perceptibility - towards understanding of perceived spatial qualities

taking example on mixed used urban complexes

Benjamin Heinrich

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感知-对可感空间品质的模拟

以混合功能城市综合体为例

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摘要

建筑品质是一个比较模糊的概念。有些研究者将其定义为对空间的印象，并以典型观测者的主观判断为依据；另一些则认为它是可以被测量的，并尝试运用一些方法加以测算。然而，这些观点仍显得含混不清，因为只有基于真实的、大量的观测者对建筑空间的感知作为判定标准，对于建筑品质的判定才是严谨可信的。这篇论文中，笔者执行了一个基于图形的调查分析，并采用了维也纳和上海的案例和观测者（以试图取得跨越文化差异的结论），来试图填补上述的研究空缺。如果建筑品质能够被基于实证的途径确定，而不是猜想或 “常识”，我们就能够更客观地接近实物的本质。

本研究包括以下几个步骤。首先，我从《情绪的身体地图》得到灵感，这篇心理学论文调查各个人体中感受情感的位置。在这个研究的基础上，我推导出一种针对感知建筑的方法，尝试以同样的方式调查城市情景下观察到的情感或“品质”。研究的参与者按照下面几个表述来区分它们的感知：纪念性；创新的；结构感的；保守的以及简洁的。上述表述不是以文字的形式而是以图像的形式来展开，即参与者在图像上做出标识，给出各个表述的确切位置。通过收集和聚合关于各个表述的相应信息，能够展示上述表述的具体地点和发生强度。

本文提出的框架可用于设计竞赛的准备和评估阶段，这个领域仍然高度主观。此外，本研究能够贡献于对人们（不一定是建筑师）眼中的建筑品质的客观化概念的探索，也能用于指导新建筑的设计并进行评估，作为得出最终的城市感知形象的基础。

关键词： 建筑，品质，感知，用户体验，纪念性的，创新的，结构感的，保守的，简洁的，occurrence maps，氛围

abstract

There is no clear notion of architectural quality; some researchers define it as an impression of space, as experienced by an outstanding observer, others say that it is measurable – and have done so using algorithmic methods. However the quality of these statements is yet unclear: there has been little work on architectural space as experienced by real people, leading to a definition in rigorous terms that can define what "quality" really is. This thesis seeks to bridge this gap by conducting a graphical survey along these lines, across a wide range of features available in a mixed use urban complex (both in Vienna as well as in Shanghai, in order to account for cultural differences), which is unprecedented in this way (to the best of the authors knowledge). If architectural quality can be defined by "evidence based methods" instead of speculation or "common sense knowledge", we might be able to approach the subject in a more fact-based way, leading to a broader discussion.

The work is split into several successive steps: initially the inspirations were from "bodily maps of emotions", a paper given by neurobiologists to survey the respective locations, where emotions are felt in the human body. Based on this ground-breaking work, it is tried to deduct a method for architecture, in which it surveys emotions or "qualities" observed in urban situations by the same means. Participants of the study enter their respective perceptions according to several terms: monumental; progressive; structured; conservative and puristic. However, this is not done textually but graphically: people draw onto "architectural" images, giving the exact locations where respective termini occur. By aggregating all gathered information regarding a single terminus, it is possible to show exactly in which *intensity* the quality occurs in a building.

The whole framework that is proposed in this thesis can be applied during the preparation or evaluation of competitions, a field that is still highly subjective and can be approved along these lines. Further implications of this thesis can be: an objectified notion of qualities, as seen by real people (not necessarily architects); the transferal of this knowledge onto new architecture; the verification of the hypothesized role of architectural features in a building – leading to the final perceived image of the city.

keywords: architecture; quality; perception; user experience; monumental; progressive; structured; conservative; puristic; occurrence maps; atmosphere.

kurzfassung

Es gibt keine klare Definition von architektonischer Qualität; einige Forscher definieren sie als räumlich wahrgenommene Eindrücke des Betrachters, andere behaupten, dass sie messbar sind - und haben dies unter Verwendung algorithmischer Methoden getan. Allerdings ist die Qualität dieser Behauptungen noch nicht nachweisbar: es gibt nur wenige Arbeiten, die sich mit der Wahrnehmung des architektonischen Raums durch den Nutzer und der daraus resultierenden Definition, was "Qualität" wirklich ist, auseinandergesetzt haben. In dieser Arbeit wird versucht, diese Lücke mittels einer grafischen Studie, über ein breites Spektrum an Qualitäten für gemischt genutzte urbane Gebiete, zu schließen (in Wien und Shanghai, um kulturelle Unterschiede oder Gemeinsamkeiten herausarbeiten zu können). Die Bearbeitung des Themas "architektonische Qualität" in dieser Art und Weise ist, nach Wissenstand des Verfassers beispiellos. Wenn architektonische Qualität mittels "evidenzbasierten Methoden" statt Spekulationen oder "Allgemeinwissen", nachgewiesen werden kann, wären wir in der Lage uns dem Thema in einer faktenbasierten Weise zu nähern, was zu einer breiteren Diskussionsbasis führen.

Diese Arbeit ist in mehrere, aufeinander folgende Schritte unterteilt: zunächst wird die Idee aus der publizierten Studie "bodily maps of emotions" aufgegriffen (im Fachgebiet der Neurobiologie), in welchem die Lage der gefühlten Emotionen im menschlichen Körper untersucht wurde. Aufbauend auf dieser bahnbrechenden Arbeit wurde eine Methode für die Anwendung in der Architektur erarbeitet, in welcher die wahrgenommenen "architektonischen Qualitäten" in urbanen Situation, in selber Weise untersucht werden. Die Teilnehmer der Studie geben ihre persönliche Wahrnehmung hinsichtlich mehrerer vorgegebener Begriffe zu Protokoll: monumental, progressiv, strukturiert, konservative und puristisch. Dieser Vorgang ist nicht textlich, sondern grafisch: die Teilnehmer zeichnen ihre Eindrücke auf Bilder, sodass die Orte, wo die Termini auftreten, genau festgehalten werden können. Durch Zusammenfügen aller gesammelter Informationen - eines einzigen Terminus, ist man in der Lage, genau zu zeigen *wo* die Qualität an einem Gebäude auftritt.

Die Struktur, die in dieser Arbeit vorgeschlagen wird, kann bei der Vorbereitung oder Beurteilung von Wettbewerben, ein Gebiet welches noch sehr subjektiv ist, Anwendung finden. Weitere Anwendungsmöglichkeiten könnten sein: das definieren ein objektiven Begriffs der Qualität, auf Basis von Nutzern (nicht zwangsweise Architekten); das übertragen des gewonnen Wissens auf neu zu schaffende Architektur; die Überprüfung der Rolle architektonischer Besonderheiten in einem Gebäude - bis hin zum endgültigen Wahrnehmung des Stadtbildes.

Stichworte: Architektur; Qualität; Wahrnehmung; Nutzer-Wahrnehmung; monumental; progressiv; strukturiert; konservative; puristisch; occurrence maps; Atmosphäre.

Аннотация

На данный момент не существует точного определения понятия архитектурного качества. Некоторые исследователи называют определяющим фактором качества представление о пространстве, которое ощущается сторонним наблюдателем; другие говорят о возможности измерения пространства с помощью алгоритмических методов. Однако достоверность этих высказываний вызывает сомнения: круг исследований архитектурного пространства как ощущаемого реальными людьми довольно узок, что делает затруднительным возможность дать точное определение понятию «качества». Данная работа имеет цель заполнить вышеописанный пробел с помощью проведенных визуальных исследований, обращаясь к широкому кругу архитектурных объектов (как в Вене, так и в Шанхае, что позволило учесть также культурные различия). В этом заключается новизна исследования. Таким образом, если предположить, что архитектурное качество может быть определено при помощи метода, основанного на доказательствах, а не на абстрактных гипотезах или чувстве здравого смысла, мы сможем применить более целенаправленный подход к этой теме, что в свою очередь сможет обеспечить возможность для проведения более широкой дискуссии.

Это исследование разделено на несколько последовательных этапов: изначально вдохновение черпалось из «телесных карт эмоций», которые являются принципом используемым нейробиологами для выявления областей человеческого тела, которыми именно ощущаются те или иные эмоции. Этот принципиально новый подход был использован для разработки метода, применимого к архитектуре, с помощью которого возможно анализировать эмоции или характерные черты связанные с наблюдением урбанистического окружения при использовании сходных методов. Участникам исследования предлагалось выразить свои ощущения, касающиеся следующих понятий: монументальность, прогрессивность, структурирование, консервативность и пуританизм. Их выбор был выполнен не в форме текста, а в графическом представлении: люди отмечали соответствующие места в «архитектурных» изображениях, при виде которых у них возникала ассоциация с соответствующим термином. После обработки полученного материала, касательно каждого отдельного термина, появилась возможность показать где именно в здании проявляется конкретное качество интенсивнее всего.
Метод, используемый в данной работе, может быть применен во время подготовки или при оценивании конкурсных проектов. Так как эта сфера по-прежнему является довольно субъективной, выше упомянутый метод может придать ей более убедительную аргументацию. Дальнейшие практические применения работы могут являться следующими: создание объективного понятия о качестве, как именно оно воспринимается реальными людьми (не обязательно архитекторами); применение данных знаний в новой архитектуре; подтверждение гипотетической роли архитектурных особенностей в структуре зданий, формирующих финальное ощущаемое восприятие города.

ключевые слова: Архитектура; качество; представление; опыт пользователя; монументальность; прогрессивность; структурирование; консервативность; пуризм; карты распространенности; атмосфера

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1. introduction

problem

When people talk about the quality of something, there is a gap between the subjective perception of the viewer and the objective validation of the given opinion. This thesis works towards filling this gap, for an exemplary case of perceived architectural quality, by scientific proof.

"Architectural quality" is a well discussed topic that has been (intentionally or unintentionally) present in the discourse of architectural theory for a long time. Even if the books, texts or papers do not directly implicate or refer to the term "quality", architectural theorists and especially phenomenologists write about atmospheres, feelings, cognition, intuition, which in the broadest sense take an evaluating point of view in terms of their quality. *"As architects we do not primarily design buildings as physical objects, but the images and feelings of the people who live in them."* (Pallasmaa, 1987, p.250) In order to design this targeted image, as Juhani Pallasmaa stated, one has to substantially understand his/her own state of mind, because all creation processes implicate an evaluating point of view, since everybody feels different and has his/her own understanding, attitude, taste and state of the mind - we are all individuals. *"Taste is subjective. The judgment of taste does not have the means of objectification, which are available for the analytical mind."* (Franck & Franck, 2008, p.12)

In that sense we cannot objectively evaluate quality, since we are always influenced by our taste. In their Book Franck and Franck assume that good architecture has literally positive influence on the human being, yet creating contradiction by on the one hand saying that taste is subjective and on the other stating that good architecture is positive, implying an evaluative point of view for a general hypothesis, that cannot be objectified. **This contradiction creates a gap between the theoretical approach and the scientific validation is central to this thesis.**

objective

The key objective of this thesis is working towards the analysis of perceived spatial qualities, focusing, by targeting only one human sense, on the visual component of architecture and trying to extract the allocated feeling/atmosphere it conveys.

The perception of the human being is based on its five senses. One can see, the visual perception (eyes), hear, the auditory perception (ears), smell, the olfactory perception (nose), taste, the gustatory perception (tongue) and touch, the tactile perception (skin). The reduction of activating only one sense at a time in real life situations, hardly happens, even though for example a person is blind (having no possibility of a visual perception) the other senses become more dominant trying to even the loss. This natural occurrence of constantly having a complex combination of various perceptive factors makes it almost impossible to objectively reduce a real life architectural or urban situation to target only one sense and afterwards analyze it to find its core. Accepting the factor of not being able to analyze the complete perceptive system at once, an area of investigation was chosen. By looking closer to the theory and methods of phenomenologists it shows that: *"Phenomenology is a purely theoretical approach to research in the original sense of the Greek word theoria, which means precisely 'a looking at.' The phenomenology of architecture is thus 'looking at' architecture from within the consciousness experiencing it, through architectural feeling in contrast to analysis of the physical proportions and properties of the building or a stylistic frame of reference."* (Pallasmaa, 1987, p. 250) So by visually observing a situation, with the target to extract the mood or feeling allocated to it, certain conclusions in terms of the pleasantness can be drawn. As Pallasmaa stated, it is not about

proportions or stylistic elements, it is the reduction to the perception of the observer and his subjective point of view. Based on that, all other senses, besides the visual stimulation, need to be faded out for the examination of the architectural or urban situation, which in the easiest way is to implement pictures of the investigated areas. Leaving aside the factors a person perceives during watching the picture, one can state that a photograph on the computer screen does not make any noise, smell, tastes different than the screen anyway does or feel any different than the material the screen is made of.

The objective of this thesis is to work towards the analysis of visually perceived spatial qualities, creating occurrence maps and after analyzing them trying to simulate new architectural/urban situations, in which those qualities are predefined.

thesis structure

theory

In order to fulfill the defined objective, a profound theoretical base/framework is established with influences from architectural theory, urban psychology, phenomenology and other fields. The appropriate cases for investigation, the terminology of the questionnaire, the evaluating criteria for the interpretation of results, and all other factors used in this thesis are outlined (see chapter '2. theory').

cases

Based on the criteria the case studies, one in Vienna, Austria (see chapter '5.1. viertel zwei') and one in Shanghai, China (see chapter '5.2. shanghai'), were chosen and developed/prepared to be investigated and subjected to further analysis. Both are upcoming urban areas, relatively new built and provide spaces for various functions.

methodology

The methodology for further analysis is outlined in chapter '3. methodology'.

implementation

In a developed online questionnaire the participants of the study are required to transport their visual stimulation for certain asked keywords to the (visual) canvas of the tool (see chapter '4.2. questionnaire'). The participants are doing this for several situations (photographs) of the areas and by that each one is providing their subjective impression. By superimposing the output of every step they take a more and more refined result is being produced (see chapter '4.3. visual information processing'). By using the outcome (statistics and pictures) the two dimensional result is brought into the three dimensional urban situation and an 'occurrence map of these perceived spatial qualities' for each term and case is created (see chapter '4.4. occurrence mapping'). Furthermore the attraction or deflection of the investigated spatial qualities among themselves can be analyzed and the differences are drafted (see chapter '4.5. comparative analysis'). All gathered visual or quality based/atmospheric data is backed up with a compiled and evaluated demographic survey of the study participants (see chapter '4.6. demographics').

results
The three dimensional urban heat maps are then interpreted, by again using the theoretical framework outlined at the beginning, and certain connections or tendencies can be traced. This step sums up the whole process and provides the result of the investigation (see chapter '6. results').

discussion
The parts of the used methodology, specifics of the chosen cases, ambiguous decisions taken in the implementation phase of the content, need to be discussed and further elaborated (see chapter '7. discussion').

conclusion
The gathered results of the process provide a solid base for drawing a coherent conclusion (see chapter '8. conclusion').

future work
A glimpse in the opportunities opened by the means of the thesis is given in order to arouse further interest into this field of research (see chapter '9. future work').

appendix
All created tools and the outcome data are summarized in the appendix (see chapter '10. appendix').

research question

Since this field of study has various theoretical roots which it is based on (in architectural philosophy, urban psychology, phenomenology, ...) the core question is:
Can the theoretical, partially philosophical, approach of outlining the influence of architectural/urban qualities on human beings, be scientifically proven?

For this thesis the deepening question, which shall be answered in the following, is:
Are there architectural/urban elements/situations that contain certain (visual) qualities and are those for explicitly given situations verifiable?

“The only way to forward, if we are going to improve the quality of the environment, is to get everybody involved.”

Richard Rogers

2. theory

Figure 2.1. Church of Light | Tadao Ando | © features.cgsociety.org

2.1. phenomenology

Phenomenology [literally, the study of 'phenomena', appearances of things or the ways we experience things] is simply put the method of thoughts and approaches directly concerned with the human experience. The research field is spread across the planet and one of the most significant philosophical movements of the 20th century with disciplines in architecture, literature, law, medicine, ecology and so on (Center for Advanced Research in Phenomenology, 2015). The goal is to analyze and interpret situations or experiences "*as they spontaneously occur in the course of daily life*" (von Eckartsberg, 1998, p.3). In order to find those experiences "*[…] the phenomenologist pays attention to specific instances of the phenomenon with the hope that these instances, in time, will point toward more general qualities and characteristics that accurately describe the essential nature of the phenomenon as it has presence and meaning in the concrete lives and experiences of human beings.*" (Seamon, 2000, p.3)

Phenomenology in architecture

As related to architecture, phenomenology is the way of 'looking at' things and by that experiencing them through atmosphere and feeling, rather than simply the analysis of their physical attributes. "*Phenomenology is a purely theoretical approach to research in the original sense of the Greek word theoria, which means precisely 'a looking at.' The phenomenology of architecture is thus 'looking at' architecture from within the consciousness experiencing it, through architectural feeling in contrast to analysis of the physical proportions and properties of the building or a stylistic frame of reference.*" (Pallasmaa, 1987, p. 250) The multisensory experience of the human body is a constant theme of Juhani Pallasmaa's writings (Pallasmaa, 1986, 1996) in which he partially criticizes the emphasis of visual aspect of contemporary architecture. Architects put more effort in the visual appearance, than in the perceptive qualities and break the link between the architectural statement and sensory experience/perception. (sensory experience example see figure '2.1. Church of Light')

In his work the Norwegian architect Thiis-Evensen investigates "*the most basic elements in architecture*" floor, wall and roof (Thiis-Evensen, 1987, p.8) on their basic existential qualities and their impact on the perception and experience of architectural form and space. On the simple example of stairs he demonstrates that "*narrow stairs typically relate to privacy and make the user move up them more quickly than up wide stairs, which better express publicness and ceremonial significance.*" (Seamon, 2000, p.11). Broken down to the simplest characteristics of the stairs, designing them either 'wide' or 'narrow', changes the perceived quality from 'public' to 'private' and directly influences the behavior of the user.

To further deepen the understanding of such phenomena the ANFA, The Academy of Neuroscience for Architecture, emerged in the last decade. It should link neuroscientific research with architecture and gain expertise of the bodily experience in the built environment (http://www.anfarch.org). One of the key figures in this new emerging field is Harry Francis Mallgrave who describes the neuroscientific background of perception as "*[…] today neuroscientists are reminding us that the one-eighth of an inch mantle of "gray matter" that abuts the inner circumference of the skull is but a small part of a much larger neurological and visceral biological operation that is driven internally and externally from below that is, by sensory-emotive activity as well as by its own spontaneous rules of engagement. This old, but at the same time new, realization holds a very important lesson for designers. Architects may like to rationalize the variables of design, but people largely perceive buildings emotionally through the senses."* (Mallgrave 2010, p. 188) By that Mallgrave is outlining the way people perceive architecture in contrast to the way architects think in a very rational.

Methods of phenomenological research (in architecture)

According to Seamon (2000) there are three major phenomenological methods of research:

- first-person phenomenological research;
- hermeneutical phenomenological research;
- existential phenomenological research.

First-person phenomenological research

First-person "*experience is always that which a singular subject is subjected to that any given time and place, that to which he/she has access 'in the first-person'*" (Depraz, 2003, p.2). This method is concerned with the description of the "*authentic and intimate contact of the subject with its own experience' may be of interest to neuroscientist attempting to correlate brain imaging techniques with the experience of the person […]*" (Roth, 2012) Using this method it is possible to gain first hand information from the researcher him-/herself by experiencing the chosen situation, yet not applicable to a group of people.

Hermeneutical phenomenological research

It is the theory and practice of the interpretation of texts (poems, songs, documents, …). The researcher has to find the meaning rather than its creational process. Von Eckartsberg (1998, p.50) describes it as: "*One embeds oneself in the process of getting involved in the text, one begins to discern configurations of meaning, of parts and wholes and their interrelationships [...]*"

Existential phenomenological research

In contrast to the other two proposed methods, the existential phenomenological research method is applicable to a (preferably preselected) group of people and following a 'predefined' scheme of steps. *"The basis for generalization in existential-phenomenological research is the specific experiences of specific individuals and groups involved in actual situations and places."* (von Eckartsberg, 1998, p.4) Seamon (2000) summarizes the steps von Eckhartsberg proposes as follows:

1. identifying the phenomenon in which the phenomenologist is interested;
2. gathering descriptive accounts from respondents regarding their experience of the phenomenon;
3. carefully studying the respondents' accounts with the aim of identifying any underlying commonalities/patterns;
4. presentation of findings, both to the study respondents and to fellow researchers.

For conducting a existential phenomenological study the described scheme of steps shall be seen as a guideline, which can be altered and individualized by the researcher and has to be customized to the specific nature of the phenomenon. Seamon and von Eckartsberg emphasize, that the individualization is the most important part for establishing the tools of description. Depending on the targeted phenomenon an individual implementation of the basic methodology has to be developed, which means that the idea is applicable to any field of study and can be used in architectural research.

For architectural research the investigated (1) phenomenon is outlined in the research question (see chapter '1. introduction'), the (2) accounts from respondents are gathered in the survey (see chapters '4. implementation' & '5. cases'), carefully (3) studying the accounts in the discussion (see chapters '6. results' & '7. discussion') and the presentation of findings by publishing the results.

2.2. urban analysis

Framework

The contemporary discourse of urban design tackles a big variety of topics. Walkability, Space Syntax and so on, are just keywords of what scholars work on. In terms of introducing the phenomenological thought to urban design, Jane Jacobs 'The Death and Life of Great American Cities' marks one of the deepest impacts of the 20th century. This book argues that streets and the pedestrian activity in them are the most important factors. It claims that a lively mix of land uses, building types and their organization provides particular qualities for the physical city. On the contrary a group of researcher of the Bartlett School of Architecture and Planning, London, work on the evidence based approach of measuring the 'qualities' of the city by examining the relationship between the physical space and social life of: *"the social content of spatial patterning and the spatial content of social patterning"* (Hillier & Hanson, 1984, p. x-xi). This theory has provided a profound empirical support for Jacobs approach to the subjective claim of the perception of urban environment by supporting the idea of the importance of the streets, visibility, and so on.

As the approaches of phenomenologists are mostly purely intuitive and not 'evidence based', also a central point of criticism of Jabobs' theory, the space syntax team provided a clear cartographic and mathematical procedure for recording certain elements and by that establishing empirical measurements of certain phenomena. *"Hillier's work has immediate relation to the phenomenological vantage point, because he recognizes how a world's underlying spatial structure, or morphology, as he calls it, guides particular actions and circulations of human bodies moving through that world and, how, in turn, a selfconscious understanding of this human world/physical world intimacy might lead to environmental design and policy that supports a stronger sense of place and community."* (Seamon, 1994, p. 36) So by mathematical/evidence based methods certain phenomena can be proven and the qualities they contain can be deducted, by decompile their structure of the quantitative validation.

According to Seamon (1994) there are at least three reasons for the phenomenological interest in the work of space syntax:

1. *It has demonstrated once and for all that the built environment, particularly through its spatial qualities, plays a significant role in supporting a lively urban environment;*
2. *Space syntax uses quantitative evidence in such a way that one can see clearly why the relationship between physical and human worlds makes such a difference;*
3. *Space syntax identifies the type of street network that supports a lively public life.*

A phenomenological additive would be the examination of specific qualities the urban environment consists of, because as the street (network) and its characteristics, the visibility and urban structure (land use) are defined, the repatriation onto the purely intuitive level of perception of space can help to even further understand everyday experiences and behaviors.

Evidence based approach

The multitude of aspects of which an urban space consists (as stated before) are quantitative and subjective intuitive qualities. In order to bridge the gap in terms of the measurement of perceived spatial qualities, specific cases has to be defined, on which the phenomenological methodology (in an adapted version) has to be tested. The cases shall be in an contemporary international context to account for cultural differences and being able to participate in today's architectural/ urban design discourse.

cases - mixed use urban complexes

"Traditional, organic cities grew on the basis of everyday activities over time. Travel was on foot, and construction was based on generations of experience. The result was cities on a scale adapted to the senses and potential of human beings. Today urban planning decisions are made on the drawing board, and little time is lost between decision and realization. The speed of new forms of transport and the often massive scale of building projects pose new challenges. Traditional knowledge about scale and proportions has gradually been lost, with the result that new urban areas are often built on a scale far removed from what people perceive as meaningful and comfortable." (van Gehl, 2010, p.80) This criticism of van Gehl illustrates the necessity of human scale and the retrieval of qualitative urban space. In the contemporary development of urban areas (in international context) - mixed use urban complexes (offices, retail, housing, ...) in medium scale are becoming popular. The density and intensity are reduced (compared to the central business districts) and a major focus is the urban quality and the users experience. Gehl states that in order to realize "[...] the dream of lively, safe, sustainable and healthy cities, we must begin with a thorough knowledge of the human scale. Understanding the scale of the human body is important if we are to work purposefully and appropriately with it as well as address the interplay between the small slow scale and the other scales also in operation." (van Gehl, 2010, p.80)

For this thesis two successive areas, one in Austria and one in China, have been chosen to on the one hand as a representation of the newly developed mixed use urban complexes and on the other hand account for cultural differences in any means. The two cases are:

- 'Viertel Zwei', Vienna;
- 'KIC Jiangwan', Shanghai.

methodology

The general idea of the methodology - of introducing a measurement method for subjectively experienced emotions was inspired by a study of neurobiologists of the Department of Neuroscience and Biomedical Engineering School of Science Aalto University, Finland. In their paper 'bodily maps of emotions' they conducted following study: *"Emotions are often felt in the body, and somatosensory feedback has been proposed to trigger conscious emotional experiences. Here we reveal maps of bodily sensations associated with different emotions using a unique topographical self-report method. [...] participants were shown two silhouettes of bodies [...] asked to color the bodily regions whose activity they felt increasing or decreasing while viewing each stimulus. [...] Perception of these emotion-triggered bodily changes may play a key role in generating consciously felt emotions."* (Nummenmaa, et al, 2013, p.1)

This method of visually record subjective emotions was transferred into an architectural context. As in the neuroscientific study people were shown certain images and specific terms which they should work on, yet the most outstanding difference is, that in the architectural context people have to mark the perceived quality onto the buildings, instead of where they have been felt. By aggregating the outcome images of the range of participants an 'average' or 'median' result of the overall results can be generated. The methodology of processing of the information works along the lines of the neuroscientific study and generates visual as well as text-wise information.

2.3. evaluation criteria

For being able to conduct the proposed 'evidence-based' phenomenological survey (see chapter '2.2. urban analysis') certain parameters have to be defined, on which it is established. One main parameter is set by defining the area of investigation (cases) yet the qualities questioned have to be defined.

Choice of terms

"If people are indeed sensitive to and respond to the perceptual clues of architectural environments, then it behooves us to elicit their impressions. To do so, we will need descriptive tools, and, especially, we will need to provide a sale appropriate for the description of the physical environment." (Kasamar, 1970, p.145) In his study Kasamar (1970) proposes a methodology to generate a catalog of terms and did so on an exemplary case:

- multi-occurring terms (describing architectural or urban situations) were taken from publications and magazines and compiled in a list;
- the terms were implemented in a study, in which contestants had to rate if there is a general relation to architecture or urban design and assign their importance on a numeric scale;
- the outcome values and their relations have been clustered and summarized to categories.

This catalog was taken and the most fitting:

- in terms of having a relationship to elements of the investigated areas;
- being partially abstract to provide room for interpretation;

terms for the cases were extracted:

1. *monumental;*
2. *progressive;*
3. *structured;*
4. *conservative;*
5. *purisitc.*

In order not to influence the contestants and gather the most genuine information concerning each term, no further definition of 'how to interpret the term' or 'what does it mean in architectural context' has been given.

Continuation of the thought

"As Hall noted in 1966, there was still so much to learn about the emotional and meaningful aspects of space that the field was just in the process of being delimited. It should be obvious that if the physical and psychological aspects of architectural space or the physical environment could be identified, then it might be possible to construct a scale on which environments could be rated." (Kasamar, 1970, p.145) In that sense the proposed methodology can provide a step forward to find the 'scale' on which environments could be rated.

Choice of terms for the atmospheric survey

Based on the same principles as the terms for the graphical survey, the terms are selected from the catalog (Kasamar, 1970) by using the most fit for the investigated cases (regarding the occurrence of urban elements, covering a broad spectrum of variations, ...). The only difference in choice was that not only one terms, rather a pair of termini (which are

opposing) was selected and questioned during the survey:

calm - busy; flexible - rigid; inspiring - discouraging; lively - dull; natural - artificial;
open - closed; orderly - chaotic; private - public; simple - complex.

Further parameters providing a base for the methodology

Distances

The size of the area was chosen to be almost equal for both cases and situations with certain distances to the evaluated object were provided. Van Gehl (2010) defines the distances appearing in urban spaces as follows:

- *Intimate distance: 0 to 45 cm - is the distance at which strong emotions can be exchanged;*
- *Personal distance: 45 cm to 1.20 m - is the contact distance between close friends and family members. Conversations on important topics take place here;*
- *Social distance: 1.20 to 3.70 m - describes the distances at which conversations about work, vacation memories and other types of ordinary information can be exchanged;*
- *Public distance: more than 3.70 m - describes the distance of more formal contact and one-way communication.*

This mixture of distances between the image frame and the situation which has to be evaluated can be seen in the outlining of the cases (see chapter '5. cases').

Human Scale

"For many reasons, in future we will have to build many large complexes and buildings with large dimensions and many stories. But neglecting the human scale is never an option. The human body, senses and mobility are the key to good urban planning for people. All the answers are right here, encapsulated in our own bodies. The challenge is to build splendid cities at eye height with tall buildings rising above the beautiful lower stories." (van Gehl, 2010, p.85) The sizes, shapes and proportions of the buildings, plazas and other elements of the area have not been directly included into the study or serve as a base for conclusions. Referring to Pallasmaa this study deals with the perception of urban space and not the "*[...] analysis of the physical proportions and properties of the building or a stylistic frame of reference.*" (Pallasmaa, 1987, p. 250) The results are broken down onto the human scale and work with the inputs given by the contestants.

3. methodology

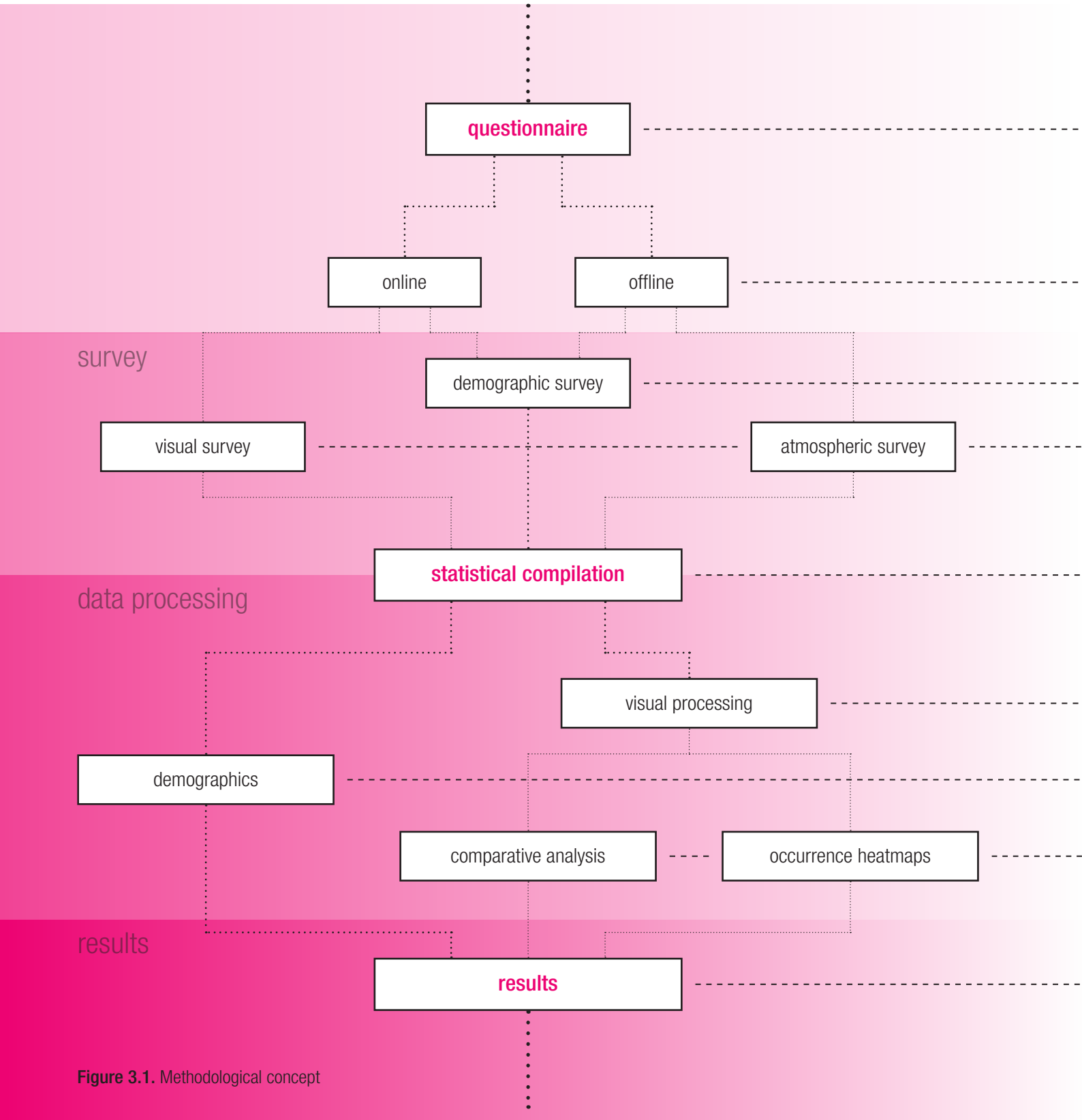


Figure 3.1. Methodological concept

Based on the elaborated theory (see chapter ‘2. theory’) a questionnaire (see subchapter ‘questionnaire’) was developed which investigates the visual perception of urban attributes.

The survey consists of two parts: an online visual inquiry (see chapter ‘4.2. questionnaire.online questionnaire’), executed in a drawing function and an offline questionnaire with ad-hoc, on site, real time participant interaction (see chapter ‘4.2. questionnaire.offline questionnaire’).

The demographic survey investigates general information (see subchapter ‘demographics’) in both online and offline questionnaire.

The visual and atmospheric survey inquires perception/feeling based data (see subchapter ‘visual survey’ & ‘atmospheric survey’).

In the statistical compilation all the gathered data is being processed and subjected to further analysis (see chapters ‘4.3. visual information processing’, ‘4.4. occurrence mapping’ & ‘4.5. comparative analysis’)

Superimposed visual data is generated (see subchapter ‘visual processing tool’).

The demographic information is evaluated and summarized (see subchapter ‘demographics’).

The comparative analysis contrasts the terms, in terms of difference within the sampled situations (see subchapter ‘comparative analysis’) and the occurrence heat-maps in a purely ‘graphic way’ (see subchapter ‘occurrence maps’).

The outcome of the gathered information is documented in chapter ‘6. results’.

The following description is organized corresponding to the workflow of this thesis (see figure '3.1. Methodological concept'). For replicating the process, one can use the following guideline.

questionnaire

Based on the theoretical input (see chapter '2. theory') a two-phase survey was developed in an:

- online questionnaire;
- offline questionnaire.

online questionnaire

Each participant has to provide:

- the major demographics:
  - » a name or alias;
  - » a gender;
  - » an age class;
  - » a statement, whether the contestant is trained as architect/urban designer or not.
- visual data in a series of images (of the investigated area) combined with a trigger-term (stating the questioned quality) in which each pixel:
  - » is 0 = no value = visual data does not match the term;
  - » is 1 = value = visual data matches the term.

The data is processed into a demographic section with a matching visual output and subjected to further analysis (see: for demographics subchapter 'demographics' & for visual data subchapter 'visual processing').

offline questionnaire

Each participant has to provide:

- the major demographics:
  - » a name or alias;
  - » a gender;
  - » an age class;
  - » a statement, whether the contestant is trained as architect/urban designer or not.
- atmospheric data in a series of ad-hoc on spot questions, asking to rate the perceived quality on a scale from one to five:
  - » 1 = the perceived quality matches the term nr.1;
  - » 5 = the perceived quality matches the term nr.2.

The data is processed into a demographic section and an atmospheric section and subjected to further analysis (see: for demographics chapter 'demographics' & for atmospheric data chapter '7. discussion').

statistical compilation

The outcome of the questionnaire is used for further analysis, which is subdivided into three main steps:

- demographics - processing all demographic data;
- visual processing & occurrence mapping - processing all visual data;
- comparative analysis - processing the terminology based visual data to find their intensity and density.

demographics

All the demographic data (from the online and offline survey) is analyzed and output into statitics showing:

- the general overview among the whole survey;
- an average of the three basic information questioned (gender, age, architect or not).

visual processing

The visual data of the questionnaire (from each participant, every input given) is taken and the matching image of the series (for the matching term) are compiled to one outcome image (average mean):

- a mask is applied to restrain the field of investigation (every pixel outside is locked on 0)
- each pixel is read for its value (0 or 1);
- each value is stored into one list, if there are double entries, they are summed up;
- after reading all the available data the values of the list are divided by the number of participants.

The outcome image is subjected to further processing (see subchapter ‘occurrence mapping’ & ‘comparative analysis’).

occurrence mapping

The input two dimensional visual data (see subchapter ‘visual processing’) is mapped onto an abstracted three dimensional model of the investigated situation by:

- importing the data onto the matching location in the 3D model;
- transferring the values of the 2D image onto the abstracted 3D model;
- saving the values on the 3D model and depending on the amount, changing the color (red).

The generated occurrence maps are subjected to further analysis (see chapter ‘6. 2. occurrence maps’).

comparative analysis

The comparative analysis uses the two dimensional visual data (see subchapter ‘visual processing’) and evaluates the difference of density of drawn inputs with their affiliated intensity.

results

There are four major outcomes which are subjected to further analysis (see chapter ‘6. results’) and further on to a discussion (see chapter ‘7. discussion’) namely:

- the demographics (see chapter ‘6.1. demographic statistics’);
- the occurrence maps (see chapter ‘6.2. occurrence maps’);
- the comparative analysis (see chapter ‘6.3. comparative analysis’);
- the atmospheric data (directly passed on from the survey) (see chapter ‘6.4. atmospheric data’).

This previous text sums up the whole process, for implication please see chapter ‘4. implementation’.

4. implementation

The survey (see figure ‘4.1’ & ‘4.2’), dataflow (see figure ‘4.3’ & ‘4.4’) and outcome (see figure ‘4.5’ to ‘4.8’) of the survey is schematically explained in the following:

- see **Figure 4.1.** Demographic data input: The demographic data has to be filled in the home screen of the online survey or stated during the on spot ad-hoc questionnaire. A name or alias, a gender, an age class and the question whether the contestant is an architect or not has to be answered and submitted. The gathered data is subjected to further analysis (see figure ‘4.7. Demographic statistics’)

- see **Figure 4.2.** Visual data input: The visual canvas enables the user/contestant to mark or ‘draw’ onto a given image. There are two functions which allow either to give an input via drawing or to take out via erasing. The pen/eraser have a standardized size. The information has to be submitted via the ‘step forward’ or revoked via the ‘step backwards’ button and is subjected to further processing (see figure ‘4.3. Applying mask’).

- see **Figure 4.3.** Applying mask: The submitted information is filtered via the application of a mask, which blends out the areas of non interest and the information is subjected to further processing (see figure ‘4.4. Visual processing’).

- see **Figure 4.4.** Visual processing: The filtered data is compiled by superimposing all submitted data (from every participant of the survey) and outputs a two dimensional graphic file with the information of the asked quality. The generated data is subjected to further processing (see figure ‘4.5. Occurrence map’ & figure ‘4.6. Comparative analysis’)

- see **Figure 4.5.** Occurrence map: The provided 2D information (see figure ‘4.4. Visual processing’) is transferred into 3D data and projected onto the affiliated location (based on the image given in the online questionnaire). This process of allocates the ‘quality’ into the area of investigation.

- see **Figure 4.6.** Comparative analysis: Each visual outcome of the questioned terms (see figure ‘4.4. Visual processing’) will be compared to every other term, as the single pixels will be analyzed in every situation to find differences among the qualities regarding intensity and density.

- see **Figure 4.7.** Demographic statistics: The gathered data (see figure ‘4.1. Demographic data input’) is analyzed and compiled to provide an overview about the participants of the survey.

- see **Figure 4.8.** Atmospheric data: The gathered data of an on spot ad-hoc survey (see subchapter ‘offline questionnaire’) is compiled to provide an overview of the perceived spatial qualities on the site of investigation.

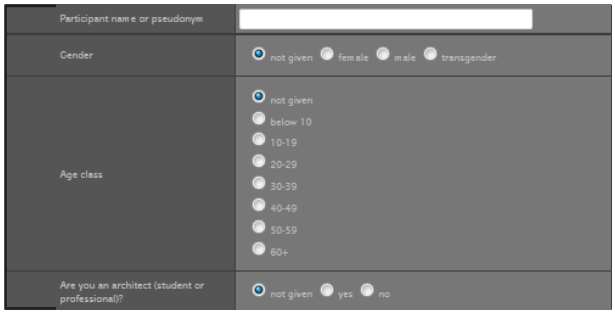


Figure 4.1. Demographic data input

Figure 4.2. Visual data input

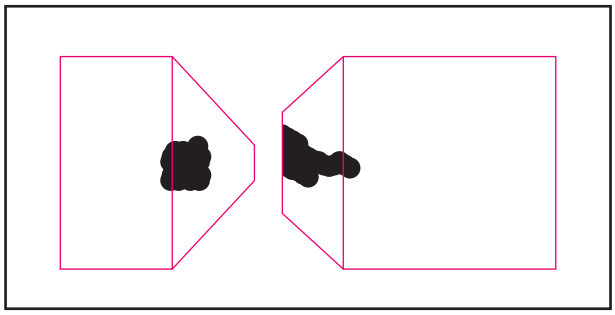


Figure 4.4. Visual processing

Figure 4.3. Applying mask

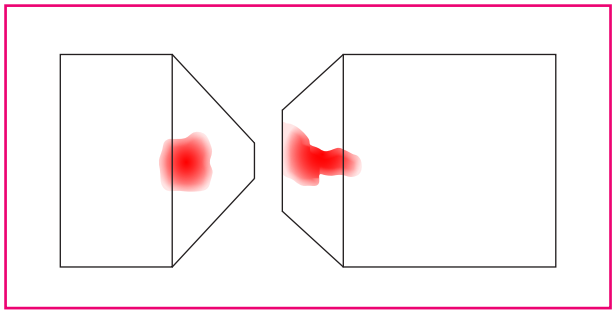


Figure 4.5. Occurrence map

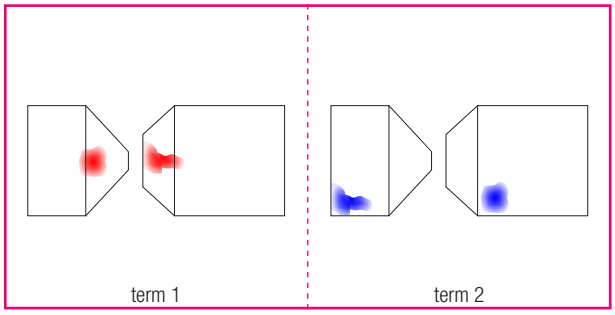
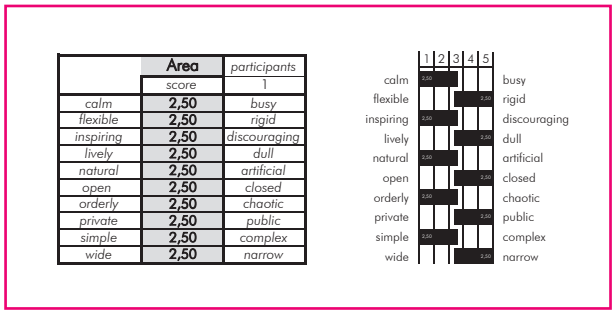


Figure 4.6. Comparative analysis



	Area score	participants 1	
calm	2,50	busy	busy
flexible	2,50	rigid	rigid
inspiring	2,50	discouraging	discouraging
lively	2,50	dull	dull
natural	2,50	artificial	artificial
open	2,50	closed	closed
orderly	2,50	chaotic	chaotic
private	2,50	public	public
simple	2,50	complex	complex
wide	2,50	narrow	narrow

Figure 4.8. Atmospheric data

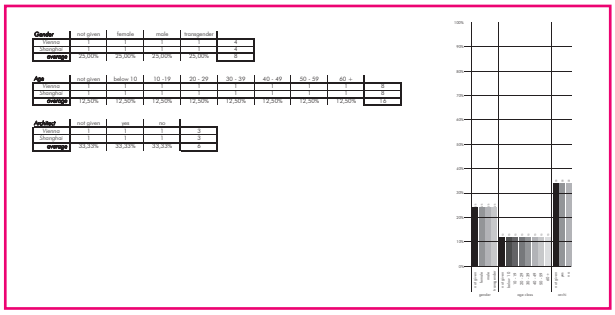


Figure 4.7. Demographic statistics

4.1. questionnaire

Details

The questionnaire was developed in two phases to target different investigation values (both are gathering demographic information):

- an online tool, to exclusively target the visual aspect (see subchapter 'Online questionnaire [V 2.0]');
- an offline, ad-hoc, on site survey, to record the atmospheric/emotion based perception of the participants (see subchapter 'Offline questionnaire').

Online questionnaire [V 1.0]

The first version of the survey tool was set up as an online drawing function. The user was navigating through a series of pictures on which he/she was able to mark and erase areas, with different colors, different pen and rubber thicknesses and the ability to show or hide the drawn information. The photograph, which was investigated by the user, was set in the background and in front of it, a canvas for manipulation was placed.
The program is able to record the necessary data and generate a visual output, which has to be saved to the users own device. In the next step, the user has to send a data package to the author in order to be able to use it for further investigation. The output of the visual data is directly ready for further treatment, yet the demographic information, which is also asked for, is saved as picture and has to be manually transferred into a useful data structure.

The first tests were run with the program, but since the idea is to make the survey as attractive as possible for the user, a few problems had to be solved before going public:

- There demographic information was saved in an inefficient file format, which had to be changed manually from a picture to a data structure;
- The provided tools for drawing were to diverse, which prolonged the amount of time for finishing the questionnaire and made it very difficult to use it efficiently;
- The fact that the user has to safe the generated data on his/her own device, turned out to be the major problem, because in some cases the device did not allow to do so.

Due to the issues of version 1.0 an updated version was developed and used for the online survey, which shall be described in depth (see subchapter 'Online questionnaire [V 2.0]')

Online questionnaire [V 2.0]

The V 2.0 of the online questionnaire was set up as an online application, which is embedded in a homepage and saved on a server that also allows storing the gathered information directly in a directory on it. The code of the application is printed in the appendix (see chapter '10.3. survey tool').

The explanation of the performance of the survey tool will be elaborated in parts:

- Basic setup of the application on the homepage (see subchapter 'Setup of the application');
- The canvas and the storage on the server (see subchapter 'Canvas and upload to server');
- The outcome data and download for further usage (see subchapter 'Data storage').

Setup of the application

Users who want to participate in the survey have to enter the specific 'URL' to get directed to the home-screen of the questionnaire. This screen provides all the basic information about the survey as text and also serves as the gate for entering the core of the questionnaire. In order to be able to move further to the first slides, general demographic information needs to be provided (see figure '4.1.1. Homescreen'). This information is:

- A name or alias (which will serve as the prefix in the name of any saved information during the user participating in the survey);
- A gender (which can be *not given *female *male or *transgender);
- An age class (*not given *below 10 *10-19 *20-29 *30-39 *40-49 *50-59 *60+);
- And the question, whether the contestant has somehow a relationship to architecture (*not given *yes *no).

The only mandatory data, that needs to be filled in, is the users name/alias (if the name/alias is typed in, the program automatically checks the file directory, in which the data is saved, if it was already used - if yes, it informs the participant to choose another one). All other inputs are voluntarily and can always be set on *not given.

This basic demographic information is automatically being saved to the server under the name provided. This text file will be created for any user who presses the 'start survey' button, even if the participant does not finish the whole process.

The first output of the survey is the demographic data sheet providing the requested information, saved as a text file onto the server.

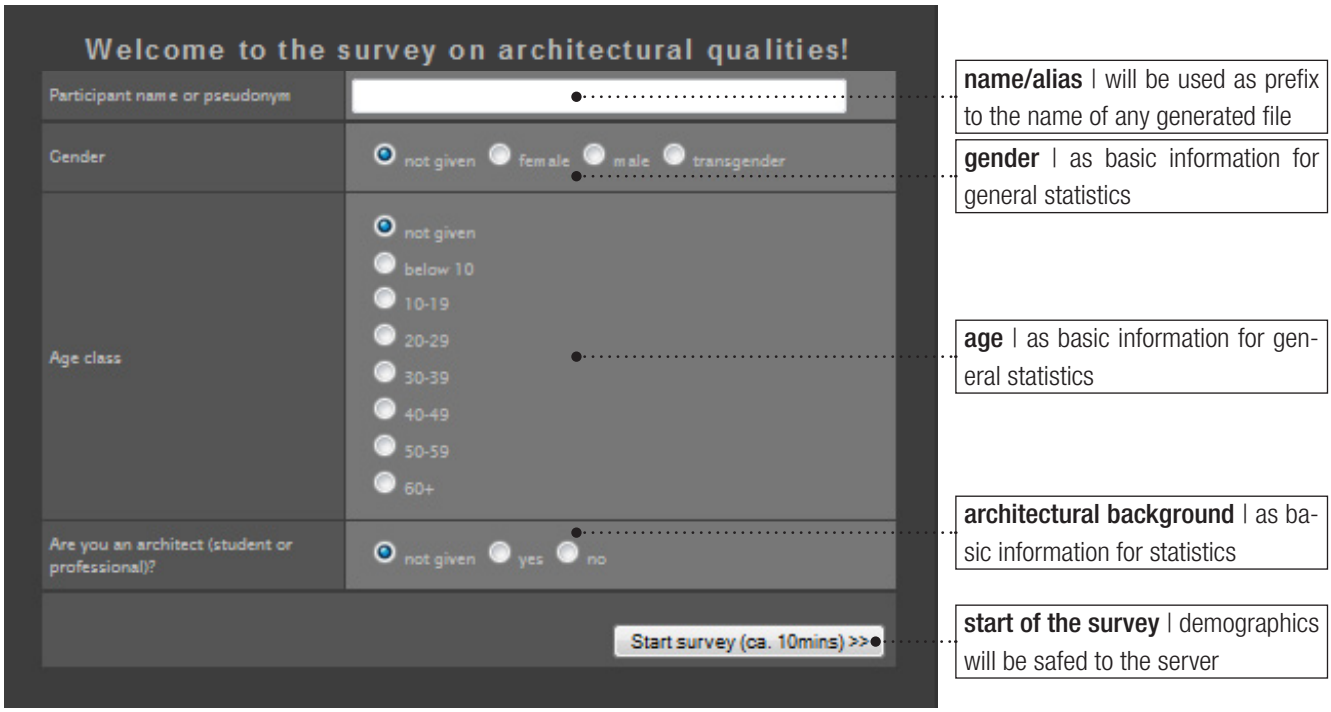


Figure 4.1.1. Homescreen | Demographic data input

Canvas and upload to server

After the necessary information was provided in the home-screen, the participant moves further to a series of photographs, on which he/she has to mark certain architectural qualities, based on the terms stated in the headline (see figure '4.1.2. Visual data input screen'). For every photograph each term will be named and the contestant has the possibility to mark areas on it. The screen is divided in three main parts:

- The headline, stating which term the person has to work on;
- The canvas, in which the person is actually doing something;
- The previous or next buttons, which bring you to the previous or next step of the survey.

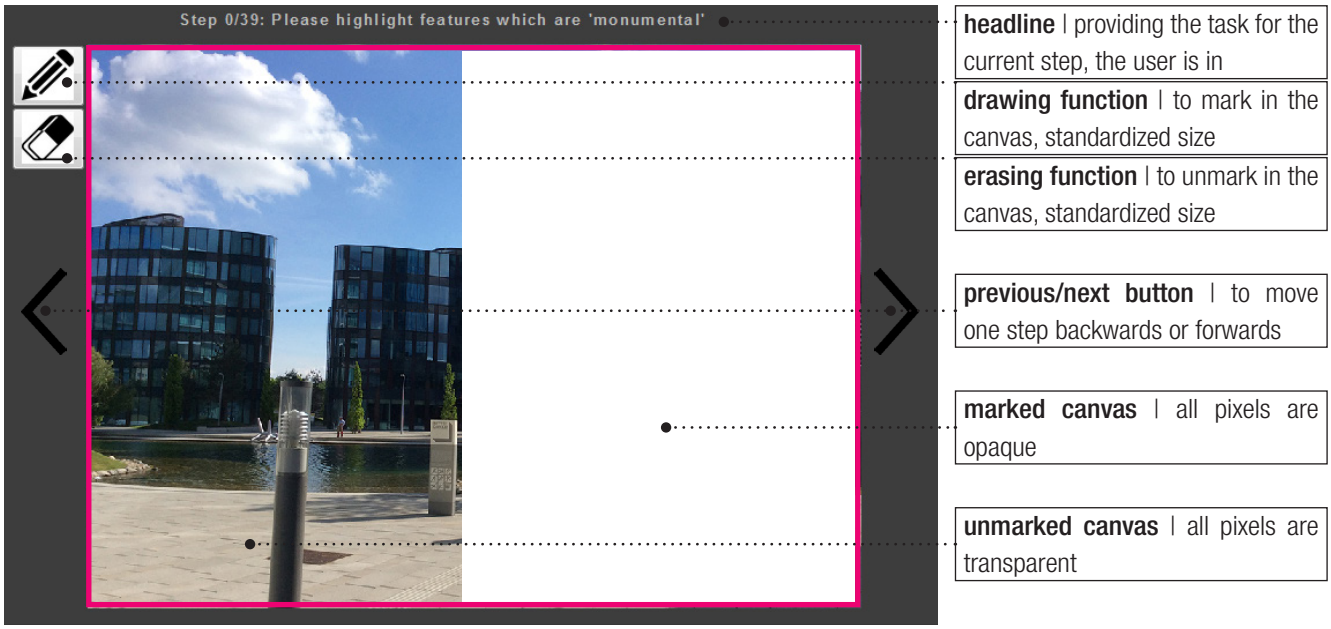


Figure 4.1.2. Visual data input screen I Example

The headline (see figure '4.1.2. Visual data input screen') is a simple text, which will be updated for every step the participant takes. The counter at the beginning marks the steps already taken compared to the total amount of steps in the survey (Example: Step 0/39). For every step taken the term in quotation marks (Example: 'monumental') will be replaced with a new "quality" - term, yet the task stays the same.

The canvas (see figure '4.1.2. Visual data input screen') serves as the area of direct interaction between the user and the survey. It is a same sized transparent layer put above the photograph and as the user thinks he/she is drawing onto the picture, he/she is actually changing the values of pixels set in front of the photograph from 0 = transparent to 1 = opaque (white) or vice versa for erasing. When the drawing or erasing function is active and the cursor pressed somewhere inside the given canvas, each pixel that is inside the circular region of the pen will change its value and saved temporarily. (see figure '4.1.3. conception of the canvas') The size of the pen and eraser is fixed to avoid confusion and to simplify the interaction process. The pen is set as the standard tool for entering any step, since the whole canvas is transparent, the erasing tool would not show any effect on it, if there is nothing drawn yet.

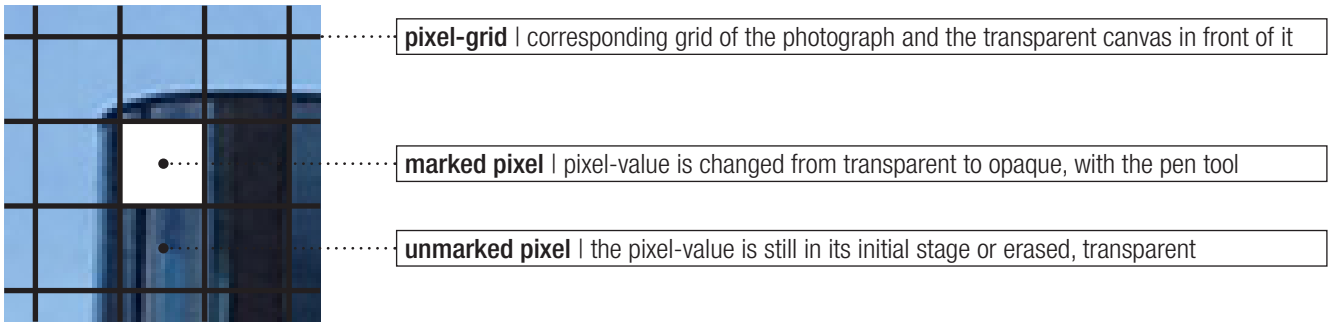
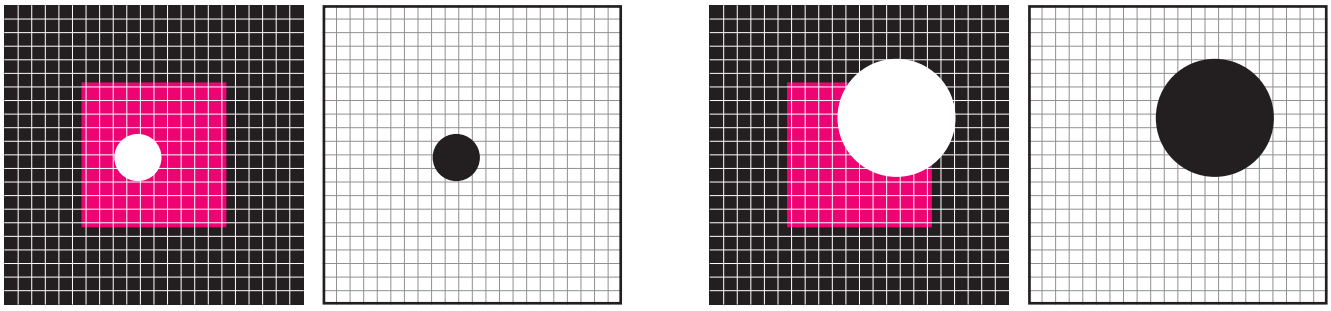


Figure 4.1.3. Conception of the canvas | Example

The previous or next buttons (see figure '4.1.2. Visual data input screen') work as the major saving function. As the "start survey" button on the home-screen, these functions safe the input data to the server. As soon as the contestant presses the 'next' button, the application will automatically create a new file with the name/alias as prefix followed by the number of the step which was finished. The application does this for every step, till the participant reaches the "goodbye screen" at the end (see figure '4.1.5. Goodbye screen'). If a participant choses, to move to the previous step, the 'previous' button has to be used. It will lead to the screen before, but all the input information will not be available anymore. An empty new canvas will appear and every step that was taken after the one the participant is in has to be redone. In the background the program automatically jumps back to this step and overwrites all following data.

The examples (see figure '4.1.4. Application processing example') *schematically illustrate the input and outcome.*



1 | Marked area in canvas 1 | Stored data (image) 2 | Marked area in canvas 2 | Stored data (image)

Figure 4.1.4. Application processing example | Outcome is saved to the server

Data storage and goodbye screen

As the application automatically safes all files to the server, the data can easily be accessed. The files are named with the prefix of the 'name/alias' divided by an underscore and after the 'number of step' (as an image), to have a clear structure. Together with the demographic data 'name/alias' (as a text file) all the needed information are provided for the next steps.

In order of being able to receive feedback (providing the contact information of both the author and tutor professor) for the survey and to express the gratitude for taking time to do the survey, a goodbye screen is installed (see figure '4.1.5. Goodbye screen').

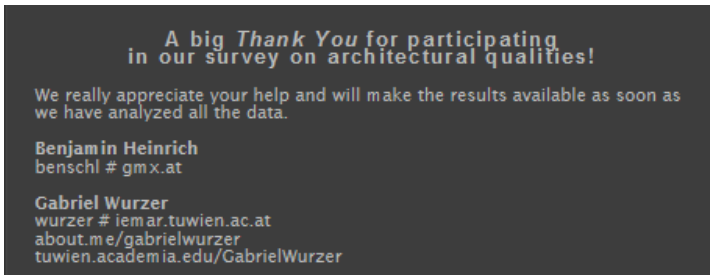


Figure 4.1.5. Goodbye screen | Providing the contact information of the author and tutor professor

Offline questionnaire

The gathering of the onsite information of atmosphere and feeling of participants, a simple questionnaire was developed, which asks for general demographics in combination with a rating of certain terms on a scale from one to five (see figure '4.1.6. On site survey'). The contestants are approached directly and for every situation in the area asked for their input, which was entered in the sheet.

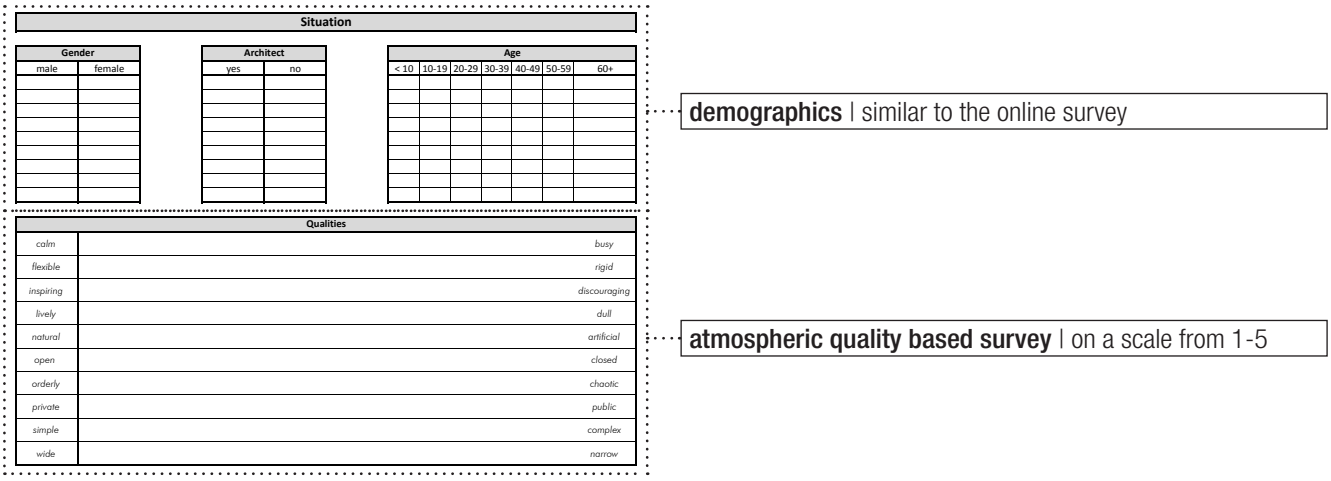


Figure 4.1.6. On site survey | Form that the observer fills in

The participants of the survey will be placed in the exact point the photographs for the online survey were taken and aligned into the direction of the image frame. By looking at the specific real life imagery, the information gathering dialogue/process starts:

- The survey is done with a simple data sheet, which can be accessed online and opened on any mobile device (excel file);
- The applicable data stated by the participant are entered in the cells provided for it;
- For every situation in the area a new sheet is set up and for the demographic survey a text file, which is corresponding to the one from the online questionnaire, is generated.

The 'quality based survey' area divides itself into ten parts, within each has a pair of terms. The rating from one to five will be entered and after finishing the survey with all the contestants, the values will be added up and divided by the number of participants (this creates the arithmetic mean).

4.2. visual information processing

Basic information

The visual information processing tool compiles the gathered visual information of the online questionnaire, for further development into the three-dimensional heat map. It automatically finds the matching situations and terms from all the participants of the survey and exports the superimposed information as an image. The code of the tool is printed in the appendix (see chapter '10.4. visual information processing tool').

Data input

The data provided by the online questionnaire is downloaded and imported as one package into the application. The files (images, named as stated in the previous chapter '4.1. questionnaire') are analyzed and being sorted corresponding to their situation and term. The amount of files is depending on the number of participants and will be shown for each case in a histogram/density distribution diagram.

The filenames are split into two parts, the first part (name/alias) will be deleted and the second part (number (situation/term)) will be used for the further operations. This process anonymizes the data and stores it for the matching numbers in a list (see figure '4.2.1. Process example').

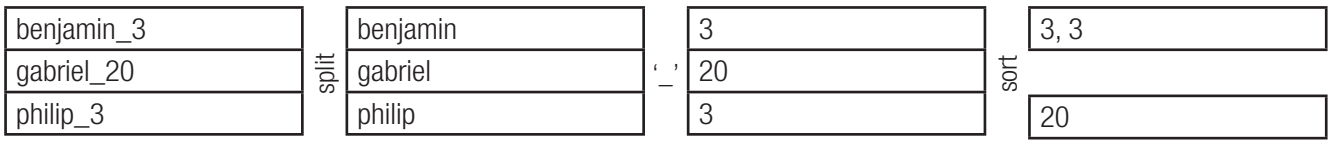


Figure 4.2.1. Process example | anonymization and sorting process

Processing data

The sorted files are then individually taken and analyzed. Each file is broken into its pixels (each pixel receives a number) and the value is read. If the value is 0 (transparent) nothing will be saved for the pixel number and the process moves to the following pixel. If the number is 1 (opaque) the value will be saved under the corresponding number of the pixel into a new list. This process will be repeated for every image in the number storage and the new list will receive the complete data set, as the tool adds up the values for each image and content.

Applying masks

In order to differentiate between certain elements of the image, masks can be applied (see figure '4.2.3. Process example'), which exclude areas of none or separate the output into areas of different interest. This can be due to:

- If only the built environment shall be investigated, the natural elements (Example: trees, bush, ...) can be excluded and vice versa;
- Disturbing elements (Example: sun reflections, people, lamps, ...) can be excluded if desired.

The mask contains a list of pixels, which is corresponding to the list of the processed data, in which certain values are locked/deleted and due to that not capable of saving data. This step keeps the length of the list, yet changes the contents of certain numbers. As for the output of an image it will not show any transparencies outside of the, from the mask, defined area.

Remapping

The newly created list contains now the superimposition of all values (entered by the participants) of the online survey and will in the next step be divided by the number of files used. This arithmetic mean of values (sum of values divided by the number of participants) is further on remapped from a 0 - 1 range to a 0 - 255 range and the values created are rounded to integer numbers (round up), which is beneficial for creating an image file with transparencies (Example: *.png) (see figure '4.2.2. Remapping of the transparency values').

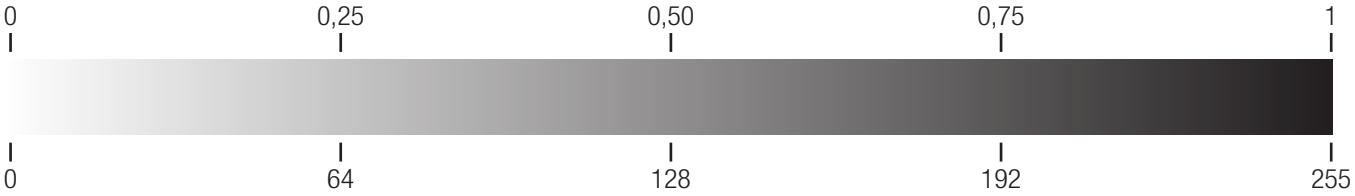


Figure 4.2.2. Remapping of the transparency values | from 0 - 1 to 0 - 255

Outcome

Due to the superimposition of all the data, the tool will create:

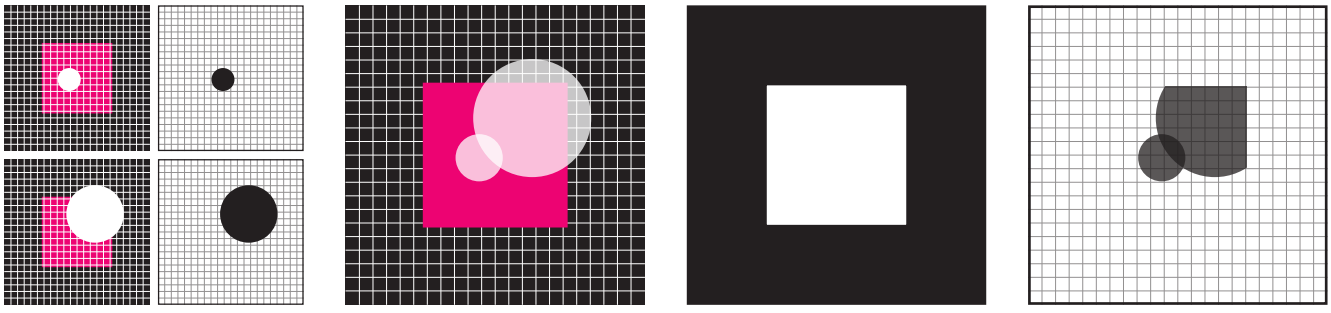
*number of situations in the area * terms asked for = number of superimposed images*

These images (file type must be able to carry an alpha/transparency channel) contain pixels with various gradients of transparencies (of white or black) depending on how many participants marked the same pixel for the same situation and term. Examples for the values of one pixel:

non of the participants marked the pixel (255,255,255,0)
half of the participants marked the pixel (255,255,255,128)
all of the participants marked the pixel (255,255,255,255)

The images are saved as independent files (example: *.png) to a chosen directory for further usage.

The example uses the dummy files from the chapter 'questionnaire' and schematically shows the process (see figure '4.2.3. Process example').



processed data of survey tool | superimposition of data | application of mask | generated output

Figure 4.2.3. Processing example | import of the survey data | output of superimposed image

4.3. occurrence mapping

Basic information

In order to create the desired urban quality heat-map, two main inputs need to be prepared appropriately:

- the two dimensional information, extracted and compiled in the previous steps (see chapter '4.1. questionnaire' and '4.2. visual information processing') serves as the fundamental base;
- a three dimensional model of the investigated area, which serves as the carrier material on which the two dimensional information will be projected on.

The code of the occurrence mapping tool is printed in the appendix as a screenshot out of grasshopper - an application for rhino 3D (see chapter '10.4. occurrence map tool').

3D model

The three dimensional model is an abstracted version consisting of the volumetric information of the area. Based on information extracted form plans and online 3D models the area was modeled. The street level is generally kept as a simple plane, only if there are major level changes in height (more than approximately 50cm), these are taken in consideration. A regular point grid is set onto the whole area for further usage in the process.

The 3D model of the area consists of various abstracted information (see figure '4.3.1. 3D model example'):

- the volumetric abstraction of the buildings;
- the street level as a plane;
- the greenery abstracted to approximately fit the real situation (no trees, bushes, ...);
- water elements if they serve as a major design input of the area;
- the location point of the photographer, at which the pictures for the survey tool were taken.

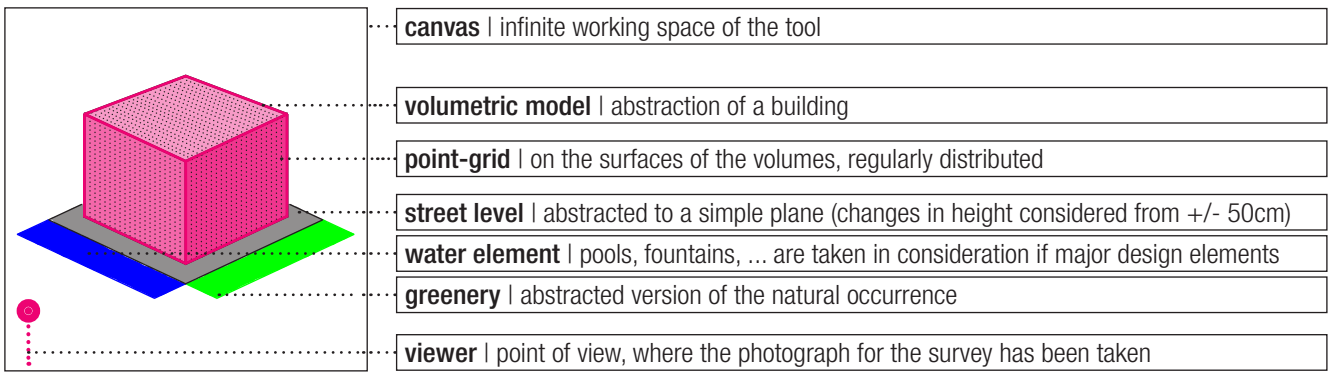


Figure 4.3.1. 3D model example | basic information/elements that can occur in the abstracted 3D model

Point of view | location of the photographer

The approximate location and the settings of the camera are being saved during the survey and are subjected to further usage. The information is transported into the 3D model as a location point with a fixed height, a direction of view, a tilt, a roll and a field of vision, which is matched to the abstracted model in order to be the most fitting (see figure '4.3.2. Projection settings example').

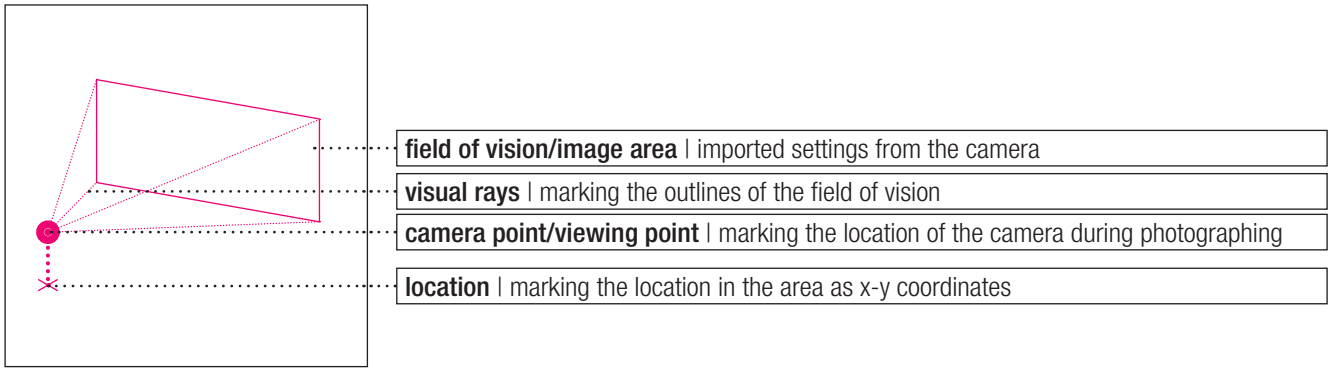


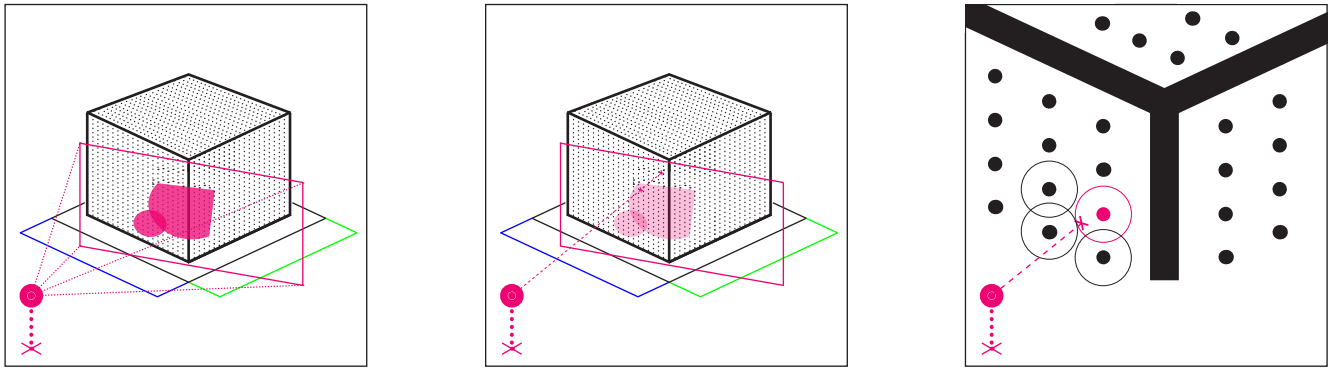
Figure 4.3.2. Projection settings example | basic information/elements that can occur in the abstracted 3D model

quality mapping

All the previous stated information (see subchapter '3D model' & 'Point of view') needs to be imported and set up in the tool in order to proceed to the quality mapping procedure. The sequence of mapping works as follows:

- the compiled outcome of the 'visual processing tool' is imported and set on the location of the field of vision/ image area (see figure '4.3.3. Process example');
- the tool automatically divides the image into fully transparent and partially opaque pixels;
- the transparency value of all pixels is read from the image source and saved into a list, corresponding to the list of pixels (each pixel one value);
- all pixels with a value higher than 0 receive a 'middle' point (located in the center of gravity of the square-pixel);
- a visual ray, starting from the camera point/viewing point, is passing through the middle point of the pixel with an infinite length (see figure '4.3.3. Process example');
- as soon as the visual ray intersects with a 3D element (building, floor, greenery) of the area, the intersection point is marked;
- the closest point of the regular point grid (generated) is evaluated and the transparency value of the pixel is stored into a list, corresponding to a list of points (see figure '4.3.3. Process example').

The example shows the process of transferring 2D data on the 3D model (see figure '4.3.3. Process example').

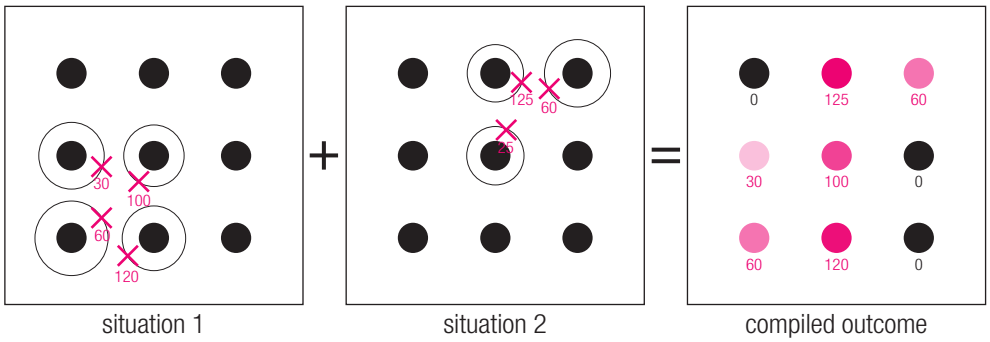


import of the compiled image | visual ray intersecting image & volume | finding closest gridpoint on volume

Figure 4.3.3. Process example

Heat-map generation

This process of transferring the transparency values of the image to the regular point gird of the area is repeated for every pixel of every image for the same term (questioned in the survey). If there are two values set onto the same grid point, the maximum will be stored and the smaller value deleted. This process of finding the maximum regularizes the whole area in order to patch incoherencies during the photographic survey (pictures might overlap in certain areas) (see figure '4.3.4. Compiling example').



The intersection points of situation 1 and situation 2 are being superimposed and in order to regularize the outcome only the maximum value will be stored in the list of grid points.

Figure 4.3.4. Compiling example | two situations are compiled to one outcome gird

After compiling all the images the outcome will be one grid point list for every term of the survey (which further on equals one heat-map) (see figure '4.3.5. Process example').

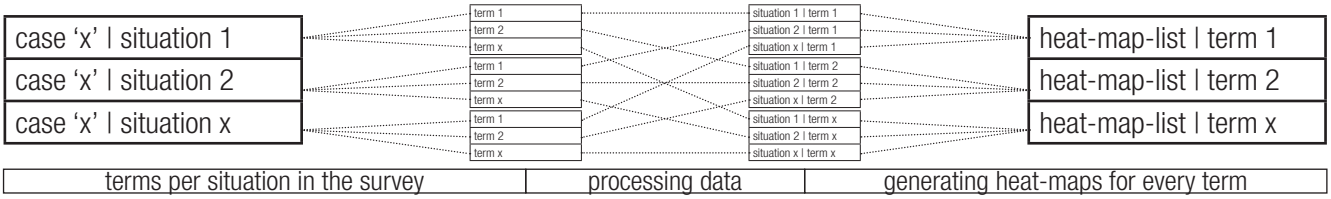


Figure 4.3.5. Process example | reduction of situations to heat-maps of the whole area for every term

The list generated in the process now has at least one value to every point in it (at least 0). The introduction of a color spectrum now allows to visually output the 'heat-map' and serves as a 3D overview of the investigated qualities of the area (see figure '4.3.6. 3D heat-map example').

For the example used in the previous steps, the outcome (urban-quality-heat-map) is shown (see figure '4.3.6. 3D heat-map example'). *It is an abstract example for illustration and shows an approximate solution.*

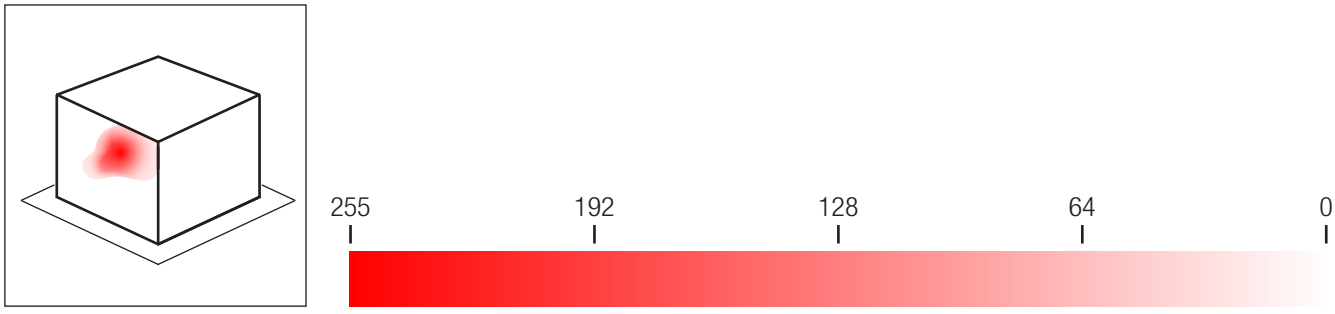


Figure 4.3.6. 3D heat-map example | outcome of the heat-map-generation tool; exemplary colorscale (every color possible)

4.4. comparative analysis

Input

The compiled images (see chapter '4.2. visual information processing') are being analyzed and compared to each other. Each image of a situation for a term is taken and being contrasted to an image of the same situation of another term (see figure '4.4.1. Process example | comparative analysis').

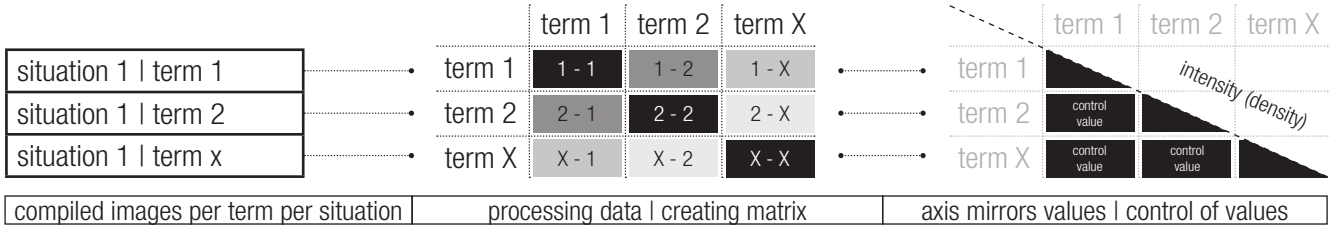


Figure 4.4.1. Process example | comparative analysis

Process

The tool (code of the tool see appendix chapter '10.7. comparative analysis tool') imports the compiled images and creates for each situation a matrix of the size:

number of terms by number of terms (according to the cases, see chapter '5. cases').

In this matrix every term will be compared to every other term in the means of each pixel of the image will be taken (see figure '4.4.2. Pixel comparison') and:

- Analyzed if it was marked (intensity) and compared to the correlating pixel of the other image:
  - » if non was marked it will move to the next pair of pixel and the value 0 will be saved;
  - » If one was marked in either picture, the value will be saved;
  - » if both were marked the lower value will be subtracted from the higher one and saved;
- Analyzed for the saved values, in terms of their density:
  - » no value - equals 0;
  - » two similar values - equals 0;
  - » two different values - equals the absolute difference of the values.

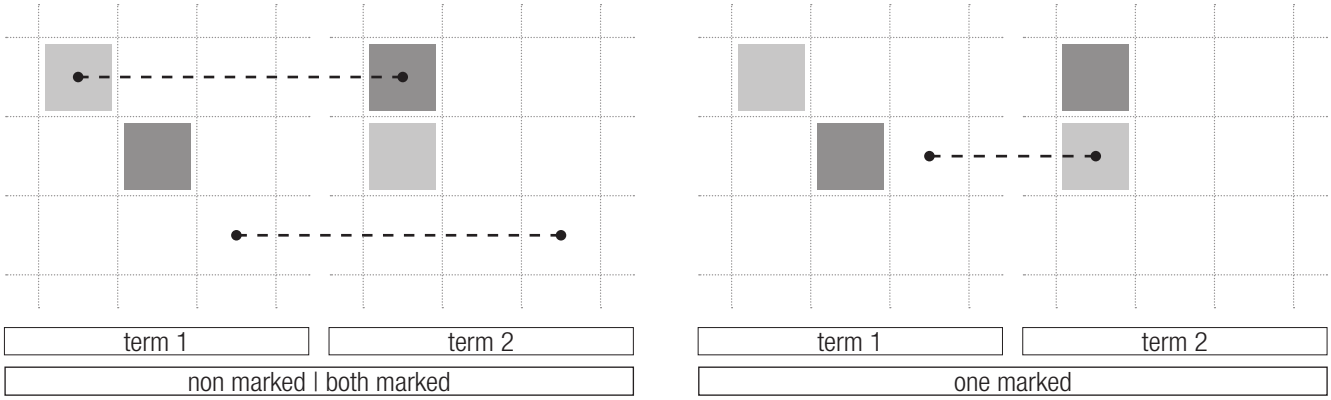
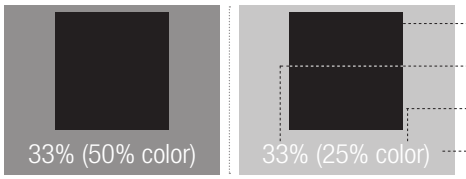


Figure 4.4.2. Pixel comparison

The comparative analysis tool creates a new list (and a corresponding image) of values which will be

Outcome

All outcome values are exported in matrices which carry various information (see figure '4.4.3. Matrix example'):



- the generated image of the difference in intensity and density;
- intensity in '%' of difference;
- density in '% color' of difference (shown in brackets);
- the background color in a transparency to highlight the color difference.

Figure 4.4.3. Matrix example, data shown is purely fictional

Single results

For every situation a matrix of outcome values and images (the values can always be used for creating a corresponding image to the outcomes of the visual information tool) will be created, which can be used to:

- have immediate feedback to find visual inconsistencies in the shaping;
- make an interpretation of single results (find highest or lowest difference and analyze the visual features);
- find architectural/urban elements of interesting values for interpretation.

Overall results

There are two variations of the overall result created:

- the average:
  It is the result of the total of the values divided by the number of items in the set;
- the median:
  It is the result of the number where half of them are lower and half are higher.

The average and the median can be the same, might be close or differ highly.

Interpretation of the results

The values generated in the comparative analysis can be (evidence based) interpreted, under the condition that people understood what they have to do and did this carefully, in the following way:

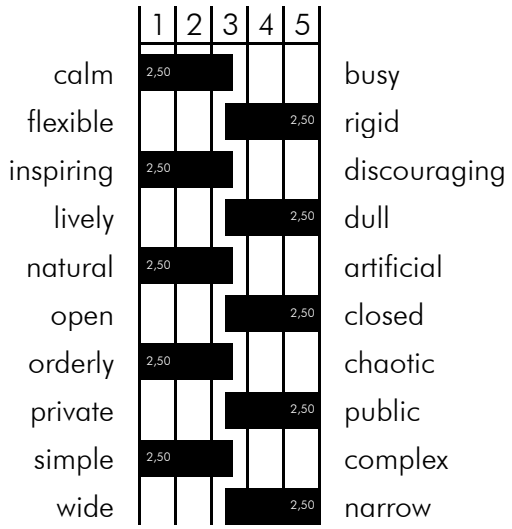
- if the intensity is low and the density is low as well people either:
  - » marked very specific elements;
  - » agree on the quality of certain elements;
- if the intensity is low and the density is high people either:
  - » did not mark specific elements;
  - » distributed the quality in the picture;
- if the intensity is high and the density is low people either:
  - » marked very specific elements;
  - » agree on the quality of certain elements;
- if the intensity is high and the density is high as well people either:
  - » did not mark specific elements.
  - » distributed the quality in the picture.

4.5. atmospheric data

The atmospheric data gathered in the offline survey (see chapter '4.1. questionnaire', subchapter 'offline questionnaire') is processed to graphs/diagrams in order to serve as a base (see chapter '6. results') for discussion of the results (see chapter '7. discussion').

The terms asked during the investigation are analyzed separately, the values gathered are compiled and divided through the number of participants in order to calculate the arithmetic mean. Each pair of terms was rated on a scale from one to five:

calm - busy; flexible - rigid; inspiring - discouraging; lively - dull; natural - artificial;
open - closed; orderly - chaotic; private - public; simple - complex.



	Area	participants
	score	1
calm	2,50	busy
flexible	2,50	rigid
inspiring	2,50	discouraging
lively	2,50	dull
natural	2,50	artificial
open	2,50	closed
orderly	2,50	chaotic
private	2,50	public
simple	2,50	complex
wide	2,50	narrow

Figure 4.5.1. Graph/Data example, data shown is purely fictional

The calculated values are used to generate graphs for visualization. These graphs are generated for each area of investigation (see figure '4.5.1. Graph/Data example').

4.6. demographics

The demographic information gathered during the survey in the:

- online questionnaire (see chapter '4.1. questionnaire', subchapter 'online questionnaire');
- offline questionnaire (see chapter '4.1. questionnaire', subchapter 'offline questionnaire');

is analyzed and output in graphs/diagrams, to illustrate the values (see figure '4.6.1. Graph/Data example').

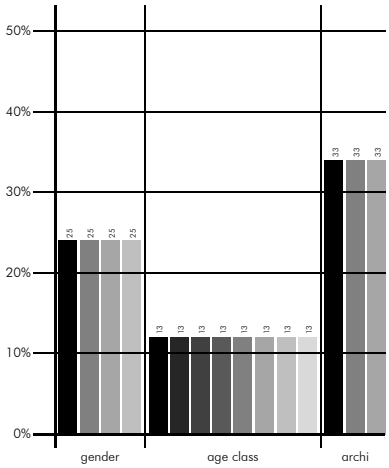
The gathered information is divided into three groups:

- gender (which can be *not given *female *male or *transgender);
- age (*not given *below 10 *10-19 *20-29 *30-39 *40-49 *50-59 *60+);
- the question, whether the contestant has somehow a relationship to architecture (*not given *yes *no).

As every information given, is processed in the analysis, the answer 'not given' is output as a separate, value in order not to distort the results.

The answers to every question are taken and summed up according to their affiliation and afterwards divided through the total number of inputs. The result is output as a percentage to generate a simple overview for:

- each case - online;
- each case - offline;
- the total amount of participants - online;
- the total amount of participants - offline;
- the total amount of participants.



Gender	not given	female	male	transgender	
Vienna	1	1	1	1	4
Shanghai	1	1	1	1	4
average	25,00%	25,00%	25,00%	25,00%	8

Age	not given	below 10	10 -19	20 - 29	30 - 39	40 - 49	50 - 59	60 +	
Vienna	1	1	1	1	1	1	1	1	8
Shanghai	1	1	1	1	1	1	1	1	8
average	12,50%	12,50%	12,50%	12,50%	12,50%	12,50%	12,50%	12,50%	16

Architect	not given	yes	no	
Vienna	1	1	1	3
Shanghai	1	1	1	3
average	33,33%	33,33%	33,33%	6

Figure 4.6.1. Graph/Data example, data shown is purely fictional

'Figure 4.5.1. Graph/Data example' demonstrates the two variations of displaying the output data:

- the table: illustrates the amount of collected data, as well as the corresponding percentage calculated;
- the graph: illustrates only the percentage of the corresponding data - purely visual.

The processed demographic data is subjected to further analysis and discussion (see chapter '7. discussion'). The results are stated in chapter '6. results'.

5. cases

The developed methodology (see chapter '3. methodology') and its implementation (see chapter '4. implementation') are to be tested on two international cases:

- Vienna, the 'Viertel Zwei' area (see subchapter 'viertel zwei');
- Shanghai, the 'KIC Jiangwan' area (see subchapter 'kic jingwan').

Both cases are successful examples of urban development and highly competitive in the international context. The cases were chosen due to their similarities in:

- the contemporary design;
- the general urban layout;
- the functions (offices, (temporary) housing, recreation, ...);
- the integration in the city;
- ...

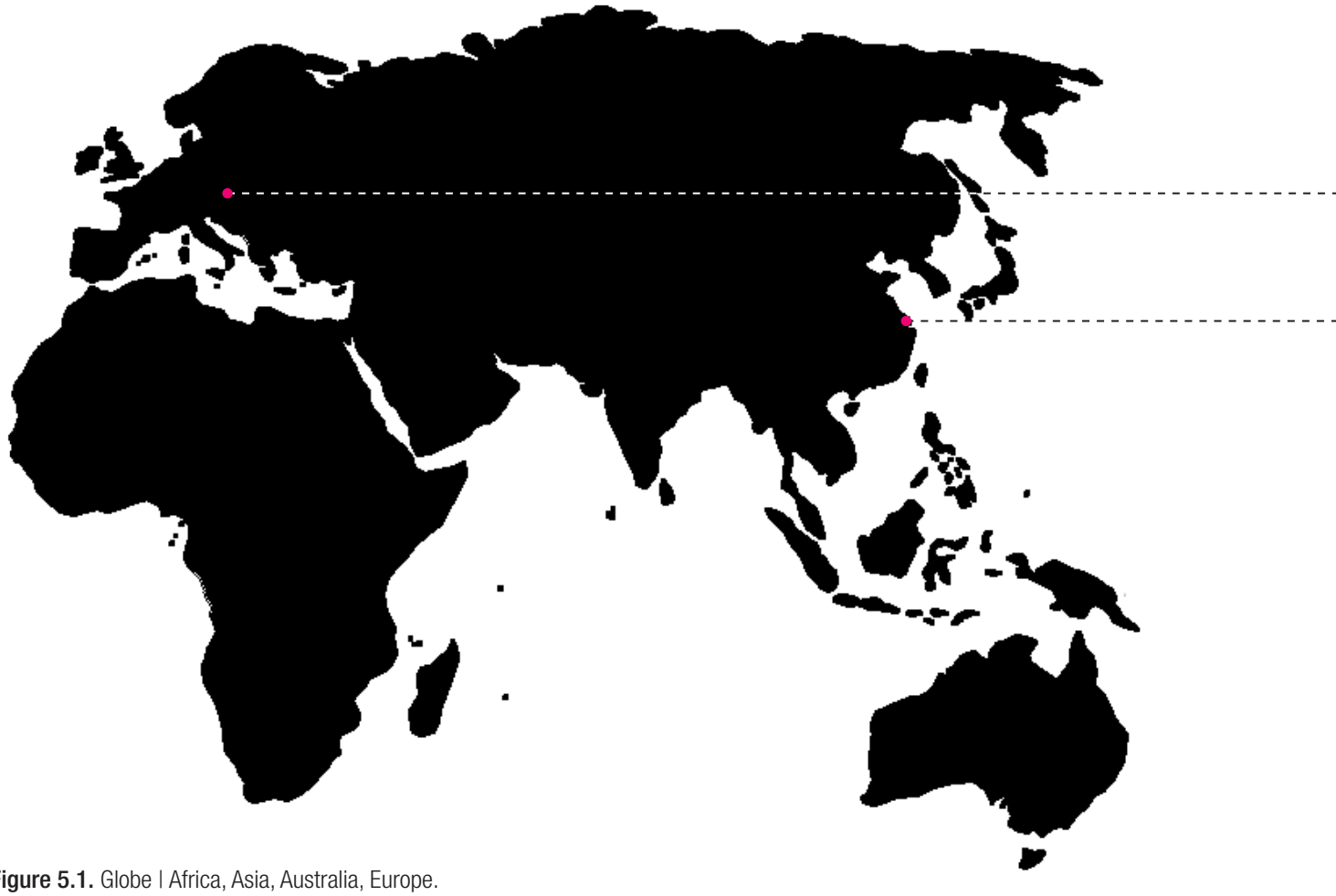


Figure 5.1. Globe | Africa, Asia, Australia, Europe.

Figure 5.2. Vienna, Austria, Europe. | © banjado.com

Figure 5.3. Shanghai, P.R. China, Asia. | © 123rf.com

5.1. viertel zwei

The VIERTEL ZWEI area is one of the most successful city development projects of Vienna in the last years. It covers about 40.000m² and is located in the second district, northeast of the city center, directly next to the recreational Prater area. Due to the extension of the subway line U2 (the station 'Krieau' is located at the main entrance) in 2008, the area is directly connected to the city center and serves as attractive location for business visitors or tourists. There are several functions in the area, as there is a hotel with over 250 guest rooms, the head office of a major Austrian oil company, several offices, restaurants, a nursery school and even apartment buildings. A few teams of well know national architects designed the buildings and after the official opening in 2008 it received the most prestigious Austrian project development award DIVA, for its visionary and innovative character. The whole concept of the area serves as one big conglomeration of ideas, where not only the architecture, also the landscape design, the branding and commercialization works hand in hand.
The greenery of the Prater and the idea of water from the river Danube, which is located in the north, were taken into the area by building only 50% of the ground area. Recently it was named as one of the most attractive urban public spaces in Vienna (result of a public voting on Facebook).

Infrastructural key facts of the area (see u2stadt.at/projekte_viertel2)**:**

- ~5km to the city center (Stephansplatz) and about ~17km to the airport of Vienna (VIE);
- 4 subway stations to the center (about 6 minutes) & close to the highways A4, A22 and A23;
- directly next to the 'Messe Wien' (the major convention space of the city);
- directly next to the new campus of the University of Economics and Business;
- various sports facilities in walking distance (jogging, golf, horse riding, tennis, soccer, baseball, ...).

The project was so successful, that the construction of the second phase VIERTEL ZWEI PLUS starts in 2015.

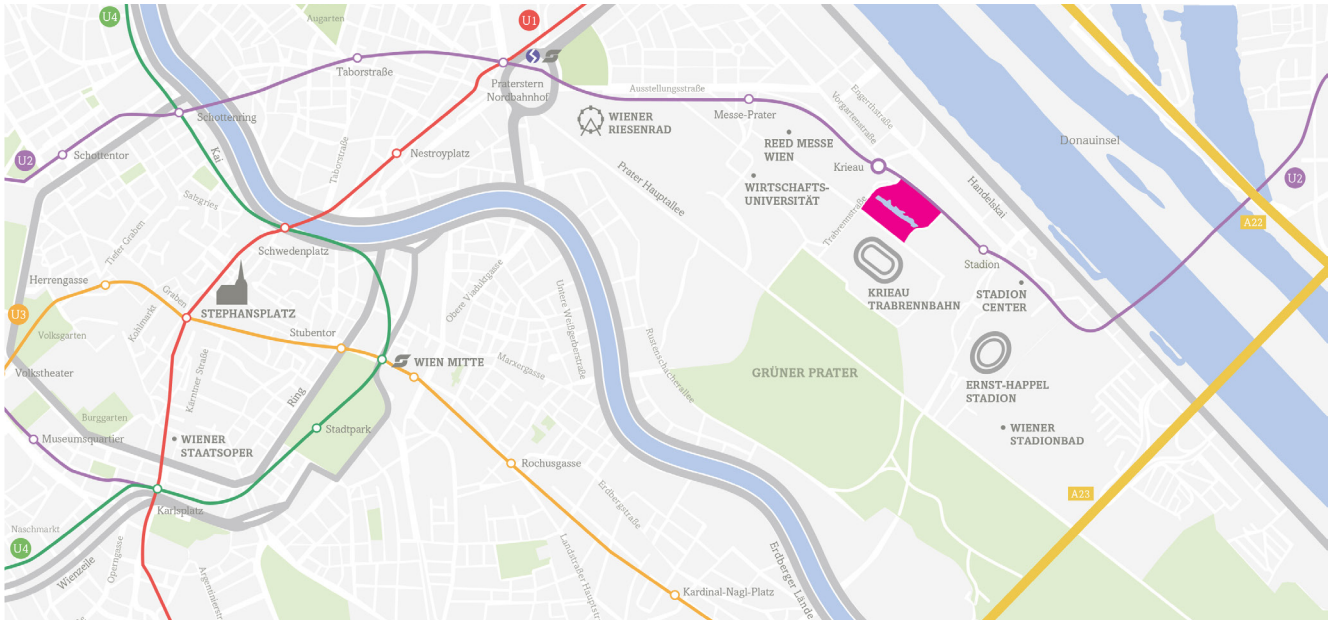


Figure 5.1.1. Location in the city context | north-east of the the city center | © IC Projektentwicklung

Selection criteria

The VIERTEL ZWEI area is not only successful in marketing and commercialization, it also serves as a profound example for the current architectural/urban design discourse in Vienna. There is a fast population growth (by 2029 there are supposed to be two million inhabitants) and this requires on the one hand to expand the city (Seestadt Aspern, new district in the north-east of Vienna) and on the other had redensification (of currently un- or misused spaces) - two main ideas of the city development plan 2025. These two concepts are found all over the city and the VIERTEL ZWEI project serves as a good example of redensification. Due to its urban character, design and organization, as well as the architectural formalization it is highly competitive with international examples of newly developed urban areas. Its functional mixture, the generous usage of 'natural' landscape and the ecological building systems make it an appealing project.

As the VIERTEL ZWEI shows a lot of beneficial tangible aspects and is very popular for people to linger and enjoy their time, the "architectural qualities" and atmosphere it creates are interesting factors, which have to be deeper investigated. To make them feasible, an overview of the core area is provided (see figure '5.1.2. Walkthrough') and are implemented in the questionnaire (see chapter '4.2. questionnaire').

Figure 5.1.2. Walkthrough the core area of the Viennese site | Starting from the main entrance, the pictures were taken in a clockwise walk around the central pont, with the intention to cover most of the built and natural environment.

5.2. ‘kic’ jiangwan

The ‘Knowledge & Innovation Community’ (KIC) JIANGWAN is situated in Wujiachang sub-center of the Yangpu district. It covers about 800.000m² and is directly located next to the Jiangwan stadium. The main plaza was built below street level at Songhu Road No. 234, which also serves as one of the main entrances to the area. Due to its ultimate proximity to the metro (line 10) stop ‘Jiangwan Stadium’ it is directly connected to the city center. Furthermore Songhu Road serves as a major street leading to the north, starting from the northern ‘city-sub-center’ Wujiaochang. There are about ten major universities and colleges close to the area (Tongji University, Fudan University, Shanghai University of Finance and Economics, ...) and more than one hundred research institutions. The core development idea was to create a “Work-Live-Study-Relax” environment for people with the emphasis on education, technology, culture, research and business. The masterplan was consulted by SOM Co., Ltd. (Skidmore, Owings and Merrill, LLP) and consists of the KIC Plaza, KIC Village, Jingwan Regency, University Road and the Jiangwan Sports Centre. About 500 national and international enterprises are gathered in the area (IBM Global, Oracle R & D Center, Deloitte, ...) and residences/apartment buildings, as well as hotels are distributed all around. A conference center and shopping opportunities/restaurants are integrated to supply the area. The sunken plaza serves as the main area of investigation, due to its character and refinement. Greenery (grass, trees, ...) serves as a major design element and the leveling of the area creates a protected area (sound, ...).

Infrastructural key facts of the area (see kic.net.cn/en)**:**

- ~10km to the city center (People Square) and ~40km to the international airport of Shanghai (PVG);
- 9 subway stations to the center (about 40 minutes) & close to the ‘Middle Ring Road’;
- directly next to the ‘Jiangwan Sports Center’;
- directly next to the ‘Qiujiang River’ and a major recreational area of the city in the north;
- close to University campuses of Fudan, Tongji and Shanghai University of Finance and Economics.

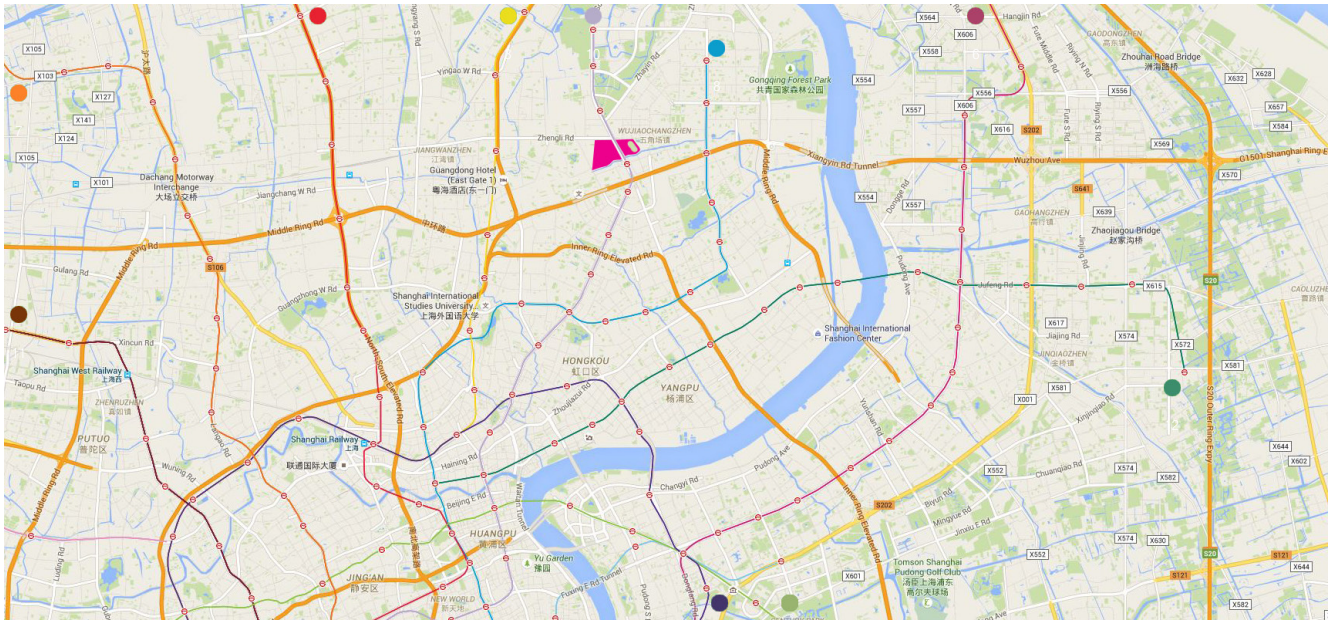


Figure 5.2.1. Location in the city context | Situated north of the the city center, connected to metro line 10

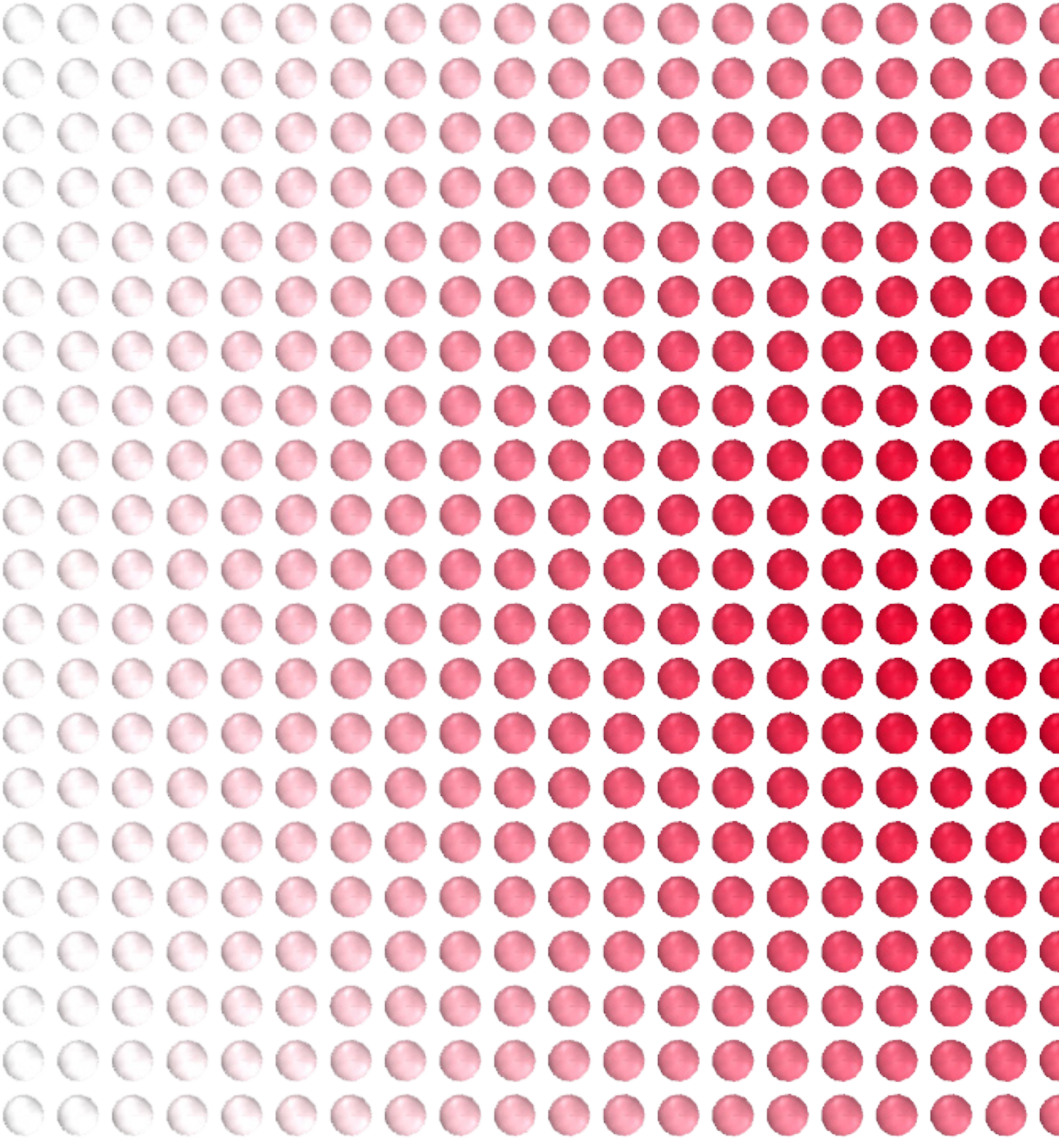
Selection criteria

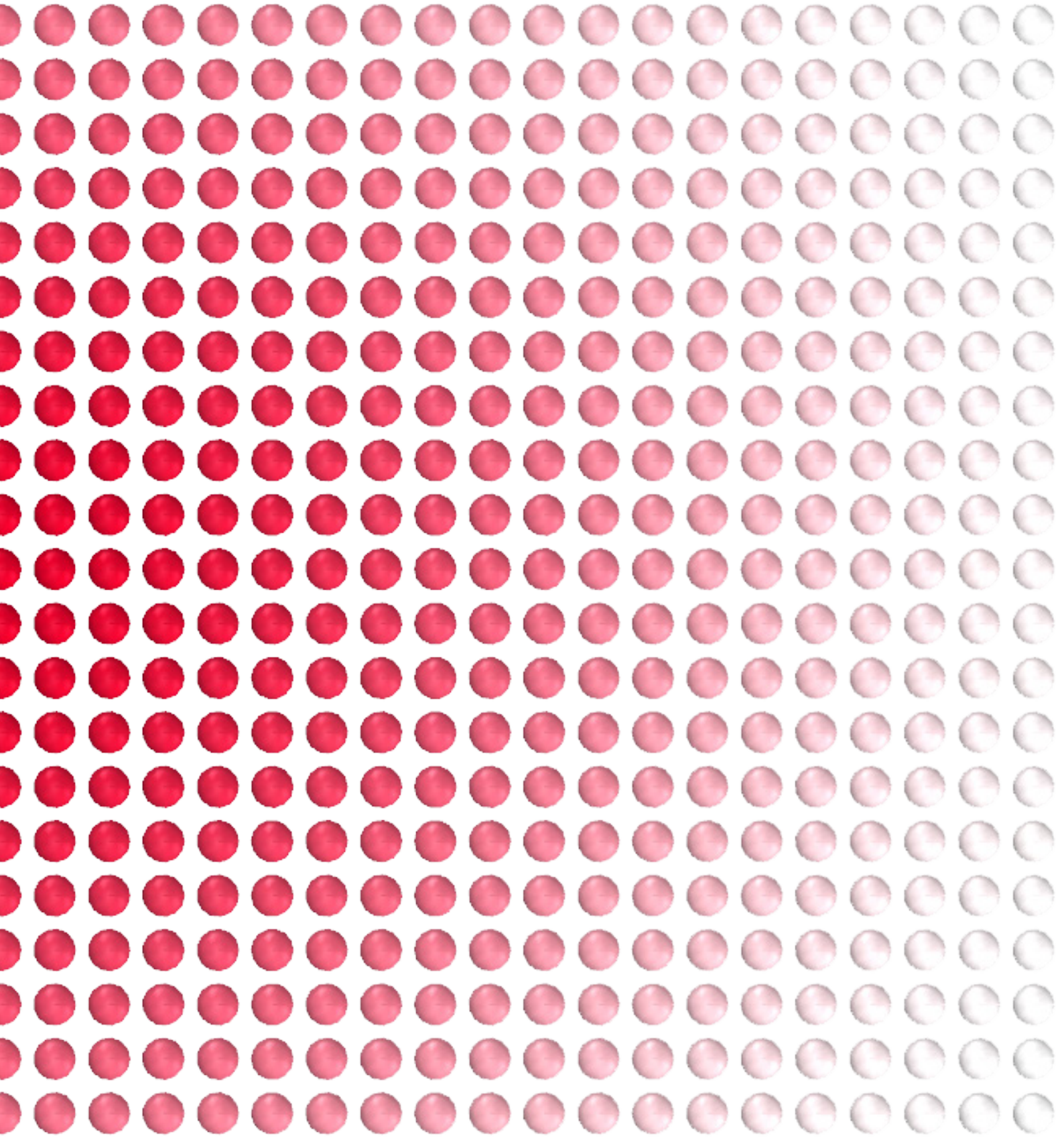
The KIC JIANGWAN area is not only successful in business development and attractive for international companies, it also serves as a profound example of the current architectural/urban design discourse in Shanghai. The fast population growth of the central area of Shanghai requires the city to rethink its current structure and provide new working/housing forms for the new generation of inhabitants. It is an innovative pilot urban construction and catching the spirit of scientific innovation of Silicon Valley. The locality becomes a hub for cultural exchange, communication and an entrepreneurial paradise.
"Innovation, entrepreneurship, LOHAS, Building the Think Tank of Shanghai", is the key motive of the area. Due to its functional conception and the broad spectrum of living/working/eating/shopping opportunities the area becomes highly attractive and competitive for international comparison. Architecture/urban design wise it is a highly diverse area with an uncountable number of points of interest.

As the KIC JIANGWAN shows a lot of positive aspects for the development of urban areas in Shanghai, the "architectural qualities" and the atmosphere on spot are highly interesting factors. To make them feasible, an overview of the area is provided (see figure '5.2.2. Walkthrough') and implemented in the questionnaire (see chapter '4.2. questionnaire').

Figure 5.2.2. Walkthrough the core area of the Shanghai site | Starting from the main entrance, the pictures were taken in a clockwise walk around the central plaza, with the intention to cover most of the built and natural environment.

6. results





6.1. demographic statistics

The demographics gathered in the survey (see chapter '4.1. questionnaire') are being processed (see chapter '4.6. demographics') and output (see chapter 'Viertel Zwei | Vienna' & 'KIC Jingwan | Shanghai').

'Viertel Zwei' | Vienna

The overall (compilation of the online & offline demographics) demographics (see figure '6.1.1. Overall demographics') show that the participants were almost equally distributed in gender, yet the age class was mainly young people (between 20 - 40 years) (~84%). Most of the contestants who participated in the survey did not have any relation to architecture or urban design (79%).

Regarding the online demographics (see figure '6.1.2. Online demographics) it clearly shows that the majority of contestants was male (~57%) and in an age class of 20 - 29 years (~71%). Most of the contestants did not have any relation to architecture or urban design (~57%) or did not give an answer (14%).

The evaluation of the offline demographics (see figure '6.1.3. Offline demographics) shows that the gender of participants was almost equally distributed (female ~54% & male 45%) and in an age class was situated between 20 years and 40 years. Most of the participants questioned in the area of investigation did not have any relation to architecture or urban design (~92%).

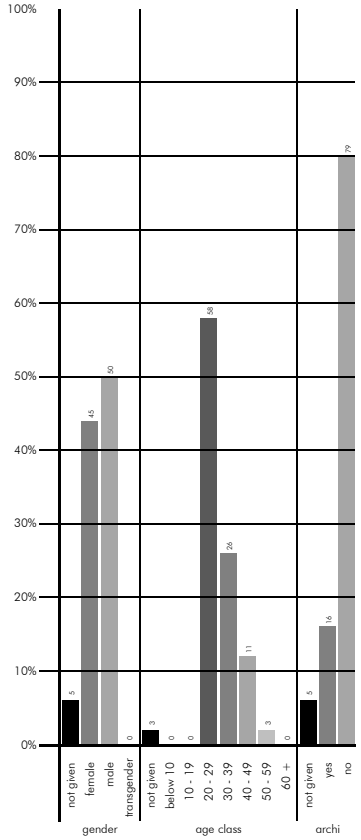


Figure 6.1.1. Overall demographics

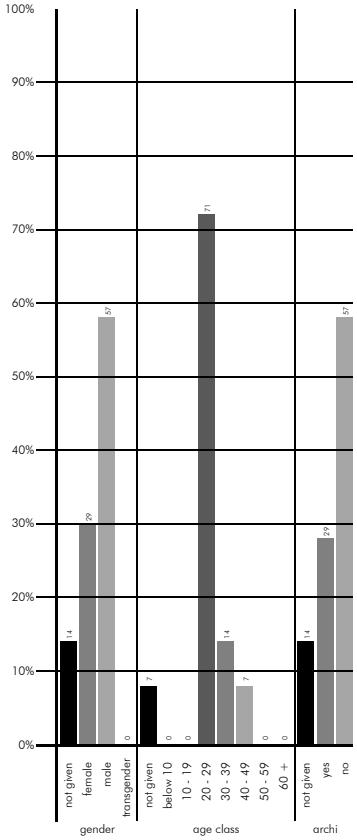


Figure 6.1.2. Online demographics

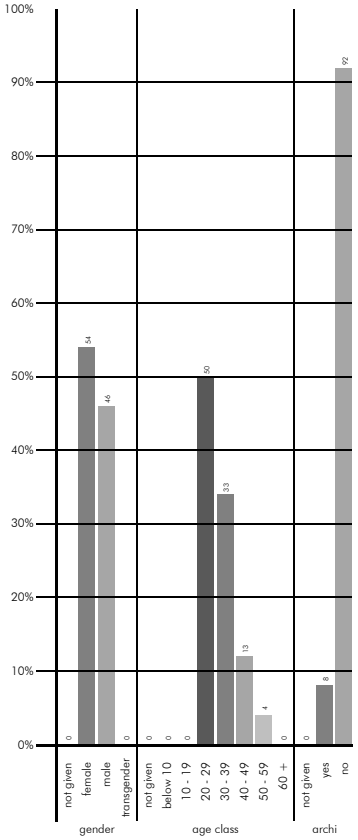


Figure 6.1.3. Offline demographics

‘KIC Jingwan’ | Shanghai

The overall (compilation of the online & offline demographics) demographics (see figure ‘6.1.4. Overall demographics’) show that there have been slightly more male (55%) than female (41%) contestants. The age class was mostly between 20 - 29 years (72%) and the majority of the participants did not have any relation to architecture or urban design (79%). Generally there was a low percentage of ‘not provided’ information.

Regarding the online demographics (see figure ‘6.1.5. Online demographics) it outlines that the distribution of the gender of the contestants was equal (46% male and female) with 8% of not provided information. The majority of the participants was between 19 - 29 years and in general with non younger than 19 and older than 39 years. 8% of the participants did not provide their age. Concerning the relationship to architecture or urban design 70% did not have any, 15% had a connection and 15% did not provide any information.

The evaluation of the offline demographics (see figure ‘6.1.6. Offline demographics) shows that there were slightly more female participants (63%) than male ones (37%). The age distribution had a range of 19 - 49 years with 12% of 10 - 19; 63% of 20 - 29 and 25% of 30 - 39. The majority 88% of participants did not have any relationship to architecture, yet 12% had a link.

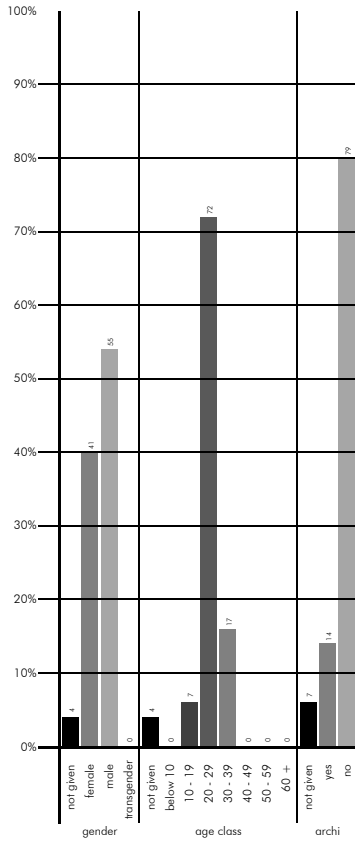


Figure 6.1.4. Overall demographics

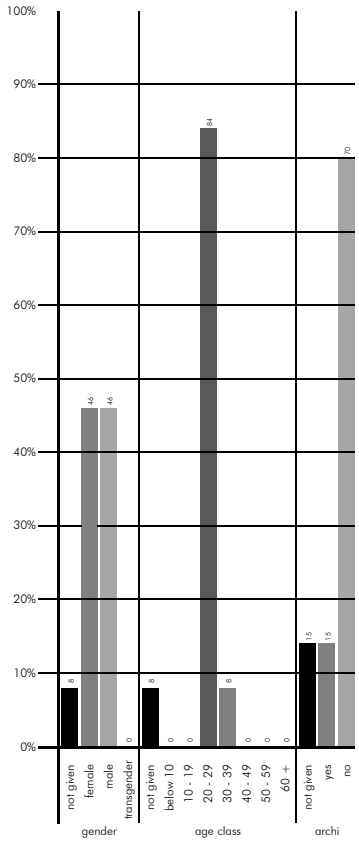


Figure 6.1.5. Online demographics

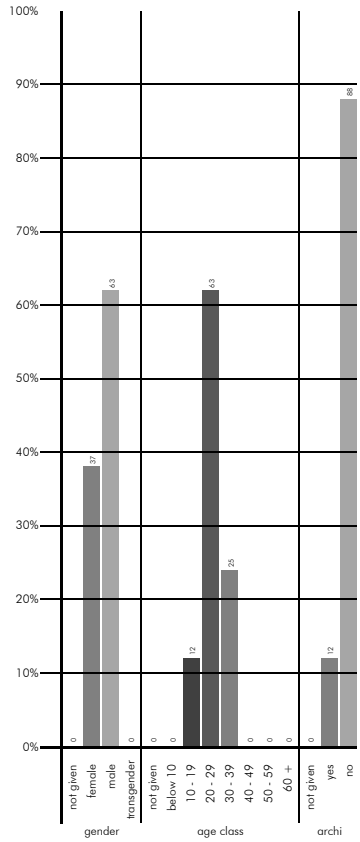


Figure 6.1.6. Offline demographics

Demographics [Vienna & Shanghai]

The overall (compilation of the online & offline demographics of the Viennese and Shanghainese case of 69 participants) demographics (see figure '6.1.7. Overall demographics') show that there have been slightly more male (52%) than female (43%) contestants (5% the 'non given'). The age class was mostly between 20 - 29 years (64%), 3% between 10 - 19 years; 22% between 30 - 39 years; 6% between 40 - 49 years and 2% between 50 - 59 years. Only 3% did not provide any information about their age-class. The majority 79% of the participants did not have any relation to architecture or urban design, 15% did have and 6% did not give any input.

Regarding the online demographics (see figure '6.1.8. Online demographics) outline that there have been more female (52%) than male (37%) contestants participating in the online survey. 11% did not provide any information regarding their gender. The majority of contestants have been between 20 - 29 years old and no relationship to architecture or urban design (63%).

The evaluation of the offline demographics (see figure '6.1.9. Offline demographics) shows that there were slightly more male participants (52%) than female ones (48%). The age distribution had a range of 19 - 49 years with the largest group in 20 - 29 years. 90% did not have any link to architecture or urban design, yet 10% did.

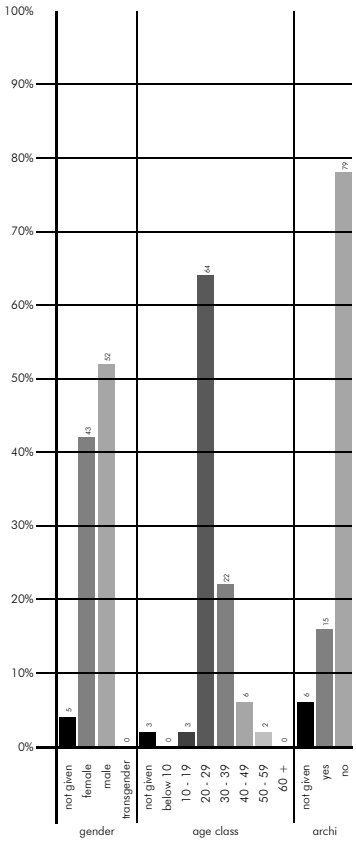


Figure 6.1.7. Overall demographics

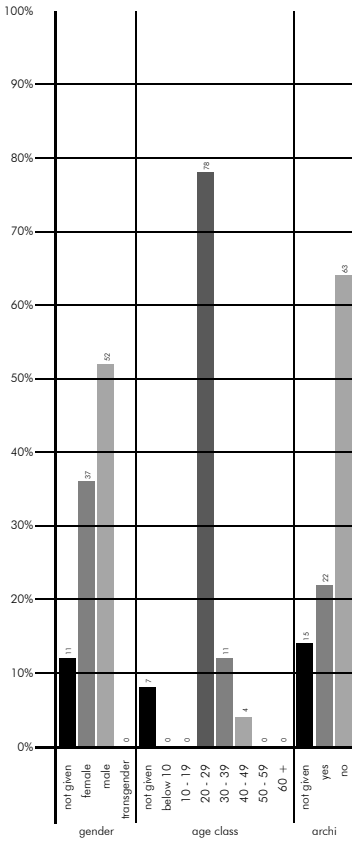


Figure 6.1.8. Online demographics

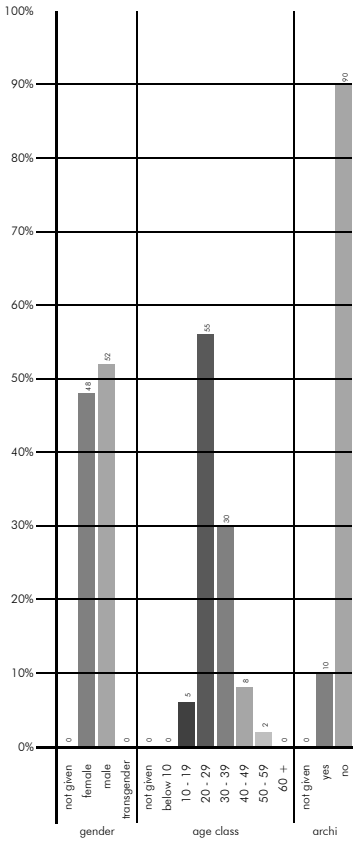


Figure 6.1.9. Offline demographics

6.2. occurrence maps

Based on the information gathered in the online survey (see chapter '4.1. questionnaire', subchapter 'online questionnaire') and processed with the visual information processing tool (see chapter '4.2. visual information processing') the occurrence maps are being generated (see chapter '4.3. occurrence mapping') for each case.

'Viertel Zwei' | Vienna

The participation in the survey is illustrated (see figure '6.2.1. Histogram/Density Distribution | Viennese Case') to show the density of input values. The Histogram shows that the participation decreased over the series of questioned images.

The demographics were completed by every contestant, since it was mandatory to do so in order of being able to enter the survey.

Whilst the first situation (series of five pictures) was completed and submitted by every contestant, the fourth situation had 79% and the last situation an average of only ~74% participation.

The overall average participation (during the visual survey of images) had an average of 83% of completion (with a total amount of 14 contestants).

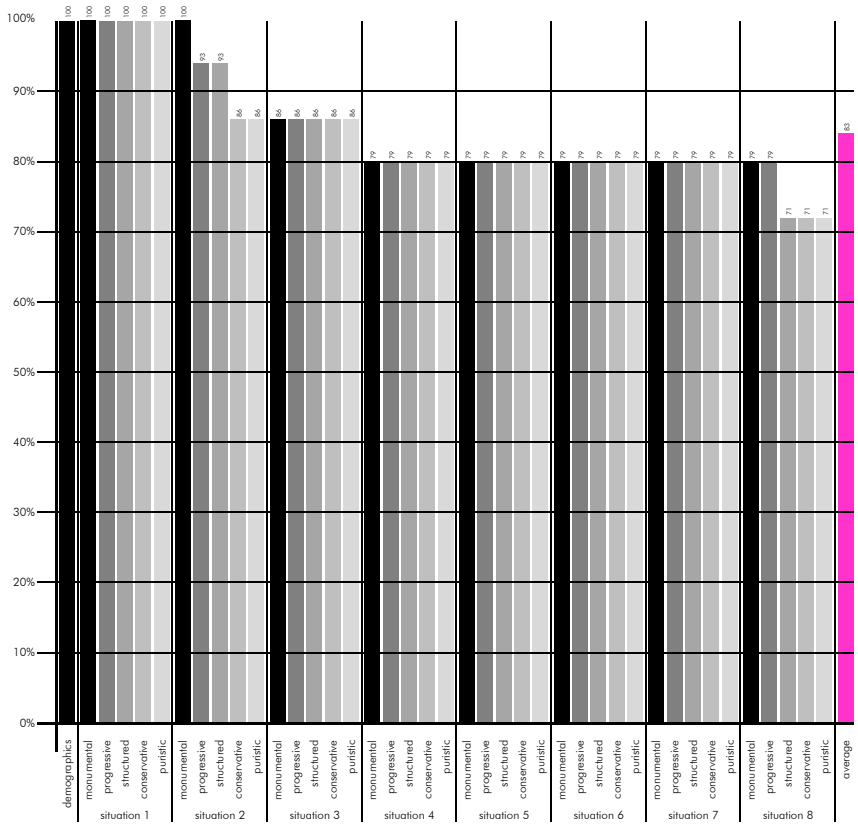


Figure 6.2.1. Historgram/Density Distribution | Viennese case

Occurrence maps Viennese case

The occurrence maps of the perceived spatial qualities.

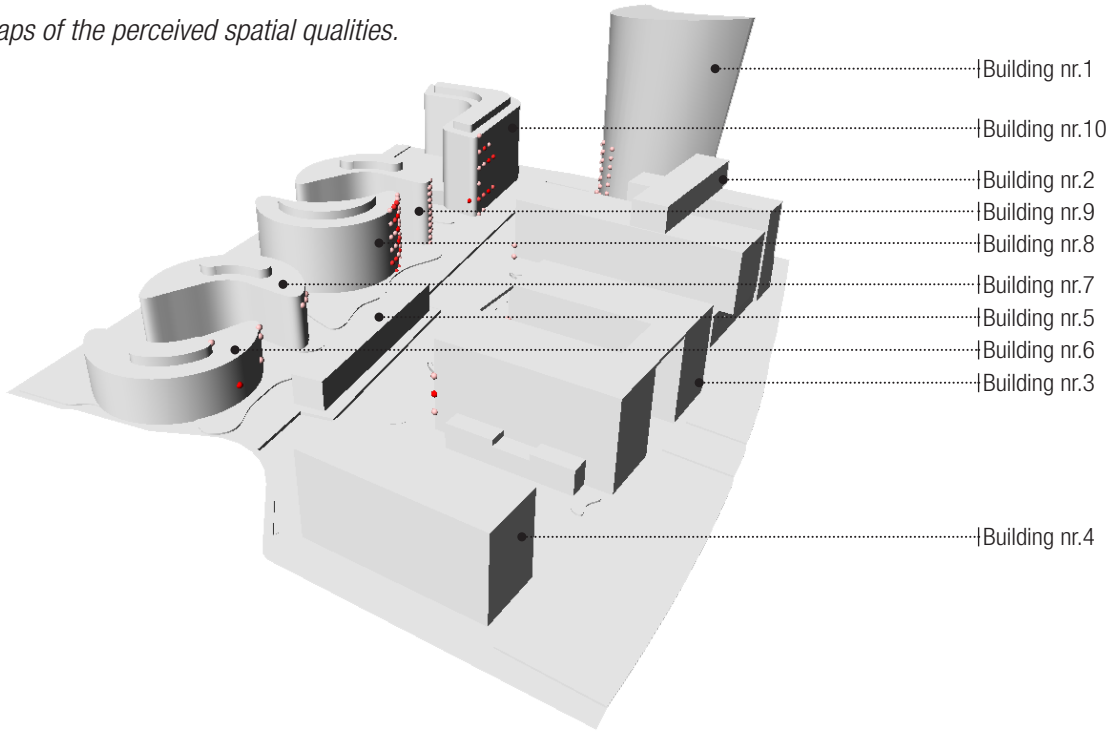


Figure 6.2.2. Occurrence map | monumental | view A

monumental

Figure 6.2.2 - 4. 'Occurrence map | monumental' show that the distribution of the quality 'monumental' is higher in the curved buildings, than in the orthogonal ones. Outstanding values of the occurrence map are:

- the strictly orthogonal buildings nr.4,5 have no monumental quality;
- the curved buildings nr.1,2 have almost no monumental quality;
- the partially curved buildings nr.8,10 are rated as highly progressive;
- the more interleaved building (volume-wise) nr.3 is rated the most monumental amongst the orthogonal ones.

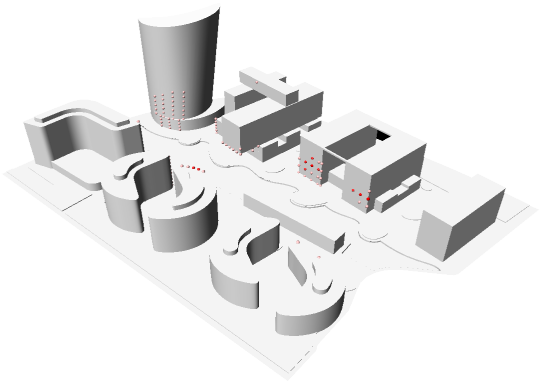


Figure 6.2.3. Occurrence map | monumental | view B

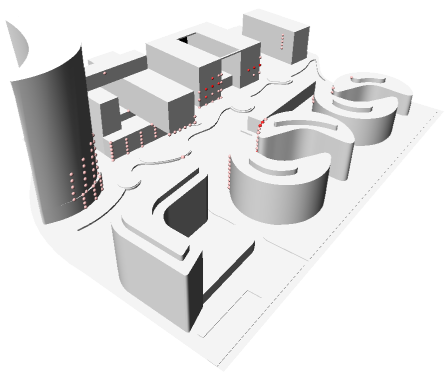


Figure 6.2.4. Occurrence map | monumental | view C

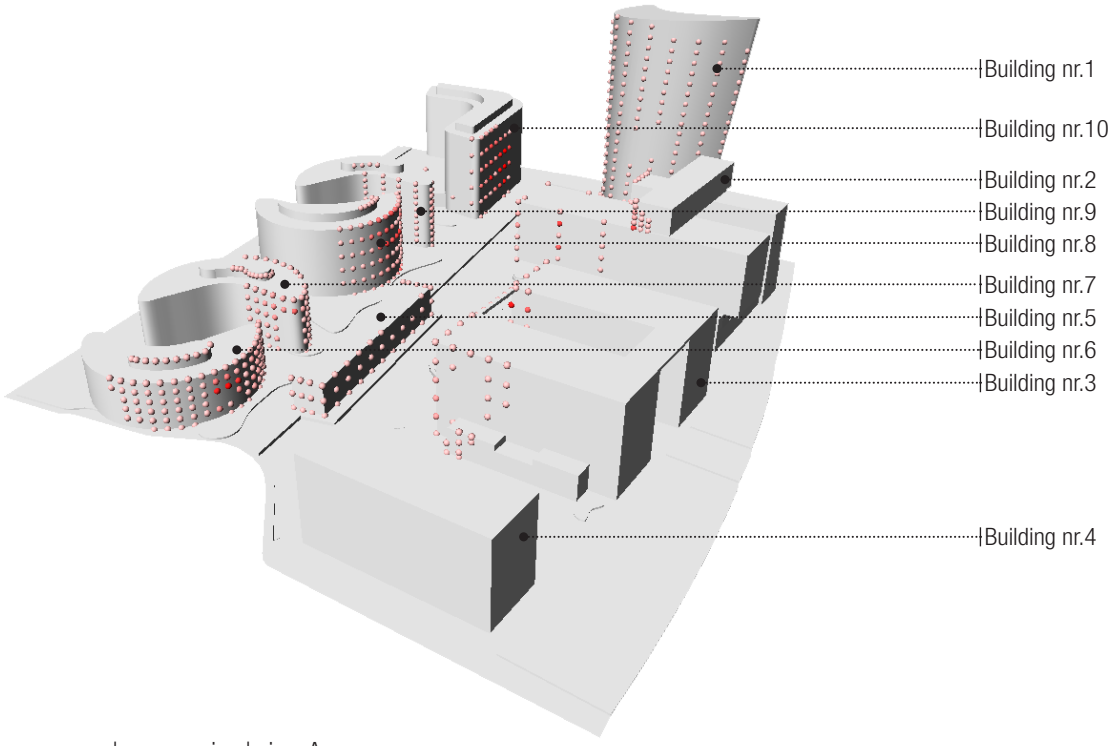


Figure 6.2.5. Occurrence map | progressive | view A

progressive

Figure 6.2.5 - 7. 'Occurrence map | progressive' show that the distribution of the quality 'progressive' is higher in the curved buildings, than in the orthogonal ones. Outstanding values of the occurrence map are:

- the strictly orthogonal building nr.4 has almost no progressive quality;
- the cantilever of building nr.2 and the area beneath are rated as highly progressive;
- the curved buildings nr.1,6,7,8,9 are rated as highly progressive;
- the connection-beam on top of building nr.3 is rated as progressive.

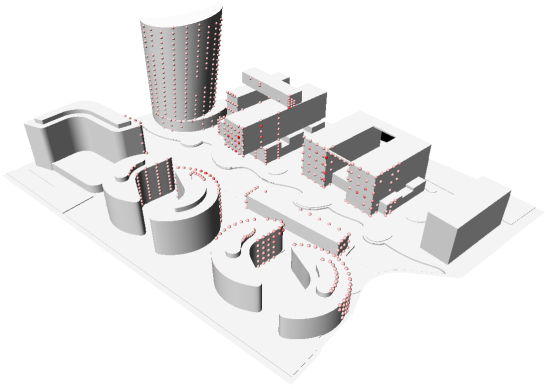


Figure 6.2.6. Occurrence map | progressive | view B

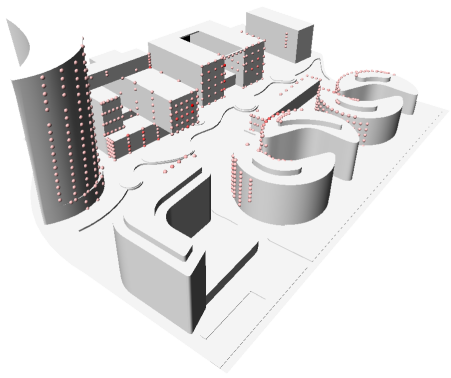


Figure 6.2.7. Occurrence map | progressive | view C

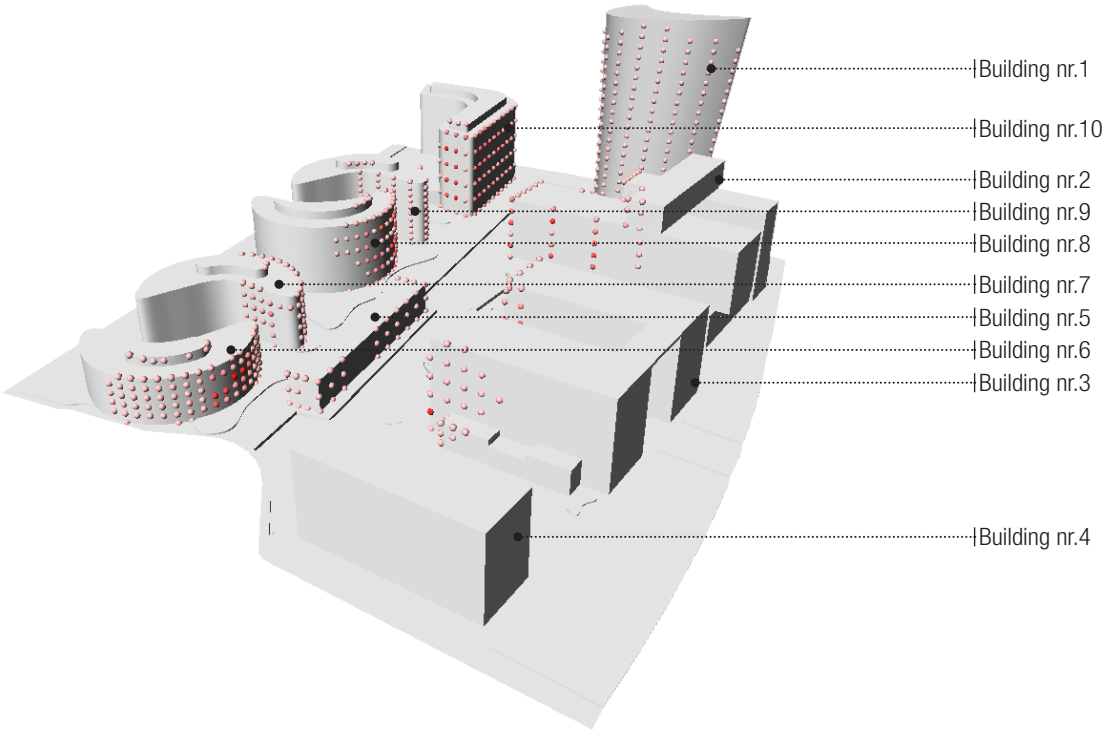


Figure 6.2.8. Occurrence map | structured | view A

structured

Figure 6.2.8 - 10. 'Occurrence map | structured' show that the distribution of the quality 'structured' is averagely distributed in the area. Outstanding values of the occurrence map are:

- the quality in the curved building nr.1 is almost equally distributed on the surface;
- the cantilever on building nr.2 is rated as highly structured;
- the curved buildings nr.6,7,8,9,10 are rated as highly structured;
- all the orthogonal buildings nr.4,5 are rated as almost not structured.

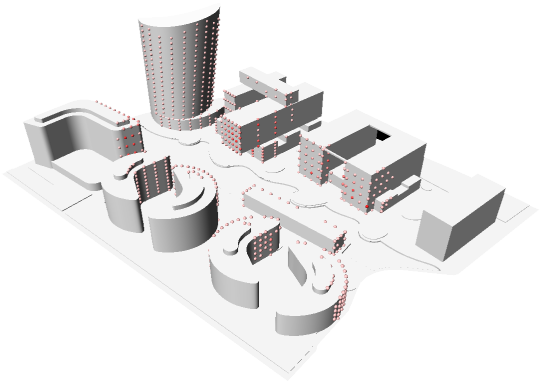


Figure 6.2.9. Occurrence map | structured | view B

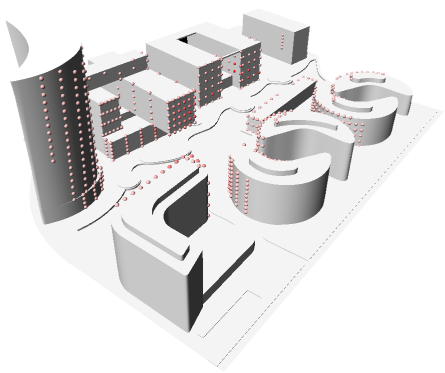


Figure 6.2.10. Occurrence map | structured | view C

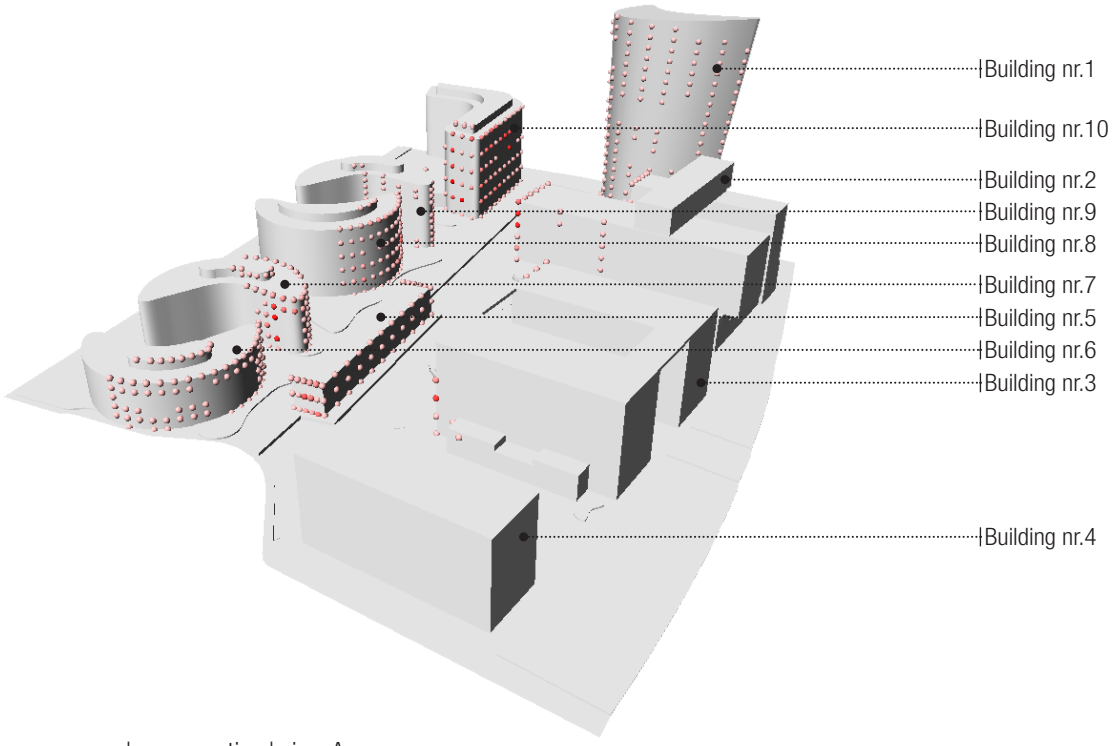


Figure 6.2.11. Occurrence map | conservative | view A

conservative

Figure 6.2.11 - 13. 'Occurrence map | conservative' show that the distribution of the quality 'conservative' is higher in the orthogonal surfaces, than in the curved ones. Outstanding values of the occurrence map are:

- the quality in the curved buildings nr.6,7,8,9 is distributed almost equally;
- the orthogonal surfaces of buildings nr.2,3,4,5,10 are rated with high values of the quality;
- the building nr.4 has almost no conservative quality;
- all the surfaces of building nr.5 are rated almost equally conservative.

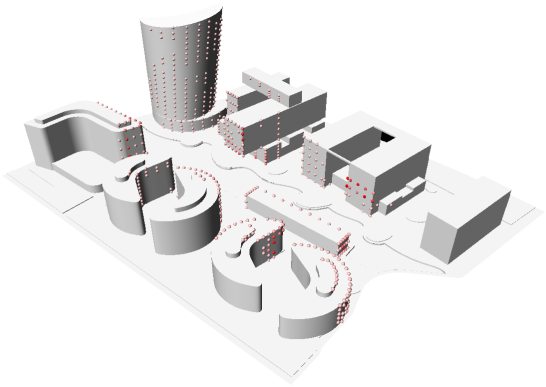


Figure 6.2.12. Occurrence map | conservative | view B

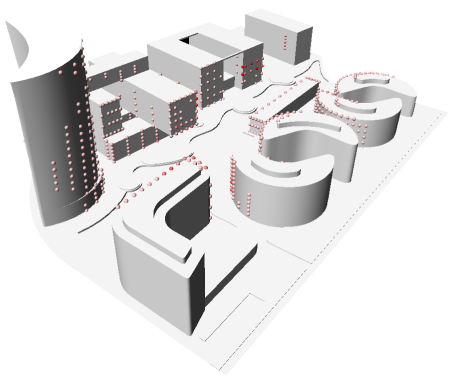


Figure 6.2.13. Occurrence map | conservative | view C

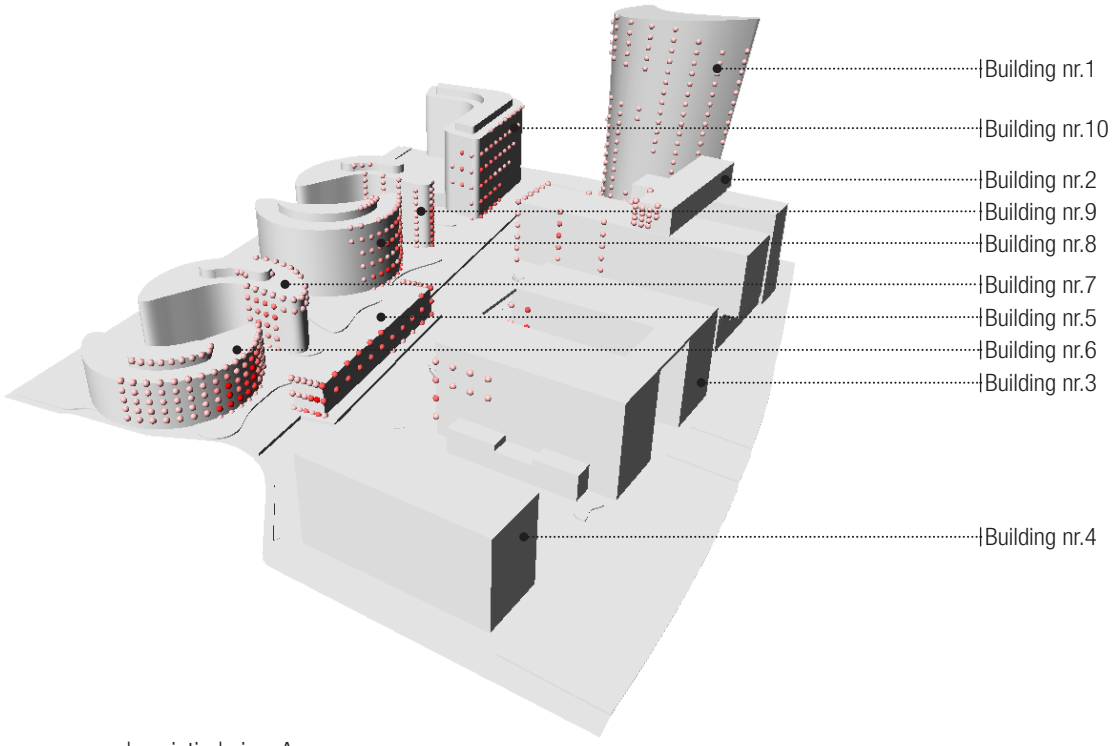


Figure 6.2.14. Occurrence map | puristic | view A

puristic

Figure 6.2.14 - 16. 'Occurrence map | puristic' show that the distribution of the quality 'puristic' is higher in the curved surfaces, than in the orthogonal ones. Outstanding values of the occurrence map are:

- the quality in the curved buildings nr.6,7,8,9 is rated as high;
- the orthogonal surfaces of buildings nr.2,3,4,5 are rated with almost no pursitic quality;
- the building nr.4 has almost no conservative puristic;
- all the surfaces of building nr.5 are rated as highly puristic.

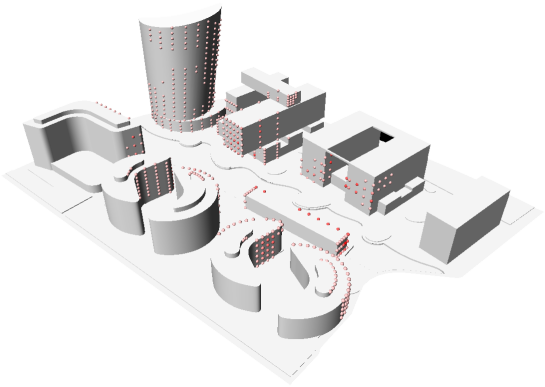


Figure 6.2.15. Occurrence map | puristic | view B

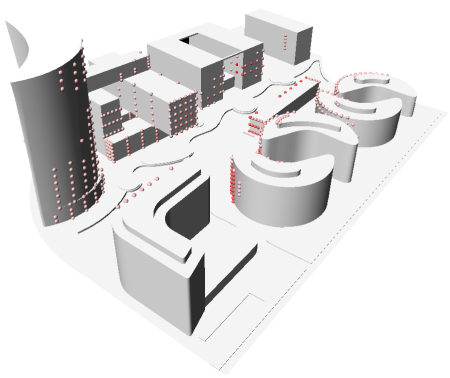


Figure 6.2.16. Occurrence map | puristic | view C

‘KIC Jiangwan’ | Shanghai

The participation in the survey is illustrated (see figure ‘6.2.17. Histogram/Density Distribution | Shanghainese Case’) to show the density of input values. The Histogram shows that the participation decreased over the series of questioned images.

The demographics were completed by every contestant, since it was mandatory to do so in order of being able to enter the survey. 90% of the participants did enter information, yet 10% did not provide any and selected the option ‘not given’ in the demographic part for age, gender and relation to architecture or urban design.

Whilst the first situation (series of five pictures) was completed and submitted by every contestant, the fourth situation had ~94% and the last situation an average of only 92% participation.

The overall average participation (during the visual survey of images) had an average of 96% of completion (with a total amount of 13 contestants).

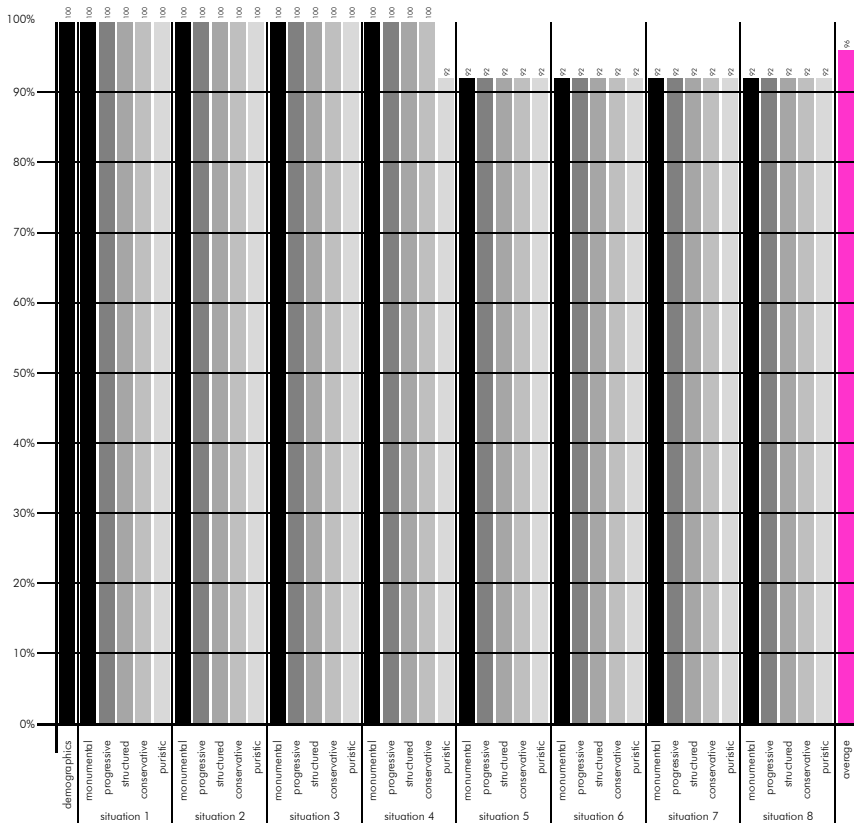


Figure 6.2.17. Historgram/Density Distribution | Shanghainese case

Occurrence maps Shanghainese case

The occurrence maps of the perceived spatial qualities.

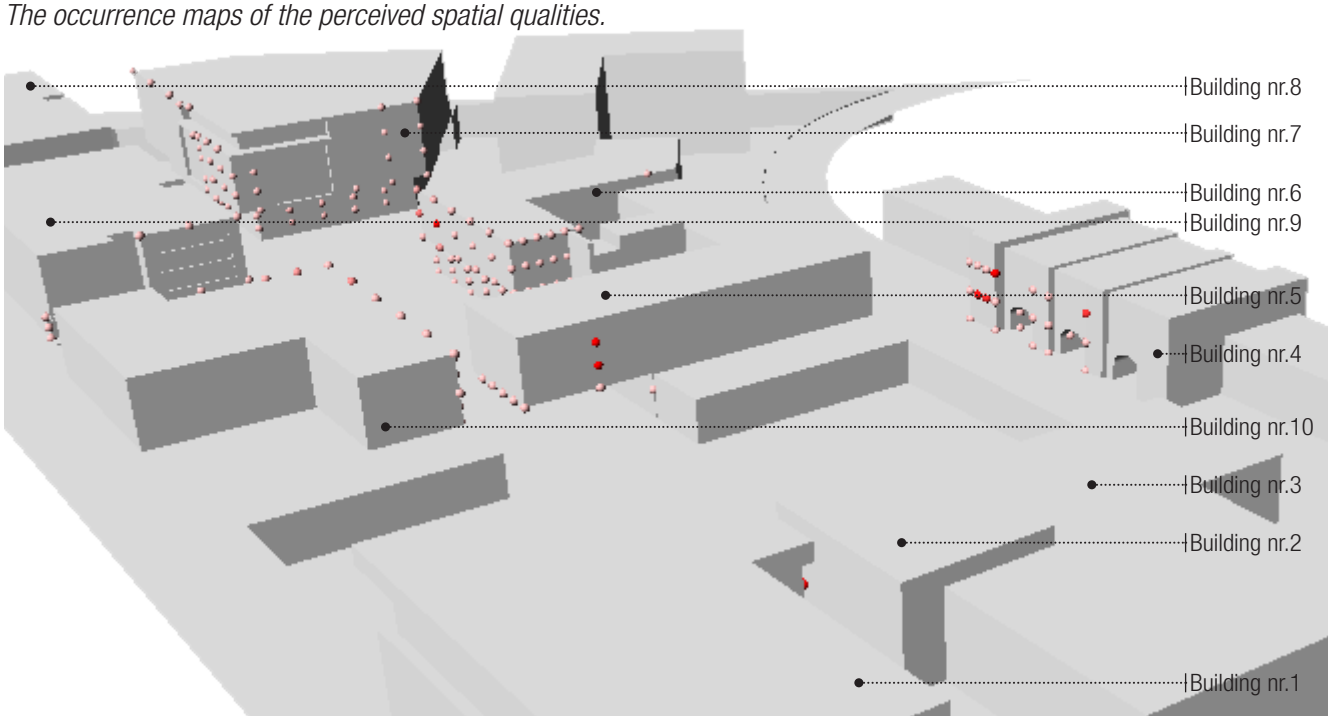


Figure 6.2.18. Occurrence map | monumental | view A

monumental

Figure 6.2.18 - 20. 'Occurrence map | monumental' show that the distribution of the quality 'monumental' is the highest in the buildings close to the covered space - by the cantilever. Outstanding values of the occurrence map are:

- the buildings nr.1,3,8 have almost no monumental quality;
- the buildings nr.7,9 have a low level of monumental quality;
- the buildings nr.5,6,10 have the most monumental quality;
- the entrance gate of the stadium (building nr.4) has areas of high monumental quality;

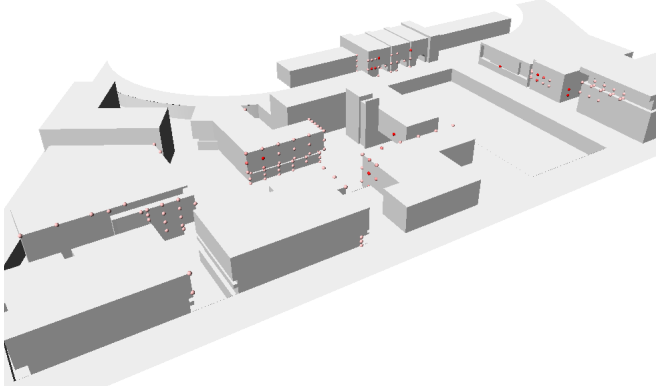


Figure 6.2.19. Occurrence map | monumental | view B

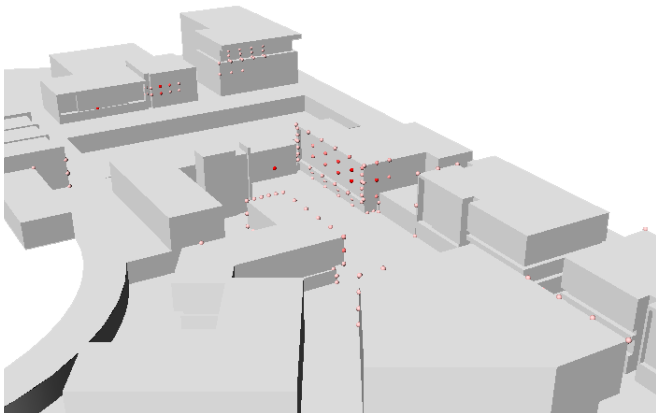


Figure 6.2.20. Occurrence map | monumental | view C

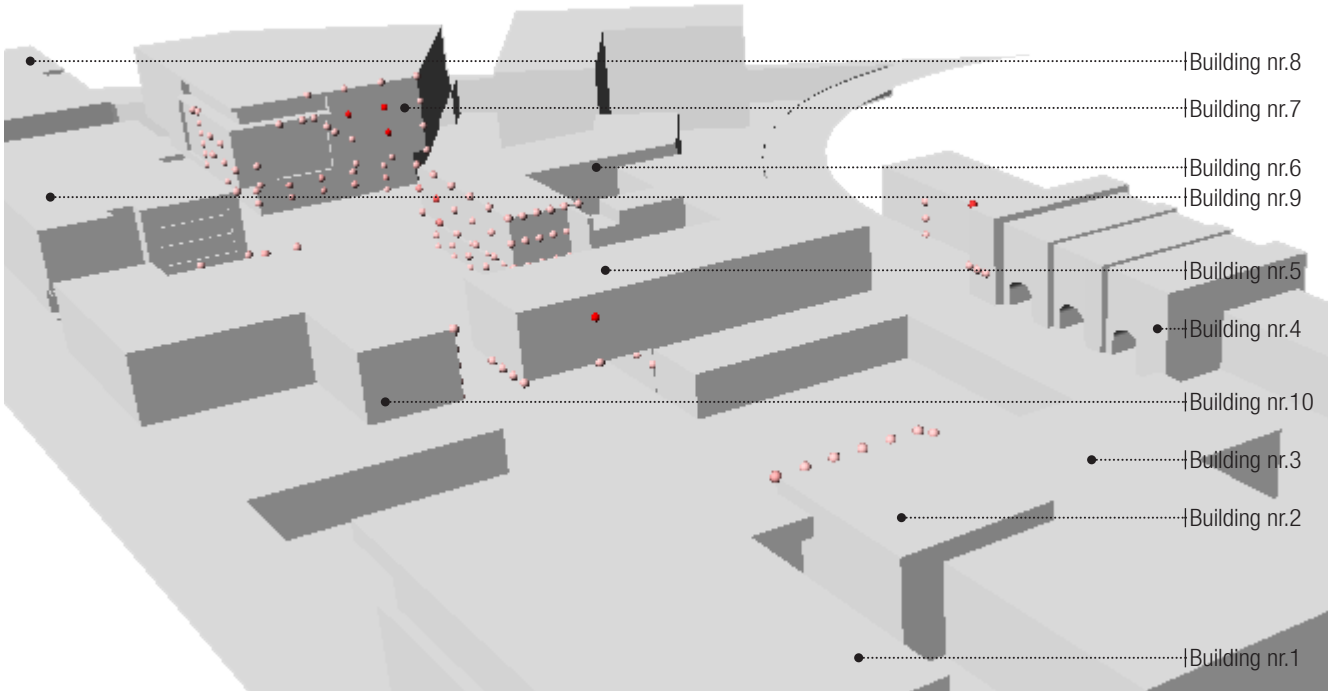


Figure 6.2.21. Occurrence map | progressive | view A

progressive

Figure 6.2.21 - 23. 'Occurrence map | progressive' show that the distribution of the quality 'progressive' is equally distributed around the area. Outstanding values of the occurrence map are:

- the buildings nr.3,8,9 have almost no progressive quality;
- the buildings nr.4,9 have a low level of progressive quality;
- the buildings nr.1,2,5 have certain areas of high progressive quality;
- the buildings nr.6,7,10 have the most progressive quality.

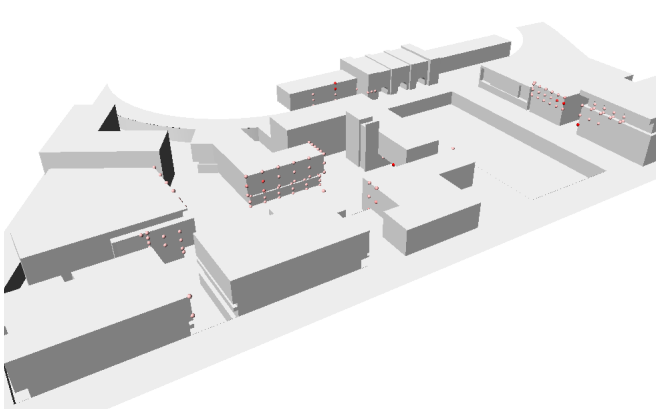


Figure 6.2.22. Occurrence map | progressive | view B

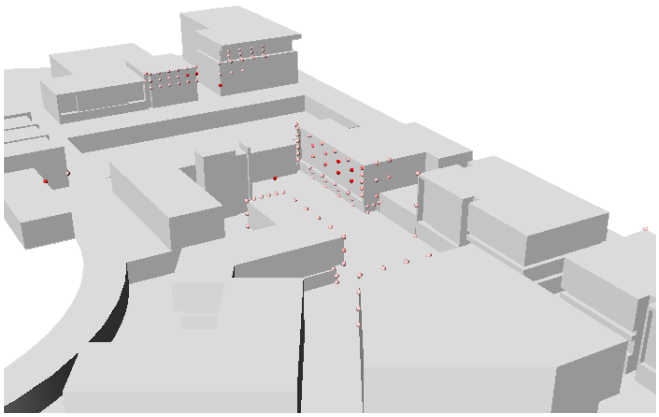


Figure 6.2.23. Occurrence map | progressive | view C

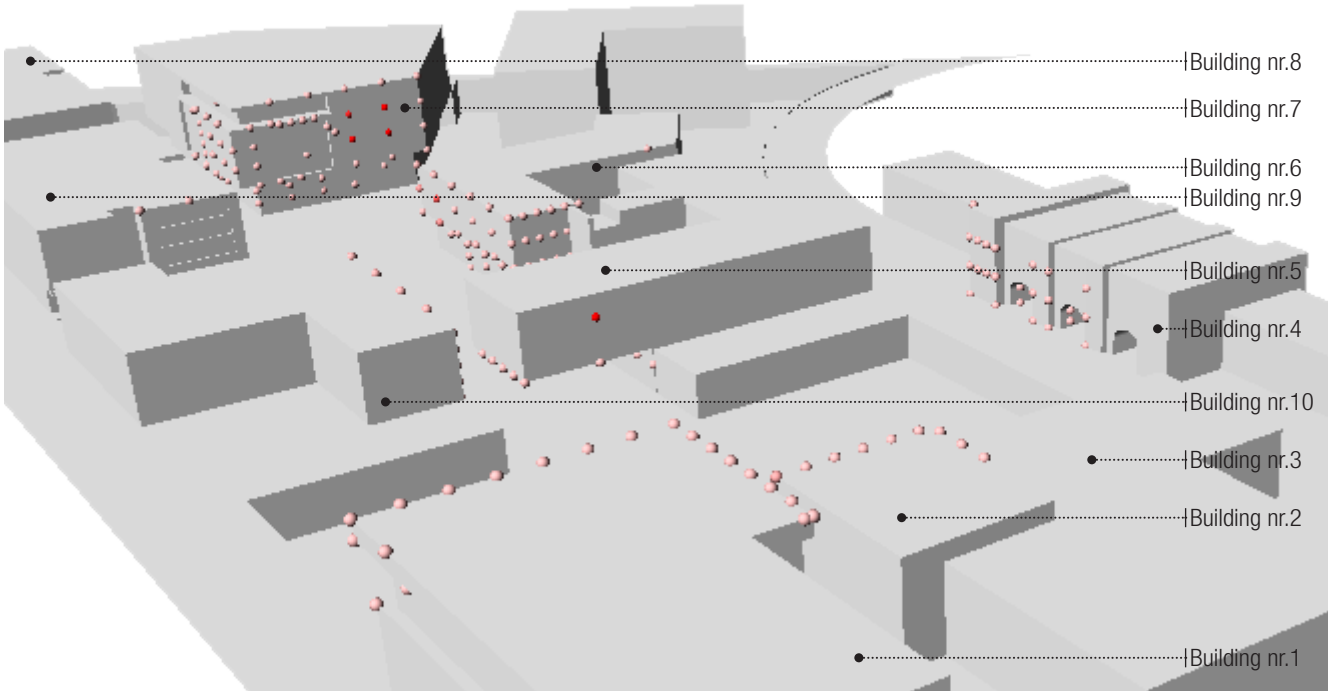


Figure 6.2.24. Occurrence map | structured | view A

structured

Figure 6.2.24 - 26. 'Occurrence map | structured' show that the distribution of the quality 'structured' is almost equally appearing in the area. Outstanding values of the occurrence map are:

- the buildings nr.3,8 have almost no structured quality;
- the buildings nr.5,9 have a low level of structured quality;
- the buildings nr.1,2,4 have certain areas of high structured quality;
- the buildings nr.7,10 have the most structured quality.

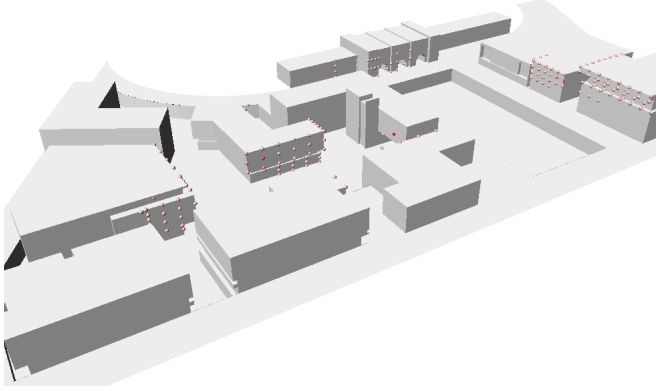


Figure 6.2.25. Occurrence map | structured | view B

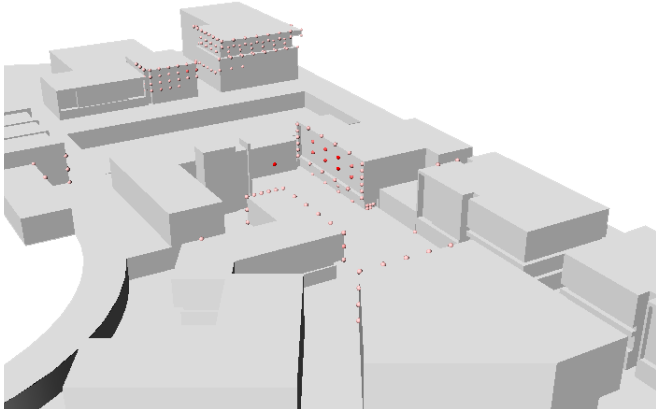


Figure 6.2.26. Occurrence map | structured | view C

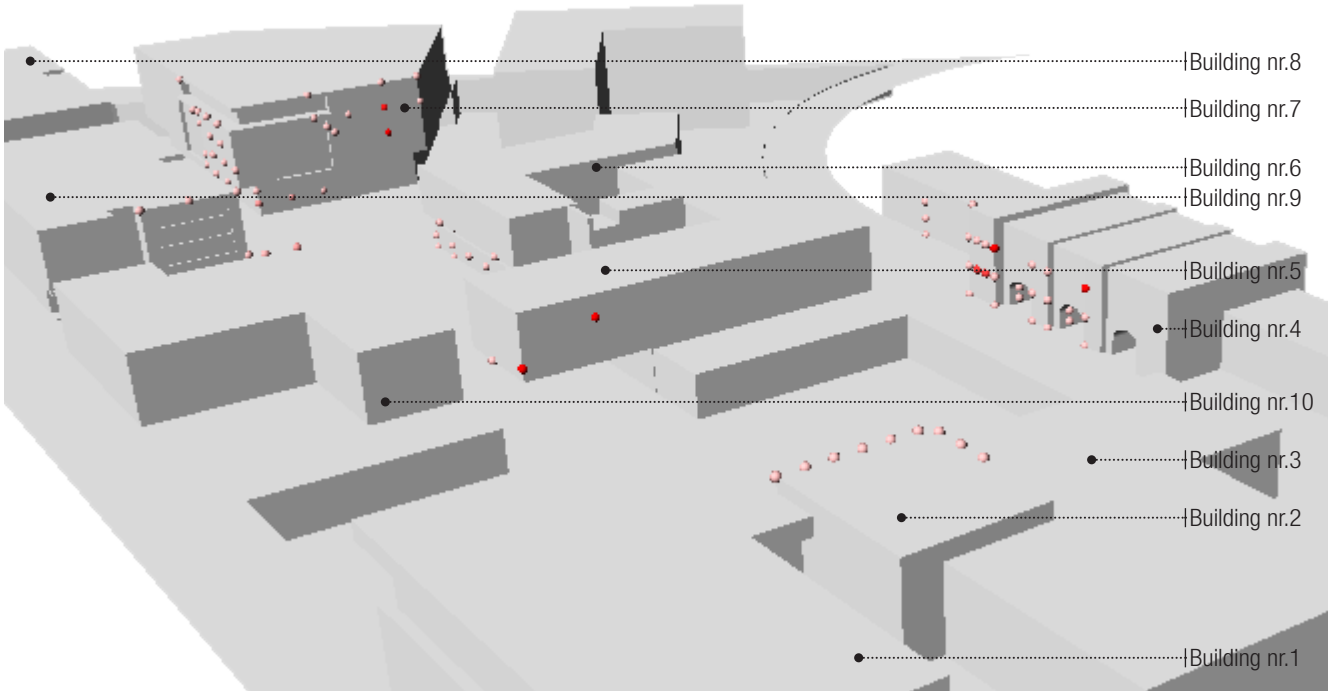


Figure 6.2.27. Occurrence map | conservative | view A

conservative

Figure 6.2.27 - 29. 'Occurrence map | conservative' show that the distribution of the quality 'conservative' is focused in on specific buildings of the area. Outstanding values of the occurrence map are:

- the buildings nr.1,3,8 have almost no structured quality;
- the buildings nr.6,9 have a low level of structured quality;
- the buildings nr.2,5,6,7 have certain areas of high structured quality;
- the entrance gate of the stadium (building nr.4) has areas of high conservative quality;

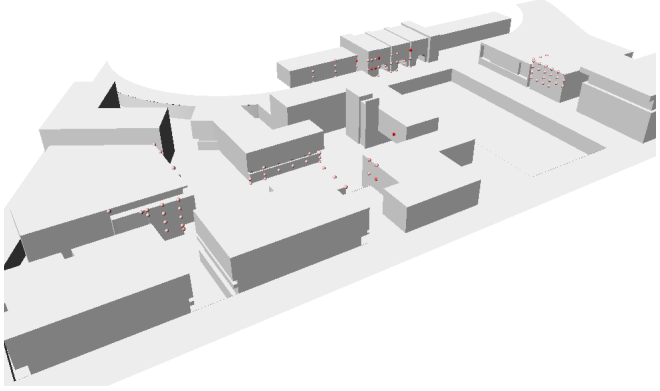


Figure 6.2.28. Occurrence map | conservative | view B

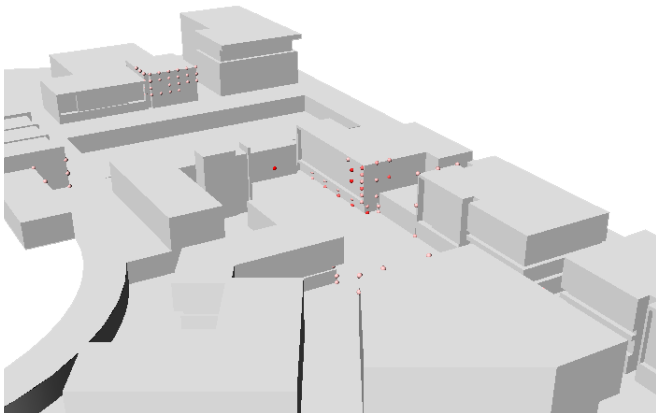


Figure 6.2.29. Occurrence map | conservative | view C

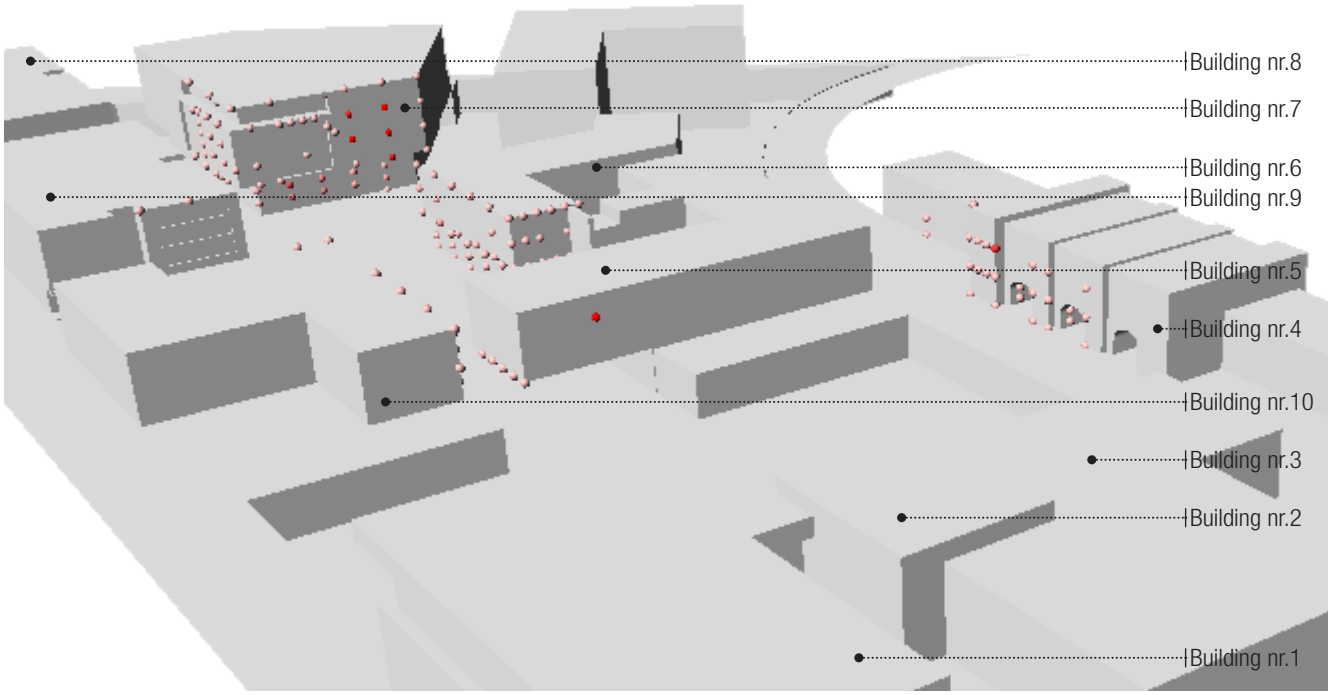


Figure 6.2.30. Occurrence map | puristic | view A

puristic

Figure 6.2.30 - 32. 'Occurrence map | puristic' show that the distribution of the quality 'puristic' is almost equally appearing in the area. Outstanding values of the occurrence map are:

- the buildings nr.3,8 have almost no purisitc quality;
- the buildings nr.5,9 have a low level of puristic quality;
- the buildings nr.1,2have certain areas of high puristic quality;
- the buildings nr.4,6,7,10 have the most purisitc quality.

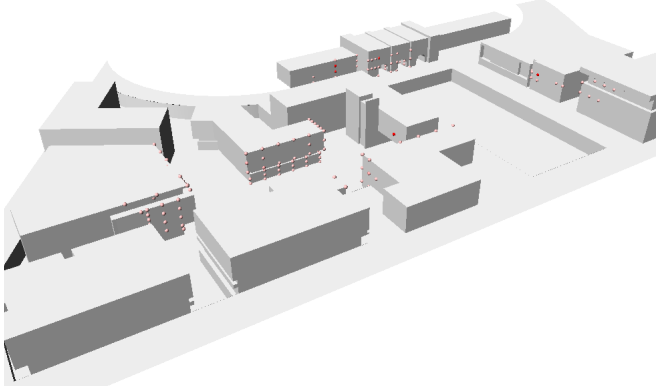


Figure 6.2.31. Occurrence map | puristic | view B

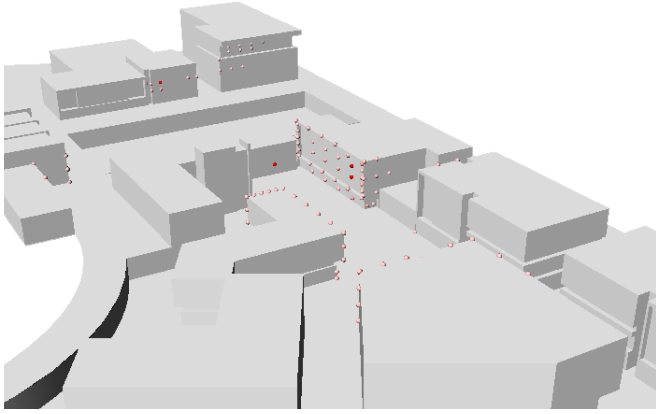


Figure 6.2.32. Occurrence map | puristic | view C

6.3. comparative analysis

The data gathered in the survey (see chapter '4.1. questionnaire') is being processed (see chapter '4.2. visual information processing'), evaluated for this comparative analysis (see chapter '4.4. comparative analysis') and the detailed results are printed in the appendix (see chapter '10.8. comparative analysis data').

Description

Both cases (see chapter '5. cases') have been analyzed and the overall:

- average results (see figure '6.3.1. Overall comparative data' & '6.3.4. Overall comparative data');
- median results (see figure '6.3.2. Overall comparative data' & '6.3.5. Overall comparative data');

as well as most outstanding single situations:

- situation 6 of the Viennese case (see figure '6.3.3. Exemplary excerpt of the Viennese results');
- situation 6 of the Shanghainese case (see figure '6.3.6. Exemplary excerpt of the Shanghainese results');

have been generated. This outcome data has been compiled and is outlined in the five by five matrix of terms.

'Viertel Zwei' | Vienna

The two figures (see figure '6.3.1. Overall comparative data | average' & '6.3.2. Overall comparative data | median') illustrate the same results, yet the highlighted values stated in the following refer to the average option:

- *'monumental' - lowest total intensity - term;*
- *'monumental' - lowest total density - term;*
- *'conservative' - highest total intensity - term;*
- *'structured' - lowest total density - term;*
- *'structured x monumental' - lowest intensity - term combination;*
- *'monumental x conservative' & 'structured x conservative' highest intensity - term combinations;*
- *'progressive x puristic - lowest density - term combination;*
- *'monumental x structured' & 'structured x progressive' & 'structured x conservative' - highest density - term combinations.*

average	puristic	monumental	structured	progressive	conservative
puristic	0% (0% color)	21% (30% color)	20% (32% color)	19% (29% color)	21% (32% color)
monumental	21% (30% color)	0% (0% color)	14% (33% color)	16% (30% color)	25% (32% color)
structured	20% (32% color)	14% (33% color)	0% (0% color)	20% (33% color)	25% (33% color)
progressive	19% (29% color)	16% (30% color)	20% (33% color)	0% (0% color)	24% (30% color)
conservative	21% (32% color)	25% (32% color)	25% (33% color)	24% (30% color)	0% (0% color)

Figure 6.3.1. Overall comparative data | Viennese case | average

median	puristic	monumental	structured	progressive	conservative
puristic	0% (0% color)	19% (31% color)	18% (31% color)	17% (29% color)	19% (31% color)
monumental	19% (31% color)	0% (0% color)	14% (31% color)	12% (30% color)	23% (31% color)
structured	18% (31% color)	14% (31% color)	0% (0% color)	17% (32% color)	20% (32% color)
progressive	17% (29% color)	12% (30% color)	17% (32% color)	0% (0% color)	24% (31% color)
conservative	19% (31% color)	23% (31% color)	20% (32% color)	24% (31% color)	0% (0% color)

Figure 6.3.2. Overall comparative data | Viennese case | median

To illustrate the results for the single situations - situation 6, with the highest values in intensity and density, is outlined (see figure '6.3.3. Exemplary excerpt of the Viennese results').

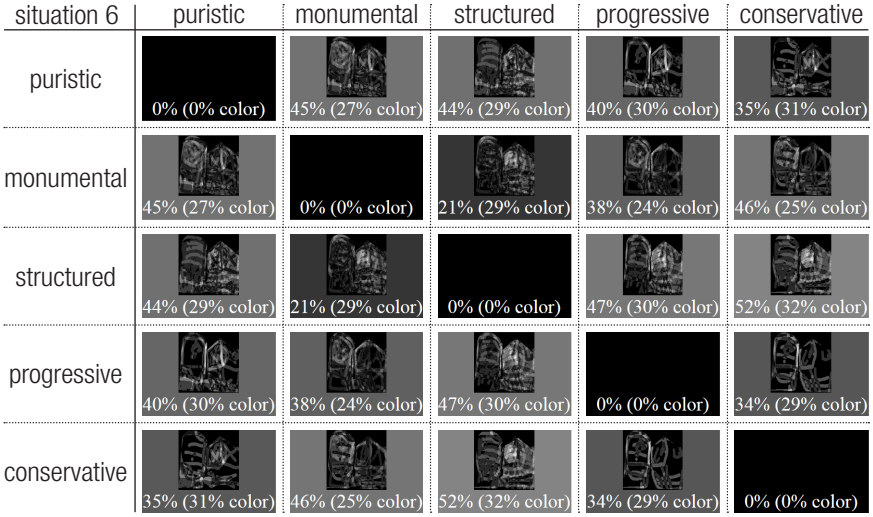


Figure 6.3.3. Exemplary excerpt of the Viennese results | situation 6

The most outstanding values are:

- *'structured x conservative' - highest intensity & density - term combination;*
- *'progressive x conservative' - lowest intensity- term combination;*
- *'monumental x progressive' - lowest density- term combination;*

'KIC Jiangwan' | Shanghai

The two figures (see figure '6.3.5. Overall comparative data | average' & '6.3.6. Overall comparative data | median') illustrate the same results, yet the highlighted values stated in the following refer to the average option:

- *'structured' - lowest total intensity - term;*
- *'monumental' - lowest total density - term;*
- *'conservative' - highest total intensity - term;*
- *'conservative' - lowest total density - term;*
- *'puristic x structured' - lowest intensity - term combination;*
- *'progressive x conservative' - highest intensity - term combination;*
- *'structured x progressive' - lowest density - term combination;*
- *'progressive x conservative' - highest density - term combination.*

average	puristic	monumental	structured	progressive	conservative
puristic	0% (0% color)	9% (39% color)	7% (36% color)	9% (35% color)	15% (37% color)
monumental	9% (39% color)	0% (0% color)	8% (33% color)	10% (33% color)	16% (33% color)
structured	7% (36% color)	8% (33% color)	0% (0% color)	8% (27% color)	15% (40% color)
progressive	9% (35% color)	10% (33% color)	8% (27% color)	0% (0% color)	19% (41% color)
conservative	15% (37% color)	16% (33% color)	15% (40% color)	19% (41% color)	0% (0% color)

Figure 6.3.4. Overall comparative data | Shanghainese case | average

median	puristic	monumental	structured	progressive	conservative
puristic	0% (0% color)	9% (40% color)	7% (35% color)	11% (33% color)	15% (35% color)
monumental	9% (40% color)	0% (0% color)	8% (31% color)	10% (32% color)	16% (31% color)
structured	7% (35% color)	8% (31% color)	0% (0% color)	8% (26% color)	18% (38% color)
progressive	11% (33% color)	10% (32% color)	8% (26% color)	0% (0% color)	20% (42% color)
conservative	15% (35% color)	16% (31% color)	18% (38% color)	20% (42% color)	0% (0% color)

Figure 6.3.6. Overall comparative data | Shanghainese case | median

To illustrate the results for the single situations - situation 6, with the highest values in intensity and density, is outlined (see figure '6.3.5. Exemplary excerpt of the Shanghainese results').

situation 6	puristic	monumental	structured	progressive	conservative
puristic	0% (0% color)	16% (34% color)	14% (32% color)	14% (25% color)	26% (33% color)
monumental	16% (34% color)	0% (0% color)	20% (33% color)	15% (32% color)	30% (42% color)
structured	14% (32% color)	20% (33% color)	0% (0% color)	13% (19% color)	30% (35% color)
progressive	14% (25% color)	15% (32% color)	13% (19% color)	0% (0% color)	28% (28% color)
conservative	26% (33% color)	30% (42% color)	30% (35% color)	28% (28% color)	0% (0% color)

Figure 6.3.5. Exemplary excerpt of the Shanghainese results | situation 6

The most outstanding values are:

- *'monumental x conservative' & 'structured x conservative'- highest intensity - term combinations;*
- *'monumental x conservative' - highest density - term combination;*
- *'structured x progressive' - lowest intensity- term combination;*
- *'structured x progressive' - lowest density- term combination.*

6.4. atmosphere

The gathered atmospheric data (see chapter '4.1. questionnaire', subchapter 'offline questionnaire') is processed (see chapter '4.5. atmospheric data') and for each area of investigation (see chapter 'Viertel Zwei | Vienna' & 'KIC Jingwan | Shanghai') an output is generated. The output for every situation of every case is printed in the appendix (see chapter '10.9. atmospheric data').

'Viertel Zwei' | Vienna

A total amount of 24 participants took part in the survey. For each situation, questioned in the online survey (see chapter '4.1. questionnaire', subchapter 'online questionnaire'), 3 persons were asked to rate their perception of their current view.

	Area	participants
	score	24
calm	1,58	busy
flexible	3,13	rigid
inspiring	2,33	discouraging
lively	2,17	dull
natural	3,21	artificial
open	2,04	closed
orderly	1,54	chaotic
private	3,38	public
simple	2,04	complex
wide	1,96	narrow

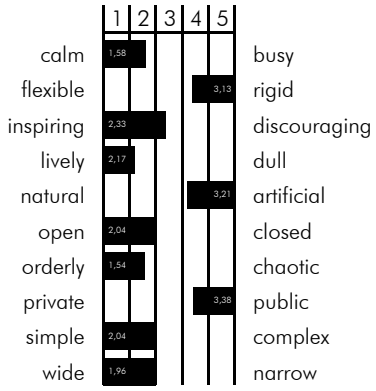


Figure 6.4.1. Atmospheric data | Vienna

'Figure 6.4.1. Atmospheric data | Vienna' shows that the investigated area is perceived by the participants:

- rather calm, than busy;
- almost as flexible as it is rigid;
- neutral, but a bit more inspiring than discouraging;
- a bit more lively, not dull;
- not as much neutral as artificial;
- more open than closed;
- very orderly and not chaotic;
- not very private, rather public;
- simple not complex;
- pretty wide, not narrow.

The most outstanding atmospheric values (see figure '6.4.1. Atmospheric data | Vienna') are:

- the area is very **calm** (1,58 with 1 as maximum);
- the area is very **lively** (2,17 with 1 as maximum);
- the area is very **open** (2,04 with 1 as maximum);
- the area is very **orderly** (1,54 with 1 as maximum);
- the area is very **simple** (2,04 with 1 as maximum);
- the area is very **wide** (1,96 with 1 as maximum).

‘KIC Jiangwan’ | Shanghai

A total amount of 16 participants took part in the survey. For each situation, questioned in the online survey (see chapter ‘4.1. questionnaire’, subchapter ‘online questionnaire’), two persons were asked to rate their perception of their current view/the area.

	Area	participants
	score	16
calm	2,13	busy
flexible	2,94	rigid
inspiring	2,50	discouraging
lively	2,25	dull
natural	2,75	artificial
open	1,69	closed
orderly	1,63	chaotic
private	4,25	public
simple	2,38	complex
wide	1,75	narrow

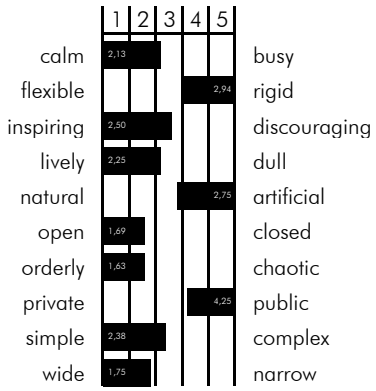


Figure 6.4.2. Atmospheric data | Shanghai

‘Figure 6.4.2. Atmospheric data | Shanghai’ shows that the investigated area is perceived by the participants:

- rather calm, than busy;
- not so flexible, rather rigid;
- neutral, as inspiring as it is discouraging;
- a bit more lively, not dull;
- slightly less natural than artificial;
- more open than closed;
- very orderly and not chaotic;
- not private, but very public;
- a bit simple, not complex;
- pretty wide, not narrow.

The most outstanding atmospheric values (see figure ‘6.4.2. Atmospheric data | Shanghai’) are:

- the area is very **calm** (2,13 with 1 as maximum);
- the area is very **rigid** (2,94 with 5 as maximum);
- the area is very **open** (1,69 with 1 as maximum);
- the area is very **orderly** (1,63 with 1 as maximum);
- the area is very **public** (4,25 with 5 as maximum);
- the area is very **wide** (1,75 with 1 as maximum).

7. discussion

"A great building must begin with the unmeasurable, must go through measurable means when it is being designed and in the end must be unmeasurable."

Luis Kahn

Figure 7.1. Louis Kahn | © tkhunt.com

"I never said I can measure the quality of a building. As my topic states; I am working towards evidence based understanding of perceived spatial qualities, that's different dude."

Benjamin Heinrich

Figure 7.2. Benjamin Heinrich

limitation of research

As there is a time limit on a master thesis, the whole survey had to be conducted in a limited amount of time. This simple limitation in time directly influences the amount of participants of the surveys. There is/was no reason why the Viennese, Shanghainese and "virtual built scenario" survey was online for a limited amount of time (about 2 weeks). Due to that there is a lack in participation and the results have no significant output to make a general statement. Yet by starting to implement the methodology and testing it with proper results for the specific cases (but no statistical validity) it can "easily" being transformed in a full fledged study (which would exceed the frame of a master thesis by far).

theory

reliability of the phenomenological approach

The usage of the phenomenological approach always involves an interpretive appropriateness. The feeling itself and the visual or description with words always implicates a deviation of its genuine source. The multisensory experience of a feeling or the perception of a predefined situation transported to a visual media loses accurateness and by that already creates the need of interpretation in the evaluation of the results. Yet by using the proposed method of existential phenomenological research the study itself gets a step closer to an 'evidence based' research itself, with an interpretive notion in evaluating the results. It would be highly interesting to push the evaluation of the results further into an even more 'evidence based' framework.

source of terminology

The terms were chosen from the scientific sources, yet quite old and not all of them are equally relevant. There is no such thing as a catalogue of "architectural quality" termini in the means of the conducted survey. In order to find such, each term would need to be tested and evaluated to find its relevance in the larger context. This could be done in a fully fledged study.

choice of terminology

The choice of questioned terms was in direct relation to architecture, yet quite abstract (both for the online and offline survey) to still providing space for interpretation. This fact was chosen on purpose in order to test the methodology and implementation and find the weak points before conducting a rigorous architectural/urban design survey.

choice of participants

There was no such thing as a specific scheme of participants, neither for the online, nor for the offline survey. For the online survey: All people (reachable by the author with support from the professors) were invited to participate and given the opportunity to "not provide" their general information. This creates on the one hand a broad spectrum and mixture of people, yet on the other hand removes the "controlled environment" for the study. It would be interesting to not allow the participation without providing all the demographics and furthermore inviting the same (amount of) people for the conducted cases, to have full control and the opportunity of a direct comparison.

For the offline survey: The people were chosen by random means and it was tried to gather as much information as possible. This worked quite well for the survey, yet it would be highly interesting if there would be a larger number of participants.

Furthermore the implementation of the difference between the heritage of the participant would be interesting in order to outline cultural differences in the means of perception. For this study it was purposely left out to generally see the study as one whole test, without splitting into further groups.

online questionnaire

The 2D visual survey was a full success in the means of the results. The workflow itself (of the participant in the tool) could be refined. As there was the V1.0 of the online questionnaire, in which the participants could chose between different brush and eraser sizes (in V2.0 the size was standardized to speed up the workflow) it would be interesting if this could be implemented again. A compromise between speed and practicality of inputting the values has to be found.
As the study was conducted in 2D and then transferred into the 3D urban environment, the idea of directly drawing into the 3D situation would be highly interesting. The splitting of 2D and 3D could be avoided and directly worked with an online 3D drawing function (by using textures or else).

As stated there is/was no reason for the time limitation of the survey, besides the limitation of time for the master thesis. In theory the questionnaire could be continuously online and in certain key moments the program could automatically update itself and produce the occurrence maps, to have all the information at the time when needed. This interactive tool could become a platform of sharing ideas and rating them by quality. Even the integration of repositories (like sketchup central/ flicker) could be thought of, in order to use first hand data.

understanding of terminology

As there are participants with and without relationship to architecture/urban design, the understanding of the terms might be highly different. It was intended not to influence any contestant by giving a description on how to understand the surveyed terms and by that gather genuine information.
The feedback (reactions to the questionnaire) of the contestants shows that in some cases the participant was not able to find the relationship of the term to the investigated objects, so for further studies it would be very interesting to, on the one hand divide the results in architect and non architect occurrence maps and on the other hand provide clear descriptions of the possible understanding of the term, to see if this changes the results (without description compared to the description survey). For this particular thesis, the intended purpose of gaining genuine abstract information was necessary to test the methodology, which was successfully completed.

offline questionnaire

The approach or even the group of people questioned ad-hoc on spot could be improved. For this thesis random people were directly confronted with the survey (just a short introduction of the reason and idea) what on the one hand created the pure, impulsive information of the person, on the other lead to certain questions (like: what do you mean by “calm or busy”) which could be standardized and clarified in the beginning.

visual processing

As there have been masks applied during the visual processing, this raises the question what should be integrated and

left out. For this research only the buildings (as a volume) were taken into consideration to gather the pure “architectural” results. It would be highly interesting to use the same method and evaluate urban elements such as greenery, water elements, furniture, lighting elements and so on. This could help to deepen the results for urban designers and help them to get direct feedback of the design, from the users.

occurrence mapping

The 3D model of the investigated area was abstracted to the ‘simplest’ volumes of buildings. This abstraction necessarily led to elements on the buildings being simplified or ‘left out’ to increase the processing speed and reduce the amount of dataflow. This method of simplification worked well for the investigated areas, since almost all buildings are simplifiable, yet for more complex situations or in order to get a higher resolution of outcome data (more detailed information for single characteristics), it would be necessary rethink the amount of abstraction.
In order to be able to transfer the two dimensional information into the third dimension, a standardized grid of “measurement nodes” was introduced to the surfaces of the buildings. This grid was chosen in a compromise of having a reasonable density of points and still being able to compute the results in a reasonable amount of time. This compromise needs to be investigated, for the thesis it worked very well in those terms, yet a denser grid would make the results more accurate.

During the transferal the maximum value of transparency of all the visual rays (leading to that point or having it as closest point on the grid) was taken to unitize the whole system. This could be changed, for example to the median value, yet the outcome would be needed to be investigated. The direct comparison of both possibilities would be highly interesting.

comparative analysis

online questionnaire - visual function

After compiling the visual data and evaluating it in the comparative analysis, a few results have shown interesting deviations compared to the majority of outcomes. Due to deeper investigation and returning to the input values (inserted visual data of the contestants) it shows that in the first few images (about 2-3 situations) seem to be less processed (see figure ‘7.4.3. Examples’). This fact can be due to two reasons:

1. the questioned values have been marked and appeared in the stated amount (less);
2. the process ‘what to do’ or ‘how to enter data’ was not explained clearly.

To ensure that the case nr. 2 does not happen, a tryout example series of situations could be applied before entering the actual questionnaire to give the contestant the opportunity of trying the tool.
The investigation furthermore shows, that the amount and detailing of input increases after 2-3 situations enormously and provides a solid base for further processing, as the results of the comparative analysis show.

Figure 7.4.3. Examples I of contestant input in the first few situations

application of masks

The application of masks during the visual information processing removes areas of the images, which shall not be further investigated (floor, sky, greenery,...). As this process serves as a help to focus on the specifics which are interesting for this analysis, it also narrows the spectrum of transparent values. To overcome this obstacle in terms of processing in the comparative analysis, the range of transparencies has been set relative to the remaining levels (after the application of the mask) and scaled up to the original 255 levels. This method shows interesting results, yet it would be interesting to process the data without masks and keep the original compiled images in every step.

amount of participants

As the results show, the more participants complete the survey, the less difference in intensity is created. This fact is caused due to the amount of data input, as the contestants distribute the quality different. In other terms, the whole image is marked after the visual processing. This could be due to:

- the different understanding of the term;
- the same understanding of the term, yet finding it in different elements;
- the standardized size of the pen for marking in the online questionnaire is not delicate enough to mark more precise.

This high intensity must not necessarily relate to the density (difference in transparency) since the fact that the participants mark a lot, does not mean that they do not mark specific elements - there can be a different understanding of the quality by every contestant.

demographics

As previously stated the cultural difference between the perception of European and Asian people could be investigated by implementing the question of heritage in the survey. This was not done for this thesis, because it is not meant to be a cultural but architectural study. Furthermore not only the locals should have been given the opportunity to evaluate their case, it should be a mixture of participants to have a neutral demographical background for the thesis.

atmospherics

The atmospherics were always treated as something different and only incorporated in the whole process in the discussion. It would be very interesting to implement them in an earlier stage or even compile them with the visual survey. The questions: when, in which way and how intense this could happen, shall be raised here.

cases

As the environmental conditions, of the chosen cases are fundamentally different, this also reflects/influences the mood and rating of the participants. To have a broader spectrum and then sharpen one general outcome, every case would need to be investigated in different times of the day, during different weather conditions, and so on. By enlarging the field of investigation (at the moment only the core area of the urban environment was chosen) a whole area could be analyzed. This could be “easier” done if people would directly work and rate in the 3D space, as mentioned in the subchapter online questionnaire.

The chosen images used for the online survey, were taken due to various reasons. On the one hand the core area should be presented in its best way, on the other hand it was tried to have every building surface in an equal amount present - in the whole survey. A more specific choice of images would be highly interesting.

results

A broad spectrum of results was generated during the process and the most outstanding and interesting outcomes shall be discussed.

participation of the contestants

The histogram/density distribution shows that the participation of the contestants decreases over the amount of steps. This fact limits the number of inputs, yet leads to the assumption that those who finished the whole survey, gave their inputs deliberately and the aggregated images of the last steps can be seen as even more precise in terms of input values. On the other hand the majority of participants had no experience in architecture, which supports the conclusion that the results can be generalized. Since most were students, it can be said that the results represents the opinion of the younger generation.

atmospheric data

The gathering of the atmospheric values and their results lead to a general rating of 'perceived feelings' in the investigated areas. The data is not directly implemented in the process of the graphical survey, rather seen as a control unit, which gives feedback of the overall quality of the urban design. The response was overall very positive and can be seen as a good rating for the individual cases. Furthermore the assumption can be taken, that the appearing qualities (of the visual survey) are associated with a positive feeling. This can be interpreted as originating in the built space of the two cases (ensemble of the buildings).

occurrence maps

The generated occurrence maps show clear distribution of the investigated qualities. Areas which are loaded with certain qualities can be identified and specific elements have emerged in terms of having outstanding results. For the investigated areas and specific amount of people, following assumptions can be taken:

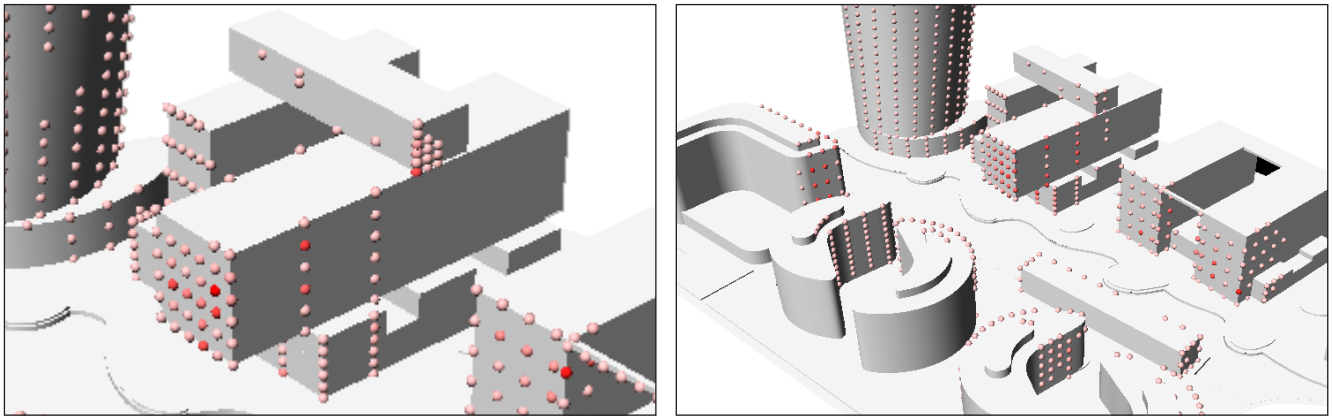


Figure 7.4.4. Examples | progressive cantilever | structured all over the area

For the Viennese case (see chapter ‘5.1. viertel zwei’) the terms ‘progressive’ and ‘structured’ are to be highlighted, since those appear either on very specific buildings or generally in the area (see figure ‘7.4.4. Examples’).

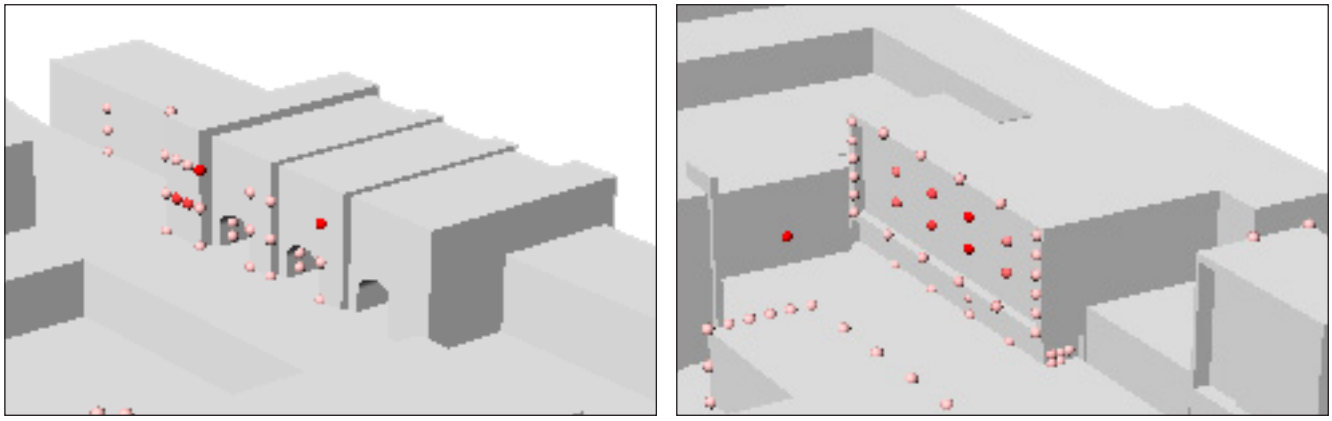


Figure 7.4.5. Examples | conservative entrance gate | structured building

For the Shanghainese case (see chapter ‘5.2. KIC Jiangwan’) the terms ‘conservative’ and ‘structured’ are to be highlighted, since those appear either on very specific buildings (see figure ‘7.4.5. Examples’).

comparative analysis

The differences in the two cases are:

- in the Viennese case, the choices of marked areas (intensity) were more diverse, yet the areas which were marked, have been very specific (density) - assumption: a lot of quality distributed in the area, sure where it is;
- in the Shanghainese case, the choices of marked areas (intensity) were less and very specific, yet the areas which were marked have been more diverse (density) - assumption: less quality in the area, not sure where it is.

The most outstanding results of the overall outcome (average) shall be discussed as follows, in order to find the most occurring and correlating qualities:

- the quality ‘conservative’: is the most controversial term since it was marked very specificly, yet the contestants distributed their marking very diversly - disagree about the location;
- the quality ‘structured’: is distributed all around the areas and marked very diversly, in the meaning of everything in the area can be structured.

8. conclusion

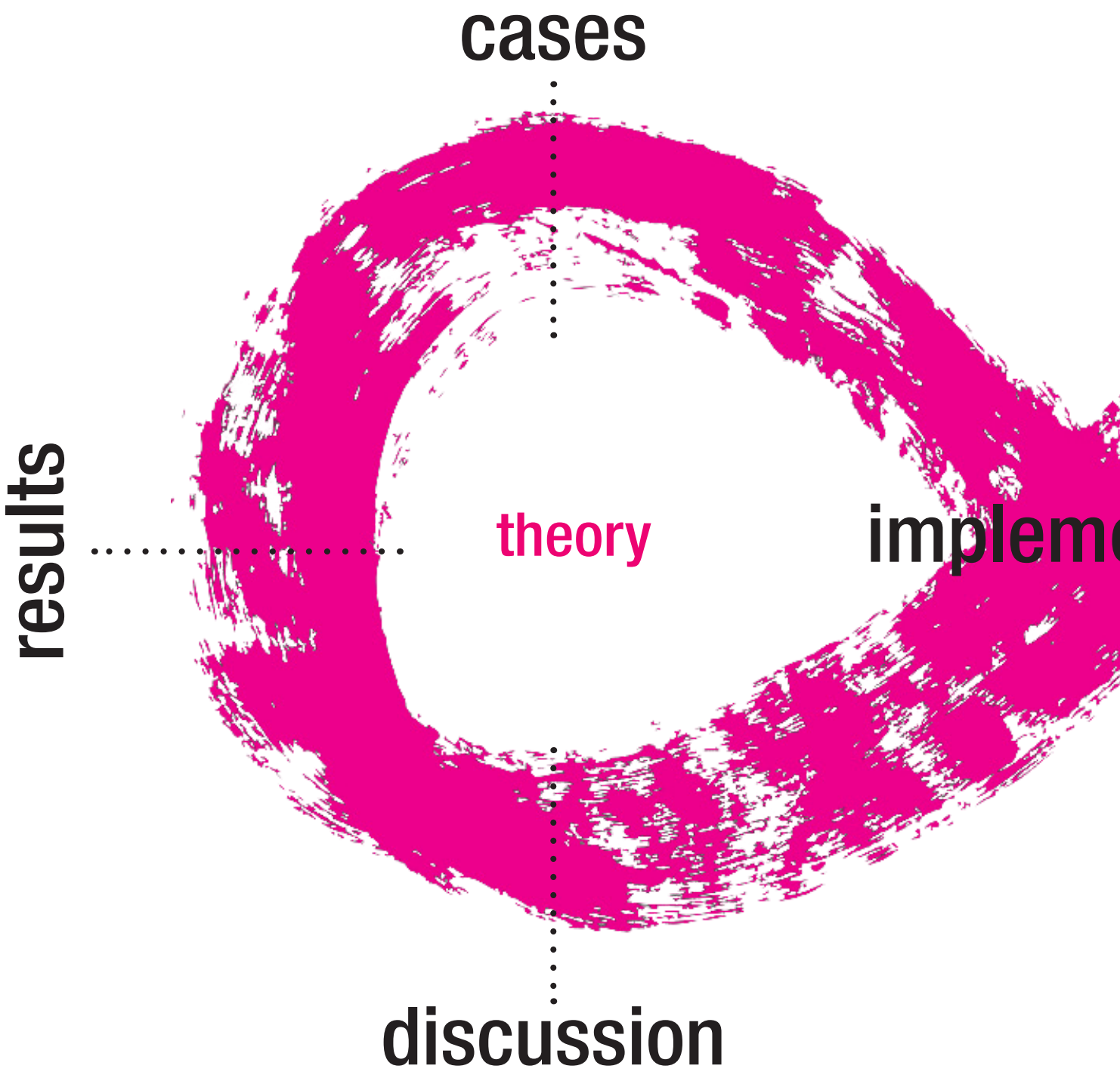
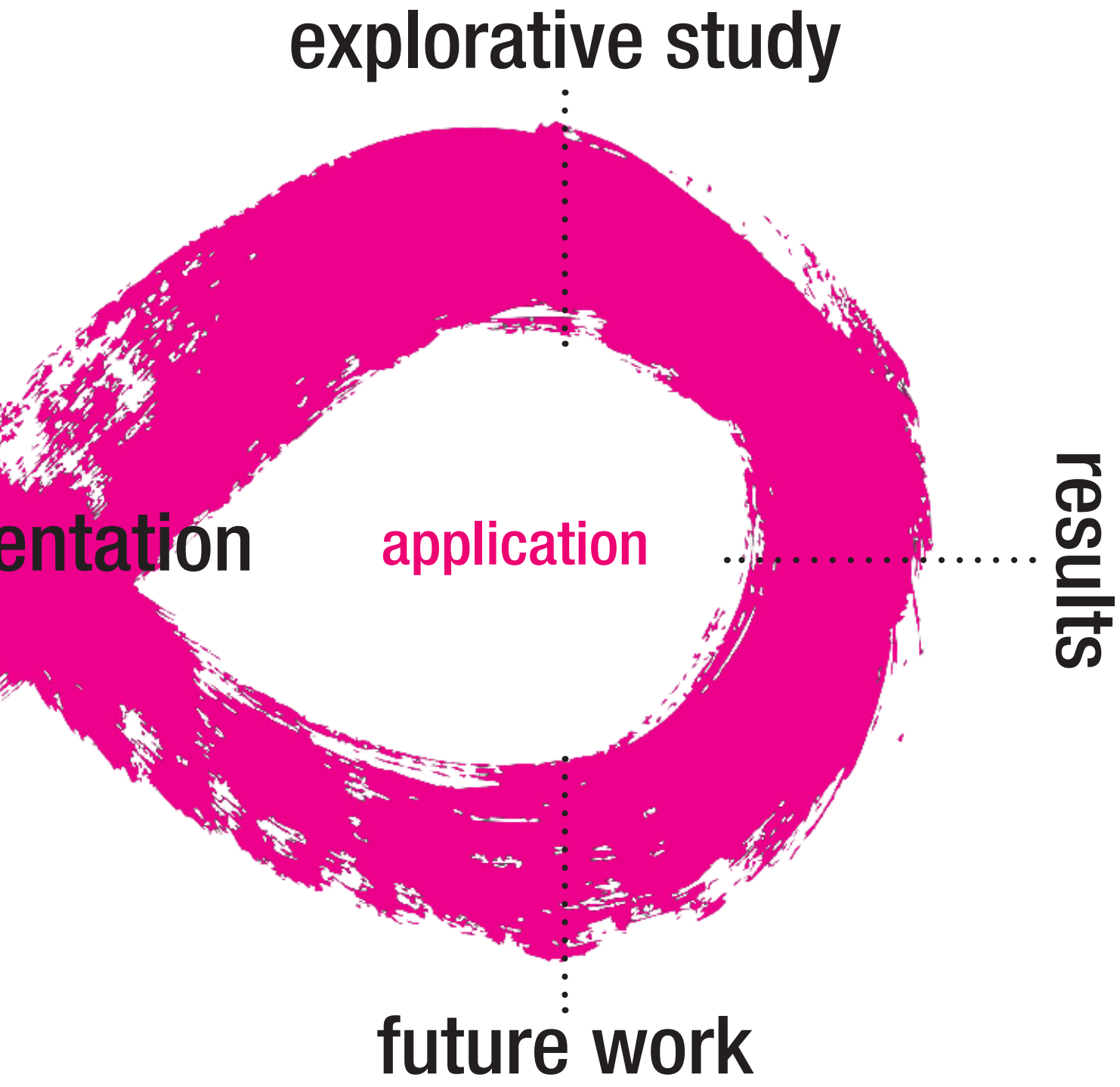


Figure 8.1. conclusion diagram | original infinity sign © 123rf.com


explorative study
entation
application
results
future work

There was no clear notion of architectural quality as perceived by the user until now. This thesis bridges the gap between the subjectively given statements and objectively - 'evidence based' methods, by introducing a clear methodology of how to investigate certain urban areas for their visual stimuli. The definition of 'the sought' quality was given by outlining the theoretical framework, which partially roots in the work of scholars in the early 20th century and combines them with algorithmic methods to make use of these clear strategies. The dissolving of the subjective approach and partially tackling the solution with the pure logical/mathematical methods provides a profound base of discussion. The key objective of this thesis was to work towards the analysis and understanding of perceived spatial qualities by focusing on only one human sense (visual), which was shown to be a successful attempt with a broad range of (for the applied cases) significant outcome.

It is shown, that by conducting a graphical survey, on two exemplary cases (in Vienna and Shanghai), across a wide range of features available in the mixed used urban complexes, the methodology can account for cultural differences and change the subjective speculation or 'common sense knowledge' to a more fact-based approach. This theory enables a broader discussion which can bring new impulses to the architectural discourse.

The work was split into several successive steps, which were initially triggered by the methodological idea of the paper "bodily maps of emotions". This idea was transferred into the architectural context and received acknowledgment as well as feedback by the original authors (neuroscientists). The qualities (monumental; progressive; structured; conservative and puristic) questioned during the survey were recorded graphically in 2D images and successfully transferred to their location in a 3D model. The gathered information from a series of (all together) 69 participants was aggregated and provided the possibility to show exactly where and in which intensity the quality occurs in the investigated areas.

The three major approaches of targeting the research question are: firstly the generation of occurrence maps, which show the distribution of the investigated qualities in a visual way to provide a simple method of being able to interpret the results. Secondly by conducting the comparative analysis, which uses a pure mathematical approach of contrasting the aggregated information (of the contestants) and highlights the areas of most interest. Thirdly by conducting the atmospheric analysis, which gives direct feedback of how people experience the investigated areas and the information correlates to the outcome of the graphical survey.

By asking for feedback from different scholars it was shown that the proposed framework can be applied in various ways and fulfills the goal of new impulses in the architectural discourse. By further developing in one of the proposed directions it can be applied: during the preparation or evaluation of competitions; in the design process or the transferal onto new architecture and to verify the hypothesized role of architectural features in buildings.

As the major research question for this thesis was: "Are there architectural/urban elements/situations that contain certain (visual) qualities and are those for explicitly given situations verifiable?", it was shown that by applying the proposed methodology and implementation architectural/urban elements/situations contain certain visual qualities and those are verifiable for the investigated areas.

9. future work

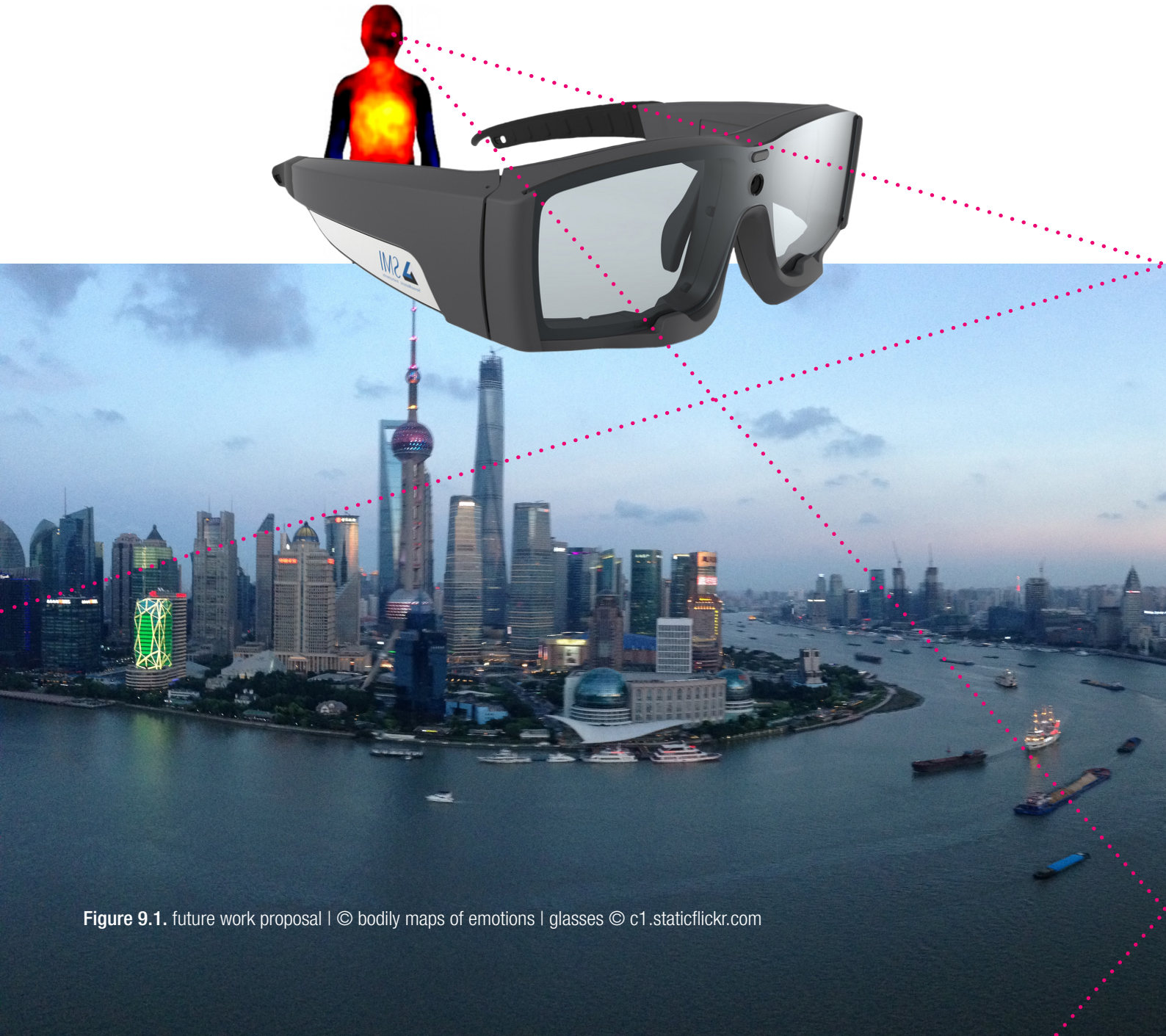
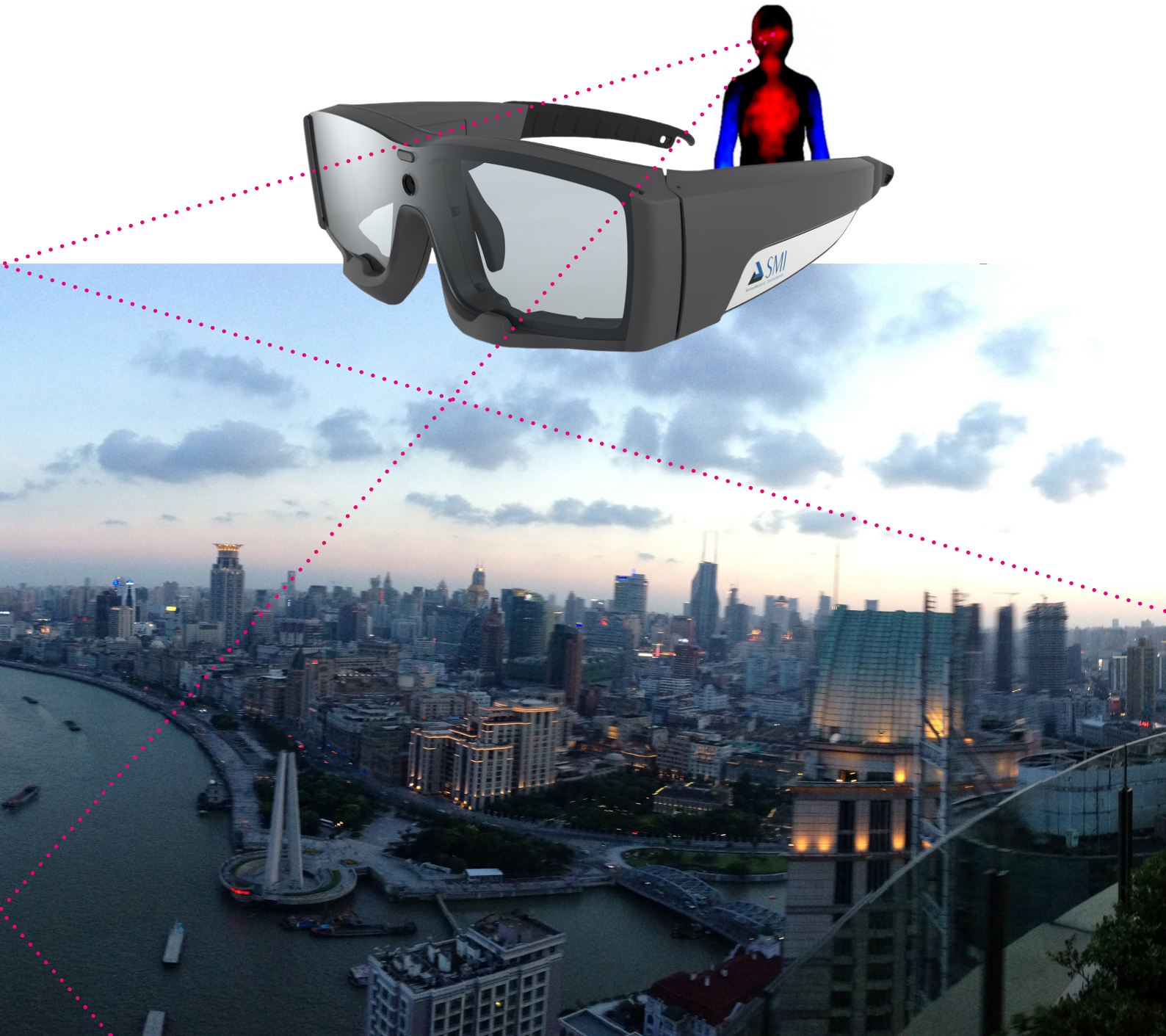


Figure 9.1. future work proposal | © bodily maps of emotions | glasses © c1.staticflickr.com


SMI

Scientific prospects of the idea

The gained insights, concerning the attempted and successfully completed usage of the methodology, can be used to further development of:

- the tool itself (regarding the proposed improvements (see chapter '7. discussion')); or
- the range of the research question (raised in chapter '1. introduction').

The already gained results (regarding the evaluation of the tool and the results of the cases) serve as a solid base for proposing to continue and expand the idea into a full fledged study. It shall either be:

- Used in order to become an independent scientific research project; or
- Proposed to be used by the author for obtaining a PHD, in the interdepartmental research center COCOS (complex computations system - PHD program) of the Technical University Vienna.

Scientific prospects of the implementations

New technologies

As Prof. Dr. Lauri Nummenmaa, Department of Biomedical Engineering & Computational Science Aalto University School of Science, (bodily maps of emotions) proposed the aspect of using further developed techniques to carry out the thesis. She suggested working with eye tracking, in which one asks the participants to focus on certain qualities whilst walking through the area of investigation and the glasses (worn by the contestant) are recording the movement of the participants eyes. This technique is already used in various fields and leaving the financial factors aside, this could take the research of finding architectural qualities to the next level and is considered for further pursuance. "*People often pay attention to the features they find interesting etc., thus this would give you a natural and unobtrusive way to see how people evaluate architectural features.*" (Nummenmaa, 2015)

New approach

Prof. Dr. Riitta Hari, Department of Neuroscience and Biomedical Engineering School of Science Aalto University, proposed a quite interesting point of extending the idea. "*I guess that one quite an interesting approach would be to really collect bodily maps from people who are viewing different (aspects of the) buildings.*" (Haarii, 2015) This would shift the initial idea of finding the perceived qualities on the building, to finding how the building is experienced or how people feel when confronted with certain elements/situations. This became a highly interesting point of view, which will be discussed for implication in further projects.

Prospects of usage of the idea

Competitions

As the evaluation of competitions is always triggered by the architects (invited by the competition organizer) and their opinion on the designs, the implementation of this transparent method of analysis could serve as a part of the judgment process. Predefined criteria, in the competition brief, can be evaluated in the competition entries and based on that, a recommendation can be given. This should be seen as a small addition to the general evaluation criteria and shift this level of subjective perception to a more objective/'evidence based' judgment, which could contribute to the representation of results and by that leading to a higher level of understanding of the participants.

Evaluation of built architecture/urban design

As the topics walkability or quality of life in the city context, which are evaluating the built environment, are becoming more and more interesting and popular, the question of implicating the factor of the sensory experience in the city, of the city should be raised. As developing the tool form the 2D to a 3D version was already raised in the discussion (see chapter '7. discussion') an application to a mobile device driven interface can be carried out. By offering the opportunity to enter data ad-hoc on spot without any limitation in the field of investigation (besides the boarders of the city) 'everybody' could become a contestant and the gained data would be highly valuable. This could lead, after reaching the defined period of validity, to an city-sized quality map, in which one could access live 'quality' data and may also lead to find areas which need to be improved. In which way this could be targeted, the criteria questioned and application of results has to be further investigated. The methodology proposed in this thesis can directly be applied to this thought, yet needs to be deepened and carried out in more detailing.

Catalog of termini

As there is an uncountable number of termini /qualities that can describe design/architecture/urban environment and their features, the development of a 'standardized' catalogue can be thought of. By using the proposed method, each term would need to be analyzed and taken through a series of 'standardized' cases. The results would need to be compared and clustered afterwards and by comparing the out-coming clusters, this catalogue would be generated. Due to the constant implication of new terms/qualities (extension of catalogue) it would always shit and apply to the new overall scheme.

Termini based tool

By taking the idea of a catalog of termini, there would be the opportunity to a tool that would generate certain architectural or urban situations based on the correlating analysis.

As an abstract example the analysis of the whole city can be taken and the results can be applied to the development of new city(-parts). If the need for urbanity in the new development area is given, one could filter the qualities allocated to the feeling of 'urban-ness' in the study of the city and apply the character/elements/building regulations/..., to the new design. The outcomes used should not be seen as the 'final design', but still be taken in consideration for using in terms of spatial design. The tool should be seen as a support for the process of decision making and not as the generalized answer to all questions raised during an urban design project.

Architectural workflow

As the architect mostly targets to communicate and transport a certain atmosphere or feeling through his design, the idea of evaluating architectural quality/attributes during the designing process could be investigated. This could give direct feedback, whilst working on the project and become a generative process of constant reevaluation. Intended spatial/architectural qualities can be fed into the 'tool' as parameters on which the current design should be evaluated. This requires the development of a multiplatform, 'stand-alone' application, which can be based on the same methodology (and the implication ideally in 3D) as proposed in this thesis.

10. appendix

Figure 10.1. Appendix


<html>
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<title> this is the end </title>
</header>
<body>
goodbye world
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10.3. survey tool

As the performance of the survey tool is described in the chapter ‘questionnaire’ the major part of the source code shall be provided in the following. This clipping specifically focuses on the visual survey tool (the operational part following the homescreen menue. This code requires a javascript library named ‘jquery’ and ‘processing’.

```
<!DOCTYPE html>
	<head>
		<meta http-equiv=”content-type” content=”text/html; charset=utf-8” />
		<title>questionnaire</title>
		<script src=”jquery-2.1.4.min.js” type=”text/javascript”></script>
		<script type=”text/javascript”>
		var tool = “draw”;
		function switchTool(selectedTool){
		  tool = selectedTool;
		}
		function setLabel(text){
			var span = document.getElementById(‘label’);
			while( span.firstChild ) {
				span.removeChild( span.firstChild );
			}
			span.appendChild( document.createTextNode(text) );
		}
		function clearCanvasRegion(canvasName, x,y,w,h){
			document.getElementById(canvasName).getContext(‘2d’).clearRect(x, y, w, h);
		}
		function getURLParam(sParam){
		  var sPageURL = window.location.search.substring(1);
		  var sURLVariables = sPageURL.split(‘&’);
		  for (var i = 0; i < sURLVariables.length; i++) {
		    var sParameterName = sURLVariables[i].split(‘=’);
		    if (sParameterName[0] == sParam) {
		      return sParameterName[1];
		    }
		  }
		}
		$(function(){
		  var step = getURLParam(‘step’);
		  var steps = getURLParam(‘steps’);
```

```
        var category = getURLParam('category');
        setLabel('Step ' + step + '/' + steps + ': Please highlight features which are \" + category + '\");
        var img = getURLParam('img');
        $('#questionnaire').css('background-image','url('+img+')');
        $('img#next').mouseover(function(){
          $(this).attr('src','next_hover.png');
        });
        $('img#next').mouseout(function(){
          $(this).attr('src','next.png');
        });
        $('img#prev').mouseover(function(){
          $(this).attr('src','previous_hover.png');
        });
        $('img#prev').mouseout(function(){
          $(this).attr('src','previous.png');
        });
        $('img#next').click(function(){
                var canvas = document.getElementByld('questionnaire');
                var result = canvas.toDataURL("image/png");
                $('#results').attr('value',result);
                $('#return').submit();
        });
        $('img#prev').click(function(){
                $('#back').attr('value','true');
            $('#return').submit();
        });
      });
      </script>

      <style type="text/css">
body {
  margin: 0;
  background-color: #333; color: #bbb; line-height: normal;
  font-family: Lucida Grande, Lucida Sans, Arial, Helvetica Neue, Verdana, Geneva, sans-serif;
  font-size: 11px; font-weight: normal; text-decoration: none;
        line-height: 1.5em;
}
```

```
a img {
        border: 0px solid transparent;
}
a, a:link, a:visited, a:active, a:hover {
        color: #cdcdcd; text-decoration: underline;
}
h1 {
    font-family: Arial, Helvetica Neue, Verdana, Geneva, sans-serif;
        width: 100%; letter-spacing: 0.1em;
        margin-bottom: 1em; font-size: 1.65em;
}
canvas {
        display: block;
        outline: 0px;
        margin-bottom: 1.5em;
}
#content {
        /*margin: 50px auto 0px auto;*/
        /*padding: 25px 25px 15px 25px;*/
        /*width: 960px;*/
        min-width: 300px; overflow: auto;
        border-left: 1px solid #444; border-top: 1px solid #444;
        border-right: 1px solid #333; border-bottom: 1px solid #333;
        background-color: #3d3d3d;
}
        </style>
        <!--[if lt IE 9]>
                <script type="text/javascript">alert("Your browser does not support the canvas tag.");</script>
        <![endif]-->
        <script src="processing.js" type="text/javascript"></script>
        <script type="text/javascript">
// convenience function to get the id attribute of generated sketch html element
function getProcessingSketchId () { return 'questionnaire'; }
</script>

        </head>
        <body>
```

```
<form id="return" method="POST" action="survey.php">
        <input type="hidden" name="back" id="back" value=""/>
        <input type="hidden" name="results" id="results" value=""/>
        <input type="hidden" name="type" id="results" value="png"/>
</form>
<table border="0" width="100%">
<tr>
<td width="121" align="left">
<img src="previous.png" id="prev"/>
</td>
<td align="center">
        <div id="content">
        <table border="0">
        <tr>
        <td colspan="2" align="center">
                <h1>  <span id="label">Questionnaire Title</span></h1>
        </td>
        </tr>
 <tr>
        <td valign="top" width="90">
                <button id="draw" onClick="javascript:switchTool('draw');">
                        <img width="64" height="64" src="pen.png"/>
                </button>
                <button id="erase" onClick="javascript:switchTool('erase');">
                        <img width="64" height="64" src="eraser.png"/>
                </button>
        </td>
 <td>
                <div>
                        <canvas id="questionnaire" data-processing-sources="questionnaire.pde"
                                width="960" height="700">
                                <p>Your browser does not support the canvas tag.</p>
                                <!-- Note: you can put any alternative content here. -->
                        </canvas>
                        <noscript>
                                <p>JavaScript is required to view the contents of this page.</p>
                        </noscript>
```

```
                    </div>
                    </td>
                    </tr>
                    </table>

                    </div>
          </td>
          <td width="121" align="right">
        <img id="next" src="next.png"/>
          </td>
          </tr>
          </table>
          </body>
</html>
```

```
                ****************************************** questionnaire.pde ******************************************
int brush = 40;
void setup() {
  size(960, 700);
  background(0,0);
  noStroke();
}

void draw() {
  if (mousePressed) {
    if(tool == "draw") {
      fill(255);
      ellipse(mouseX,mouseY,brush,brush);
    }else{
      int brush_half = brush / 2;
      int fromX = max(mouseX - brush_half, 0);
      int fromY = max(mouseY - brush_half,0);
      // bug workaround: custom written clear function in template
      clearCanvasRegion("questionnaire",fromX,fromY,brush,brush);
    }
  }
}
```

10.4. visual information processing tool

As the performance of the visual information processing tool is described in the chapter ‘visual information processing’ the source code shall be provided in the following. In order to have it working, ‘python’, with the extension PIL (Python image library) has to be installed on your device.

```
#!/usr/bin/python

import sys
print sys.argv[1]

import glob
all_pngs = sys.argv[1] + “/*.png”
png_files = glob.glob(all_pngs)

import os
output_dir = sys.argv[1] + “_output”
if not os.path.exists(output_dir):
    os.makedirs(output_dir)
num = 0
for i in range(0, len(png_files)):
        this_png = png_files[i]
        # print this_png
        parts = this_png.split(“_”)
        # print parts
        right_part = parts[1]
        subparts = right_part.split(‘.’)
        number = int(subparts[0])
        if number > num:
                num = number
from PIL import Image
print str(num + 1) + “ items found!”
for i in range(0, num + 1):
        pngs_for_this_number = glob.glob(sys.argv[1] + “/*_” + str(i) + “.png”)
        print “now aggregating all pngs for “ + str(i)
        raw = [0 for k in range(960 * 700)]
        raw_max = 0
        for j in range(0, len(pngs_for_this_number)):
                current_png = pngs_for_this_number[j]
                print current_png
```

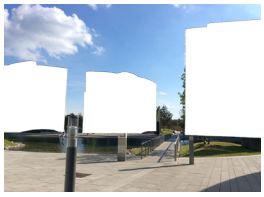
```
        img = Image.open(current_png)
        pix = img.load()
        for x in range(0, 960):
                for y in range(0, 700):
                        existing_val = raw[x + y*960]
                        if pix[x,y][3] != 0:
                                # print "pixel " + str(x) + ", " + str(y) + " is set!"
                                raw[x + y * 960] = existing_val + 1
                                if raw_max < raw[x + y * 960]:
                                        raw_max = raw[x + y * 960]
mask = Image.open(str(i) + ".mask")
mask_raw = mask.load()
print "applying mask..."
for x in range(0,960):
        for y in range(0,700):
                if mask_raw[x,y][3] == 0:
                        raw[x + y * 960] = 0
print "generating aggregate..."
aggregate = Image.new('RGBA', (960,700), (0,0,0,0))
for x in range(0,960):
        for y in range(0,700):
                raw_number = raw[x + y * 960]
                if x == 0 and y == 0:
                        print "pix 0:" + str(raw_number)
                if x == 198 and y == 256:
                        print "pix 198,256: " + str(raw_number)
                if raw_number > 0:
                        scaled = int((float(raw_number) / float(raw_max)) * float(255))
                        if x == 0 and y == 0:
                                print "pix 0 after scaling:" + str(scaled)
                        if x == 198 and y == 256:
                                print "pix 198,256 after scaling: " + str(scaled)

                        aggregate.putpixel((x,y),(255, 255, 255, scaled))
                else:
                        pass
                        # aggregate.putpixel((x,y),(raw_number, raw_number,raw_number,255))
aggregate.save(output_dir + '/' + str(i) + ".png")
```

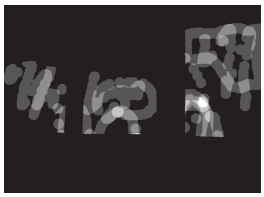
10.5. visual information data

'Viertel Zwei' | Vienna | Output of the visual information processing tool | 27.07.2015


situation 1


situation 1 | mask


monumental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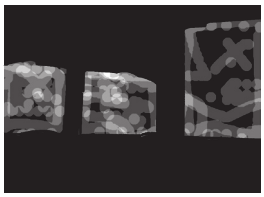
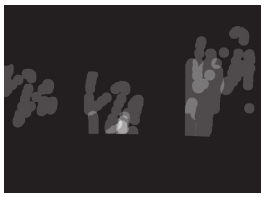
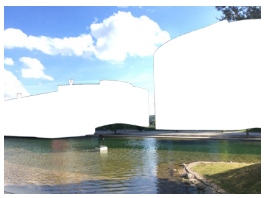
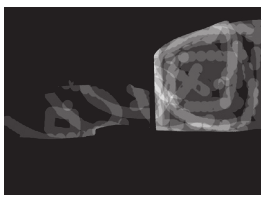

structured


conservative


puristic


situation 2


situation 2 | mask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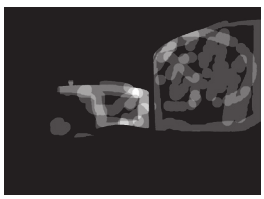
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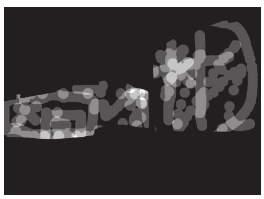
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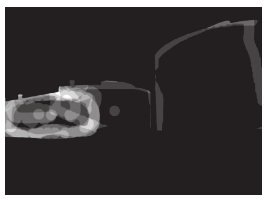
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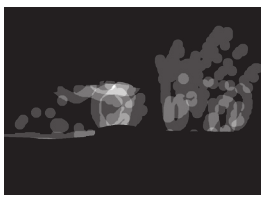
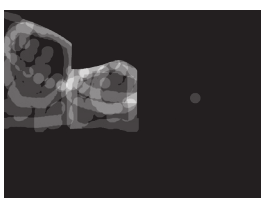

puristic


situation 3


situation 3 | mask


monumental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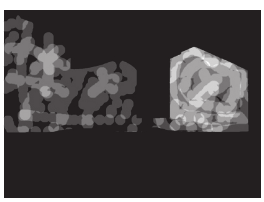

structured


conservative


puristic

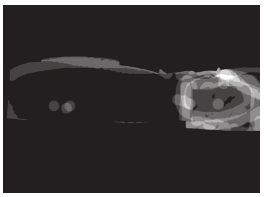

situation 4


situation 4 | mask


monumental


progressive

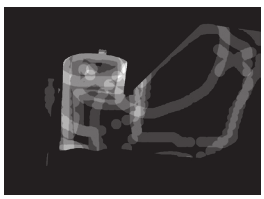

structured


conservative

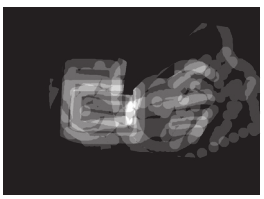

puristic


situation 5


situation 5 | mask


monumental


progressive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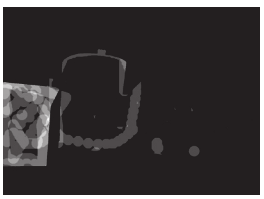
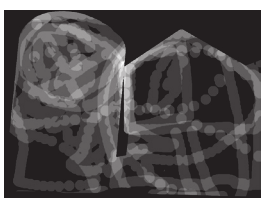

conservative


puristic


situation 6


situation 6 | mask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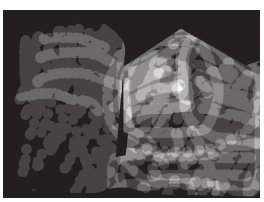
progressive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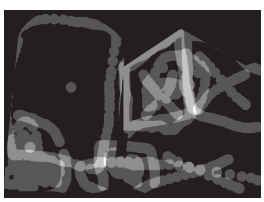
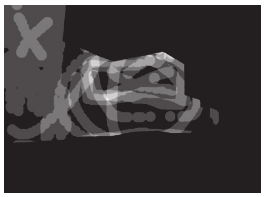
conservative


puristic

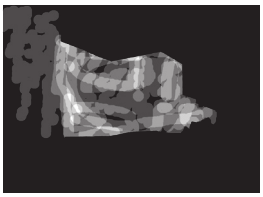
situation 7

situation 7 | mask



monumental

progressive



structured

conservative

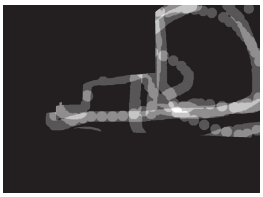
puristic

situation 8

situation 8 | mask

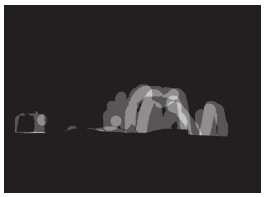
monumental

progressive



structured

conservative

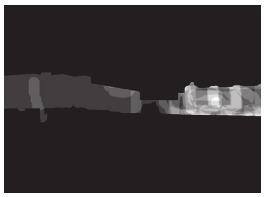


puristic

‘KIC Jiangwan’ | Shanghai | Output of the visual information processing tool | 29.08.2015


situation 1


situation 1 | mask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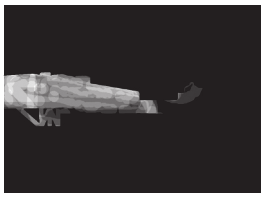
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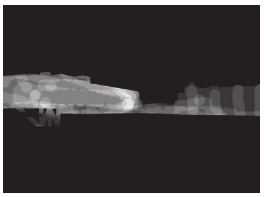
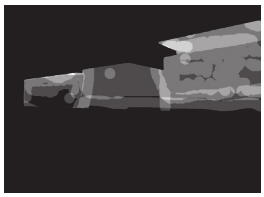

structured

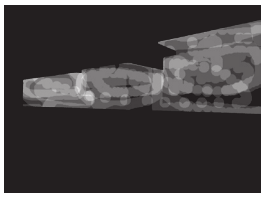

conservative


puristic


situation 2


situation 2 | mask


monumental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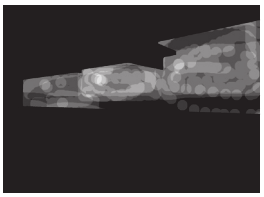
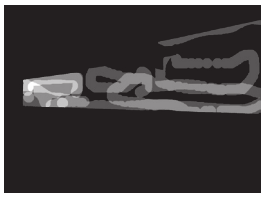
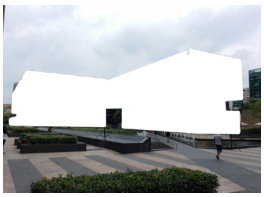

structured


conservative

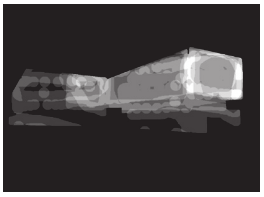

puristic

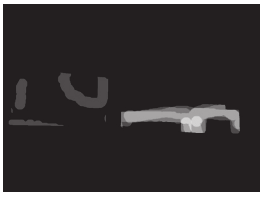

situation 3

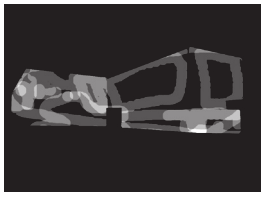

situation 3 | mask


monumental

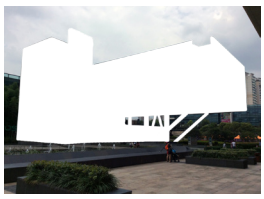

progressive


structured

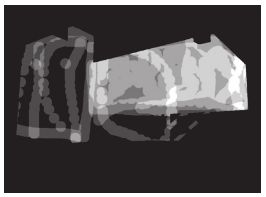

conservative


puristic

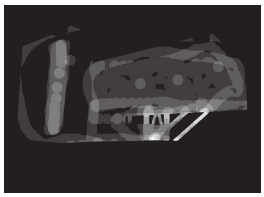
situation 4



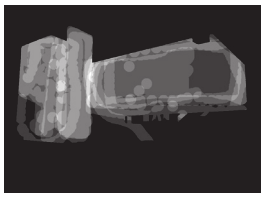
situation 4 | mask



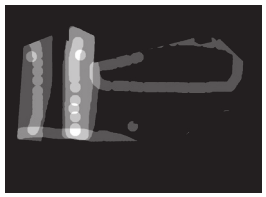
monumental



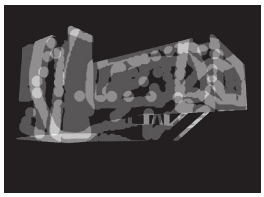
progressive



structured



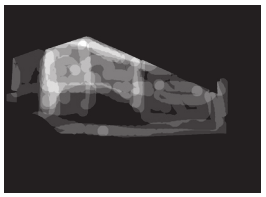
conservative



puristic

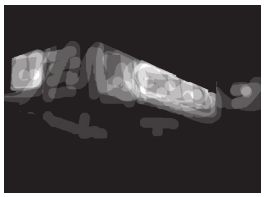
situation 5

situation 5 | mask



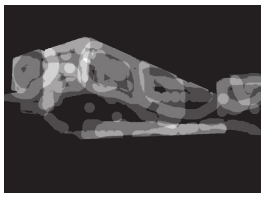
monumental

progressive



structured

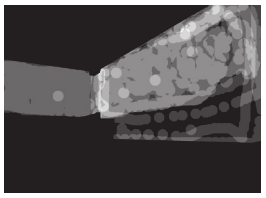
conservative



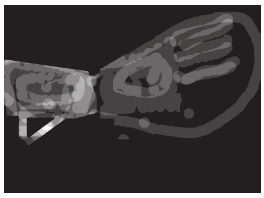
puristic

situation 6

situation 6 | mask



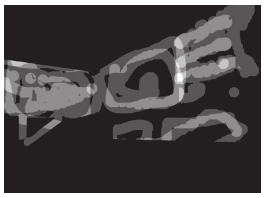
monumental



progressive

structured

conservative



puristic

situation 7

situation 7 | mask

monumental

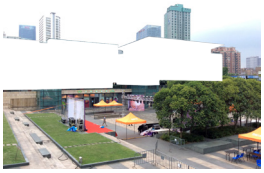
progressive

structured

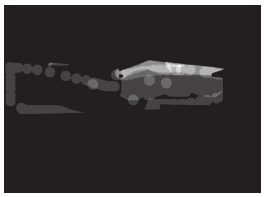
conservative

puristic

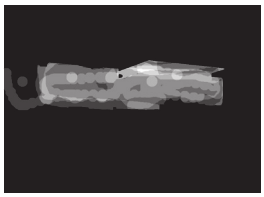
situation 8



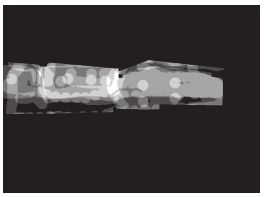
situation 8 | mask



monumental

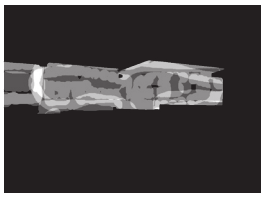


progressive



structured

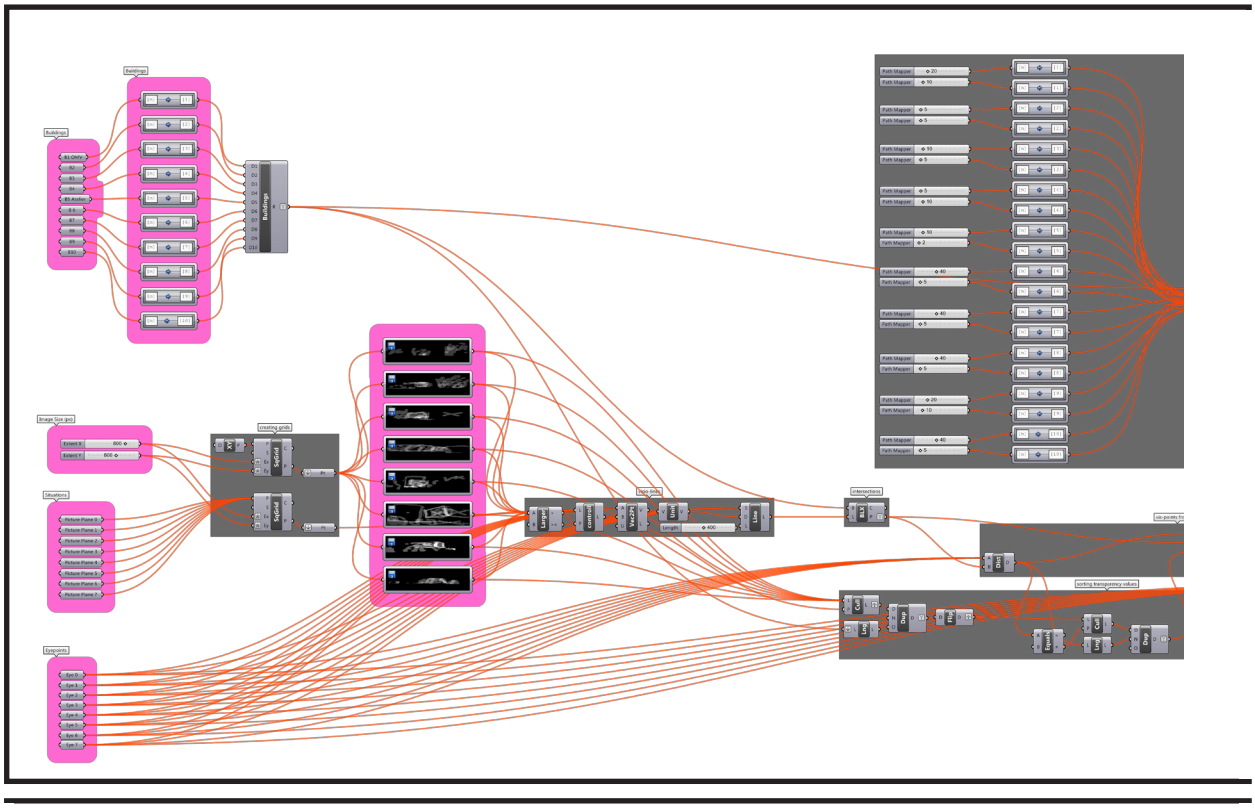
conservative



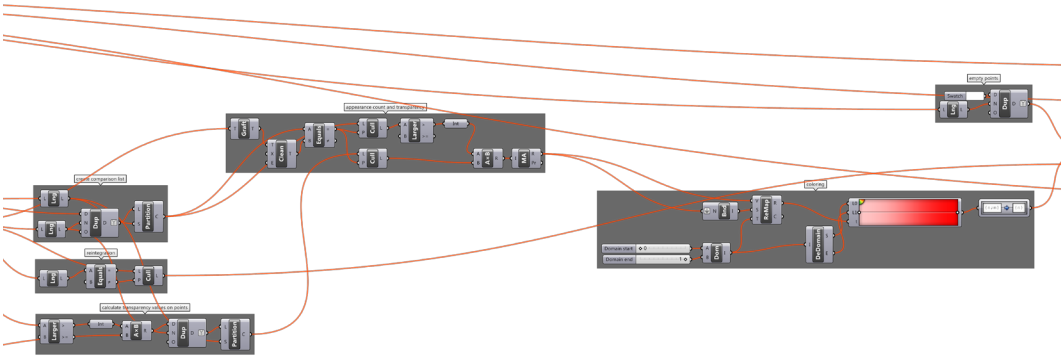
puristic

10.6. occurrence map tool

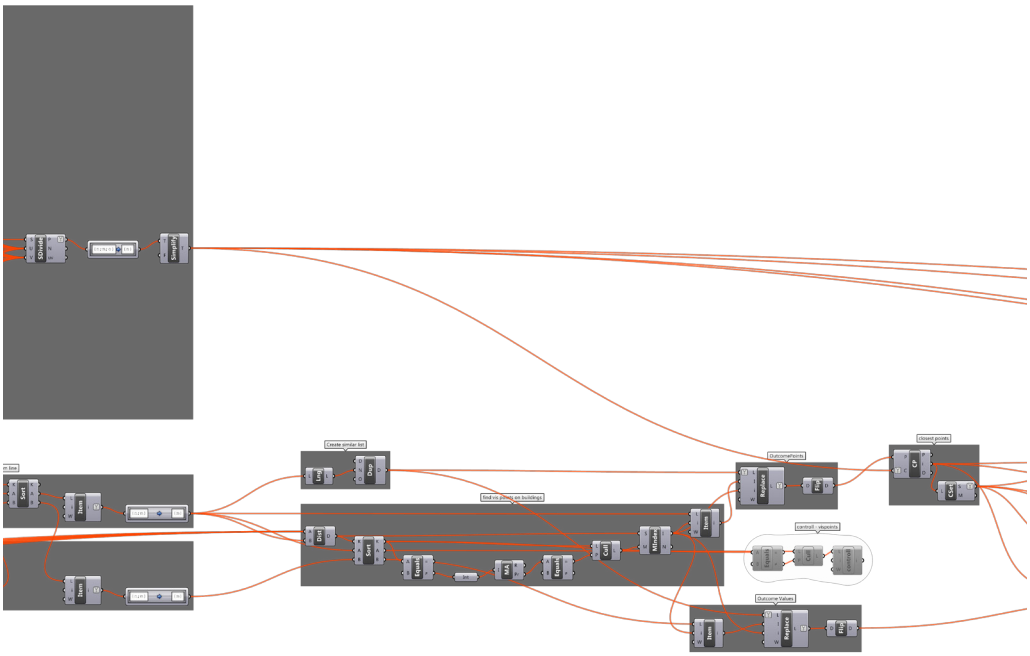
The ‘occurrence map tool’ was coded in Grasshopper (a Plugin to Rhinoceros 3D).



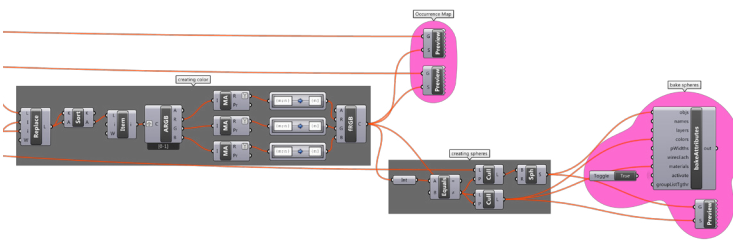
1



3



2



4

10.7. comparative analysis tool

As the performance of the comparative analysis tool is described in the chapter 'comparative analysis' the source code shall be provided in the following. In order to have it working, 'python', with the extension PIL (Python image library) & ITERTOOLS has to be installed on your device.

```
from PIL import Image
from PIL import ImageChops
from itertools import izip
import math, operator
import glob
import numpy
import os
from sre_parse import CATEGORIES
from _collections import defaultdict

def equal(im1, im2):
    return ImageChops.difference(im1, im2).getbbox() is None

def rmsdiff(im1, im2):
    "Calculate the root-mean-square difference between two images"
    h = ImageChops.difference(im1, im2).histogram()

    # calculate rms
    return math.sqrt(reduce(operator.add,
        map(lambda h, i: h*(i**2), h, range(256))
        ) / (float(im1.size[0]) * im1.size[1]))

point_table = ([0] + ([255] * 255))

def black_or_b(a, b):
    diff = ImageChops.difference(a, b)
    diff = diff.convert('L')
    diff = diff.point(point_table)
    new = diff.convert('RGB')
    new.paste(b, mask=diff)
    return new

def write_diff(im1, im2, out):
    im = ImageChops.difference(im1, im2)
    im.save(out)

def get_category(folder):
    parts = folder.split(" ")
    return parts[1]

def get_number(file):
    parts = file.split('.')
    number = int(parts[0])
    return number

import sys
print "using base directory: " + sys.argv[1]
```

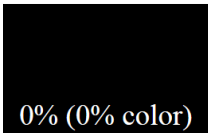
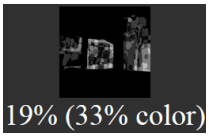
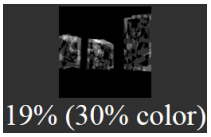
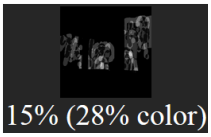
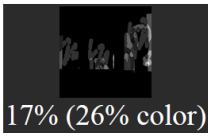
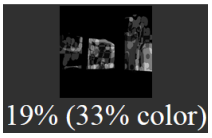
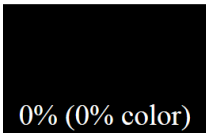
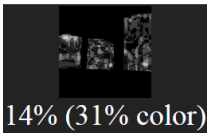
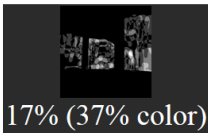
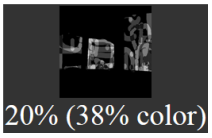
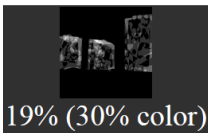
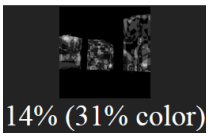
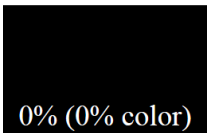
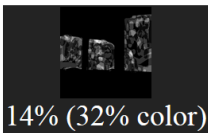
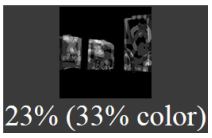
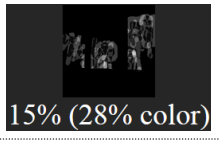
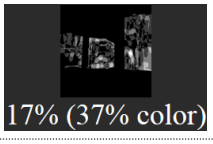
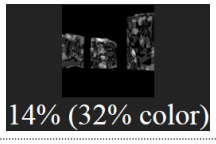
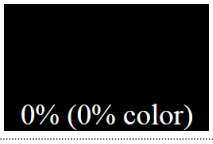
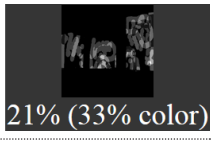
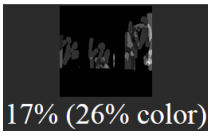
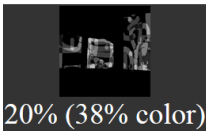
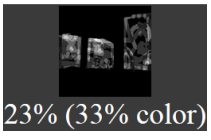
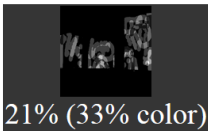
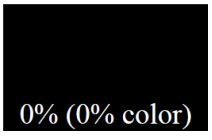
```
from collections import defaultdict

overall_binary_dif = defaultdict(dict)
overall_color_dif = defaultdict(dict)

category_to_folder = {}
number_to_file = {}
statistics = {}
cases = 1000
for name in os.listdir(sys.argv[1]):
    path = os.path.join(sys.argv[1], name)
    if not os.path.isdir(path):
        continue
    category = get_category(name)
    category_to_folder[category] = path
    file_list = os.listdir(path)
    numbers = []
    for file in file_list:
        number = get_number(file)
        number_to_file[number] = os.path.join(path, file)
        numbers.append(number)
    numbers = sorted(numbers)
    if len(numbers) < cases:
        cases = len(numbers)
    statistics[category] = numbers

items = len(statistics.keys())
for a_category in statistics.keys():
    for b_category in statistics.keys():
        overall_binary_dif[a_category][b_category] = [0] * cases
        overall_color_dif[a_category][b_category] = [0] * cases


output_dir = sys.argv[1] + "_cluster"
if not os.path.exists(output_dir):
    os.makedirs(output_dir)


MAX = 184.69
icounter = 0;

out = open(os.path.join(output_dir,"index.html"),"w")
out.write("<html><head><link rel='stylesheet' href='stylesheet.css'></head><body>")
for case in range(0, cases):
    print "case " + str(case)
    out.write("<table>")
    out.write("<tr>")
    out.write("<td class='header'>Case " + str(case) + "</td>")
    for b_category, b_cases in statistics.iteritems():
        out.write("<td class='header'>" + b_category + "</td>")
    out.write("</tr>")
```

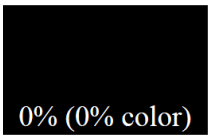
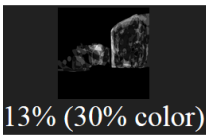
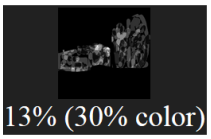
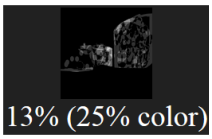
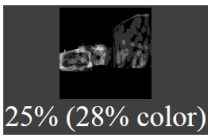
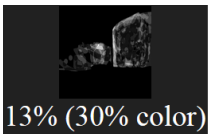
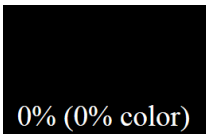
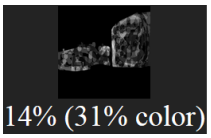
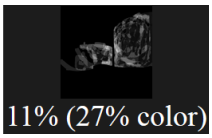
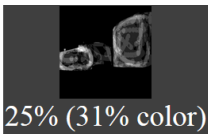
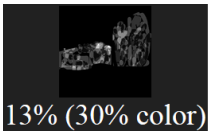
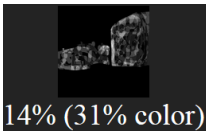
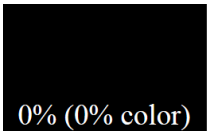
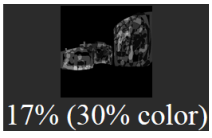
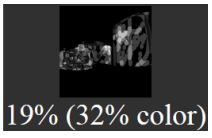
```
    for a_category, a_cases in statistics.iteritems():
        out.write("<tr><td class='header'>" + str(a_category) + "</td>")
        a_number = a_cases[case]
        a_file = number_to_file[a_number]
        a = Image.open(a_file)
        a_red, a_green, a_blue, a_alpha = a.split()
        for b_category, b_cases in statistics.iteritems():
            b_number = b_cases[case]
            b_file = number_to_file[b_number]
            b = Image.open(b_file)
            b_red, b_green, b_blue, b_alpha = b.split()

            pairs = zip(a_alpha.getdata(), b_alpha.getdata())
            resolution =  960*700

                                    # where are the images different?
            num_differences = 0
            binary_dif = 0
            for p1, p2 in pairs:
                p1_set = p1 != 0;
                p2_set = p2 != 0;
                if (p1_set or p2_set) and not (p1_set and p2_set):
                    binary_dif += 1
                    num_differences += 1
            binary_dif_pct = int((float(binary_dif) / float(resolution)) * 100.0)

            dif_color = 0
            dif_color_pct = 0
            if num_differences > 0:
                        for p1, p2 in pairs:
                            p1_set = p1 != 0;
                            p2_set = p2 != 0;
                            if (p1_set or p2_set) and not (p1_set and p2_set):
                                difference = abs(p1-p2)
                                dif_color += difference
                        dif_color_pct = int( ((float(dif_color) / float(num_differences)) / 255.0) * 100.0 )

             print " " + a_category + " x " + b_category + ": " + str(binary_dif_pct) + "% different, (" + str(dif_color_pct) +
"% color)"
            color = int((float(binary_dif_pct) / 100.0) * 255.0)
            write_diff(a_alpha,b_alpha, os.path.join(output_dir, str(icounter) + ".png"))
            out.write("<td class='cell' style='background-color: rgb("+
                    str(color)+","+str(color)+","+str(color)+")'>" +
                    "<img width='50' height='50' src='" + str(icounter) + ".png'><br>" +
                    str(binary_dif_pct) + "% (" + str(dif_color_pct) + "% color)</td>")
            overall_binary_dif[a_category][b_category][case] = binary_dif_pct
            overall_color_dif[a_category][b_category][case] = dif_color_pct
            icounter += 1
            a.close()
            b.close()
        out.write("</tr>")
    out.write("</table>")
```

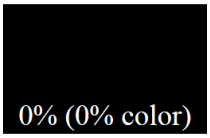
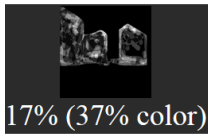
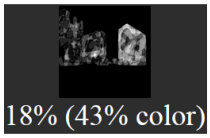
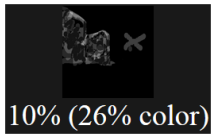
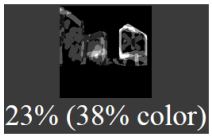
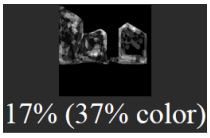
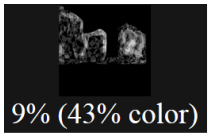
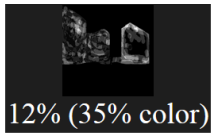
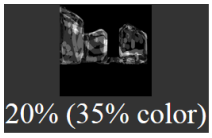
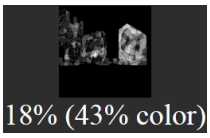
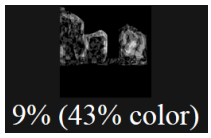
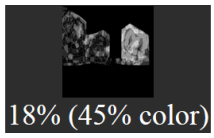
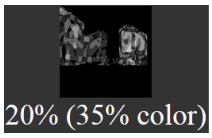
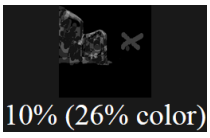
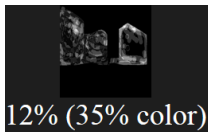
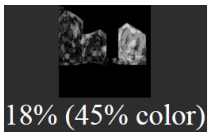
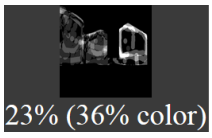
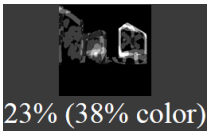
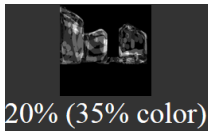
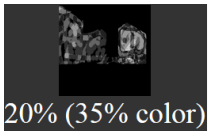
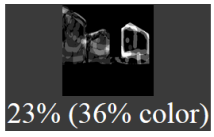
```
    out.write("<br>")

print "overall average"
out.write("<table>")
out.write("<tr>")
out.write("<td class='header'>Overall Average</td>")
for b_category, b_cases in statistics.iteritems():
    out.write("<td class='header'>" + b_category + "</td>")
out.write("</tr>")
for a_category, a_cases in statistics.iteritems():
    out.write("<tr><td class='header'>" + str(a_category) + "</td>")
    for b_category, b_cases in statistics.iteritems():
        binary_dif_cases =  overall_binary_dif[a_category][b_category]
        color_dif_cases = overall_color_dif[a_category][b_category]
        binary_dif_avg = numpy.average(binary_dif_cases)
        color_dif_avg = numpy.average(color_dif_cases)
        print " " + a_category + " x " + b_category + ": " + str(binary_dif_avg) + " avg"
        color = int((float(binary_dif_avg) / 100.0) * 255.0)
        out.write("<td class='cell' style='background-color: rgb("+
                str(color)+","+str(color)+","+str(color)+")'>" +
                str(int(binary_dif_avg)) + "% (" + str(int(color_dif_avg)) + "% color)</td>")
    out.write("</tr>")
out.write("</table>")
out.write("<br>")

print "overall median"
out.write("<table>")
out.write("<tr>")
out.write("<td class='header'>Overall Median</td>")
for b_category, b_cases in statistics.iteritems():
    out.write("<td class='header'>" + b_category + "</td>")
out.write("</tr>")
for a_category, a_cases in statistics.iteritems():
    out.write("<tr><td class='header'>" + str(a_category) + "</td>")
    for b_category, b_cases in statistics.iteritems():
        binary_dif_cases =  overall_binary_dif[a_category][b_category]
        color_dif_cases = overall_color_dif[a_category][b_category]
        binary_dif_median = numpy.median(binary_dif_cases)
        color_dif_median = numpy.median(color_dif_cases)
        print " " + a_category + " x " + b_category + ": " + str(binary_dif_median) + " median"
        color = int((float(binary_dif_median) / 100.0) * 255.0)
        out.write("<td class='cell' style='background-color: rgb("+
          str(color)+","+str(color)+","+str(color)+")'>" +
          str(int(binary_dif_median)) + "% (" + str(int(color_dif_median)) + "% color)</td>")
    out.write("</tr>")
out.write("</table>")
out.write("<br>")


out.write("</body></html>")
out.close()
```

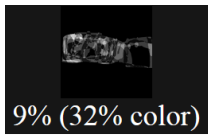
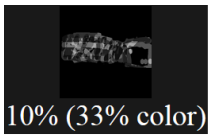
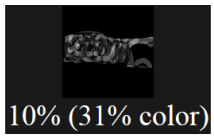
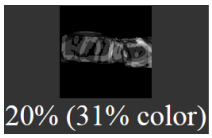
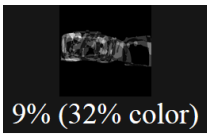
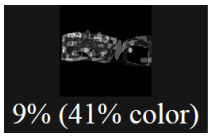
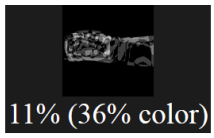
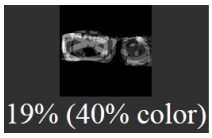
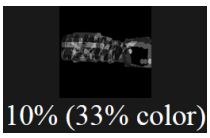
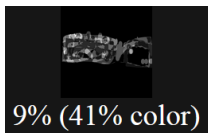
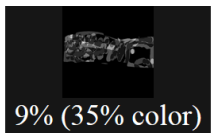
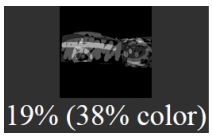
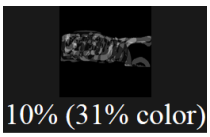
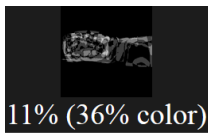
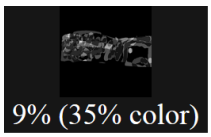
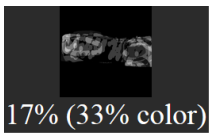
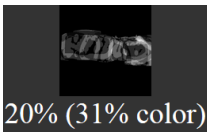
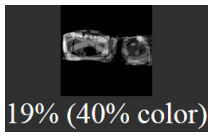
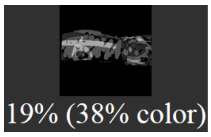
10.8. comparative analysis data

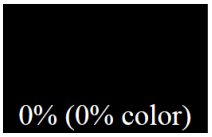
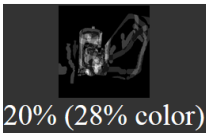
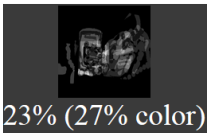
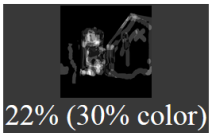
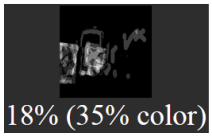
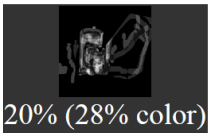
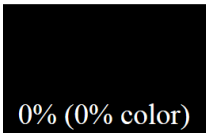
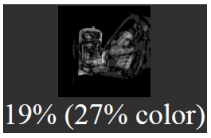
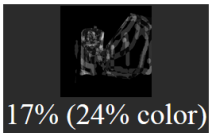
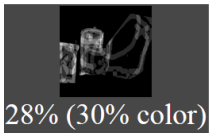
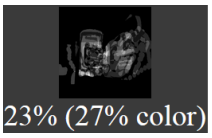
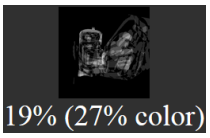
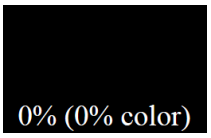
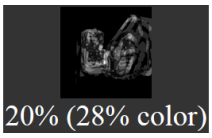
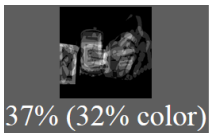
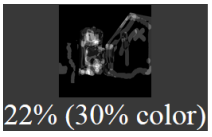
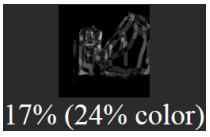
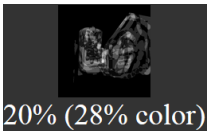
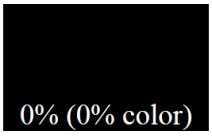
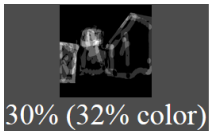
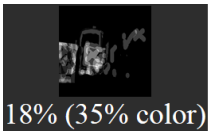
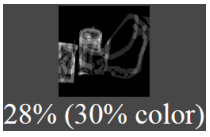
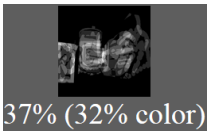
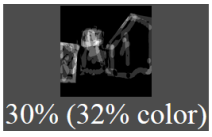
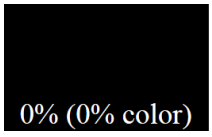
'Viertel Zwei' | Vienna | Output of the comparative analysis tool

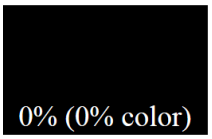
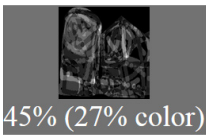
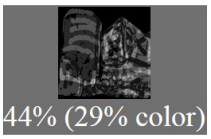
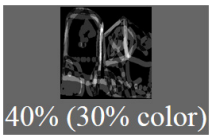
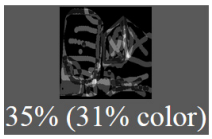
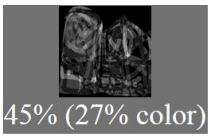
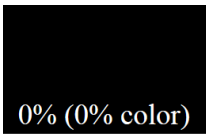
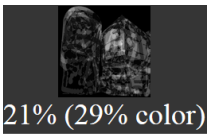
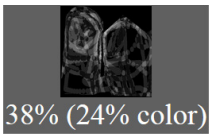
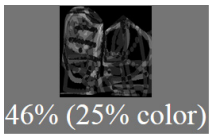
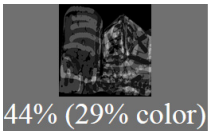
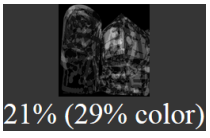
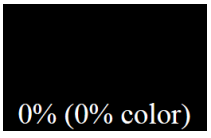
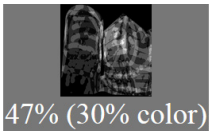
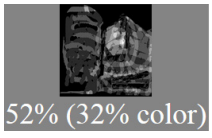
situation 1	puristic	monumental	structured	progressive	conservative
puristic	 0% (0% color)	 19% (33% color)	 19% (30% color)	 15% (28% color)	 17% (26% color)
monumental	 19% (33% color)	 0% (0% color)	 14% (31% color)	 17% (37% color)	 20% (38% color)
structured	 19% (30% color)	 14% (31% color)	 0% (0% color)	 14% (32% color)	 23% (33% color)
progressive	 15% (28% color)	 17% (37% color)	 14% (32% color)	 0% (0% color)	 21% (33% color)
conservative	 17% (26% color)	 20% (38% color)	 23% (33% color)	 21% (33% color)	 0% (0% color)

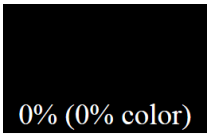
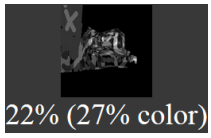
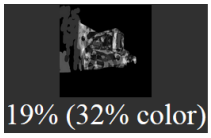
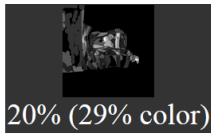
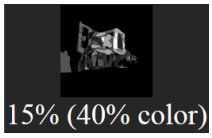
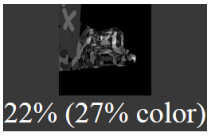
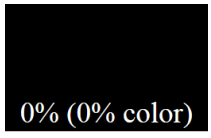
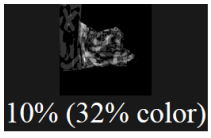
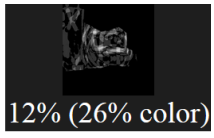
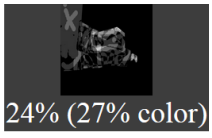
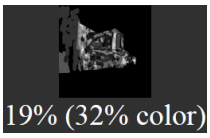
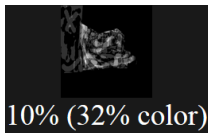
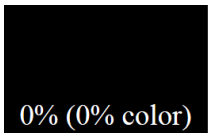
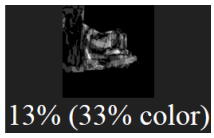
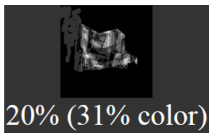
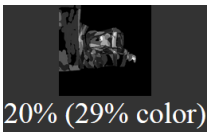
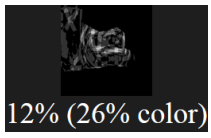
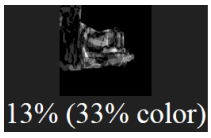
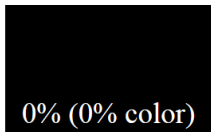
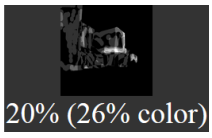
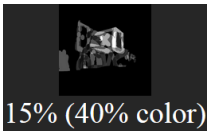
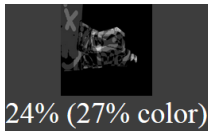
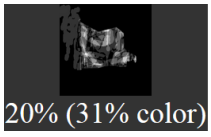
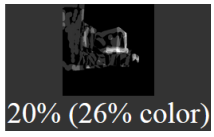
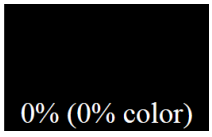
situation 2	puristic	monumental	structured	progressive	conservative
puristic	 0% (0% color)	 13% (30% color)	 13% (30% color)	 13% (25% color)	 25% (28% color)
monumental	 13% (30% color)	 0% (0% color)	 14% (31% color)	 11% (27% color)	 25% (31% color)
structured	 13% (30% color)	 14% (31% color)	 0% (0% color)	 17% (30% color)	 19% (32% color)
progressive	13% (25% color)	11% (27% color)	17% (30% color)	0% (0% color)	25% (31% color)
conservative	25% (28% color)	25% (31% color)	19% (32% color)	25% (31% color)	0% (0% color)

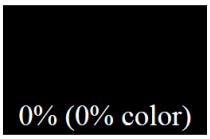
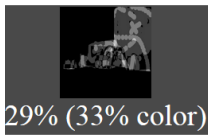
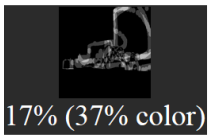
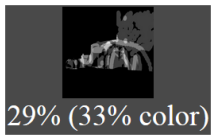
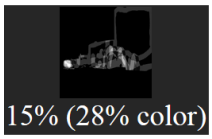
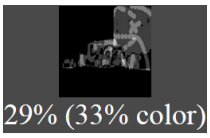
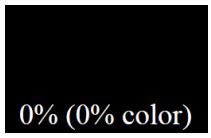
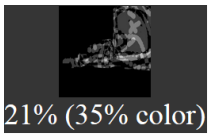
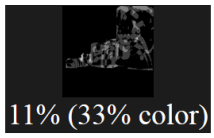
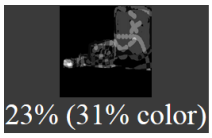
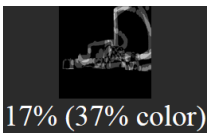
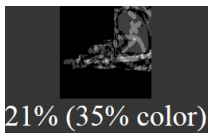
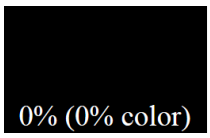
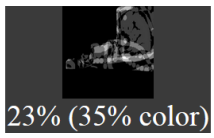
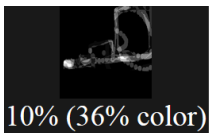
situation 3	puristic	monumental	structured	progressive	conservative
puristic	 0% (0% color)	 17% (37% color)	 18% (43% color)	 10% (26% color)	 23% (38% color)
monumental	 17% (37% color)	0% (0% color)	 9% (43% color)	 12% (35% color)	 20% (35% color)
structured	 18% (43% color)	 9% (43% color)	0% (0% color)	 18% (45% color)	 20% (35% color)
progressive	 10% (26% color)	 12% (35% color)	 18% (45% color)	0% (0% color)	 23% (36% color)
conservative	 23% (38% color)	 20% (35% color)	 20% (35% color)	 23% (36% color)	0% (0% color)

situation 4	puristic	monumental	structured	progressive	conservative
puristic	0% (0% color)	 9% (32% color)	 10% (33% color)	 10% (31% color)	 20% (31% color)
monumental	 9% (32% color)	0% (0% color)	 9% (41% color)	 11% (36% color)	 19% (40% color)
structured	 10% (33% color)	 9% (41% color)	0% (0% color)	 9% (35% color)	 19% (38% color)
progressive	 10% (31% color)	 11% (36% color)	 9% (35% color)	0% (0% color)	 17% (33% color)
conservative	 20% (31% color)	 19% (40% color)	 19% (38% color)	17% (33% color)	0% (0% color)

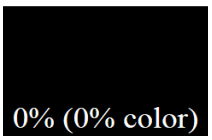
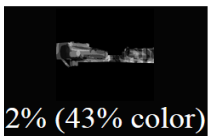
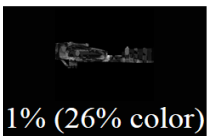
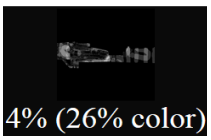
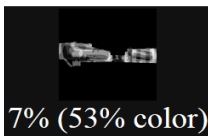
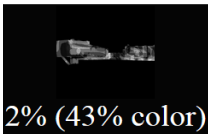
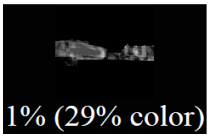
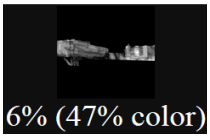
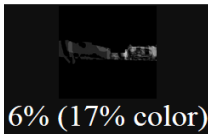
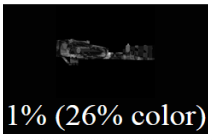
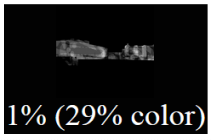
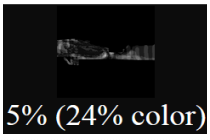
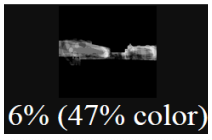
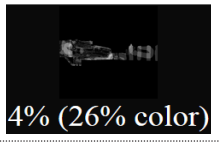
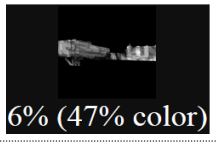
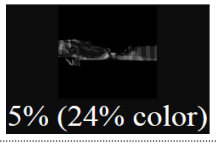
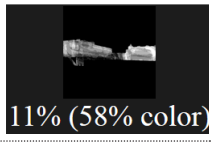
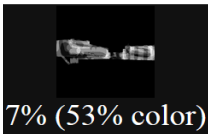
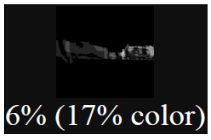
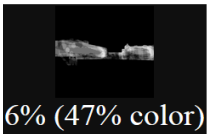
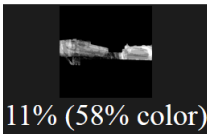
situation 5	puristic	monumental	structured	progressive	conservative
puristic	 0% (0% color)	 20% (28% color)	 23% (27% color)	 22% (30% color)	 18% (35% color)
monumental	 20% (28% color)	 0% (0% color)	 19% (27% color)	 17% (24% color)	 28% (30% color)
structured	 23% (27% color)	 19% (27% color)	 0% (0% color)	 20% (28% color)	 37% (32% color)
progressive	 22% (30% color)	 17% (24% color)	 20% (28% color)	 0% (0% color)	 30% (32% color)
conservative	 18% (35% color)	 28% (30% color)	 37% (32% color)	 30% (32% color)	 0% (0% color)

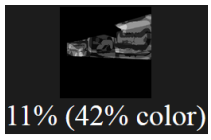
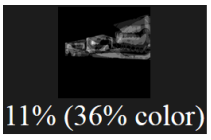
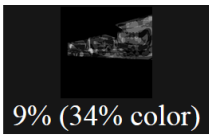
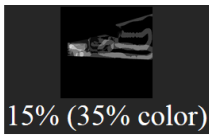
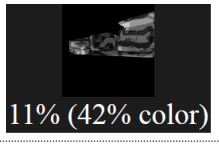
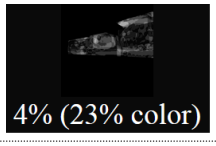
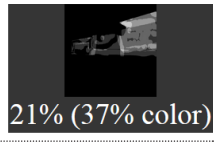
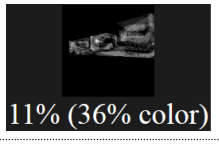
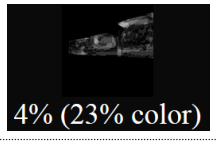
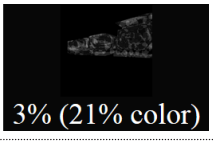
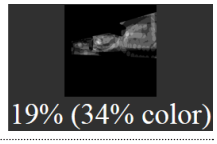
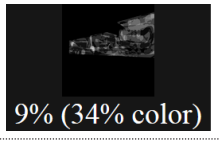
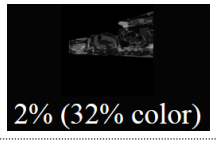
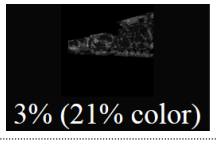
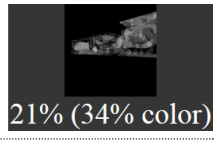
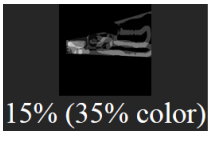
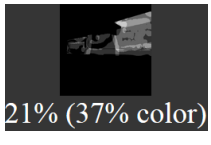
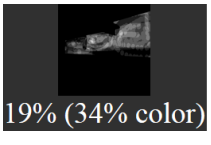
situation 6	puristic	monumental	structured	progressive	conservative
puristic	 0% (0% color)	 45% (27% color)	 44% (29% color)	 40% (30% color)	 35% (31% color)
monumental	 45% (27% color)	 0% (0% color)	 21% (29% color)	 38% (24% color)	 46% (25% color)
structured	 44% (29% color)	 21% (29% color)	 0% (0% color)	 47% (30% color)	 52% (32% color)
progressive	40% (30% color)	38% (24% color)	47% (30% color)	0% (0% color)	34% (29% color)
conservative	35% (31% color)	46% (25% color)	52% (32% color)	34% (29% color)	0% (0% color)

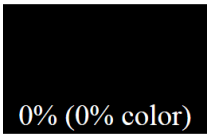
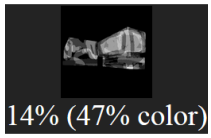
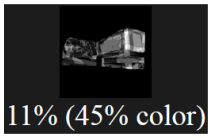
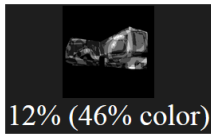
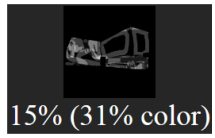
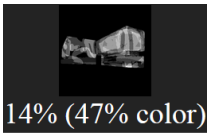
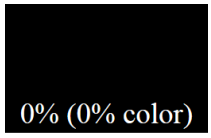
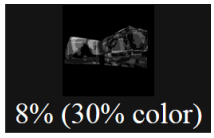
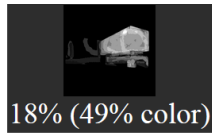
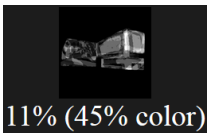
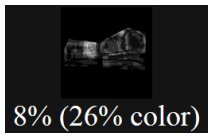
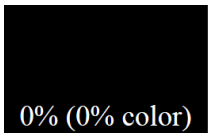
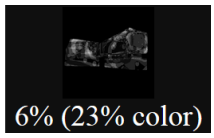
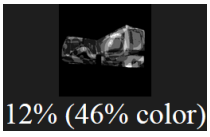
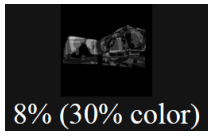
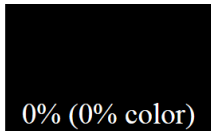
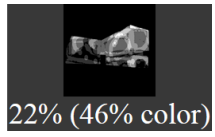
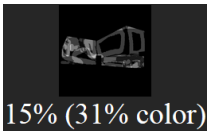
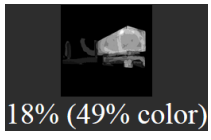
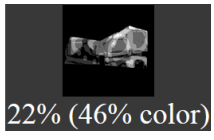
situation 7	puristic	monumental	structured	progressive	conservative
puristic	 0% (0% color)	 22% (27% color)	 19% (32% color)	 20% (29% color)	 15% (40% color)
monumental	 22% (27% color)	 0% (0% color)	 10% (32% color)	 12% (26% color)	 24% (27% color)
structured	 19% (32% color)	 10% (32% color)	 0% (0% color)	 13% (33% color)	 20% (31% color)
progressive	 20% (29% color)	 12% (26% color)	 13% (33% color)	 0% (0% color)	 20% (26% color)
conservative	 15% (40% color)	 24% (27% color)	 20% (31% color)	 20% (26% color)	 0% (0% color)

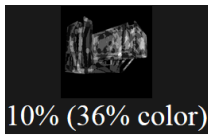
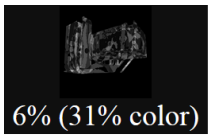
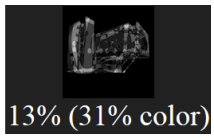
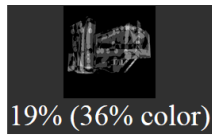
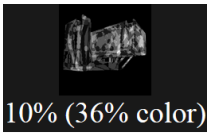
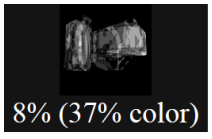
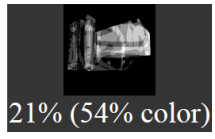
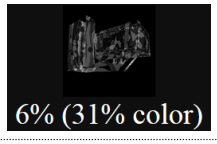
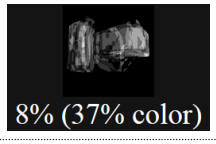
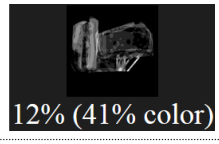
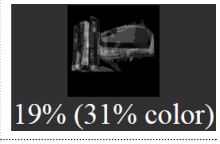
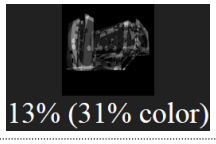
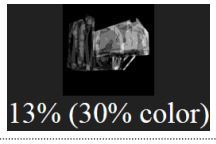
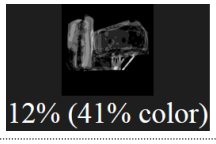
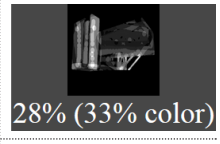
situation 8	puristic	monumental	structured	progressive	conservative
puristic	 0% (0% color)	 29% (33% color)	 17% (37% color)	 29% (33% color)	 15% (28% color)
monumental	 29% (33% color)	 0% (0% color)	 21% (35% color)	 11% (33% color)	 23% (31% color)
structured	 17% (37% color)	 21% (35% color)	 0% (0% color)	 23% (35% color)	 10% (36% color)
progressive	29% (33% color)	11% (33% color)	23% (35% color)	0% (0% color)	25% (27% color)
conservative	15% (28% color)	23% (31% color)	10% (36% color)	25% (27% color)	0% (0% color)

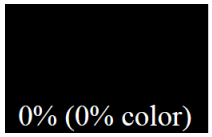
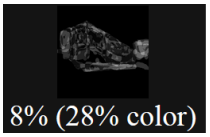
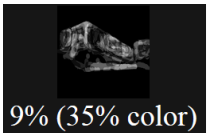
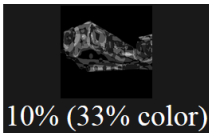
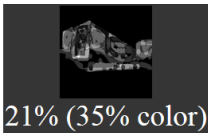
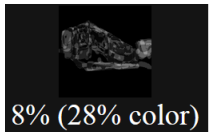
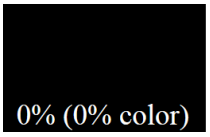
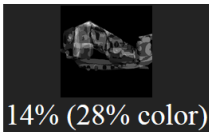
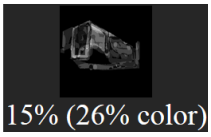
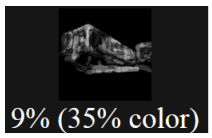
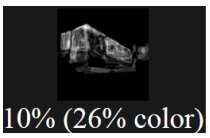
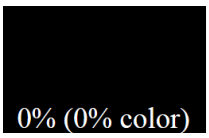
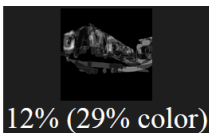
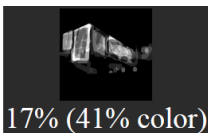
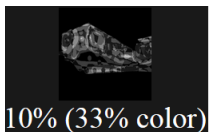
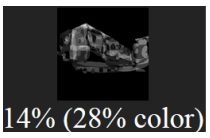
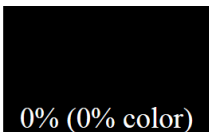
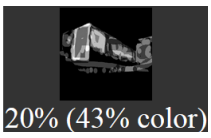
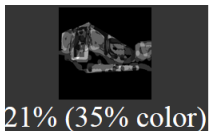
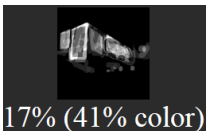
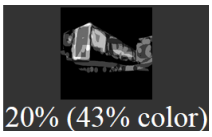
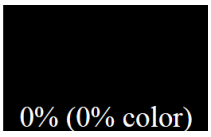
'KIC Jiangwan' | Shanghai | Output of the comparative analysis tool

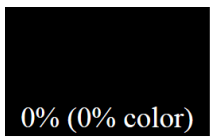
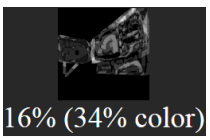
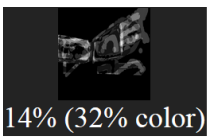
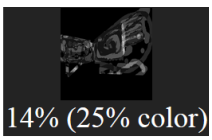
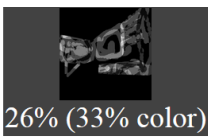
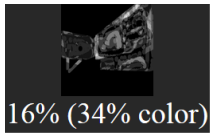
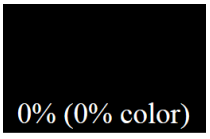
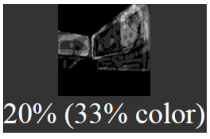
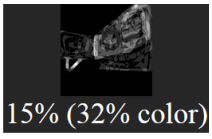
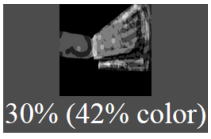
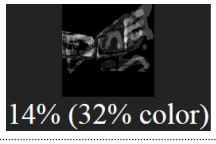
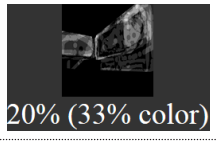
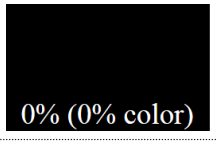
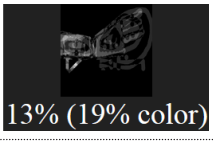
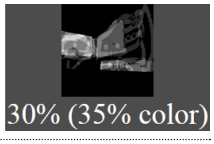
situation 5	puristic	monumental	structured	progressive	conservative
puristic	 0% (0% color)	 2% (43% color)	 1% (26% color)	 4% (26% color)	 7% (53% color)
monumental	 2% (43% color)	0% (0% color)	 1% (29% color)	 6% (47% color)	 6% (17% color)
structured	 1% (26% color)	 1% (29% color)	0% (0% color)	 5% (24% color)	 6% (47% color)
progressive	 4% (26% color)	 6% (47% color)	 5% (24% color)	0% (0% color)	 11% (58% color)
conservative	 7% (53% color)	 6% (17% color)	 6% (47% color)	 11% (58% color)	0% (0% color)

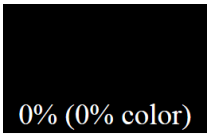
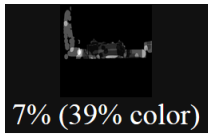
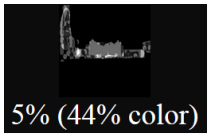
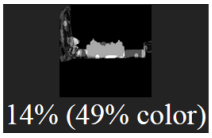
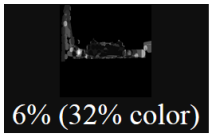
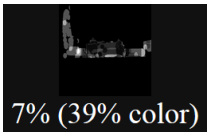
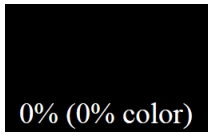
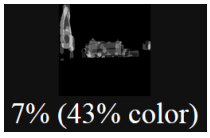
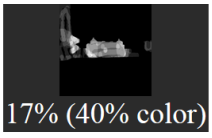
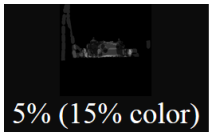
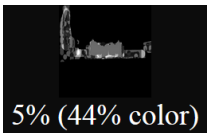
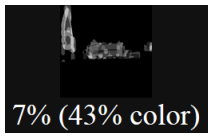
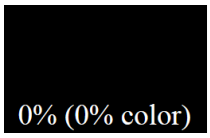
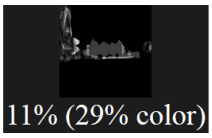
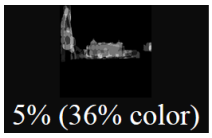
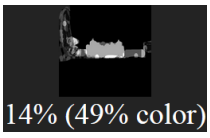
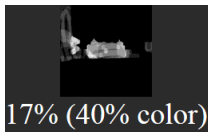
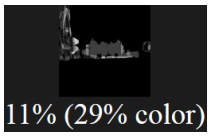
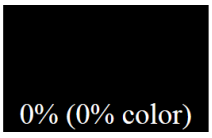
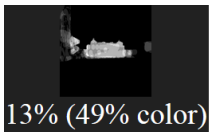
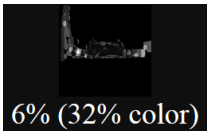
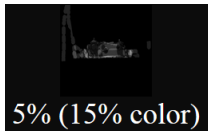
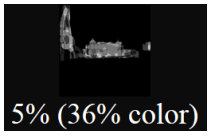
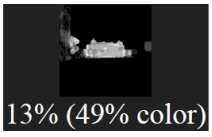
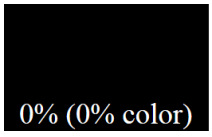
situation 6	puristic	monumental	structured	progressive	conservative
puristic	0% (0% color)	 11% (42% color)	 11% (36% color)	 9% (34% color)	 15% (35% color)
monumental	 11% (42% color)	0% (0% color)	 4% (23% color)	 2% (32% color)	 21% (37% color)
structured	 11% (36% color)	 4% (23% color)	0% (0% color)	 3% (21% color)	 19% (34% color)
progressive	 9% (34% color)	 2% (32% color)	 3% (21% color)	0% (0% color)	 21% (34% color)
conservative	 15% (35% color)	 21% (37% color)	 19% (34% color)	21% (34% color)	0% (0% color)

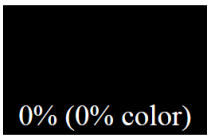
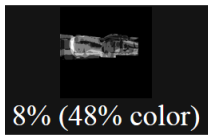
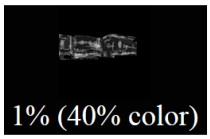
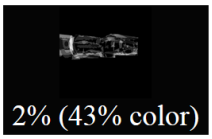
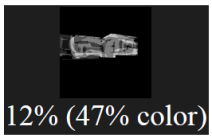
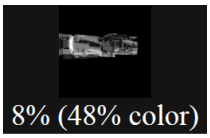
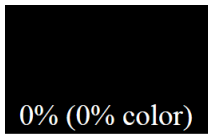
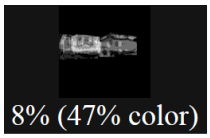
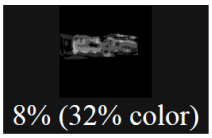
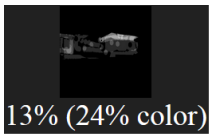
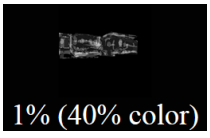
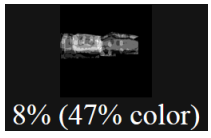
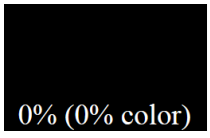
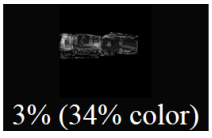
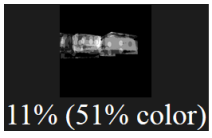
situation 7	puristic	monumental	structured	progressive	conservative
puristic	 0% (0% color)	 14% (47% color)	 11% (45% color)	 12% (46% color)	 15% (31% color)
monumental	 14% (47% color)	 0% (0% color)	 8% (26% color)	 8% (30% color)	 18% (49% color)
structured	 11% (45% color)	 8% (26% color)	 0% (0% color)	 6% (23% color)	 19% (45% color)
progressive	 12% (46% color)	 8% (30% color)	 6% (23% color)	 0% (0% color)	 22% (46% color)
conservative	 15% (31% color)	 18% (49% color)	 19% (45% color)	 22% (46% color)	0% (0% color)

situation 8	puristic	monumental	structured	progressive	conservative
puristic	0% (0% color)	 10% (36% color)	 6% (31% color)	 13% (31% color)	 19% (36% color)
monumental	 10% (36% color)	0% (0% color)	 8% (37% color)	 13% (30% color)	 21% (54% color)
structured	 6% (31% color)	 8% (37% color)	0% (0% color)	 12% (41% color)	 19% (31% color)
progressive	 13% (31% color)	 13% (30% color)	 12% (41% color)	0% (0% color)	 28% (33% color)
conservative	19% (36% color)	21% (54% color)	19% (31% color)	28% (33% color)	0% (0% color)

situation 5	puristic	monumental	structured	progressive	conservative
puristic	 0% (0% color)	 8% (28% color)	 9% (35% color)	 10% (33% color)	 21% (35% color)
monumental	 8% (28% color)	 0% (0% color)	 10% (26% color)	 14% (28% color)	 15% (26% color)
structured	 9% (35% color)	 10% (26% color)	 0% (0% color)	 12% (29% color)	 17% (41% color)
progressive	 10% (33% color)	 14% (28% color)	 12% (29% color)	 0% (0% color)	 20% (43% color)
conservative	 21% (35% color)	 15% (26% color)	 17% (41% color)	 20% (43% color)	 0% (0% color)

situation 6	puristic	monumental	structured	progressive	conservative
puristic	 0% (0% color)	 16% (34% color)	 14% (32% color)	 14% (25% color)	 26% (33% color)
monumental	 16% (34% color)	 0% (0% color)	 20% (33% color)	 15% (32% color)	 30% (42% color)
structured	 14% (32% color)	 20% (33% color)	 0% (0% color)	 13% (19% color)	 30% (35% color)
progressive	14% (25% color)	15% (32% color)	13% (19% color)	0% (0% color)	28% (28% color)
conservative	26% (33% color)	30% (42% color)	30% (35% color)	28% (28% color)	0% (0% color)

situation 7	puristic	monumental	structured	progressive	conservative
puristic	 0% (0% color)	 7% (39% color)	 5% (44% color)	 14% (49% color)	 6% (32% color)
monumental	 7% (39% color)	 0% (0% color)	 7% (43% color)	 17% (40% color)	 5% (15% color)
structured	 5% (44% color)	 7% (43% color)	 0% (0% color)	 11% (29% color)	 5% (36% color)
progressive	 14% (49% color)	 17% (40% color)	 11% (29% color)	 0% (0% color)	 13% (49% color)
conservative	 6% (32% color)	 5% (15% color)	 5% (36% color)	 13% (49% color)	 0% (0% color)

situation 8	puristic	monumental	structured	progressive	conservative
puristic	 0% (0% color)	 8% (48% color)	 1% (40% color)	 2% (43% color)	 12% (47% color)
monumental	 8% (48% color)	 0% (0% color)	 8% (47% color)	 8% (32% color)	 13% (24% color)
structured	 1% (40% color)	 8% (47% color)	 0% (0% color)	 3% (34% color)	 11% (51% color)
progressive	2% (43% color)	8% (32% color)	3% (34% color)	0% (0% color)	13% (41% color)
conservative	12% (47% color)	13% (24% color)	11% (51% color)	13% (41% color)	0% (0% color)

10.9. atmospheric data

Viertel Zwei | Vienna

	Situation 1		participants
	score	average	3
calm	5	1,67	busy
flexible	10	3,33	rigid
inspiring	9	3,00	discouraging
lively	8	2,67	dull
natural	9	3,00	artificial
open	7	2,33	closed
orderly	7	2,33	chaotic
private	7	2,33	public
simple	7	2,33	complex
wide	10	3,33	narrow

	Situation 2		participants
	score	average	3
calm	3	1,00	busy
flexible	6	2,00	rigid
inspiring	6	1,00	discouraging
lively	5	1,00	dull
natural	11	3,67	artificial
open	4	1,33	closed
orderly	5	1,67	chaotic
private	11	3,67	public
simple	5	1,67	complex
wide	5	1,67	narrow

	Situation 3		participants
	score	average	3
calm	6	2,00	busy
flexible	10	3,33	rigid
inspiring	5	1,67	discouraging
lively	6	2,00	dull
natural	11	3,67	artificial
open	10	3,33	closed
orderly	5	1,67	chaotic
private	10	3,33	public
simple	12	4,00	complex
wide	6	2,00	narrow

	Situation 4		participants
	score	average	3
calm	6	2,00	busy
flexible	9	3,00	rigid
inspiring	10	3,33	discouraging
lively	8	2,67	dull
natural	6	2,00	artificial
open	6	2,00	closed
orderly	4	1,33	chaotic
private	8	2,67	public
simple	3	1,00	complex
wide	4	1,33	narrow

	Situation 5		participants
	score	average	3
calm	5	1,67	busy
flexible	12	4,00	rigid
inspiring	8	2,67	discouraging
lively	6	2,00	dull
natural	8	2,67	artificial
open	6	2,00	closed
orderly	5	1,67	chaotic
private	10	3,33	public
simple	4	1,33	complex
wide	6	2,00	narrow

	Situation 6		participants
	score	average	3
calm	3	1,00	busy
flexible	11	3,67	rigid
inspiring	8	2,67	discouraging
lively	8	2,67	dull
natural	9	3,00	artificial
open	6	2,00	closed
orderly	3	1,00	chaotic
private	12	4,00	public
simple	4	1,33	complex
wide	5	1,67	narrow

	Situation 7		participants
	score	average	3
calm	6	2,00	busy
flexible	9	3,00	rigid
inspiring	6	2,00	discouraging
lively	7	2,33	dull
natural	12	4,00	artificial
open	5	1,67	closed
orderly	4	1,33	chaotic
private	12	4,00	public
simple	8	2,67	complex
wide	5	1,67	narrow

	Situation 8		participants
	score	average	3
calm	4	1,33	busy
flexible	8	2,67	rigid
inspiring	7	2,33	discouraging
lively	6	2,00	dull
natural	11	3,67	artificial
open	5	1,67	closed
orderly	4	1,33	chaotic
private	11	3,67	public
simple	6	2,00	complex
wide	6	2,00	narrow

KIC Jiangwan | Shanghai

	Situation 1		participants
	score	average	2
calm	5	2,50	busy
flexible	8	4,00	rigid
inspiring	4	2,00	discouraging
lively	8	4,00	dull
natural	3	1,50	artificial
open	2	1,00	closed
orderly	4	2,00	chaotic
private	9	4,50	public
simple	3	1,50	complex
wide	2	1,00	narrow

	Situation 2		participants
	score	average	2
calm	4	2,00	busy
flexible	5	2,50	rigid
inspiring	5	2,50	discouraging
lively	2	1,00	dull
natural	6	3,00	artificial
open	3	1,50	closed
orderly	2	1,00	chaotic
private	10	5,00	public
simple	7	3,50	complex
wide	6	3,00	narrow

	Situation 3		participants
	score	average	2
calm	2	1,00	busy
flexible	6	3,00	rigid
inspiring	4	2,00	discouraging
lively	4	2,00	dull
natural	4	2,00	artificial
open	2	1,00	closed
orderly	2	1,00	chaotic
private	8	4,00	public
simple	4	2,00	complex
wide	2	1,00	narrow

	Situation 4		participants
	score	average	2
calm	7	3,50	busy
flexible	4	2,00	rigid
inspiring	4	2,00	discouraging
lively	3	1,50	dull
natural	6	3,00	artificial
open	5	2,50	closed
orderly	4	2,00	chaotic
private	8	4,00	public
simple	5	2,50	complex
wide	4	2,00	narrow

	Situation 5		participants
	score	average	2
calm	4	2,00	busy
flexible	5	2,50	rigid
inspiring	5	2,50	discouraging
lively	4	2,00	dull
natural	9	4,50	artificial
open	4	2,00	closed
orderly	6	3,00	chaotic
private	9	4,50	public
simple	5	2,50	complex
wide	4	2,00	narrow

	Situation 6		participants
	score	average	2
calm	4	2,00	busy
flexible	5	2,50	rigid
inspiring	7	3,50	discouraging
lively	4	2,00	dull
natural	4	2,00	artificial
open	5	2,50	closed
orderly	2	1,00	chaotic
private	10	5,00	public
simple	4	2,00	complex
wide	3	1,50	narrow

	Situation 7		participants
	score	average	2
calm	4	2,00	busy
flexible	8	4,00	rigid
inspiring	4	2,00	discouraging
lively	7	3,50	dull
natural	6	3,00	artificial
open	4	2,00	closed
orderly	3	1,50	chaotic
private	8	4,00	public
simple	4	2,00	complex
wide	3	1,50	narrow

	Situation 8		participants
	score	average	2
calm	4	2,00	busy
flexible	6	3,00	rigid
inspiring	7	3,50	discouraging
lively	4	2,00	dull
natural	6	3,00	artificial
open	2	1,00	closed
orderly	3	1,50	chaotic
private	6	3,00	public
simple	6	3,00	complex
wide	4	2,00	narrow