BACK TO THE USER

Shaping the user experience of architecture through evidence-based design

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Research report
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Abstract

'Back to the User' addresses a critical issue in contemporary architectural practice: the dissociation from the user. In the software industry, 10% to 40% of a project's budget is allocated to 'User Experience (UX) Research', which focuses on assessing and fulfilling users' needs and experiences throughout the entire design process. This investment not only doubles sales but also nearly triples user satisfaction. Despite its proven value, UX Research is significantly underrepresented in architecture. This paper explores how to better integrate and utilize UX Research in architectural practice, proposing a new methodology.

The methodology closest to UX Research in architecture is 'Post-Occupancy Evaluation' (POE), but only 5% of architectural firms in the EU offer (and even fewer conduct) it during the design phase. Architects may talk closely with clients, but not with users. Additionally, most UX Research involves 1:1 prototype testing with users to ensure that the design meets its intended benefits. In architecture, 'prototyping' usually consists of 2D plans, visualizations, or scaled models, which are often not comprehensible, accurate, or immersive enough. While constructing a full 1:1 prototype is possible, it is not economically, spatially, or sustainably feasible for large projects—or is it?

With the rise of Virtual Reality (VR), we can now test virtually unlimited 1:1 designs, leading to more objective, evidence-based conclusions. This paper explores this approach through participatory qualitative sessions using VR, where multiple design variations are tested and rated by users based on their satisfaction levels. The data collected informs design decisions, resulting in a final proposal to address the challenges of post-Soviet, concrete-prefab panel construction in the 'Jižní Město' district of Prague, Czech Republic. This 'Back to the User' methodology, is in fact a practice's step 'Back to the Future'.

Keywords

User experience research, user experience in the built environment, evidence-based design, participatory study using virtual reality, Jižní Město, concrete-prefab panel construction revitalization

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Intro

Architect's (bad) dream

"The nightmare would start moments after entering the lobby. Stench of urine, beer, and stale sweat would seep from shadows, the lights would be smashed again and the corridor vandalised into gloom. Silence did not mean no one was there. [...] Fresh graffiti, used condoms and a passed-out vagrant might have been waiting inside when the doors parted. [...] Grind up another three floors and you would be where a 27-year-old woman was dragged from the lift and raped. Down the same corridor a depressed young mother jumped to her death. On the 21st floor, an 11-year-old girl was dragged from a lift into the chute room and attacked." [1]

While it may sound like a description from a fictional horror movie, this was a real story of the Trellick Tower, or better to say its residents in the, once so-called, 'Tower of Terror'. Designed by Hungarian architect Erno Goldfinger, the tower "was supposed to represent a utopian future in which families could live high above the smog, with every convenience close at hand." [2] But the opposite became true. Within months after its completion, the level of vandalism, burglaries, muggings, and rubbish led the inhabitants to 'beg' the municipality for a solution to this failed dream. [3]

Figure 1: The failed dream of the Trellick Tower, or the so-called 'Tower of Terror'
[*Imgur,* Trellick Tower, London [OC].]

After studying architecture for years, these stories still fascinate me. Stories of a beautiful architect's dream with good intentions that just failed terribly. I've been fascinated by the profession that, I believe, aims and claims to provide more liveable spaces enriching users' experience but is still able to confidently propose a design that could not be further from such a goal. While the Trellick

Tower is a remarkably bad example, it is not alone. Such unsuccessful projects can be found around the world. The dream of Brasilia, a utopian modernistic city that degraded into a violent place with never-ending traffic jams. Masdar City, a vision of Abu Dhabi's zero-carbon 'ecotopia', which has currently only a few hundred inhabitants comparably to the 50,000 initially expected. And likely the most controversial urban vision under construction today, the 170km long 'Line', is already doomed by some experts. [4,5,6] I intentionally highlight these projects as they span almost a hundred years of architectural history touching different scales of intervention while (potentially) failing on a similar scale of users' satisfaction.

Figure 2: The 'deserted' desert city of Masdar, once a vision for sustainable 'ecotopia' [7]

[*Malapert.*]

When the High Line project in New York City was first proposed, it generated a lot of distrust regarding its value for users and its economic feasibility.

"'The High Line was so risky when we built it, which is sort of funny now because it's so popular, but at the time the developers were mostly against it,'" said Robert Hammond, the co-founder of what is now one of the most visited sites in NY. [8]

With 7 million visitors per year, the High Line's popularity surpasses even icons like the Statue of Liberty and the Empire State Building. Developers have successfully capitalized on the area by building offices, apartments, and stores nearby, which, in the end, positively impacts the city's budget too. Yet, the High Line still relies on private donations for its annual operation costs, seeing none of the income it helps generate for mentioned parties. Hammond argues that this situation resulted from their inability as co-founders to prove the value well in advance, emphasizing the need to "capture the value before you create the public space." [9]

1   Carroll, "How Did This Become the Height of Fashion?"
2,3   "From 'Tower of Terror' to Brutalist Icon: A London Landmark Abides, Property - THE BUSINESS TIMES."

4   Carroll and Phillips, "Trouble in Utopia as the Real Brazil Spills into Niemeyer's Masterpiece."
5   Miller, "A Rare Tour Of Masdar, The Failed Smart City In The Arabian Desert."
6   Barker, "Sustainability and Liveability Claims of Saudi 170km City Are 'Naive' Say Experts."
7   Miller, "A Rare Tour Of Masdar, The Failed Smart City In The Arabian Desert."
8,9   Wiggins, "Get the Money, Then Get the People."

Figure 3: Highline in New York as an example of a successful project regarding user experience drawing 7 million visitors annually and fostering development in the area around. [10,11]

[*Baan*, The High Line.]

The project clearly demonstrates that architectural designs can significantly enhance user experience (UX) in the built environment. However, the lack of clarity, evidence, and reliability in the process's outcomes creates distrust among stakeholders, jeopardizing successful and sustainable development.

Yet, despite the current insecurity and distrust, I have a dream. I dream that one day, we as architects will be able to reconnect with the users of our designs and truly understand each other. I dream that one day, we will be able to draw a design and honestly say to users: "You will feel better in this environment, you will appreciate it, you will care for it." I dream that one day, we could sit at the table with all stakeholders and, with evidence in hand, prove the value of such a design. Only then can we reach our discipline's potential. Only then can we truly provide the public service we ought to deliver.

Problem statement

When discussing the potential and relevance of architectural services, User Experience (UX) should play a major role in the conversation. Architecture is inherently a multidisciplinary practice, incorporating knowledge from construction, structural engineering, and material engineering, as well as more human-oriented disciplines like sociology, psychology, and philosophy. However, in reality, the vast majority of resources and time for a project are devoted to the technical aspects, ensuring the building is structurally sound and provides environmental comfort for living. While the proportions may vary between offices and countries, the Czech Chamber of Architects' planning calculator, for example, suggests dedicating only 13% of a project's resources to the study phase—the only phase that partially addresses questions of mental comfort. [12]

Structural and thermal integrity are undoubtedly crucial, as they directly impact the safety of inhabitants. However, the lack of research into how various physical features of architecture affect the psychological user experience is concerning. [13]

UX affects your health

In 1984, Roger Ulrich released a groundbreaking study titled "View through a Window May Influence Recovery from Surgery", which became one of the most influential papers in the field of evidence-based design. This work positioned Ulrich among the most respected healthcare researchers. As the title suggests, the study demonstrated that patients with views from their windows involving trees and greenery recovered significantly faster from their injuries. [14,15] Over the following decades, more research aimed at uncovering the influence of spatial properties on health became integral to hospital design worldwide. Perhaps surprisingly, these studies often do not originate from architects themselves.

In one such scientific paper from 2021, the authors pointed at the lack of studies arguing that the "architectural research connecting the human response to design relies on philosophical constructs, whereas traditional psychological research investigating the human–environment relationship relies on observation and subjective measures." [16] A few years before that in 2015, Ulrich himself commented on this gap in the implementation of evidence-based studies in architectural practice, offering a straightforward critique: "'Architects and

10   "The High Line."
11   Wiggins, "Get the Money, Then Get the People."
12   "Pozemní a krajinářské stavby."
13   Tawil et al., "The Living Space."
14   Marberry, "A Conversation With Roger Ulrich – HCD Magazine."
15   Ulrich, "View through a Window May Influence Recovery from Surgery."
16   Tawil et al., "The Living Space."

designers generally don't read much research.'" He noted that this view was shared by many university-based design researchers and teachers over the years, attributing it to a lack of time, resources, or interest. [17] Unfortunately, my personal experience with the discipline so far does not provide grounds to counter-argue this observation.

Experience of one cannot be applied to all

I encountered this situation frequently throughout my studies to the point where I almost became unconscious of it. It became the norm for me. This refers to the UX design methodologies taught in my architectural studio classes. As a student, I would present designs for spaces aiming to evoke various emotions—coziness, excitement, calmness, warmth, coolness... I had my 'logical' reasonings, such as material choices, color palettes, functional connectivity, or lighting accessibility. However, during consultations, the studio tutor often challenged my ideas, offering counterarguments that, though sounding reasonable, occasionally clashed with my intuition and generated distrust.

As a result, I asked for evidence. Something I could study to better understand the issue. However, I would often receive rather subjective explanations 'proved' by the experience of the single tutor. From an external observer's point, it was a clash of individual perceptions without a clear resolution. Still, despite my initial skepticism, I ultimately chose to trust this judgment based on the designer's experience.

Years later, the same issue arose in practice as well. Our team would meticulously design a structure enveloping a space to make it exciting and inviting, envisioning it as the standout 'crown' that would draw people from across the city. Internally, we truly believed the concept. Nonetheless, when facing the jury during the final competition round, doubts were cast: "What's the tangible benefit of this structure? Could you guarantee people will perceive it the way you do?" The honest truth is, we couldn't. We could not guarantee that our designer's perspective would align with the users. Although we had certain arguments, we had no direct proof, no evidence that would support our claims, and without the guarantee, other stakeholders were unwilling to take the risk. The satisfaction of our personally perceived needs could not, by itself, assure the satisfaction of actual users.

Back to the user – the future needs to meet the past

The experience from the previous chapter is only a personal story, but the issues and questions it raises have broad relevance within the discipline. Human perception is inherently individual, influenced by unique contextual and physiological factors. The question then becomes: How can a single architect, with their distinct perspective, truly grasp the numerous individual perceptions of all people interacting with their design? How can we achieve full user inclusion?

Firstly, it is important to realize that the described disconnection between an architect and a user was not always as present as it is now. As Dr. John Zeisel, a mental health specialist with degrees in architecture and sociology, pointed out in 1975, the Industrial Revolution fundamentally changed the position of architectural service in society and its relationship to the user. Previously, an architect would work directly with a client, who was often the end user of a de-

sign—likely a wealthy person seeking to fulfill personal desires. However, rapid urbanization suddenly required fast solutions to meet the needs of various target groups of different statuses and backgrounds. In the past, an architect could develop a design through regular, profound dialogue in a relationship of 'architect-client/user'. However, the new industrialized city defined a new relationship of 'architect-client-user(s)'. Suddenly, a communication gap was established where architects no longer interacted directly with users, but with a client who doesn't necessarily represent, or even want to represent, the users' needs, seeking different personal benefits. Zeisel further argues that the issue could be better solved through a larger integration of social research into architectural design. Yet, even after 50 years, this is still not the practice's reality. [18,19,20]

In 2021, a study issued by the Architect's Council of Europe revealed that only 13% of architectural firms in the EU offer (not necessarily conduct) what's known as 'post-occupancy evaluation' (POE) for their projects—a feedback on a building's performance both from technical view and user satisfaction. [21,22] Even without considering whether such research is conducted in the most accurate manner sociology can currently offer, the low level of integration is staggering. Given this limited data feedback, how do architects design user experience in reality? What knowledge informs their decisions? What is the probability of success, and how precisely can they target the specific user needs? Furthermore, what methods might prove more efficient in this regard?

[17]   Zeit, "Seeds Of Change."

[18]   Bittencourt, Pereira, and Júnior, "The Usability of Architectural Spaces."
[19]   "John Zeisel."
[20]   "The LOEB Fellowship | John Zeisel."
[21]   Mirza & Nacey Research Ltd, "ACE 2020 Sector Study: ACE."
[22]   RIBA, "Post Occupancy Evaluation: An Essential Tool to Improve the Built Environment."

per cent of practices who offer service	offer a Post Occupancy Evaluation	Stage at which architects agreed to undertake the POE:		
		Design phase	Construction phase	after Completion
Austria	14	46	31	23
Belgium*	10	11	11	78
Croatia	6	100	0	0
Czechia	1	67	33	0
Denmark	6	0	0	100
Estonia*	0	n/a	n/a	n/a
Finland	9	20	40	40
France	10	41	7	52
Germany	8	43	18	39
Greece	18	33	17	50
Hungary*	27	25	25	50
Ireland	17	52	4	44
Italy	12	39	25	36
Lithuania*	13	0	100	0
Luxembourg	17	54	8	38
Netherlands*	25	56	0	44
Norway	11	50	0	50
Poland*	13	60	20	20
Portugal	26	22	19	58
Romania	35	28	23	49
Serbia*	0	n/a	n/a	n/a
Slovakia	7	18	45	36
Slovenia	7	56	0	44
Spain	15	30	10	60
Sweden	4	43	14	43
United Kingdom	24	39	9	52
2020 EUROPE-26	13	38	18	45
2018 EUROPE-26	13	n/a	n/a	n/a
2016 EUROPE-27	n/a	n/a	n/a	n/a
2014 EUROPE-26	n/a	n/a	n/a	n/a
2012 EUROPE-25	n/a	n/a	n/a	n/a
2010 EUROPE-23	n/a	n/a	n/a	n/a

* caution - small sample

Table 1: A 'post-occupancy evaluation' offered by architectural offices in the EU. A rather low percentage suggests a lack of data for efficient UX design.

[*Mirza & Nacey Research Ltd,* Architectural Practices Offering POE Analysed by Country.]

For the successful future of the discipline, architecture needs to go back to its roots, back to the user. It needs to recognize flaws in its methodologies and adjust them to re-establish the relationship, to reunite with the user.

PanelStory – the infamous UX

Referenced data about the low integration of POE, observations of a number of scientists in healthcare and other disciplines as well as my personal experience all point towards flaws integrated possibly in the entire discipline. Nonetheless, to investigate described phenomena in more depth I decided to focus on a specific context that I'm also personally familiar with in order to reach relevant conclusions.

The context of focus became Jižní Město, a housing district in Prague, Czech Republic, facing large UX issues leading to broader social problems, such as facility abandonment, rising crime, and class segregation.[23,24] This 1970s development typifies the prefab concrete-panel high-rises called 'panelák' constructed under the communist regime in the country. Currently, roughly 40% of Prague's population lives in such 'panelaks' and Jižní Město is the largest among them.[25,26]

Considering the scale of application, addressing issues of such construction could have a profound impact on the lives of Prague residents and more.

While these developments offer certain advantages, like the amount of vegetation, good public transport access, and nearby schools, strolling through Jižní Město is not particularly enjoyable. Partially due to its repetitive character, it's harder to navigate, dull, empty of activities, and generally empty of 'life' of any kind. The panelak character became so notorious that it earned the unflattering nickname 'lidské kralíkárny' or 'human rabbitry' by the Czech society.[27] This infamous visibility in media and popular culture is probably represented the best by the movie 'PanelStory or Birth of a Community'. This satiric depiction of 'the birth' of panelaks in Jižní Město had been censored for many years for criticizing the product of the regime.[28] Nonetheless, its exaggerated illustrations of life situations happening around panelaks reminiscent closely their perception by Czechs up until today.

Figure 4: A villager lost in the repetitive environment of 'panelák'—a prefabricated panel concrete apartment building. A scene out of a satiric 1979 movie 'Panelstory or Birth of a Community' which had been banned for many years due to critically depicting the communist society and its construction of Jižní Město.[29]

[Panelstory aneb Jak se rodí sídliště.]

Current issues include demographic shifts, with the elderly population increasing from 8.3% in 1980 to 18.6% today. The number of foreigners, especially from other Eastern European countries (for instance Moldavians and Ukrainians) has

23   Vránková, Šulek, and Cibulka, "Jižní Město – sídliště bez lidí?"
24   Horváth, "Jižní Město řeší problém s narůstající kriminalitou, okradli tam i starostu."
25   Veselá, "'Lidské kralíkárny' jsou v Praze už 50 let. Sídliště Jižní Město zanechalo odkaz i v kultuře."
26   Skálová, "Praha má přes padesát sídlišť, paneláky přežily předvídanou smrt."

27   Veselá, "'Lidské kralíkárny' jsou v Praze už 50 let. Sídliště Jižní Město zanechalo odkaz i v kultuře."
28,29   "Panelstory."

doubled in the past decade leading to social tensions and economic disbalance. [30] Families who live here often do so out of necessity or as a temporary solution before moving to more desirable localities. [31] Jižní Město faces threats of ghettoization, class divisions, rising crime and an overall decline in quality of life. How can the current architectural community reverse the negative trends defined by its predecessors and their methodologies?

Jižní Město, the largest prefabricated concrete panel district in the Czech Republic faces a possible threat of ghettoization due to its undesirable character. [32]

[Divíšek.]

30   Vránková, Šulek, and Cibulka, "Jižní Město – sídliště bez lidí?"
31   Prokop, "Co vede k vylidňování Jižního města a jaké kroky podniká MČ Praha 11?"
32   Veselá, "'Lidské králíkárny' jsou v Praze už 50 let. Sídliště Jižní Město zanechalo odkaz i v kultuře."

Research questions

Main research question:

What kind of architectural design process could provide evidence-based suggestions to efficiently and reliably enhance users' experience of Jižní Město to the point when the district becomes desirable for the current and new generations?

Sub-research questions:

Localizing the problem

1. When was or is Jižní Město undesirable regarding the UX?
2. Where, in which areas, is Jižní Město undesirable regarding the UX?
3. Which social group finds Jižní Město undesirable regarding the UX?

Understanding the problem

1. Which research methods historically brought possibly false conclusions about users' needs and desires in Jižní Město?
2. What kind of architectural design methods did not target specific user needs in Jižní Město correctly and efficiently?

Targeting the problem

1. Which research methods could unveil the true individual users' needs and desires in Jižní Město?
2. What are the individual users' needs and desires in Jižní Město?
3. What kind of architectural design methods could target specific user needs in Jižní Město with a definable efficiency supported by evidence?

Theoretical and methodological framework

Built environment = UI

We spend about 90% of our life indoors (in EU) surrounded by designs of the built environment with which we constantly interact to fulfil our needs.[33,34] From moving a chair across a room to sit under the light of a rising sun next to our window that we open in just the right angle to allow the fresh spring air come in, up to a heater that we turn on by the end of the day to comfortably warm up our bodies and calm our minds before lighting a hallway to easily navigate in our beds to sleep.

We spend about 30% of our life in front of screens (globally) immersed in designs of a user interface of applications and websites with which we constantly interact to fulfil our needs.[35,36] From moving a note document across a desktop to stay visible next to our Zoom-call window that we open in just the right size to allow the new messages on Slack come in, up to a blue filter button that we turn on by the end of the day to comfortably calm our eyes and mind before lighting up the start menu to easily navigate the device to sleep.

While the term 'User interface' (UI) was defined and is typically conceived as a designed space for purely human-computer interactions, the interactions of humans with physical objects require a designed space, a designed interface, as well.[37] The built environment is by definition a man-made designed physical space and infrastructure to intentionally support specific human-oriented interactions.[38] The terms could practically describe the same, still one is used for all physical and the other for mainly virtual computer related environment. Furthermore, as indicated by the illustrative comparison in paragraphs above, the style and purpose of interactions within the built environment and UI are not so different as it may seem. Newcastle University professor Dade-Robertson further argues that these differences will be reducing as technology increasingly more mediates interactions also in the built environment.[39,40]

This strong relation between the built environment and UI became a foundation for the theoretical framework of this thesis allowing methods to be tested between disciplines—specifically architecture and UX research.

Architecture! Have you met UX?

The term User Experience was first coined by Don Norman in 1993 when developing products with his team at Apple Computers, but as his colleague Jakob Nielsen from the NNgroup mentions, the field is older than that. The roots could be traced likely to Bell labs in 1940s when they first hired a psychologist for developing human-centered design of interactive systems of their phone.[41] However, as partially argued previously in the chapter 'Back to the user – the future needs to meet the past', architecture and likely many more design disciplines focused on the quality of interactions with their products long before the 20th century. The only difference is the absence of computer in the interaction.

The definition differs across scholars, however, when rephrasing the original by Don Norman, 'User experience' encompasses all aspects of the end-user's interaction with the company, its services, and its products with the aim to satisfy specific user's needs through simplicity and efficiency as well as overall joy of use. It therefore includes the design of user interface as well as the general usability of a product or service.[42]

Since the 1950s, the interest in UX professionals rapidly increased following a logarithmic trend—from 10 in 1950 to estimated 100,000,000 in 2050.[43] The reason for this is that companies applying UX research in their projects can see a significant rise of satisfaction of their customers which potentially lead to large returns on investment (ROI). Already with 10% of the projects' budget devoted to UX, monitored companies in a study by the NNgroup could see a 100% increase on their sales and over 160% on users' productivity.[44] While these levels can vary significantly, a well applied UX research can greatly increase the chances for a product to succeed as well as higher satisfaction of users.[45]

33 "Indoor Air Pollution: New EU Research Reveals Higher Risks than Previously Thought."
34 Bittencourt, Pereira, and Júnior, "The Usability of Architectural Spaces."
35 "Screen Time Statistics 2024 | The Independent."
36 Indeed editorial team, "What Is User Interface (UI)?"
37 "Definition of USER INTERFACE."
38 "Built Environment."

39 "Staff Profile | School of Architecture, Planning & Landscape | Newcastle University."
40 Bittencourt, Pereira, and Júnior, "The Usability of Architectural Spaces."
41 Nielsen, "A 100-Year View of User Experience (by Jakob Nielsen)."
42 Norman and Nielsen, "The Definition of User Experience (UX)."
43 Nielsen, "A 100-Year View of User Experience (by Jakob Nielsen)."
44 Jakob, "Return on Investment for Usability."
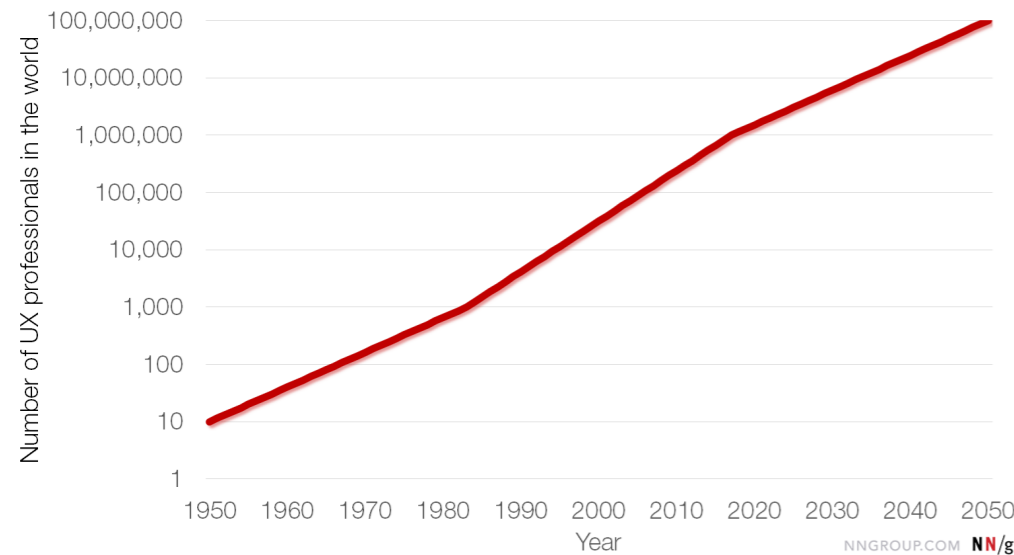45 Soares, Rebelo, and Ahram, Handbook of Usability and User-Experience.

Figure 6: The number of UX professionals in the world, with a logarithmic scale for the y-axis (data from 1950 to 2017 are best estimates; 2018–2050 are forecasts) unveils an exponential interest in the expertise of UX

[*Nielsen Norman Group*, UX Professionals in the World, with a Logarithmic Scale for the y-Axis.]

In a study from 2022 by a research collective, an effort had been put to compound knowledge on UX and usability across disciplines resulting in a handbook of different methods and techniques. Despite the clear advantages of UX application, this study revealed a significant underrepresentation of UX research in the built environment with some scholars even stating that "usability is one of the most important, but most often neglected, aspects of building performance" calling for a "need of establishing building assessments as a scientific process, precisely maintained by consolidated techniques and methods."[46] The Post-occupancy evaluation is not enough. Instead of only evaluating after construction, we need techniques throughout the entire design process. Therefore, I decided to investigate the UX research methodologies that proved to be successful in software design and see whether they could be translated for use in the built environment. Major sources became:

1. *UX Research: Practical Techniques for Designing Better Products*—a full overview of the field of UX research including its phases, methods, how to prepare and facilitate sessions with users, and how to extract valuable insights out of these sessions that lead to a more successful product.[47]

2. *Handbook of Usability and User Experience: Methods and Techniques*—a compound study on UX Research across disciplines including those related to the built environment providing insights into the specifics of architecture, and where in its methodologies makes sense to include more of the UX testing.[48]

3. *Soft City: Building Density for Everyday Life*—a study by David Sims from Gehl architects provide an overview of design typologies and approaches leading to healthier and happier people living in cities. The study is based on observational techniques developed by Jan Gehl and his colleagues who is among the most respected urbanists on this topic.[49]

VR as Archi-lab

Developing a product or service using UX research methods includes multiple phases, but one thing is common for all of them—the interaction with a user. Whether it's discovering the context of user's needs, exploring how to address them, testing design options, or listening for feedback after the product's release, it always involves users.[50] The way how to involve them, however, can vary greatly from qualitative or quantitative surveys, interviews, external observations of interactions with competitive products… or one that particularly stands out—prototype testing. About 80% of all UX research includes prototype testing and according to Susan Farrell, senior UX expert from NNgroup, if there's only one activity you can fit into the product's development budget, it should be qualitative usability testing as it's the most effective method.[51,52]
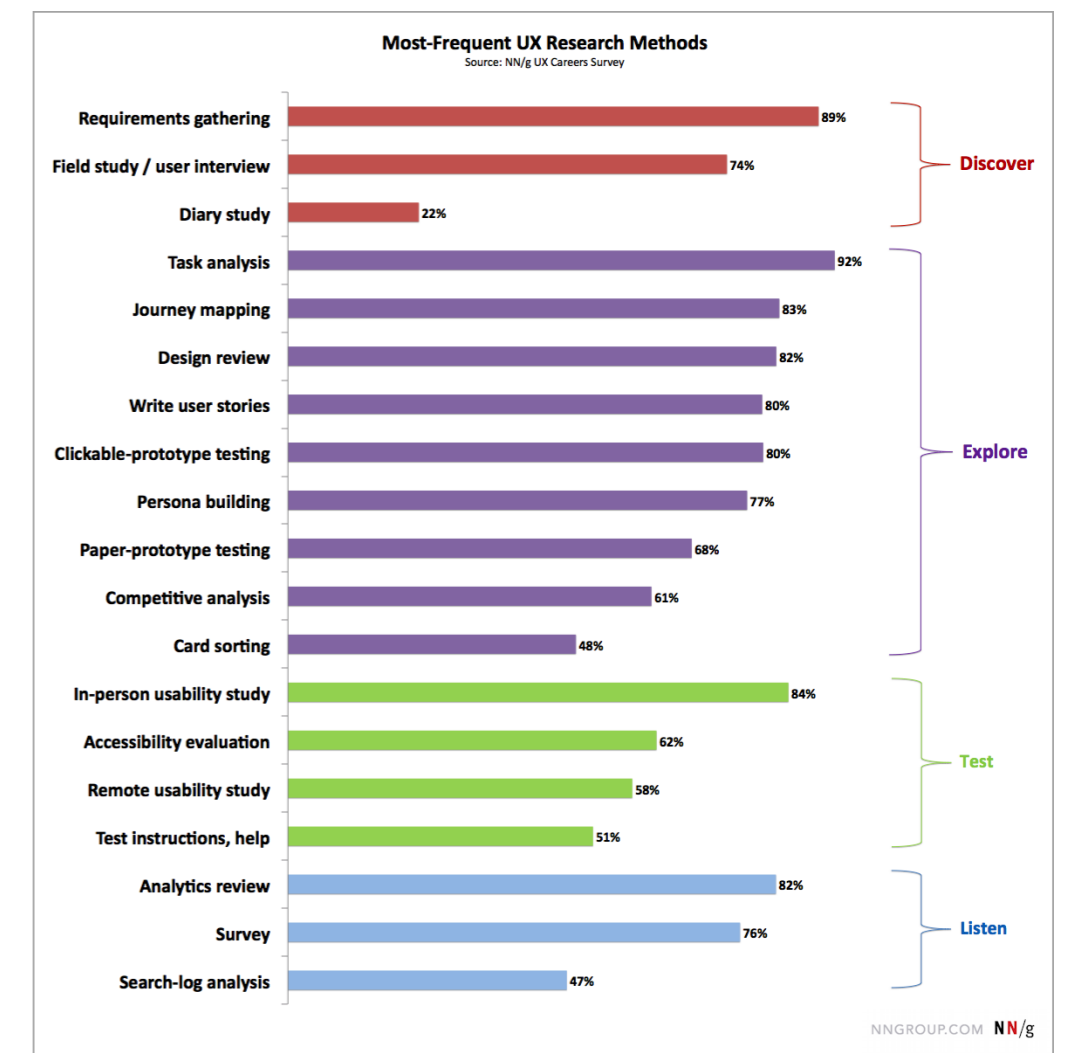
Figure 7: Most frequent UX research methods show that around 80% of all research includes prototype testing.

[*Nielsen Norman Group*, Most Frequent UX Research Methods.]

46   Bittencourt, Pereira, and Júnior, "The Usability of Architectural Spaces."
47   Nunnally and Farkas, UX Research.
48,49   Soares, Rebelo, and Ahram, Handbook of Usability and User-Experience.

50,51   Farrell, "UX Research Cheat Sheet."
52   Nielsen Norman Group, "Articles and Videos by Susan Farrell."

Looking at the field of architecture, prototyping with users is practically fully absent. Visible from the overview table of POE conducted by EU offices, less than 40% include POE in the design phase out of 13% doing any POE whatsoever. That means only 5% of offices evaluate users' satisfaction before construction ('product release').[53] They may do it with clients on a regular basis, but mostly not with users.

Furthermore, what's considered prototyping in architecture should also be put in question. 2D drawings, plans, sections, or even sketches are not always readable for clients being to 'shy' to even admit they don't understand what they are being shown.[54] Visualizations out of virtual 3D models are also limiting, as they show only a particular view disallowing to observe the project as a whole and feel physically immersed.[55,56] Scaled down models could be closer in getting a full picture, but they also distort the observer's perception when looking at the scene from bird's eye level. Lastly, while there are 1:1 prototypes constructed and encouraged by some firms, it's not economically, materially and spatially feasible to test the entire development, only fragments. These fragments are invaluable, as they show the real materiality, shapes and colors generating real emotions in users, but they still cannot test the 'immersive feeling' of the entire design.[57,58,59]

Issues raised could be addressed at present with the implementation of Virtual Reality into the design process. Highly immersive, requiring only virtual modelling that is significantly faster than physical construction, zero materials involved increasing sustainability of the process, and a small amount of equipment needed for gradually more affordable prices, this technology could redefine the way architectural practice operates.[60,61,62]

It certainly has its limitations starting with the lack of touch or smell sensations as well as dissociation of the visual experience and physical movement, or still lower visual accuracy.[63] Nevertheless, the ability to test a practically unlimited amount of variants anywhere in the world from anywhere in the world makes it a powerful research tool providing, maybe for the first time in the history of the practice, a true 'architectural laboratory'. This laboratory had been investigated and tested as part of this paper with the help of following book as a key guiding theory:

Virtual Reality Methods: A Guide for Researchers in the Social Sciences and Humanities—a study providing insights into the potentials and flaws of VR as a research tool highlighting its benefits for psychological and sociological investigations. It provides examples of various situations where VR proved to be successfully delivering similar results between testing in real and virtual environment.[64]

Back to the User – methodology

Architecture revisited by UX
Users are an underrepresented group in the development of architectural products. While it's clear that buildings will not be used necessarily by clients, municipality representatives, construction technicians, investors, or developers, the true users are still not as much included in the process as they should be.

It may be caused by a feeling that grasping the perception of so many users is incomprehensible, but as urban anthropology shows us, "'through the foundation of our knowledge of human form and psychology, combined with historical precedent, we can anticipate urban 'user' needs much the same way as any other digital interface or physical product,'" and we must do so in order to understand the future needs too.[65] As Katrina Zimmerman, an urban anthropologist, further argues, a "'user-friendly city is like a good homepage—information is clear, navigation intuitive and, before you have a chance to even think about how to get rid of your empty cup, a trashcan is but a step away. […] When you build a city for people in this way, people will want to live there—in much the same way that they would buy a good product.'" Architecture practice could gain significantly from integration of UX research methods, but it's far from doing so at the moment.

Software companies spend about 10% up to 40% of total project's budget on user experience development only leading to more than doubling the sales and close to tripling user satisfaction on average.[66,67] While this may differ significantly between different architectural offices in different countries, the project calculator provided by the Czech Chamber of Architects suggests to dedicate just 13% of project's budget on the design study phase—the only phase truly dealing with the experience of potential users. Within this phase, however, the designer has to deal with significantly more than just the end experience of the building. They need to address structural integrity, thermal integrity, urbanistic integration into the neighborhood, economic feasibility, climate sustainability, time planning, touchpoints with different stakeholders, administration, and many more.[68] It is probable that out of these 13% only about half goes to actual UX Design and even less to UX Research. Lastly, this percentage corresponds solely to the project's documentation, not including the construction costs, forming just about 10% of the total building's costs.[69] In the end, less than 1% of built environment budgets goes to UX design and research.

One might hope that these studies are conducted by other experts integrated into the process, but typically, the team includes only experts in structure, construction, technology, energy, and climate—if the budget allows. There are standardly no experts in psychology, sociology, or anthropology.[70] Architects are expected to be the most knowledgeable in the process, but as previously shown, this raises the question of whether that is sufficient.

Constructing physical infrastructure is certainly different to developing software or even hardware of a computer—first and foremost, there are life-threatening responsibilities in architecture. Nonetheless, if architectural practice does not or cannot fit more user-oriented research into its process, maybe it's time to reconsider what is an architectural product for current society needs, and how it should be developed.

Standard phases of an architectural project's development in the Czech Republic:[71]

1. Project preparation – assessment of client's development intention—feasibility study, program suggestion, preliminary site analysis, project's work expectations

2. Design study – concept research through references and literature study, concept development, fundamental material choices, concept documen-

53   Mirza & Nacey Research Ltd, Architectural Practices Offering POE Analysed by Country.
54,59   Milton, "Do Clients and Contractors Struggle to Understand What Your Projects Should Look Like?"
55,57   Vital do Rogo, "How Prototyping in Architecture Is Important on the Construction Process."
56,58   Jones and Osborne, Virtual Reality Methods.
60   R. Chow, "How Virtual Reality Could Transform Architecture."
61   Soares, Rebelo, and Ahram, Handbook of Usability and User-Experience.
62,63,64 Jones and Osborne, Virtual Reality Methods.

65   J. Zimmerman, "Newco Shift | Urban Anthropology."
66   Jakob, "Return on Investment for Usability."
67   "The Business Case for User Experience Investment."
68   "Pozemní a krajinářské stavby."
69   Horalík, "Projektová dokumentace na rodinný dům."
70,71   "Pozemní a krajinářské stavby."

tation, specialists' coordination and consultation, preliminary finance estimate, climate strategy

3. Project for building's placement – check of pre-liminary project's documentation, documentation for building's placement for the Building Municipality Office (primarily urban scale references and affects), inclusion of comments of involved public organizations

4. Project for building's approval – check of project's documentation, documentation for building's approval for the Building Municipality Office (full construction, time and economic overview for the end result understanding), inclusion of comments of involved public organizations

5. Project for building's construction – assessment of the building's approval, full construction documentation including contractors' deliveries and management, specification of individual materials and products, coordination of individual specialists

6. List of works and deliveries – supporting documents for the construction contractor, report of areas, itemization including pricing, support with contractors' documentation

7. Author's supervision – control of the construction and its alignment with the documentation, climate sustainability implementations, construction troubleshooting surveillance

Standard phases of a UX Research: [72,73]

1. Discover – early-stage research into the needs of users through field studies and interviews, gathering business requirements and constraints from stakeholders, competitive testing (analyzing products on the market and how users interact with them), KPIs definition (Key-performance indicators)

2. Explore – persona building out of discovery data, first design explorations and testing with users (iterative prototyping), measuring task fulfillment by users

3. Test – in depth review of final design prototypes through qualitative and quantitative usability testing and surveys, social media monitoring, benchmark testing (fulfillment of tasks, troubleshooting)

4. Listen – analysis after the product release aiming to understand long-term usage performance, surveys quantitative or qualitative, dimensions and metrics monitoring to discover trends for the product, FAQ collection
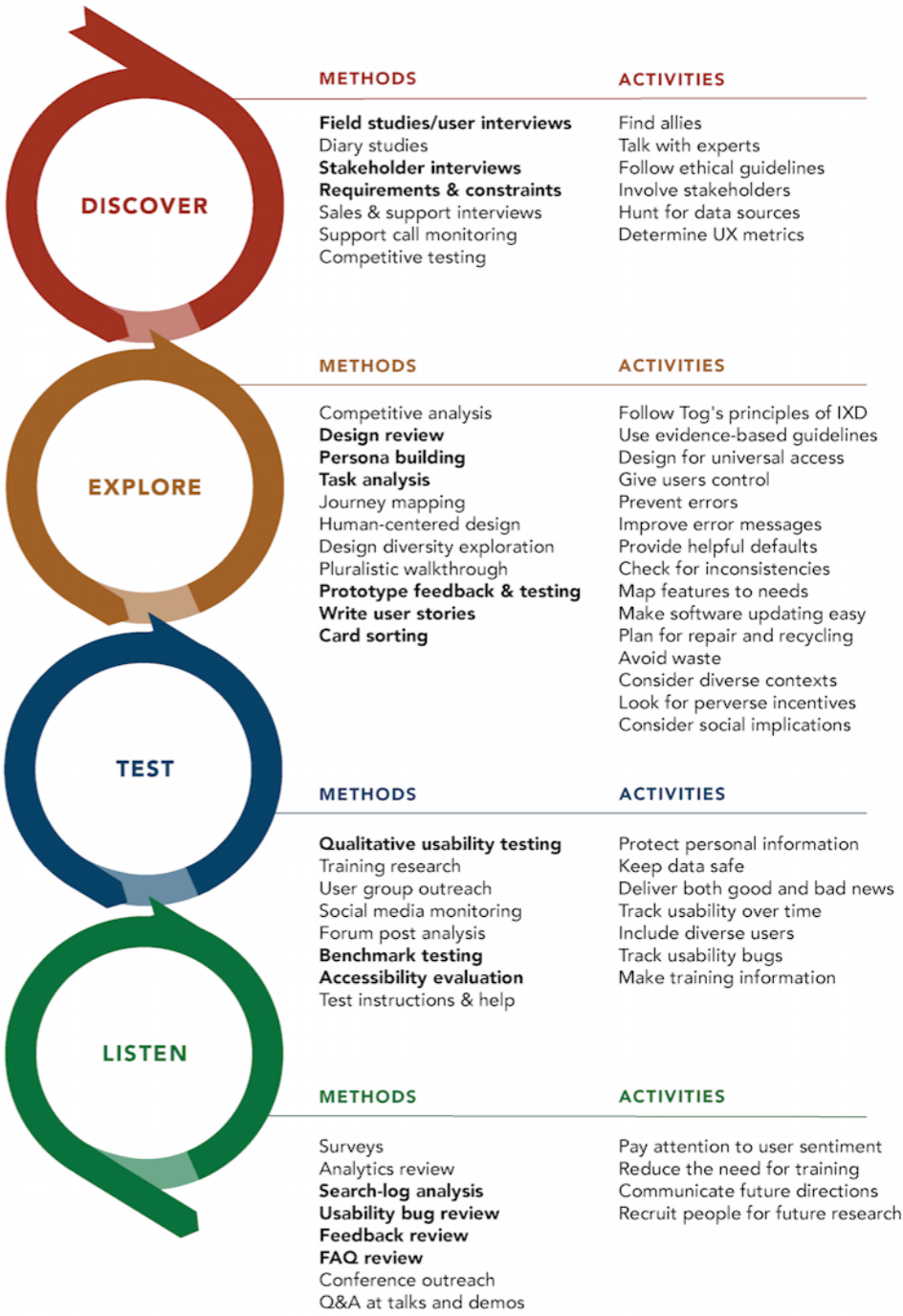
Figure 8: UX Research overview with 4 stages of the process and methods involved
[*Nielsen Norman Group*, UX Activities in the Product & Service Design Cycle.]

72   Farrell, "UX Research Cheat Sheet."
73   Nunnally and Farkas, UX Research.

By merging the methodologies and specifications of both disciplines, a new proposition for a methodological arrangement for architectural practice was established.

Back to the User phases

1. Discover and prepare

    1.1. merge of UX 'Discover', 'Explore' and architectural 'Project preparation'

    1.2. site analysis—typologies of the environment

    1.3. profound user needs research through field studies and interviews

    1.4. persona building

    1.5. research of competition and references, literature study

    1.6. competitive testing through observation of users' interactions with the design

    1.7. preliminary building program

    1.8. preliminary project's planning

    1.9. preliminary feasibility study—assessment of client's intentions

2. Explore and design

    2.1. merge of UX 'Explore' and architectural 'Design study'

    2.2. neural network analysis of needs in relation to existing typologies and possible interventions

    2.3. Key performance indicators (KPI) and building program definition

    2.4. concept design explorations and testing for individual typologies categories with users using VR—comparative analysis through iterative prototyping

    2.5. leading designs out of the comparative analysis

        2.5.1. fundamental material choices

        2.5.2. climate strategy

        2.5.3. concept documentation

        2.5.4. consultation and coordination with specialists

    2.6. Feasibility study for a 'beta-version' design proposal

3. Test and place

    3.1. merge of UX 'Test' and architectural 'Project for building's placement'

    3.2. Long-term testing of the 'beta-version' design in VR/AR—multiple days session to test and ensure liveability, diary study

    3.3. KPIs fulfillment check

    3.4. Documentation for building's placement

    3.5. Check with all stakeholders

    3.6. Troubleshooting

4. Build and check

    4.1. merge of UX 'Test', 'Listen', and architectural 'Project for building's approval and construction', 'List of works and deliveries', and 'Author's supervision'

    4.2. Project for building's approval

        4.2.1. assessment of the building's approval

        4.2.2. full construction documentation including contractors' deliveries and management

        4.2.3. specification of individual materials and products

        4.2.4. coordination of individual specialists

        4.2.5. check changes due to construction requirements and their interference with researched users' needs → revalidate and change if needed

    4.3. Project for building's construction

        4.3.1. assessment of the building's approval

        4.3.2. full construction documentation including contractors' deliveries and management

        4.3.3. specification of individual materials and products

        4.3.4. coordination of individual specialists

        4.3.5. supervision to fulfill pre-defined user requirements

    4.4. Construction

        4.4.1. List of works and deliveries

        4.4.2. Author's supervision—ensuring alignment with the documentation and troubleshooting during the construction

5. Listen and reflect

    5.1. Merge of UX 'Listen' and architectural 'Post-Occupancy Evaluation'

    5.2. Quantitative review

        5.2.1. building sensors—climate performance, light exposure, air ventilation, construction flaws

        5.2.2. user interactions observations

        5.2.3. movement tracking

        5.2.4. social media responses

    5.3. Qualitative review

        5.3.1. User survey

        5.3.2. Diary study

    5.4. Reflection

The following chapters will explore each process step in more depth and demonstrate its method application on the redevelopment project of Jižní Město's panelaks.

Discover and prepare

The first phase of the project builds an insight into the unfulfilled needs of users, the strengths and weaknesses of the site as well as how competitors tried to deal with it previously or elsewhere. It starts with an overview of the client's desires and expectations including the budget.[74,75] In this study case, however, no specific client will be assigned, but rather a general aim to maximally fulfill users' desires regarding user experience. The client will hypothetically be the users themselves.

Site analysis

Collecting consistent information about UX requires understanding the context of the needs they are related to. Some human needs are generally more applicable across cultures and places same as their possible solutions, others will be very characteristic for a specific locality. What local means depends on the research's focus. Local can be a scale of a neighborhood, it can also be one apartment building or even a single apartment unit, but it can also be an entire region or country. Understanding the needs and UX within the context of locality is therefore needed, because it can determine their level of urgency, application, and therefore priority. Addressing needs that are more urgent and generally applicable can lead to the most impactful results.[76]

Site analysis – Panelak as the Ford Model A of architecture

These potentially impactful results became also a motivation for choosing Jižní Město as the research site. While its characteristic prefab panel construction typology became a standard for many countries around the globe, the local communistic regime of 1970s and 1980s together with the local culture of people set its specifics. Firstly, as mentioned before, 40% of Prague inhabitants live in panelaks covering 6% of the city area.[76] The communistic government reacted to the high demand for housing especially after 1960s with these rapid developments providing space for all with little to no difference—from a higher-class university-educated doctor to a lower-class factory worker. This is contradictory to some of the examples in the Western countries where panel construction tended to be more a social housing solution for lower classes.[77,78,79,80]

Thanks to this level of diversity, the districts never faced extreme levels of criminality and even nowadays they are not in a particularly bad condition or situation. From a sociological study between 1976–1980, people even rated the living in panelaks as of a higher quality than in the old city centers.[82] The vision to provide to all citizens the right for apartments bathing in light with free space and lushing greenery sounded great. The panel construction promised to raise the standard of living of masses similarly to the first factory-produced car Model A from Ford. In both cases, it was supposed to be 'machine' for better life accessible to everyone.[83]

And in some parameters, it truly did succeed. Since mostly young families were moving here at that time, the vision of fresh air out of polluted car-dominated city centers was attractive for raising their offsprings.[84] For these needs and the overall demand for immediate housing options, the development was working quite well. For other parameters, however, was not as successful anymore.[85]

The execution quality of apartments was low, walls did not isolate the noise enough, and small interior widths disallowed more generous spaces for living rooms. Furthermore, the highly repetitive appearance led to anonymous feeling and lack of diversity for different needs of inhabitants. Therefore, already during the time of its development, the typology would be commonly highly criticized earning itself pejorative names like 'human rabbitry'.[86,87,88] Nonetheless, due to the high demand for places to live, and nothing else to offer, people stayed trying to deal with the flaws of construction over time.[89,90]

However, this doesn't apply to the situation after the revolution in 1989. People started to seek more comfort and privacy with a private house in suburbia becoming the most desired type of living.[91,92,93] Jižní Město doesn't attract anymore young families of all classes in large numbers, but mostly those that could not afford better including immigrants from farther eastern European countries—from 4,5 to 8,8% in last ten years. This increase of other ethnicities causes further shifts due to latent xenophobic tendencies of 'originally' Czech ethnicity.[94,95] Because of the lack of interest of young people, the district's population is also aging on top of the already existing issues—from 8,3% in 1980 to 18,6% in 2011.[96] Even though the current state is still balanced, without successful and gradual revitalization these trends may lead to destabilization and ghettoization of the area.[97,98]

Site analysis – typologies of Jižní Město

After the contextual overview of the locality, typological study was conducted using Google Earth Street View and original photography on site to provide better understanding of possible architectural flaws causing issues in the area (unfulfillment of needs).

74   Nunnally and Farkas.
75   "Pozemní a krajinářské stavby."
76   Soares, Rebelo, and Ahram, Handbook of Usability and User-Experience.
77   Skálová, "Praha má přes padesát sídlišt, paneláky přežily předvídanou smrt."
78   Problémy Sídliště (1/6).
79   Problémy Sídliště (2/6).
80   Špaček, "Michal Kohout, David Tichý, Filip Tittl, Jana Kubánková, Šárka Doležalová: Sídliště, Jak Dál?"

81,83,85,87,89,93,95,98   Špaček, "Česká panelová sídliště: Faktory stability a budoucího vývoje."
82,90,94,96   Vránková, Šulek, and Cibulka, "Jižní Město – sídliště bez lidí?"
84   Jansová, "Paneláci.Cz: Sídliště Patří v Praze Mezi Nejoblíbenější Bydlení. Ghetta Se z Nich Nestala."
86   Problémy Sídliště (1/6).
88   "Paneláky řešily bytovou krizi, díky ceně lákají kupce i dnes | Byznys."
91   Veselá, "Lidské králíkárny' jsou v Praze už 50 let. Sídliště Jižní Město zanechalo odkaz i v kultuře."
92   Lux, Sunega, and Kubala, "Dráhy bydlení mileniálů."
97   Prokop, "Co vede k vylidňování Jižního města a jaké kroky podniká MČ Praha 11?"

Google Streetview

These data were organized into thematic clusters for easier specifications of problems in next steps.

- Blind wall – the perpendicular (shorter) side of panelaks that is typically with very small or no windows forming a large non-porous, non-diverse wall

- Borders – meaning roads, fences, impermeable bushes, privatized areas disallowing free movement and access

- Building forms – the form style of individual buildings and clusters

- Courtyard – while panelaks do not form an enclosed block with a clearly defined courtyard like in a traditional urban block, they typically form clusters with more tightened and more open 'leftover' space. In this case, the term refers to the tightened space having likely a greater potential for local community gatherings

- Entrances – to the buildings as well as urban areas

- Facade

- Greenland – large undefined green areas in between the panelak blocks usually with no specific program nor a character of a natural habitat or a park

- Heavy roads – high-traffic roads that cut through the urban pattern

- Loggias

- Parking – including parking lots, buildings as well as individual spots on streets

- Playgrounds

- Plinth relationships – the relationship between the groundfloor and the street, describing the possible level of communication and interaction between interior and exterior

- Public accessories – bins, street lamps, benches, water fountains... any publicly usable accessory

- Public amenities

- Public connections – specific, complex connections of urban space, such as bridges, public staircases, ramps...

- Public transport stops – the architecture of the stops and surrounding area

- Street – panelak neighborhoods do not have a typically looking street like in traditional urban structures. Therefore, in this case, the term refers to the pathways closest to the blocks with likely the highest chance of human interactions and circulation

- Territoriality – the phenomena of users strongly defining their private area

Blindwall

Borders

Building forms

Courtyard

Entrances

Facade
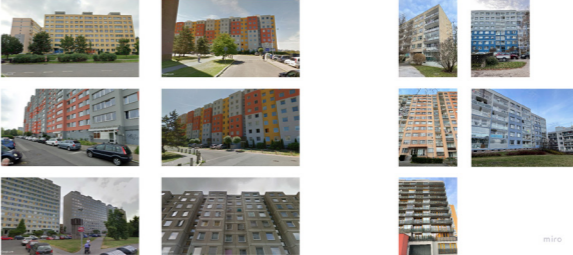
Greenland

Heavy roads

Loggias

Parking

Playgrounds

Plinth relationships
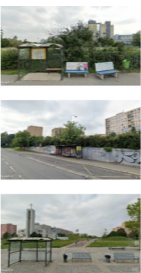
Public accessories

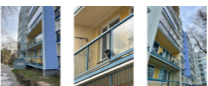## Public amenities

Public connections

Public transport stops

Street

Territoriality

User needs in the built environment

All localities have their specifications, individual characteristics and individual mix of unfulfilled users' needs. Nevertheless, to identify them, it's helpful to establish fundamental human needs in the built environment on which bases designers could evaluate. This attempt was done by a research collective in their 'Handbook of Usability and User Experience' through a merge and unification of existing studies. They split the results between psychological and physical needs:[99]

Psychological Needs Involving Environment Behavior

Pleasure stimulation	Perception of aesthetic aspects such as colors, forms, human scale, shapes influence, positive landscape, comfort conditions and nature interactions that stimulate enjoyment feeling, performing a leisure or playful activity, having fun on experiencing new sensations and activities
Relatedness/ belongingness	To a place, neighborhood or city by putting participant of a group or community, being aware of others' emotions, activities or mood, expressing feelings or emotions in a wide variety of ways, having a sense of physical intimacy and caring about others
Security— control	Of a built environment physical condition, against adverse climate or violence, and in social interactions, having a comfortable set of routines and habits, being safe from threats and uncertainty, being in control of events and personal movements, understanding how things work and interacting with transparent and clear systems and equipment
Competence— effectiveness	For using/managing environment elements and equipment correctly, usability attributes to complete difficult tasks, affordance conditions, learning how to do things or walk self-secure, interact effectively with the environment and people
Autonomy— independence	To move him/herself alone in architectural spaces, going toward desired points in urban spaces, to use public transport and access public information, feeling that activities are self-chosen and self-endorsed, having meaningful choices, personalizing one's environment and not being overly pressed or influenced to do something
Influence— popularity	As a person among a community, feels that your opinion is important, being recognized as valuable person, making friends
Self-actualizing	By attaining a deeper understanding of oneself, becoming who one really is and developing creativity and spontaneity

Source: Adapted from Attaianese (2016), Gehl (2010) and Lallemand (2015).

Figure 9: Psychological needs in the built environment compiled from studies of a number of researchers

[*Soares, Rebelo, and Ahram*, Psychological Needs Involving Environment Behavior.]

Physical Needs Involving Environment Behavior

Reachability and parking facilities	The facility to reach the place or building in a city space by car, bus, bicycle or other way of transport
Efficiency	The facility that allows an easy performance inside building with little use of resources
Accessibility	The facility of access and use of environments, products and services by any person and in different contexts, when people in normal physical condition or with varying limitations can experience the built environment so full and complete (Guimarães, 1999)
Spatial orientation	Facility that allow users how to recognize the identity and functions of spaces, and the way to move and use it (Dischinger, 2001)
Flexibility	Easily adjustable condition to suit changing circumstances (Voordt, 2009)
Safety	The capacity to feel yourself physically safe when using and moving inside the building
Environmental comfort	The conditions of habitability, respecting thermal conditions, ventilation, insulation, acoustic and visual and others able to change the performance of the building in its context, and the rational use of available resource
Readability	The possibility of organizing the environment within a pattern of consistent image generation (Lynch, 1960), which directly depends on the legibility of space

Source: Based on Bittencourt et al. (2015), Voordt and Wegen (2005), Voordt (2009), Lynch (1960), Dischinger (2001) and Guimarães (1999).

Figure 10: Physical needs in the built environment compiled from studies of a number of researchers

[*Soares, Rebelo, and Ahram*, Physical Needs Involving Environment Behavior.]

These needs were further reorganized into a network structure required for analysis in the 'explore and design' step.

99   Soares, Rebelo, and Ahram, Handbook of Usability and User-Experience.

Psychological needs

- Pleasure stimulation
  - Observation/aesthetics — Natural, Cultural
  - Activities — Leisure, Playful
- Relatedness – belongingness
  - Place
  - Neighborhood — Community — Awareness, Self expression
  - City — Environment — Caring
  - Nation
- Security – control
  - Privacy, territoriality
  - Environmental sustainability
  - Stability, environment of habits
  - Feeling of safety
  - System clarity
- Competence – usage
  - Clarity
  - Easiness
  - Effectiveness
  - Affordability
- Autonomy
  - Independent movement
  - High accessibility of spaces (low restrictions)
  - Personalized environments
- Influence – popularity
- Self-actualization

Physical needs

- Facilities to reach places
  - Parking — Accessible
  - Transportation needs — Varied - flexible
  - Transportation needs — Fast
- Resources Efficiency
- Accessibility (for people of all physical conditions)
- Spatial orientation – readability
  - Easy identification
  - Easy use
- Flexibility – adjustability
- Safety
- Environmental comfort
  - Thermal
  - Ventilation
  - Acoustic
  - Visual

User needs in Jižní Město

Opinions as well as perception of different issues and needs may vary greatly between individuals and between specialists of different disciplines or even within one. The context of Jižní Město is not different, often providing fully contradictory conclusions between people. Below are examples of these perceptions per different interest group:

Local municipality/politicians

- Vandalism is an issue in some areas—contributing aspects are the anonymity, large number of cars on the ground and large concentration of people. [100]

[100]   Horváth, "Jižní Město řeší problém s narůstající kriminalitou, okradli tam i starostu."

- The quality of the urban area rose significantly over the decades—trees grew to large scales and numbers, there is enough schools, playgrounds, medical care, sport facilities, but also a very good transportation connection (public and private). [101]

- Young people and families do not stay in the area—usually they stay just for pragmatic reasons like good public transport connections and cheap prices. However, they do not want to invest in the environment since they don't consider settling for longer period of time. Only a very small portion of young people has enough patriotic connection to stay. [102]

- The major issue is the stagnation of investments and developments in the public areas—for fulfilling current needs for various places to meet, leisure, work-out, and self-actualization. [103]

- Inclusion of residents in the decision-making process is needed—more resources are being placed into a participatory budget. [104]

Architects

- Lack of activities in the area—caused by the monofunctional nature of the typology and therefore the lack of amenities to host them. [105]

- Among major issues is the very large size of public areas—the scale is not economically feasible to take care of. There is a lot of greenery, but not in a state that would invite people to do activities, to use it. People only pass through. [106,107]

- The anonymity and repetitiveness cause spatial disorientation of people in the area and the lack of identity. [108]

- Ineffective parking—while there is even a greater need for parking spaces, their current domination in the public space shows a lack of care and more desirable solutions, infrastructure. [109,110]

- The proposal is to densify and enclose the area to create more block typology and form a street like typology that could host activities in an easier way. [111]

- Too strict border between interior and exterior—this causes reduced attractiveness and feeling of safety. [112]

- The density of inhabitants per units is decreasing—from original four people to two people per unit. [113]

Sociologists/anthropologists

- Architectural claims about the feeling of disorientation and lack of identity were never proven by sociological studies with local inhabitants. In fact, the developments are very structured, has very defined borders and identities: "The last thing that could happen to its inhabitants is to get lost here." [114,115]

- The idea of disorientation and lack of identity is a cultural construct supported by years of media articles more than a true typological feature of the environment. [116]

- Panelak neighborhoods are specific localities on the verge of urban and countryside feeling. This feature should be taken as an advantage and

strengthened. [117]

- The current architectural and urbanist agenda for block-like reorganization can be a product of the same dogmatic ideological approach as was the modernists'—modernists are, in paradox, criticized by the architectural community nowadays. More holistic cross-discipline evaluation needs to be taken into account and more communication with the actual users, inhabitants. [118,119]

- Important phenomena causing issues in the area and negative feelings of inhabitants is the cultural perception and popularity or prestige—the connection to the communistic regime and constant negative connotations assigned to the typology in mass media. This is not consistent opinion across the nation but represents a large portion of the population. [120]

- Radical interferences may destabilize the area due to the large proportion of local elderly inhabitants—changes should be gradual. [121]

- Another issue is fragmentized ownership—of the apartments, but also of the public areas which are owned by different municipalities. This context disallows holistic conceptual changes in the first place. [122]

- The quality of apartments rose increasing their popularity. Internal walls were substituted with better quality material able to reduce noise transfers. The front facades were newly isolated and painted. [123]

- Insufficient amount of rooms is among the most critical parameters causing dissatisfaction—overall satisfaction with living rated almost as 2 times worse. [124]

- The research into panelaks is just at the beginning—more is needed for successful re-development. [125]

Contradictory conclusions, especially between architects and sociologists, suggest that more research including the users is needed to address the real issues in the area.

In an ideal scenario, profound users'/residents' surveys and interviews would be conducted where the issues and phenomena described by experts could be further questioned, evaluated, and deepened. This is needed due to unconscious cognitive biases that we carry from our past experience—personally lived or through the knowledge acquired. In case of such level of disagreement among different specialists, the only way to resolve it is through testing with users drawing statistically reliable conclusions. [126]

This paper particularly focused on testing methodologies for the 'Explore and design' part of the process and due to the limited time, initial user surveys had to be substituted by examples of users' perception in existing literature.

Users

- Elderly – first generation of inhabitants

  - Satisfied with the amount of greenery and calmness of the area—the previously muddy sites after construction are now overgrown, trees and parks aged to form a nice environment.

101,102,103,104   Prokop, "Co vede k vylidňování Jižního města a jaké kroky podniká MČ Praha 11?"

105,107,108,110,111   Kouhout et al., Sídliště, jak dál?

106   Problémy Sídliště (2/6).

109   Problémy Sídliště (5/6): Nedostatek Parkovacích Míst.

112   Problémy Sídliště (4/6).

113   Jansová, "Paneláci.Cz: Sídliště Patří v Praze Mezi Nejoblíbenější Bydlení. Ghetta Se z Nich Nestala."

114   Lehečka, "Spletité uličky diskuze o českých sídlištích aneb 'Sídliště, jak začít?'"

115,116   Špaček, "Michal Kohout, David Tichý, Filip Tittl, Jana Kubánková, Šárka Doležalová: Sídliště, Jak Dál?"

116,117,118,121,122   Lehečka, "Spletité uličky diskuze o českých sídlištích aneb 'Sídliště, jak začít?'"

120   Špaček, "Česká panelová sídliště: Faktory stability a budoucího vývoje."

123,124   Sunega et al., "Jak jsme spokojeni se svým bydlením? Jak si představujeme své ideální bydlení?"

125   Lehečka, "Spletité uličky diskuze o českých sídlištích aneb 'Sídliště, jak začít?'"

126   Nunnally and Farkas, UX Research.

- Cultural amenities like a theater or a concert hall are missing (cultural activities), but otherwise satisfied with the environment.
- Public transport very good and close. [127]
- Fear of more densification as it may decrease the amount of greenery and calmness. [128]
- Young – incomers to the area, and offsprings of the first generation
  - Families
    - Scenario 1: A temporary stay for economic reasons, prices 1/3 cheaper on average than in the city center. Wishing to buy a private house when saved enough money.
    - Scenario 2: Born in the locality, considering the area as the best for raising children. Enough greenery, school facilities. They enjoy it here and want to stay. More international families and kids in the area (Vietnam, Ukraine, Russia, Turkey, Slovakia). More small amenities are being integrated into the houses which is seen as a significant improvement. [129]
    - Sociological research proves that people have a strong tendency to copy the housing typology of their parents. [130]

Persona building

Based on the information provided, elderly living in Jižní Město are generally satisfied wishing to limit drastic changes, but the area fails to successfully attract young people and families of especially middle to higher classes. This supports the aging of population and potentially lowers overall economic income. The lack of initial interest also decreases general care and investments into the area by its inhabitants which may lead to further deepening of the issues. Attracting and satisfying the younger economically productive generation may lead to positive impacts for the locality.

Determining the right demographic focus group to address with the product or service is a key first step of UX Research. It increases the potential impact of interventions as well as economic gains. [131] The focus group in this case became a young generation between 25–40 years old of all classes with an increased interest in attracting middle to higher status. Out of the collected information, personas could be defined which represents a fictional image of user types to be addressed helping to orient in the data more easily and tangibly: [132]

Born to stay
- Singles, couples, or families where at least one person was born in the area or a similar typology having patriotic tendencies.
- They value the existing qualities such as the large amount of green space, amenities for kids (playgrounds, schools, kindergartens), and good public transport.
- They may be actively trying to help and revitalize the area or actively participate in public initiatives.
- They would appreciate more options for activities, self-actualization, and community forming.
- They need more space for their apartments, more flexibility.
- They want to diversify the public area space, but not necessarily densify existing urban structure.
- They want to stay and are committed to increasing the qualities of the locality.

Live to survive
- Singles, couples, or families from lower social class (potentially also immigrants from less economically developed countries)
- This is the only type of housing they can afford.
- They may desire higher qualities, greater spaces, but cannot afford to turn them into reality.
- Their economic situation reduces options to invest resources and time into revitalization of the area—they care for their own survival.

Live to leave
- Singles
  - Just after studies or at the beginning of their career with lower income, but potential to reach middle or higher class in the future.
  - They stay because of the cheap prices, and good public transport connection, but only temporarily before they raise enough money to move to a more attractive place—closer to work-opportunities and activities in the city center.
  - They need activities for socializing, sport, culture and for self-actualization, career rise.
  - They need more prestigious locality that represents their status ambitions.
  - Smaller apartments fit their needs, but not if they want to live together with friends—living rooms are too small.
  - They want less cars in the public space and more options for micro-mobility (bikes, scooters, …)
- Couples
  - Just after studies or at the beginning of their career with lower income, but potential to reach middle or higher class in the future.
  - They stay because of the cheap prices, and good public transport connection, but only temporarily before they raise enough money to move to a more attractive place—closer to work-opportunities and activities in the city center, or to a private house if they want to start a family.
  - They need activities for socializing, sport, culture and for self-actualization, career rise.
  - They need a more prestigious locality or accommodation style

127   Vránková, Šulek, and Cibulka, "Jižní Město – sídliště bez lidí?"
128   Skálová, "Praha má přes padesát sídlišť, paneláky přežily předvídanou smrt."
129   Vránková, Šulek, and Cibulka, "Jižní Město – sídliště bez lidí?"
130   Sunega et al., "Jak jsme spokojeni se svým bydlením? Jak si představujeme své ideální bydlení?"
131   Nunnally and Farkas, UX Research.
132   Nunnally and Farkas.

(private house) that represents their status ambitions.

- · Smaller apartments fulfill their current needs, but they want an increase of space to start a family or increase their luxury.
- · They want less cars in the public space and more options for micro-mobility (bikes, scooters, ...)

- · Families
  - · Just after studies or at the beginning of their career with lower income, but potential to reach middle or higher class in the future.
  - · They stay because of the cheap prices, good public transport connections, and amenities for children, but only temporarily before they raise enough money to move to a private house—the house provides more privacy, space, garden, and prestige.
  - · They need possibilities for self-actualization, and career rise.
  - · They need closer amenities like supermarkets, hardware stores, hairdressers to decrease the time spent travelling.
  - · They need more community-forming spaces to bond and help with children.
  - · They need parking spaces close by their apartments for easy traveling with children.
  - · They need more space in their apartments and higher quality generating prestige representing their status ambitions.

Needs defined through the site analysis were further compiled into a cluster of key points required for the next steps of the process.

Addressing fragmentized ownership	Vandalism decrease	Living options for singles	No densification - threat for calmness	No densification - threat for the greenery
Ground empty of cars	Urban and countryside feeling	Greenery - higher quality	Anonymity decrease	Keeping low-cost
Class diversity	Spatial Readability	Greenery - keeping existing amount or larger	Attractivity for young generation	Typological diversity
Exciting active environment	Secured elders			

Competitive research and testing

Competition case studies are nothing new in architectural practice. Drawing inspiration out of existing projects is likely one of the most common ways to start a design in the first place. What is very important to realize, however, is the difference in how UX Research treats competitive analysis comparably to architectural practice. The difference is much greater than we may think.

When looking for references about the refurbishment of concrete panel construction, Lacaton-Vassal studio immediately pops-up. Their project 'Transformation of 530 dwellings' is likely one of the most well-known examples of revitalization of the 20th century social housing earning the studio wide-spread recognition and awards including the Pritzker prize in 2021 or EU Mies van der Rohe prize in 2019. [133,134] With their non-destructive approach, they provided a simple large extension of 3,8 m width to the existing apartments in the form of a winter garden shared with neighboring units increasing significantly their space, thermal control, and fostering social interaction among the inhabitants. [135]

Figure 11: Project 'Transformation of 530 dwellings' shows a non-destructive way for enhancing prefabricated panel construction typologies

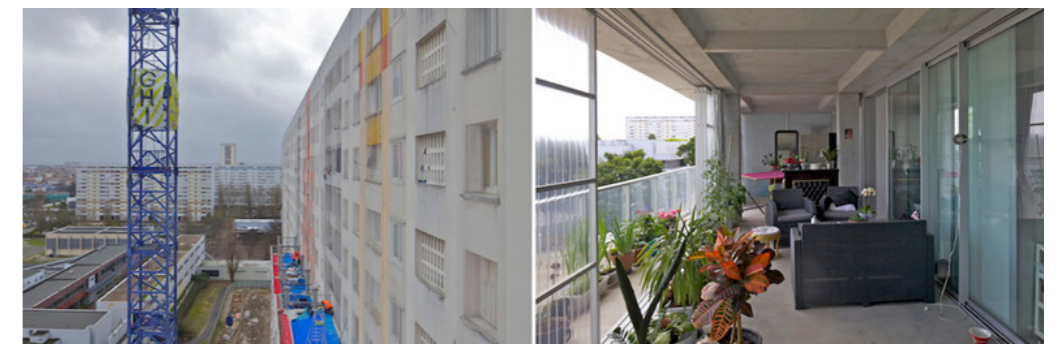[*Ruault*, Transformation de 530 Logements: Image 1.]

Figure 12: Project 'Transformation of 530 dwellings' added winter gardens to the existing units to provide additional space, greater climate control, and foster social interactions

[*Ruault*, Transformation de 530 Logements: Image 5.]

133   "Anne Lacaton and Jean-Philippe Vassal | The Pritzker Architecture Prize."
134   Ayers, "Retrospective."
135   Slessor, "Building Study: Lacaton & Vassal's Renovation of a Bordeaux Housing Estate."
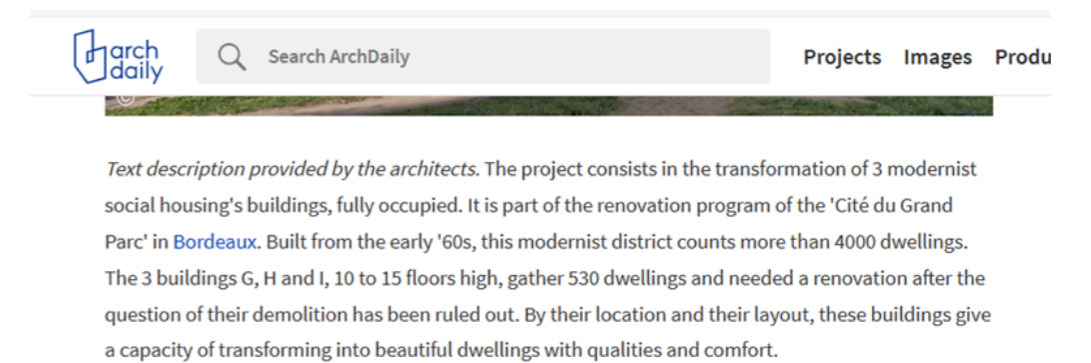
Figure 13: Project 'Transformation of 530 dwellings' creates winter gardens shared among neighboring units which inhabitants adjust in their own unique ways
[*Ruault*, Transformation de 530 Logements: Image 107.]

By no means, this is a project that should get recognition for its innovative yet cost-effective approach. What is striking, however, is the visible lack of interest in the actual usage of the space, in the genuine experience of users. In the first dozens of articles that showed to me when googling the project, there is always a profound description of the concept, recognition of its value in non-destructive and inclusive way of thinking, the philosophy of the architectural practice and all the recognition the project get including awards. But there are no users. There are no interviews, there are no actual studies into the usage, no data comparisons.

For better illustration of the issue serves an article headlined as a building study in Architect's Journal, an influential UK architecture magazine founded in 1895. There is a full chapter provided to architect's view, there is a full chapter provided to client's view (meaning developer), both talking about what they created for users but without the users present. [136,137] Another typical example is the server Archdaily claiming to be 'The world's most visited architecture platform'. What I would typically find there are articles with text written directly by the architectural firm the project belongs to. In these articles, usually concepts are profoundly described with all the presumed benefits for different stakeholders, but mostly with no data to validate the claims. [138] Basing design decisions on such sources is close to flipping a coin, because even if users are truly satisfied in these developments, with no insight into their thinking we can only assume what makes the projects successful.

Text description provided by the architects. The project consists in the transformation of 3 modernist social housing's buildings, fully occupied. It is part of the renovation program of the 'Cité du Grand Parc' in Bordeaux. Built from the early '60s, this modernist district counts more than 4000 dwellings. The 3 buildings G, H and I, 10 to 15 floors high, gather 530 dwellings and needed a renovation after the question of their demolition has been ruled out. By their location and their layout, these buildings give a capacity of transforming into beautiful dwellings with qualities and comfort.

UX Research encourages gathering and even creating such data by conducting interviews, surveying users when testing competitors' products. This approach helps to truly understand what makes these products stand out and, conversely, what they may be lacking and can be used as a potential market advantage. [139]

Architectural practice should shift from relying as heavily on philosophical ideas and place greater emphasis on validating concepts through interaction with users.

Preliminary building program

The overview of users' needs and specifications of the environment provides enough information at this moment to make a list of programs missing or required to be adjusted in the locality (yet without their level of priority).

Urban district scale
- Parking facilities
  - Currently spread parking places in the public space could be collected into parking facilities positioned evenly around the district.
  - This would lead to a reduction of roads and traffic in a close proximity of housing units leading to more safety and pleasure.
  - More places could be added to fulfill the demand.
- Office
  - Small office parks around the district centers could provide more work opportunities in a close proximity of the housing units.
  - This could lead to reduced traffic into the city center, increased local profits enabling faster overall revitalization.
- Cultural centers
  - Local theater or concert hall to decrease a need to travel for such events into the city center.
- Urban park
  - A district level plan for an interconnected park strategy strengthening current quality of large green but not well used spaces.
- Urban connectivity

136   Slessor.
137   "About the AJ."
138   "Transformation of 530 Dwellings / Lacaton & Vassal + Frédéric Druot + Christophe Hutin Architecture."

139   Nunnally and Farkas, UX Research.

- New or revitalized infrastructure for pedestrians and micro mobility making clearer interconnection between individual urban blocks.
- This could strengthened relationships across the district with increased feeling of community and the amount of social and economic activities.

Urban block scale
- Parking facilities
  - New or revitalized infrastructure for pedestrians and micro mobility making clearer interconnection between individual urban blocks.
- Local amenities
  - Café
  - Restaurant/pub
  - Hardware store
  - Hairdresser
  - Groceries shop
- Community hub
- Co-working space
- Courtyard park
  - Strategy for revitalization and repurposing of green spaces in between buildings to provide better opportunities for leisure, sport activities, and community gatherings.
- Temporary rental rooms/houses—to accommodate visitors.

Building scale
- New units—flexible sizes with a focus on singles or more luxurious family units.
- Community
  - Common rooms inside—with flexible functionality for hosting different events, providing space to work.
  - Bike storage
  - Common spaces outside—varied with potential greenery, sport activities, and community activities (such as barbeque).
- Local amenities
  - Café
  - Restaurant/pub
  - Hardware store
  - Hairdresser
  - Groceries shop

Building unit scale
- Additional rooms
- Room extensions
- Outside (semi-)private space (with potential greenery)

Preliminary project's planning

With the expert and users' opinions collected as well as required programs and general information about the locality, a preliminary project's planning is possible to determine for a client. This planning is based on the office's personal experience as well as competition references. With the addition of UX Research to the design process, offices with little experience in such expertise may need a consultation with a UX Research specialist.

Preliminary feasibility study

Similarly to project planning, a preliminary feasibility study can be derived for the investigated program based on prior experience and potential references. This study can then be compared to the client's economic options.

Explore and design

Explore phase is characterized by brainstorming, experimentation and a constant test and feedback loop. From understanding the problem and needs more accurately and in depth to building a typified persona from target users up to actual interaction with them through iterative prototyping. The methods included help to determine the biggest issues and design solutions with the greatest potential to address them. [140,141]

UX design principles in the built environment

The needs are established at this stage, but knowing what design style and intervention could satisfy them is a crucial next step. Looking into expert sources for UX design in the built environment, one particularly stands out—Jan Gehl and his studio. Gehl became a key researcher and protagonists of observational techniques and human-centered environments advocating for better pedestrian experience and community strength. [142] A follower and colleague of Gehl, David Sims, summarized recent findings of the studio into a book 'Soft City—Building density for everyday life'. In a condensed way he proposes nine criteria for liveable urban density: [143]

38   "Introducing Apple Vision Pro."
39   "Apple Vision Pro."
40   Knibbs, "Apple's Vision Pro Isn't the Future."
41   Sorrel, "Is Vision Pro the Future of Computing, or a Dystopian Mind Prison?"
42   "Introducing Apple Vision Pro."

140   Farrell, "UX Research Cheat Sheet."
141   Nunnally and Farkas, UX Research.
142   Soares, Rebelo, and Ahram, Handbook of Usability and User-Experience.
143   Sim and Gehl, Soft City.

Nine Criteria for Livable Urban Density

1. Diversity of Built Form 2. Diversity of Outdoor Spaces 3. Flexibility
4. Human Scale 5. Walkability 6. Sense of Control and Identity
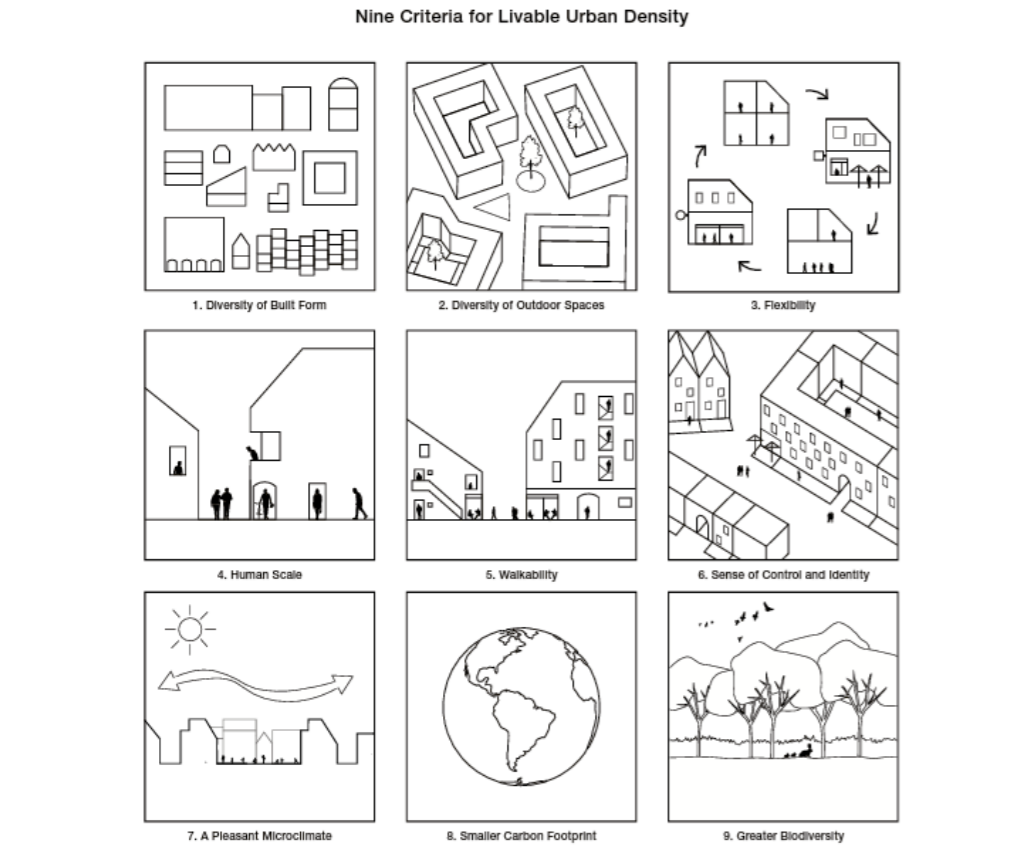7. A Pleasant Microclimate 8. Smaller Carbon Footprint 9. Greater Biodiversity

Figure 14: Nine criteria for liveable urban density by Gehl architects providing overview of principles for succesful UX design in the built environment

[*Sim and Gehl*, Nine Criteria for Liveable Urban Density.]

Diversity of built form	What to look for:
Densely built, urban form should accommodate a broad range of building types (different typologies, shapes, dimensions, and spatial conditions) in close proximity to each other. Buildings should be physically respectful of each other while remaining organizationally independent.	Different kinds of buildings
	Different dimensions
	Different typologies
	Smaller plots
	Smaller subdivisions
	Smaller and more-diverse ownership
	Balance of building component parts: ground floor, middle, and top
	Visual variation
Diversity of outdoor spaces	**What to look for:**
Dense, urban form should accommodate different kinds of outdoor spaces, in close proximity to each other, in response to the wide spectrum of needs for public and private life.	Different kinds of public outdoor space
	Different kinds of private outdoor space
	Different kinds of shared/common outdoor spaces
	shared/common outdoor spaces
	Different typologies of space that respond to different needs and activities, from the very general to the most specific
	Hybrid spaces that connect inside and outside
	Streets as public spaces
	Public spaces as places for mobility
Flexibility	**What to look for:**

|	Multipurpose spaces, indoors and outdoors
Dense and diverse urban form, with both buildings and spaces, should be flexible and responsive to change (including densification), at all scales, in the short, medium and long term.	A greater proportion of built volume is ground floor
	Independent access to different parts of a building (especially direct access from the public realm)
	Ancillary spaces such as outbuildings, basements and attics
	Backs with room for growth
	Enclosure spaces that can contain activities
	Room on the edge of buildings for temporary overflow
	Independent fractals
Human scale	**What to look for:**
Urban form should deliver density at a human scale, meaning at dimensions and with details that can offer comfort and well-being to people living in and around the buildings and the spaces in between.	Smaller dimensions
	Smaller spaces
	No higher than six stories—ideally four or five
	Multi-sensory experiences
	Particular care for the eye-level experience
	Consistent quality at eye level
Walkability	**What to look for:**
The built form should allow for easy accessibility and connectedness. In the simplest terms, accessibility is about being able to move quickly with the least amount of effort, in, out, and through buildings and between as many different spaces and places as possible. It also means walkability at a neighborhood scale, with walking as the most comfortable and convenient option for short distances.	Walk-in buildings
	Walk-through buildings
	Walk-up buildings
	A higher proportion of ground floor
	Visual connection and physical access between inside and outside
	Direct access to useful outside spaces
	Walkability at the neighborhood scale
A sense of control and identity	**What to look for:**
The built form should offer people, as individuals and in smaller and large groups, better control over the spaces around them. The spaces should foster a sense of identity as well as aid orientation and navigation.	A hierarchy of identifiable territories
	Clarity between public and private
	Fronts and backs
	Enclosure and spatial clarity
	Smaller units and subdivisions
	Common/shared spatial focus
	Useful edge zones
	Significant corners
A pleasant microclimate	**What to look for:**
Creating a pleasant microclimate with a built form allows people to spend more time outdoors.	Consistent microclimatic conditions throughout a space
	Protection from strong winds and avoidance of turbulence
	Solar penetration and avoidance of shadows
	Aerodynamic roof shape
	Protected or enclosed outdoor spaces
	Useful openings
	Rain protection at edges
Smaller carbon footprint	**What to look for:**
The built form should use fewer resources in construction and operation while promoting behaviors and lifestyles with a smaller carbon footprint, such as walking and cycling.	Fewer exposed facades (thanks to joined-up buildings)
	Smaller dimensions to allow natural light and ventilation
	Simpler construction and foundation systems
	Less reliance on complex technology and heavy engineering
	Layout promoting active mobility (especially walking)
Greater biodiversity	**What to look for:**

Urban form should accommodate natural life. The layout, size, and shape of the buildings and use of spaces should accommodate natural life and make greater biodiversity possible.	Multiplicity of smaller, individual outdoor green spaces
	Many protected spaces and edges
	Smaller dimensions of buildings to allows green walls and roofs to thrive
	Smaller scale for water management with slower water filtration
	Soft landscaping where possible

These principles were again translated into a network structure of separate categories and interventions to be used for the next step analysis.
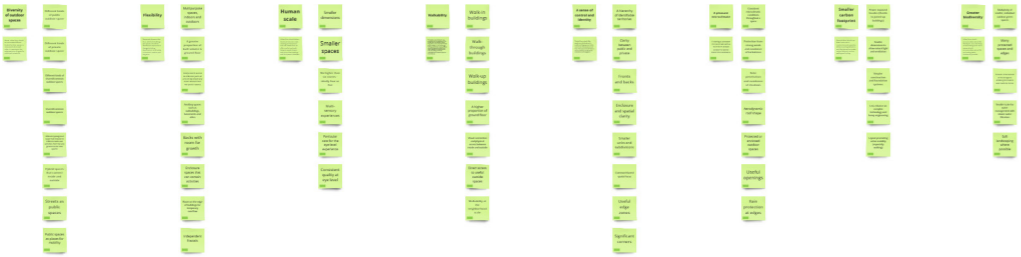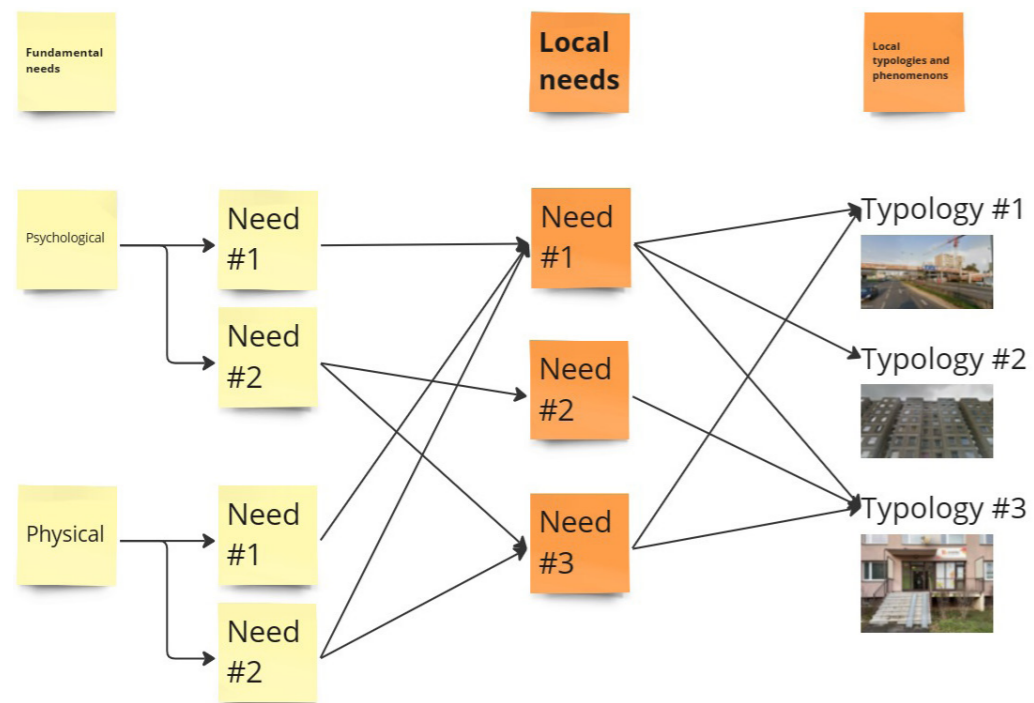

Neural network analysis of needs

All the acquired data about fundamental user needs in the built environment, the specific needs in the locality and local typologies are placed next to each other and linked based on their relation to form a network. This network is treated and inspired by the neural network used in computer science, and therefore the neurons of human brains, including its evaluation process.[144] This method is needed in order to reduce biases in the decision making—it helps to determine the most unfulfilled needs and design interventions with highest potential to address them for the most efficient outcome. Following steps explain the method in a template format:
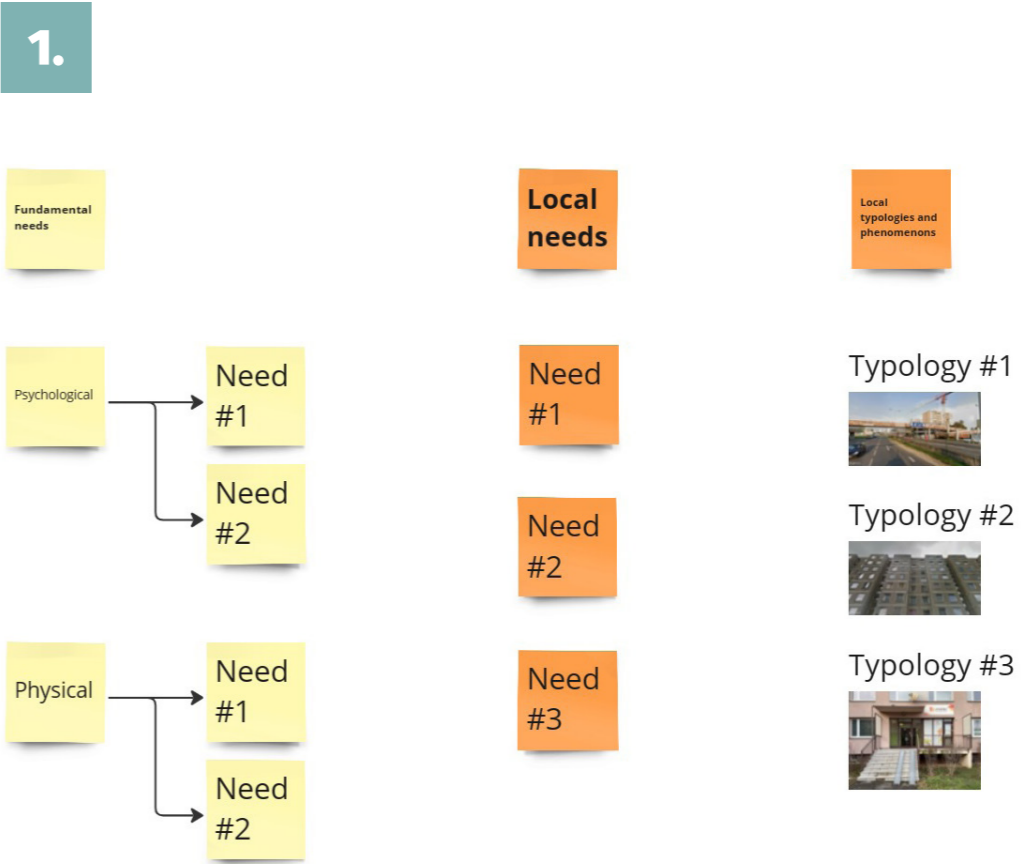
Organizing the fundamental needs, local specific needs, and local typologies and phenomena next to each other per category as individual nodes.

144   "What Is a Neural Network?"

Fundamental needs

Local needs

Local typologies and phenomenons

Psychological

Need #1

Need #2

Physical

Need #1

Need #2

Need #1
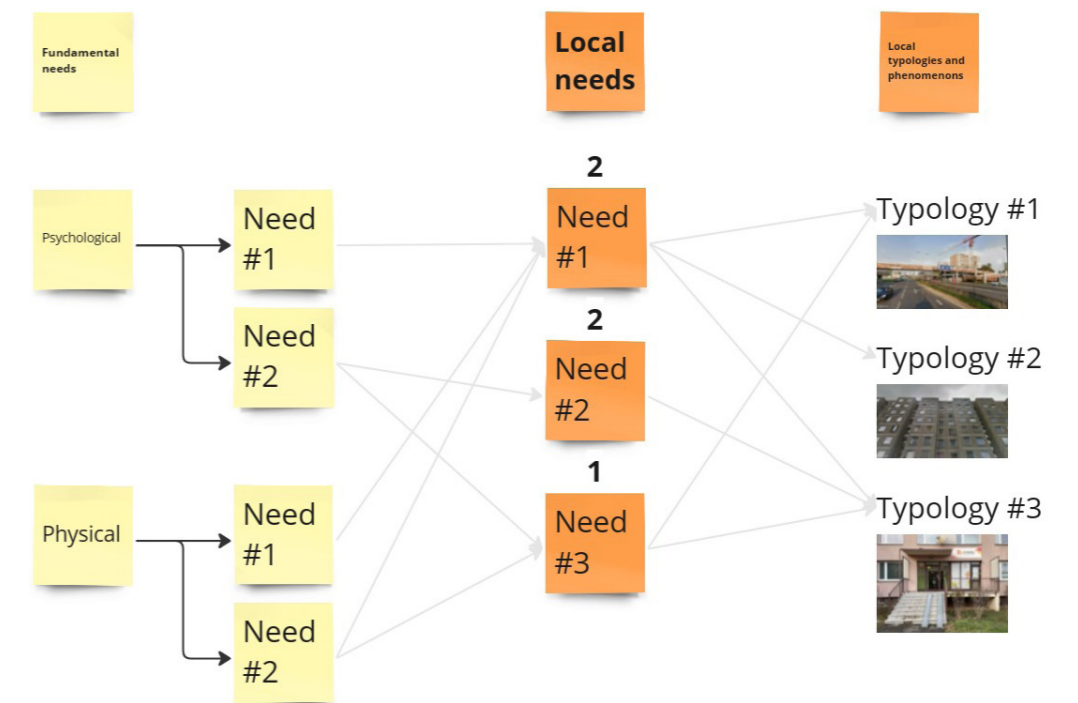
Need #2

Need #3

Typology #1

Typology #2

Typology #3

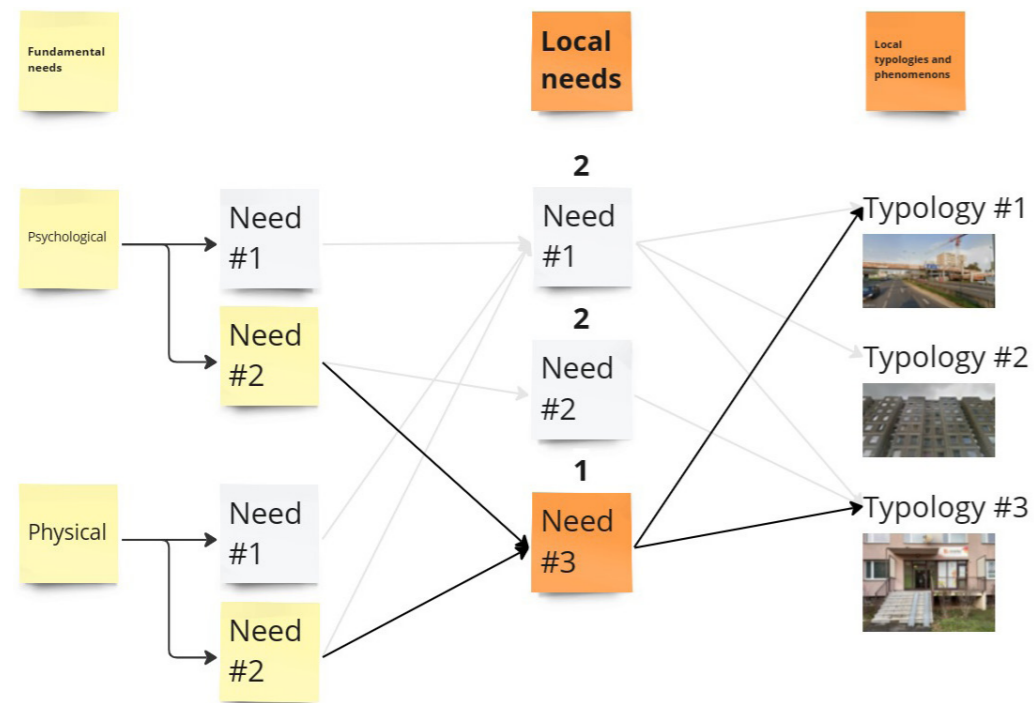Defining all possible relations between nodes of:

- Local needs with the corresponding fundamental needs. This helps with in-depth understanding of the specific combination of unfulfilled needs in the local context.
- Local typologies with the local needs that the typology may trigger—the typology may cause certain problems that generate or support the existence of the need.

Fundamental needs

Local needs

Local typologies and phenomenons

Psychological

Need #1

Need #2

Physical

Need #1

Need #2

2

Need #1

2

Need #2

1

Need #3

Typology #1

Typology #2

Typology #3

At this moment the network of relations may get so complex that no conclusions can be easily drawn. The first step of prioritization via comparison is needed. This starts with the local needs being rated according to their level of urgency, level of dissatisfaction and therefore importance in comparison to other needs—'1' meaning the highest urgency and gradually increasing number meaning less urgency. In the computer science terminology, this could be conceived as 'weights'.[145] Two or more needs could be categorized with the same weight (level of urgency).

145   "What Is a Neural Network?"

4.

Fundamental needs

Local needs

Local typologies and phenomenons

|			2		
Psychological	Need #1		Need #1		Typology #1
	Need #2		Need #2		Typology #2
Physical	Need #1		Need #3		Typology #3
	Need #2				

The previous step of weighing individual needs allowed for the prioritization of which to address first with design interventions, aiming to achieve the greatest impact at minimum cost. By defining a reasonable weight value to address, a threshold is established that limits further analysis of nodes above this level.[146] In this, case it will be number '1'—everything above is not included. This decreases the analysis time and therefore increase efficiency.

At this moment, the number of relations is reduced thanks to the threshold, but it may still be too many to draw a conclusion. Another weighing is needed.

5.

Fundamental needs

Local needs

Local typologies and phenomenons
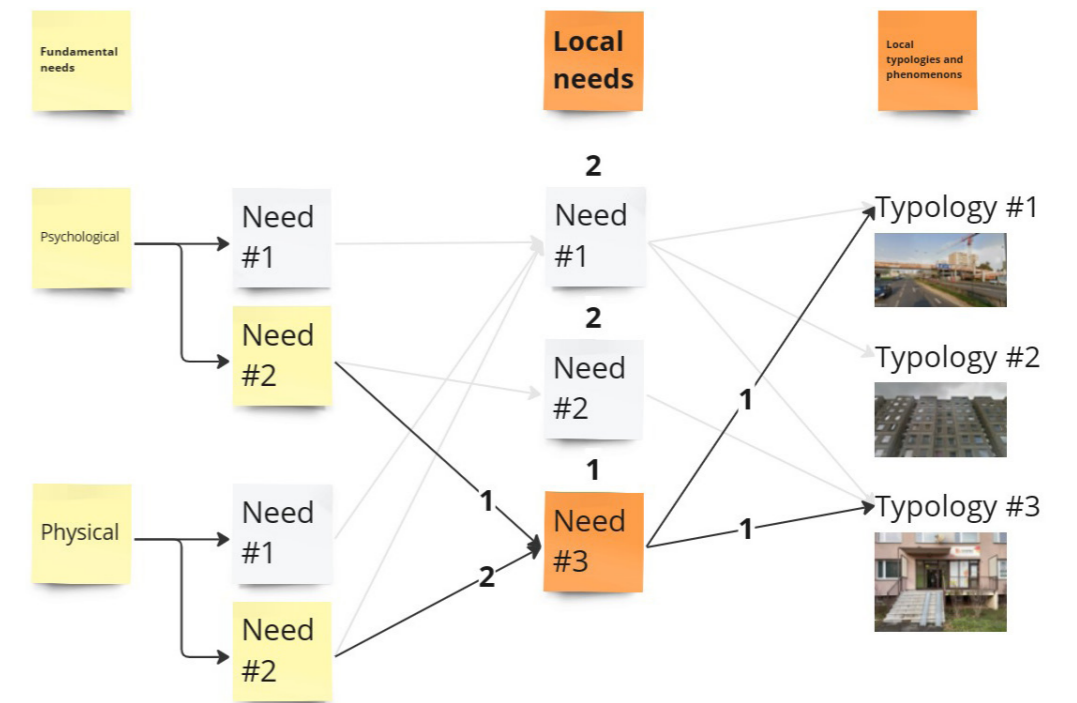
The weight of each relation to the needs above threshold is evaluated and compared providing further prioritization for future interventions.

146   "What Is a Neural Network?"
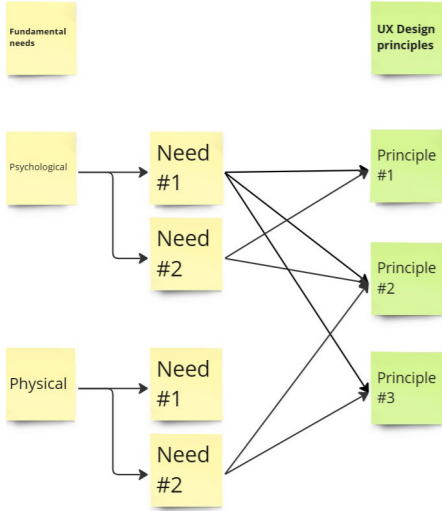
At this moment we know the least fulfilled fundamental needs and local typologies that most likely generate the issue. In the next step, fundamental needs are linked to the general UX design principles (Soft City principles) that may positively address them.
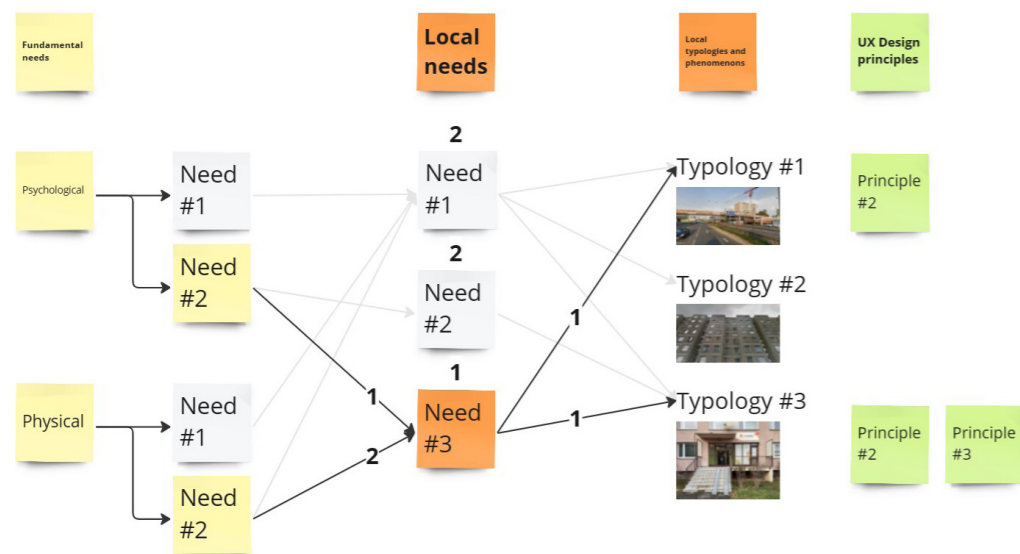
Value of connections	Number of connections	Average value
2	1	2
1	2	1,5
2		
2	1	1
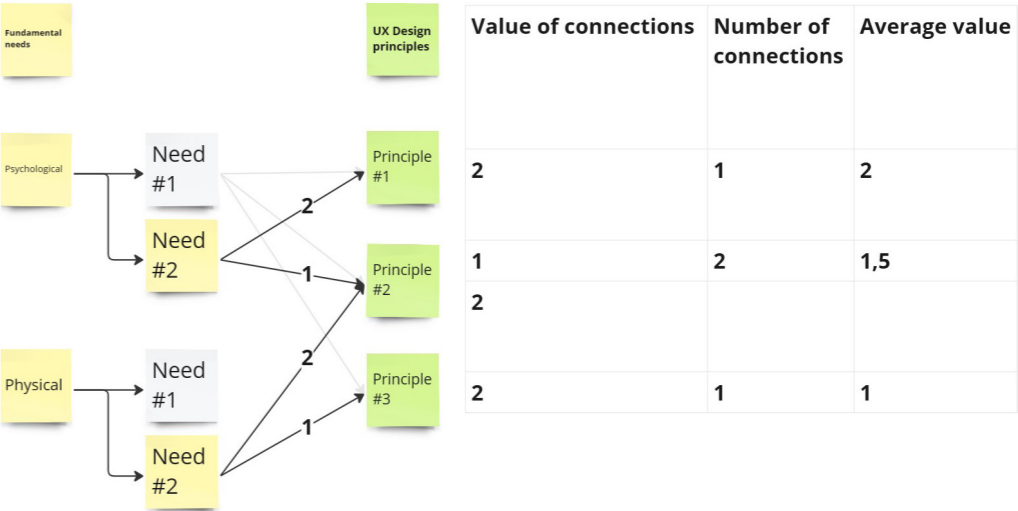
At this stage, we take the acquired knowledge about the fundamental unfulfilled needs and typologies that may cause it and determine the possibly most fulfilling typologies again through neural network analysis. As each design principle may get a lot of connections of diverse weights, further calculations may help to prioritize the most impactful solution. The key performance indicators are:
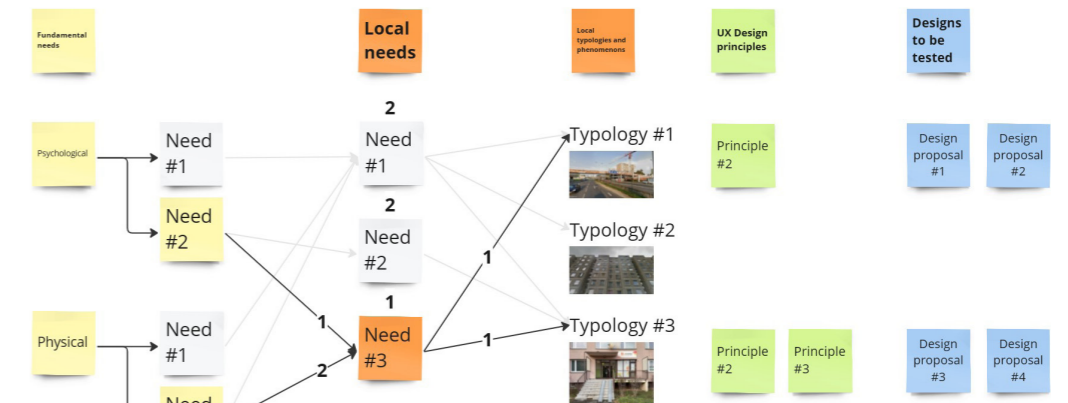
- the amount of connections—higher amount means more needs addressed at once

- average weight—the lower the weight is, the more impactful intervention may be

8.

Fundamental needs

Psychological

Need #1

Need #2

Physical

Need #1

Need #2

Local needs

2
Need #1

2
Need #2

1
Need #3

1 2 1

Local typologies and phenomenons

Typology #1

Typology #2

Typology #3

UX Design principles

Principle #2

Principle #2 Principle #3

Principles scoring below weight '2' were chosen to be the main guides and assigned to the corresponding local typologies to be addressed.

9.

Fundamental needs

Psychological

Physical

Need #1
Need #2

Need #1
Need #2

Local needs

2
Need #1

2
Need #2

1
Need #3

Local typologies and phenomenons

Typology #1

Typology #2

Typology #3

UX Design principles

Principle #2

Principle #2 Principle #3

Designs to be tested

Design proposal #1 Design proposal #2

Design proposal #3 Design proposal #4

In the last step, actual design proposals per typological category are derived while being inspired by the fundamental UX design principles and competitors' case studies. This way the designer addresses the most problematic typologies causing the greatest unsatisfaction of the key needs while offering design interventions with the highest chance of successfully addressing them.

When applied to the context of Jižní Město, the analysis reveals an extensive and interconnected network, highlighting the complexity of relationships in the area. The true value of this exercise becomes apparent now—we simply lack the cognitive capacity to process such a large number of calculations simultaneously using rational analytical thinking. Without the detailed subdividing steps demonstrated, conclusions about the locality would be mere intuitive guesses about the most important issues, needs, and solutions, which could be far from accurate.

In this paper, the relationships and weights were established solely by me as the author, reflecting a single individual's perspective rather than accurately representing the average perception of the target group. Ideally, all links and values would be derived from a poll of end-users, with the statistical average serving as the final data point. Nonetheless, even with this limitation, the exercise has already proven valuable by providing more accurate conclusions about my own perception of the issues and the knowledge and experience I have gathered.
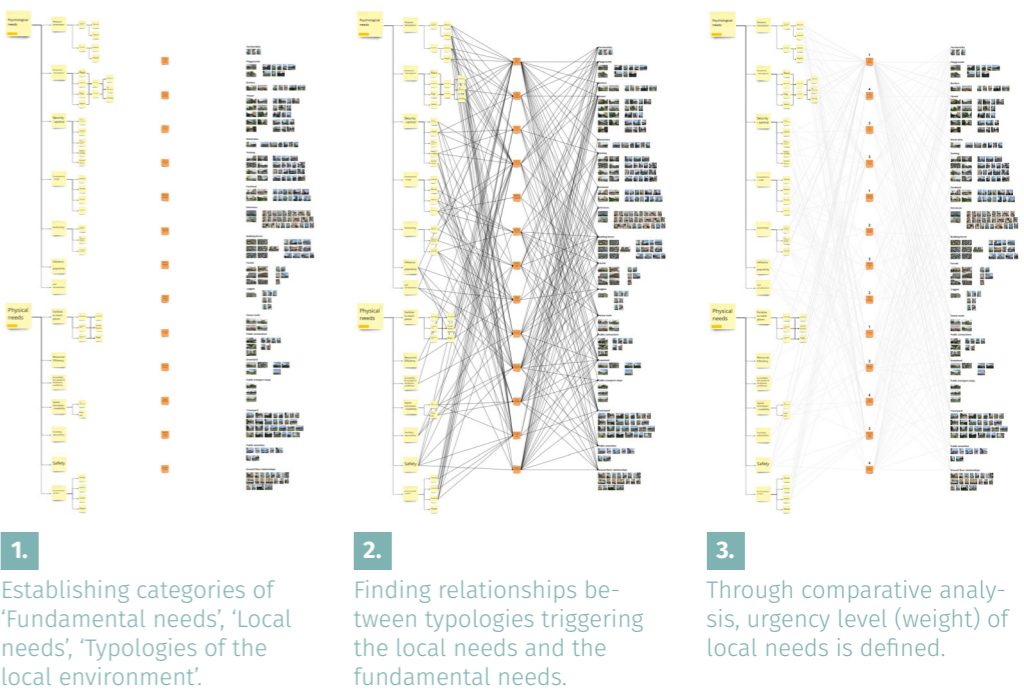
The problem lies in the division of our mind into intuitive and analytical ways of thinking. These two mental systems are well described by Daniel Kahneman, a psychologist who won the Nobel Prize in Economic Sciences and authored the New York Times bestseller *Thinking, Fast and Slow*. He spent much time of his life researching human irrationality and what's called 'cognitive biases'.[147] 145F In an interview with UBS, Kahneman explains that we naturally prefer intuition because it requires significantly less energy for our mind and body. This preference is reasonable, as we are experts in many areas, such as face recognition, where our intuitive mind is usually correct.

However, Kahneman points out that intuition can be problematic in complex cases like medical diagnosis. He says, "'You can have a physician who has a wonderful intuition about a particular medical disease, because he's seen it many times, and he's diagnosed it many times... But does the doctor know when he doesn't know?'" He further continues, saying, "'and the problem with intuition is that subjectively, intuition feels just the same when it's wrong and when it's right. [...] you're just equally confident.'"[148]
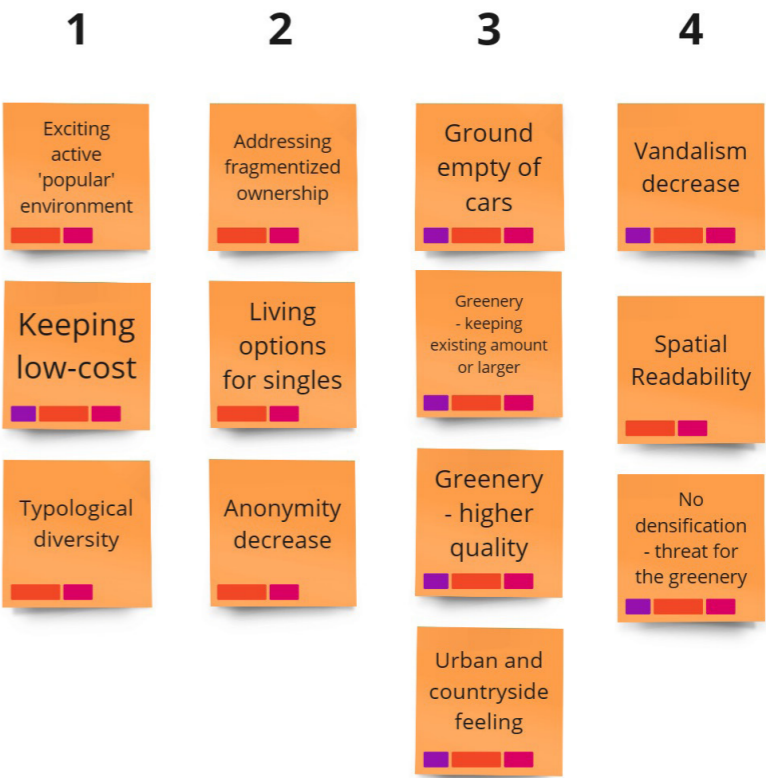
In UX research, cognitive bias is seen as highly common, but also likely the most problematic part of the design process. While it's practically impossible to fully avoid it, techniques exist to achieve greater objectivity. The neural network analysis presented in this paper could become one such technique.[149]

Lastly, however 'technical', 'artificial' or 'inhuman' such analysis may seem, it is in fact very much rooted in the emotional nature of human behavior and interaction. All links and weights are based on the feeling and personal experience of the participant. The only difference is that rather than trying to grasp overwhelming amounts of data at once, the subsequent steps of the methodology allows to focus on one specific aspect at a time being able to more easily and accurately describe the emotions related to it.

On the following pages, the application on a real case of Jižní Město is showcased, starting with establishing the relationships across categories:


1.
Establishing categories of 'Fundamental needs', 'Local needs', 'Typologies of the local environment'.

2.
Finding relationships between typologies triggering the local needs and the fundamental needs.

3.
Through comparative analysis, urgency level (weight) of local needs is defined.

Defining the level of urgency, weights, of each local need via comparative rating:

1
Exciting active 'popular' environment

Keeping low-cost

Typological diversity

2
Addressing fragmentized ownership

Living options for singles

Anonymity decrease

3
Ground empty of cars

Greenery - keeping existing amount or larger

Greenery - higher quality

Urban and countryside feeling

4
Vandalism decrease

Spatial Readability

No densification - threat for the greenery

147 Holt, "Thinking, Fast and Slow — By Daniel Kahneman — Book Review."
148 DrAlanBarnard, "Can We Trust Our Intuition? And Interview with Daniel Kahneman," June 23, 2022, https://www.youtube.com/watch?v=X5Q1S34qfBY.
149 Nunnally and Farkas, UX Research.

Continue focusing solely on one of the key needs for creating more 'exciting, active, or popular environments' and defining weights for all relationships linked to this need. These relationships are further reduced to the ones being equal or less than threshold '1'. In a similar way, UX Design principles are linked to the fundamental needs and rated with the highest scoring becoming the source for design ideas.
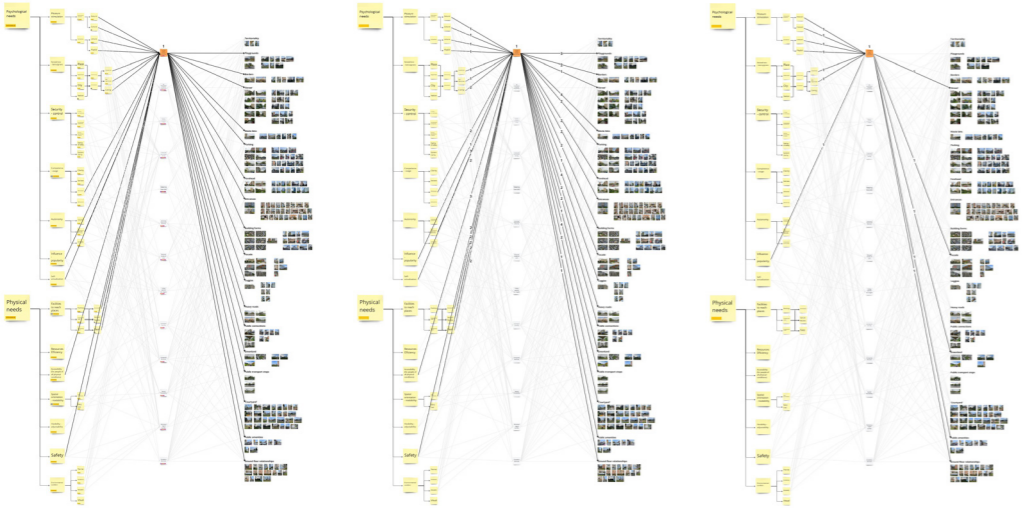
4.
Only the relationships related to the need(s) above threshold are further evaluated.

5.1.
Weights are set for all relationships linked to the need(s) above pre-defined urgency threshold.

5.2.
Only relationships above defined threshold are left to further prioritize typologies to address.
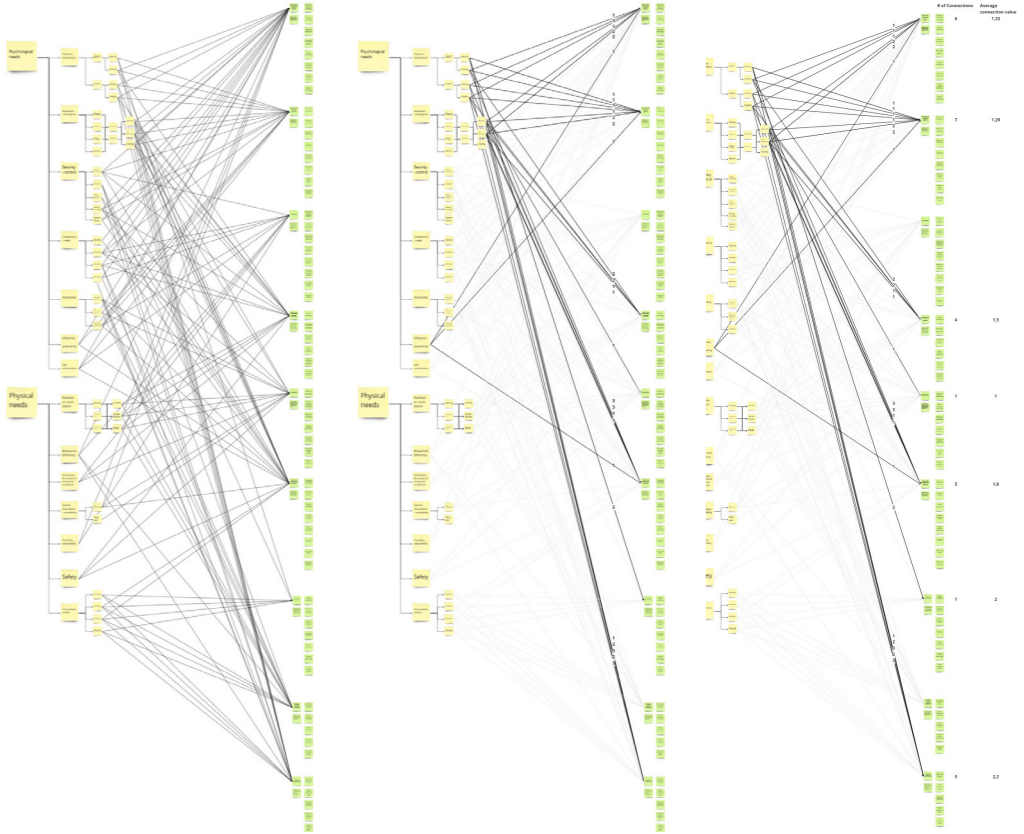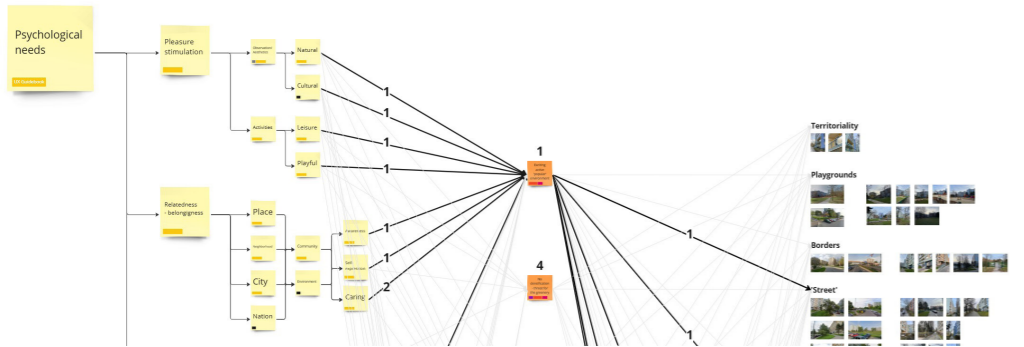
6.
Relationships between fundamental needs and UX design principles sets a foundation for final design ideas.

7.1.
Weights are set for all relationships based on the previously defined most unfulfilled local needs.

7.2.
To further prioritize design interventions, new KPIs are set like the number of connections or the average weight value.
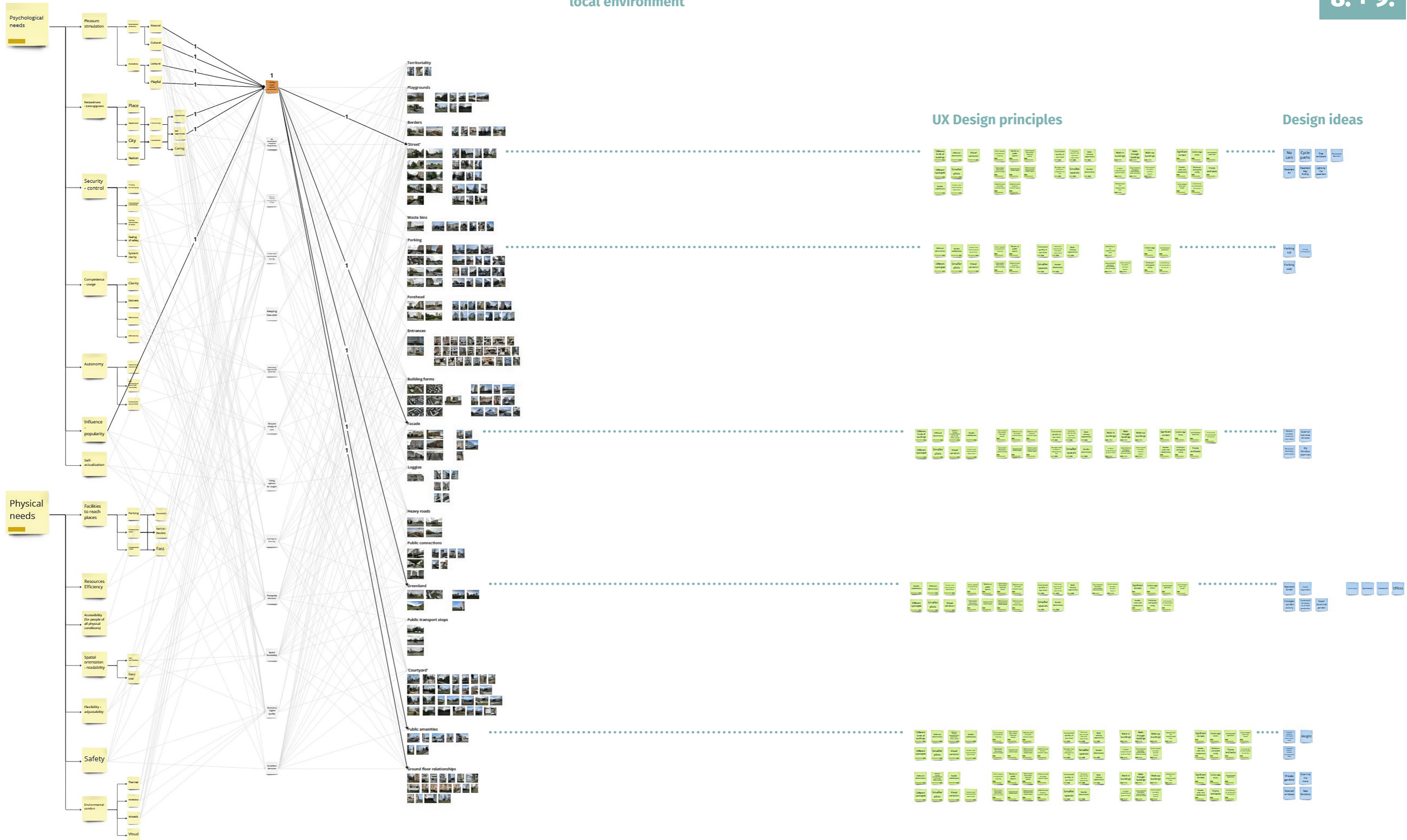
In the last stage, UX Design principles scoring the highest are linked to the typologies they could address, and potential design intervention ideas are derived.

Fundamental needs

Local needs

Typologies of local environment

UX Design principles

Design ideas

Psychological needs

- Pleasure stimulation
  - Natural
  - Cultural
  - Leisure
  - Playful
- Relatedness - belongingness
  - Place
  - City
  - Nation
- Security - control
  - Testing of safety
  - Spatial clarity
- Competence - usage
  - Clarity
- Autonomy
- Influence - popularity
- Self-actualization

Physical needs

- Facilities to reach places
  - Parking
  - Varied - flexible
  - Fast
- Resources Efficiency
- Accessibility (for people of all physical conditions)
- Spatial orientation - readability
  - Easy use
- Flexibility - adjustability
- Safety
- Environmental comfort
  - Thermal
  - Outdoor
  - Acoustic
  - Visual

Typologies:
- Territoriality
- Playgrounds
- Borders
- "Street"
- Waste bins
- Parking
- Forehead
- Entrances
- Building forms
- Facade
- Loggias
- Heavy roads
- Public connections
- Greenland
- Public transport stops
- "Courtyard"
- Public amenities
- Ground floor relationships

Among the most problematic typologies are following:

Street
In this context, purely technical infrastructure for accessing individual buildings and omnipresent cars. There is little to no activity happening on the streets. There are almost no amenities directly connected to the street that could host any kind of community event or interaction. Even though the density of people living in the area is high, the streets are mostly empty. [150]

Parking
Cars are an essential feature of the environment's appearance that anyone witness immediately. The lack of more systematic and concentrated approach towards car management led to a space flooded with them from each individual street to 'courtyards' between buildings looking like a pool of cars. This dominancy generates a border, physical and visual, and a feeling of distress when moving around the neighborhood. That said local's need for car spots is in fact growing, and management strategies are therefore even more urgent. [151,152]

Facade
Facades witnessed significant changes over the last decades when restoration procedures were held. Changing from monotonous gray concrete to colorful showcase of patterns and tints. This was probably an attempt to reduce the level of anonymity, increase orientation ability, and generate a more positive atmosphere. However, even more quality needs to be provided. Interventions that would lead to more interaction between neighbors and connectivity with the space around the buildings. [153]

150   Kouhout et al., Sídliště, jak dál?
151   Problémy Sídliště (5/6): Nedostatek Parkovacích Míst.
152   Kouhout et al., Sídliště, jak dál?

153   Kouhout et al.

Greenland

The modernist idea of living in vast space full of vegetation ended in a 'waste-land' of green, 'greenland'. It does not act like a forest, and it does not act like a park. For the forest it's probably too small or not dense enough, for the park it's too large to be maintained and filled with activities. Result is a space where you only pass by, but do not really stay while it's not even interesting for fauna or flora to flourish. [154,155]

Public amenities

there is enough schools, kindergartens, playgrounds, supermarkets... but there is not enough life. Simply said, there's not much to do for the 21st century generation. There are very few places of gathering like restaurants, cafes, pubs and if so, usually in a bad condition. No office places or other work opportunities. The mono-functional establishment leads to an environment empty of activities and lacking energy. [156,157]

Plinth relationships

The division between private and public is a strict line. There is practically zero interaction between the ground floor and its surroundings in continuation with the cultural standard of high privacy. The previous communist regime likely generated such fear of constant surveillance and distrust in communities that inhabitants like to keep their rooms fully enclosed. Not only with curtains, but sometimes even fences to protect their loggias that serve more as a storage space than actual place of recreation and interaction. [158,159]

Key performance indicators (KPI) and building program definition

The urgent needs and issues are known, possible design principles to address them as well, but there is no method to evaluate their true performance or in other words, how successful the design is in satisfying the users by fulfilling their needs. In UX Research both quantitative and qualitative methods are used for such evaluation with pros and cons on each side. Generally speaking, it is ideal to combine both data streams as quantitative data could be gathered in much larger numbers providing statistical accuracy, while qualitative testing helps to better understand such data leading to more accurate interpretations. [160]

Table 3-1. Quantitative research methods

Method Name	Description	Insight-Driven	Evaluative	Generative
A/B testing	A method of implementing two solutions and, by displaying them to randomly selected customer groups, determining a preferred solution.		X	

154   Problémy Sídliště (2/6).
155   Kouhout et al., Sídliště, jak dál?
156   Prokop, "Co vede k vylidňování Jižního města a jaké kroky podniká MČ Praha 11?"
157   Kouhout et al., Sídliště, jak dál?

158   Kouhout et al.
159   Problémy Sídliště (4/6).
160   Nunnally and Farkas, UX Research.

Analytics	Any measure of statistical data or usage of a system. This may include click rates, bounce rates, time on task, and more.		X	X
Card sorting	A method of seeking understanding for a customer's mental model of a system's architecture. May be open (where customers can create their own labels and groups) or closed (where labels and groups are provided).	X	X	X
Customer feedback	Any format of requesting and gathering large-scale customer input.	X	X	
Email surveys	One method for gathering customer feedback.	X	X	
Eye tracking	A lab-based method where cameras track a customer's eye movement across a digital product.		X	
Intercept testing	A method of randomly requesting customer feedback as they engage with a product.	X	X	
Moderated product testing	A method of validating a product with a researcher actively engaging customers.	X	X	X

Surveys	Any format where customers are presented with open or closed questions on their experience with a product.	X	X
Taxonomy review (tree jacking)	An analytical method to address system architecture and taxonomy.	X	X
Unmoderated product testing	A method of validating a product with a researcher setting up questions for a customer to re-		

Figure 15: Quantitative UX research methods

[*Nunnally and Farkas*, Quantitative Research Methods.]

Notable quantitative UX research methods besides standard survey are A/B testing, Eye tracking, and Tree jacking. A/B testing is a systematic test of 2 design scenarios where participants compare each solution and choose the preferable one per measured parameter. This can be especially useful while tracking the eye movement of participants. Slowing down or staring at a specific point for longer period of time may suggest abnormal positive interest or on the contrary dissatisfaction.[161] Such eye tracking or even the whole-body movement is allowed to be recorded in VR providing the researcher with additional data about the design's performance. While simply showing two 2D visualizations of each design to a user can also unveil interesting conclusions, the immersive experience and free movement in VR allows the participant to explore the site in a personal way, not preconceived by the researcher.[162]

Tree jacking could be especially interesting in the topic of wayfinding. If a user of built environment seeks to find a specific destination, what are the architectural elements that define their orientation towards reaching it? This taxonomy of space is comparable to the taxonomy of an internet website. If we want to find for example a contact to the owner of the website, what are the buttons we expect to see and the path to 'click through'? Iteratively testing different scenarios of such taxonomical organization not only on a website, but also in a physical space can significantly help in understanding users' way of orienting in the built environment. Such technique is therefore particularly useful when tackling the lack of orientation in Jižní Město.

An example of studies on wayfinding can be provided by Sarah Manning, an Architectural Association researcher. She highlights an interesting finding where 75% of movement in space is defined by the spatial organization of space rather than attractors. The places of natural crossings of people's paths are also the

161   Nunnally and Farkas, Quantitative Research Methods.
162   Jones and Osborne, Virtual Reality Methods.

ones where retail has the biggest potential and naturally tends to emerge. [163] Understanding architectural language and how people use it is therefore crucial also for the economic and cultural stability of the area.
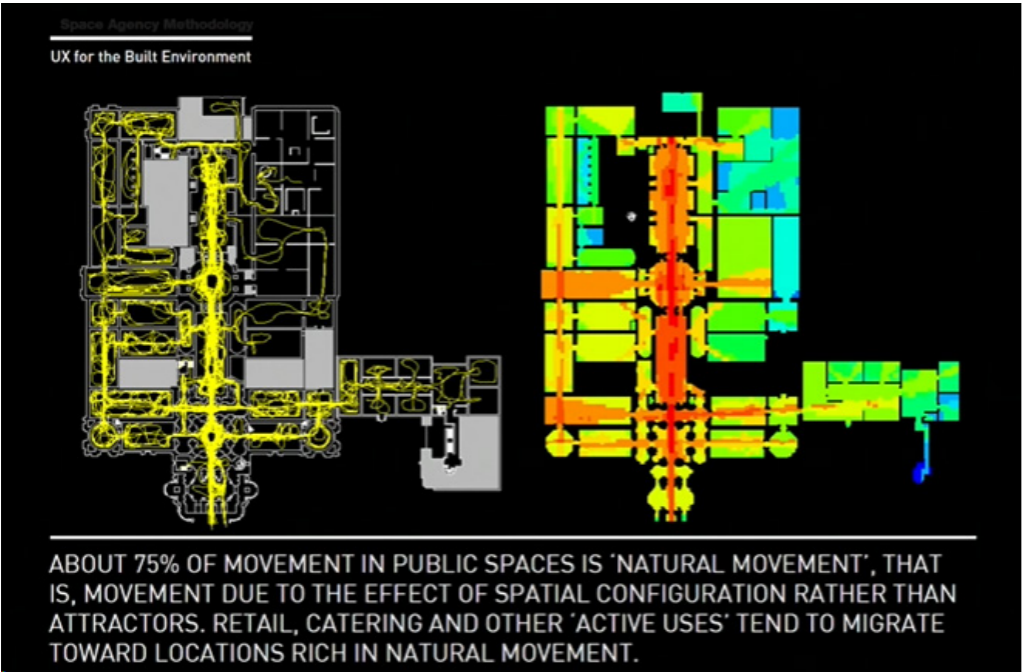

Figure 16: Tracking the movement in public spaces unveils insightful principles about users' behavior in the built environment.

[*Manning*, Tracking the Movement in Public Spaces.]

When the methods are established, what parameters could be used to measure the performance? In website design, Google analytics is the most used tool for system analytics with years of development and more than 17 million websites actively using it. [164] The platform provides 500+ parameters to evaluate, making it a powerful tool and potentially large inspiration source for architectural analysis. [165]
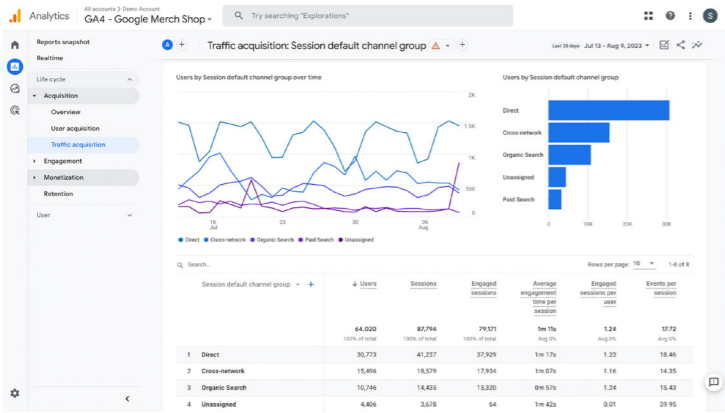
Figure 17: Google analytics dashboard that used by millions of websites for tracking their performance. What could be an alternative of such tool in the built environment?

[Traffic Acquisition Report.]

Google analytics parameters are divided into two categories—metrics and dimensions:

- "Metrics are quantitative measurements. They represent the 'how much' or 'how many' in your data using a numerical value.

- Dimensions, on the other hand, are non-numeric attributes. They describe the who, what, where, when, and why behind the metrics." [166]

When looking at how to translate these metrics and dimensions into built environment, some become immediately impossible or redundant. Impossible are typically the ones exclusively related to website/software interface—as an example, 'Query Word Count' meaning 'the number of words in the search query' or 'Screen Colors' meaning the color depth of users' monitors, retrieved from the DOM of users' browsers. Redundant or very specific might be a 'Shopping Stage' describing 'various stages of the shopping experience that users completed in a session (visit of the website)'. [167] Even though the parameter is translatable into the shopping experience in a mall, it is not as useful for more general measurements within the built environment. Based on this selection approach, a translated list of around 50 parameters was created.

163   Sarah Manning - UX for the Built Environment.
164   Gohil, "25 Google Analytics Statistics That Matter."
165   Ritwik, "500+ Dimensions & Metrics Of Google Analytics (With Definition)."

166   Pol, "12 Key Google Analytics Metrics to Track."
167   Ritwik, "500+ Dimensions & Metrics Of Google Analytics (With Definition)."

GOOGLE ANALYTICS				SELECTION		BUILT ENVIRONMENT		
NAME	TYPE	DEFINITION	COMMENT			NAME	DEFINITION	COMMENT
Users	METRIC	The total number of users for the requested time period.		Yes		Users	The total number of users of an area/building/POI for the requested time period.	
New Users	METRIC	The number of sessions marked as a user's first sessions.		Yes		New Users	The number of sessions marked as a user's first session in an area/building/POI.	
Sessions	METRIC	The total number of sessions.		Yes		Sessions	The total number of sessions in the area/building/POI.	Sessions mean a visit of an analyzed area/building/POI with potentially included set of actions
Bounce Rate	METRIC	The percentage of single-page session (i.e., session in which the person left the property from the first page).	Not always relevant - For instance single-page websites; When you drive the users to a specific page for a specific purpose - expectation is always one. https://www.youtube.com/watch?v=90-Ru6EnF1k&t=610s	Yes		Bounce Rate	The percentage of single-building/place sessions (i.e., sessions in which the person left the area from the first POI).	Not always relevant, because sometimes people come to the area intentionally to visit a specific place only. Still may be relevant to measure the overall attractivity of the area
Impressions	METRIC	Total number of campaign impressions.	An impression means that a user has seen (or potentially seen) a link to your site in Google Search, Discover, or News. In general, an impression is counted whenever an item appears in the current page of results, whether or not the item is scrolled into view, as long as the user need not click to see more results (such being required to click "see more" to see the link). https://support.google.com/webmasters/answer/7042828?hl=en#impressions	Yes		Impressions	Total number of campaign impressions of a POI in a defined area.	This means how many times a user potentially sees a campaign spatial 'guide' for a specific POI - it could be a billboard, a line on a sidewalk,... leading to an office building, playground, café, square,...
Clicks	METRIC	Total number of times users have clicked on an ad to reach the property.		Yes		Reaches	Total number of times users reached a POI after seeing a campaign 'guide' for the POI.	For instance, if there's a guide sign in the area suggesting to session a supermarket, how many times users go to the supermarket after seeing the sign.
CPM	METRIC	Cost per thousand impressions.		Yes		CPM	Cost per thousand impressions.	How much does it cost to implement a spatial guide to get 1000 impressions
Cost per Goal Conversion	METRIC	The cost per goal conversion for the property.	Ad Cost per Goal Conversion is the amount of money spent on an ad that leads to a goal conversion. It is used to measure the investment in a single advertisement required to achieve a set goal. https://www.metrichq.org/marketing/ad-cost-per-goal-conversion/	Yes		Cost per Goal Conversion	The cost per goal conversion for the POI.	How much do the campaigning guides cost to successfully reach a goal in the area - for instance realizing an existence of a café, finding the café, entering the café, buying a product in the cafe
Goal Completions	METRIC	Total number of completions for all goals defined in the profile.	Goals measure how well your site or app fulfills your target objectives. A goal represents a completed activity, called a conversion, that contributes to the success of your business. Examples of goals include making a purchase (for an ecommerce site), completing a game level (for a mobile gaming app), or submitting a contact information form (for a marketing or lead generation site). https://support.google.com/analytics/answer/1012040?hl=en#zippy=%2Cin-this-article	Yes		Goal Completions	Total number of completions for all goals defined in the profile.	Completion of set goals for the defined area - e.g. reaching a POI, specific number of people concentrating at a POI, following a set of guides/signs,...
Goal Conversion Rate	METRIC	The percentage of sessions which resulted in a conversion to at least one of the goals.		Yes		Goal Conversion Rate	The percentage of sessions which resulted in a conversion to at least one of the goals.	
Browser	DIMENSION	The name of users' browsers, for example, Internet Explorer or Firefox.		Yes		Means of Browsing	The name of users' means of browsing in the area - e.g. google maps, google street view, physical map, but also feet, bike, car,...	Different means of browsing requires different designs that increase attractivity of the area
Continent	DIMENSION	Users' continent, derived from users' IP addresses or Geographical IDs.		Yes		Continent	Users' continent of origin - permanent place of living	
Country	DIMENSION	Users' country, derived from their IP addresses or Geographical IDs.		Yes		Country	Users' country of origin - permanent place of living	
City	DIMENSION	Users' city, derived from their IP addresses or Geographical IDs.		Yes		City	Users' city of origin - permanent place of living	
Language	DIMENSION	The language, in ISO-639 code format (e.g., en-gb for British English), provided by the HTTP Request for the browser.		Yes		Language	Users' native/fluent language skills	

GOOGLE ANALYTICS					BUILT ENVIRONMENT		
NAME	TYPE	DEFINITION	COMMENT	SELECTION	NAME	DEFINITION	COMMENT
Screen Resolution	DIMENSION	Resolution of users' screens, for example, 1024x738.		Yes	POI Resolution	The distance at which a POI is visible, readable, and recognizable.	
Landing Page	DIMENSION	The first page in users' sessions, or the landing page.	Important to measure the bounce rate with this = how engaging is the first page, and whether the customer wants to stay there	Yes	Entry Point/POI	Users' entry point to the researched area, building, POI.	
Second Page	DIMENSION	The second page in users' sessions.	In conjunction with the landing page = where people go to as the next step - this unveils the potential intent of an user; 1.About page => they're looking for information about the business; 2.Contact page => they want to contact you	Yes	Second POI	The second POI of users' sessions.	
Exit Page	DIMENSION	The last page or exit page in users' sessions.	For instance, you want to lead people to perform specific task	Yes	Exit Point/POI	Users' exit point of the research area, building, POI.	
Page Depth	DIMENSION	The number of pages visited by users during a session. The value is a histogram that counts pageviews across a range of possible values. In this calculation, all sessions will have at least one pageview, and some percentage of sessions will have more.		Yes	POI Depth	The number of POI visited by users during a session in an area.	
Pages / Session	METRIC	The average number of pages viewed during a session, including repeated views of a single page.	For example, if a user were to scroll halfway down a page and then leave, that user's page session would have a scroll depth of 50%.	Yes	POI / Session	The average number of POI viewed during a session, including repeated views of a single POI.	
Scroll Depth	METRIC	Measure scroll events in Google Tag Manager - The scroll depth trigger is used to fire tags based on how far a user has scrolled down a web page.		Yes	Visit Depth	The depth of users' exploration in the area - how much into the 'interior' does a user decides to go. Determined by passing specific POI.	e.g. Just passing around a researched neighborhood vs entering inner courtyards all the way to a café inside of a building.
Unique Pageviews	METRIC	Unique Pageviews is the number of sessions during which the specified page was viewed at least once. A unique pageview is counted for each page URL + page title combination.		Yes	Unique POI-views	Unique POI-views is the number of sessions during which the specified POI was viewed/visited at least once.	
Time on Page	METRIC	Time (in seconds) users spent on a particular page, calculated by subtracting the initial view time for a particular page from the initial view time for a subsequent page. This metric does not apply to exit pages of the property.	How engaging is the website?	Yes	Time at a POI	Time users spent at a particular POI.	
Avg. Time on Page	METRIC	The average time users spent viewing this page or a set of pages.		Yes	Avg. Time at a POI	The average time users spent viewing/visiting this POI or a set of POI.	
Search Term	DIMENSION	Search term used within the property.	A list of search terms that a significant number of people have used before seeing your ad. https://support.google.com/google-ads/answer/2684537?hl=en#:~:text=A%20list%20of%20search%20terms,in%20your%20ad%20being%20shown.	Yes	Search Typologies	Typologies that are used for searching and finding a specific POI.	e.g. What signs do you follow to find a shop.
Site Search Goal Conversion Rate	METRIC	The percentage of search sessions (i.e., sessions that included at least one search) which resulted in a conversion to at least one of the goals.		Yes	Site Search Goal Conversion Rate	The percentage of search sessions (i.e., sessions that included at least one search) which resulted in a conversion to at least one of the goals.	e.g. Finding a café thanks to clues in the area.
Event Label	DIMENSION	Event label.	An event allows you to measure a specific interaction or occurrence on your website or app. For example, you can use an event to measure when someone loads a page, clicks a link, or completes a purchase, or to measure system behavior, such as when an app crashes or an impression is served. https://support.google.com/analytics/answer/9322688?hl=en#zippy=%2Creal-time-report%2Cdebugview-report	Yes	Event Label	Event label.	e.g. entering a POI building.
Total Events	METRIC	The total number of events for the profile, across all categories.		Yes	Total Events	The total number of events for the user profile, across all categories.	
Revenue	METRIC	The total sale revenue (excluding shipping and tax) of the transaction.		Yes	Revenue	The total sale revenue of a specific POI or the entire area.	Important to determine the economic gains of an area in comparison to the costs of building it.

GOOGLE ANALYTICS						BUILT ENVIRONMENT		
NAME	TYPE	DEFINITION	COMMENT	SELECTION		NAME	DEFINITION	COMMENT
Quantity	METRIC	Total number of items purchased. For example, if users purchase 2 frisbees and 5 tennis balls, this will be 7.		Yes		Quantity	Total number of items purchased. For example, if users purchase 5 beers and 2 cakes, this will be 7.	Could be also applied on the buying/renting of apartments.
Social Actions	METRIC	The total number of social interactions.		Yes		Virtual Social Actions	The total number of virtual social interactions in the area.	e.g. the number of pictures/videos from the area shared on social media, the amount of reviews on google maps
				Yes		Real Social Encounters	The total number of encounters with people in the area.	
				Yes		Real Social Actions	The total number of social interactions in the area.	e.g. starting a conversation, waving at each other, inviting for a coffee
Unique Social Actions	METRIC	The number of sessions during which the specified social action(s) occurred at least once. This is based on the the unique combination of socialInteractionNetwork, socialInteractionAction, and socialInteractionTarget.		Yes		Unique Social Actions	The number of sessions during which the specified social action(s) occurred at least once.	
Actions Per Social Session	METRIC	The number of social interactions per session.		Yes		Social Actions Per Session	The number of social interactions per session.	
Week of Year	DIMENSION	Combined values of ga:year and ga:week.		Yes		Week of Year		important especially in connection with the changing seasons and other possible events that could affect the measurement
Age	DIMENSION	Age bracket of users.		Yes		Age	Age bracket of users.	
Gender	DIMENSION	Gender of users.		Yes		Gender	Gender of users.	
Affinity Category (reach)	DIMENSION	Indicates that users are more likely to be interested in learning about the specified category.	Lifestyles similar to TV audiences, for example: Technophiles, Sports Fans, and Cooking Enthusiasts. https://support.google.com/analytics/answer/2799357?hl=en#zippy=%2Cin-this-article	Yes		Affinity Category (reach)	Lifestyles similar to TV audiences, for example: Technophiles, Sports Fans, and Cooking Enthusiasts.	
Publisher Impressions	METRIC	An ad impression is reported whenever an individual ad is displayed on the website. For example, if a page with two ad units is viewed once, we'll display two impressions.		Yes		Stakeholder Impressions	Total number of a particular stakeholder's campaign impressions of their POI in a defined area.	How much can the 'interface' of the site provide for gaining stakeholder's recognition
Publisher Clicks	METRIC	The number of times ads from a linked publisher account (AdSense, AdX, DFP) were clicked on the site.		Yes		Stakeholder Reaches	Total number of times users reached the stakeholder's POI after seeing a stakeholder's campaign 'guide' for the POI.	
Acquisition Campaign	DIMENSION	The campaign through which users were acquired, derived from users' first session.		Yes		Acquisition Campaign	The campaign through which users were acquired, derived from users' first session.	Was it a specific paid campaign at bus stops for instance, or sign directly at the POI?
Acquisition Medium	DIMENSION	The medium through which users were acquired, derived from users' first session.	e.g. 'affiliate': users who click a link through an affiliate program; 'cpc': (short for cost-per-click) users who click a paid advertisement; 'email': users who click a link in an email marketing campaign; 'organic': users who click a link from a search engine; 'referral': users who click a link on a website (e.g., a link in a video description);'(none)': direct traffic https://support.google.com/analytics/answer/12922540?hl=en&co=GENIE.Platform%3DAndroid	Yes		Acquisition Medium	The medium through which users were acquired, derived from users' first session.	e.g. people recommendation, maps, sign on a path way; sign on a drive-way; sign directly on the shop;...
Acquisition Source	DIMENSION	The source through which users were acquired, derived from users' first session....),	For example, users who return to your website from Google Search show as "google" in the Session source dimension. Examples include "google", "youtube", and "gmail". https://support.google.com/analytics/answer/12922540?hl=en&co=GENIE.Platform%3DAndroid	Yes		Acquisition Source	The source through which users were acquired, derived from users' first session.	e.g. specific company/individual recommending the POI, Google Maps, specific signs (municipality, private company advertisement boards,...),

NAME	TYPE	DEFINITION	COMMENT	SELECTION		NAME	DEFINITION	COMMENT
Acquisition Source / Medium	DIMENSION	The combined value of ga:userAcquisitionSource and ga:acquisitionMedium.	The source and medium that led a user to arrive on your website or application. https://support.google.com/analytics/answer/12922540?hl=en&co=GENIE. Platform%3DAndroid	Yes		Acquisition Source / Medium	The source and medium that led a user to arrive to the POI.	
Product Adds To Cart	METRIC	Number of times the product was added to the shopping cart (Enhanced Ecommerce).		Yes		POI Placed Into Navigation	Number of times users placed the POI into their navigation app to find directions (e.g. Google maps)	
Product Checkouts	METRIC	Number of times the product was included in the check-out process (Enhanced Ecommerce).		Yes		POI Visited	Number of times users visited a POI.	
Product Detail Views	METRIC	Number of times users viewed the product-detail page (Enhanced Ecommerce).		Yes		POI Detail Views	Number of times users viewed the POI-detail page on the mapping app (e.g. Google maps)	
Number of Sessions per User	METRIC	The total number of sessions divided by the total number of users.	Total/total; Whether people tend to visit the website more often.	Yes		Number of Sessions per User	The total number of sessions divided by the total number of users.	
Transactions per User	METRIC	Total number of transactions divided by total number of users.		Yes		Transactions per User	Total number of transactions divided by total number of users.	Important in combination with revenue to determine what is the general financial turnover in the area and how much are users using the area for various activities.

Notable parameters from the list are for example:

Goal Conversion Rate

= the percentage of sessions which resulted in a conversion to at least one of the goals.

This is an important parameter when a designer aims to measure users performing a specific task in the built environment. The frequency or speed with which this task is performed during each individual visit to the area could serve as a measure of successful design.

Bounce rate

= The percentage of single-building/place sessions (i.e., sessions in which the person left the area from the spot of the first point of interest—POI)

This parameter can indicate multiple insights and depends on the user group being measured. A high bounce rate means that users tend to leave the area immediately after their first interaction or entry point. This suggests that the environment is unattractive or does not meet the users' needs, desires, or expectations. In website design, the first impression often determines whether the user stays on the website or not despite the fact that the content may be valuable for them.[168] Arguably, this is the case also for the built environment where inhabitants may find a building, street or a block unattractive within seconds demotivating them to explore the sight further.[169]

Entry Point/POI

= Users' entry point to the researched area, building, POI.

This parameter becomes particularly interesting when combined with the bounce rate. If the bounce rate is high and the entry point experience is poor, this lack of quality may discourage users from entering the area of interest, even if the interior experience is satisfactory. Consequently, the entry point's quality could undermine the success of the entire area's 'interface'.

For each individual project a different mix of parameters to measure could make sense to establish. Regardless of the specific mix, however, it is important to set what's called Key Performance Indicators (KPIs). The purpose of KPIs is to measure the performance of a certain design. It consists of a title, metric, current value, and a target value we want to achieve.[170] How quickly or how much closer do we get to the target value can be a way of measuring a successful positive development of a design.

In case of this paper and the study of Jižní Město, a very simple KPI was set as part of the comparative A/B testing during the participatory VR session:

Name: **UX Score Threshold**

Metric: **UX Score in the comparative analysis**

Current value: **Target value:**

X   ⟶   **1,5*X**
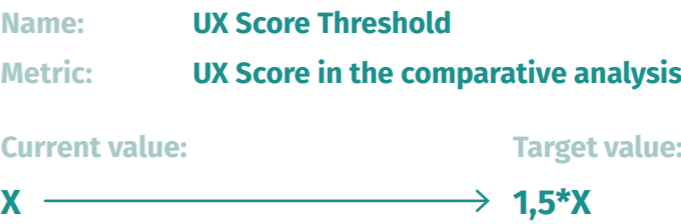
To put it in words, in order for a design intervention to be considered for the final design, it needs to be at least 50% more desirable than the original state within the comparative scale of other considered interventions. More explanation what this means can be found in the next chapter 'Rapid VR prototyping with users'.

Some KPIs could also be linked to the program mix of the desired project defining in detail how many square meters are desired for a specific program, or in what proximity this program needs to be from residents. In the case of Jižní Město, it is logical to set such target amounts for new office space or co-working, parking facilities, restaurants, cafes, or urban parks for a specific location

[168]   Pol, "12 Key Google Analytics Metrics to Track."
[169]   Sim and Gehl, Soft City.

[170]   The Difference between Metrics, KPIs & Key Results - YouTube.

as described previously in the 'Preliminary building program' chapter.

Since my approach was to address Jižní Město more generally, no specific location was chosen. Instead, a typical representative area was selected and altered into a 'testing site'. This alteration was crucial for the subsequent participatory session to prevent participants from recognizing the area. Using an existing site that participants might personally connect to could lead to biased opinions, influenced by their specific individual experiences and emotions (such as bad experiences with neighbors), regardless of the site's true qualities.

The Jižní Město district with highlighted area (on following pages) serves as an inspiration for the testing site.

The site is composed of two prefabricated panel construction typologies Larsen-Nielsen S2a and S9a with following typical floorplans:[171]

Figure 18: Typical floorplan of the prefabricated panel typology Larsen-Nielsen S2a showing three units per floor

[*Lipták*, Typické podlaží řadové sekce S2a.]

Figure 19: Typical floorplan of the prefabricated panel typology Larsen-Nielsen S2a showing four units per floor

[*Lipták*, Typické podlaží řadové sekce S9a.]

Following table provides a data overview of the testing site:

Building type	Amount of floors	GFA per floor [m2]	Units per floor	Amount of units	Amount of people per unit	Amount of people	Total GFA [m2]	Site area [m2]	FAR	Population density [population/ha]
S2a	131	225,4	3	393	2	786	29527			
S9a	59	440	4	236	2	472	25960			
TOTAL				1258		55487	50251	1	250	

171   Lipták, "Larsen-Nielsen."

Original environment
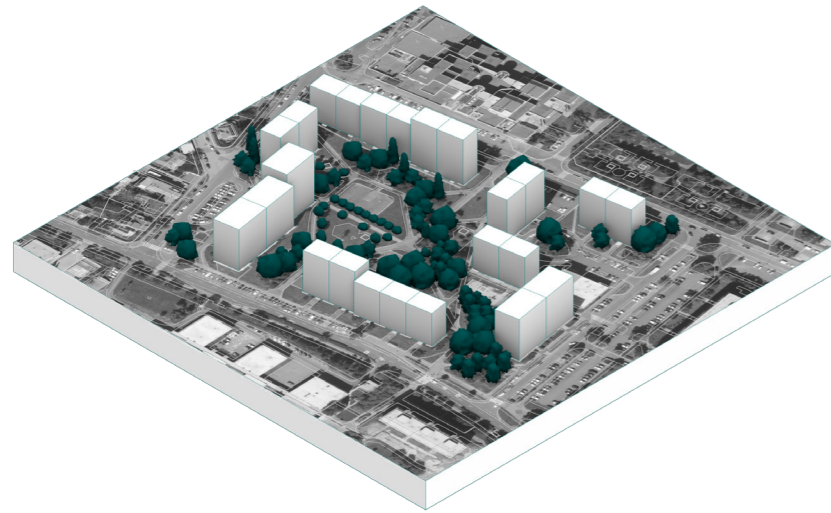
Altered testing situation
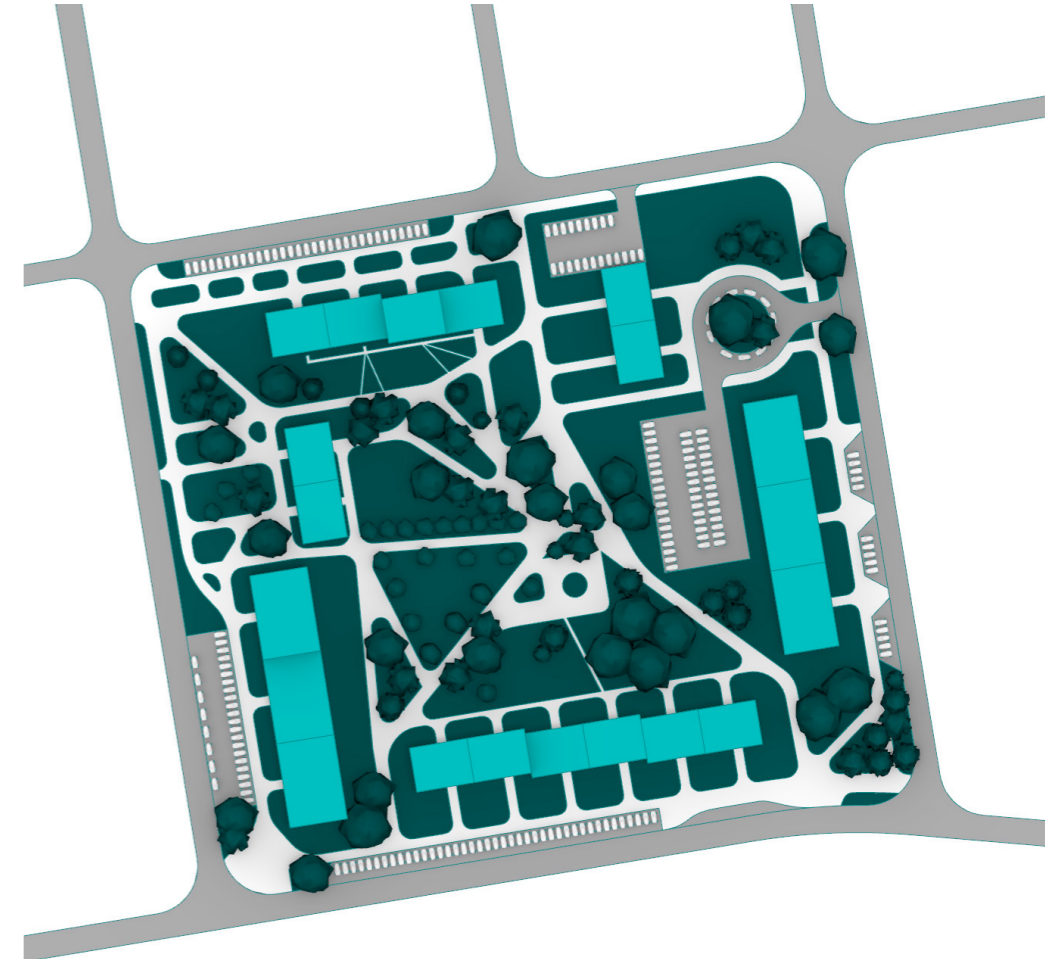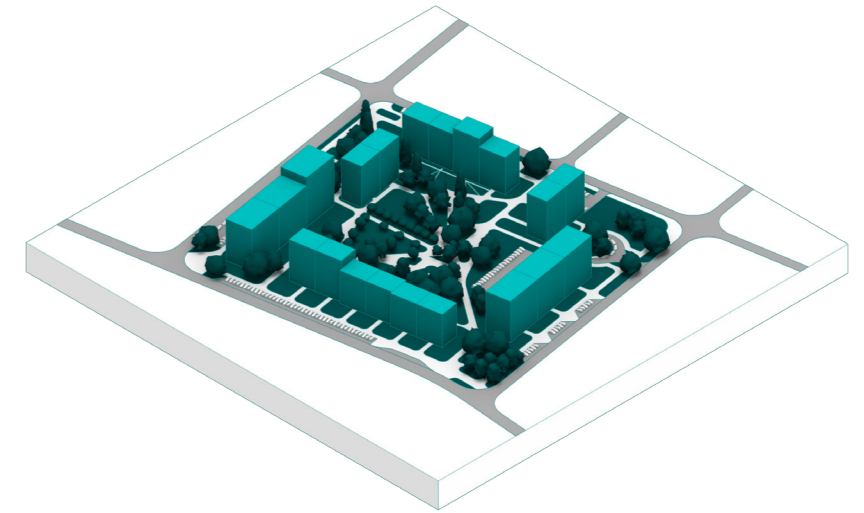
Parking

With this level of GFA, about 640 parking spaces should be provided according to Prague city regulations which could be set as a KPI target value. [172] However, this would require approximately 15.000 m² of parking lot or even more GFA for a multi-storey parking garage. Such an area or development could significantly impact the appearance and overall experience of locality. Design solutions may therefore require more urban level approach to satisfy such demand, but provide better UX locally.

Schematic showcase of different volumetric options for the parking lot within the location:

Pool

Underground

House

Slab

Extension

Hill
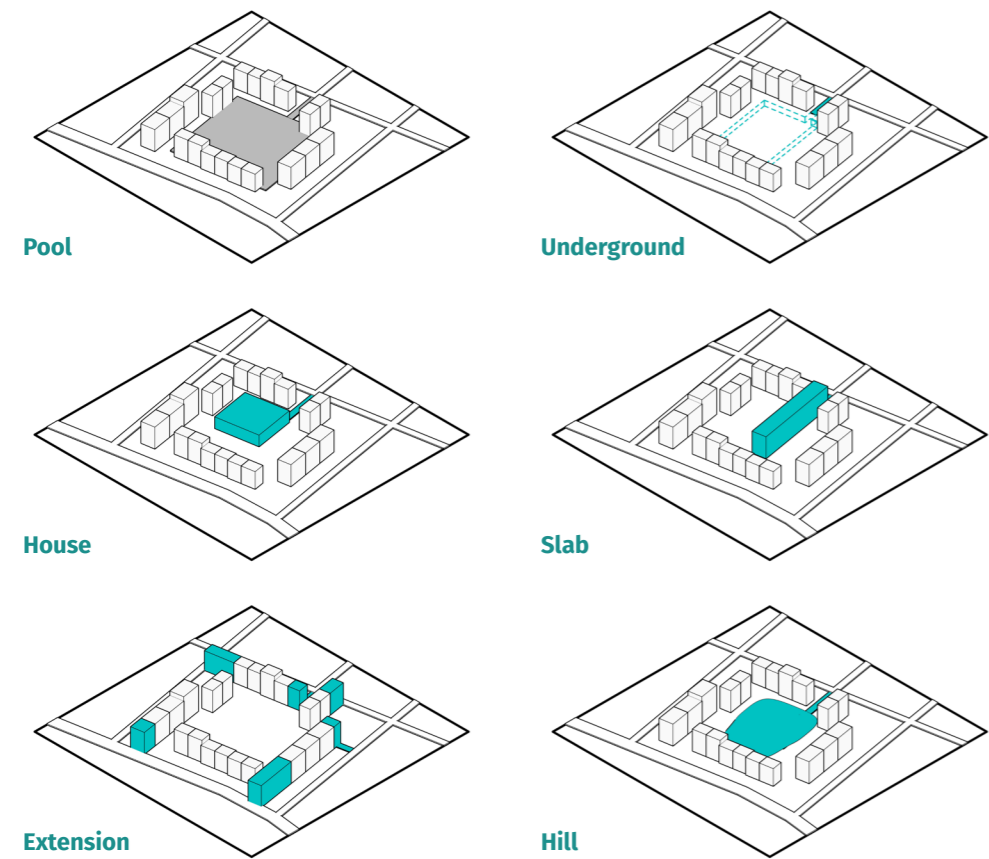
Other programs were further treated individually per specific concept.

Rapid VR prototyping with users

"If you can do only one activity and aim to improve an existing system, do qualitative (think-aloud) usability testing, which is the most effective method to improve usability." [173]

– Susan Farrell, Senior UX Researcher at NN/g

Quantitative methodologies can reveal various issues or trends, and their numerical data are easy to share among stakeholders. However, without proper interpretation, they are practically useless. Qualitative participatory sessions are among the most effective ways to uncover the nature of these issues or trends. Although time-consuming, they are worth implementing in the early design stages. [174]

As part of the paper's and project's ambitions, a methodology of such session with VR implementation had been developed and tested in a pilot with users.

Following timeline was used:

-15–0	0–10	10–15	15–55	55–60 min
Preparation	**Collaging over the site**	**VR explanation, first experience**	**VR prototype testing**	**Wrap-up, Feedback**
Organizing data from the previous session; reseting the research environment; explaining to the participant the structure of the session; VR risks and characteristics; participant's consent; establishing trust and comfort with the participant	Exploring the original site in an open conversation with the participant helping them get comfortable and able to explain their feelings; collaging of the site's photos with photos of emotions, social interactions, and environments	Explanation of the VR control system; reminder about the dangers—establishing clear connection with the participant to avoid motion sickness; first exploration in the base environment to get familiar and overcome the initial 'wow' effect	Testing of the prototypes in blocks per typology; each block includes quantitative ranking and qualitative conversation afterwards; ranking and qualitative conversations happen outside VR to minimize exposure and therefore motion sickness chances	Possibility to ask additional questions and address potentially missed topics by the participant; feedback on the session structure itself; leaving good social impressions to keep a possibility for further research collaboration

Ideally, there should be at least two researchers present during the session: one handling administration, note-taking, and time management, and the other managing the interaction with the user, including questioning and VR operation. If users permit, it is advisable to video-record the entire session, ensuring that both the user's movement within the VR scene and their body movements are clearly visible. This approach offers a significant advantage over regular audio recordings, as the user's non-verbal behavior can provide valuable insights in addition to their verbal responses. An example of such a setup can be seen here:

Right now, I will put you in the first base environment, come in right now.

[172]   Institut plánování a rozvoje hlavního města Prahy, "Pražské stavební předpisy 2022 s aktualizovaným odůvodněním."

[173]   Farrell, "UX Research Cheat Sheet."

[174]   Nunnally and Farkas, UX Research.

The session is divided into five sections and takes approximately 75 minutes to complete: Preparation, Collaging about the site, VR explanation and first experience, VR interventions testing, and Wrap-up and feedback. The following paragraphs describe each section in more detail and place them within the overall aim of the session.

Preparation (<15 minutes)

In the first stage of the session, participants are welcomed and informed about the session's structure and safety concerns, allowing them to provide informed consent. While one researcher handles this information session, the other finalizes notes from the previous session and resets all technical and virtual features.

The success of every participatory session relies heavily on the physical and mental comfort of the participants. Only a relaxed, open, and genuine conversation can yield valuable insights. If participants feel uncomfortable or tired, their responses may be reduced to short "yes/no" answers or "I'm not sure," lacking important context. One of the researchers' key tasks is to create a safe and comfortable environment for the participant. The preparation stage is crucial for establishing this relationship. [175]

Additionally, VR has unique aspects that participants need to be aware of. The VR experience is highly immersive, making the mind feel as if we are truly moving in space. However , this perception does not align with the body, which is moving very little or not at all. This disconnect can cause motion sickness, similar to car sickness, as well as headaches or eye strain. Therefore, it is important to regularly check in with participants and take frequent breaks to prevent undesired complications from interrupting or even canceling the session. [176] To address this, the session limits VR usage to no more than 10 minutes at a time, with breaks filled with other activities relevant to the research. This approach helps participants stay comfortable without losing valuable session time.

Participants need to be informed by these potential complications before signing the consent.

Collaging about the site (10–15 minutes)

As part of the strategy to make a participant more comfortable as well as able to explain their feelings and emotions of their experience, collaging exercise is implemented at the beginning of the session. [177] In this exercise, participants are confronted with mood-oriented pictures from 3 categories: Spatial typologies of the site (Jižní Město), Social interactions and emotions, and Environments.

Typologies of Jižní Město   Social interactions and emotions   Environments

The selection of typological pictures corresponds to the most problematic typologies in the district previously identified through the neural network analysis: facades, plinth relations, and greenland. Participants are asked to choose any of these typological pictures and describe the emotions or stories that intuitively come to mind when they look at them. To aid in their descriptions, they may use pictures from two other categories: social interactions and emotions, and environments. By associating pictures with their feelings, participants can more easily and playfully express themselves. The collaging activity helps to:

1. Open up the participant and make them comfortable

2. Help the participant find a way to express and describe their emotions

3. Familiarize the participant with the site and issues to be discussed in later phases of the session

4. Prompt interesting, unscripted stories and insights out of the participant's previous experiences

5. Strengthen the trust between the participant and the researcher

To provide enough options for expression, the selection of pictures for social interactions and emotions should cover a wide range, from anger, depression,

175   Nunnally and Farkas.
176   Jones and Osborne, Virtual Reality Methods.
177   Nunnally and Farkas, UX Research.

and frustration to neutral calmness, genuine happiness, joy, confidence, and excitement. Similarly, the environments should range from those with negative connotations, like prisons and highways, to positive settings, like lush forests and lively bars.

While the main purpose of collaging is to establish a comfortable interaction between the participant and the researcher in an unscripted conversation, the researcher may gently guide the participant toward certain topics of interest. This needs to be done carefully to avoid leading the participant to conclusions that are not genuinely theirs. Leading questions are considered as a major threat in UX Research, as they can project the researcher's bias into the results. Effective questioning requires concentration and experience to minimize these effects, though it is never fully avoidable. For instance, instead of asking, "How do you like this facade?" we should use neutral language like, "How do you feel about the facade of this building?" Even better, if the picture focuses specifically on an element, we may skip mentioning it altogether and ask about the participant's general feelings.

Participants tend to want to satisfy the researcher, so if they sense the researcher has a preference, they may skew their answers to align with it, even if it is not truthful to their own feelings. [178]

this feeling for me so this really like reminded me of like being really enclosed there's also

so frustration from the enclosure yeah frustration from the enclosure for example this part yep yep

"This one for me is very just functional (...) you have a car parking you have a sidewalk and a strip of greenery but you won't really use this space other than for commuting."

Participant #2

VR explanation, first experience (5 minutes)

Following the collaging activity, the session transitions to testing in VR. Operating VR has a learning curve due to the use of controllers and the unnatural experience of wearing a headset, as well as the disconnection between physical movement and the visual experience. In a short five-minute timeframe, participants are given instructions and space to familiarize themselves with the headset while exploring the base setup. This base setup represents the previously defined original testing site, inspired by a real urban block in Jižní Město. This approach ensures that the session time is used efficiently, allowing participants to adjust to the VR experience while 'calibrating' their real physical experience in Jižní Město with the virtual representation.

178 Nunnally and Farkas.

You will point to a certain area and then you will press the button to teleport there.

This VR dry-run is also important for calming the initial excitement that people often experience when entering VR for the first time. These emotions usually lean towards highly positive excitement, which could skew the data if applied directly to the tested design scenarios.[179]
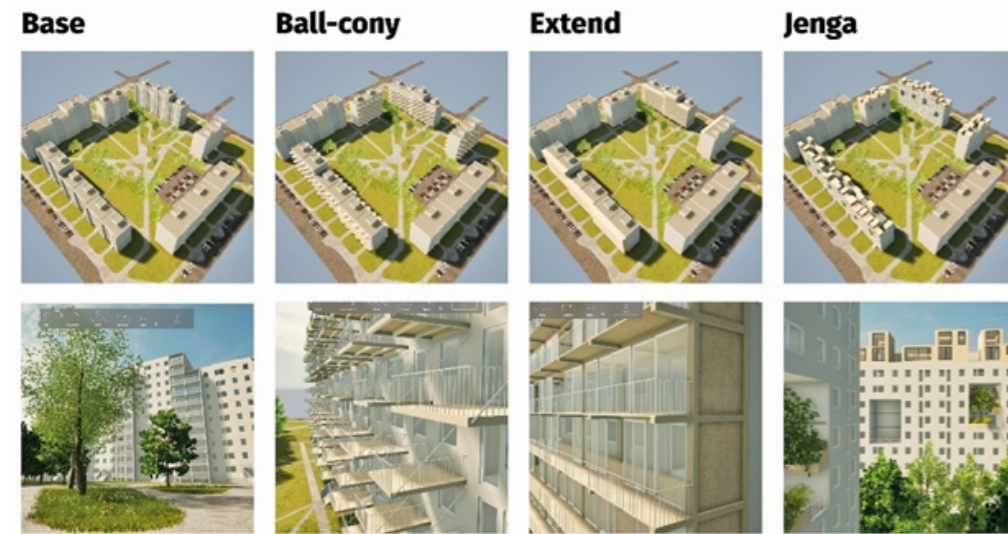

Right now, I will put you in the first base environment, come in right now.

Wow.

Oh my God.

VR prototype testing (40 minutes, 20 minutes per block)

The previous phase also provides an opportunity to explain the procedures for the current phase—VR prototype or interventions testing—in greater detail. In this phase, users experience various design prototypes that address the established problematic typologies of the site and then rank them according to their preferences. This strategy is inspired by the A/B testing UX research methodology described earlier. However, in this case, up to four design options are compared instead of just two. Limiting the number to four ensures that participants can remember and evaluate each option without difficulty.[180]

The prototypes are organized into blocks based on typology, with each participant testing two blocks per session.

The first block addresses Facades and includes three prototypes with the following names: Ball-cony, Extend, and Jenga.

179 Jones and Osborne, Virtual Reality Methods.

180 Nunnally and Farkas, UX Research.

Base   Ball-cony   Extend   Jenga

The second block addresses plinth relations and includes two prototypes with the following names: Open-up, and Gardening.

Base   Open-up   Gardening
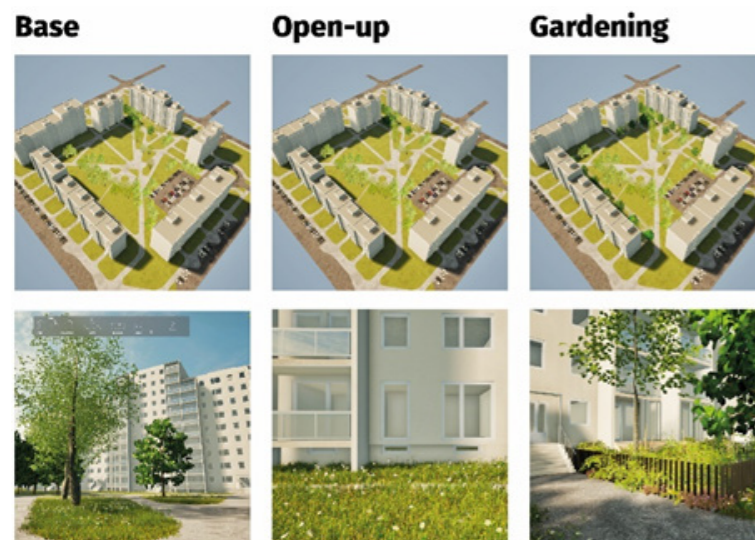
The third block addresses greenland and includes three prototypes with the following names: Garden nation, Urban orchard, and Jungle.

Base   Garden nation   Urban orchard   Jungle

Each prototype addresses the problematic typology with a distinct strategy, ensuring that each option is significantly different from the others. This differentiation makes it easier for participants to distinguish between the options and reach clear conclusions.

Each test block has a following time structure:

0–2	2–4	4–10	10–17	17–20 min
First impresion VR walk-through	**First impresion rating**	**Informed VR walkthrough**	**Informed rating**	**Post-edit rating**
Quick exploration of the prototype environment between 15–45 s without any explanation provided by the researcher	Without any comments, participant organizes all prototypes including the base environment in the order of their preference	All prototypes are explored again with unified explanation provided by the researcher; 1,5–2 minutes/prototype; participant may ask additional questions	Participant looks at the first rating again and re-rate the prototypes based on the knowledge gained; researcher questions the reasonings behind decisions and changes made	Participant may propose edits or mixing of prototypes and re-rates them again with the changes applied

There are always three rounds of rating and two rounds of VR exploration in between. The ratings differ in the amount of information given to the participant as well as the freedom to propose edits or combinations.

1. First impression VR walk-through: Participants view and explore each prototype for 15–30 seconds with no explanation provided. This simulates a real scenario of someone passing by the site without prior knowledge, forming strong initial opinions about its qualities. As noted earlier, we often make quick judgments in the first seconds of the confrontation, and if these first impressions do not catch our attention, we may lose interest entirely regardless of potential values.

2. First impression rating: After the initial walk-through, participants leave the VR space, take cards with representative renders of each prototype, and arrange them in order of preference based on their user experience. This step is conducted without any involvement or questions from the researcher.

3. Informed VR walk-through: Following the first rating session, participants re-enter VR and explore the prototypes again in the same order. This time, they spend 1,5–2 minutes per prototype while the researcher provides descriptions of the concept, intentions, advantages, and disadvantages. Participants are allowed to ask questions to better understand the interventions.

4. Informed rating: With this new information, participants exit VR and are encouraged to revisit their previous ratings for re-evaluation. They may choose to keep the same order, but often the additional details about functionality prompt reconsideration. If changes are made, the researcher seeks an explanation for the new preferences. For example, participants might initially dislike the aesthetics, but the functionality overruns this fact, offering valuable insights for designers to improve the beauty aspect of the prototype while maintaining functionality or to emphasize functional features in its future marketing.

5. Post-edit rating: In the final part, participants propose their own edits and ideas for the prototypes or suggest combining elements from different prototypes. After making these edits, they rank the prototypes again to see if the changes significantly impact their preferences.

The alternation between VR and rating without the headset allows participants to rest, reducing the probability of motion sickness or headaches while maintaining session efficiency. To prevent data from being influenced by the order of prototype presentation, the sequence is varied for each participant.

For the pilot testing with five participants, only Facade and greenland prototypes were investigated with the following results:
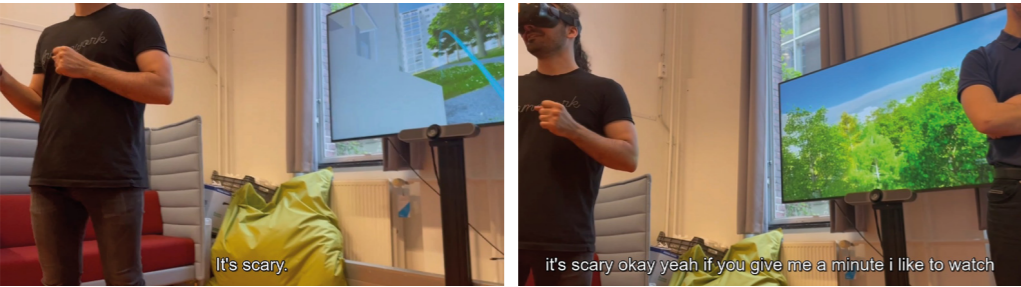
FACADE	Order #/Score	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Prototype	Score
Order of showcase	1	Base	Base	Base	Base	Base		
	2	Ball-cony	Ball-cony	Ball-cony	Extend	Jenga		
	3	Extend	Extend	Extend	Jenga	Extend		
	4	Jenga	Jenga	Jenga	Ball-cony	Ball-cony		
Rating - First impression	1	Extend	Base	Base	Extend	Ball-cony	Base	8
	2	Base	Ball-cony	Extend	Base	Base	Ball-cony	12
	3	Ball-cony	Jenga	Ball-cony	Ball-cony	Jenga	Extend	12
	4	Jenga	Extend	Jenga	Jenga	Extend	Jenga	18
Rating - Informed impression	1	Base	Base	Base	Ball-cony	Ball-cony	Base	7
	2	Ball-cony	Ball-cony	Ball-cony	Base	Base	Ball-cony	8
	3	Extend	Extend	Extend	Extend	Jenga	Extend	16
	4	Jenga	Jenga	Jenga	Jenga	Extend	Jenga	19
Rating - Personal edits	1	Missing data	Base	Base	Ball-cony	Ball-cony	Base	6
	2		Ball-cony	Ball-cony	Base	Base	Ball-cony	6
	3		Jenga	Extend	Extend	Jenga	Extend	14
	4		Extend	Jenga	Jenga	Extend	Jenga	14
TOTAL							Base	21

FACADE	Order #/Score	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Prototype	Score
							Ball-cony	26
							Extend	42
							Jenga	51

GREEN-LAND	Order #/Score	Participant 1	Participant 2	Participant 3	Participant 4	Participant 5	Prototype	Score
Order of showcase	1	Base	Base	Base	Base	Base		
	2	Garden Nation	Garden Nation	Garden Nation	Urban Orchard	Garden Nation		
	3	Urban Orchard	Urban orchard	Urban Orchard	Jungle	Jungle		
	4	Jungle	Jungle	Jungle	Garden Nation	Urban Orchard		
Rating - First impression	1	Urban Orchard	Base	Base	Urban Orchard	Base	Base	10
	2	Jungle	Urban orchard	Urban orchard	Garden Nation	Garden Nation	Garden Nation	14
	3	Base	Garden Nation	Garden Nation	Jungle	Urban Orchard	Urban Orchard	9
	4	Garden Nation	Jungle	Jungle	Base	Jungle	Jungle	17
Rating - Informed impression	1	Urban orchard	Base	Base	Garden Nation	Base	Base	7
	2	Base	Urban orchard	Garden Nation	Base	Urban Orchard	Garden Nation	12
	3	Garden Nation	Garden Nation	Urban Orchard	Urban Orchard	Garden Nation	Urban Orchard	11
	4	Jungle	Jungle	Jungle	Jungle	Jungle	Jungle	20
Rating - Personal edits	1		Base	Base	Garden Nation	Base	Base	5
	2		Urban orchard	Garden Nation	Base	Urban Orchard	Garden Nation	9
	3		Garden Nation	Urban Orchard	Urban Orchard	Garden Nation	Urban Orchard	10
	4		Jungle	Jungle	Jungle	Jungle	Jungle	16
TOTAL							Base	22
							Garden Nation	35
							Urban Orchard	30
							Jungle	53

The score for each round of rating was calculated by summing the values from each participant. A higher score indicated a better perception by the participants. The total sum of all individual rating rounds provided the final results. All ratings were accompanied by comments that provided deeper insights and context regarding the motivations behind the choices made. For example, a typical comment in the Facade block was to combine the Jenga prototype providing communal gathering spaces within the individual buildings with entirely private Ball-conies or winter gardens of the Extend prototype.

Some prototypes had consistent results across all participants, such as the Jenga, which scored 3 or 4 in all rounds. Others evoked very contradictory emotions. A notable example of this was the Jungle, which proposed creating denser forestry between residential blocks as a low-maintenance yet desirable solution for the undefined green spaces in the area.

This is the third one.

Oh shit.

Oh, shit.

On shit.

It's scary

it's scary okay yeah if you give me a minute i like to watch

And last one!

I like this.

These data come only from a pilot study and are therefore not scientifically reliable, as they lack a proper demographic sampling of participants, a consistent session structure (as it had only been tested), and a sufficient number of participants to achieve statistically significant results. Nonetheless, the method is in place, and with the correct group of local participants and data collected from them, designers, developers, and municipalities could make better-informed architectural decisions.

It is essential to include the original situation in all ratings to provide a basis for performance measurement and comparison. For instance, if the KPI 'UX Score Threshold' is set to target a value of 150% of the original state, it's immediately visible that the Ball-cony and Urban Orchard prototypes fall below this threshold and are therefore not suitable for the final design. Conversely, the other solutions score higher, and with the possibility of combining or editing them, this score could increase even further. Thus, these prototypes should be revisited and refined into a new set of more focused prototypes for the next round of testing. This process of 'rapid prototyping' gradually increases the design's precision, leading to a high-performing solution.

A question may arise: when is it reasonable to stop such prototyping, considering its time-consuming and costly nature? The answer lies again in the score values.

Nation	Orchard		Testing reasonable until options reach a score **equilibrium**
Jungle	Jungle	16	
	Base	22	35
	Garden Nation	35	35
	Urban Orchard	30	35
	Jungle	53	35

When the values start to show little to no difference, practically reaching equilibrium, it indicates that no solution particularly stands out and they are all equally (un)desirable. It is then up to each researcher and company to decide how deep and precise they want their analysis to be.

Wrap-up, feedback (5-10 minutes)
At the end of the session, participants are given the opportunity to share any

ideas and reflections that may not have been discussed during the session. This includes feedback on the overall experience, the session structure, and the researchers' approach. This feedback is important for improving future sessions and establishing a good connection with participants for potential future collaboration.

As previously mentioned, avoiding leading questions is a crucial skill. The end feedback from the pilot session revealed, without my direct intention, that participants felt very comfortable and free to express their own thoughts without being guided to specific conclusions:

"I really value being able to speak my mind [...] letting me basically do that and then you give your own thoughts on it. [...] it was quite nice as to why you probed certain points, like, oh, you value these functionalities. That was quite nice. It felt very reciprocal.

[...] So, it's nice that you focus on certain features, but you didn't necessarily add or you didn't try to change my view on things. If anything, you were just trying to complement the points I had."

Participant #4

Leading designs development

The data acquired from the VR sessions serve as the foundation for a final design for the site. By identifying the highest-performing prototypes and incorporating user suggestions for further enhancements or combinations, the end result can be delivered with significantly greater accuracy and confidence compared to standard practices that lack UX research and participatory sessions.

This approach was also used when delivering the final design of this thesis. Even though it was still only a pilot, the conversations and data provided by participants showed me directions that are likely to be more successful in the end.

At this stage, various stakeholders can be brought together to discuss the conditions necessary to implement the different prototypes, including financial and material cost estimates. When all the input are brought together a feasibility study can be developed.

Feasibility study

Thanks to the quantitative comparison of different design options, clients gain a valuable asset for precise and easier economic strategies and feasibility studies. Along with construction cost estimates, they can decide which solution is the most cost-effective for their specific target group. While the percentage score difference may not directly translate into price valuation, it aids in better overall pricing of the product.

Including recent competitor developments in the VR testing, where prices are known, could provide even greater help by setting a benchmark. If the proposed designs surpass the competition, this can also become an input for marketing strategies.

Test and place

Before this final stage of conceptual design development, preliminary conclusions were drawn based on prototype testing and user evaluations. A pre-final proposal, or "beta" version, can be created by combining the acquired knowledge, including the most desirable design principles. This beta undergoes long-term testing, during which potential flaws are addressed. Meanwhile, the documentation for building placement is sent to the municipality. A final check and troubleshooting of user and stakeholder needs are conducted, leading to the final proposal for the next building phase.

Beta-version testing in VR

Software development has one significant advantage over building construction—it is fully virtual. This allows its product to be instantly transportable across the globe or at least wherever internet connection and users are. For UX research, this condition is highly valuable. While moderated product validation (where the researcher and users actively interact) leads to more insight from a single session comparable to unmoderated, the virtual access provides an option to test with significantly more users with less resources and time needed. There are various possibilities online to measure UX performance including third party platforms such as usertesting.com.[181] What might be the most interesting, however, is the possibility to release a beta version of the actual company's product and collect information about users' interaction with it over a longer timespan.

For larger construction development, this is practically impossible. The image that you could have users strolling around your unbuilt project for days or weeks, measuring where they go, what tasks do they perform and collect their opinions sounds more like a fantasy. The image that you could have a "beta" building sounds like a fantasy. However, a fantasy that is closer to reality than we may think.

When the tech giant Apple announced the release of their newest product 'Vision Pro' in June 2023, it promised to bring revolution to the way we interact not only with technologies but the world itself. Under the newly coined term 'spatial computing', Apple promised a fluent integration of a virtual and real environment creating a new environmental experience for itself.[182,183]

Critically speaking, this vision is probably still far from its complete potential. Even though the product brings undeniable advancements to its competitors, the still 'bulky' physical appearance is too strong of a border for human-like interactions.[184,185] Despite this fact, the headset became immediately viral and early-adopters community is growing while testing the product ambitiously in all kinds of environments from car to gym, or on a casual return home in subway.[186]

In the scenario where a future version of such headset would truly become an everyday wearable, the possibilities for UX Research in the built environment would expand enormously. Imagine that you're walking on a street in your neighborhood where a new (re-)development is planned and a notification in your augmented reality headset pops-up: "Would you like to experience the potential future of this area"? You decide to spare a minute and confirm the survey, and in a second, the scene changes into a newly proposed design. You

[181]   Nunnally and Farkas.

[182]   "Introducing Apple Vision Pro."

[183]   "Apple Vision Pro."

[184]   Knibbs, "Apple's Vision Pro Isn't the Future."

[185]   Sorrel, "Is Vision Pro the Future of Computing, or a Dystopian Mind Prison?"

[186]   Stanley, "Apple Vision Pro — New Viral Trend Is Catching People Wearing Apple's Headset Exactly Where They Shouldn't | Tom's Guide."

can immediately comment on anything you like, point a finger to the beautiful green terrace or critically refer to the overhang blocking a view to your favorite park.

With this advancement, architects, developers and municipalities can release their beta versions and reach levels of inclusivity and accuracy like never before. For several weeks or even months, they could collect information about the users' satisfaction (including comments on social media) helping to change possible flaws of the design before the largest building investment is made.

Figure 20: In a world where VR/AR headset would become an everyday wearable like suggests Apple with its product 'Vision Pro', how much more could we learn about users and their interaction with the built environment? [187]

[*Apple*, Using Apple's Vision Pro Mixed Reality Headset to Take Meetings While Working from Home.]

KPIs fulfillment check
The data collected from the beta testing should be reassessed to ensure it meets the KPIs defined in earlier stages. If these goals are not met, new beta versions should be released until the goals are achieved.

Documentation for building's placement
Municipal approval can take a long time, so it is efficient to use the waiting period for other project tasks. Since the beta version is unlikely to require fundamental design changes, even if beta testing reveals flaws to be addressed, the documentation for this version can be sent before the testing to save time and resources.

Check with all stakeholders
Along with beta testing and the municipality's assessment, it is advisable to consult all other possible stakeholders to double-check their requirements before proceeding. Reaching a general agreement at this stage is crucial to maintain the integrity of the user-targeted design in the subsequent phases and to reduce the need for potentially expensive revisions later on.

Troubleshooting
Addressing the flaws before construction phase can largely pay-off in a long

run. For illustration, the previously described project calculator by the Czech Chamber of Architects standardly uses 71% of project documentation resources for the construction part and the entire project's documentation is standardly only around 10% of the entire building construction according to some estimates. [188,189]

Build and check
At this stage the design should be fully adjusted to fit users' needs and is ready to be developed technically in depth for construction. Technical difficulties may arise during the process which may lead in the worst scenario to necessary adjustments on the program or form composition and functionality, esthetics, or other aspects of UX. If these adjustments become significant, it may be important to revalidate, check the design with users to see if their needs are still going to be met.

Project for building's approval
The stage follows standard procedures and other expertise management. As this is the first time all technical concepts and details are presented to stakeholders and specialists, significant changes to the overall structure may appear due to e.g. fire safety, structural integrity, thermal comfort, technical infrastructure connectivity, and more. Validation with users may be needed if the changes interfere too much with UX.

Project for building's construction
At this moment, all details are known and with a proficient level of supervision, UX qualities should stay untouched.

Construction
In this stage, author's (researcher's, designer's) supervision is a key as during construction many aspects may be misinterpreted by individual contractors and builders. Leaving enough resources for that is advisable.

Listen and reflect
UX Research throughout the design development is a key part of the process in order to make the building, the product, a correct fit for the user. The time to develop the product is, however, always limited and anticipating especially long-term usage characteristics, or even new trends can be challenging. Therefore, collecting regular feedback from users after the construction's completion is important to realize unresolved issues or potentials or discover fully new ones. [190,191]

This process is covered in the field by Post-Occupancy Evaluation which is, however, significantly underused in practice as argued earlier. An urge for increasing its implementation is present even from authorities like RIBA (Royal Institute of British Architects) calling it "an essential tool to improve built environment." [192] In their 2020 report, they reveal that allocating just 0,1-0,25 % of a project's budget to POE can significantly enhance both the building's energy performance and user satisfaction. [193]

187   "Introducing Apple Vision Pro."

188   "Pozemní a krajinářské stavby."
189   Horalík, "Projektová dokumentace na rodinný dům."
190   Nunnally and Farkas, UX Research.
191   Farrell, "UX Research Cheat Sheet."
192   RIBA, "Post Occupancy Evaluation: An Essential Tool to Improve the Built Environment."
193   McDonald, "Post Occupancy Evaluation – an Essential Tool to Improve the Built Environment."

Quantitative review

For this stage of UX Research, quantitative methods would typically dominate, as they could effectively and almost passively gather data over a longer period of time. From standard traffic analytics (number of visits, time on the website, bounce rate…) described in the previous chapter 'Key performance indicators (KPI) and building program', websites also typically do search-log analysis. [194,195] This provides data about the internal search engine, and what are users looking for/expecting to find on the website. What path leads them to their goal, how direct is it, fast and therefore efficient. [196]

It's worth to mention that such analysis is so successful and only possible due to the standard approach of users towards privacy on the internet. Despite the fact that concerns about internet privacy are rising on significance, in 2022 study about 43% of Americans still accept all cookies, and 33% are knowingly comfortable with sharing these personal information as an exchange for a discount on the website. [197] It is a question whether such level of surveillance would be comfortable to users also in the physical world, and whether that is even ethically acceptable. Solely for research purposes, however, using existing wearables such as smartphones or smartwatch and possibly 'smartglasses' in the future could provide a lot of valuable insights into the daily operation of users within buildings. With a clear setup for the user's consent, companies should explore this opportunity to enhance the quality of their architectural developments.

Other typical method is usability bug review determining the unexpected flaws happening with the product. [198] With the advent of building sensors ranging from thermal, humidity to CO_2 levels, and increase interest in allowing users an effortless way to report, companies could gather a lot more feedback with little to no additional work.

Qualitative review

Long-term measured quantitative data about the product/building can effectively reveal the existence of an issue or an emerging trend but interpreting it might require a deeper dive into users' motivations. When an issue or trend begins to recur regularly or increases in severity, an additional qualitative survey with a sample of users can help researchers better understand the nature of the observed quantitative phenomena. [199,200]

Reflection

With all the data gathered, architectural offices may reflect on designs' performance, suggest enhancements on the existing developments or bring new ideas for upcoming ones. This approach does not only make better experience for users, but can also provide advantages against competitors, positively strengthened business relationships, and therefore potentially increase the amount of commissions.

Forward to the user – final reflection

At the beginning of this thesis, I started with a great curiosity in understanding the core principles of the architectural design process and identifying the roots of its often-unreliable results. Throughout my research, I uncovered various issues, starting with the disconnection between architects and users, the complexities of architectural prototyping, and the limitations of testing methods. Specifically in Jižní Město, this proved to be especially problematic in the current era where the new needs and desires of users are hard for stakeholders to determine and target.

In the following lines, I reflect on the research questions and to what extent was the goal of reconnecting with the user achieved.

Localizing the problem

While exploring when and where Jižní Město became undesirable, I uncovered a complex historical context of the previous communist regime, which predetermined the perception of the entire development. Despite this negative connotation, desirable qualities do exist in the district. Via the neural network analysis, I revealed some of the most problematic typologies that should be addressed while building on the development's potential. This is particularly important for attracting young (higher) middle-class people in their productive years, , the underrepressented demographic group, who expect different elements from modern architecture—variability of meeting places, variability of work places close to home, communal while private character, prestigious look.

Understanding the problem

Initially, the most important user demand was simply having a place to live, and in that sense, the historical strategy succeeded bringing a large amount of housing in a very short period. However, as the time passed, users demanded more qualities, which have further evolved over the decades. The research showed a fundamental lack of sociological understanding and research that could help determine these desires more accurately and thus better target potential redevelopments. This lack of sociological and UX research approach showed to be present till today among architects concerned about the area. Their design conclusions, therefore, seem to not yet target users' needs well enough consdiering the total potential.

Targeting the problem

Reflecting on the lack of a sociological approach in design development, I intensively focused on analyzing users through their own perceptions as well as insights from various specialists. Based on this knowledge, I continued and deepened the search for individual needs via neural network analysis, identifying the least satisfied demands. The research further revealed that the architectural method lacked principles from UX research, which became a major source of inspiration for my study.

In the end, I proposed an entirely new methodology that, although tested only as a pilot, showed great potential in delivering evidence-based conclusions to better target specific user needs in Jižní Město. While the final data are not yet sufficient to fully answer the research questions, this study sets a clear foundation for future research, to test the methodology in practice and bring final results—to move yet more forward, forward to the user.

196   Farrell, "Search-Log Analysis."
197   Hein, "43% of Americans Still Accept All Cookies despite Growing Privacy Concerns, per New Study."
198   Farrell, "UX Research Cheat Sheet."
199   Nunnally and Farkas, UX Research.
200   Farrell, "UX Research Cheat Sheet."

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UX Research

Nunnally, Brad, and David K. Farkas. UX Research: Practical Techniques for Designing Better Products. 1st ed. Beijing Boston Farnham Sebastopol Tokyo: O'Reilly, 2017.

One key responsibility of product designers and UX practitioners is to conduct formal and informal research to clarify design decisions and business needs. But there's often mystery around product research, with the feeling that you need to be a research Zen master to gather anything useful. Fact is, anyone can conduct product research. With this quick reference guide, you'll learn a common language and set of tools to help you carry out research in an informed and productive manner.

This book contains four sections, including a brief introduction to UX research, planning and preparation, facilitating research, and analysis and reporting. Each chapter includes a short exercise so you can quickly apply what you've learned.

- Learn what it takes to ask good research questions.
- Know when to use quantitative and qualitative research methods.
- Explore the logistics and details of coordinating a research session.
- Use softer skills to make research seem natural to participants.
- Learn tools and approaches to uncover meaning in your raw data.
- Communicate your findings with a framework and structure.

Soares, Marcelo M., Francisco Rebelo, and Tareq Z. Ahram, eds. Handbook of Usability and User-Experience: Methods and Techniques. Accessed January 22, 2024. https://www.routledge.com/Handbook-of-Usability-and-User-Experience-Methods-and-Techniques/Soares-Rebelo-Ahram/p/book/9780367357702.

Handbook of Usability and User Experience: Methods and Techniques is concerned with emerging usability and user experience in design concepts, theories and applications of human factors knowledge focusing on the discovery, design and understanding of human interaction and usability issues with products and systems for their improvement.

This volume presents methods and techniques to design products, systems and environments with good usability, accessibility and user satisfaction. It introduces the concepts of usability and its association with user experience, and discusses methods and models for usability and UX. It also introduces relevant cognitive, cultural, social and experiential individual differences, which are essential for understanding, measuring and utilizing these differences in the study of usability and interaction design. In addition, the book discusses the use of usability assessment to improve healthcare, the relationship between usability and user experience in the built environment, the state-of-the-art review of usability and UX in the digital world, usability and UX in the current context, and emerging technologies.

Architectural research on the perception and use of space

Sim, David, and Jan Gehl. Soft City: Building Density for Everyday Life. Washington ; Covelo ; London: Island Press, 2019.

Imagine waking up to the gentle noises of the city, and moving through your day with complete confidence that you will get where you need to go quickly and efficiently. Soft City is about ease and comfort, where density has a human dimension, adapting to our ever-changing needs, nurturing relationships, and accommodating the pleasures of everyday life. How do we move from the current reality in most cites--separated uses and lengthy commutes in single-occupancy vehicles that drain human, environmental, and community resources--to support a soft city approach? In Soft City David Sim, partner and creative director at Gehl, shows how this is possible, presenting ideas and graphic examples from around the globe. He draws from his vast design experience to make a case for a dense and diverse built environment at a human scale, which he presents through a series of observations of older and newer places, and a range of simple built phenomena, some traditional and some totally new inventions. Sim shows that increasing density is not enough. The soft city must consider the organization and layout of the built environment for more fluid movement and comfort, a diversity of building types, and thoughtful design to ensure a sustainable urban environment and society. Soft City begins with the big ideas of happiness and quality of life, and then shows how they are tied to the way we live. The heart of the book is highly visual and shows the building blocks for neighborhoods: building types and their organization and orientation; how we can get along as we get around a city; and living with the weather. As every citizen deals with the reality of a changing climate, Soft City explores how the built environment can adapt and respond. Soft City offers inspiration, ideas, and guidance for anyone interested in city building. Sim shows how to make any city more efficient, more livable, and better connected to the environment

Healthcare – Evidence-based design

Ulrich, R. S. "View through a Window May Influence Recovery from Surgery." Science (New York, N.Y.) 224, no. 4647 (April 27, 1984): 420–21. https://doi.org/10.1126/science.6143402.

Records on recovery after cholecystectomy of patients in a suburban Pennsylvania hospital between 1972 and 1981 were examined to determine whether assignment to a room with a window view of a natural setting might have restorative influences. Twenty-three surgical patients assigned to rooms with windows looking out on a natural scene had shorter postoperative hospital stays, received fewer negative evaluative comments in nurses' notes, and took fewer potent analgesics than 23 matched patients in similar rooms with windows facing a brick building wall.

A revolutionary study from Roger Ulrich that become a foundation stone for the establishment of so called 'evidence-based design'. This field led to improvement of hospitals all around the world bringing more reliable designs affecting positively health of patients.

Psychology/Sociology

Tawil, Nour, Izabela Maria Sztuka, Kira Pohlmann, Sonja Sudimac, and Simone Kühn. "The Living Space: Psychological Well-Being and Mental Health in Response to Interiors Presented in Virtual Reality." International Journal of Environmental Research and Public Health 18, no. 23 (January 2021): 12510. https://doi.org/10.3390/ijerph182312510.

There has been a recent interest in how architecture affects mental health and psychological well-being, motivated by the fact that we spend the majority of our waking time inside and interacting with built environments. Some studies have investigated the psychological responses to indoor design parameters; for instance, contours, and proposed that curved interiors, when compared to angular ones, were aesthetically preferred and induced higher positive emotions. The present study aimed to systematically examine this hypothesis and further explore the impact of contrasting contours on affect, behavior, and cognition. We exposed 42 participants to four well-matched indoor living rooms under a free-exploration photorealistic virtual reality paradigm. We included style as an explorative second-level variable. Out of the 33 outcome variables measured, and after correcting for false discoveries, only two eventually confirmed differences in the contours analysis, in favor of angular rooms. Analysis of style primarily validated the contrast of our stimulus set, and showed significance in one other dependent variable. Results of additional analysis using the Bayesian framework were in line with those of the frequentist approach. The present results provide evidence against the hypothesis that curvature is preferred, suggesting that the psychological response to contours in a close-to-reality architectural setting could be more complex. This study, therefore, helps to communicate a more complete scientific view on the experience of interior spaces and proposes directions for necessary future research.

The UX of Jižní Město and panel construction housing in the Czech Republic

Kouhout, Michal. Sídliště, jak dál? Prague: České vysoké učení technické v Praze, 2016. https://www.kavkabook.cz/p/sidliste-jak-dal.

Approximately one-third of the population of the Czech Republic lives in housing estates today, and in Prague it is even less than half. So far, we as a society have focused on individual buildings and their construction-technological standard in revitalisation projects and have not paid much attention to finding a long-term strategy for the development of these locations.

What next? What should the long-term vision of these areas look like? How to enter them conceptually and how to start the process of their gradual transformation into an attractive part of the urban fabric? How to limit the risks of future negative development? The publication summarizes the results of the research of the same name and is divided into three parts: the introductory theoretical part is devoted to the analysis of the background of settlement development and a general summary of the possibilities of its further development. The second part presents 18 model studies and 2 pilot projects for the adaptation of specific sites in Czech cities. The last part of the publication is devoted to data summaries and graphical comparisons: it contains the results of analyses of the examined sites of Czech housing estates, comparisons of individual case studies and an overview of the most interesting European examples of housing estate regeneration from the last 25 years.

Lux, Martin, Petr Sunega, and Petr Kubala. "Dráhy bydlení mileniálů." Prague: Sociologický ústav AV ČR, 2021. https://seb.soc.cas.cz/attachments/article/133/TZ_Dr%C3%A1hy%20bydlen%C3%AD%20mileni%C3%A1l%C5%AF.pdf.

The press release presents the first results of a unique questionnaire survey that was conducted during October-December 2020 and focused on the topic of housing from the perspective of young people aged 18-35 in four selected cities in the Czech Republic. The questionnaire survey was conducted as part of the research project "Millennials' Housing Trajectories: the Growing Tension between the Normalization of Ownership Housing and the Deteriorating Affordability of Housing in the Czech Republic" and was co-authored by Martin Lux, Petr Sunega, Petr Kubala and Tomáš Hoření Samec.

VR

Jones, Phil, and Tess Osborne. Virtual Reality Methods: A Guide for Researchers in the Social Sciences and Humanities. Bristol: Policy Press, 2022.

Since the mid-2010s, virtual reality (VR) technology has advanced rapidly. This book explores the many opportunities that VR can offer for humanities and social sciences researchers. The book provides a user-friendly, non-technical methods guide to using ready-made VR content and 360° video as well as creating custom materials. It examines the advantages and disadvantages of different approaches to using VR, providing helpful, real-world examples of how researchers have used the technology. The insights drawn from this analysis will inspire scholars to explore the possibilities of using VR in their own research projects.

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Why this color?

Marrs Green R:0 G:140 B:140
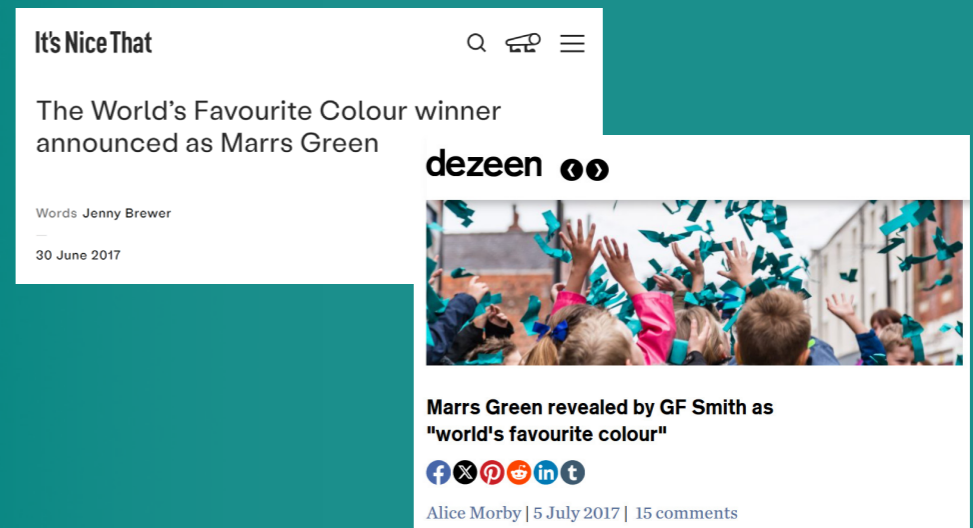
In 2017, a global survey conducted by the paper maker GF Smith suggested 'Marrs Green' to be the 'world's favorite color'. Chosen through an online survey out of 30,000 submissions from more than 100 countries, the color should have "simultaneous warmth and coolness to it, feeling somehow inviting and absorbing," as its author, Annie Marrs, explains.[201,202]

Where Annie Marrs explored colors, I explored architecture with the same effort of finding the most enjoyable human experience. As a symbolic manifestation of this 'collaboration', the Marrs Green color became your guide through the project—like a green light beacon illuminating important phrases, design elements, and notes navigating throughout the journey.

201   Brewer, "The World's Favourite Colour Winner Announced as Marrs Green."
202   Hooton, "A Deep Teal Is the World's Favourite Colour, According to Survey."

Acknowledgements

'Back to the User' addresses a critical issue in contemporary architectural practice: the dissociation from the user. In the software industry, 10% to 40% of a project's budget is allocated to 'User Experience (UX) Research', which focuses on assessing and fulfilling users' needs and experiences throughout the entire design process. This investment not only doubles sales but also nearly triples user satisfaction. Despite its proven value, UX Research is significantly underrepresented in architecture. This paper explores how to better integrate and utilize UX Research in architectural practice, proposing a new methodology.

The methodology closest to UX Research in architecture is 'Post-Occupancy Evaluation' (POE), but only 5% of architectural firms in the EU offer (and even fewer conduct) it during the design phase. Architects may talk closely with clients, but not with users. Additionally, most UX Research involves 1:1 prototype testing with users to ensure that the design meets its intended benefits. In architecture, 'prototyping' usually consists of 2D plans, visualizations, or scaled models, which are often not comprehensible, accurate, or immersive enough. While constructing a full 1:1 prototype is possible, it is not economically, spatially, or sustainably feasible for large projects—or is it?

With the rise of Virtual Reality (VR), we can now test virtually unlimited 1:1 designs, leading to more objective, evidence-based conclusions. This paper explores this approach through participatory qualitative sessions using VR, where multiple design variations are tested and rated by users based on their satisfaction levels. The data collected informs design decisions, resulting in a final proposal to address the challenges of post-Soviet, concrete-prefab panel construction in the 'Jižní Město' district of Prague, Czech Republic. This 'Back to the User' methodology, is in fact a practice's step 'Back to the Future'.

Back to the User

Shaping the user experience of architecture through evidence-based design

Research report

Šimon Knettig | 2023/2024