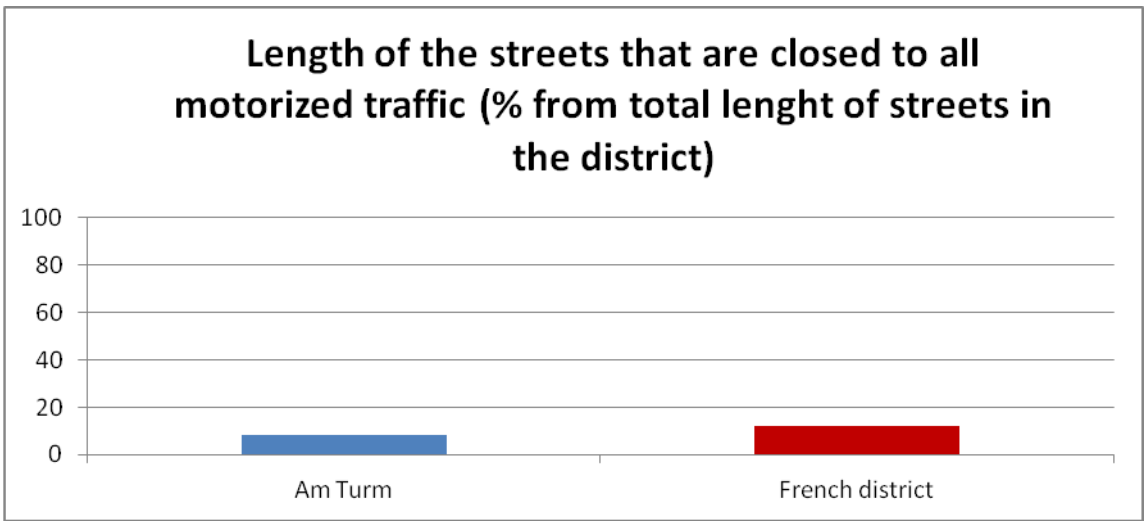

Chart 11: *Length of the streets that are closed to all motorized traffic (% from total length of streets in the district).* ***Source:*** *Author's own, 2013.*

Traffic calmed streets (maximum speed 30 km/h) represent 88, 05 % of the total length of streets in the French district (2503 meters out of a total of 2843 meters), the rest being streets closed to all motorized traffic. In the 'Quartier am Turm', they represent 15, 91 % of the total length of streets in the district (485 meters out of a total of 3048 meters). Consequently, traffic calmed streets in the French quarter have 5,5 times more length relative to the total compared to the traditional neighborhood!

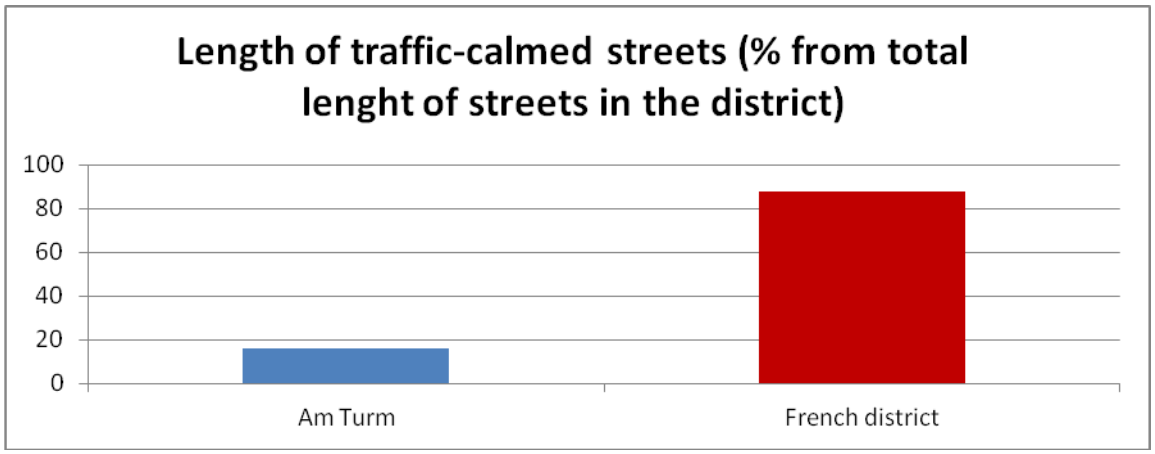

***Chart 12:** Length of traffic-calmed streets (% from total lenght of streets in the district). **Source:** Author's own, 2013.*

These large differences can be traced backed to the vision of Mr. Feldtkeller and the subsequent guidelines of the 'Rahmenplan' for developing a sustainable quarter in place of the former French garrison in Tübingen (Heinrich, 2013). It was envisaged that pedestrians would have priority over motorized traffic in the whole neighborhood and that cycling would be encouraged through restrictions imposed on the latter (Stadt Tübingen, 1994).

These goals were strengthened by the designation of streets as 'free spaces', similar to public places, squares, and the wooden areas adjacent to the city (ibid.). Furthermore, this definition had some important consequences for the redevelopment of the area, as the traditional role of the streets as traffic carriers would not be fully applicable to the French neighborhood (ibid.). Instead streets fulfill first the function of being a meeting, communication and relaxing space for people, and serve motorized vehicles only as a secondary role (ibid.). This viewpoint is in line with the objective of creating an environmental-friendly neighborhood that prioritizes pedestrian walking and bicycle trips, and led to significant changes both in the physical outcome of the district (traffic calming measures were introduced, some streets were closed for automobiles, crossings were designed to be 'at level' in order to further discourage motorized traffic), as well as in its life-style.

These measures were implemented into practice by designating the streets as "traffic spaces without a determined purpose" in the 'BBP', a legal solution that allows for flexibility in the development of the district (Stadt Tübingen, 1996, p.6). Such a designation allowed for the implementation of two measures, which shaped the role of streets in the French district:

First, all streets are traffic calmed and speed restrictions are in place, some streets being even closed to motorized traffic (Stadt Tübingen, 2005), a measure which also led to the virtual disappearance of 'through-going traffic' (Ledwoch, 2012). Second, all crossing are at level with the road, a psychological measure that further shows that priority within the neighborhood is given to pedestrian transport (Stadt Tübingen, 1994).

This point highlights how the concepts of pedestrian priority were further implemented through technical (level street crossings) and strategic (speed limits on all streets and even motorized traffic constraints on some) traffic calming means; measures which positively impacted the sustainability of the French neighborhood, as suggested by the above analysis.

g) ***Further conserving energy through passive design solutions*** for the quarter and for buildings (planting of tree belts and vegetation; building Green roofs and facades).

The planting of vegetation plays an important role in increasing the quality of life, reducing pollution, and regulating temperatures (thus decreasing energy consumption) in an urban settlement. As for green roofs and facades, they account for the following advantages:

- Reductions of 25% for the cooling requirements in the summer.
- Absorbing rain water: A green roof with a support layer of 20-40 cm in thickness can absorb a layer of 10-15 cm of water.
- Increasing air quality: a green roof of 2000 square meters can clean up to 4000 kg of air particles per year.
- Reducing urban heat island effects.
- Creating new habitats and providing habitats for endangered species.
- Combating noise pollution: a green roof with a supporting layer of 12cm can reduce noise intensity with 40 db.
- Intensive green roofs provide supplementary recreational areas.
- Potential for organic agriculture on intensive green roofs.
- Integration in landscape, aesthetical grounds (Author's own, 2013).

However, these advantages come at high initial and significant yearly maintenance costs, and as such only a low cost/benefit ratio relative to the dwelling's overall energy consumption is achieved. The financial aspect is the most important determinant for the relative low numbers of Green roofs (and facades) existent today in most urban agglomeration.

For this section, two indicators are taken into account: the average surface per hectare (of built space) of buildings with green roofs; and the "urban tree canopy average as percentage of total urbanized area" (Lynch et al., 2011, p. 59). The second indicator will be analyzed based on high resolution aerial imagery taken in the summer; and the projected area of the individual trees will be considered for calculations.

Figure 23: Inner courtyards in the French district.

Source: Modified version of Stadt Tübingen, 2012.

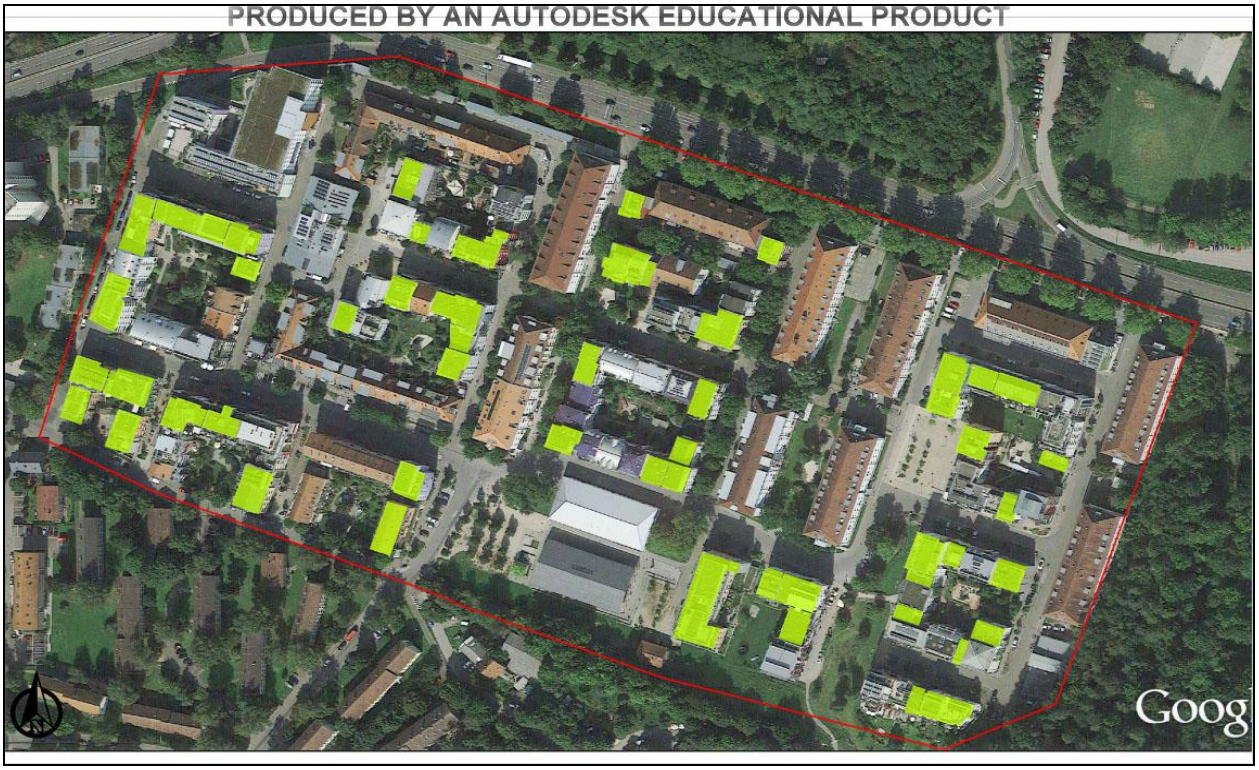

Figure 24: Dwellings with Green roofs in the French district. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013. **Initial Scale:** 1:7.500.

Legend: Dwellings with Green roofs.

Name:	Area:
Aixer Strasse (11 buildings)	1660 m^2
Marienburger Strasse (4 buildings)	485 m^2
Eisenhutstrasse (1 building)	100 m^2
Wennfelder Garten (2 buildings)	170 m^2
Allee des Chasseurs (2 buildings)	120 m^2
Cezanneweg (2 buildings)	245 m^2
Franzoesische Allee (9 buildings)	1395 m^2
Henriettenweg (3 buildings)	260 m^2
Landkutchersweg (2 buildings)	105 m^2
Mirabeauweg (6 buildings)	630 m^2
Mistralweg (2 buildings)	310 m^2
Moempelgarder Weg (2 buildings)	200 m^2
Bei den Pferdestaellen (2 buildings)	215 m^2
Provenceweg (1 building)	150 m^2
Wankheimer Taele (4 buildings)	675 m^2
Total:	**6720 m^2**

Table 15: Buildings with Green roofs in the French district. **Source:** Author's own, 2013.

Figure 25: Dwellings with Green roofs in the 'Quartier am Turm'. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013. **Initial Scale:** 1:7.500.

Legend: Dwellings with Green roofs.

Name:	**Area:**
Fabrikstrasse (15 buildings)	1083 m^2
Felix Wankel Strasse (5 buildings)	650 m^2
Franz Kruckenberg Strasse (2 buildings)	194 m^2
Heinrich Fuchs Strasse (4 buildings)	855 m^2
Helaweg (14 buildings)	475 m^2
Rudolf Hell Strasse (1 building)	400 m^2
Lindenweg (8 buildings)	314 m^2
Karl von Drais Weg (11 buildings)	530 m^2
Konrad Zuse Strasse (2 buildings)	380 m^2
Georg Mechtersheimer Strasse (6 buildings)	900 m^2
Total:	**5781 m^2**

Table 16: Buildings with Green roofs in the 'Quartier am Turm'. **Source:** Author's own, 2013.

The average area of dwellings with green roofs per hectare (of built space) represents 1866 m^2 in the French district (6.720 m^2 out of 36.005 m^2 total surface); and 1765 m^2 in the 'Quartier am Turm' (5.781 m^2 out of 32.746 m^2 total surface). That means, that on average, Green roofs in the French quarter have only with 5,7 % more surface per one hectare than in the traditional district.

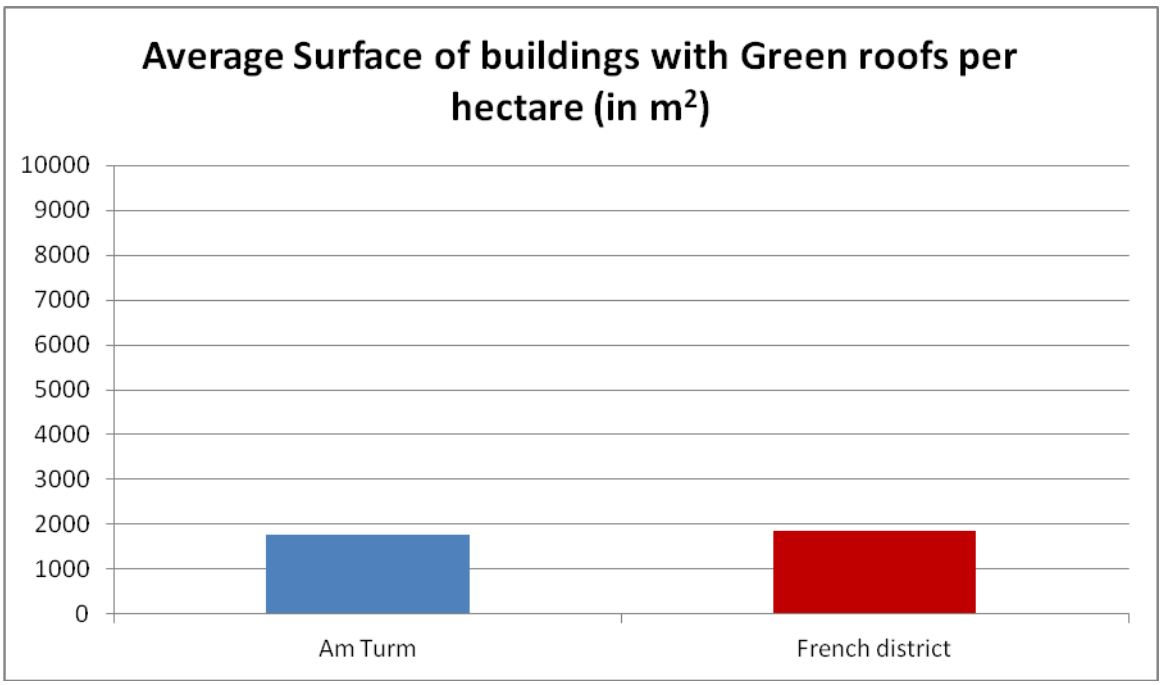

Chart 13: *Average Surface of buildings with Green roofs per hectare (in m^2).* ***Source:*** *Author's own, 2013.*

These comparable values can be explained through the similar regulations of the land-use plans for the two quarters regarding the greening of roofs. For the French district, the 'BBP' obliged the constructors to 'green' at least 50% of all roofs with a slope between 10% and 50% (or terraces) (Stadt Tübingen, 1996, p.7). In addition to this regulation, the increased attractiveness for land in the French district and the resulting sustainability point system for awarding the lots resulted in more sustainable constructions, where many private building cooperatives freely greened the entire area of their roof in order to gain more sustainability points and receive the permission to build on the lot (Heinrich, 2013). In the 'Quartier am Turm', despite no competition for receiving construction approval based on sustainability criteria, a strict measure of the land-use plan, which obliged constructors to green at least 80% of all roofs with a slope equal or lower than 15% led to such impressive amounts of Green spaces on the roofs of dwellings, amounts which are impressive for a 'traditional', market driven urban development (Stadt Heidelberg, 2002).

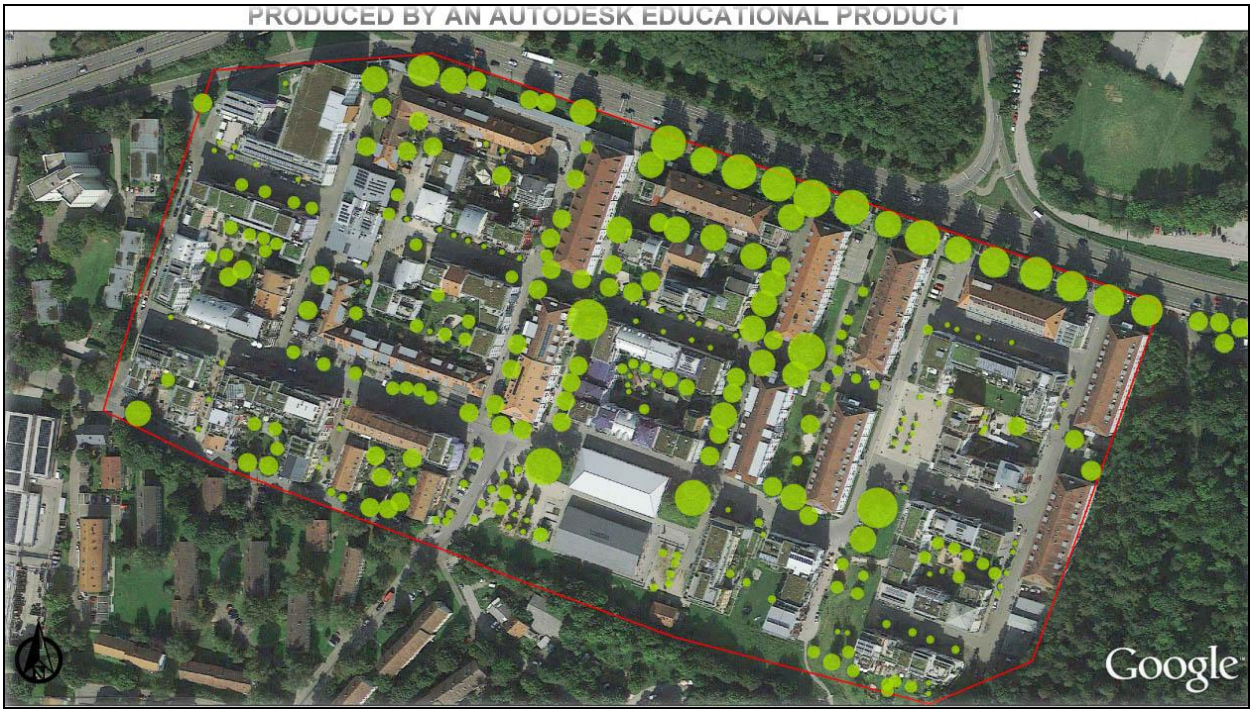

Figure 26: Tree canopy in the French district. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013. **Initial Scale:** 1:7.500.

Legend: Tree canopy.

Name:	Amount:	Total Projected Area:
Small trees (1-5 m^2 for the projected area of the canopy)	127	282,65 m^2
Medium trees (6-20 m^2 for the projected area of the canopy)	117	1430,8 m^2
Large trees (21-82 m^2 for the projected area of the canopy)	37	1732,1 m^2
Total:	281	**3445,4 m^2**

Table 17: Total projected area of tree canopies in the French quarter. **Source:** Author's own, 2013.

Name:	Amount:	Total Projected Area:
Small trees (1-5 m^2 for the projected area of the canopy)	218	186,17 m^2
Medium trees (6-20 m^2 for the projected area of the canopy)	217	976,2 m^2
Large trees (21-82 m^2 for the projected area of the canopy)	15	591,2 m^2
Total:	450	**1753,6 m^2**

Table 18: Total projected area of tree canopies in the 'Quartier am Turm' (*see map on next page). **Source:** Author's own, 2013.

Figure 27: Tree canopy in the 'Quartier am Turm'. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013. **Initial Scale:** 1:7.500.

Legend: Tree canopy.

In the French district, the total projected area of tree canopies represents 9, 56% of the total built area (3.445 m^2 out of 36.005 m^2 total built area); whereas in the 'Quartier amTurm', it represents 5,35 % of the total built area (1.754 m^2 out of 32.746 m^2 total built area). Therefore, tree canopies in the French district account for an area with 78% larger than in the traditional neighborhood (relative to the total built area of the district).

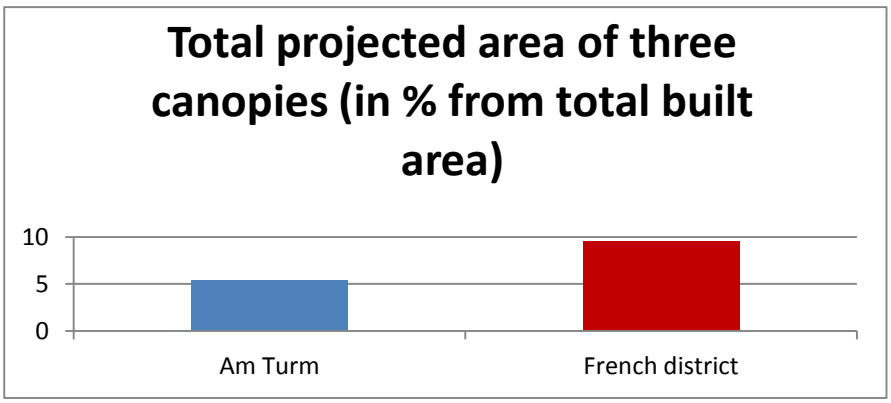

Chart 14: *Total projected area of three canopies (in % from total built area).*

Source: *Author's own, 2013.*

The land use plans for both districts contain detailed information about the types of trees (and their characteristics) that have to be planted alongside the roads and in public areas. However, such a large difference between the two quarters can mostly be explained by three factors:

First of all, a stipulation of the 'Rahmenplan' that was enforced in the land-use plan of the French district prevented the removal of deciduous trees unless necessary for natural causes (Stadt Tübingen, 1996); a measure which led to the preservation of important numbers of medium and large-sized trees. This measure might also be responsible for the large difference between the size of trees in the two quarters, as most of the trees from the 'Quartier am Turm' are young, and have a small-size (a factor which contributed decisively to the big difference regarding the total projected tree canopy area in the two quarters); in contrast to the much older and larger trees that already existed in the French neighborhood.

Second of all, another stipulation of the French district land-use plan obliged the constructors to 'green' at least 40% of all surfaces that aren't built upon (ibid.), thus not only substantially increasing public green areas, but also the number of trees planted in the neighborhood.

Third of all, the high-density, 'perimeter' type of construction in the quarter also resulted in additional public spaces, and consequently, in additional trees that were planted.

The combination of these measures led to the large differences regarding overall tree canopy surface between the French district and the 'traditional' one.

h) ***Using district heating systems such as CHP*** ('Combined Heat and Power') that can support the energy needs of an entire neighborhood, and are more energy-efficient and protective towards the environment than individual heating/cooling systems.

The advantages of using district heating systems for a larger urban area, such as a neighborhood, are multiple: "the increase in air quality through the dismissing of individual heating systems, especially in densely-populated areas; supplementary reduction of polluting substances through modern facilities and high environmental standards; introduction of modern technologies for the cleaning of exhaust gases; possibilities of a centralized optimization of the heating system" (Stadtwerke Tübingen, 2006, p.7).

Unlike for the 'Quartier am Turm', the land-use plan for the French quarter imposed the connection of the French neighborhood to a district heating system on environmental and energy-efficiency grounds (Stadt Tübingen, 1996). The French garrison used its own centralized heating system that served the barracks and the workshops, and the urban design proposal of the 'Rahmenplan' proposed the reconversion of a former barrack located on the Reutlinger Street into a power plant that would serve the entire area (Stadt Tübingen, 1994).

Figure 28: Building of the Stadtwerke Tübingen in the SW part of the French district. **Source:** Stadtwerke Tübingen, 2006.

As such, the 'Stadtwerke Tübingen', the public utility company of the city, was created and serves parts of the city (including the French neighborhood) and some surrounding villages (Stadtwerke Tübingen, 2006). The heating and energy distribution building is located due to logistical reasons not on the Reutlinger Street, as initially intended, but on the Eisenhut Street, on the South-West side of the French district (ibid.). The connection of the entire French district to this building has fulfilled the instructions of the 'BBP' related to the district heating demands, and its importance and efficiency for the French district is augmented by its location within the boundaries of the neighborhood.

One can notice the emphasis set by the local authorities on the district heating system that now serves the entire French neighborhood. It is important to note that throughout the planning and development process, such a system was central to the intentions of creating a sustainable neighborhood, as evidenced by the measures first suggested in the 'Rahmenplan', and then implemented into practice first through the 'BBP', and then through the actual construction of the building that distributes energy, heat and warm water within the boundaries of the French neighborhood.

As such, the vision for a sustainable quarter developed in the 'Rahmenplan' can be considered the main determinant for the creation of a CHP plant that serves the whole French district, a solution which was not even taken in consideration in the traditional, market-based 'Quartier am Turm' (a statement based on considerations of its land-use plan).

i) ***Provide an efficient public transport system*** as a viable and much more environmental-friendly alternative to private motorized vehicles.

Local authorities realized that a successful new district developed in place of a former enclosed and isolated area would require an efficient public transport system in order to increase its accessibility and attractiveness (Stadt Tübingen, 2005). Such a prerequisite becomes much more important if the goal is to create a sustainable district, which relies on private motorized vehicle as little as possible, and sets important restriction on such transport modes. In such a case, an attractive and efficient public transport service can be of great importance in offering a viable alternative to private automobiles; and can thus have a great impact in reducing pollution and fuel consumption.

Two indicators will be taken into account for comparison between the two quarters: the ratio between public transport use and private motorized vehicle use for daily trips; and the area within a 100 meter radius from public transport stops relative to the total area of the quarter. Due to the fact that the exact numbers for the 'Quartier am Turm' are not available, the average data for German cities will be used for comparison with the French quarter.

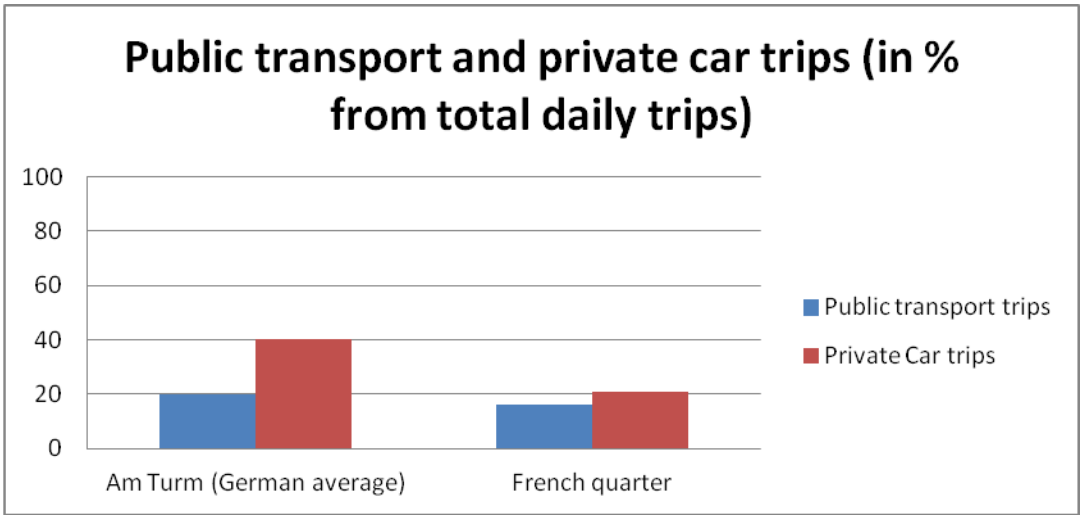

Chart 15: *Public transport and private car trips (in % from total daily trips). These figures take into account all trips, including internal traffic.* ***Source:*** *Adapted version of Ledwoch, 2012.*

In the French quarter, 16% of daily trips are undertaken by bus, while 20% by private auto vehicles (Ahrens, 2009, in: Ledwoch, 2012). That means a daily ratio of 1,25 car trips for each public transport trip undertaken. In an average German quarter, 20% of daily trips are undertaken

by private transport, while 40% by private auto vehicles (ibid.). That means a daily ratio of 2 car trips for each public transport trip undertaken. The rest of daily trips are divided between walking and cycling (see section 'c' of this chapter).

In other words, public transportation trips represent 80% of all daily private auto vehicle trips in the French district, compared to only 50% in a 'traditional' district (an increase of 60%).

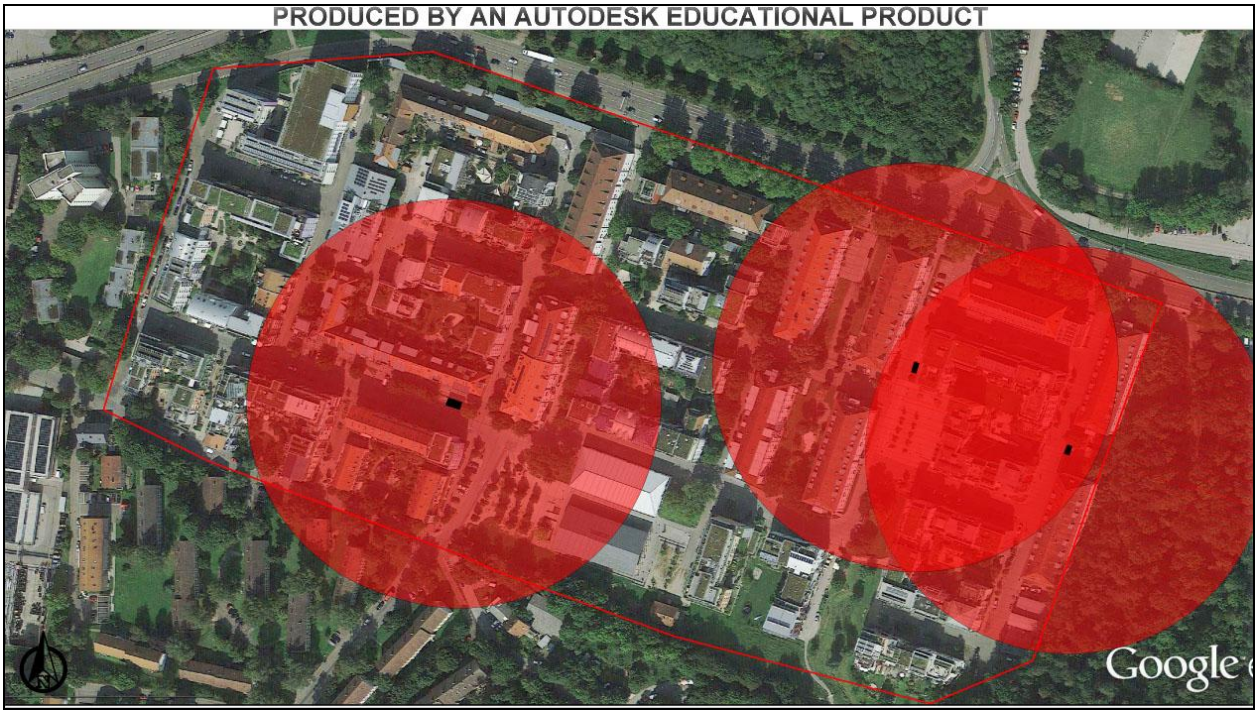

Figure 29: Areas within 100 m radius of a public transport stop in the French quarter. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013.
Initial Scale: 1:7.500.

Legend: Public transport stops.

Name of public transport stop:	Area of neighborhood covered:
Tübingen Aixer Strasse	30.078 m^2
Tübingen Wankheimer Taele	30.311 m^2 (including overlap)
Tübingen Landkutchersweg	4.201 m^2 (not including overlap)
Total:	64.590 m^2

Table 19: Areas of the French quarter within a 100 m radius of a public transport stop. *Only the surfaces inside the boundary of the quarter were considered, and the overlapping zone on the Western side of the district was considered just once. **Source:** Author's own, 2013.

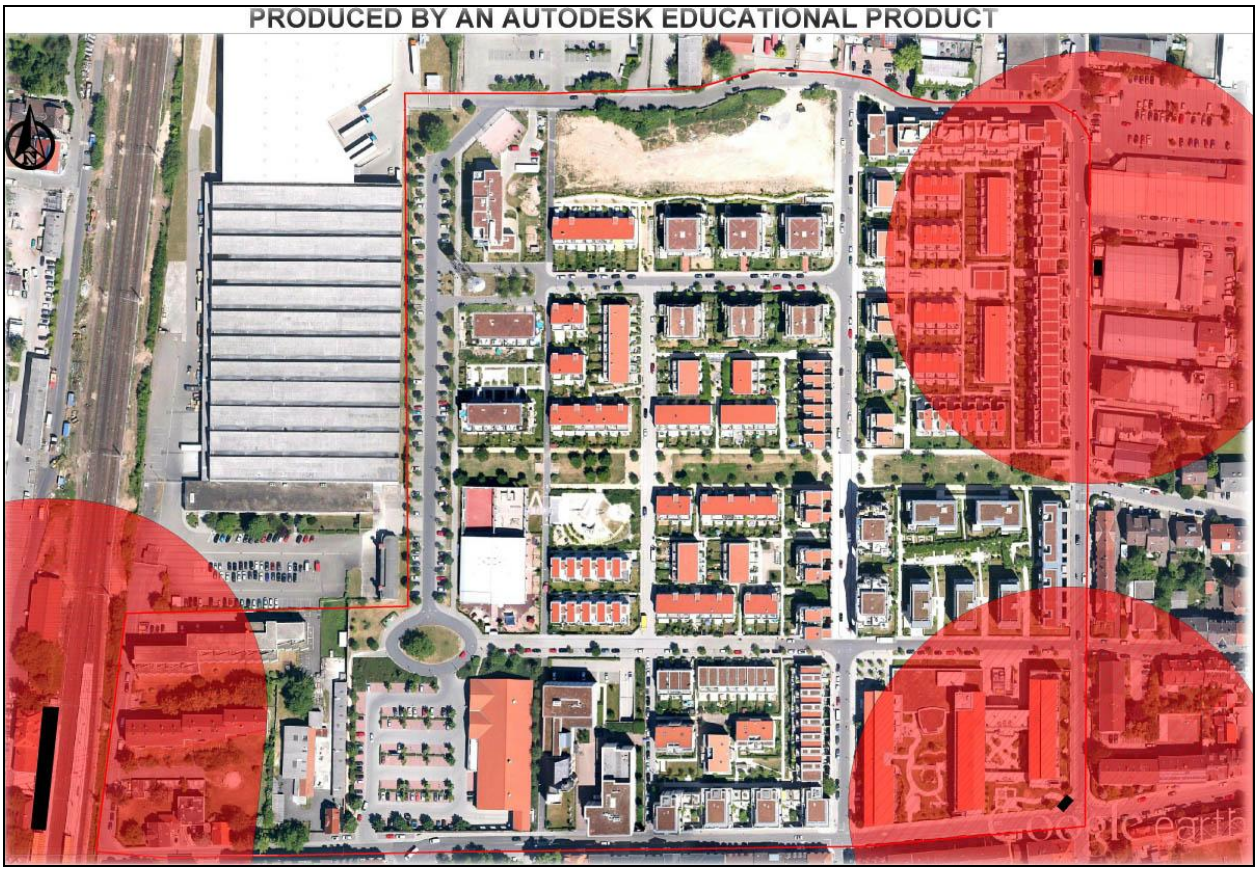

Figure 30: Areas within 100 m radius of a public transport stop in the 'Quartier am Turm'. *Only the surfaces inside the boundary of the quarter were considered. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013.
Initial Scale: 1:7.500.

Legend: Public transport stops.

Name of public transport stop:	Area of neighborhood covered:
Bürgerstrasse	8.311 m^2
Fabrikstrasse	11.362 m^2
Quartier am Turm	14.850 m^2
Total:	34.523 m^2

Table 20: Areas from the 'Quartier am Turm' within a 100 m radius of a public transport stop. *Only the surfaces inside the boundary of the quarter were considered, **Source:** Author's own, 2013.

In the French district, the total area covered within a 100 meter radius from a public transport stop represents 58,5% of the total area of the district (64.590 m^2 out of 110.374 m^2 total surface of the neighborhood). In the 'Quartier am Turm', it represents 25,5 % of the total area of the district (34.523 m^2 out of 135.480 m^2 total surface of the neighborhood). That means, that the area covered within 100 m radius from a public transport stop is 2,3 times larger in the French quarter than in the 'traditional' one.

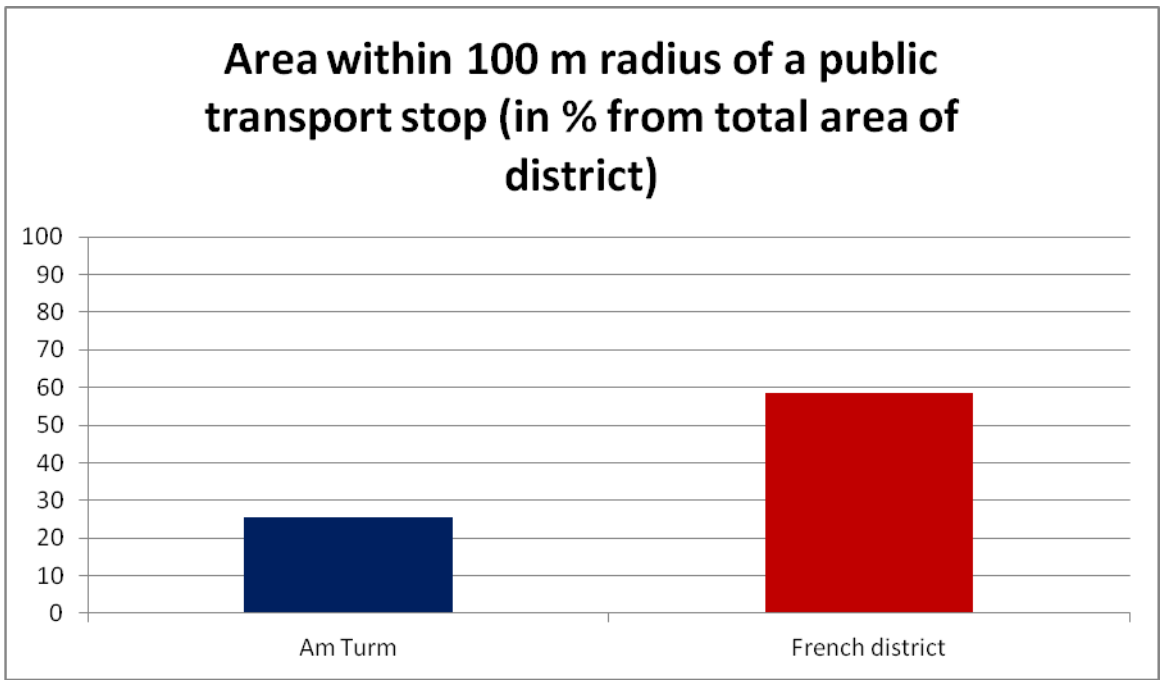

Chart 16: *Area within 100 m radius of a public transport stop (in % from total area of district).* ***Source:*** *Author's own, 2013.*

These significant differences between the two quarters are the result of the attention given to the planning of the public transport from the early stages of development in the French district (Stadt Tübingen, 1994). An attractive public transport system was seen as a key solution for creating a sustainable, car-restricted district; as it would provide, together with the bicycle lanes, pedestrian-friendly streets and car-sharing organization, the much needed alternative to private motorized vehicles (ibid.).

One important measure was the decision to integrate the public transport infrastructure in the development process, in order to improve the connectivity of new dwellings right after their construction was concluded (ibid.). Another result of this 'integrative' approach was the fact that the "public transportation in the district was to offer the same distances, not more than 300

metres, to public transport users in order to reach the bus stop as to car drivers in order to reach their car" (Ferber, 2004, p.5); thus enhancing the use of public transport as a viable alternative to private automobiles. The results of this approach can be observed in the plan layout of the district, as bus stops are integrated inside its boundaries, unlike in the 'Quartier am Turm', where all public transport stops are located at the far edge of the district, with no buses passing through it.

The French neighborhood is served nowadays by three regular bus lines and one night line, "with a bus leaving every 10 minutes during the day, and every 30 minutes at night" (Ledwoch, 2012, p.13). The main train station can be reached via bus in twenty minutes, while the city center and university in twenty-five minutes (ibid.).

In conclusion, it is important to note the significant impact of the overarching transport concept that was conceived for the French neighborhood even from the first planning phases; and the positive effects of the integrated planning of the transport system with the step-by-step development of the lots. Both these innovative planning measures have had an undisputable influence on the favorable results of the French quarter compared to the traditional district.

j) ***Save or rejuvenate specific sites or dwellings within the neighborhood that bear a special signification***, in order to increase the attractiveness and uniqueness of the district.

Uniqueness and points of attraction are desirable qualities for any streets, districts or parts of urban settlements. They are not only a good advertisement for the area, but also attract tourists, tenants and investments. Particular site characteristics and historic dwellings that were preserved shape the identity of a space, and have the potential to determine the attractiveness of a district over the long time.

For the beginning of section, one indicator will be used for comparison: the surface of historical dwellings that were preserved from the old function of the site, as a percentage of the total built surface of the district.

It is worth mentioning that both quarters retained the 'hallmarks' of their former functions, which now play the role of symbols for the two districts: the 'Panzerhalle' (tank garage) in the French quarter, and the 'Wasserturm' (water tower) in the 'Quartier am Turm'.

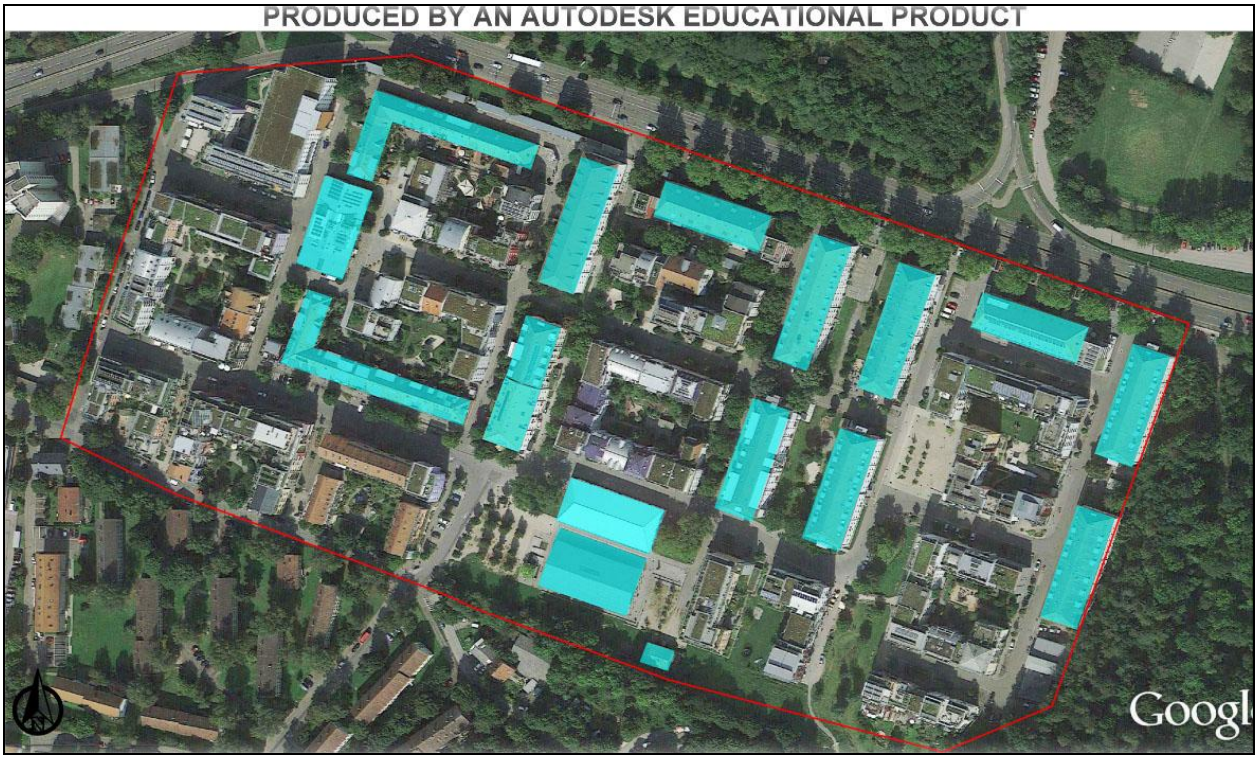

Figure 31: Buildings of the former military base, which were reconverted and are in use today in the French district. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013.
Initial Scale: 1:7.500.

Legend: 'Historic' dwellings.

Name:	Area:
Former stables (2 dwellings)	2727 m^2
Former military garages (3 dwellings)	3313 m^2
Former workshop (1 dwelling)	135 m^2
Former soldier's quarters (10 dwellings)	9426 m^2
Total:	**15.601 m^2**

Table 21: Areas of the buildings of the former military base, which were reconverted and are in use today in the French district. **Source:** Author's own, 2013.

Figure 32: Buildings of the former train carriage factory, which were reconverted and are in use today in the 'Quartier am Turm'. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013.
Initial Scale: 1:7.500.

Legend: 'Historic' dwellings.

Name:	**Area:**
Former factory dwellings (4 dwellings)	4622 m^2
Water tower (1 dwelling)	35 m^2
Total:	**4657 m^2**

Table 22: Areas of the buildings of the former train carriage factory, which were reconverted and are in use today in the 'Quartier am Turm'. **Source:** Author's own, 2013.

A direct comparison between the two quarters reveals that dwellings with a historical character represent today 43,3 % of the total built space in the French quarter (15.601 m^2 out of a total of

36.005 m^2 of built space in the district); and 14,2 % of the total built space in the 'Quartier am Turm' (4.657 m^2 out of a total of 32.746 m^2 of built space in the district). That means, that historical buildings account for 3 times more surface (relative to the total built area) in the French district, than in the traditional neighborhood.

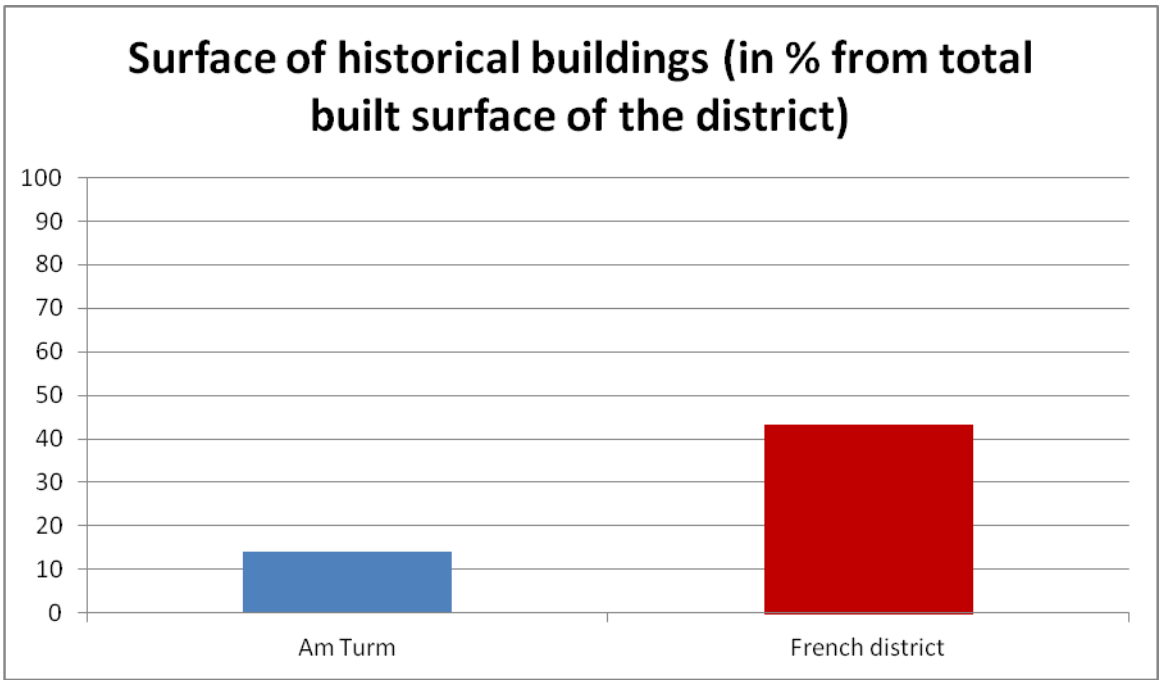

Chart 17: *Surface of historical buildings (in % from total built surface of the district).* ***Source:*** *Author's own, 2013.*

However, one might argue that the above comparison isn't objective, given the different former functions of the two quarters. It is easier and more feasible to reconvert former barracks (which were used for accommodating the soldiers) into residences, as they share the same base function; than to reconvert dwellings of a factory, which were used for completely different purposes. Therefore, a more objective comparison between the two quarters shouldn't take into consideration the barracks of the former French garrison, and should focus just on the reconversion of the buildings that didn't have initial residential purpose (garages, workshops, stables).

Thus, if we subtract the area of the former barracks, buildings with a historical character in the French quarter account for 17,1 % of the total built space (6.175 m^2 out of a total of 36.005 m^2 of built space in the district); and for 14,2 % in the 'Quartier am Turm' (4.657 m^2 out of a total of 32.746 m^2 of built space in the district). That is still an increase of 20,4 % for the French district compared to the traditional neighborhood.

Figure 33: A comparison between the old French garrison at the beginning of the 90's and the French neighborhood as of 2004. Notice the retaining and conversion of the 10 former military barracks, of the 'Panzerhalle' (in the South) and of the former stables (in the Vest) in the current district. **Source:** Modified version of Stadt Tübingen, Grohe, 2012.

These results can be explained through the attention given to the reuse of existing dwellings from the start of the development of the French quarter.

The urban design concept of the 'Rahmenplan' proposed short- and long-term uses for the existing dwellings, based on the potential for reconversion of individual dwellings and on the needs of the new district that was about to be developed (Stadt Tübingen, 1994). These proposals were incorporated later into the binding 'BBP' document, which designated as one of the objectives of the development the overhauling of the 'garrison character' of the area (Stadt Tübingen, 1996). As a consequence, "nearly all of the older military buildings are given to other uses; an attractive offer particularly to small industrial workshops" (Stadt Tübingen, 2005, p.4). This measure can be considered the main determinant for the better results of the French quarter, compared to the traditional neighborhood.

The most notable dwellings to be converted were six former barracks, that are now housing almost 500 students, as well as providing a living place for some disadvantaged groups (Kieninger R., Edelmann N., 2004); the former stables are now used as workshops by photographs, illustrators and plastic artists, as well as housing a restaurant at the ground floor (ibid.); the former tank garage ('Panzerhalle') is now a playground in front of which an open, public space has been arranged; while most other smaller dwellings are currently used for various artisanal activities and commercial purposes (ibid.).

Figure 34: Drawing of the Heinrich-Fuchs train carriage factory, which was reconverted in the 'Quartier am Turm'. **Source:** E&K Unternehmensgruppe, 2008.

k) ***Create open, flexible spaces within the neighborhood*** that can be used for a variety of activities; and **'*reserve some of the best sites in the neighborhood for community purposes'*** (Farr, 2008, p.12).

The provision of public, open spaces in an urban environment increases the opportunity for socializing, thus contributing to a more 'communicative' space; enhances the attractiveness of the area, through the provision of leisure opportunities; and reduces the need to travel outside of the district for leisure activities, thus decreasing pollution and fossil fuel consumption.

One indicator will be used for comparison between the two quarters: The average area per hectare of public, open spaces.

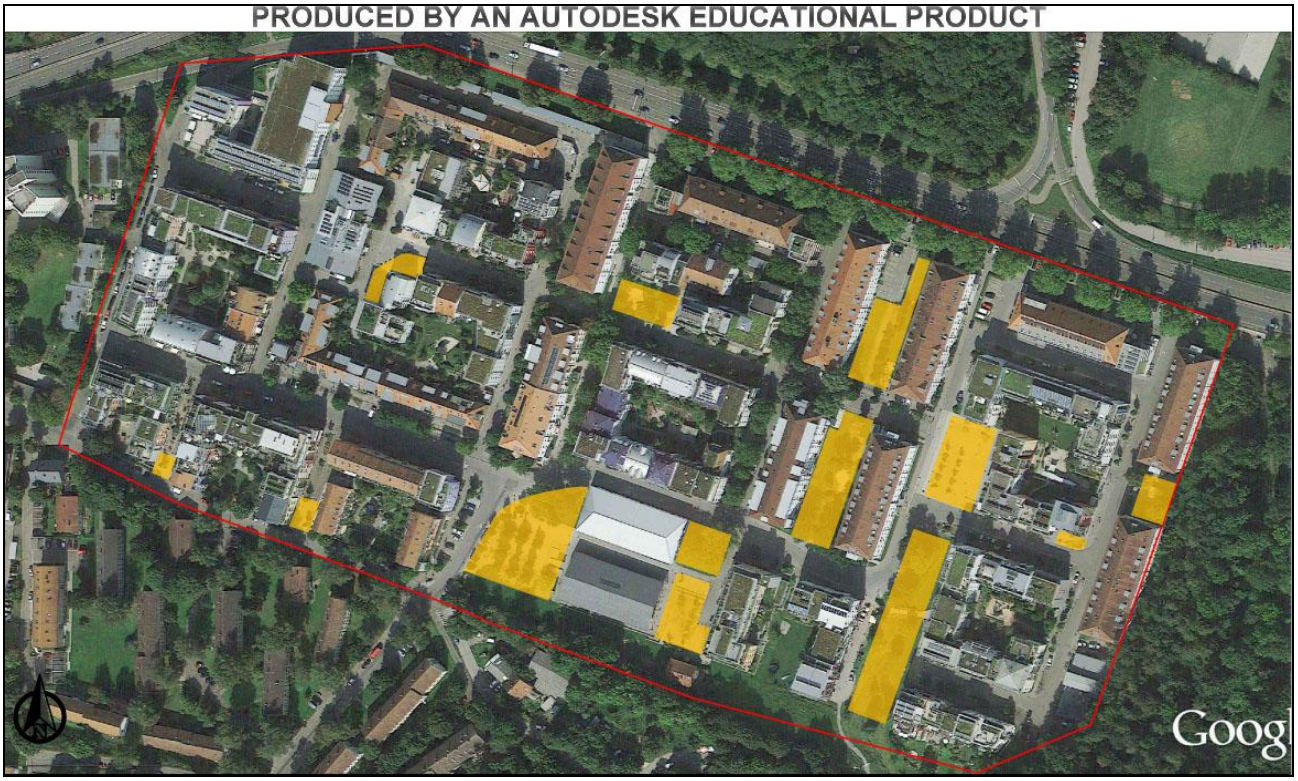

Figure 35: Public, open spaces in the French district. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013.
Initial Scale: 1:7.500.

Legend: Public, open spaces.

Name:	**Area:**
Public space 'Bei den Pferdestaellen'	225 m^2
Public space 'Marienburger Strasse'	81 m^2
Public space 'Eisenhutstrasse'	130 m^2
Public space 'Franzoesische Allee'	406 m^2
Public space 'Panzerhalle 1'	1654 m^2
Public space 'Panzerhalle 2'	581 m^2
Public space 'Ballspielhalle'	391 m^2
Public space' Moempelgarder Weg 1'	815 m^2
Public space 'Moempelgerder Weg 2'	1065 m^2
Public space 'Wankheimer Taele 1'	840 m^2
Public space 'Wankheimer Taele 2'	1545 m^2
Public space 'Mirabeauweg'	74 m^2
Public space 'Landkutchersweg'	288 m^2
Total:	**8095 m^2**

Table 23: Areas of public, open spaces in the French district. **Source:** Author's own, 2013.

Figure 36: Public, open spaces in the 'Quartier am Turm'. **Source:** Author's own (created in AutoCAD Map 3D 2014; base map image from Google Earth), 2013.
Initial Scale: 1:7.500. **Legend:** Public, open spaces.

Name:	**Area:**
Public space 'Wasserturm'	484 m^2
Public space 'Karl von Drais Weg'	188 m^2
Public space 'Rudolf Hell Strasse'	192 m^2
Public space 'Franz Kruckenberg Strasse'	576 m^2
Public space 'Lindenweg 1'	645 m^2
Public space 'Lindenweg 2'	685 m^2
Public space 'Lindenweg 3'	1198 m^2
Public space 'Lindenweg 4'	1634 m^2
Public space 'Konrad Zuse Strasse'	1258 m^2
Public space 'Helaweg'	212 m^2
Total:	**7072 m^2**

Table 24: Areas of public, open spaces in the 'Quartier am Turm'. **Source:** Author's own, 2013.

In the French district, public, open spaces represent on average 733 m^2 per hectare (8.095 m^2 out of 110.374 m^2 total area); while in the 'Quartier am Turm', their average is 522 m^2 per hectare (7.072 m^2 out of 135.480 m^2 total area). Therefore, public, open spaces in the French district account with 40,7 % more surface on average per one hectare, than in the traditional neighborhood. That is even more impressive, given the high-density nature of the French quarter, and the larger proportion of built spaces in it compared to the 'Quartier am Turm' (32,6 %, compared to 24,1 % for the latter).

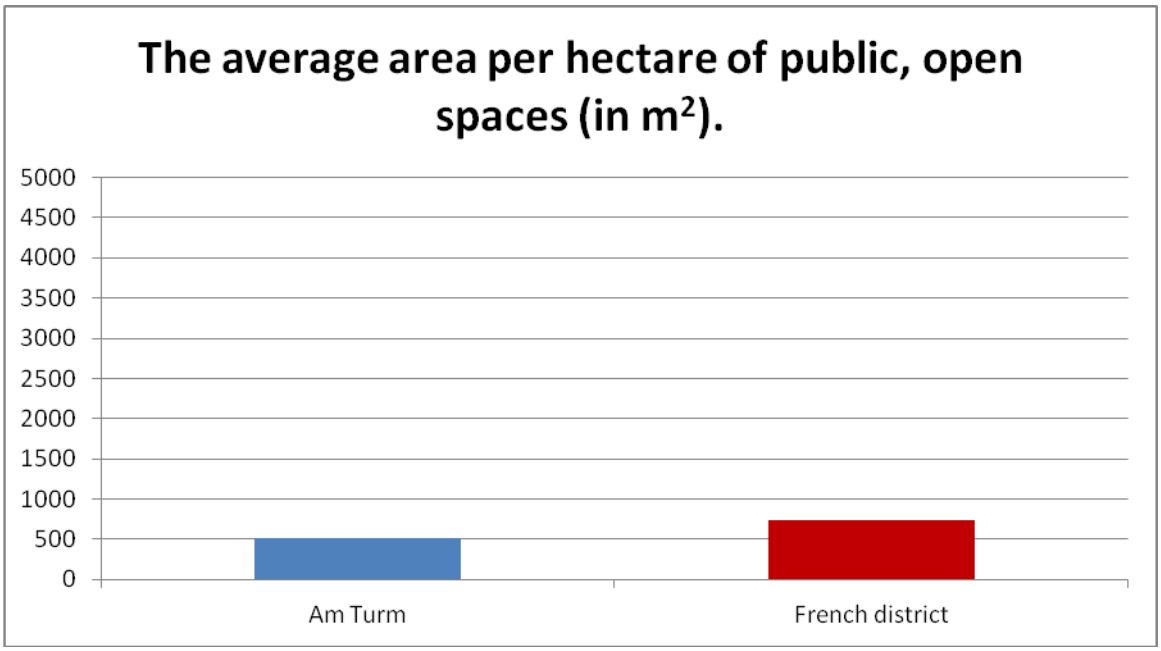

Chart 18: *The average area per hectare of public, open spaces (in m^2).* ***Source:*** *Author's own, 2013.*

This difference comes from the different approaches for the two quarters: in the 'Quartier am Turm', the land-use plan aimed for the minimum required balance between public and built spaces, thus saving more land for development; while the plans for the French district aimed at balancing high-density development with an socially and environmentally attractive quarter (Stadt Tübingen, 1994).

One of the main issues that a high-density, mixed-used neighborhood has to face is the fact that there is little open space left, due to intensive constructions and subsequent infrastructure. This is the case especially for the French neighborhood, where the existence of the former military dwellings that were to be converted and reused determined the distribution of free spaces. Since one of the objectives for the development of the neighborhood was also to create a 'communicative community', solutions that allow for the coexistence of a high-density, mixed-used and 'communicative' district had to be found (ibid.).

Therefore, three development solutions that could assure this coexistence were applied: first of all, the role of streets and of free spaces was determined (see point 'f' of this chapter). The importance of free spaces for maintaining a high quality of life in a high-density district was acknowledged (ibid.), and consequently the term 'free space' was used for public streets, squares, recreational places, private 'green' sites (mostly inner courtyards) and wooden areas adjacent to the city (ibid.). This definition had some important consequences for the redevelopment of the area, as the traditional role of the streets as traffic carriers would not be fully applicable to the French neighborhood (ibid.). Instead streets fulfill first the function of being a meeting, communication and relaxing space for people, and serve motorized vehicles only as a secondary role (ibid.). This viewpoint is in line with the objective of creating an environmental-friendly neighborhood that prioritizes pedestrian walking and bicycle trips, and led to significant changes both in the physical outcome of the district (traffic calming measures were introduced, some streets were closed for automobiles, crossings were designed to be 'at level' in order to further discourage motorized traffic), as well as in its life-style. These measures were implemented into practice by designating the streets as "traffic spaces without a determined purpose" in the 'BBP', a legal solution that allows for flexibility in the development of the French district (Stadt Tübingen, 1996, p.6).

Second of all, the ways of construction- perimeter development with 'enclosed blocks' around an inner courtyard (ibid.), fulfilled both the need for high-density living, as well as providing the district with an important additional amount of 'green' spaces, both public and private. Furthermore, the lack of parking spaces and front yards inside the district allow for more encompassing streets and open spaces (Stadtsanierungsamt Tübingen, 1997).

Third of all, it has been decided (due to the restriction that high-density posed) to provide several smaller public spaces inside the district, instead of the big, central squares traditionally used in urban planning (Kieninger R., Edelmann N., 2004). This measure is augmented by the designation of the surrounding woods and of the valley of the river Blaulach as public space, restricting construction on these areas and further augmenting the recreational areas that are available to the inhabitants of the French neighborhood (Stadt Tübingen, 1996).

l) ***'Localizing' the economy and providing provide a mix of land-uses and services within the neighborhood,*** *in order to increase the attractiveness of the district and to reduce the need for commuting.*

The mix of land-uses represents an important aspect of a sustainable community, because such a community needs to provide a certain amount of local jobs, most of the services, as well as commercial, sport and leisure infrastructure to its inhabitants, in order to reduce the fuel consumption caused by daily motorized trips to other parts of the city. Such an approach would give the neighborhood a higher level of independence compared to a solely-residential neighborhood.

One indicator will be taken into account, based on the available data from the two districts: the percentage of available working places per capita.

In the French district, there are officially 750 working places for a population of approximately 2300 (Kieninger R., Edelmann N., 2004), which means 0,32 working places per capita; while in the Quartier am Turm, there are 500 working places (Innen-BW website, 2013) for a population of approximately 2000 (unconfirmed number), meaning 0,25 working places per capita. This represents an increase of 28% in the French district, compared to the traditional one.

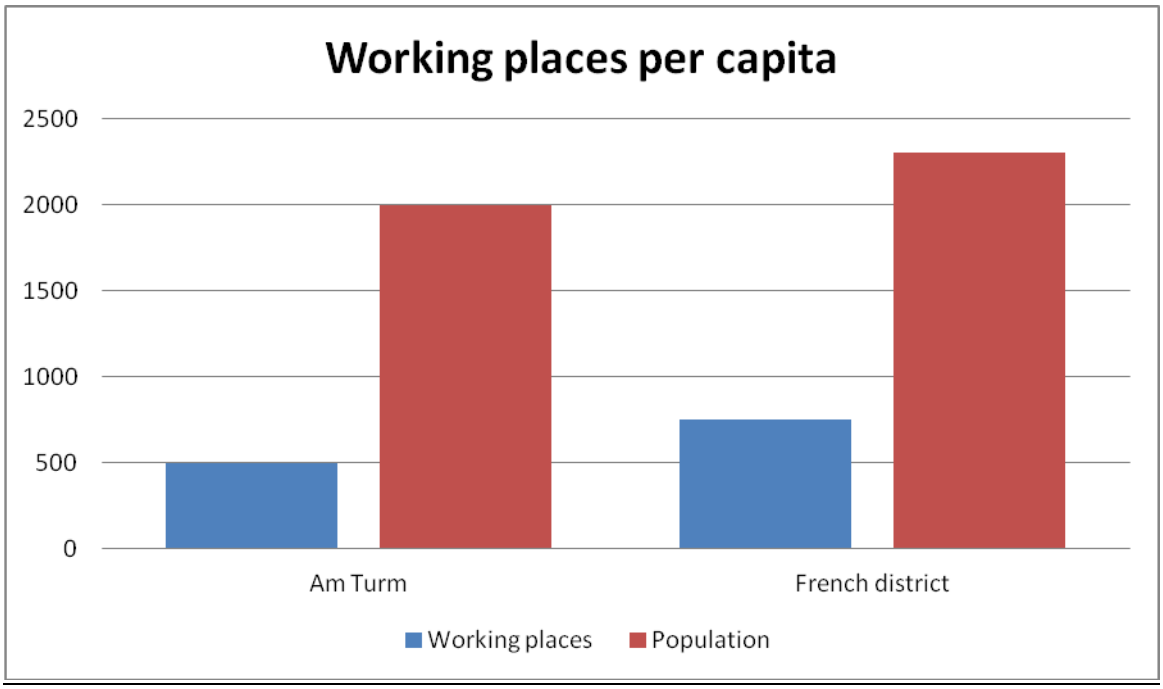

Chart 19: *Working places per capita in the two quarters. * The numbers for the 'Quartier am Turm' are unconfirmed estimates.* ***Source:*** *Author's own, 2013.*

The difference can be explained through the fact, that one of the main objectives for the redevelopment of the former French military garrison in Tübingen was not only to create a new neighborhood, but "an example for a mixed-used area, [...] a small town with urban flair" (Ferber, 2004, p.2). In this new neighborhood, "housing, working, supply and infrastructure are mixed in an area of high density, in order to realize a district of short distances" (ibid.). This leads to a smaller amount of trips "to work, shopping, and leisure activities"; and therefore "saves traffic volumes, energy, local emissions, traveling time, and contributes to safer transport" (Ledwoch, 2012, p.5). Furthermore, an important number of local workplaces can be created in a mixed-used neighborhood, especially in a high-density one. In order to gain such advantages, the local authorities insisted with proposals for a mixed-used development in the 'Rahmenplan', proposals which eventually found their way in the binding 'BBP' and thus, into practice.

It was clearly emphasized that a clear separation between strictly working areas and strictly residential areas is not to be undertaken (Stadt Tübingen, 1994); and areas will be divided in small parcels in order to encourage the desired mixed land use model (ibid.). This approach would allow the local authorities to fulfill the need for supplementary workplaces of Tübingen by redeveloping a former isolated area, and without having to build on usable Greenfield land. It was mentioned that regulations and careful planning must prevent production activities from disturbing residential living, while priority is to be given to businesses that encourage the public life of the district and that deal with environmental protection (ibid.). Maximum surface limitations were set both for small and medium enterprises, as well as for large enterprises (ibid.). Additionally, informative campaigns and meetings were to clearly present the district as a mixed-used area (ibid.).

Consequently, the 'BBP' officially designated the area of the French neighborhood as a 'mixed land-use area' (Stadt Tübingen, 1996), "in order to ensure the legality of mixed-use, [because] mixed areas are the only kind of areas in German building law where intensive mixed-use is permitted" (Ferber, 2004, p.3). As a result, the mixture of "workplaces, residential living, cultural and social choices" shapes the present character of the French neighborhood (Kieninger R., Edelmann N., 2004, p.7).

The 'BBP' thus imposed that the existing building stock, as well as the buildings that are to be constructed, will include a combination between residential and commercial uses for each block (Stadt Tübingen, 1996). Usually, at the ground floor commercial activities take place, while the other floors are reserved for residential living (Kieninger R., Edelmann N., 2004). A report from 2002 mentioned the existence of 750 working places in 120 companies, divided as follows: "50% provision of qualified services, 20% production and artisanal companies,10% retail industry, 20% social and cultural [activities]" (ibid., p.5).

Figure 37: Map of available services in the French district. **Source:** Stadt Tübingen, 2012.

6.4 Summary of the comparative analysis

The table on the following page represents the summary of the comparative analysis between the two districts. One can notice that for all the 21 urban sustainability indicators used for comparison, the French quarters bodes better in comparison with the typical 'Quartier am Turm'.

Only for one indicator (the average surface per hectare of built space of buildings with green roofs) are the results between the two districts comparable (below 10% difference). For only four indicators are the results in favor of the French quarter with less than 50% more favorable; for seven indicators, the results are in favor of the French district with a percentage between 50% and 100%; and for the remaining 9 indicators, results are over 100% in favor of the French district.

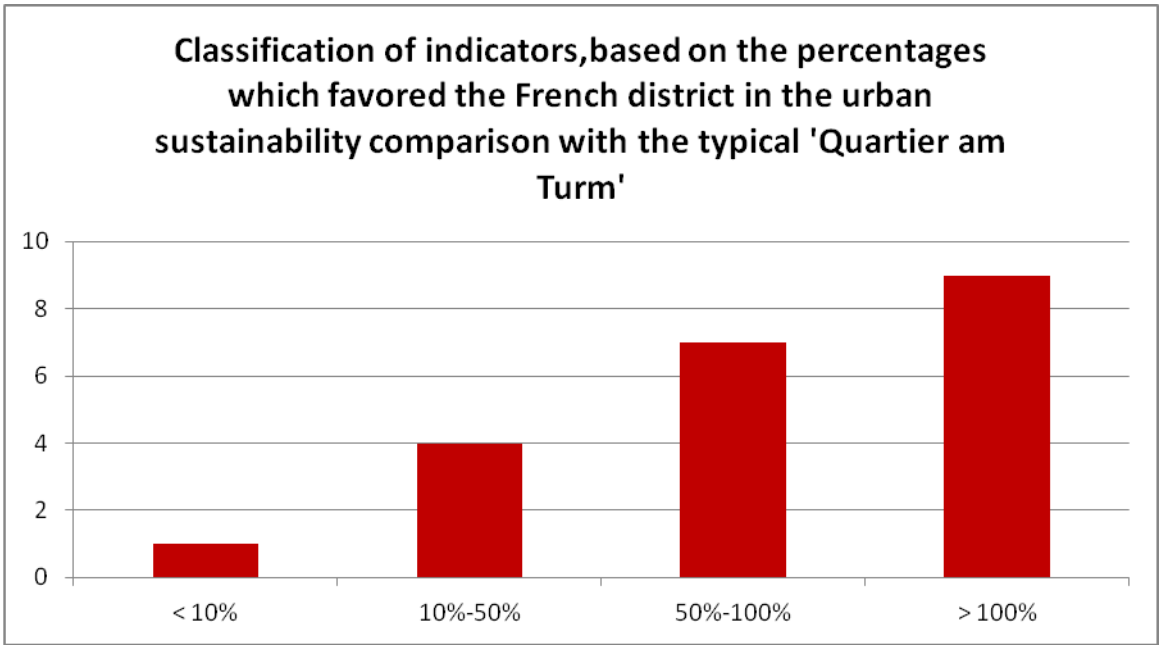

Chart 20: *Classification of indicators, based on the percentages which favored the French district in the urban sustainability comparison with the typical 'Quartier am Turm'.* ***Source:*** *Author's own, 2013.*

As such, one can conclude that the French district is indeed a sustainable quarter, at least compared to a 'typical' development from the German state of Baden-Wuerttemberg; and fares considerably better than the typical quarter in 9 urban sustainability areas (16 indicators).

The various measures that led to such favorable results for the French district will be summarized in the following table:

Sustainability Characteristic:	**Indicators:**	**Results: (French quarter compared to 'Am Turm')**	**Measures taken for achieving the results:**
a) The existence of sufficient parks/ green spaces within the neighborhood.	1) % parks from total area; 2) Surface of Public Green Spaces per hectare (in m^2).	1) + 50%; 2) + 58,7%	- Preservation of some areas that were rife for development as parks; in order to balance environmental, with social and developmental goals; - Obligation to green at least 40% of areas that aren't built upon.
b) The use of renewable energy sources for heating/cooling or electricity generation.	1) number of dwelling units with solar panels from total number of dwellings; 2) Area of households with solar panels per hectare.	1) 27 times more; 2) 35 times more.	- 'Sustainability Point allocation system' used for allocating land in the French district. - Market-driven approach in the traditional quarter.
c) Give priority to pedestrian or bicycle transport.	1) % of daily trips undertaken by walking and cycling; 2) % of daily trips undertaken by private motorized vehicles; 3) Proportion between non-motorized and private motorized transport modes.	1) + 62,5%; 2) – 50%; 3) 3 times higher.	- Parking restrictions inside the quarter; - Restrictions for building gas stations inside the quarter; - Level crossings; - Speed limits on all streets; - Providing viable alternatives: public transport, and car-sharing company.
d) Provide a minimal dwelling density per hectare.	1) Gross Floor Area per hectare.	1) + 70,5%	- Determining in the land-use plan a 'fixed 'method of construction for most of the buildings (perimeter blocks, between 3-5 stories high).
e) Reduce the space 'lost' because of auto vehicle parking.	1) Average area per hectare lost to parking spaces in the district; 2) Proportion of the dedicated parking spaces that are located at the edge of the district, relative to the total surface of dedicated parking spaces for the whole district.	1) - 250%; 2) + 150 %.	- Alternative parking concept.
f) Introduce traffic calming measures.	1) Added length of streets that are closed to motorized traffic, relative to the total length of the streets in the district; 2) Added length of traffic calmed streets (maximum 30 km/h speed), relative to the total length of the streets in the district.	1) + 42%; 2) + 550%.	- Designating streets as 'traffic spaces without a determined purpose' in the land-use plan, allowing for the application of speed and traffic restrictions on all of them. - Level-street-crossings.

Sustainability Characteristic:	**Indicators:**	**Results: (French quarter compared to 'Am Turm')**	**Measures taken for achieving the results:**
g) Further conserving energy through passive design solutions.	1) Average surface per hectare (of built space) of buildings with green roofs; 2) "Urban tree canopy average as percentage of total urbanized area" (Lynch et al., 2011, p. 59).	1) + 5,7 %; 2) +78%.	- Similar regulations in the land-use plans regarding the greening of roofs of a certain shape. - A stipulation that prevented the removal of deciduous trees in the French district unless necessary for natural causes; and obliging the constructors to 'green' at least 40% of all surfaces that aren't built upon.
h) Using district heating systems such as CHP.	1) Existence of a CHP plant.	1) +100%.	- Stipulation for developing a CHP plant in the land-use plan.
i) Provide an efficient public transport system.	1) Ratio between public transport use and private motorized vehicle use for daily trips; 2) Area within a 100 meter radius from public transport stops relative to the total area of the quarter.	1) + 60%. 2) + 230%.	- Integrating the public transport infrastructure in the development process. - Overarching transport concept.
j) Save or rejuvenate specific sites or dwellings within the neighborhood that bear a special signification.	1) Surface of historical dwellings that were preserved from the old function of the site, as a percentage of the total built surface of the district; 2) Surface of historical dwellings that were preserved from the old function of the site, minus the former garrison dwellings of the French quarter, as a percentage of the total built surface of the district.	1) +300%; 2) + 20,4 %.	- Decision to retain the historical, 'garrison' character of the area led to proposing short- and long-term uses for the existing dwellings, based on the potential for reconversion of each individual dwelling.
k) Create open, flexible spaces within the neighborhood.	1) Average area per hectare of public, open spaces.	1) + 40,7%	- Provide several smaller public spaces inside the district, in order to balance social and environmental aspects with high-density,' perimeter' construction.
l) Localizing' the economy and providing a mix of land-uses and services within the neighborhood.	1) % of available working places per capita.	1) + 28%	- Designating the whole quarter as 'mixed land-use area' in the land-use plan. - Reserving the ground floor of most buildings for commercial purposes.

6.5 The underlying causes and factors that affect the redevelopment of a former military site (Brownfield land) into a sustainable neighborhood in the case of the French neighborhood in Tübingen

This section represents the exploratory part of this Thesis, as it is beyond the scope of this study due to the large amount of research needed for exploring such an aim. Results from this section are by no means definitive, given the very small number of interviews; however they are of use in further enhancing the scientific relevance of this Thesis, by underlining the methodological difficulties in studying the development of a neighborhood stretched for over a decade, and by determining a specific area for future research!

Difficulties in gathering sufficient relevant information:

Early in my study, in trying to determine the underlying causes that affected the redevelopment of the French district from a Brownfield land to a sustainable quarter, I tested a variety of research methods. First, I compiled questionnaires based on the framework for exploratory purpose of this Thesis (see second part of theoretical framework chapter), and sent them to over 100 contacts of the Tübingen local authorities. The rate of response was extremely low (only 8 completed questionnaires), and many of the contacted people answered that they lack the in-depth knowledge regarding the French district for tackling such a questionnaire. Next, I contacted a number of people from the planning, construction and housing department of the city of Tübingen (about 25 people) and asked them about the possibility of undertaking interviews about the French district. Upon viewing the framework based on which I was going to ask the questions, they answered that they do not posses such knowledge, and linked me to the responsible person for the French neighborhood (who kindly accepted the interview). Furthermore, the other persons who have been working on the French district have either left or retired, highlighting the issues that might appear when trying to analyze a development that is stretched for over a decade. I realized that determining the causes affecting the redevelopment of the French district, in addition to the main aim of this study, would prove to be a much more ample undertaking than the purpose of a Master's Thesis, and as such, I added the information from the two interviews I managed to take in an 'exploratory part'. The difficulties I encountered make me think that in order to determine the underlying causes of a sustainable quarter, especially one who was developed over a considerable amount of time, one would require sufficient time, financial means, and cooperation from local authorities in order to succeed.

Summary of results from the undertaken interviews:

For this section, two in-depth interviews with Ms. Selina Heinrich from the city development department of the city of Tübingen, and with Ms. Katharina Manderscheid, author of the book "Milieu, Urbanität und Raum" ('Milieu, urban design and space'), which uses the French neighborhood as a case-study for determining the social impact of urban development concepts, will be undertaken. The interviews were based on the framework with determinants for the development of a sustainable neighborhood that emerged in the 'theoretical framework' chapter after the relevant literature review. The two interviews revealed that the following underlying factors were crucial to the redevelopment of the former French garrison in the sustainable French district:

1. The ownership of the site by the local authorities combined with a sustainable urban development vision. The ownership of the site by the municipality, after buying it at a cheap price from the German Bund as a consequence of the departure of the French garrison, represented a decisive factor in the development of the French quarter. It allowed for the implementation of the vision for the French neighborhood, for the urban design competitions that finally shaped the Master plan, and for the private building cooperative system (Manderscheid, 2013). It practically allowed the municipality to set the directions for the development of the quarter, and choose a social and environmental sustainability approach, rather than the more traditional free market-oriented one. However, the ownership of the site by the local council is an important factor for the development of a sustainable quarter only if combined with a sustainable urban development vision; because as seen in the second chapter, despite a vast amount of land available to German cities after the departure of the Allied forces, there are very few similar examples of sustainable quarters. This vision of a sustainable urban development for the French quarter is existent largely due to the urban development visions of Mr. Andreas Feldtkeller, a well-known town-planner with future-oriented ideas, such as developing a quarter that is based on sustainability grounds, or creating a mixed-used and highly dense district. His ideas led to the urban design competition that became an integral part of the 'Rahmenplan' ('framework plan'), and to many of the guidelines for the South city development that were present in it (Heinrich, 2013); most of which were later transferred into the detailed land use plan that represents the legal basis for the development of the French quarter. Such a ground-breaking vision, combined with the ownership of the land by the local authority, which made the implementation of the vision possible, appears to represent a determining factor in the redevelopment of a Brownfield site into a sustainable neighborhood.

2. The authority of the municipality over the development process and over the outcomes through binding planning tools, which are used to implement the sustainable character of the district.

The authority of the local council over the development process is important in pursuing a sustainable direction for an urban development, as otherwise sustainability principles such as social equity or environmental awareness would be left behind economic rationales, especially in times of financial struggle. It is believed that the French quarter would have developed in a much more traditional; free-market oriented way, had it not been for a way for the municipality to

control the development process. The main legal tool for this was the 'BBP', the detailed land-use plan for the area, which consists of a series of requirements and limitations, some of which have a clear sustainability-oriented character. These requirements can best be described as framing dimensions that constitute the backbone of the project, and although strict, they leave a lot of individual freedom for the residents to decide on details. Such an approach imposes a sustainability direction for the quarter, but also is flexible enough to allow for individual planning, ideas, design and creativity (Heinrich, 2013). As such, the possibility for the municipality to shape and control the direction for development of the French quarter was really important for the sustainable evolution of the neighborhood.

3. The integration of solutions from the local communities in the policy-making and implementation process

Local groups, people who were interested in moving to the new quarter, members of local schools or kindergartens, each with different interests; they all took part in a series of formal and informal meetings (Manderscheid, 2013). The results and the commonly-agreed solutions from this participative process were incorporated alongside the ideas of Mr. Feldtkeller in the 'Rahmenplan', which provided the basis and guidelines for the binding detail land-use plan of the area. As a result, not only was the neighborhood shaped by taking account of the desires of local people, but some more controversial topics, such as the parking policy which is now central to the functioning of the neighborhood, were ultimately accepted. As such, these public participative meetings have proved to be an important factor for the sustainable development of the French quarter.

4. The existence of adequate financial resources played an important part in the development process, as the financial management of the development was realized different compared to traditional practices for the most part. The ownership of the land by the authorities and the direct selling of the lots to the future inhabitants through the private building communities meant that no private developer was involved, and the city was solely responsible for the financing of the social, children and cultural infrastructure of the entire neighborhood. The fact that the city reinvested a large amount of the money gained from selling the land into the infrastructure of the quarter had an important positive impact on the development of the district, on the social dimension and everyday life inside of it, and on its attractiveness for potential new inhabitants.

5. Mutual agreements between the municipality and the building cooperatives (private developers), that further enhance the sustainability aspect of the district, also had an important impact for the sustainability direction of the quarter. Once the demand for living places in the French quarter exceeded the availability of land, the municipality devised a system that awards the purchasing option for the lot to the project that brings the most environmental or social advantages to the area; rather than awarding the lots to the highest bidders, as accustomed for a traditional development. This measure further enhanced the sustainability aspect of the quarter beyond legal regulations and requirements, and made the inhabitants more responsible for the sustainability of their living environment. As such, it was an important factor in shaping the sustainability aspect of the French quarter.

6. The cost and time span required to clean up the site was also an important factor for the development of the French quarter; as the little contamination of the soil meant that few resources were needed to be allocated for the site in order to make it reusable again.

7. The accessibility and connectivity of the site represents another important factor in the development of the French quarter; as the good public transport system, the bicycle path, the car-sharing scheme and the pedestrian-friendly streets, coupled with good roads leading from the quarter to the rest of the city and the surrounding areas, all contributed at making the area very accessible and well connected, while not having to rely solely on private motorized vehicles for that (Manderscheid, 2013). Furthermore it enhanced the attractiveness of the areas for potential future inhabitants and investors. As such, accessibility and connectivity were key factors for the development of the sustainable French quarter.

It must be stated once more that this section only has an exploratory purpose for the Thesis, and that the above-mentioned results can by no means be considered as definitive, given the reduced number of interviews that informed them! Nonetheless, it has some importance as it provides an initial platform for future studies on similar topics.

Chapter VII: Conclusions

In this chapter, the conclusions and recommendations of this Thesis will be presented.

7.1 Research overview

My main interest before starting this Thesis was to analyze if and how sustainable development has been applied in an urban setting, in such a manner that impacts the life of people in the respective area. As such, the question of the appropriate scale for analysis was the first that came to mind. The literature review, as well as my own experience as an architect, revealed that the neighborhood scale is the most appropriate for evaluating the implementation of sustainable development in urban areas, as it is big enough to encompass all three spheres of sustainability and influence the daily life of people living in the respective area, and small enough to allow for an effective implementation to be possible (as larger scale developments, such as entire 'sustainable cities', have not been realized so far). The 'scale' question represents in my opinion an important (and sometimes neglected) aspect of urban development policy-making; and the literature, as well as the results from this Thesis suggest that measures for implementing sustainable urban development should have the neighborhood scale in mind, as the most appropriate one for making life of people in urban settlements more sustainable.

Once the scale has been decided, it was important to delineate the context of the research, by narrowing down the research focus. Literature mentions the redevelopment of inner-city urban Brownfield land as an important strategy for urban sustainability, and as such I decided to consider neighborhoods that were developed on such land. The results of this Thesis strengthen this claim, as the French district represents an example of reinvigorating a former 'blank area' on the 'mental' map of the city, and transforming it into one of the attractions points of Tübingen. There is a large difference between the role that the former military site (Brownfield land) played for the city, and the role the French district (as a redevelopment of the respective Brownfield site) plays now, including here environmental, social, and economic benefits. Such potential benefits were reported by the literature on urban Brownfield areas, and could be replicated given the plethora of similar sites in Germany, and even beyond.

Going back to the context of the Thesis, since I was mainly interested in determining if sustainable development has been applied at the neighborhood scale, and how; I decided that the best way to go forward with my research would be to take a neighborhood that is broadly regarded as being sustainable; and then to compare it to a similar, but 'traditional' neighborhood. If results would be positive, than the difference in the adopted planning measures for development would explain to a certain extent the differences between the two neighborhoods, and could potentially provide a basis for developing such 'sustainable' quarters in the future.

Given this emphasis, the context of Germany seemed appealing for the purpose of this research for three reasons: it offered some interesting examples of neighborhoods developed on Brownfield land that were marketed as 'sustainable'; reducing Greenfield expansion was a national policy with specific objectives attached to it; and since I am fluent in German, it would have been much easier for me (compared to a non-German speaker) to understand documents from German city archives.

Once Germany has been established as the country on which I would focus my research, the French district in Tübingen in the state of Baden-Württemberg appeared as an interested case-study of sustainable neighborhood, as it won several prizes for sustainability over the years, and was much less researched than the Vauban district of Freiburg, another 'sustainable' neighborhood from the same state. The 'Quartier am Turm' in Heidelberg was selected as the similar, but traditional neighborhood for the comparative analysis with the French district, due to its similarities regarding size, planning system, geographical location relative to the city center, and demographics with the former; despite its 'traditional' methods for development.

Regarding the research methodology, I decided that aerial analysis of high-quality imagery, backed up by an archival study and the review of various policy documents, would provide the necessary insight for the purpose of the Thesis. GIS software was used for the comparative analysis of the two quarters, as it is considered a powerful, professional tool for spatial research; and the information extracted from the archival and desk study research allowed for establishing the planning measures that led to the different results between the two neighborhoods. Using various sources for the input of data allowed for reducing the potential errors of the comparative analysis.

7.2 Research approach

The main aim of this Master's Thesis has been phrased as follows: to determine whether the French district in Tübingen really is more sustainable than a similar, 'typical' quarter, and to unravel the planning measures that led to the potential differences between the two.

Before answering the central research question, which addressed the main aim of the Thesis, some theoretical considerations were necessary. Therefore, the academic context of the research is linked to the first research question of the Thesis (*What is the role of Brownfield reconversion as a strategy for sustainable urban development?)*. It deals with the degradation of the quality of life, especially from an environmental point of view, in urban settlements, and the benefits that urban sustainability could bring as a solution to this trend. The second part of the academic context defines the concept of 'Brownfield land' and analyzes the importance of redeveloping such sites for achieving sustainable urban development. The analysis reveals that Brownfield conversion can be considered an important strategy in achieving sustainable urban development, given the fact that it can contribute to the reduction of urban sprawl, and has the potential to reinvigorate deprived inner-city areas. That is even more valid in the case of Germany, due to the high availability of former inner-city military sites as a result of the ending of the Cold War.

Next, the theoretical framework chapter answers the second research question (*How can planning processes towards sustainable urban development and planning outcomes be evaluated as regards to their sustainability?)*; and consists of an analysis of various frameworks on urban sustainability, based on which a comprehensive framework for the comparative analysis of the empirical chapter was developed. This consists of 12 general urban sustainability areas, which were operationalized through the development of 21 indicators, used for the comparative analysis between the two quarters. Additionally, based on the work of Gilbert et al., a supplementary framework consisting of the underlying causes and factors that affect the redevelopment of Brownfield land into a sustainable neighborhood was devised for the exploratory part of this Thesis.

The third research question regarding *the policy context for implementing sustainable urban development at the local level in Germany* is dealt with in the fourth chapter of this Thesis. First, the effects of two important policy documents devised at the German federal level ('Perspectives for Germany: Our Strategy for Sustainable Development' and the 'Target 30 ha' policy document), as well as of the sustainable development strategy of the state Baden-Württemberg are evaluated. It can be concluded, that despite of the theoretical importance of the studied policy documents, aimed especially at providing guidelines and 'shaping the mind' of relevant stakeholders in urban development, little practical results have been achieved due to them so far.

Next, the planning system of Germany was analyzed, and the freedom and leverage granted by this system to local authorities is considered an essential factor for the scope of this research, despite the need for vertical consistency of local-level plans with those set by the higher institutional tiers. This means that higher tiers only draw broad guidelines and objectives, with little emphasis on detail, thus granting considerable freedom to local authorities regarding the ways of implementing state-level and federal goals. This means that the main factors for developing sustainable neighborhoods on Brownfield land are to be found at the local level, and local actions and initiatives are the main drivers behind such developments (and much less so incentives or policies from higher tiers).

The central research question of this Thesis has been formulated in the following manner: *In which areas is the 'French district' in Tübingen more sustainable than a similar, 'typical' quarter, and which planning measures can account for the potential different results between the two?*; and is linked directly to the main aim of this Thesis.

Its scope is to analyze the sustainability of the French district, by comparing it with a similar, typical quarter (the 'Quartier am Turm' in Heidelberg). The analysis is focused not only on the comparison between the two districts, but also on the undertaken planning measures that help explain the differences between them. The analysis was divided into 21 indicators (categorized in 12 urban sustainability spheres) devised by the main framework of the theoretical chapter specifically for the purpose of this research question.

7.3 Main results of the Thesis

Results have shown that the French quarter fares better for each of the 21 indicators, being thus entitled to the 'sustainable district' label (at least in the context of Baden-Württemberg). Only for one indicator are the results between the two districts comparable (below 10% difference). For only four indicators are the results in favor of the French quarter with less than 50% more favorable; for seven indicators, the results are in favor of the French district with a percentage between 50% and 100%; and for the remaining 9 indicators, results are over 100% in favor of the French district.

The French district fares considerably better than the traditional quarter in the following urban sustainability categories: The use of renewable energy sources for heating/cooling or electricity generation; Giving priority to pedestrian or bicycle transport; Providing a minimal dwelling density per hectare; Reducing the space 'lost' because of auto vehicle parking; Introducing traffic calming measures; Using district heating systems such as CHP; and providing an efficient public transport system.

The most important planning measures that led to these favorable results are summarized in the 7 categories of measures below:

1. A holistic transport and parking concept that gives priority to pedestrian, bicycle and public transportation as a viable alternative to private motorized vehicle use. In order to combat the intensive use of private cars, it is necessary not only to set restriction on car usage, but also to provide viable alternatives for it, otherwise the concept couldn't be enforced. The integration and simultaneous implementation of the following measures have yielded very good results in terms of prioritizing pedestrian, bicycle and public transportation in the case of the French quarter:

- The prohibition of car parking inside of the neighborhood (with little exceptions), and the obligation for inhabitants and visitors to park their cars in specially designed car-parking buildings at the edge of the quarter; as well as allowing only for embarking and debarking procedures (from and into private cars) inside of the neighborhood.

- Providing an efficient public transport system as a viable alternative to private car usage; by providing an adequate accessibility from all areas of the quarter that equals with the walking distance to the car-parking buildings, by maintaining a good connectivity to the rest of the city, and by assuring a good frequency throughout the day. Furthermore, a car-sharing scheme can also be of great help in providing alternatives to private car usage.

- Increasing pedestrian accessibility through the careful planning of an interconnected network of streets.

- Additional traffic calming measures, such as speed restrictions on the streets of the quarter; pedestrian-only areas; no delineation between street and sidewalks, in order to discourage car usage; and restrictions for 'through-going traffic' and heavy vehicles.

2. Providing an abundance of Green spaces, especially in case of a high-density quarter; in order to increase the quality of air, reduce pollution and noise, and provide aesthetically pleasant spaces for leisure and social interaction. Especially in high-density urban areas free spaces are scarce, and therefore solutions for achieving abundance in Green spaces can be mainly achieved in three ways: through the perimeter building method, which allows for a large number of private and public inner courtyards as additional Green spaces in a crowded area; through legal regulations in the detailed land-use plan that imposes the 'greening' of certain types of roofs and terraces; and by obliging the constructors to 'green' at least 40% of all surfaces that aren't built upon. These three measures combined can greatly enhance the percentage of green spaces in a crowded urban area, and thus considerably increase the quality of life of its inhabitants.

3. Creating a mixed land-use district, by applying legal measures in the land-use plan that avoid compartmentalization and impose a mix of land-uses for the whole quarter. The result of such an approach is a mixture of "workplaces, residential living, cultural and social choices" (Kieninger R., Edelmann N., 2004, p.7) inside the neighborhood. The resulting advantages from a sustainability point of view are many: directly supporting the local economy through the creation of workplaces; increasing the attractiveness of the area; greatly reducing the need for car usage and of the environmental burdens generated by it, as most daily needs can be catered for inside of the neighborhood; and reducing the need for unnecessary developments on Greenfield land. The measures that have to be taken in order to create a mixed land-use quarter revolve around reserving ground floor spaces of most dwellings for commercial purposes; around setting surface limitations for different types of enterprises, in order to increase business diversity; and around dividing of parcels into small lots, in order to allow for a multitude of different dwellings and thus commercial activities.

4. Providing a minimal density of dwellings per hectare, in order to reduce the need for making long trips with the car; to prevent urban sprawl, thus saving land for agricultural use; to reduce the costs of infrastructure; and to make public transportation viable. The measures responsible for this revolve around determining a specific height (between 3-5 floors) and construction method (perimeter construction) for most new dwellings.

5. Making use as much as possible of renewable energy systems for heating/cooling or electricity generation. The high amount of buildings with solar panels in the French district is attributed to the 'points allocation system' used by the municipality for allocating land. Land was allocated in the French district only if construction projects reached a certain number of points, which were attributed to projects that contained benign environmental and social measures (such as solar panels or specific flats with social rent). As such, a non-market, and environmentally-oriented approach in allocating building permissions appears to be essential for the existence of large amounts of dwellings with renewable energy systems in a neighborhood.

6. Reserving open, flexible spaces in the neighborhood for community purposes, as this will not only lead to an increase of social interaction, but will also allow for the opportunity to host cultural/social events inside the quarter, further enhancing the prospects for a communicative community. Furthermore, such events will attract visitors to the district. This measure can be achieved through the legal designation of streets in the district as "traffic spaces without a determined purpose" (Stadt Tübingen, 1996, p.6), a planning measure that gives flexibility to the development process, allows for the unrestricted implementation of speed and motorized travel restrictions, and encourages the creation of a pedestrian- and environmental-friendly neighborhood.

7. Saving or rejuvenating specific sites or dwellings within the neighborhood that bear a special signification, in order to increase the attractiveness and uniqueness of the district, thus supporting the local economy by attracting visitors and tourists, and making the quarter more interesting for investors. This was achieved through the decision of retaining the historical, 'garrison' character of the area, which led to proposing short- and long-term uses for the existing dwellings, based on determining the potential for reconversion of each individual building.

The 7 categories of measures summarized on the preceding pages, together with the results of the comparative analysis from the empirical chapter (which were brought together in a summarizing table at the end of the preceding chapter), represent the answer to the main aim of this Thesis. They could be potentially used as a reference for any future similar urban development in the state of Baden-Württemberg and throughout Germany.

Once the French district has been proven to be 'sustainable' (at least compared to typical developments from Baden-Wuerttemberg), and the planning measures that led to this label defined; an exploratory section based on two in-depth interviews was added to this research, as a mean of guiding future research and highlighting the difficulties that the author encountered in his attempt to analyze a sustainable quarter that was developed for over a decade.

It must be stated that the results of the exploratory section are by no means definitive, given the limited number of interviews, however a 'preliminary' list of seven important determinants that have had an overarching influence into the redevelopment of the French garrison in Tübingen into a sustainable neighborhood was developed for guiding future research: The ownership of the site by the local authorities combined with a sustainable urban development vision; The authority of the municipality over the development process and over the outcomes through the binding planning tools, which are used to implement the sustainable character for the district; The integration of solutions from the local communities in the policy-making and implementation process; The existence of adequate financial resources; Mutual agreements between the municipality and the building cooperatives (private developers), that further enhance the sustainability aspect of the district; The cost and time span required to clean up the site; and the accessibility and connectivity of the site.

The difficulties I encountered while trying to gather the necessary information for this 'exploratory section' make me think that in order to determine the underlying causes of a

sustainable quarter, especially one who was developed over a respectable amount of time, one would require considerable free time, financial means, and cooperation from local authorities in order to succeed.

Given the availability of inner-city Brownfield land in Germany and even throughout Europe, and given the current global pursuit for sustainability and sustainable communities; the results and the analysis of this Thesis could be seen as guidelines that might help any future similar urban developments in the strive for sustainability. The French district could be considered an example or 'standard' of sustainable urban development within a specific planning framework; given the results of the comparative analysis of this Thesis and the 'deciphering' of the measures that were adopted in this particular case for reaching urban sustainability.

Although theoretically the particularities of the planning system restricts the validity of the findings to Germany, one can argue that the transferability of the results from this Thesis to future such potential developments is possible even outside such a decentralized framework, if particular solutions for applying the main measures that were applied in the case of the French district can be found.

Recommendations for future research are mainly related to the exploratory part of this Thesis, as determining the underlying factors that influence the development of a sustainable neighborhood would represent an important addition for empirical urban sustainability studies. Furthermore, if similar aerial analysis is to be undertaken, I would suggest the researchers to try and get as many pre-existing GIS data from the local authorities as possible, in order to vastly reduce the time needed for the input of such data manually, as was the case for this Thesis.

As a summarizing conclusion, this Thesis confirms the validity of redeveloping inner-city Brownfield areas as an important strategy for implementing sustainable urban development at a relative large scale, by highlighting the planning measures required for achieving a successful development of this kind within the planning context of the German state of Baden-Württemberg.

The global emphasis on sustainable development increased considerably over the last two decades, and this suggests that sustainability will represent an ever increasingly important aspect of urban development. As such, this Thesis and similar studies can provide important insights to planners, policy makers, decision makers, and interested persons, in the quest for sustainable urban development.

References:

Books and articles:

Alker, Sandra. Joy, Victoria. Roberts, Peter. Smith, Nathan. 2000. The Definition of Brownfield. *Journal of Environmental Planning and Management, 43(1), pp. 49-69.*

Bagaeen, S. 2006. Redeveloping former military sites: competitiveness, urban sustainability and public participation. *Cities, 23 (5). pp. 339-352*.

Berke, Philip R. 2002. Does Sustainable Development Offer a New Direction for Planning? Challenges for the Twenty-First Century. *Journal of Planning Literature*, Vol. 17, No. 1, pp. 21-36.

BICC. 1995. *Report 4: Restructuring the US military bases in Germany- Scope, Impacts and Opportunities*. Bonn, Germany: BICC.

Breheny, Michael J. 1992. Sustainable Development and Urban Form: An Introduction. In: Breheny, M.J. 1992. *Sustainable Development and Urban Form II*. London, UK: Pion Ltd.

Carmona, Matthew. 2001. Sustainable Urban Design- A Possible Agenda. In: Layard, Antonia. Davoudi, Simin. Batty, Susan. *Planning for a Sustainable Future*. 2001. New York, USA: Spon Press.

Campbell, Scott. 1996. Green Cities, Growing Cities, Just Cities? Urban Planning and the Contradictions of Sustainable Development. *Journal of the American Planning Association (Summer, 1996), pp. 1-30.*

Commission of the European Communities. 1990. *Green Paper on the Urban Environment*.

Davoudi, Simin. Layard, Antonia. 2001. Sustainable Development and Planning: an overview. In: Layard, Antonia. Davoudi, Simin. Batty, Susan. Planning for a Sustainable Future. 2001. New Yourk, USA: Spon Press.

Farr, Douglas. 2008. *Sustainable Urbanism: Urban Design with Nature.* New Jersey, USA: Jon Wiley & Sons.

Federal Government of Germany (FGG). 2002. *Perspectives for Germany: Our Strategy for Sustainable Development*. FGG: Berlin.

Ganser, Robin. Williams, Katie. 2007. Brownfield Development: Are We Using the Right Targets? Evidence from England and Germany. *European Planning Studies, 15:5, pp. 603-622.*

Gilbert, Richard. Stevenson, Don. Girardet, Herbert. Stren, Richard. 1996. *Making cities work- the role of local authorities in the urban environment*. London, UK: Earthscan Publ.

Grimski, Detlef. Ferber, Uwe. 2001. Urban Brownfields in Europe. *Land Contamination &. Reclamation, 9 (1), pp. 143-148.*

Haughton, Graham. Hunter, Colin. 1994. *Sustainable cities.* London, UK: Jessica Kingsley Publishers.

Heywood, Jan. Cornelius, Sarah. Carver, Steve. 2011. *An Introduction to Geographical Information Systems*. New Jersey, USA: Prentice Hall Publishers.

Hugentobler, Margrit. Brändle-Ströh, Markus. 1997. Sustainable urban development: A conceptual framework and its application. *Journal of Urban Technology, 4:2, pp. 85-99.*

Jacoby, Christian. 2008. *Konversionsflächenmanagement zur nachhaltigen Wiedernutzung freigegebener militärischer Liegenschaften. Forschungsvorhaben im Rahmen des BMBF-Förderschwerpunktes REFINA, Schlussbericht Konzeptionsphase, Studien zur Raumplanung und Projektentwicklung Heft 4/08*. Universität der Bundeswehr München: Neubiberg.

Kazimee, Bashir. 2001. Sustainable urban design paradigm: twenty five simple things to do to make an urban neighborhood sustainable. In: Brebbia, C.A. Martin-Duque, J.F. Wawdha, L.C. 2002. *The Sustainable City II: Urban Regeneration and Sustainability.* Southhampton, UK: WIT Press.

Koll, Schretzenmayr, Martina.1999. From Greenfield Development to Brownfield Redevelopment- New challenges for planning process, planning strategies and planning law. *DISP, 139, pp. 43-48.*

Ledwoch, Sven. 2012. *The 'French District': Sustainable Urban Neighborhood in Tubingen, Germany*. Eschborn, Germany: Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH.

Lynch, Amy. Andreason, Stuart. Eisenman, Theodore. Robinson, John. Steif, Kenneth. Birch Eugenie. 2011. *Sustainable Urban Development Indicators for the United States*. Philadelphia, USA: Penn Institute for Urban Research.

McGranahan, Gordon. Satterthwaite, David. 2003. Urban Centers: An Assessment of Sustainability. *Annual Review of Environmental Resources, 2003,vol 28, pp. 243–274.*

Mittler, Daniel. 2001. Hijacking Sustainability? Planners and the Promise and Failure of Local Agenda 21. In: Layard, Antonia. Davoudi, Simin. Batty, Susan. *Planning for a Sustainable Future*. 2001. New York, USA: Spon Press.

Newman, Peter. 2006. The environmental impact of cities. *Environment & Urbanization, Vol. 18(2), pp. 275–295.*

Raco, Mike. Henderson, Steven. 2006. Sustainable urban planning and the Brownfield development process in the United Kingdom: Lessons from the Thames Gateway. *Local Environment: The International Journal of Justice and Sustainability, 11:5, pp. 499-513.*

Renn, Ortwin. Goble, Rob. 1996. A regional concept of qualitative growth and sustainability—support for a case study in the German State of Baden-Württemberg. *International Journal of Sustainable Development & World Ecology, 3:4, pp. 1-22.*

Renn, Ortwin. Leon, Christian. Clar, Günther. 2000. *Nachhaltige Entwicklung in Baden-Württemberg: Statusbericht 2000 (Langfassung)*. Akademie für Technikfolgenabschätzung: Stuttgart.

Robinson, John. 2003. Squaring the circle? Some thoughts on the idea of sustainable development. *Ecological Economics, vol. 48 (2004), pp. 369– 384.*

Saunders, M.; Lewis, P.; Thornhill, A. 2009. *Research Methods for Business Students. (Fifth Edition)*. Harlow: Pearson Education Ltd.

Shen, Liyin. Peng, Yi. Zhang, Xiaoling. Wu, Yuzhe. 2012. An alternative model for evaluating sustainable urbanization. *Cities, 29 (2012), pp. 32–39.*

Schmidt, Stephan. 2009. Land Use Planning Tools and Institutional Change in Germany: Recent Developments in Local and Regional Planning, *European Planning Studies*, 17:12, pp. 1907-1921.

Schmidt, Stephan. Buehler, Ralph. 2007. The Planning Process in the US and Germany: A Comparative Analysis. *International Planning Studies, Vol. 12, No. 1, pp. 55–75.*

Stadt Tübingen. 1994. *Städtebaulicher Rahmenplan: Stuttgarter Strasse/ Französischer Viertel*. Tübingen, Germany: Stadt Tübingen Stadtsanierungsamt.

Stadt Tübingen. 1996. *Bebaungsplan: Französischer Viertel. Tübingen/ Wankheimer Täle*. Germany: Stadt Tübingen Stadtsanierungsamt.

Stadt Tübingen. 2005. *Tübingen: Südstadt Development- Städtebaulicher Entwicklungsbereich „Stuttgarter Straße / Französisches Viertel", Tübingen/Germany*. Tübingen, Germany: Municipal archives.

Stadtsanierungsamt Tübingen. 1997. *Stadt mit Eigenschaften*. Hausdruckerei der Stadt Tübingen: Tübingen, Germany.

Stadtwerke Tübingen. 2006. *Fernwärme für Tübingen*. Hausdruckerei der Stadt Tübingen: Tübingen, Germany.

Tils, Ralf. 2007. The German Sustainable Development Strategy: Facing Policy, Management and Political Strategy Assessments. *European Environment, Vol. 17, pp. 164–176.*

Thornton, Gareth. Franz, Martin. Edwards, David. Pahlen, Gernot. Nathanail, Paul. 2007. The challenge of sustainability: incentives for Brownfield regeneration in Europe. *Environmental Science & Policy, 10 (2), pp. 116-134.*

Turowski, Gerd. 2002. *Spatial planning in Germany: Structures and concepts*. Hannover: ARL.

Weber, Reinhold. Häuser, Iris. Wehling, Hans-Georg. Urban, Dorothea. Pflug, Konrad. Turecek, Oliver. 2008. *Baden-Württemberg: a Portrait of the German Southwest* (sixth edition). Stuttgart: Landeszentrale für politische Bildung Baden-Württemberg.

World Commission of Environment and Development. 1987. *Report of the World Commission on Environment and Development: Our Common Future*. UK: Oxford University Press.

On-line sources:

Bachmann, Günther. 2008. *Das Ziel-30-ha: Nachhaltigkeit auf dem Prüfstand*. Available online at: http://www.lfu.bayern.de/altlasten/refina_workshop/doc/refina_bachmann.pdf [22.06.2012]

Baden-Württemberg State Portal. 2012. *Our State*. Available online at: www.baden-wuerttemberg.de/en/Our_State/86236.html [22.06.2012]

CommSec Website. 2009. *Average Size of New Homes across the Globe*. Available online at: http://images.comsec.com.au/ipo/UploadedImages/craigjames3f6189175551497fada1a4769f74d09c.pdf [01.10.2013].

E&K Unternehmensgruppe. 2008. *Quartier am Turm in Heidelberg-Rohrbach*. Available online at: http://www2.mvi.baden-wuerttemberg.de/servlet/is/54496/Heidelberg.pdf?command=downloadContent&filename=Heidelberg.pdf [01.10.2013]

Ferber, Gabi. 2004. *Land use and transport planning Tübingen Stuttgarter Straße / Französisches Viertel.* Available online at: *www.eltis.org/studies/tubingen.pdf* [01.10.2013]

Heidelberg Official Website. 2013. *The city*. Available online at: http://www.heidelberg.de/english,Len/Home/Live/The+City.html [01.10.2013]

Infotech Website. 2010. *Advantages and Disadvantages of GIS*. Available online at: http://ptran-infotech.blogspot.co.uk/2010/10/gis-advantages-and-disadvantages-of-gis.html [01.10.2013]

Innen-BW Website. 2013. *Heidelberg: Quartier am Turm.* Available online at: http://www2.mvi.baden-wuerttemberg.de/servlet/is/103831/ [01.10.2013]

Kieninger, Regina. Edelmann, Niels. 2004. *Seminar „Nachhaltige Siedlungen in Baden-Württemberg".* Available online at: http://www.oeksiedlungen.de/franzoesisches_viertel/ studienarbeit.pdf [10.12.2012]

Knieling, Jörg. Othengrafen, Frank. 2005. *Approaches and Attributes of the Planning Culture in Germany.* Available online at: http://www.cultplan.org/ [01.10.2013]

Ministry of Land, Infrastructure, Transport and Tourism, Japan (MLIT). 2013. *An Overview of spatial policies in Asian and European countries.* Available online at: http://www.mlit.go.jp/kokudokeikaku/international/spw/general/germany/index_e.html [01.10.2013]

Map service Heidelberg Website. 2013. *Bebauungspläne in Heidelberg***.** Available online at: http://map-service.heidelberg.de/mobile/index.jsp [01.10.2013].

Müller, Frank. 2009. *Quartier am Turm: Gelungene Stadtentwicklung*. Available online at: http://www.bundesbaublatt.de/artikel/bbb_Gelungene_Stadtentwicklung_137164.html [01.10.2013].

Niedersächsisches Ministerium für Frauen, Arbeit und Soziales. *Nachhaltige Siedlungsentwicklung in Niedersachsen.* Available online at: www.wirz.de/pdf/mfas.pdf [22.06.2012]

Penn-Bressel, Gertrude. 2010. *Zwischen Utopie und Wirklichkeit – Wie lässt sich das 30 ha-Ziel der Bundesregierung umsetzen? Überlegungen aus Sicht des Umweltbundesamtes*. Available online at: http://www.umwelt.sachsen.de/umwelt/download/Vortrag-01-30_ha_Ziel_der_Bundesregierung_-_Die_Sicht_des_UBA-Textversion.pdf [22.06.2012]

Rat für nachhaltige Entwicklung. 2012. *Baden-Württemberg beschließt Eckpunkte für Klimaschutzgesetz*. Available online at: www.nachhaltigkeitsrat.de/index.php?id=6921 [22.06.2012]

Stadt Heidelberg. 2002. *Bebaungsplan Rohrbach –Ehemalige Wagonfabrik Fuchs*. Available online at: http://map-service.heidelberg.de/mobile/index.jsp [01.10.2013].

Stadt Tübingen Official Website. 2012. *Portrait of the City***.** Available online at: http://www.tuebingen.de/en/1815.html [01.10.2013].

Stadt Tübingen Official Website. 2012. Available online at: http://www.tuebingen.de/en [10.12.2012]

The German Council for Sustainable Development, 2004. Available online at: http://www.nachhaltigkeitsrat.de/uploads/media/Broschuere_Flaechenempfehlung_02.pdf [22.06.2012]

Tüpedia website, 2013. Available online at: http://www.tuepedia.de/index.php/Andreas_Feldtkeller [31.01.2013].

Figures:

Tables:

Charts:

Chart 1: Public green spaces in the two quarters compared to the respective total area of the neighborhoods: 100% represents the total surface of the 'Am Turm' (larger) neighborhood- 135480 m^2. **Source:** Author's own, 2013.

Chart 2: Surface of Public Green Spaces per hectare (in m^2) in the two quarters. **Source:** Author's own, 2013.

Chart 3: Proportion of dwellings with solar panels relative to the total amount of dwelling units in the two quarters. **Source:** Author's own, 2013.

Chart 4: Area of households with solar panels per hectare (in m^2) in the two quarters. **Source:** Author's own, 2013.

Chart 5: Percentage of walking and cycling trips. These figures take into account all trips, including internal traffic. **Source:** Adapted version of Ledwoch, 2012.

Chart 6: Percentage of private motorized trips. These figures take into account all trips, including internal traffic. **Source:** Adapted version of Ledwoch, 2012.

Chart 7: Proportion between private motorized and non-motorized transport modes. These figures take into account all trips, including internal traffic. **Source:** Adapted version of Ledwoch, 2012.

Chart 8: Gross Floor Areas of the built spaces in the two quarters, compared to a 'sustainability' benchmark. **Source:** Author's own, 2013.

Chart 9: Average Space per hectare lost to autovehicle parking in of the district (in m^2). **Source:** Author's own, 2013.

Chart 10: Parking spaces located at the edge of the district (in % from total amount of parking spaces of the district). **Source:** Author's own, 2013.

Chart 11: Length of the streets that are closed to all motorized traffic (% from total length of streets in the district). **Source:** Author's own, 2013.

Chart 12: Length of traffic-calmed streets (% from total lenght of streets in the district). **Source:** Author's own, 2013.

Chart 13: Average Surface of buildings with Green roofs per hectare (in m^2). **Source:** Author's own, 2013.

Chart 14: Total projected area of three canopies (in % from total built area). **Source:** Author's own, 2013.

Chart 15: Public transport and private car trips (in % from total daily trips). These figures take into account all trips, including internal traffic. **Source:** Adapted version of Ledwoch, 2012.

Chart 16: Area within 100 m radius of a public transport stop (in % from total area of district). **Source:** Author's own, 2013.

Chart 17: Surface of historical buildings (in % from total built surface of the district). **Source:** Author's own, 2013.

Chart 18: The average area per hectare of public, open spaces (in m^2). **Source:** Author's own, 2013.

Chart 19: Working places per capita in the two quarters. **Source:** Author's own, 2013.

Chart 20: Classification of indicators, based on the percentages which favored the French district in the urban sustainability comparison with the typical 'Quartier am Turm'. **Source:** Author's own, 2013.

<u>Interviews:</u>

Ms. Heinrich Selina, realized on the 8th January 2013.

Ms. Manderscheid Katharina, realized on the 10th January 2013.