Architects' Council of Europe
Conseil des Architectes d'Europe

A.I. Architects for Innovative Research

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Midjourney V5.2 image prompt

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Contents

Foreword

Pavel Martinek

Chair of ACE Practice Committee

The ACE is studying digitalisation as part of its practice-based area of interest. In Spring 2021, the Practice Committee, as the Work Group responsible for this task, proposed to take a look at the upcoming AI tools which, at the time, were a more or less theoretical methodology of designing that might have an significant impact on our profession in the near future.

A conference and research were proposed and approved as part of the ACE Creative Europe programme. It seemed crucial to know where to start to guide the discussion if no one had any experience of AI at the time.

Using the ACE network, we invited various experts such as Matias DEL CAMPO, Fillipo LODI, Pascal TERRACOL, Andrew VANDE MOERE, Marjan COLLETTI and Georg VRACHLIOTIS.

ACE “Architects for Innovation” Conference

The conference ‘Architect for innovation’ was held in the framework of the ACE General Assembly in November 2022. The conference was moderated by AI expert Gry HASSELBALCH, who introduced the speakers and animated discussion. We were honoured to get insights from keynote speakers, Julia ANGWIN, award-winning investigative journalist and Daniel BOLOJAN, one of the leading voices in the implementation of deep learning strategies in architecture and the architectural design process.

The conference was divided into thematic areas such as the urban design, sustainability, creativity, practice, ethical and legal issues. The common denominator of the conference’s outcome was a clear message about the power of the AI tool for human use, not only as regards the technical aspects, but also in a certain shift in the creativity paradigm, offering designers the possibility of working with existing patterns. What could be seen as a wake-up call for designers could instead be recognised as an open door to creativity. However, the results also showed that a certain level of ‘standard design’ could soon be replaced by AI. At the time of the conference, AI algorithms did not ‘recognise’ architecture as a goal in itself, but as the expression of ideas through images that need to be translated and transformed into functional models by the designer.

Keynote speakers’ take aways and bios:

Julia ANGWIN

Her presentation focused on the theory of human influence on AI outcomes as a political and ethical issue. The problems associated with the formation of datasets by existing past-dependent data, even if biased by humans, were demonstrated in the context of crime prediction software.

Julia is the founder and Editor-at-Large at The Markup, a nonprofit newsroom that produces meaningful data-centered journalism about technology and the people affected by it.

Daniel BOLOJAN

He provided an in-depth theoretical insight into the creativity of humans and machines based on the expert and learning approach, demonstrating the difference in creativity between machines based on various types of creativity such as combination, discovery and transformation.

Daniel is the founder of Nonstandardstudio, a Senior Architect - Computational Design Specialist at CoopHimmelblau, an Assistant Professor of AI and Computational Design at Florida Atlantic University’s School of Architecture, and a Ph.D. candidate at Die Angewandte Kunst in Vienna. He is a leading voice in the implementation of AI strategies in architecture and the architectural design process.

Thanks to all the speakers of the ACE Conference:

Emmanuel DI GIACOMO, Ingrid PAOLETTI, Jiří VITEK, Matias DEL CAMPO, Fillipo LODI, Josef MUSIL, Pascal TERRACOL, Marjan COLLETTI, Andrew VAN DE MOERE, Georg VRACHLIOTIS, Angela BALDELLOU, Ilektra PAPADAKI.

Discover more about them here.

Watch the conference on the ACE youtube channel.
ACE Study “Architects for Innovation”
https://www.youtube.com/watch?v=e-dh6XZal9c

A.I. Architects for Innovative Research

2023 launched the second part of the AI programme - a call for research. The aim of the research was to initiate a dialogue with various bodies engaged in the field of AI and likely to provide a broader perspective through their own work. Each was asked to propose a project that the ACE would have supported if selected.

In the first call in March 2023, 17 submissions were received. The projects submitted covered a wide range of interests, including creativity, education, dataset development, urban planning and sustainability.

For a better assessment, the ACE also asked for a detailed questionnaire in order to obtain a perspective on the objectives, future use, financial conditions, etc. The jury was composed of the ACE members Diego ZOPPI, Pavel MARTINEK, Peter SØRENSEN, Ursula FAIX and independent member Gry HASSELBALCH. It is important to point out that the introduction of Chat GPT in January 2023 and the rapid arrival of AI graphic generators influenced the jury’s priorities. The focus was on more fundamental research.

The projects were evaluated by reasonability of the study in terms of :

- Discovering new frontiers
- Ablity to meet ACE objectives;
- Originality;
- Applicability in practice.

After two rounds of evaluation and shortlisting, 3 research teams were selected:

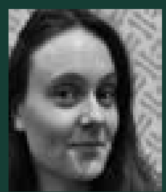
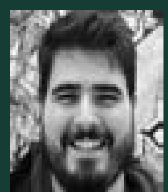
Neural correlates of object and spatial visual cognitive styles. Psychological and electroencephalographic assessment

Linda BUONDONNO and Gaia LEANDRI

The project focuses on basic research into how digital tools influence human creativity. There was a general discussion about the extent to which the project meets the criteria for AI, but the jury concluded that basic research should take priority at a time when the application of AI is booming. The scientific and verified approach to the study of the programme was found to be credible and the objectives to be achieved feasible. The ACE recommends cooperation in the questionnaire research phase in order to use the practical experience of the architectural profession. ACE also raised the issue of the use of the results for software developers.

A participatory planning program for the youth

Urbanist A.I.

The jury evaluates a project focusing on the education of the younger generation in the field of artificial intelligence. The organisation of webinars accessible to a wide audience and the possibility of ACE involvement were considered worthy of support. The implementation of the project within the framework of a university programme also lends credibility.

A.I. Successive Palimpsest Masterplan

Evolutionary Laboratory for Architecture

This project was selected for its complexity and practicality. It proposes the creation of an AI application evaluating the sustainable approach to urban planning. Compared to other submitted projects that also focused on sustainability, the approach to the urban scale of the assessment was considered more effective and the facts were proven by using existing and publicly available environmental data. The audit on the city of Brno would serve as a demonstration of the research. ACE recommends focusing more on creating a tool than giving conclusions on sustainability, as the assessment methodology is still subject to a wider social and scientific debate.

Explore more: on page 60. This was overseen by ACE during 2023 with a final presentation at the ACE General Assembly in November 2023.

As a conclusion to the AI project, Diego ZOPPI, ACE Executive Board Member and Coordinator of the thematic area 'Practice of the profession" shared his insights on digitalisation (page 50) and the ACE Practice Committee published a thesis in which the fundamental characteristics and awareness of our profession are expressed. It shows the impact on the various aspects of the work of architects and will be monitored on an ongoing basis by the ACE.

Acknowledgements for the expertise and the work developed by the Members of the Practice committee:

Fulgencio AVILES INGLES, Matei BOGOESCU, Preben DAHL, Marnik DEHAEN, Larissa DE ROSSO, Konstantin DIMOV, Ursula FAIX, Daniel FÜGENSCHUH, Sandor GERGELY, Cornelia HAMMERSCHLAG, Paula HUOTELIN, Michael GRACE, Benoît GUNSLAY, Martin HRISTOV, Peter HYTTEL SORENSEN, Paul K. JEPPESEN,Kornel KOBAK, Lars Emil KRAGH, Rafal LANGOWSKI, Andrew MCMULLAN , Lena MCNAIR, Emmanuelle MEUNIER,Ian PRITCHARD, Dorte SIBAST, Diego ZOPPI.

Special mention to our dear colleague Eric Wirth, a committed friend and colleague that was a tireless advocate for the profession. He was deeply committed and motivated by a desire to serve the public good.

Thanks to the ACE secretariat for its support and coordination work.

Panorama

01. A.I. as a Creative Design Steroid

Furdui Cosmin

Aim
How can AI empower architects in their design process and ensure that our profession adapts to the technology? The objective is to popularise AI tools among architects and document the interaction. To do this, we need to present the tools, encourage architects to use them, collect data on the interaction, process the data and publish the results.

Concrete outcome
The result will describe the methodology and findings, highlighting the position of architects in relation to AI in 2023.

02. From 2d Ai-Generated Images to the Design of the 3d Model of Architectural Project in Virtual Reality in Neos Vr Metaverse/ Tropical Villa with Pool In Costa Rica

Markéta Gebrian

Aim
Let's explore how AI-generated images can be used as references and sources of inspiration in architecture, and how to create a functional 3D model in the metaverse from an AI-generated 2D image. The objective is to explore the potential of AI-generated images as an architectural design tool and their effectiveness in communicating design concepts to clients.

Concrete outcome
The final case study - a text with AI-generated images, renderings, collages, sketches- will describe the process of designing architecture with the use of AI and VR, and demonstrate its effectiveness for communicating design concepts to clients.

03. Dyna-BIM : The art of building with Artificial Intelligence

Mustapha Adder

Aim
The research aims to explore how to promote the competitiveness of the architectural profession through efficiency and sustainability by anticipating the normative and constructive aspects that can be adapted to new constructions and built heritage through systemic analysis of their life cycle.

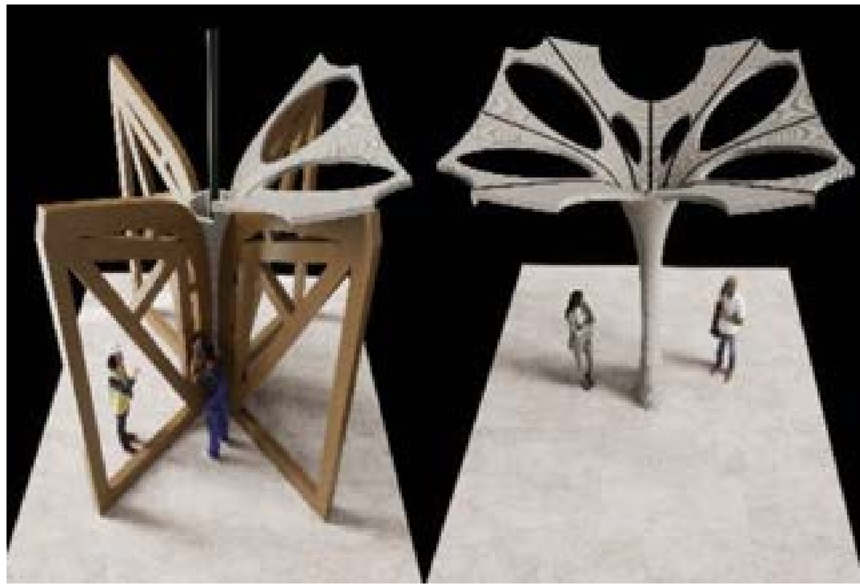
Concrete outcome
The research will address the development of configurable scenarios for the behaviour of buildings and infrastructures and their adaptation to conditions of use and location, in order to facilitate guidance in the revision of construction standards and the choice of materials,anticipate the development of new materials in the context of sustainable development, new professions in the construction sector, and consequently new training courses.

04. A New Architectural Design Process to Educate

Alessandro Angione, Ilaria Cavaliere, Francesco Ciriello, Dario Costantino, Giuseppe Fallacara, Angelo Vito Graziano

Aim
The aim is to test the use of AI during the Architectural Design IV course at Bari Polytechnic. The students will try out an innovative design process that starts with visual suggestions produced by dialogue with an AI; they will then explore the possibility of transformingthe suggestions into real architectural pavilions, modelling their designs in 3D and hypothesising the construction processes. The ultimate aim is to build the best-designed pavilion.

Concrete outcome
The concrete result consists of various architectural projects by students and doctoral students: each project will be presented at a final exhibition using project tables and models and the best project will be built and exhibited in Andria, in the south of Italy.



05. **Computation Past-Forward : The Endless Recurring of the New**

Marco Vanucci

Aim
The project explores the potential of machine learning and artificial intelligence to investigate latent design spaces in global architecture in order to explore new combinatorial possibilities and hybrid typologies. Inspired by the notion of 'simulacra', elaborated by Jean Baudrillard in his book Simulacra et Simulation (1981), the project refers to the monuments, architecture and architectural styles of cities around the world,

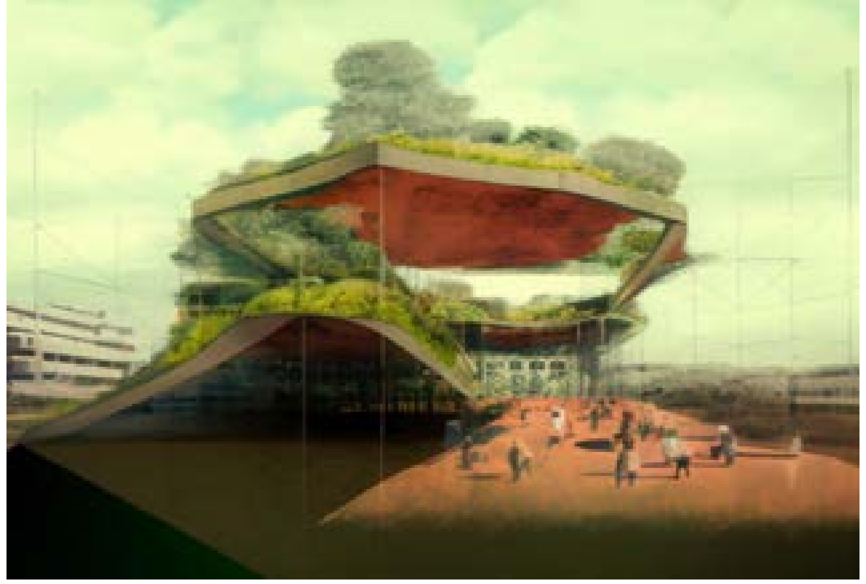
Concrete outcome
The results of the research will be published in a book and will address the use of A.I. for architectural design in practice and in architectural education. In particular, it will look at the possibility of creating new architecture (new typologies, new urban settlements, etc.) by remixing and hybridising the architecture of the past and new educational models.

06. **Artificial Intelligence Research Project of Architecture School of Ecology and Sustainability**

Antónia Stretavská, Diana Kravchenko

Aim
The development of computer technologies and research in the field of artificial intelligence have led to the development of tools for generating images from text. The aim of this study is to test the potential of these tools for creating architecture and to explore the possibilities of customising AI with its own data, libraries and datasets to make more effective use of image incentive programmes in architectural design. The main objective is to create our own libraries to better define the language of architects.

Concrete outcome
Explore the creation of a database, an environment for the practice of architecture.

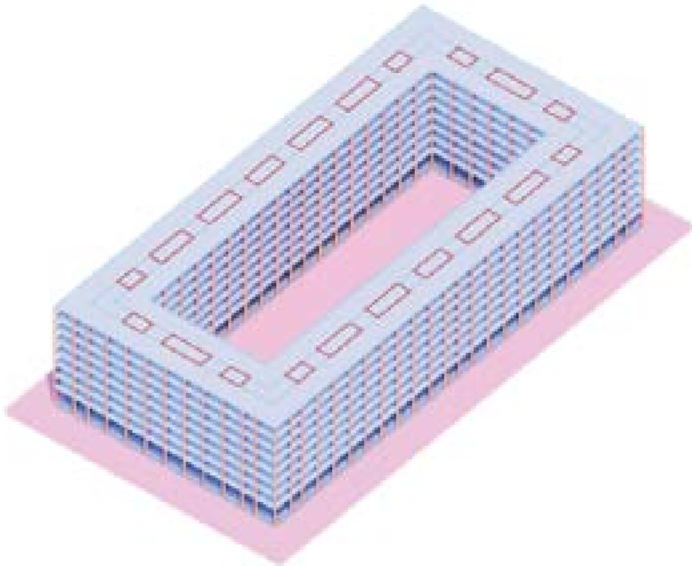


07. **A carbon simulation programme to assist architects in their design at the urban scale**

Cro&Co Architecture (Bigand Roch, Beyoux Felix, Mélanie Uriot, Henri-Luc Julienne)

Aim
The main objective is to identify and quantify the CO2 emissions in the urban context that can be influenced by the implementation of different urban density vectors. The first stage of the research will focus on the issue of transport emissions in correlation with urban density and on the issue of carbon released into the atmosphere as a result of the land artificialisation process. These deltas of CO2 emissions from the urban context will then be combined with different types of buildings to obtain an overall view of the carbon relevance of the various assumptions of transformation of the city.

Concrete outcome
The first step is to determine how to quantify CO2 emissions from the construction and use of urban space as a function of housing density. The second stage consists of defining the parameters of the study for the construction of the model (area considered, street grid, infrastructure, measurement criteria for obtaining the results, type of artificial intelligence we wish to use). The final stages will largely involve implementing the model and analysing the results.



08. **The Weights of Cities within Large-scale Language Image Models**

Daniel Koehler

Aim
This research investigates synthetic building representations using large-scale language image (LLI) models, focusing on synthetic qualities and objective grounds. The study will involve reverse-engineering synthetic images and fine-tuning LLI model for open-source use. By examining stochastic representations of latent spaces, the study aims to determine synthetic features related to specific places and understand the implications of AI-generated artefacts, such as vegetation to promote an environmentally inclusive architecture.

Concrete outcome
The concrete outcome of the research will be a refined understanding of synthetic city representations generated by LLI models, leading to the identification of location-specific synthetic features and innovative building typologies that address contemporary challenges in urban planning and sustainability.

09. **Common House: Semantic Plan Dataset for A.I. Applications in Architecture Design**

Dr. Matias del Campo,Dr. Sandra Manninger, Devishi Suresh (CS), Janpreet Singh (CS)

Aim
This project makes use of the progress in the research on AI and architecture made by the author of the proposal. One of the main obstacles that emerged is the lack of datasets that are made for architecture applications, such as for automated plan generation and plan analysis. This proposal presents itself as an opportunity to tackle a specific dataset: plans with semantic information. In order to teach an AI the specifics of a plan (what is aliving room, what is a sleeping room, what is a kitchen, etc.) - the AI needs to be trained with data that is labelled accordingly. The project team created a streamlined workflow to build a dataset of plans with semantic information and need to create a proof-of-concept plan generator.

Concrete outcome
The first application will serve the purpose to optimise social housing with the development of this proof-of-concept application. For this, the AR2IL laboratory will set up the proof-of-concept project with members of the Computer Science department.

10. **REA - Interconnected and Sustainable Real Estate Development.**

Juan Perez Amaya

Aim
The research project focuses on the integration and development of AI, parametric design and Big Data tools for urban planning, housing development and sustainable construction. The Aim is to integrate AI, parametric design and Big Data tools to create personalised, sustainable and efficient urban environments that respond to specific local conditions. This will help property developers and city councils to develop better-informed personalised projects at a local level.

Concrete outcome
The concrete outcome of the research will be a web platform that assesses land suitability for optimal mixed-use city planning, integrating Big Data tools for urban planning, housing development and sustainable construction.

11. **Towards A.I.ded Design in Architectural Education, leveraging Indexical and Generative Neural Nets**

Agostino Nickl, Adil Bokhari

Aim
Rapid advances in artificial intelligence (AI) are forcing architects to rethink their role in the design process: where do humans add value and where should we let machines do the `work? The research aims to broaden this question by deploying a ‘suggestive search engine’ that retains links to specific objects while using generative models to develop search queries.

Concrete outcome
The research will result in a prototype application that combines LLMs and discrete custom databases that can be part of the toolbox of architecture students and practitioners. A “suggestive search engine” will be used to find the most relevant information, this engine can navigate the big data of personal references, precedents and portfolios while using the generative powe of contemporary artificial intelligence tools.

12. **A New Path for Urban Analysis, Dealing with Open Data Repositories**

Pascal Terracol, Vincent Dubois

Aim
Use of open data and thus open up a new path in the purpose of urban analysis, merging the power of code to data repositories within the scope of Urban Data Mining: UDM.

Concrete outcome
We are going to study the following problem: is the positioning of taxi terminals linked to tourist areas? To answer this, we are going to see datasets, found in the Paris open data, on the location of taxi terminals as well as tourist areas, green and public spaces to conclude if there is a relationship between the positioning of taxi terminals and tourist areas of Paris.

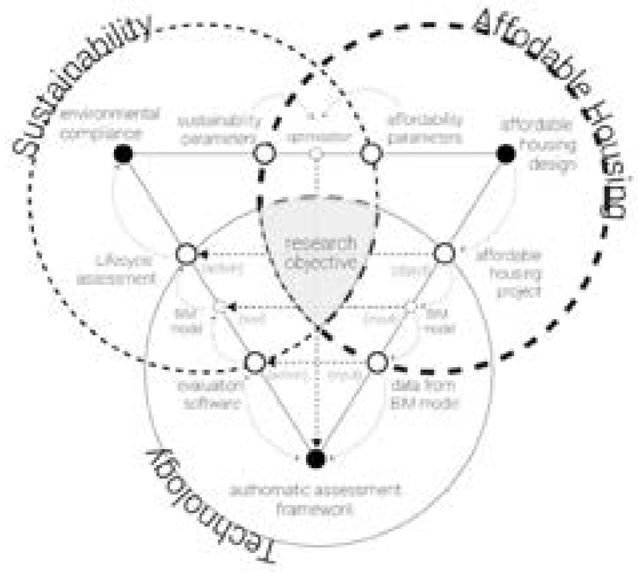
13. **A.I. for Sustainable and Affordable Housing**

Aydan Aghabayli, José Nuno Beirão

Aim
The research addresses establishing a computer-aided workflow for the optimisation of life-cycle assessment in affordable housing design using BIM models and integrated data-driven and machine learning techniques.

Concrete outcome
The expected outcome of the PhD thesis is to provide an automated, open-source prototype life-cycle assessment software with embedded knowledge of optimising housing designs in terms of balancing sustainability and affordability using artificial intelligence techniques.

The concrete outcome of the current phase of the research is to have a coherent, well-structured and organised dataset on affordable and sustainable housing, which will then be trained by artificial intelligence algorithms.



14. **Crystal Palace - ECO|BIO-TECH Nineteenth Century Geometry**

Sandra Ferreira, Cilisia Ornelas

Aim
The aim is to research and validate the LEAD typology as a genesis of 19th century urban models and as a reference for the (re)construction of regenerative cities in the 21st century.

This research project is the hinge between a bachelor thesis (pre-Bologna) and the initial generator of a concept to be developed in a future research.

Concrete outcome
The outcome of the study will be: 1/ digitize (cad 2D/3D) the building designed for the International Port Exposition of 1865 2/describe the technologies used in its materialisation (national and international industry) and validate a LEAD construction approach 3/ understand the geometrical elements in the design of this typology of spaces (19th century parameters).

Linda Buondonno, Ph.D. Student
Ph.D Gaia Leandri, Fellow Researcher

Neural correlates of object and spatial visual cognitive styles. Psychological and electroencephalographic assessment

Linda Buondonno, Ph.D. Student
Ph.D Gaia Leandri, Fellow Researcher

Neural correlates of object and spatial visual cognitive styles. Psychological and electroencephalographic assessment

Academic Context

The research is part of the Ph.D. research developed by Linda Buondonno, tutored by Prof. A. Giachetta, and it's designed together with Arch. Ph.D. Gaia Leandri, Prof. Angelo Schenone, Prof. Massimo Leandri, Prof. Manila Vannucci and Prof. Carlo Chiorri.

The aim of the research is to explore the interaction between mental imagery and digital tools for design. More specifically, we seek insight into the neural correlates of different visual cognitive styles using electroencephalography.

The study we propose represents a multidisciplinary collaboration and follows a neurological methodology validated through the research conducted by Ph.D. Gaia Leandri, Prof. Angelo Schenone and Prof. Massimo Leandri.

We believe this can be a forerunner approach for future research on the design process, that can benefit from both the contributions of psychological research and neurophysiology methodology.

1 Introduction

From a cognitive point of view, designing space is a complex activity that involves multiple skills and processes; a review by Hay et al. (2017) identifies 35 different cognitive processes involved in design activity that can be grouped into 6 categories: long-term memory, semantic processing, visual perception, mental imagery processing, creative output production and other executive functions.

Our study, through a multidisciplinary approach that integrates architecture, psychology and neurophysiology, focuses on the ability to imagine space during the design activity and on its interaction with digital tools of type BIM.

In general, considering the role of tools in the design process is essential because, whatever the process is in progress, from a cognitive point of view, "the human organism is linked with an external entity in a two-way interaction, creating a coupled system that can be seen as a cognitive system in its own right" (Clark & Chalmers, 1998). The extended mind theory elaborated by Clark and Chalmers demonstrates just how what is organically external to our body is not necessarily alien to our cognitive process; for this reason, the authors introduce the notion of "active externality". In this context, overcoming the traditional dualisms mind/body, culture/nature, external/internal, the mind can only be studied through the relationships that emerge between the entities involved in a given process, not localizable a priori. An important book written by the cognitive archaeologist Lambros Malafouris (2013), How Things Shape The Mind, radicalizes the theory of the extended mind and defines the Material Engagement Theory: thought is co-constituted with matter and its possibilities, "we think with and through the matter with which we interact" (Malafouris, 2013, p. 50).

In the design activity, architects, to elaborate and communicate the complex system of relations that constitutes the project, make use of representations, which are managed through different tools.

Representations of space are partial and abstract models of what will be materialized at the end of the construction process and which, according to some aspects, represent the final work. Each model –technical drawing, digital three-dimensional model, plastic model, verbal description, sketch, photorealistic image, structural calculation simulation, etc.– can convey certain types of information related to the project: only through integration and mutual exchange between them is it possible to approach the maximum possible specification of the characteristics of the space in its renewed configuration. Each model is managed by one or more tools, able to store and process information in great quantity and extreme precision.

Today, most of the tools architects rely on are digital. Some tools such as CAD represent a digitized version of the corresponding analog instrument, while other tools, such as BIM or generative design software, incorporate completely new potential, which induces radically different spatial cognition than would occur without them. Precisely this action on design thinking is the field in which this study moves, especially with regard to the effects on imaginative capacity. In a previous experiment (Buondonno et al., 2023), we demonstrated that the use of digital tools (CAD 2D-3D) during a design task has some implications on cognitive and emotional dimensions. Here we extend the research seeking to find correlations between the visual cognitive styles of expert architects and their cerebral activity during a task aimed to simulate a design process that relies on BIM software.

In the following sections, we explain the notion of visual cognitive style and analyze the BIM software from a cognitive perspective.

1.1

Visual cognitive styles and visualization abilities

2 "formats" of information processing

IMAGES

visualizers:
individuals that rely primarily on imagery when attempting to perform cognitive tasks

Visual cognitive style

LANGUAGE

verbalizers:
individuals that rely primarily on verbal-analytical strategies when attempting to perform cognitive tasks

Verbal cognitive style

OBJECT
imagery system

Processes the visual appearance of objects and scenes in terms of their:

- shape
- colour
- texture
- details

Could also refer to imagery of patterns and scenes

SPATIAL
imagery system

Processes object and scenes in terms of spatial attributes such as:

- location
- movement
- distance
- transformations

Could refer to spatial relation between parts of the object and also, it could refer to the object's movement

Mental imagery is the human ability to experience the perception of some object, event, or situation in the absence of the corresponding visual input. In architecture, mental imagery is a fundamental cognitive process that allows the architect to generate new images representing a new form of the space to be transformed. This complex ability is possible thanks to some features of mental imagery such as the inspection, maintenance and transformation (rotations, re-sizing, manipulating,...) of the object represented (Kosslyn, 1999).

Traditionally it was believed that people could process information through the verbal code or through the visual code. More recent research (Kosslyn et al.,2001), thanks to the advances in neurosciences, demonstrated that there are at least two different modalities of processing information visually, corresponding to two distinct pathways in the brain, dorsal and ventral. The ventral pathway process correlates to "object" visual ability: the cognitive capacity to process visual information in terms of shape, color, and texture. The dorsal pathway process corresponds to the "spatial" visualization ability: the cognitive capacity to process information about spatial relations, position of objects in space, and to perform spatial transformations. Although object imagery is related to visual appearances of individual objects, it is not limited to individual objects, but could also refer to imagery of patterns and scenes, characterizing their colour, vividness, shapes or details. Similarly, spatial imagery is not limited to spatial locations or relations between objects in spatial array, but could refer to spatial relation between parts of the object and also, it could refer to the object's movement and to the dynamic spatial transformations of different elements of the object.

While the ability is the cognitive capacity per se of performing a specific task, the same dissociation between object and spatial has been demonstrated in connection with visual cognitive styles. Kozhevnikov (2007) suggests that cognitive styles represent heuristics an individual uses to process information about his or her environment; they are stable in time and develop as the result of long-term external factors. Kozhevnikov et al. (2013) demonstrated how object visualization (ability and style) relates to artistic creativity, and spatial visualization (ability and style) relates to scientific creativity; considering the three types of domain-specific creativity that overcame the unitary creativity construct.

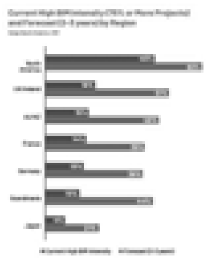
Architects are expected to have strong spatial abilities and actually are required to have

> "understanding of design components in terms of both scientific aspects and artistic aspects"
> (Cho, 2017).

1.2

BIM software: a cognitive perspective

1. Graphics from Dodge Data Analytics' "Accelerating Digital Transformation Through BIM, 2021



2. Graphics from ACE's "The architectural profession in Europe 2020, a sector study".

BIM Building Information Modelling is a methodology for design development in AEC Industry. It allows the creation of virtual 3D models that contain multi-disciplinary data, that can be managed by different stakeholders.

Due to the numerous benefits in terms of time, cost, and manpower, during project construction, BIM has widely been utilized by architects, engineers, individuals, and businesses in the AEC industry not only in every step of the design process, but also in operation, maintenance, and even demolition of the physical products of the process (Rafsanjani & Nabizadeh, 2023). ACE, in The architectural profession in Europe 2020, a sector study, reports that around 30% of architects in Europe already implemented BIM in their practice (Fig. 2) and Autodesk forecasts an increasing trend of BIM users (Fig. 3). This would happen also in response to regulatory requirements that almost everywhere increasingly ask AEC professionals to implement BIM in their practice.

Since BIM constitutes a transformational methodology in the architectural design process, its implications on different levels should be investigated, to reach a balance between the tool's power and the designer's will. There is plenty of literature, mainly in the field of engineering and construction, that demonstrates the advantages of BIM implementation in terms of costs and efficiency, but research so far does not cover BIM use implications on the design process on a cognitive level.

One of the main aspects of the design process that has been transformed by BIM software concerns the interaction between technical agents participating in the process: we can observe a transition from authorship to consensual leadership; the decisional process in the BIM environment is based on negotiations to reach a compromise among the invited parties. While it can induce collaboration, it also favors the inclination toward the less risky solution to allow the process to continue smoothly, resulting in a leveling effect (Carpo, 2017). "The move towards [BIM] integration appears to be leading to oversimplified buildings, lower fees, and shorter design schedules rather than to the quest for the perfect jewel of a project. It is, therefore, necessary to question what this revolution strives to accomplish" (Oppenheimer, 2009).

To allow the design process to really adapt to and take advantage of the possibilities of BIM software, the agents involved in the design should be organized accordingly. This could have a different impact on big corporations and on small firms.

The taxonomic organization of predefined architectural elements to insert in the project is another aspect that could bring, under certain circumstances, a closure of the range of possible solutions to a spatial problem. Looking for the right element to add to the building constitutes a different process compared to thinking of the performances that an element or group of elements should comply with (Raiteri, 2014). "Do not think about the roof, but about rain and snow", suggested Loos (Loos, 1962, p. 272), and the same advice could be applied to all the sub-problems that make up the spatial problem to be addressed. To set as objectives - for example - those of designing a covering or a connection system between floors at different heights, instead of a roof or a staircase, opens up a range of design possibilities probably wider than what would seem available to us if we approached the project directly thinking about organizing predefined building components between them (Giachetta, 2022). Construction elements are categorized and organized into "families" and the building form is developed through a very rigid and diagrammatic series of inputs, determining a process comparable to a sum of predefined parts. It is important that architects maintain a holistic vision of the space they are designing to create space with quality. Making a parallel between the music by Johann Sebastian Bach and architecture, Peter Zumthor (1998) observes: "Its construction seems clear and transparent. It is possible to pursue the details of the melodic, harmonic and rhythmical elements without losing the feeling for the composition as a whole – the whole which makes sense of the details. (...) Construction is the art of making a meaningful whole out of many parts".

To create such complex models BIM software are provided with a demanding interface that "asks" users to give a high quantity of inputs of various kind through drop-down menus, abstract symbols, and hierarchical organization of elements. This structure represents a series of pre-defined sub-problems of the general spatial problem the architect is confronting, resulting in a limiting factor for the architects' creative potentialities.

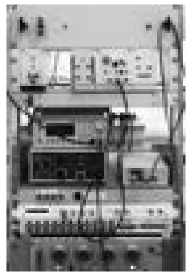
Although relying on a solid interface such as BIM's facilitates the process of building modeling on many levels, for some architects could represent a straining on the consolidated processes or a constraint on students' developing processes and competencies. "Will BIM be the paradigm shift that brings architectural drawings to life by moving seamlessly from concept to integration to fabrication, or will it fall apart in a wave of liability fears and take root as yet another tool to make better documents instead of better projects?" (Oppenheimer, 2009).

1.3 Electroencephalography (eeg)

4.

5.

6.



The electroencephalographic (EEG) recording from the scalp is an innocuous procedure and provides instrumental evidence of the activity of brain cortical areas that are somehow influenced, among other factors, by the cognitive or emotional status of the subject. In order to detect subtle changes of such activity, it is paramount to increase of several orders of magnitude the signal to noise ration of the recording. The most efficient method than can provide immediately understandable results with simple mathematics performed by any computer is the averaging. This is based upon the principle that if we perform a longitudinal operation of mean, those parts of the signal that are time and phase linked to an event will be enhanced, whereas those parts that occur randomly will cancel out. In our case, we propose to explore the EEG activity which is synchronous to the movement of clicking the mouse to select an image on the screen. The average obtained in consequence of such movement is called movement related cortical potential, or MRCP. It is possible, by storing the digitized EEG in a continuous memory loop of appropriate length, to recall the EEG occurring before a definite event (in this case the click). So it is possible to explore the cortical activity that eventually leads to the motor command for clicking. This activity may form up in several parts of the cortex, according to the responsible cognitive process, called praxis. In neuropsychology, praxis is defined as the ability to perform skilled or learned complex movements finalized to a definite aim (Kriegstein & Brust, 2013).

All our actions are performed in response to inner thoughts or to stimuli from the environment; from these early steps, the will of movement is born and the motor plan, core of the praxis, forms up. So, in the recent past, a series of experiments were devised to understand praxis. When asked to perform cognitively demanding tasks, the investigated subjects produced cortical activity approximately 3 seconds before the actual movement. Such activity was localised both in the prefrontal and also in the posteriorly situated parietal area of the brain

Previous page:

4. The Neurological clinic of the San Martino Hospital, Genoa.
5. Testing of the procedure
6. Equipment for the EEG registration

cortex. It could be demonstrated that such activity was specific of complex praxic actions (Bozzacchi et al., 2015; Wheaton et al., 2005). Interestingly, the very early activity which occurred in the prefrontal areas was modulated by an emotional expectancy state. Tackling the subject of the present proposal, we hypothesise that complex cognitive activities like those employed in architectural designing could influence the characteristics of MRCP linked to the movement mouse clicking necessary to operate the selection of images.

We aim to understand if architects with different visual cognitive styles (object or spatial) show differences in their cerebral activity during a task that simulates a design process relying on a BIM software.

2 Aim

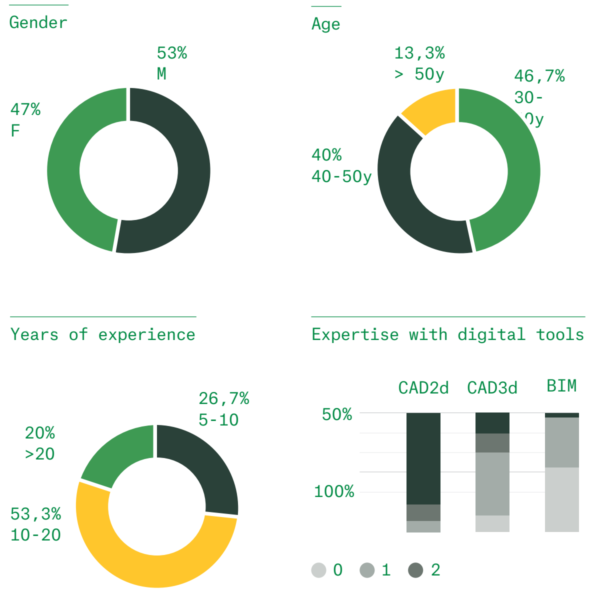
Based upon the general aim described in the previous paragraphs, the purpose of the EEG recordings will be 1) the feasibility of recording MRCPs during a simulated BIM design session 2) to assess the intra- and inter-subject reliability of the procedure, 3) to identify the MRCP parameters influenced by different cognitive or emotional statuses, 4) to quantify possible differences between subject groups or tasks.

3 Methods and Results

3.1 Phase i : psychological pre-assessment

3.1.1 Participants and Procedure

With the aim of recording, in the following Phase II, the cerebral activity of 3 architects corresponding to the profile of "object" visualizer and 3 architects corresponding to the profile of "spatial" visualizer, we pre-assessed 30 expert architects with psychometric instruments. The subjects were 16 males and 14 females, aged 32-64 and with 5-35 years of previous professional experience. They were asked to fill out a data-sheet in which we asked for personal information (age, gender, education) and professional information (years of professional experience, main activities carried out, proficiency in the use of different software) (Fig. 7). In the same session, we tested architects with three different psychometric instruments to assess cognitive styles and visual ability: Object Spatial Imagery Verbal Questionnaire, Vividness of Visual Imagery Questionnaire, Paper Folding Test.



7. Demographic information, years of experience and expertise of the participants.

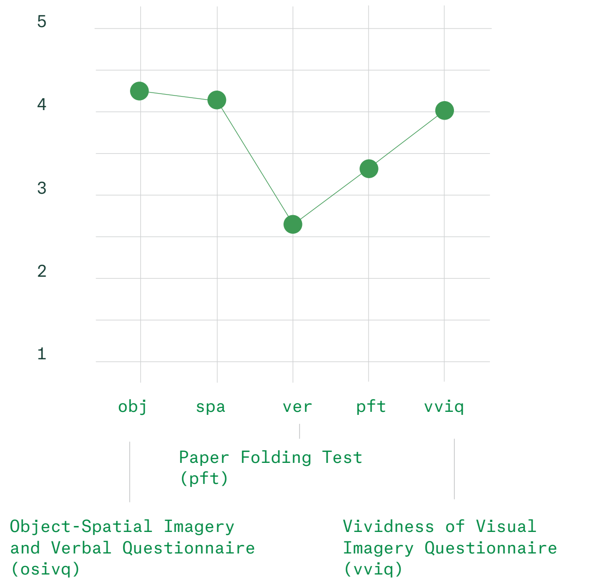
3.1.2 Object-Spatial Imagery and Verbal Questionnaire (osivq)

The OSIVQ is a self-report instrument to assess individuals' visual (object and spatial) as well as verbal cognitive style dimensions (Blazhenkova & Kozhevnikov, 2009). The OSIVQ consists of 45 items with 15 items assessing visual–object cognitive style, 15 items assessing visual–spatial cognitive style, and 15 items assessing verbal cognitive style. Participants are asked to rate on a 5-point scale each statement ('5' indicating absolute agreement with the statement and '1' indicating total disagreement).

3.1.3 Paper Folding Test (pft)

According to Ekstrom & Harman (Ekstrom & Harman, 1976) the Paper Folding Test measures spatial visualization ability, which reflects the ability to apprehend, encode, and mentally manipulate abstract spatial forms. The test consists of 2 series of 10 items, each representing a square sheet of paper that undergoes two- or three-folds and punched through all layers. The participants are asked to select one correct drawing among five drawings, which depicts how the sheet would look when fully opened. They have 3 min to complete the test.

3.1.4
Vividness of Visual Imagery Questionnaire (vviq)



8. Example chart. The scales named "OBJ", "SPA", "VER" measure the self-reported preference of object, spatial or verbal code, resulting from the Object-Spatial Imagery and Verbal Questionnaire. The "PFT" scale measures the ability of performing spatial rotations, resulting from the Paper Folding Test. "VVIQ" measures the self reported vividness of mental images, resulting from the Vividness of Visual Imagery Questionnaire.

The VVIQ is a self-report instrument assessing vividness and brightness of individuals' imagery (Marks, 1973). Subjects are asked to rate from 5 to 1 (from 'no image at all' to 'perfectly clear image', respectively) the vividness of the evoked visual images of a list of 16 items.

3.1.5
Qualitative results of phase i

At the end of Phase 1 we were able to identify 2 groups of 3 architects each, composed –Group A- by the architects that resulted as "object visualizers" and –Group B- by the "spatial visualizers".

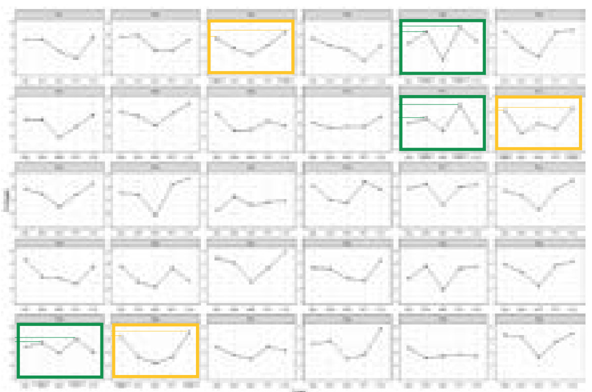
We adopted precautionary criteria to select the subjects for the two groups for the Phase II assessment. We identified as object visualizer who scored both in the object self-report (OBJ) and vividness questionnaire (VVIQ) higher than both spatial self-report (SPA) and paper folding test (PFT). Vice-versa, we considered a spatial visualizer who scored both in the spatial self-report (SPA) and in the paper folding test (PFT) higher than both the object self-report and vividness questionnaire (VVIQ). Then, a further selection was made to have equal numbers of subjects for each group, based on the availability and on the age of the subjects. All the selected subjects have between 6 and 23 years of professional experience and are between 32 and 47 years old. 3 of them were females and 3 of them were males. Group A ("object visualizers") was formed by P03, P12, P26. Group B was formed by P05, P11, P25 (See graphics).

We also found that 2 (P09, P12) architects reported to prefer the verbal code in the OSIVQ to the spatial visual style, while 1 (P15) architect reported to prefer the verbal code in the OSIVQ to the object visual style. From this qualitative analysis, we can deduce that in our sample architects do prefer the visual code to process information. 5 architects (P01, P04, P12, P19, P22) reported to prefer the verbal code and scored lower in the PFT, meaning that their ability to perform spatial rotations is weaker than their verbal referred capacities.

Considering the results in the VVIQ and in the PFT, we would have 22 architects more able to visualize and inspect rather than perform spatial rotations.

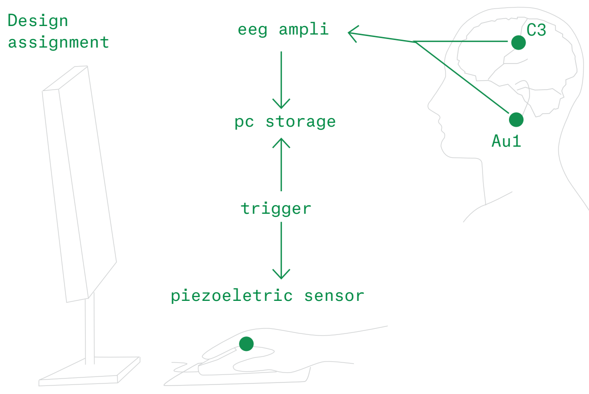
3.2

Spatial-visual cognitive style	spa > obj	pft vviq
Object-visual cognitive style	obj > spa	vviq pft



9. Profiles resulted from the battery of three tests. Each chart represents the results of each participant. The pink marked charts correspond to the participants determined as "object" visualizers and the green marked charts correspond to the participants determined as "spatial" visualizers, following the above-mentioned criteria.

Phase ii :
Electroencephalographic Assessment
3.2.1
Electroencephalographic (eeg) recording



10. Set-up of the experiment.

The EEG related to 100-200 movements was recorded in each session. Each subject repeated the same recording in identical conditions three times, to assess intra-subject repeatability. Each click triggered the memory storage of 3500 ms before and 500 ms after click. Consequently, the subjects were asked to click the mouse at intervals not shorter than 5000 ms. Recordings acquired at shorter intervals were discarded.

A piezoelectric sensor was attached to the left mouse button. Each time the subject pressed the button to select an icon, a synchronising signal was sent to the EEG recording apparatus for MRCP averaging. The EEG was recorded from 1 derivation according to the international 10-20 system (C3-Au1), C4Au1 and Cz-Au1). The EEG signal was amplified with bandpass of 0.1-2000 Hz) and digitized with an analog to digital converter (NI PCIe-6320, X Series Multifunction DAQ, 16 Bit, 250KS/s sampling rate by National Instruments, Austin, Texas). Signal storing and analysis (averaging and cross-correlation among samples) were performed with dedicated applications developed in LabView2019© language. Analysis of the MRCP components were performed in accordance to the methods already proposed by (Leandri et al., 2021). The components of interest for this work are N-150, P-40, N+30, P+120, N+300. Their latencies, amplitudes and areas were assessed as principal parameters. Per each session an averaging was produced. Once a set of repeatable recordings will be identified, and averaging of the single averages, or grand-average, will also be calculated to identify a common trend. Descriptive statistics and Student's T test were used where needed, with a p value < 0.01 set as significance level. The Shapiro–Wilk test was used to assess normal distribution of the data when needed.

3.2.2
Task

11. Participants while being prepared for the EEG registration during the performance of the task.

Each participant, both from Group A and Group B, was seated in front of a computer and received, in each session, six design briefs with some information on the site, the budget, and a list of a few client requests (see examples). Groups of three briefs were shown in a pdf series of boards consisting of three introductive boards followed by a series of boards, each one stating a design topic and providing icons to choose. Participants were told to click on the icon that was most representative of the design they were imagining. The topic ranged from "position in the site" to "type of handrail" etc. (Fig. 12-13).

We built the task to simulate the following BIM features:

- **a.** The fragmentation of the design process into pre-determined sub-problems,
- **b.** The abstract approach to space cognition,
- **c.** The closure of the proposed problems.

3.2.3
Data analysis and results of the eeg experiment

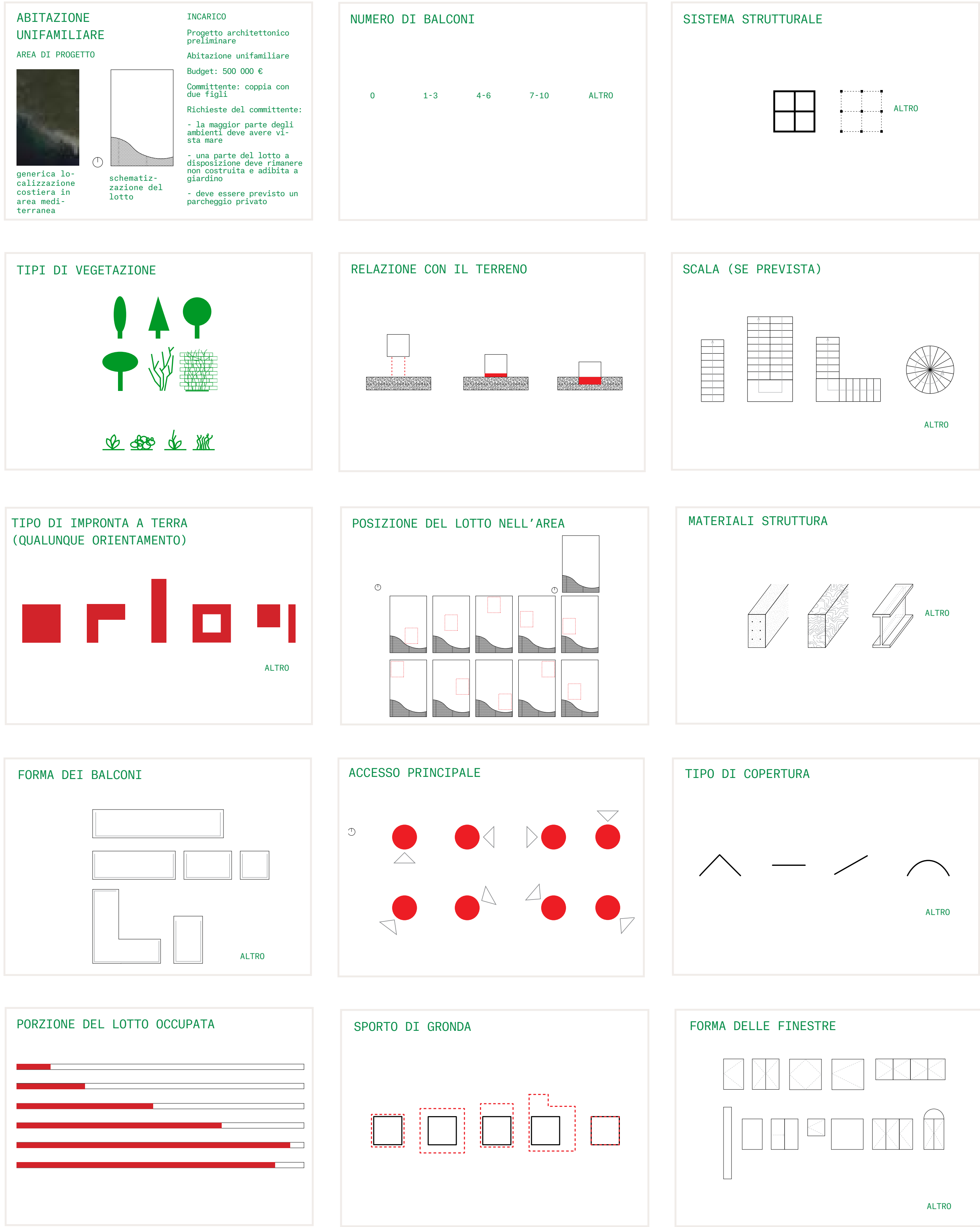
In the following figures the averaged recordings from the three object oriented and the three space oriented subjects are shown. It is to note that since approximately 1 second before movement (marked by the vertical dotted line) the brain activity shows an increase, reaching its maximum at the time of the movement or just after it. This part of the record reflects: 1) between the mark -1000 and -100 on x axis, the neuronal activity of the association areas during preparation of the movement, and 2) between the mark -100 and 0 the activity of the primary cortical neurons sending the final orders to muscles for hand and arm movement. After that, all waves represent the sensory perception by the parietal cortex, due to excitation of movement and tactile sensors of the hand. This latter activity may represent an important element in eliciting the birth of new ideas in the frontal motor areas by feedbacking to them the processed perception. When comparing the traces of the object oriented with those of the spatial oriented subjects, it is very evident that in the latter case their amplitude is far smaller. Given the complex waveforms, the amplitude of the signal is not a reliable measurement, and it is better substituted by the area under curve, or, even better, by the calculation of the signal energy expressed in picoJoules in a given time epoch (Leandri et al., 2021). In Figure 16 the two grand averages obtained in the two tasks are compared and the graph surface used for energy calculation is shown in colour. In the case of object oriented, the mean signal energy was 3530.45+/-2263.02 pJ, to be compared with the result in the case of spatially oriented, which was 370.15+/-233.67 pJ. Because the variability of the single recording, the smallness and typology of the sample no statistical significance was attainable. Nevertheless, the large difference that is visible between the two conditions (Fig. 14-15) let us foresee that with a larger number of subjects or of repetitions within the same subject a significant result could be reached.

4
Conclusions

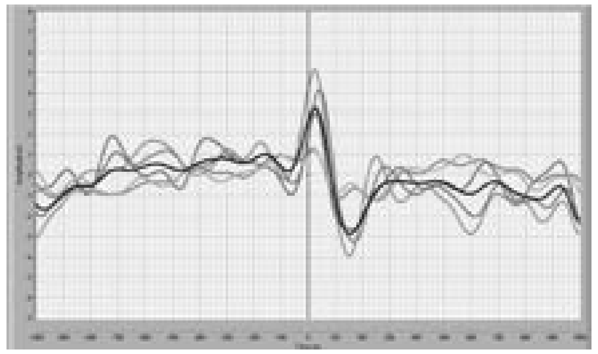
The aim of the EEG experiments was to investigate whether the use of a simulated BIM software by two groups of differently minded subjects (object oriented versus spatially oriented) could be associated with two different kinds of cerebral activity detected by electroencephalography. Detection by electroencephalography would provide an objective and quantified instrumental evidence about the hypothesized differences in cognitive processes by the two groups of architects. Such evidence could be used to tune BIM software and procedures for better adaptation to the way of thinking of the architect.

What we did with the EEG experiments was to detect the activity of the cerebral cortex related to the simulation of the choice of a certain item proposed by the BIM software. We could explore what was such activity in the moments before the choice and also just after the choice. The meaning of the activity before the choice was linked to the brain processes of divergent thinking and of the final decision (both constituting the most relevant aspects of creativity). The activity after the choice was linked to the mental gratification of the performed action. Such activity was larger if the choice was to full satisfaction of the architect. On the contrary, in case the proposed images were not suitable to the thinking of the architect, any choice would be unsatisfactory, and the activity would be lower.

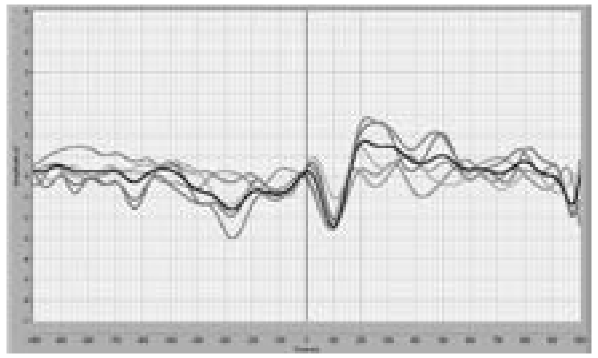
The results of our experiments demonstrate that a far larger activity was present in the brain of the object oriented group, suggesting that their creativity was more stimulated and that their choices were more satisfactory. The lesser activity of the spatial oriented group suggested just the opposite, that is their creativity was at a lower level and they were somehow frustrated by their choices. Of course, the number of subjects that we investigated was not large enough to allow reaching statistical significancy, and this research should be considered as a preliminary feasibility and proof of concept study. Nevertheless, we may consider that the evidence is robust enough to conclude that this line of investigation ought to be pursued to the benefit of the general knowledge on the mental processes of architects and to design software either BIM or CAD specifically suited to their way of thinking. In our case, for example, it is evident that the items proposed by the simulated BIM software were more suited to the group of object oriented architects than for the spatial oriented ones. Such result ought to be taken in due consideration to design an application dedicated to the latter group. A change that could reverse the results of analogous experiments, and make the EEG recordings detect larger activity in the spatial than in the object oriented group. We plan to push our future research in this direction and assess if different BIM applications could provide optimal results according to the individual mental disposition.



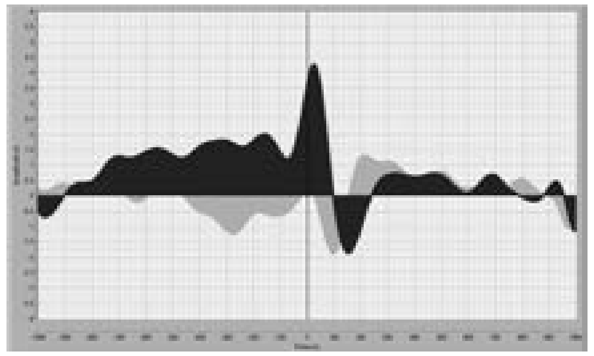
12. Examples of "topic boards" for the first assignments. The "topic boards" for the other design assignments were similar, adapted to the specificity of each one of them.



Averages of MRCPs in the three object oriented subjects (two averages are shown per each subject to assess repeatability)

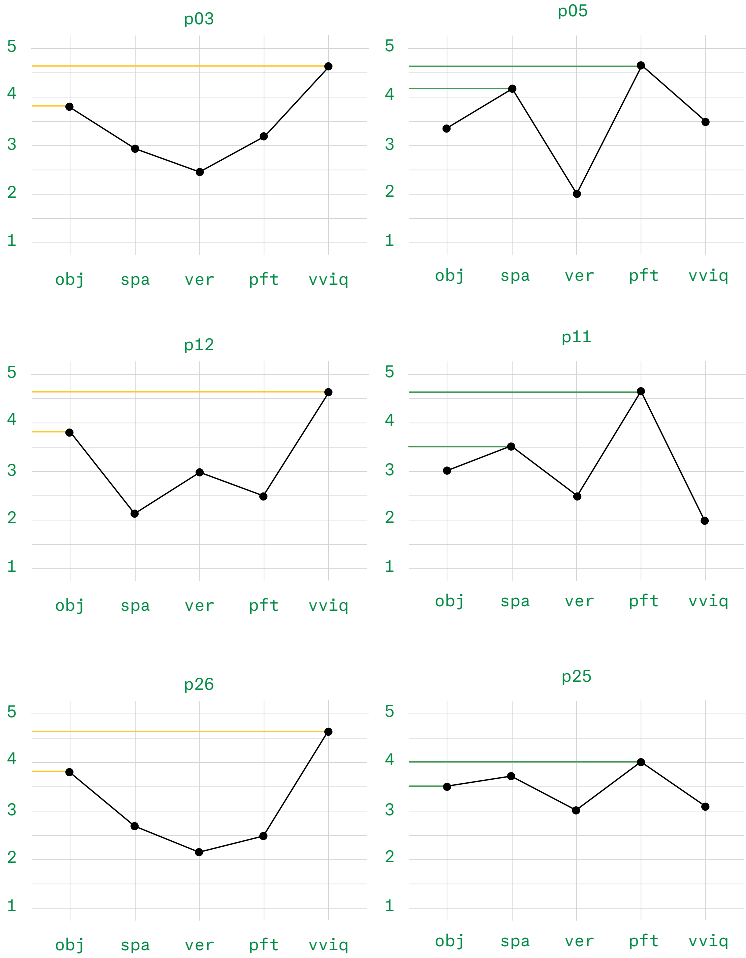


Averages of MRCPs in the three spatial oriented subjects (two averages are shown per each subject to assess repeatability)



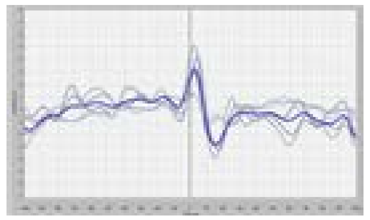
The energy surface calculation in the two grand averages, object oriented in blue and spatial oriented in gray.

Phase I

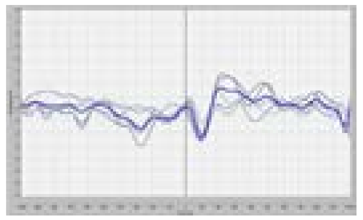


Phase II

task simulating the development of a design assignment using bim software
+
eeg registration



Averages of MRCPs in the three object oriented subjects (two averages are shown per each subject to assess repeatability)



Averages of MRCPs in the three spatial oriented subjects (two averages are shown per each subject to assess repeatability)

5
Future Developments

Building Information Modelling (BIM) has radically transformed how the architecture, engineering, and construction (AEC) industry practices and operates. Over the past twenty years, BIM technology, in continuous development and expansion, has been gradually implemented in design firms as an essential tool for project development. From the earliest concept to detailed design, BIM technology appears to be highly favored by designers who appreciate its numerous benefits. In this regard, even research and scientific literature often express favorable views, highlighting its merits and advocating for its increasing use, both in the workplace and in the educational sphere.

However, entrusting a complex design process, which by nature would require different expertise, timelines and methodologies, to a single type of technology, entails carefully considering all its aspects.

Indeed, as initially discussed in this research, BIM runs the risk of creating a form of "standardized" design, tied to the convenience of libraries and prior knowledge of the software – an aspect that has not yet been extensively addressed by educators and students (Borkowski, 2023). However, other criticisms of BIM have arisen during the information exchange phase among the various parties involved in the project, including the challenge of sharing data with subcontractors who may not have or be willing to embrace the technology. Furthermore, sharing libraries is not always straightforward or utilized by different parties, leading to confusion about design standards, resulting in errors and workflow delays.

Possible solutions can be found in the development of diverse types of libraries and standards that can interact with each other, and especially in the hybrid use of graphic tablets, making manual annotations easily implementable on technical sheets.

If the scientific evidence presented here pertains to the initial phase of the project, the concept, where it appears that there is a need to limit the designer's choices as little as possible, the proposed solutions can easily adapt to the entire project development. They offer alternative tools that make software more "tailored" to the architect's inclinations and the needs of the design phase.

Some start-ups led by young designers are beginning to address the issue of the current inflexibility of software. For a preliminary investigation into the sector, we thank the collaboration of Ewa Lenart and Yannick Koitzsch, founders of Howie, who state, "Construction is one of the most impactful and powerful sectors in the world. Yet our productivity in the last two decades has dropped [...] What differentiates AEC from other management sectors is the way we communicate. We talk through drawings. Howie knows it, and bases its information analysis and sourcing through drawing output." [https://howieapp.io/our-mission]

For future research related to this preliminary study, we hope to collaborate with software developers and companies to experiment with tools, new libraries, and different features (such as the possibility of freehand drawing and writing). These will be monitored and evaluated to make architectural software increasingly cater to the individual designer's needs.

References

Blazhenkova, O., & Kozhevnikov, M. (2009). **The new object-spatial-verbal cognitive style model: Theory and measurement. Applied Cognitive Psychology**, 23(5), 638–663. https://doi.org/10.1002/acp.1473

Borkowski, A. (2023). **Experiential learning in the context of BIM**. STEM Education. 3. 190-204. 10.3934/steme.2023012.

Bozzacchi, C., Spinelli, D., Pitzalis, S., Giusti, M. A., & Di Russo, F. (2015). **I know what I will see: Action-specific motor preparation activity in a passive observation task.** Social Cognitive and Affective Neuroscience, 10(6), 783–789. https://doi.org/10.1093/scan/nsu115

Buondonno, L., Chiorri, C., Vannucci, M., & Giachetta, A. (2023). **Mental imagery and digital media in architectural design process. An experimental study.** IDEA – Investigating Design in Architecture 2023 Edition, 126–136.

Carpo, M. (2017). **The second digital turn: Design beyond intelligence.** The MIT Press.

Cho, J. Y. (2017). **An investigation of design studio performance in relation to creativity, spatial ability, and visual cognitive style** | Elsevier Enhanced Reader. https://doi.org/10.1016/j.tsc.2016.11.006

Clark, A., & Chalmers, D. (1998). **The Extended Mind. Analysis,** 58(1), 7–19.

Ekstrom, R. B., & Harman, H. H. (1976). **Manual for kit of factor-referenced cognitive tests.** Educational testing service.

Giachetta, A. (Ed.). (2022). **Architettura e immagini mentali: Processi cognitivi per il progetto dello spazio costruibile nell'era della complessità.** FrancoAngeli.

Hay, L., Duffy, A. H. B., McTeague, C., Pidgeon, L. M., Vuletic, T., & Grealy, M. (2017). **A systematic review of protocol studies on conceptual design cognition: Design as search and exploration.** Design Science, 3. https://doi.org/10.1017/dsj.2017.11

Kosslyn, S. M. (1999). **Le immagini nella mente: Creare e utilizzare immagini nel cervello. Giunti.**

Kosslyn, S. M., Ganis, G., & Thompson, W. L. (2001). **Neural foundations of imagery. Nature Reviews Neuroscience,** 2(9), Article 9. https://doi.org/10.1038/35090055

Kozhevnikov, M. (2007). **Cognitive styles in the context of modern psychology: Toward an integrated framework of cognitive style.** Psychological Bulletin, 133(3), 464–481. https://doi.org/10.1037/0033-2909.133.3.464

Kozhevnikov, M., Kozhevnikov, M., Yu, C. J., & Blazhenkova, O. (2013). **Creativity, visualization abilities, and visual cognitive style.** British Journal of Educational Psychology, 83(2), 196–209. https://doi.org/10.1111/bjep.12013

Kriegstein, A. R., & Brust, J. C. M. (2013). Appendix B **The Neurological Examination of the Patient.** In E. Kandel, Schwartz, J. H., T. M.

Jessell, S. A. Siegelbaum, & A. J. Hudspeth (Eds.), **Principles of Neural Science** (Fifth Edition, pp. 1533–1549). Mac Graw Hill.

Leandri, G., Schenone, A., & Leandri, M. (2021). **Detection of movement related cortical potentials in freehand drawing on digital tablet.** Journal of Neuroscience Methods, 360, 109231. https://doi.org/10.1016/j.jneumeth.2021.109231 Loos, A. (1962). Parole nel vuoto. Adelphi.

Malafouris, L. (2013). **How things shape the mind: A theory of material engagement.** MIT Press.

Marks, D. F. (1973). **Visual Imagery Differences in the Recall of Pictures.** British Journal of Psychology, 64(1), 17–24. https://doi.org/10.1111/j.2044-8295.1973.tb01322.x

Nanay, B. (2018). **Multimodal mental imagery.** Cortex, 105, 125–134. https://doi.org/10.1016/j.cortex.2017.07.006

Oppenheimer, N. (2009). **An Enthusiastic Sceptic.** Architectural Design, 79(2), 100–105. https://doi.org/10.1002/ad.862

Rafsanjani, H. N., & Nabizadeh, A. H. (2023). **Towards digital architecture, engineering, and construction (AEC) industry through virtual design and construction (VDC) and digital twin.** Energy and Built Environment, 4(2), 169–178. https://doi.org/10.1016/j.enbenv.2021.10.004

Raiteri, R. (2014). **Progettare progettisti: Un paradigma della formazione contemporanea. Quodlibet.**

Wheaton, L. A., Shibasaki, H., & Hallett, M. (2005). **Temporal activation pattern of parietal and premotor areas related to praxis movements.** Clinical Neurophysiology, 116(5), 1201–1212. https://doi.org/10.1016/j.clinph.2005.01.001

Zumthor, Peter. 1998. "A Way of Looking at Things" (1988). In Thinking Architecture. Basel, Berlin, and Boston, MA: Birkhäuser

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From Playgrounds to Planning, Shaping Cities with Young Minds

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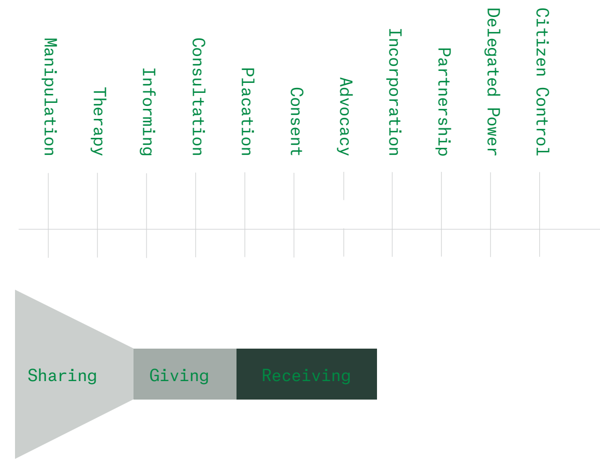
1 Introduction

The theoretical landscape of urban planning has long advocated for participatory approaches, yet the implementation of such paradigms across ages has faced significant hurdles. The complexity of planning tasks has intensified with the advent of digitalization and smart city technologies and current smart city initiatives often perpetuate the top-down, expert-led model, overshadowing participation.

Policies and practices have evolved to incorporate participation as a key strategy to align with social change and democratise the process in urban and regional development thanks also to the large variety of map-based digital survey tools and more recently participatory budgeting. Despite those advances, participatory approaches often trigger conflicts instead of fostering collective expression and unity. Tokenism played a role in building disillusionment and scepticism among community members, who may feel that their input will not have a real impact on the final decisions.

Presently, community engagement platforms are focused on surveys with citizens, applying specific metrics to gauge participation and collect people's preferences and ideas in the form of data - that later somebody has to clean, analyse, interpret and share with designers who supposedly are able to use that second-handed information for placemaking. Yet, urban co-design methodologies lag behind, struggling to adapt to rapid urban transformations and the dynamic nature of people's aspirations. Moreover, contemporary processes rarely employ the human perspective as a lens for city analysis and design. While Geographic Information Systems (GIS) mapping, digital twins, and Building Information Modeling (BIM) have become integral to master planning, they have inadvertently sidelined the human-centric viewpoint. Consequently, cities are increasingly planned and modelled from angles that don't necessarily correspond to the human experience of the urban landscape - and that ignore or even hinder the social innovations of small urban places.

1.1 Children



Specific to children, participatory planning often fails to adequately integrate their perspectives as the medium utilised are often unrelatable, as the commonly used post-its, drawings and paper-models allow children to express their creativity but don't allow them to present and evaluate their ideas to their adult audience. We find the necessity of involving children in planning with new techniques and tools that today are only available to their adult counterparts, as their exclusion can lead to social exclusion from urban life. Engaging children in participatory planning not only brings their unique perspectives into urban design but can also serve as a conduit to engage their families and communities. Workshops and design collaborations with children can lead to more inclusive and child-friendly public spaces.

1.2 Harnessing the power of collective intelligence

Participation is about democratising and joyfully negotiating urban change infusing it with the richness of diverse perspectives and collective intelligence. Facilitating a shared experience in a common space is vital to the process of building empathy and innovating ideas through debate. Yes, also for children. It is about shifting their roles from commentators to placemakers and providing the opportunity to reinforce human networks during events that help building relationships between technology and the very essence of human habitation - imagine the future of our living.

Today's changing environment requires a broad social-spatial vision for democratic city reimagination; there's a pressing need for enhanced, integrative tools for children's engagement. These tools should capture the diverse, evolving aspirations of children and harness this insight to craft more democratic, resilient urban environments.

At the heart of this transformative process is the concept of co-creation, which has emerged as the bedrock of innovation. Co-creation fosters a collaborative environment where various stakeholders come together to blend their knowledge, skills, and experiences, crafting solutions and ideas that are not only inclusive but also representative of a diverse urban tapestry. The aim of our project is to develop a digital and human platform for children to be considered one of the stakeholder groups sitting on the decision makers' table. This approach would ensure that change is not just imposed but woven into the fabric of the community, enhancing the collective ownership and engagement of those who are most affected by urban transitions. Through co-creation, the city becomes a reflection of its youth's vision, starting from the public space surrounding their schools, and ultimately leading to more vibrant, sustainable, and adaptable urban landscapes.

1.3
A Human AI

Generative AI has been lauded as a revolutionary force in technology, often portrayed as a one-size-fits-all solution. However, despite its capabilities, mainstream applications of AI have predominantly favoured experts who possess the skills to harness these complex systems. This expert-centric model runs counter to the collaborative potential that AI can offer. To tap into this potential, AI must shift from a universal tool to a customised facilitator of group innovation. This approach demands a nuanced understanding of group dynamics within which AI operates. Our team at UrbanistAI has delivered more than 20 projects using GenAI for codesign and in this project we want to use the experience we gathered so far to redesign both our approach and our technology for the youth.

The concept of "Human AI," as it could be termed, embodies the principle of collective empowerment. It is AI designed not merely for individual use but for networks of individuals collaborating towards a common goal. This concept of AI prioritises accessibility, user experience, and the social context of technology. An excellent example of such an approach is the deployment of UrbanistAI in urban planning, where AI is repackaged to foster participatory design, allowing communities to co-create their living spaces.

The transition to Human AI calls for a design philosophy that emphasises inclusivity and participative engagement. This ethos is captured in the European Commission's White Paper on AI, which advocates for "AI for the people," emphasising the need for trustworthiness and human oversight in AI systems. By focusing on the collective rather than the individual, Human AI can transform disparate groups into cohesive units aiming for a common purpose, thus reflecting the true spirit of participatory technology.

In essence, the evolution of AI into Human AI marks a significant leap towards democratising technology, and being the future our our cities, children should have the best tool to reimagine it collectively.

3.
Engaging Young Visionaries
3.1
UrbanistAI

UrbanistAI is a generative artificial intelligence (AI) platform designed for participatory planning and co-design in urban settings . It aims to transform traditional methods of urban planning by employing AI to create a more interactive and democratic design process. It is about transitioning from the aspirational to the actionable, embodying a more equitable and collaborative approach to urban development that is responsive to the complexities of the digital era.

Our team designs methods and technologies to facilitate a more profound level of participatory planning by enabling citizens to visualise and directly shape their urban environments through AI-generated simulations. With GenAI we can confront the traditional limitations of participation, where stakeholders are often relegated to commenting on pre-set agendas. Instead, UrbanistAI allows for a democratised agenda-setting where community input is integral from inception, potentially mitigating frustration and conflict by empowering citizens with a more significant role in the development of their communities. This aligns with a reimagined urban development method that conceptually and practically enhances participation, moving beyond tokenistic engagements to substantive co-design in urban planning.

3.2
Our aim

In the pursuit of understanding and enhancing the role of children in urban design, our team at UrbanistAI has embarked on a research project with Tampere University in the Hame region in central Finland. With the support of the Architects' Council of Europe we have established a pilot project to develop a children friendly interface of UrbanistAI and develop a method to bring participative GenAI to younger demographic. Our inquiry is centred around three core research questions, which aim to unravel the intricacies of children's inclusion in the urban planning dialogue.

How can children be included in participatory planning?

To address this, we are engaging with local school in Harviala to devise a cooperation framework that integrates participatory planning into the educational curriculum. This initiative explores the possibility of children contributing to urban design projects as part of their learning activities. An essential aspect of our investigation is determining the role of parental involvement in this process and evaluating how participatory planning can double as an educational tool, providing insights into the workings of a city.

What is the best method to engage with children of different age groups?

Recognizing the diverse cognitive and social abilities across various age groups, our research seeks to tailor engagement strategies that resonate with children at different developmental stages. This involves designing age-appropriate activities that can effectively capture the imaginative insights of the youth, enabling them to contribute constructively to the planning discourse.

How should a generative AI platform be designed for children?

The heart of our research lies in developing a generative AI platform that caters specifically to children. This involves not only user-friendly interfaces but also ensuring that the platform serves as a conduit for the expression of children's unique perspectives on their neighbourhoods. Our aim is to empower young minds to envision and articulate their aspirations for the future of their communities.

4
The pilot

Our pilot of developing a new interface and several methodologies to test in 3 workshops with 3 different groups of children in the school of Harviala (Harvialan koulu) in the Hame region.

The interface was meticulously crafted to provide age-appropriate activities that not only captivate but also harness the creative and analytical potential of each age group. Through this, we encourage a constructive dialogue where the voices of the young are not just heard but are instrumental in urban planning narratives. This platform creates an intuitive and engaging virtual space that invites children to project their visions and ideas onto the canvas of their communities. It is a conduit through which the candid and untarnished perspectives of children on their school spaces are channelled, fostering a sense of ownership and participation.

4.1
Method

In collaboration with Tampere University, we tailored a set of workshop delivery methods to effectively conduct an UrbanistAI session. The workshop, designed to last approximately 45 minutes, was structured as follows:

Introduction

Imagination

Ideation

Voting

1. **Introduction:** The session began with an orientation for the children, explaining the workshop's objective: to collaboratively reimagine the common outdoor spaces they frequent during school recess.
2. **Imagination:** We engaged the children's social imagination in three distinct approaches, tailored to their grade levels:
3. **2nd Grade -** Drawing Guided: Younger children expressed their initial concepts through drawings. Our specialists then translated these drawings into visual prompts for the AI.
4. **4th Grade -** Image Guided: These students began by choosing their preferred images, which we used as a basis to formulate AI prompts.
5. **6th Grade -** Unguided: Older children worked in groups, each equipped with an iPad, to brainstorm and articulate their ideas freely.
6. **Collaborative Ideation:** Each child took turns vocalizing their transformative ideas for the spaces, while a researcher from Tampere University input their suggestions into UrbanistAI. This process involved a dynamic exchange, allowing for a few rounds of interaction with the AI to refine their concepts. As ideas took visual form, children indicated their preferred images, which were then highlighted within the platform.
7. **Voting:** The workshop culminated with a collective decision-making moment. All the favoured images were projected for the group, and the children cast their votes for the top designs by a show of hands.

This structure not only fostered creativity among the participants but also allowed for a direct and effective way to involve children in the participatory planning process, capturing their unique perspectives on the communal spaces they inhabit.

For 2nd Grade - Drawing Guided Approach:

The youngest participants began their UrbanistAI experience with a hands-on activity. After the introduction to the workshop's goals, they were given drawing materials to sketch their ideal outdoor space. This tactile approach allowed them to freely express their ideas without the constraints of technology. Our specialists were on hand to observe and interact with the children, discussing their drawings and translating these ideas into visual prompts that the AI could interpret. The translation from paper to digital was a magical moment for the children, seeing their hand-drawn concepts come to life on the screen.

For 4th Grade - Image Guided Approach:

The fourth graders were introduced to a library of images reflecting various urban spaces. They navigated through these visuals, selecting the ones that most closely aligned with their vision for the ideal recess area. This method provided a balance between guidance and freedom, allowing students to make choices within a curated framework that could then be developed further through UrbanistAI. The chosen images served as starting points for the AI to generate designs, which the children then refined through discussion and selection, enhancing their understanding of urban design elements.

For 6th Grade - Unguided Approach:

The oldest group of children engaged with the workshop with a higher degree of independence. Equipped with iPads, they used the UrbanistAI app to interact directly with the platform. These students were able to articulate their ideas and navigate the interface with little to no guidance, showcasing an impressive level of digital literacy and creativity. They worked in groups, fostering collaboration and communication, as they brainstormed and developed their urban space designs. This group's ability to independently use the AI tool was a strong indicator of the platform's user-friendliness and the potential for deeper integration of technology in education.

4.2
Interface

The new interface was designed to provide a continuous experience from start to finish and be able to do so in less than one minute per cycle. A cycle is comprehensive of the selection of the starting image that shall be modified, then the selection of an idea that a children want to use to transform the space around the school and the selection of the favourite output transformation after 4 images are generated by UrbanistAI. The idea of using an idea, such as "basketball" to transform the space as if there was a basketball court, allows children to evaluate their own idea. Indeed real time evaluation of one's idea is the core innovation that is enabled by UrbanistAI. No matter the method, children and adults invited to participatory planning sessions today can propose their ideas but they have no instruments to swiftly visualise that idea in the urban space and evaluate it. This is particularly useful because about every other participant either change his mind after seeing the transformation or wants to refine it with some changes.

4.3
Observations

This pilot project has been successful in enabling children of different ages joyfully reimagining the spatial settings of their public space around the school. Across ages, the most requested solutions were places where to sit during recess and the addition of new games such as trampolines, street-chess and a large sandbox. The effectiveness of generative AI in capturing and augmenting the creative ideas of children has been demonstrated during the worksop as during a very brief period of time, children were able to find ideas, evaluate them and then decide collectively which solutions were best for them. As we transition from the pilot phase, we are poised to integrate UrbanistAI with its child-friendly interface and the refined methodologies into larger scale participatory planning initiatives.

The workshop also proved that elementary school children possessed a keen understanding of spatial configurations. When it came to evaluating and refining their concepts, they demonstrated a surprising level of precision. The children were adept at enhancing their design proposals, attending meticulously to details such as the dimensions of chairs or the scaling of specific elements within their interventions. This attention to detail in the planning phase suggests a sophisticated level of spatial awareness and a capacity for thoughtful design consideration among the young participants.

The success of this project has paved the way for future endeavours where children are not mere observers but active contributors to the urban landscapes they inhabit. Our team has also avoided using gamification methods to design the workshop as the process was developed directly from the one used with adults. In fact, the only difference in the ideation process for children and for adults is that with the 2nd grader we initiated ideation by letting the participants draw instead of choosing an inspirational image. By deploying UrbanistAI in subsequent participatory planning processes, we are committing to a future where the voices of the youngest members of our communities are heard, valued, and manifested in the spaces they engage with every day.

Eventually, to answer our original questions
Inclusion of Children in Participatory Planning:

The UrbanistAI initiative in Helsinki has successfully demonstrated that children can be actively included in participatory planning. By collaborating with the teachers of Harviala school and researchers from Tampere University, a cooperative framework was established that integrated urban design projects into the school curriculum. This approach not only enabled children to contribute meaningfully to the planning process but also served as a potent educational tool, deepening their understanding of urban dynamics. Furthermore, parental involvement emerged as a vital component, bridging the gap between educational activities and family engagement. UrbanistAI has proven effective in facilitating this inclusion, providing a platform that translates children's ideas into practical urban design elements.

Engagement Methods for Different Age Groups:

Our findings indicate that tailored engagement strategies are crucial for effectively interacting with children of varying ages. UrbanistAI was pivotal in providing age-appropriate activities that sparked the social imagination of children, allowing them to express and refine their urban visions. The platform's adaptability meant that younger children could begin with guided drawings, which the AI then transformed into digital visualizations, while older children were entrusted with more autonomy, directly interacting with the platform to articulate their ideas. The flexibility of UrbanistAI catered to the different stages of cognitive and social development, making it an invaluable tool in engaging youth in participatory planning.

Design of a Generative AI Platform for Children:

The design of UrbanistAI for children has met the objectives of our research. The platform's interface was intentionally crafted to be intuitive, enabling children to navigate and interact with ease, regardless of their previous exposure to technology. Its user-friendly nature allowed children to freely express their unique perspectives on their neighborhoods, resulting in innovative and child-centric urban design proposals. UrbanistAI's capacity to translate abstract ideas into tangible visualizations has underscored its potential as an empowering tool for young individuals, encouraging them to shape the future of their communities.

In conclusion, the UrbanistAI workshop has not only showcased the potential of generative AI in the realm of participatory design but has also established a framework that can be scaled and adapted to further involve children in the planning of their cities. We stand on the cusp of a new era of inclusive urban development, one in which the imagination of children informs the creation of vibrant, dynamic, and playful urban spaces.

5
SPIN OFF 1 - Milano Digital Week

During the Milano Digital Week 2023, UrbanistAI was utilized in a dynamic and interactive workshop tailored for children. The event, which involved 15 young participants accompanied by their parents, was structured to introduce the concepts of urban planning in an engaging and age-appropriate manner.

5.1
Methodology

The workshop began with an interactive presentation that used visual riddles to explain urban planning. This approach captivated the children's attention and encouraged active participation, setting a collaborative tone for the event. Following the introduction, each child was provided access to the mobile version of UrbanistAI on a device of their choice, be it a smartphone, iPad, or computer. This flexibility allowed for a comfortable and familiar interface for the children to interact with the platform.

5.2
Choice of Local Imagery

Unlike the other workshop we ran in Hame, in Milan the participants had the option to select from pre-generated photos of school courtyards or images of streets and parks in Milan. Two separate exercises were conducted: one focusing on envisioning the future of their school and the other on broader urban considerations for the city. The children had the autonomy to select specific areas they wanted to transform, empowering them to take charge of the design process.

As the children used the platform, the results were projected in real-time, especially when they marked their designs with a star. This feature was particularly exciting for the children, as it provided immediate validation and recognition of their creative efforts.

5.3
Voting and Discussion

At the conclusion of each exercise, the workshop transitioned to a voting phase where the children would raise their hands to select their favourite photo. This was followed by a discussion about the reasons behind their choices. While this part of the workshop was highly interactive, it was noted that the process might have been somewhat lengthy. The children seemed to tire as the number of images to review was quite large, indicating an area for potential improvement in pacing and structure.

Overall, the use of UrbanistAI during the workshop demonstrated the platform's capacity to engage a young audience in urban design. It highlighted the importance of incorporating playful, interactive elements and the power of real-time feedback in maintaining the children's interest and excitement. This event has provided valuable insights into how generative AI platforms can be effectively adapted for educational and participatory purposes with children.

5.4
SPIN OFF 2 - Exhibition at the Estonian National Museum of Natural History

UrbanistAI has been commissioned to create an engaging display for the Estonian National Museum of Natural History, intended to enable guests to envision a more eco-friendly tomorrow and the revitalization of vacant urban areas in Tallinn. This exhibit is particularly tailored to captivate the museum's younger visitors, with its design influenced by the insights gained from interactive sessions conducted with the students from Harviala school.

A special thanks to the researchers of Tampere University Anna Koskinen, Elham Jafari and Camilla Heiskanen, and to Menno Cramer with whom we conducted several discussions during the development of the children interface.

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Digital Urban Planning, from Analog to Digital

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Abstract

The text provides insights into AI applications in architecture and urban design, emphasizing the complexity of modern design processes. It discusses challenges in urban planning and proposes a generative approach to address them. Methodologies, such as sensing analysis and parametric modeling, are outlined, along with urban strategies like Successive Palimpsest. The importance of digital tools and analysis for informed design solutions is highlighted. Case studies, such as BRNO.CZ - South Centre, demonstrate practical applications. The text concludes by emphasizing the value of generative methods and invites exploration of future possibilities in digital design and fabrication.

Architecture design tools have undergone many turns over the last 30 years, but they alone will not help us solve the problems of paradigm shift or concept development. It is the level and direction of thinking that determines the next steps. In our research since 2012 we have been implementing genetic algorithms and basic AI for urban design modules with the aim of creating an emergent dynamic model that would allow not only good work with tools but also a new concept of urbanism corresponding to the 21st-century. A system that is open, yet defining, contextual, yet not romantic, efficient yet beautiful. In the course of development, we have arrived at the term successive palimpsest. Succession is a process derived from nature, a certain succession that allows vegetation to achieve harmony and climax. The palimpsest is based on Roman papyrus scraping and allows us contextuality. Every plot, place, and area today contains a lot of information that must be incorporated into the design and not ignored in a modernist way. Digital design using AI is great for this type of design.

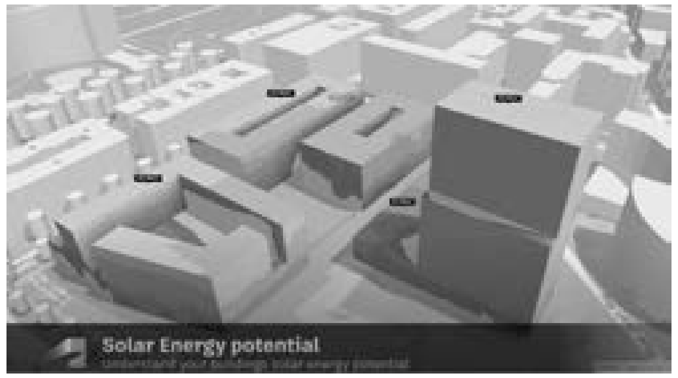
1 Introduction

Our research focuses on a range of applications of generative design methods using algorithms and AI. We map design methods and methodologies ranging from parametric model-based search for optimal solutions to creative AI tools. Architecture and urban design have become very complex processes that are difficult to grasp and record through drawing. Cities are constantly evolving and can be curated rather than controlled. With digital tools we can better analyse, simulate, predict but design. Thanks to computational power, we can quickly iterate different varieties of solutions and thus be more creative. Recently, thanks to ai algorithms, we can create images using text and work is already underway to generate 3D content.
In our research, we use and apply different strategies, which complement each other and it is possible to build robust tools that can help architects and urban planners to design better environments.

1.1 Since Modernity

In the era of modernity, the evolution of cities has propelled them into realms of increasing complexity. Traditional planning methodologies, once deemed effective, are now encountering obsolescence or inadequacy in grappling with the intricate processes inherent in contemporary urban planning. The persistence of urban planning systems tethered to historical figures remains prevalent, evident in both European cities and among architects. Figures such as Gehl, celebrated for his "cities for the people" paradigm, continue to exert influence, anchoring us in the urbanism ideologies of the 1990s and postmodernism.

This steadfast adherence prompts a crucial inquiry into the trajectory urbanism should adopt in the present day. How should it be conceptualized, conditioned, and stimulated to address the multifaceted challenges of the current urban landscape? It beckons a reflection on the requisite adaptations and paradigm shifts necessary to forge a progressive urbanism that transcends historical frameworks, encapsulating the unique complexities and demands of the 21st century. This contemplation invites stakeholders, planners, architects, and urban enthusiasts alike to collectively envision and actively shape a transformative urbanism reflective of our contemporary global context.

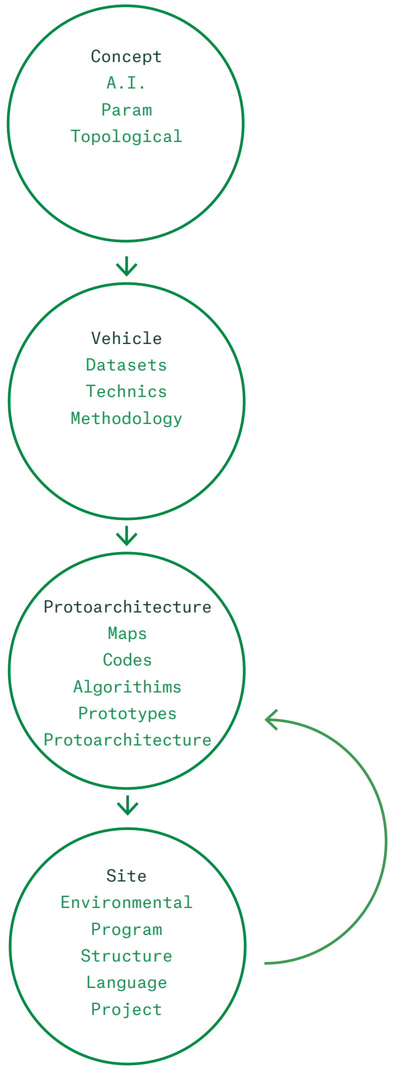


1.2 Egg or Chicken

Existing urban AI tools often gravitate towards utilizing established datasets or preconceived solutions, functioning more as expedient modeling utilities than intricate generative models. A notable drawback is their tendency to furnish solutions without adequately probing the essential questions critical for optimal outcomes. While these tools may offer post-design analysis data, their effectiveness is hampered by the lack of a proactive stance during the initial design phase.

In our innovative approach, we transcend these limitations by embracing a holistic utilization of all available data. This methodology engenders a rich spectrum of potential solutions, meticulously cataloged into a user-friendly repository. This unique cataloging system empowers users to select the most fitting solution aligned with their preferences. What sets our system apart is its dynamic adaptability, actively learning from user preferences. This adaptive learning process propels individuals towards realizing heightened levels of creativity and originality in their design pursuits.

The intersection between Autodesk and OpenAI is pivotal in this paradigm. By leveraging the computational prowess of Autodesk, known for its robust design and engineering software, and integrating the advanced AI capabilities of OpenAI, our approach bridges the gap between conventional design methodologies and cutting-edge generative AI. This synergy empowers designers with unparalleled tools, unlocking new dimensions of creativity and efficiency in urban design.



1.3
Methodology

The foundational understanding of a city and the expectations we harbor from it should precede all considerations, a realm untouched by the capabilities of AI. It is we, as humans, who must pose the essential questions that define the very essence of urban living. Nevertheless, the realm of computational design emerges as an invaluable ally, particularly in handling routine or information-intensive tasks within the urban planning domain.

Our approach initiates from the premise of envisioning a city as an emergent, pulsating entity intricately interwoven with its surrounding landscape and nature. This conceptualization demands a substantial influx of data encompassing terrain features, climate patterns, movement dynamics, program requirements, and structural considerations. Leveraging sensing analysis, we extract this indispensable data, initializing the generative process with the inaugural equation—termed as the 'vehicle.' This initiates the formation of protomodels, subsequently applied to the designated site. Through a meticulous iterative process, we navigate towards identifying the most optimal solution for a given urban challenge, facilitating a dynamic and responsive approach to urban planning.

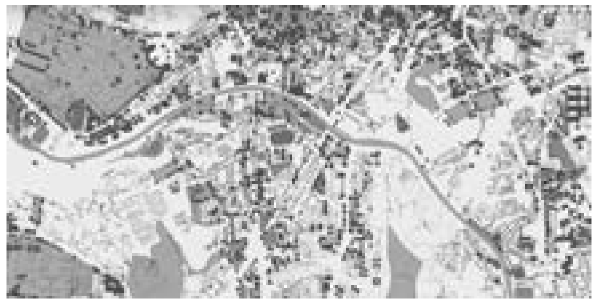
2
Urban Strategy : Successive Palimpsest

The urban strategy known as "Successive Palimpsest" introduces a fresh perspective to urban planning by delving into a profound comprehension of context and emergent processes. This approach places a significant emphasis on succession, primarily focused on establishing rules that wield influence over the

growth and evolution of urban fabric. Notably, these rules maintain a deliberate flexibility, striving to keep regulations as open-ended as possible while underscoring the paramount importance of achieving the utmost richness of outcomes.

The concept of "Palimpsest" within this strategy maximizes the utilization of existing contexts, allowing them to organically extend into new structures. It capitalizes on the inherent characteristics of the environment, such as existing routes, objects, and distinctive qualities, transforming them into catalysts for the generation of novel layers within the urban framework. This approach emphasizes a harmonious integration of the old and the new, embedding existing layers into the foundational rules that govern growth, thereby fostering a dynamic and adaptive urban development.

2.1



Digital Analysis

Digital analysis tools play a pivotal role in advancing our comprehension of urban sites. The precision offered by these digital tools, through meticulous data acquisition and measurements, contributes significantly to the attainment of accurate solutions and well-informed designs. By leveraging these tools, urban planners and designers gain the capacity to delve deep into the intricacies of a site, allowing for a nuanced understanding that extends beyond traditional methodologies. This precision not only enhances the accuracy of solutions but also fosters a more comprehensive and insightful approach to urban design, aligning with the evolving demands and complexities of contemporary city planning. In essence, the integration of digital analysis elevates the entire urban design process, empowering professionals to navigate challenges with a heightened level of precision and insight.

2.2
City Structure

The establishment of structure holds paramount importance in effectively organizing territory within urban planning. Within our framework, structured organization is facilitated through the utilization of a closest points diagram, illuminating the interconnectedness of various components and delineating coherent systems from disjointed ones. Employing this diagram alongside sophisticated algorithms, we strategically position new objects to foster the development of a sustainable and robust structure. By meticulously analyzing connectivity and leveraging algorithmic insights, we ensure the integration of new elements harmoniously within the existing urban fabric, thereby reinforcing the resilience and longevity of the urban environment. This approach not only enhances the functionality of urban spaces but also contributes to the creation of cohesive and enduring urban landscapes that cater to the diverse needs of inhabitants.

2.3
Case Study : BRNO.CZ - south centre

The location in the southern part of Brno is for urban experiments is very favourable. It is abandoned and almost forgotten area, which is, however, very well interwoven infrastructure of roads and railway lines.

The only thing missing are the mhd stops. Thanks to their absence, the area is cut off from from the rest of the city, and so it could be a successional biome that has developed into a very valuable bioculture. How to work properly with similar areas that are located in many larger cities is the whole and main theme of the palimpsest. The area is defined by the existing railway station, the freight station at Rosicka/ the future location for the new station/ and the station upper heršpice. Two main train lines define the inner space of the landscape biome where a floodplain forest has been created over the years. Preserve the existing qualities while proposing the possibility of development. We can say that the this is the area of the future Brno Manhattan with a real possibility of high rise building with a connection to the expressway train network.

Studio work by students of the Faculty of Architecture Brno under the supervision of Jiri Uran Vitek

Even though the **South Centre** lies in close proximity to the city's centre, it would be more deserving of the label Southern Periphery, as it lies on the 'periphery' in spatial, social and cultural terms.

Parks

Our area is the Brno Triangle - The part of the South Brno space that is not empty, however, is a place where activities are concentrated, which have a characteristic variability, liveliness and heterogeneity that is paradoxically richer where the long-term urban plans for its development have not yet come to fruition.

Transport

Insufficient public transport links. If comparing this area with the northern part of the city, it can be concluded that Brno South is considerably less well served by public transport than the northern part of the city.

One of the main problems is the insufficient connectivity of tram connections in the Brno triangle. The proposal seeks to address this issue by using tram loops on lines 10 and 12 to form circuits that make use of existing train tracks. (Berlin S-Bahn). The transport serviceability of an area is a very important factor for its development. The main intention is to link the newly proposed structures to each other, to the centre, to all kinds of transport, e.g. train transport with bus services, or even linking the visions of the future such as the Brno diameter or the Hyperloop.

/Studio work by students of the Faculty of Architecture Brno under the supervision of Jiri Uran Vitek

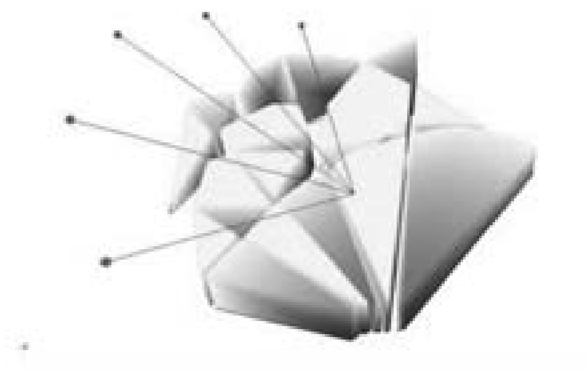
3 Basic Models

3.1 Parametric model

Following the completion of our analyses, we delved into deciphering the demographic capacities of Brno South inhabitants. Leveraging the Grasshopper program, we crafted a dynamic script by inputting specific parameters and interlinking them with other variables. This script served as a versatile tool for gauging resident capacity.

Key parameters included determining the population, alongside the pivotal consideration of residential/working area per inhabitant, contingent upon the area's developmental type and program. An integral element of the script was the inclusion of an attractor, typically a street or significant point/building tethered to the area, coupled with the incorporation of the street grid.

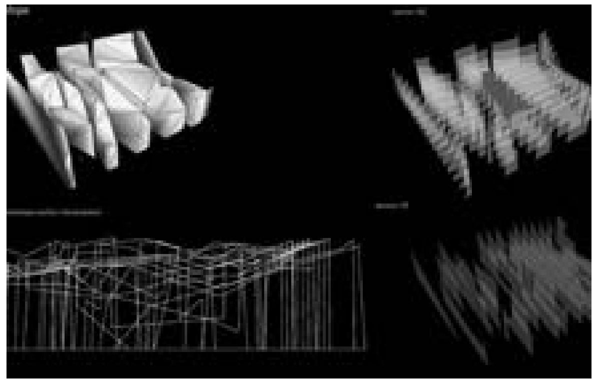
Our strategic approach rests upon a parametric model that engenders a systematic generation of objects governed by predefined rules. This model differentiates structures based on their purpose – residential blocks, 6-sided blocks for offices, and cylindrical structures for cultural/retail buildings. Employing an equation factoring in user count, a composition emerges on a refined grid, allowing for diverse combinations by manipulating the seed parameter. The immediate output manifests as a 3D model, enriched with volume and user count values, offering a comprehensive representation of the envisioned urban landscape.



3.2 Successive Palimpsest II. - Solar Envelope and Emergent cluster method,

The solar envelope concept works as a modernized dynamic planning tool corresponding to contemporary conditions and requirements, and a guide to urban design solutions for vacant lots in urban development, here specifically in the area of South Brno. Using this principle, we are completing the development of the sections around the planned urban park.

Successive Palimpsest II. - Solar Envelope Emergent cluster method,

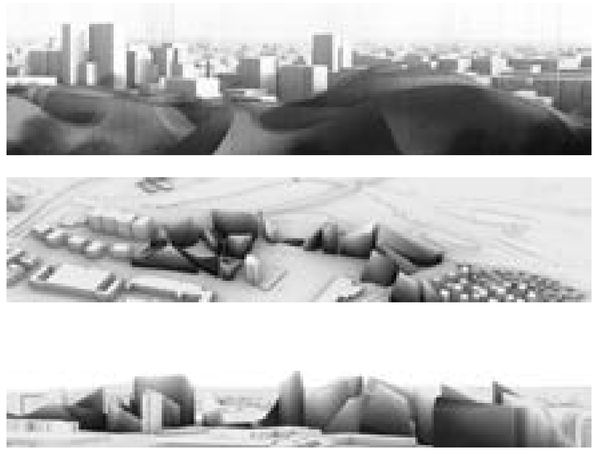


The first step is wooly paths, routes showing the most advantageous routes between the set points - attractors. The result is a network of paths and triangles that are further subdivided into points, and these points are then drawn to optimize the paths and cuts. Straight lines and routes in close proximity are connected. The result needs to be re-analysed and blocks drawn into the resulting networks and adjusted according to the local programme and the context of existing and future routes and streets. These shall be linked with the delineated blocks to existing developments to ensure that they are correlated and their relationship is balanced and to the necessary degree of continuity.

Each sub-plot has its own plan and envelope shape, which the client or architect "fills" with his design. It is assumed that in a certain paradox by setting these boundaries in 3 dimensions, a more form-rich development is created and individualisation is encouraged of individual blocks, whose plots are not in a regular grid, but create a variety of plan shapes and multiple 'covers' of envelopes that can be filled in at will construction. The envelopes are constantly updated, which in practice means that as development occurs, the envelopes of vacant plots respond to the addition of buildings.

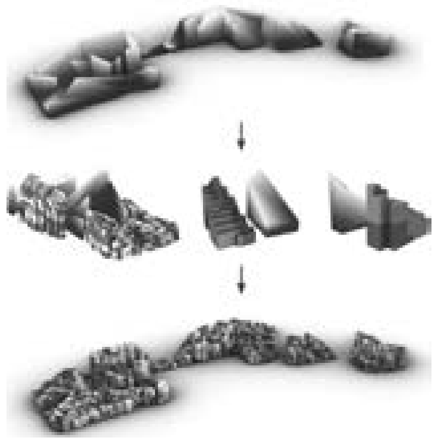
The shape of the envelopes themselves is determined by the priority of the largest solar gain for the plot and the 'vistas', gaps and cuts in the envelope, which are determined by landmarks - i.e. they allow visibility of certain sites and buildings.

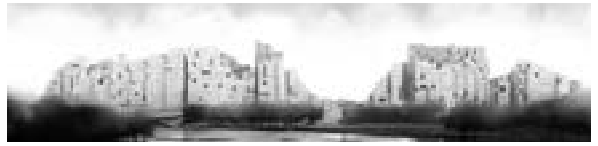
Successive Palimpsest III. - Solar Envelope and Discrete design method,

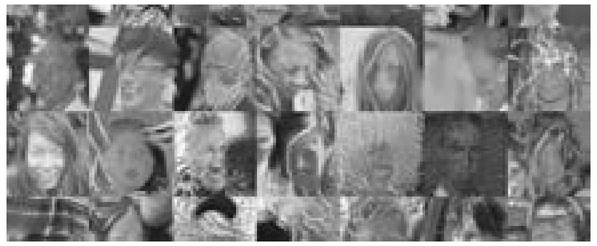


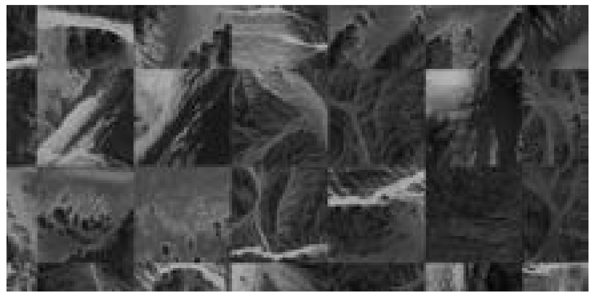
The strategic approach in Successive Palimpsest III integrates the Solar Envelope and the Discrete Design Method, both grounded in a parametric model.

Discrete design marks a promising paradigm shift in architecture, akin to the prefabricated building methods of the previous century. However, propelled by contemporary computational power and algorithms, this approach transcends traditional confines, enabling the creation of structures that are not only rich but also inherently intriguing. Emerging methods and technologies introduce novel qualities, enhancing the potential for diverse architectural expressions.









The resultant geometries are crafted through the Monoceros tool, a plugin for Rhinoceros/Grasshopper software developed by Studio Subdigital. Leveraging the Wave Function Collapse algorithm, discrete modules occupy the initial solar envelope. The distribution rules are guided by user-defined constraints, encompassing spatial relationships between modules, scale considerations, density, and more. Dynamic alterations, visible instantly, are achieved by modifying the seed and rules, providing a spectrum of design variations.

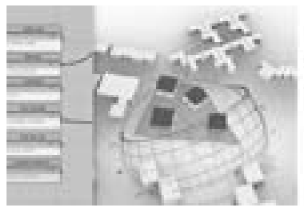
Underpinning this strategy is a parametric model that integrates our geometry with a stable diffusion AI algorithm. This amalgamation facilitates the seamless generation of visualizations for the proposed design. Through color labeling, contextual elements such as green for trees, grass, blue for water, and sky are identified, culminating in the rapid production of the final image within minutes. This innovative approach not only expedites the design process but also enriches it with a nuanced understanding of the proposed environment, fostering a swift and insightful transition from concept to visualization.

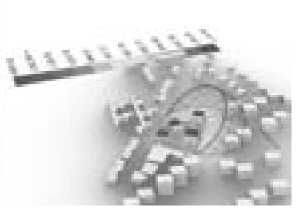
Pix2pix, Definition

Pix2Pix, a deep learning model and image-to-image translation technique, serves as a pivotal tool in urban design. Its primary objective is to transform input images into corresponding output images. Operating as a conditional generative adversarial network (GAN), Pix2Pix is versatile, designed for tasks such as image-to-image translation, image super-resolution, and style transfer.

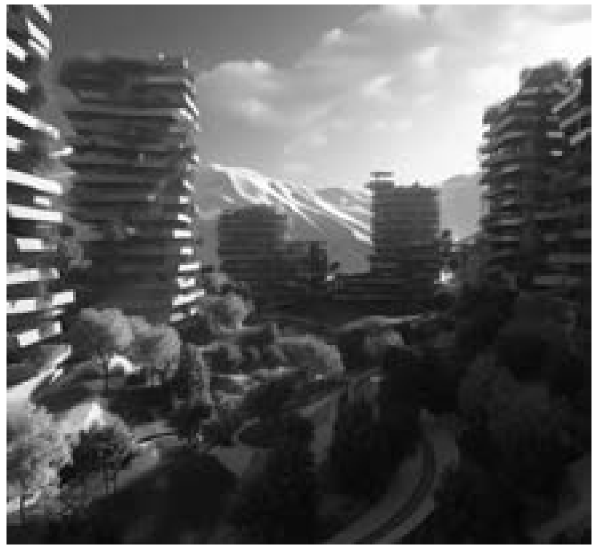
In the realm of urban design, Pix2Pix is harnessed to generate intricate images of urban areas. This involves utilizing a basic dataset comprising cadastral maps and building shapes. In our case study, a comprehensive dataset is meticulously crafted, encompassing terrain contour lines, cadastral lines, and schwarzplan of the existing urban area, along with a comparable dataset of aerial images of these locations. The subsequent step involves training a deep learning model on this dataset.

Advancing to the next phase, a new set of images is generated, illustrating the proposed urban design. These images are then processed through the trained deep learning model, culminating in the creation of a sophisticated plan delineating the landscape structure. This iterative process showcases the adaptability and efficacy of Pix2Pix in transforming basic datasets into intricate urban design representations.





3.3
Urban Generator



The Data-Driven Generator stands as a pivotal component in our architectural methodology, leveraging the capabilities of artificial intelligence to derive optimal solutions. At its core, this strategy involves a meticulous determination of the number of elements and the range of their sizes, encompassing plan dimensions and height. The algorithm then orchestrates a comprehensive exploration of potential placements for these elements, with a dual objective: maximizing exposure to natural light and calculating essential metrics such as volume, floor area, and volumetric cost.

The algorithm operates as a dynamic decision-maker, strategically positioning architectural elements to not only harness the highest solar gain but also to afford the best possible views. This is quantified through the measurement of the so-called vista area, ensuring that the resulting architectural solutions are not only functionally efficient but also aesthetically pleasing.

Throughout this intricate process, several key parameters are meticulously measured to assess the viability and success of the generated designs. These parameters include volume, floor area, the number of floors, illumination levels, vista metrics, and cost considerations. By integrating these factors into the decision-making process, the algorithm aims to identify the most optimal solution tailored to the specific task or design challenge.

This data-driven approach represents a paradigm shift in architectural design, emphasizing efficiency, sustainability, and a holistic consideration of the built environment. The resulting structures are not merely products of creative vision but are finely tuned to meet functional requirements, enhance the user experience, and align with broader architectural and environmental objectives. The Data-Driven Generator thus emerges as a powerful tool, guiding architects towards solutions that seamlessly blend innovation, functionality, and environmental consciousness in the ever-evolving field of architectural design.

3.4
Urban Generator & Stable Diffusion Model

From basic model to illustration - With the Curating AI algorithm, we can easily achieve atmosphere for the project.

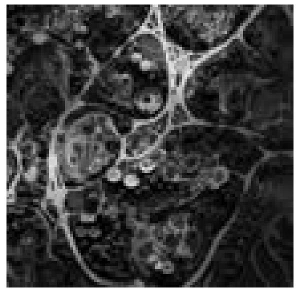
The integration of the Stable Diffusion Model amplifies the efficiency and precision of our architectural design process, particularly in the generation of conceptual ideas. The synergy between the Data-Driven Generator and the Stable Diffusion Model not only expedites the design phase but also enhances the accuracy of our creations.

The Stable Diffusion Model operates as a transformative force, rapidly translating raw data into refined conceptual images. This accelerated process is instrumental in the early stages of design exploration, allowing us to swiftly iterate through various ideas with an unprecedented level of accuracy. The stability and predictability inherent in the model contribute to its remarkable efficacy, ensuring reliable results while managing noise and randomness within the generative process.

As we transition from the basic model to the illustrative phase, the Curating AI algorithm comes into play. This algorithm serves as a curator, enabling us to infuse a distinct atmosphere into the project. Through a nuanced understanding of design prompts, image inputs, and dataset curation, the Curating AI algorithm refines and shapes the generated visuals, transforming them into compelling illustrations that encapsulate the envisioned ambiance for the architectural project.

In essence, the collaboration between the Data-Driven Generator, Stable Diffusion Model, and Curating AI algorithm signifies a transformative leap in architectural design. It empowers us to seamlessly navigate from data-driven optimization to artistic curation, ensuring that our projects not only meet functional criteria but also evoke specific atmospheres and resonate with the intended aesthetic and experiential qualities.

3.5 Stable Diffusion, Data Set Training



The use of the stable diffusion model is based on generating an image from a text prompt. The dataset is a collection of thousands of labelled images that the model recalibrates amongst themselves to achieve the most accurate result as specified. The important thing is that by generating the dataset itself, you get your original dataset which is then reflected in your new images. You create your own unique architectural language.

In essence, a stable diffusion AI model transforms random data into a desired output through a controlled, probabilistic process, with stability and predictability at its core. There is an amazing potential to be accurate and visual at the same time by combining a precise mathematical and parametric model with a trained stable diffusion model.

In our architectural pursuits, the deployment of the Stable Diffusion Model emerges as a sophisticated methodology, predominantly focused on generating images based on textual prompts. The dataset, an extensive collection of thousands of meticulously labeled images, undergoes a recalibration process within the model. This recalibration is an intricate dance among the images, seeking the most accurate and contextually aligned results as dictated by predefined criteria. What makes this approach particularly captivating is its intrinsic capacity to generate its dataset, thereby birthing a distinctive architectural language that reverberates through the fabric of the generated images.

At its essence, the stable diffusion AI model operates as an alchemist of randomness, transmuting disparate data into coherent and desired outputs through a controlled, probabilistic process. Stability and predictability are the pillars that uphold this transformative journey. The convergence of a precise mathematical and parametric model with a trained stable diffusion model presents an extraordinary potentiality, not merely for accuracy but also for infusing the visual realm with richness and depth simultaneously.

Delving deeper, the model unfolds its versatility by accommodating a reverse process, an intricate dance from the target output back to the initial input. This bidirectional capability allows the model to engage in tasks such as data generation and denoising. The training phase is a crucial juncture where the model imbibes optimal parameters and distributions for the diffusion process, meticulously minimizing the divergence between generated and authentic data. The focus remains steadfast on crafting a stable, controllable generative process, skillfully navigating the realms of noise and randomness to birth reliable and nuanced results. The input parameters, spanning from pictures to text prompts, orchestrate a symphony that culminates in the production of image outputs, each telling a unique story.

In the realm of urban planning, the stable diffusion model proved its mettle as it ingested inputs such as orthophotomaps and responded to text prompts like “Top view natural and artificial system blending.” The dataset burgeoned with over 3400 tasks, contributing to the formation of a unique architectural lexicon. Gradual

curation and meticulous balancing acted as the artisan’s touch, transforming the generic into the bespoke, utilizing prompts ranging from “successive palimpsest” to minutely detailed descriptors.

Creating a master plan with urban implications posed a challenge, given the generic nature of datasets. Enrichment from diverse fields such as physics and biology became imperative, mirroring the principles of GAN neural networks. The prompts, evolving from simplistic notions to intricate, detailed descriptors, reflected the multifaceted nature of the architectural vision.

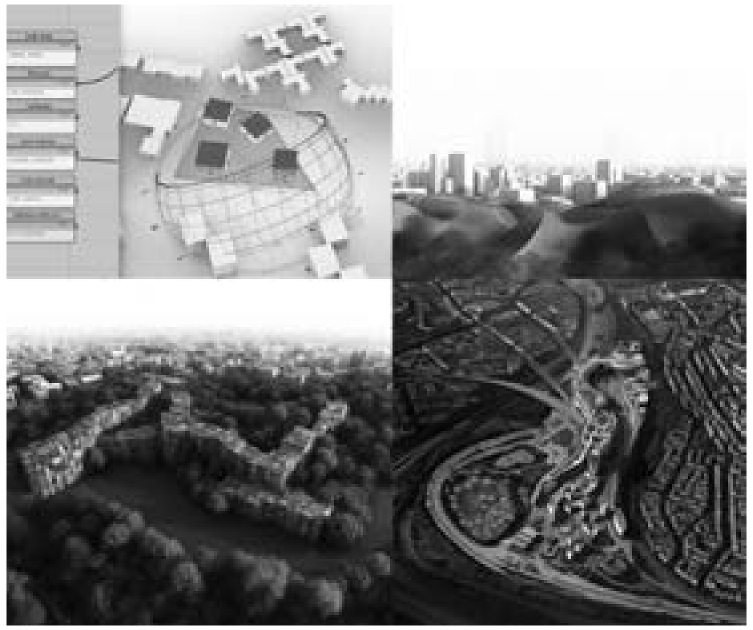
The curation process emerged as the linchpin in selecting preferable solutions, a nuanced journey that involved gradual refinement and enrichment with intricate details. The openness of the system democratizes this transformative process, making it accessible to a broad spectrum of enthusiasts. The resulting images, laden with architectural significance, serve as a canvas that can be further developed into immersive 3D representations, offering a versatile and accessible platform for architectural exploration and innovation.

In the specific context of roofs and courtyards, the stable diffusion model emerges as a harbinger of change, exploring their potential to seamlessly blend artificial architecture with nature. Roofs, once mundane structures, transform into canvases for sustainable integration into the urban landscape, manifesting as clusters within living cities. Courtyards, characterized by increasing complexity, layers, and fragmentation, emerge as dynamic structural spaces contributing to the intricate tapestry of the urban fabric, adding depth and functionality to the architectural vision.

4 Conclusion

Contemporary generative methods stand as invaluable assets in the realms of architectural and urban design. They liberate us from the confines of blind design, offering a harmonious marriage of analytical prowess and creative ingenuity through computational means. From leveraging genetic algorithms to harnessing the power of Artificial Intelligence (AI), these tools empower us to iterate through intricate solutions that would otherwise pose daunting challenges, if not impossibilities, due to their inherent complexity.

Crucially, setting a clear intention remains paramount in this symbiotic relationship with technology. Computers, while exceptional aids, are not autonomous architects;



they require our intentional guidance. The synergy between generative parametric models and creative AI emerges as a dynamic duo, amplifying our design capabilities significantly. The intricate dance between these two methodologies allows us to delegate the more routine aspects to the computational prowess of machines, freeing up creative bandwidth for human input.

Through comprehensive research endeavors, the significance of integrating both generative parametric models and creative AI becomes evident. Their collaborative application unfolds as a powerful tandem, enhancing our capacity for design thinking. This approach is not about relinquishing control to machines but rather about smartly distributing the workload. While generative parametric models bring analytical rigor to the table, creative AI infuses a touch of inventive finesse. Together, they extend the boundaries of what can be achieved, making the design process more efficient, robust, and innovative.

In essence, the contemporary designer’s toolkit is incomplete without the harmonious integration of generative parametric models and creative AI. As architects and urban planners, we wield these tools not as replacements for our creative faculties but as force multipliers that amplify our vision. By harnessing the computational capabilities of these technologies, we can navigate the intricate landscape of design challenges with dexterity, paving the way for a future where the marriage of human ingenuity and computational prowess defines the forefront of architectural and urban innovation.

4.1
...Towards the Future

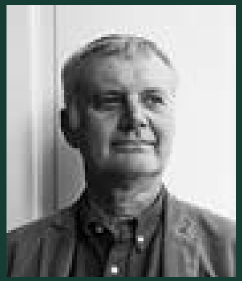
As a united team of architects and researchers dedicated to the realms of digital design and fabrication, our journey propels us towards the future. Within the collaborative folds of ICE, a company where ICE architects converge their expertise, we've meticulously crafted a pioneering solution for 3D printing concrete. Over the past two years, our endeavors have focused on pushing the boundaries of construction, envisioning applications ranging from residential homes to prefabricated structures and protective enclosures. Our approach is grounded in the fusion of parametric and AI methodologies, unlocking new dimensions in efficiency, precision, and design innovation.

In the picturesque setting of Zdar nad Sázavou, we invite you to witness firsthand the fruits of our labor. A warm welcome awaits, as we extend an invitation to explore the cutting-edge progress we've achieved in the realm of digital design and concrete 3D printing. Our team, comprising Jiří Uran Vítek, Michal Mačuda, and Kristýna Uhrová, spearheads this transformative journey. Additionally, we're proud to acknowledge the contributions of our talented students from the Faculty of Architecture at the Brno University of Technology: Mariana Kubová, Petr Malásek, Hodulíková Diana, Jan Peřina, and Nikola Pokupec. Together, we stand at the forefront of innovation, shaping a future where architectural ingenuity converges seamlessly with advanced technologies.

Conclusion

Diego Zoppi

ACE Executive Board Member
Coordinator of ACE thematic Area 2 '
Practice of the Profession'



Artifical Intelligence:

Technology has been invented a new relationship between man and machine.

* What are the respective roles?
* Which will be the target and which will be the tool?

1. Approach to Technological Evolution

In its long historical journey, human civilization has often faced technological evolutions capable of altering its course. Occasionally these evolutions have been so profound and rapid that they have become "inventions" and become Milestones between one era and another.

These moments, increasingly frequent as we approach the present, always arouse a mixture of awe and excitement. There are always clashes between the most optimistic, who are able to glimpse "positive" uses that can solve problems, and the skeptics, fearful of negative consequences. It is happening in this decade of the 21st century, when the current exponential increase in the capabilities of computers, together with the use of Big Data, available on the web for every matter, has changed the nature of computing tools and with them the role that technology has assumed in our lives.

2. The quantative change of a phenomenon determines it's qualitive change

The philosopher Georg Wilhelm Friedrich Hegel stated that the quantitative change of a phenomenon creates qualitative changes capable of modifying the landscape around us (and as architects we cannot underestimate this concept, figuratively and literally) - and this is what has happened by introducing algorithms into new computers that, using probabilistic computation, link data in an "intelligent" way giving answers to very complex questions and tasks. Dialoguing with each other, the new machines are able to enrich their knowledge and implement their skills by copying neuronal learning mechanisms typical of the biological intelligence of living beings. The term Artificial Intelligence has been coined. The highly suggestive term has further increased the excitement and apprehension about an evolution/invention that changes the Man/machine relationship, redefining their respective roles in unprecedented ways. AI's performances surprise even the programmers themselves, notwithstanding the limitations imposed by being a machine. Nevertheless, the swirling evolution of the results raises high expectations, and millions of people have generated a new mass phenomenon by entrusting chatbots with portions of their daily activities.

3. Technological Evolution no longer changes only simple and repetitive human activities

Technological evolution has always eroded (and modified, sometimes nullifying, thankfully) the most strenuous or repetitive human tasks (think of the plough) but now, technology has become so sophisticated that it has eroded human tasks and conceptual trades and is now close to eroding even the most sophisticated intellectual performances.

For several decades, architects (like many other professionals) have been making use of digital tools that not only aid the representation of their designs, but control them in static, technological, economic, temporal, environmental and urban planning respects. However, they are tools that until now have fulfilled technical functions; the purely creative function has always been the prerogative of the architect. Today some programmes provide decidedly original and complex descriptions or images, the result of mixes of reference images found on the internet, duly modified according to the instructions received.

4. New questions related to artifical intelligence in transformations of the built environment

Those we are dealing with today are new, digital, expert, thinking companions who, on demand, can then intervene in some choices, directly aiding the creative and technical process. This possibility, certainly interesting and useful, introduces new issues hitherto unexplored.

Ethics, Intellectual Property, creativity, accountability, transparency, privacy, original creation - hitherto human prerogatives, in that only human activity made choices based on its own sensibility and capacity - are now aided (or contaminated) by aids external to our minds. We need to ask ourselves who will perform the checks that the external inputs proposed by learning machines will take place according to principles consistent with those we use on a daily basis and which assign the principle of "collective interest" to our craft. "general interest"?

Because of its enormous potential, AI immediately became the focus of interest of large companies that are enjoying the new economic perspectives it offers. Given the nature of a major "influencer" on the one hand and an economic accelerator on the other, the question arises as to whether AI should be used more freely or more regulated.

Different Governments are thus opting for more liberal or regulatory choices of AI depending on their social and political inclinations.

The difficulty of making the algorithms behind AI programmes transparent makes the way the programmes act undecipherable, so setting guidelines for its shared and non-threatening use seems more necessary than ever. Its fast evolution makes it even more elusive so the European Parliament has seen fit to mandate the EU Commission to regulate AI.

5.
A.I. Act- The first regulatory act on the use of artificial intelligence

The EU COM approved the AI Act on 9 December 2023 - the first Legislative Standard that sets out rules on the use of AI to avoid uses that are contrary to ethical principles shared by member states.

What are these Principles?

The AI Act seeks to establish a safety framework for AI use, emphasising the protection of human rights and the promotion of innovation.

Measures include:

Restrictions on Biometric Identification.

The agreement introduces restrictions on the use of biometric identification systems in public spaces, requiring judicial approvals and clearly defining the crimes for which they can be used.

The use of these technologies will be limited to cases such as searching for victims of kidnapping, preventing terrorist threats or identifying suspects of serious crimes.

Specific prohibitions on the use of Artificial Intelligence.

Practices such as biometric categorisation based on sensitive characteristics (political beliefs, religious beliefs, race), indiscriminate collection of images to create facial recognition databases, emotion recognition in the workplace and schools, social scoring and the use of AI to exploit individual vulnerabilities are prohibited.

There are very severe economic penalties for violators; in addition, individuals or entities can file complaints with the relevant market supervisory authorities for non-compliance with the AI Act, with the guarantee that the complaint will be properly handled according to the authority's procedures.

Implications for High-Risk System

The agreement establishes strict requirements for AI systems considered to be high-risk, including those used in election contexts or to influence voter behaviour. Such systems will have to undergo fundamental rights impact assessments.

In addition, citizens will have the right to file complaints and demand explanations regarding decisions made by these systems.

However, support for Innovation, especially for small and medium-sized enterprises (SMEs), is provided.

The regulation excludes from its application systems used solely for military or defense purposes. Similarly, the agreement states that the regulation will not cover artificial intelligence systems used solely for research and innovation purposes, just as it does not apply to those who make use of AI for personal and non-professional purposes.

European Commission A.I. Office

To ensure compliance with the new European rules on artificial intelligence (AI), an AI Office will be created within the European Commission. This office will be tasked with overseeing advanced AI models, promoting standards and testing practices and ensuring enforcement of the rules in all Member States. A group of independent experts will advise on AI, helping in the development of methodologies for evaluating AI models and monitoring security risks. The AI Committee, composed of representatives from Member States, will act as a coordinating and advisory body, playing a key role in implementing the regulation. An advisory forum, involving various stakeholders, will also be established to provide technical expertise to the AI Committee.

Conclusions on EU rules for artificial intelligence.

This agreement represents a significant step in addressing the challenges posed by AI, seeking to balance technological progress with ethical values and human rights.

As Europe positions itself as a leader in responsible AI innovation, the world is watching closely, reflecting on how such regulations could shape the future of artificial intelligence globally.

6.
ACE-CAE and A.I.

Since 2022, - aware of the great creative potential and the responsibility that its use entails - the Architects Council of Europe (ACE-CAE) has initiated an ongoing activity of knowledge dissemination and promotion of AI in architecture, believing this revolutionary tool to be a great opportunity for architects and their role in society.

ACE guidelines

Architects for innovation

ACE encourages the creative and innovative use of digitisation.

Artificial Intelligence (AI), was recently revealed as a logical development of digital processes that started in the late '90s. In this context, ACE aims to study and identify the role, opportunities and awareness required to facilitate the introduction of this new technology into architects' practices, client interactions and legislative considerations. To achieve this, ACE has been actively engaged in studying AI for the past year, organising conferences and funding its research initiatives. This document outlines ACE's basic guidelines on various themes concerning AI.

Ethics and Creativity

Architecture is a profoundly ethical profession. Certain architectural services demand the human touch, making them resistant to being replaced entirely with AI.

Key Points:

1. AI as a Creative Tool – AI algorithms currently lack the capability to provide context, abstraction, analogy, or imagination. AI creativity relies on interpolating existing patterns.
2. Copyright – As AI becomes more autonomous in the design process, concerns about potential copyright infringements or design flaws may arise. Determining the line between derivative works and original creations could prove challenging.
3. Client Communication and Empathy – Architects need to build relationships with clients and interpret their subjective desires, which may be difficult for AI to fully replicate.
4. AI tools must not misuse clients' behaviour or influence decision-making (in relation to directives).
5. Context and Cultural consideration – Architects must account for the local environment, climate, community and cultural aspects, which may require an understanding of human values and sensitivity that AI may not possess.

Regulatory Framework at EU Level

The EU AI Act focuses primarily on AI systems categorised as "high-risk" - those posing significant risks to safety, health or fundamental rights. ACE advocates for AI systems that work within established regulatory frameworks in the built environment rather than creating separate, potentially overly broad AI-specific regulations that could lead to fragmentation and disputes.

Key Points:

1. Conformity Assessment – High-risk AI systems used in architectural and engineering processes must undergo mandatory conformity assessments to ensure they meet necessary requirements and safety standards before market placement or use.
2. Consumer Protection – Architects should understand how AI algorithms function, the origin of datasets and their adequacy. Similarly, clients need to be informed about the capabilities and limitations of the AI systems with which they interact.
3. Liability and Safety – As AI becomes more involved in architectural and construction processes, questions arise about liability and safety concerns. Manufacturers and developers could be held accountable for damages caused by high-risk AI systems.

Practice and copyright

With AI, the use of cloud services for data storage and management becomes imperative. ACE highlights key issues concerning ownership, storage and third-party use of project data and datasets.

Key Points:

1. Project Data usage – Architects and firms shall carefully consider licensing terms and intellectual property rights related to the data used for training AI algorithms.
2. Copyright considerations – Architects should assess whether using AI to modify existing copyrighted designs falls under the "fair use" doctrine or constitutes a new and distinct creation protected by copyright law.
3. Licensing Models – If AI-generated designs are intended for mass distribution or use by multiple parties, establish licensing models and usage terms to protect the rights of all involved parties. International copyright laws and agreements may be necessary for AI-generated designs used across borders.

Additional practical advice for architects :

1. Software and Tools: AI-powered architectural software and tools might have associated costs. For instance, there is AI-based design software that can generate building layouts, optimise energy efficiency and assist in parametric design. The fees for such tools can vary based on the features, capabilities and licensing models.
2. Training and Implementation: If an architectural firm decides to incorporate AI into its practices, there might be training costs associated with educating architects and staff about the AI tools and methodologies. Additionally, implementing AI systems and integrating them into existing workflows could require investments in infrastructure and personnel.
3. Customised AI Solutions: Some architectural firms might opt to develop customised AI solutions tailored to their specific needs. Developing such solutions might involve hiring AI specialists or working with AI development companies, which could incur fees.
4. AI for Automation: AI can automate repetitive tasks, such as generating 3D models, conducting simulations or analysing data. By automating these processes, AI can potentially reduce labour costs and improve efficiency.
5. Data Collection and Analysis: AI relies on data for training and decision-making. Architectural projects might require data collection efforts, such as site analysis, user behaviour data or environmental data. The costs for data acquisition and analysis should be considered.
6. For the support of small companies shall be considered: Subsidies or Financial Aids: Programs to help small practices adopt expensive technologies. Training Programs: Accessible training to upskill small firm architects in AI and BIM without significant investment. Collaborative Platforms: Encouraging collaborative platforms that allow small firms to access AI tools and resources collectively.

ace-cae.eu

Architects’ Council of Europe
Conseil des Architectes d’Europe

The Architects’ Council of Europe is the representative organisation for the architectural profession at European level: it aspires to speak with a single voice on its behalf in order to achieve its aims.

Through its 51 Member Organisations, ACE represents the interests of over half a million architects from 35 countries in Europe.

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