

## A Smart Researching and Planning Tool for the Neuralgic Urban Zone: 3D-ZPA

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Fig. 1: series of images showing ground floor facades of a Gründerzeit-street in Vienna's 9th district © Psenner

### 1 ABSTRACT

There is a strong and direct relationship between urban street space and the structures and uses of the buildings' ground floor. When addressing urban development issues the necessity to consider the “**StadtParterre**“ (street-level-environment)—a holistic urban zone of *public, private, and semi-private spaces*—must therefore be emphasized. In consequence the **spatial representation of Vienna's street-level environment 3D-ZPA** is covering both *built-up* and *non-built-up areas*, it includes the street as well as the adjacent houses and yards.

Vienna's official digital map serves as matrix where the individual ground level plans of the flanking buildings is set in—both historical plans and most recent conversion documents are taken into account, so that the morphological evolution of the street-level is reflected. Given the importance of ceiling and building heights the plan is elevated into the *third dimension*, which marks the major distinction from the *Comprehensive Ground Floor Surveys*, originally carried out in the 1960ies (Muratori, Caniggia).

**3D-ZPA** differs in precision and scale from the current settings of 3D city models that mostly render a distant bird's eye perspective and that by simply showing the external building perimeters do not provide an objective representation and description of the city's *interior structure*. **3D-ZPA** precisely represents the buildings' ground floor; the areas above and below are generically outlined as a rather simple cubic model, so that street profile and day light situation on the ground are reflected.

**3D-ZPA** yields information about a building's spatial and functional relationship to public space and topographical environment; qualitative statements can be made concerning use, use-frequency and intensity. It facilitates conclusions regarding use-potential of the ground floor zone and places structural functions of the *street space* in relation to it. Interrelations can be identified, problematic situations considered and resolved in context; thus **3D-ZPA** is providing a fundamental tool for planning *and* research.



Fig. 2: 3D-ZPA © Psenner, pilot test: images of the 3D ZPA

## 2 INTRODUCTION

### 2.1 Actual Urban Situation

Vienna's urban *street-level environment* crisis is a key focal point of the city's urban research and for its administration. Although the rapid population growth (up to twenty thousand people per year<sup>1</sup>) has created an urgent need for additional (living) space<sup>2</sup>, ground floor vacancies are still spreading. On the other hand the environmental impact generated by individual motorized traffic has become so critical that it can no longer remain a secondary debate. The current mono-structural form of street space use—while understandable in terms of its historical evolution—does not do justice to urban space with respect to the public good.

We are still a long way off understanding street as a cultural good, as “lived space”, but the signs are favorable for reaching a major turning point: in many urban centers, individual motorized transit has reached its maximum capacity; environmental issues have gained prominence and can no longer be relegated to the background,<sup>3</sup> and recent economic and financial crises have shed light on the weaknesses of the current world economic system—a system that largely relies upon resource-intensive forms of mobility.<sup>4</sup>



Fig. 3: ground floor vacancies; urban open space primarily used by the automobile, © Psenner

### 2.2 Research Questions and Objectives of the Project

In Vienna and several other European cities, the street-level environment requires increasing attention in the form of urban research and administration. This is due to an increasingly problematic rate of vacancy or underuse of the ground floor, while rapid population growth makes the search for additional (living) space an urgent matter. Given current conditions, this population growth over the next several years will also result in a further increase of car ownership and a consequent additional need for parking space.

Living space created by rooftop conversions is mostly accompanied by a sealing of the street-level zone. As a result, no additional living space is actually created; the city merely moves upwards by one floor, which leaves behind a detrimentally affected and depopulated public space. This development will ultimately render an already precarious urban environment even more unsustainable.

<sup>1</sup> Vienna's Planning director, Thomas Madreiter, expects population growth on that scale.

<sup>2</sup> The additional requirement of housing space cannot be met by using the city's reserves of undeveloped land alone, therefore in addition to the existing major development areas, living space will have to be created in densely built-up areas.

<sup>3</sup> Failure to meet the Kyoto protocol's climate protection targets for greenhouse gas emissions in the 2008-2012 commitment period will cost Austria 160 million Euros, an amount that the Austrian environment ministry will have to spend on purchasing emission allowances.

<sup>4</sup> Cf. Candeias et al. (eds.), 2011, *Globale Ökonomie des Autos*.



Fig. 4: Living space created by rooftop conversions is often accompanied by a sealing of the street-level zone. As a result, no additional living space is actually created, the city merely moves upwards by one floor. © Psenner/Nöbauer

The reasons why our cities have been converted into car-friendly milieus are certainly known:

- the car industry's powerful lobby intervened in politics from the very beginning;
- the modern era's guiding concept of separate urban functions (living, working, recreation) eventually increased the volume of traffic;<sup>5</sup>
- the suburbia movement, originating from economical<sup>6</sup>, tactical but also military<sup>7</sup> considerations, has led to a swift development of road infrastructure in outlying urban areas.

Nevertheless, we are aware of historical photographs of our urban streets that indicate a different, highly diverse structure of uses:



Fig. 5: Vienna, Mariahilfer Straße 1914 (Sinhuber/Stumpf 1992: Wien. Metamorphosen einer Stadt; pg.:180)

We also are familiar with images of megacities (such as metropolitan Tokyo with its 35 million inhabitants) where streets, in spite of an enormous volume of transit, are understood primarily as *living space* rather than as traffic corridors (see Krusche and Rost, 2010).



Fig. 6: street view in Tokyo City centre in the morning on a workday, © Psenner

It is necessary to examine the issues concerning the **street-level environment** in Vienna. That is, to consider the facts from the perspective of the urban system and identify ways in which architectural and urban research might contribute to understanding the existing problems. Experience has shown that a networked,

<sup>5</sup> In this context, reference must also be made to older ideas, like Garden City, Ciudad Lineal, The Decentrists, Radiant City, etc.

<sup>6</sup> Cf. Lewis, 2004.

<sup>7</sup> Cf. Plunz, 1990: 278f.

transdisciplinary perspective holds the greatest potential. In order to successfully address public space issues, this study emphasizes the necessity to consider the street-level environment as a whole, rather than focusing exclusively on certain parts of it.<sup>8</sup>

### 2.2.1 The “StadtParterre”

The **street-level environment concept** refers to the city’s “*Parterre*” as a holistic urban system: it covers both built-up and non-built-up areas. Thus street, ground floor and courtyard are treated as entity, so that interrelations will come to light. We perfectly know that the potentials of ground floor use and the structure of the correlating public street space are directly related to each other.<sup>9</sup>

### 2.2.2 Research Field

In order to narrow the field of research and render it in specific terms, this study will focus on the **Gründerzeit GZ** period structure.<sup>10</sup> The urban structures that emerged in the period between 1848 and 1918 were laid out on a strict grid and to this day represent a large percentage of the entire urban structure with one quarter of all apartments in Vienna located in GZ buildings.<sup>11</sup> Furthermore the project will focus on **residential streets** in the first place—as they are the ones that so far (unlike shopping streets or traffic roads) have been neglected from science and administration.

### 2.2.3 Research Questions

Since urban maps usually end at the building perimeter, little is known about the interrelations between built-up structures, ground floor use, and street use. Urban planning spares little thought for what really takes place inside the buildings lining a street.<sup>12</sup> The proposed study is therefore concerned with the following **main questions**: How did the GZ-ground floor in residential streets work originally (during GZ period)? What are the (historical) interrelations between public space and the life inside buildings?

The study is also dealing with **secondary questions** like: Is it possible for a street-level environment that no longer serves any vital function—where storage facilities, supply rooms, garbage collecting areas, garages and parked cars are taking over—to appeal to potential users? Which architectural and structural interventions have a positive impact on the street-level environment?

### 2.2.4 Objective of the Study

**The objective** of the present study is to both retrieve and generate relevant data in the form of a 3-dimensional comprehensive map of the street-level environment (as described in the methodology section: 3D-ZPA). Only when such data is available can conclusions regarding the interaction between the ground floor and street space be drawn. This morphological analysis of the urban street level is intended to yield strong arguments in support of a—possibly radical—rethinking of *street space use* as well as *ground floor architecture*.

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<sup>8</sup> See Psenner 2004: In identifying criteria of perception in public space, I focus on architecture as a determining factor. In the process, the interrelations between street space and buildings move into the foreground.

<sup>9</sup> Detailed articles by the author on this issue: Psenner, 2012b, 2011a, 2011b, 2005, 2004a

<sup>10</sup> The GZ structure evolved as part of Vienna’s urban expansion caused by 19th century historical and political developments as well as industrialization. An enormous influx of new residents made Vienna’s population grow from 440,000 in the year 1840 to 2,2 Million (in 1905), making it the fifth-largest city in the world. The architectural style of the GZ period, widespread in 19th century central Europe, was mostly an expression of the aesthetic tastes of a rising and economically powerful bourgeoisie.

<sup>11</sup> 238,100 out of a total of 956,110 apartments (Statistik Austria et al. (eds.): *Österreichs Städte in Zahlen*. Vienna. 2010: 98).

<sup>12</sup> Individual buildings’ planning data, which holds precisely the information that requires clarification, is considered being private from a legal point of view.

### 3 METHODOLOGY: 3-DIMENSIONAL COMPREHENSIVE STREET-LEVEL MAP (3D-ZPA) “ZUSAMMENHÄNGENDE PARTERRE-AUFNAHME”

#### 3.1 Original Comprehensive Ground Floor Survey: 2-Dimensional (ZGA) – “Zusammenhängende Grundrissaufnahme“

The original, two-dimensional comprehensive ground floor survey (ZGA, Zusammenhängende Grundrissaufnahme) derives from studies on the relationship between urban morphology and the typology of buildings, such as carried out by Saverio Muratori in Venice, and Gianfranco Caniggia in Florence and Como. Subsequently, Swiss architects and historians utilized such morphological studies: In the 1960s, architects in the Tessin region initiated an inventory that was continued at the Swiss Federal Institute of Technology (ETH) in Zürich in the 1970s, and made further progress when a comprehensive survey of Zürich’s urban core was conducted under the direction of architectural researcher Margareta Peters.<sup>13</sup>

A simple cadastral map (*Katasterplan*) or the multi-purpose map in use in Vienna (*Mehrzweckkarte*) show only the perimeter of the buildings; they do not provide a sufficiently objective representation and description of the *interior structure* of the city. A comprehensive plan ZGA of the ground floor level yields information about a building’s relationship to public space and the topographical environment: it *visualizes the interrelation between the interior life of individual buildings and the public street space surrounding them*. The comprehensive plan of the *ground floor* level together with the comprehensive plan of the *basement* level (very often ZGAs cover different levels, mostly: ground floor, basement and standard upper floor<sup>14</sup>) are consequently used to examine the relationship among buildings, streets, and yards.<sup>15</sup>

The present study’s primary objective is to reproduce and to model the three-dimensional sphere of the urban street-level environment (StadtParterre) in Vienna. To this end, the ZGA, described above, was developed further into the so called: **3D-ZPA** (3-Dimensionale Zusammenhängende Parterre-Aufnahme).<sup>16</sup>



Fig. 7: 3D ZPA, pilot study, © Psenner

#### 3.2 Methodological Adaptations to Relevant Research Field and Research Questions

The existing digital multi-purpose surface map (*Flächen-Mehrzweckkarte*) that documents detailed land use for the entire municipal area of Vienna in a clearly structured rendering, serves as baseline set of data. This

<sup>13</sup> Comprehensive ground floor surveys of the following Swiss cities exist: Bellinzona, Zürich (old town, 1955), Luzern, Bern (old town), Solothurn (1900), Bern (old town), Biel, Tessin, Zurzach, Le Landeron, Baden, Wil SG (old town), Zürich (old town), Zürich (industrial quarter), Zürich (Stadelhofer quarter).

<sup>14</sup> Some ZGA also include a typological register, specifying the particular type of building. The register is based on recurring elements of the ground floor, and its geometrical structure. Examples of scientific use of ZGAs include Georges Grosjean’s work, which proved a systematic expansion of the medieval city of Bern on the basis of precisely proportional firewall intervals. (Peters 1999a, 154). A metrological analysis of the ZGA Biel showed that a supposedly flat street facade previously had arcades on its northern face that had simply be closed at a later point in time.

<sup>15</sup> The upper floors are of less relevance to this study in as much as they mostly contain information on the inner structure, or as Peters puts it: “the vertical unity of the building” (Peters 1990, 30).

<sup>16</sup> The ZGA of of Ponticelli, a neighborhood in Naples, has also been complemented with an axonometric plan, which however only shows the buildings skins (Fioravanti/Caniggia: Progettare il Recupero, 1983; cited in: Caniggia, 1986: 336 and 338).

map represents a fundamental tool for planning, providing a matrix that is completed with ground level plans of individual buildings: original historic building plans, as well as archived building applications and most recently authorized plans. Additionally, given the importance of ceiling and building *heights*, sectional views are also retrieved. The plans and data—all archived at Vienna building authority’s planning database (Baupolizei, MA37)—are then reviewed, scanned, categorized, and processed.

In a next step, the official plans are verified on site and adjusted where needed, in particular with regard to the actual use. Subsequently, any additional measuring work required in order to render a sufficiently precise plan must be identified. This process is rather work-intensive, therefore the most suitable/efficient form of digital StadtParterre-mapping shall be identified. The 3D-ZPA is a special form of a 3D urban model, enriched with precise detailed StadtParterre-data and adjusted to eye level.<sup>17</sup>

### 3.3 Work plan

This study is designed to address the following: theoretical and historical information, fieldwork surveys, and comparative analyses. The research project, intended as an iterative process, will integrate various suitable scientific methods as well as the superposition of the different facets and outcomes of the study. Therefore, the work schedule and timetable do not identify precise dates: project work is overlapping; accordingly the four work packages are to be seen as mostly running in parallel (see the flowchart also).

## 4 PILOT STUDY

The 3D-ZPA method is being used, tested, and developed further in a still on-going pilot project conducted by the author and partially funded by two science awards granted to the author in 2012 (“WKO-Wissenschaftspreis” sponsored by the Economic Chamber of Vienna; and the City of Vienna’s University Jubilee Award). So far the Vienna street level environment has been explored by means of an exemplary street in the 9<sup>th</sup> district: the *Rotenlöwengasse*. The street—an archetypal Gründerzeit-structure—had been totally rebuilt in the late 19<sup>th</sup> century.



Fig. 8: 3D ZPA, pilot study, © Psenner

The preliminary work covers an in-depth historic approach (theoretical treatise on historical use and on street- and building laws; cf. Psenner 2013, 2012a, 2012b). The elaborately researched **biography of the street** includes detailed information on its outlay (geography, spatial and urban planning), the architectural building development and the precise development of the use of the adjacent ground floors and basements (trade, crafts, industry, housing, etc.)

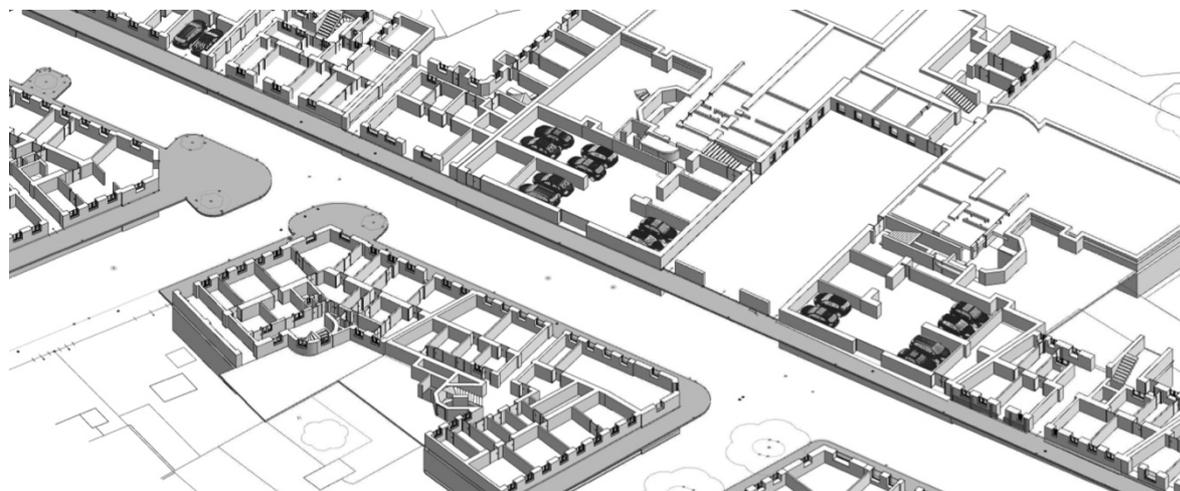


Fig. 9: 3D-ZPA © Psenner, pilot test: façades and illumination by night

The preliminaries also cover an in sight field study of the *actual* state of the street-level environment: What exactly is going on behind the walls and how does this use affect the public space of the street? What kind of work places can be found there? How is illumination/use frequency by night?

<sup>17</sup> The current settings of the 3D urban model mostly render a bird’s eye perspective. Unlike this, 3D navigational tools, such as used by taxi drivers, or Google Earth Street View, adopt an eye-level view. The navigational tools currently available offer no real 3D representations and instead project photographs on 3D urban structures.

The modelling is done with Autodesk Revit® software,<sup>18</sup> which is specifically built for Building Information Modelling (BIM) and which allows a coordinated and consistent model-based approach. Revit supports easily controllable transparency and fade-in/-out effects based on flexible keys for all objects. The *ground floor* is rendered accurately in every detail; whereas general structural data, such as weight bearing elements (outer and main interior supporting walls), access points (stairways and corridors) and the façade (opening axes) provide sufficient data regarding the *standard upper floors*, unless they are directly connected to the ground floor (same procedure concerning the *basement*). The three-dimensional representation of this data is processed with further facts in order to enabling the 3D image to yield information on the use of space (that is: is it living, working, or storage space, are cars parking there? What is the frequency of use?).<sup>19</sup>



**Fig. 10: 3D-ZPA © Psenner, pilot test: axonometric image (detail) of the 3D ZPA model, showing the ground floor**

The *axonometric image* of the 3D ZPA model is considered being a valuable form of representation. In a further processing it includes basic information on ground floor furnishing (features like cars/ double parkers). It also will identify intensity and forms of use (using *color codes*, such as *red* for semipublic spaces and spaces with high user frequency, such as offices, shops, coffee houses, studios; *orange* for housing; *green* for garages and storage space; *blue* for vacancies, and so forth).



**Fig. 11: 3D-ZPA © Psenner, pilot test: perspective image of the 3D ZPA model**

The area above and below the ground floor is broadly outlined in a *Volumensmodel*, with basic data on statics and site infrastructure. Hence, the street profile and the illumination of the ground floor and street level become readable. The façade is interpreted as a permeable interface between building and public space. (Information on the formal design of the façade is available as an option.)

## 5 PRELIMINARY RESULTS/FINDINGS

The spatial representation of Vienna's street level environment (StadtParterre), including all additional relevant data on the ground-floor, facilitates conclusions regarding the (use) structure and the (use) potential

<sup>18</sup> Revit® is a single application that includes features for architectural design, MEP and structural engineering, and construction.

<sup>19</sup> A further development of the 3D-ZPA will also contain information about Vienna's *Stadtstrukturplan*, a planning tool that identifies some pedestrian-sensible data, like privileged buildings, relevant view axis, approximate indications on intended ground floor usage (shopping streets).

of the ground floor zone (for example, illumination) and places the uses and functions of the *street space* in relation to it. Thus, interrelations can be identified and problematic situations considered and resolved in context.

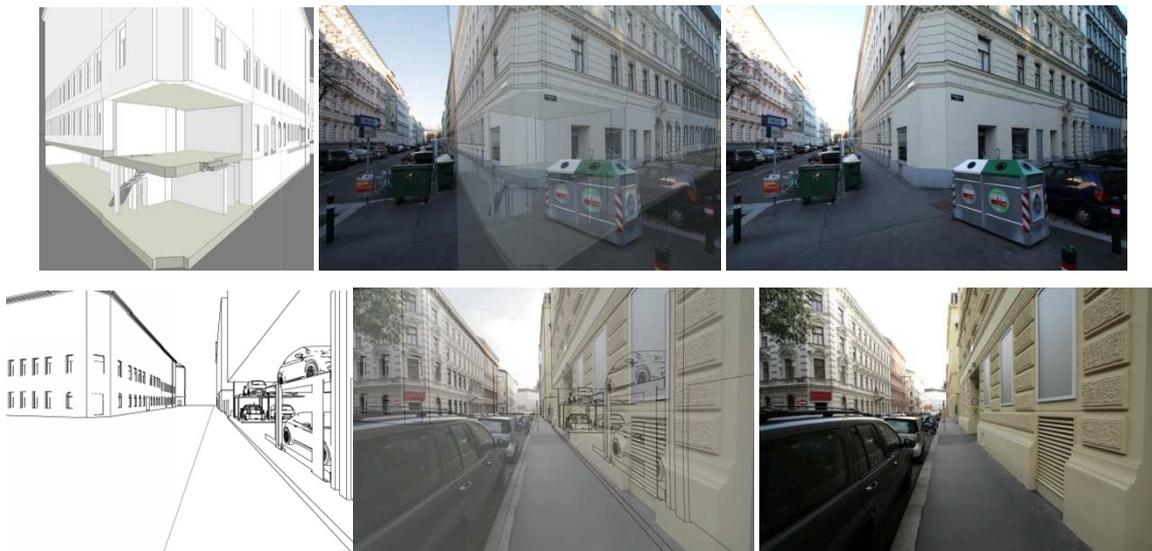


Fig. 12: 3D-ZPA © Psenner, pilot study: images of the 3D ZPA showing different street views in Vienna's 9th district

### 5.1 Importance of the Expected Results for the Discipline

This study aims to map and clearly describe the **potential** of the **street-level environment**—by inter alia thoroughly analyzing its past development. The status quo is not satisfactory: moving and stationary traffic render the ground floor unappealing and not usable for the public; ground floor vacancies augment and are consequently converted into even more parking spaces. Thus, the city migrates upwards: attics are converted, rendering the illumination of the ground floor even more precarious. It must be expected that the automobile will also ultimately overtake the first floor. This imbalance is mirrored in new constructions: residential buildings often rest on stilts, with use beginning only at a certain height. This study will provide the necessary data, analysis, and argument required to bring urgent change to the existing paradigms.

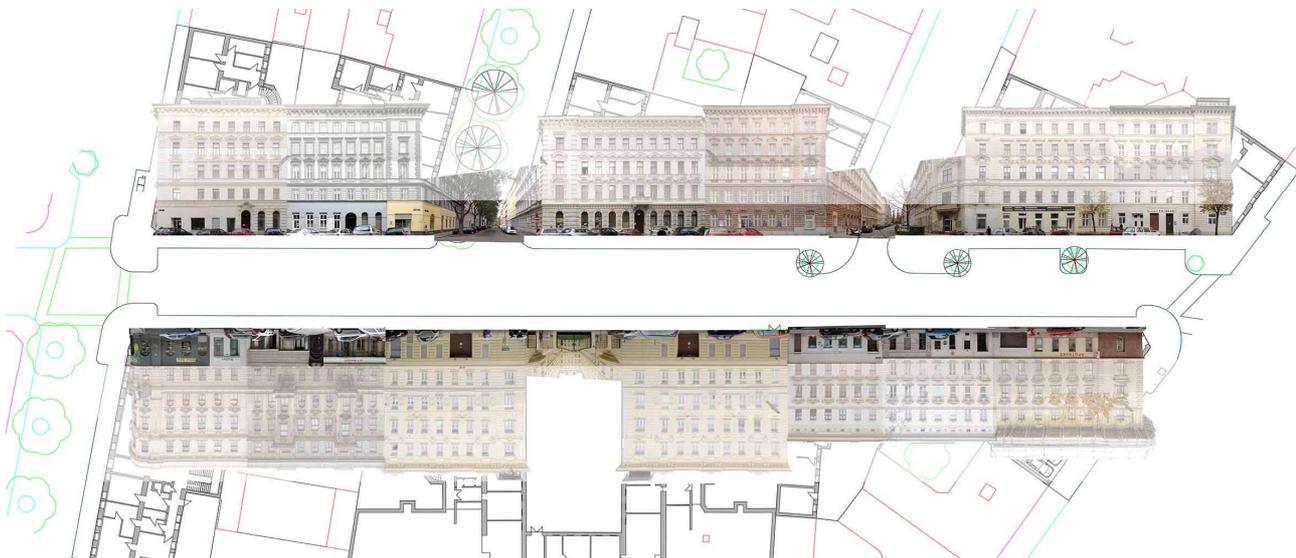


Fig. 13: 3D-ZPA © Psenner, pilot study

One significant prerequisite of successful regulatory measures in urban planning, administration, and economics is a solid and detailed knowledge of the actual architectural structure, current use—and potential use—of the street-level environment. The three-dimensional comprehensive street-level map **3D-ZPA** will realize this information in an easily accessible and locally contextualized form. Thus, the potential of the street-level environment will be clearly identified and can successfully inform urban planning (the initial focus being on Vienna's GZ neighborhoods).

Given the complex micro-analytical capability of the **3D-ZPA**, it will be possible to document vacancies and street-use issues in various neighborhoods and to analyze the contributing economic, traffic and social factors. The systematic 3D-mapping of the built-up structure and inventory of the historic, the actual and the potential ground floor uses will provide a basis for developing long-term views of Vienna's street-level environment, practical guidelines for future interventions in various neighborhoods, and for the (re-)design of individual street complexes.<sup>20</sup>

Expected Benefits:

- (1) Using the 3D-ZPA tool, the study will visualize the (historic) interrelation between street space and ground floor use over time. Thus, existing discrepancies will be identified between the private use of street space and the public's interest in the offerings of the street level environment.
- (2) This transparent and objective form of visualization of interrelated functions provides a sound argument capable of inciting to action the stakeholders in administration and business.
- (3) Concrete improvements in the urban street-level environment can be planned and realized.

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<sup>20</sup> In order to develop a sustainable solution to the various problems that plague the Vienna street-level environment, it will be necessary to employ a systems-oriented view of urban structures. Such a view will take into consideration causes, effects, benefits, and costs as well as consequential costs, resulting in the factual analysis of systemic interrelations as well as identification of a suitable spectrum of key measures. Previously, secondary consequences resulting from a street space overly burdened by parked cars have not been taken into consideration. It is one objective of this study to analyze and represent this interrelation in detail. The primary objective there must be to produce a strong and convincing argument for (re)defining street space in urban centers as *living space* and for enacting this categorization through the law.

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