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Relating systems thinking and design V

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Editorial

RSD6. Linking systems thinking and design thinking in architecture and urban design

The Relating Systems Thinking and Design Conference Series started at the Oslo School of Architecture and Design as a seminar arranged by Birger Sevaldson and his co-teachers in 2012. It emerged out of the need to search for alternative ways for designers to deal with complexity. Systems perspectives have a long history in architecture and design. However, systemic approaches in design have not made it to the forefront of the profession or academic design research. The reasons for this are many, but central is the question of linking systems thinking with design thinking and practice. Taking on this challenge has been the main goal for the RSD conferences, as it also has been for the informal emerging network that was formalized in 2018 as the Systemic Design Association (SDA). RSD conferences have taken place in Oslo at the AHO - Oslo School of Architecture (RSD1 2012, RSD2 2013, RSD3 2014 and RSD6 2017), in Banff (RSD4 2015) and Toronto at the OCADU – Ontario College of Art and Design University (RSD5 2016), in Torino at the Politecnico di Torino (RSD7 2018) and in Chicago at the IIT - Illinois Institute of Technology (RSD8 2019). These efforts have resulted in an international network and emerging field for design professionals and academics.

The sixth Relating Systems Thinking and Design Symposium (RSD6 2017) was held at the Oslo School of Architecture and Design in Norway in October 2017. The central theme of the symposium was "Environment, Economy, Democracy: Flourishing Together", and called for contributions on democratic participation and policy innovation, sustainable business innovation, flourishing communities, and related systems-thinking-oriented approaches to architecture, settlements and the built environment. A wide range of contributions addressed themes, such as social impact in flourishing and change programs, health and population wellness, ecological design and bioregion development, human-scaled and regional economies, related sociotechnical and technological systems, etc. Yet, while the five earlier symposia did receive a number of papers that were focused on architecture and urban design, RSD6 was the first RSD symposium with a dedicated paper session on architecture and urban design. This special issue of *FormAkademisk* collects together five of the papers that focus on architecture and urban design from a linked systems-thinking and design-thinking perspective. Each article pursues a distinct theme concerning the development of the profession, performance-oriented architecture and urban design, the role of exterior space in rethinking the architectural envelope, and questions of participation and community building. This breadth of themes in the selected articles indicates the increasingly deep impact of systems-thinking in the fields of architecture and urban design.

The history of architecture is rich in systemic approaches to the subject matter, starting from Vitruvius' treatise "De architectura" (*Ten Books of Architecture*) and onward. When the discipline of architecture was formally established circa 1800, systemic approaches continued, such as, for instance, in the work of Jean-Nicolas-Louis Durand who set forth the notion of type in architecture in "Recueil at parallèle des édifices de tout genre anciens et modernes". It is generally believed that Durand was inspired by advances in the then also newly formalized

discipline of biology, and more specifically by Cuvier's advances in comparative anatomy, who in turn was inspired by Linnean taxonomy. In such works, the focal point was invariably the architectural object, the building with its expression and appearance. Nonetheless, intense differences prevailed among many architects and authors that engaged in systemic treatment or that rejected it as hampering creativity.

The early 20th century witnessed the emergence of the discourse on form and function, which further fuelled arguments regarding what the subject matter of architecture is or ought to be and therefore, what and to what extent should be systematically treated. Systems and the notion of performance in architecture began to take shape in the 1930s in the context of the work of the Structural Study Associates (SSA) (Buckminster Fuller, Fredrik Kiesler, Carl Theodore Larsen, Knut Lönberg Holm, et al.). Suzanne Strum noted that the SSA, "propagated a radical technologist and productivist manifesto that anticipated the systems and communication theory that emerged in the post-war era. Their position regarding advanced technology and information has a contemporary resonance. Already in the early1930s, the SSA introduced such seemingly postmodernist terminologies as performance, emergence, emergency, ephemeralization, biologic design, networks, mobility, flows, decentralization, ecology and entropy" (Strum, 2012, p. 35).

With an expanded take on the object and its interaction with the environment systems, theoretical reflections and methods and systems-thinking took hold in various approaches to architecture. A first marked peak of the notion of systems as well as performance occurred in the period from the late 1950s to the late 1960s as part of a predominately hard-systems-theoretical approach to design problems in architecture and engineering, the utilization of cybernetic approaches (Sukrow, 2018) and models and the advent of the use of computers in architecture. Important foundational works took shape throughout this period (see e.g., Alexander, 1964; Forrester, 1969; etc.) and culminated in a series of publications focused on the topic of *performance design*, such as, for instance the August 1967 issue of *Progressive Architecture* under the same title. While the underlying engineering-based hard systems approach was soon rejected by mainstream architects, particular systems-based approaches nevertheless continued in specific circles yielding quite some attention, such as, for instance, Jay Forrester who initiated and developed system dynamics and especially urban dynamics in the 1960s and 1970s, with the aim of modelling the behaviour of complex systems.

With the emergence of actor network theory (Latour, 2005), systems-oriented design (Sevaldson, 2013), as well as a second peak of the notion of *performance* in architecture and the arrival of performance-oriented architecture and urban design (Kolarevic & Malkavi, 2005; Leatherbarrow, 2009; Grobman & Neuman, 2012; Hensel, 2010, 2011, 2013; Hensel & Sunguroğlu Hensel, 2019), softer systems approaches began to spread more widely supplementing more engineering-related harder systems approaches in architectural and urban design. Advances in environmental considerations, participatory design (Simonsen & Robertson 2012), as well as discussions focusing on expanded stakeholder notions derived from actor network theory that include nonhuman actors (Grusin 2015) furthered the need and use of expanded systems thinking. This as well as increased research efforts in architectural practice and education are beginning to make an impact on the transformation of the discipline. The selected articles give evidence of these developments.

Articles in this issue

The first article by ***Michael U. Hensel*** *and* ***Søren S. Sørensen*****,** entitled *Performance-oriented architecture and urban design - Relating information-based design and systems-thinking in architecture,* examines a performance-oriented approach to architectural and urban design that focuses on the interaction between architecture and its specific local settings and environments. The authors' aim is to expand performance-oriented design in architecture to urban design and to integrate architectural, urban and landscape design into a multi-scalar and multi-domain approach. As such, this research is elucidated along three individual research-by-design efforts

that include: first, designs for urban areas with focus on demographic and environmental aspects; second, designs for peripheral areas with focus on preserving or restoring vital local bio-physical conditions and interrelations; and third, designs for rural areas that elaborate an integrative approach towards constructions and correlated land uses. This approach links computational information-based design with systems-thinking and design-thinking aspects and was undertaken at the Research Centre for Architecture and Tectonics and the Advanced Computational Design Laboratory at the Oslo School of Architecture and Design.

The second article by ***Sareh Saeidi***, is entitled *Envelopes and exteriority - Local specificity and extended exterior as design criteria for architectural envelopes*. This work also examines the relationship of architecture to its surrounding environment. Here the objectives are to reposition the relationship of architecture and its surrounding exterior by expanding the understanding of architectural envelopes and to investigate and define exterior space as design input. The research systematically establishes key terms, pursues case studies that consider exteriority as design criteria, and furthermore, involves research-by-design inquiry to combine a systematic approach with design thinking through design experiments. The discussion focuses on conceptual and method-oriented approaches with the aim to develop an integrated design approach focused on climatic and atmospheric performances of architectural envelopes. Sareh Saeidi is a researcher and doctoral candidate at the Research Centre for Architecture and Tectonics and the Advanced Computational Design Laboratory at the Oslo School of Architecture and Design.

The third article is by ***Jotte de Koning, Emma Puerari, Ingrid Mulder and Derk Loorbach*** and is entitled *Landscape of participatory city makers - A distinct understanding through different lenses*. It starts from the premise that "today, citizens, professionals, civil servants, social enterprises, etc. form different types of coalitions in order to overcome the challenges that our modern cities face". The article examines the characteristics of these different groups and describes ten distinct types of city makers. The authors acknowledge that these types of city makers can all bring value to the city, but posit that this value can be increased through participatory approaches "to stimulate cross-overs and accelerate the transition towards sustainable futures". With this, the discussion of participatory city makers commences, which proposes that participatory approaches, interactions and networks need to be developed along with improving conditions for possible innovation. The authors develop approaches by way of joint design and systems thinking to explore and elaborate the transformative potential of different types of participatory city makers that they see vital to flourishing and sustainable communities.

Article four by ***Helen Avery and Nihal Halimeh*** is entitled *Crafting futures in Lebanese refugee camps - The case of the Burj El Barajneh Palestinian camp*. The article portrays an initiative at the Burj El Barajneh camp which is run by a network of local associations. The initiative "aims at improving living conditions, services, infrastructure and livelihoods for the inhabitants". The camp has a large number of active associations and many educated professionals that are valuable resources. However, the authors caution that any intervention in the dense context of the camp can have significant consequences and needs therefore to be considered with great care. Furthermore, the authors point out that prototypical solutions may be inappropriate and ill-adapted to local circumstances. Due to this realization, the authors explored a different approach based on collective design and collaboration that involved the inhabitants of the camp. This includes "systemic design as situated and socially positioned practice" as well as "action-oriented design approaches in community settings".

The fifth article is by ***Christos Chantzaras*** and is entitled *Architecture as system & innovation design discipline - A retrospective on architectural programming and its implications for the strategic extension of the discipline of architecture*. In his article, Chantzaras posits that "talking about architecture means talking about buildings, but also talking about processes or systems" and that "architecture is a way of thinking and looking at people, spaces, interrelations and interactions". The article examines characteristics of

architects that work with context and complexity based on the practice-oriented architectural programming method, an approach from the 1960s that offered architects a basis for applied architectural design thinking. However, this approach did not receive broad attention from practitioners and academics. In this article, the method is discussed and compared to design thinking in industrial design. This involves detailed discussion of a real-life project and students' works from a seminar at a department of architecture at the Technical University in Munich. The article examines current and future relevance of an advanced version of architectural programming for architectural practice and education and concludes with an emphasis for strengthening the core skills of architects by developing a design thinking method rooted in architecture and that architecture should be understood as a "systems & innovation design discipline" in fields of systems thinking and innovation research.

This collection of five articles can only give a first impression of just how broad the impact of linking systems thinking and design thinking has become, not only in architecture and urban design but also in landscape design. It seems reasonable that this trend will persist. For one, the coupling of systems thinking and design thinking with objects and systems is beginning to erode the artificial dichotomy between form and function that has divided architectural discourse for a century. It will be interesting to see how far and in what way the RSD conferences will continue to play an active and strategic role in this development.

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Michael U. Hensel and Søren S. Sørensen

Performance-oriented architecture and urban design

Relating information-based design and systems-thinking in architecture

Abstract

This article discusses a performance-oriented approach to architectural and urban design that seeks to intensify the interaction between architectures and their specific settings and environments. The overarching aim is to expand performance-oriented design in architecture to urban design and to integrate architectural, urban design and landscape design into a multi-scalar and multi-domain approach. This effort is currently comprised of three distinct research by design efforts: [i] designs for urban areas with a focus on demographic and environmental aspects, [ii] designs for peripheral areas with a focus on preserving or restoring vital local bio-physical conditions and interrelations, and [iii] designs for rural areas that elaborate an integrative approach towards constructions and correlating land uses. In order to facilitate this approach, computational information-based design is linked with systems-thinking. The portrayed research was undertaken at the Research Centre for Architecture and Tectonics and the Advanced Computational Design Laboratory at the Oslo School of Architecture and Design over a period of five years from 2014 to 2018.

***Keywords*:** architecture and environment interactions, performance-oriented architecture, performance-oriented urban design, integrated architecture, urban and landscape design

Introduction

This article describes an approach to the relationship between architecture and performance that is predicated on architectures that are essentially *non-discrete* (Hensel, 2013, 2019; Hensel & Sunguroğlu Hensel, 2019). Such architectures display a deep correlation with their local setting, environment and culturally specific patterns of space and land use, instead of seeking to stand out against their settings as a primary design intent. This approach aims for expanded and intensified context and architecture relations as well as environment and architecture interactions. It is interdisciplinary, multi-scalar and multivariate in character. On an architectural scale, this implies the pursuit of a notion of local condition-specific *design systems* that occupy an intermediate position between universal prototypes and bespoke architectures. Such systems entail adaptable assemblages of parts that are particular to a range of context-specific conditions, instead of fully individual designs or homogenous repetition of a singular specified construction irrespective of context. Furthermore, these systems entail the development of a related computational design method that we have termed *information-based design*. In order to approach the involved complexity in architecture and environment interactions in a broad sense, systems-thinking is employed in the design process. The research is often interdisciplinary and research by design based.

The starting point of this research is a hypothetical position that assumes that urban outward growth and sprawl is suspended. This is done with the aim to facilitate re-orientation and the definition of an alternative approach to architecture and environment relations and linked broad-range sustainability aspects, including cultural, social and environmental sustainability. For this reason, the portrayed approach to architectural and urban scale performance is inherently inclusive, with the aim of encompassing cultural, social and environmental aspects. This aim entails a focus on new collective space and the integration of

architectural and urban design with landscape architecture and various forms of culturally specific land use (Hensel, 2012, 2013, 2019).

Primary focus is placed on the correlation between the local bio-physical environment and the spatial and material organization complex that constitutes architecture and the built environment, while at the same time incorporating the cultural and social aspects that are specific to a given context (Hensel, 2013, 2019). This foregrounds local aspects and conditions as drivers in defining the interaction of architectures with their settings as key inputs for generating architectural designs. For this reason, this approach is based on locally specific conditions and circumstances, as well as societal and environmental changes that require architectural responses that invariably go beyond the scope of current practice.

The portrayed approach to performance-oriented architecture seeks to finally resolve the perceived dichotomy between form and function in architectural discourse. It is rooted in Actor Network Theory (Latour, 2005) and ascribes the capacity of agency to nonhuman actants. This chiefly concerns other species, ecosystems, geophysical systems, etc.—in other words, key aspects of the bio-physical environment. These are understood as possessing agency in interacting with and constituting the environment. Employing both a human and nonhuman perspective (Grusin, 2015) in relation to performance-oriented embedded architectures—and, by extension, to performance-oriented urbanism—enables us to consider possible correlations between cultural, social and environmental sustainability by way of significantly extending the involved roster of potential 'stakeholders' (Hensel, 2017, 2019).

Thus far, the research portrayed in this article is comprised of three lines of inquiry:

1. designs for urban areas with a focus on demographic and environmental aspects;
2. designs for peripheral areas with a focus on local bio-physical conditions;
3. designs for rural areas that elaborate an integrative approach towards land uses that are typically seen as mutually exclusive.

The portrayed research is ongoing, and the long-term objective is to correlate the three lines of inquiry and to formulate an integrated approach from these three related lines of inquiry. The need for this research arises from increasingly complex design and sustainability requirements that are insufficiently addressed and resolved in current practice. Due to fast-developing sustainability requirements, there already exists a distinct need for design approaches that enable early stage multi-criteria design specification to meet advanced sustainability criteria. This need entails analysis and synthesis in early design stages, based on an understanding that design can constitute a specific mode of inquiry towards this end. Moreover, this research anticipates that the engaged researchers will acquire the capacity to formulate multi-stakeholder projects for which currently no client exists or no latent potential has been identified prior to the investigation. This requires an understanding of design as a deliberate mode of projective inquiry, as well as a systemic and systems approach to design that can serve to handle the involved complexity.

Research context

The research portrayed in this article took place in the context of the Research Centre for Architecture and Tectonics (RCAT) and the Advanced Computational Design Laboratory (ACDL) at the Oslo School of Architecture and Design. RCAT was founded and inaugurated in 2011 and was in operation until 2018. The centre pursued experimental and practice-oriented research, combining elements of traditional knowledge production with an inter- and transdisciplinary research by design approach. In the context of RCAT, researchers conducted inquiries in a range of subject areas focused on performance-oriented architecture, embedded architectures, locally specific architecture, urbanism and landscape architecture, architecture and environment interactions, informed non-standard architectures and information-based computational design. ACDL was the innovation laboratory of the research centre. It integrates

research and teaching on master- and PhD-levels based on the research subjects in RCAT, with specific focus on informed non-standard architecture and information-based computational design. Special focus is placed on the role of data in design, multi-modal data-collection and processing and advanced computational visualization methods, including augmented, virtual and mixed reality.

Research methods

The key research method deployed in the work discussed in this paper is research by design, which utilizes design as a projective method of inquiry. Research by design is frequently utilized in architecture, urban and landscape design with largely shared traits and strategies. Our approach shares the main characteristics of research by design in landscape architecture as outlined by Lenholzer, Duchart and van den Brink (2017) as research through design. Their approach entails a distinction between four modes including (post)positivism, constructivism, transformative and pragmatism, each with its own particular type of questions, aims for new design knowledge, research methods and research evaluation criteria. While the research portrayed in this article displays aspects of all four modes, it is most noticeably placed within both the (post)positivist and the pragmatist modes. The former is characterised by aiming for deductible knowledge and verified theory/design guidelines via design hypothesis testing, and design experiments based on site-specific surveys; the latter mixes research methods depending on the specific research questions with the aim to derive new practice-oriented knowledge that includes new design knowledge (Lenholzer et al., 2017). Furthermore, Lenholzer et al. (2017) stipulate that developments in computation regarding handling of large amounts of data; advanced visualisation methods (augmented reality, virtual reality, etc.); and linked computational design, simulation and analysis methods will have a strong impact on the development and use of research by design outcomes.

This view is shared by the research portrayed in this article, which is based on a set of linked computational methods including multi-modal data collection, multi-scalar associative modelling and a series of computer-aided analysis methods in conjunction with advanced visualization methods, including virtual, augmented and mixed reality visualizations (Hensel & Sørensen, 2014; Sørensen, 2006). We term the combination of these methods *computational information-based design*. Site-specific data is collected and, by way of inquiry, structured into information (Sunguroğlu Hensel & Vincent, 2015). The latter is at the base of knowledge production via generalisation in principle and specification through research by design. Utility is accomplished by linking research by design efforts with the development of the principal working method, namely *information-based design*. The goal is to work towards a research and design method along the paradigm outlined by Pim Martins (2006), who stated that

> …a new research paradigm is needed that is better able to reflect the complexity and the multi-dimensional character of sustainable development. The new paradigm, referred to as sustainability science, must be able to encompass different magnitudes of scale (of time, space and function), multiple balances (dynamics), multiple actors (interests) and multiple failures (systemic faults). (p. 38)

In addition to the methods described above, we approached the criteria laid out by Martin (2006) by way of coupling a systems-thinking approach with a design-thinking approach. In order to handle a considerable number of design criteria related to architecture and environment interactions, both from a human and non-human perspective, we commonly deploy tools such as mind-maps and other related methods of mapping complex correlations. This is done with the aim of keeping track of key design criteria and their interactions and to set out suitable design methods. This approach does not seek to be all-inclusive, but to circumvent unjustifiable reductionism in the formulation and pursuit of design intentions.

We based our approach to systems-thinking, on the one hand, on systems-oriented design as developed by Birger Sevaldson (2013) and others, and more specifically on the work of Arnold and Wade (2015). The latter posited that

> …systems-thinking is a set of synergistic analytic skills used to improve the capability of identifying and understanding systems, predicting their behaviours, and devising modifications to them in order to produce desired effects. These skills work together as a system. (Arnold & Wade, 2015, p. 675)

They proposed a systems-thinking systemigram that combines elements proposed by other researchers (Hopper & Stave, 2008; Plate & Monroe, 2014; Sweeney & Sterman, 2000) with elements of their own. This systemigram consists essentially of nine elements:

1. Recognizing Interconnections
2. Identifying and Understanding Feedback
3. Understanding System Structure
4. Differentiating [Resources], Flows and Variables
5. Identifying and Understanding Non-Linear Relations
6. Understanding Dynamic Behaviour
7. Reducing Complexity by Modelling Systems Conceptually
8. Understanding Systems at Different Scales
9. Undertaking a Systems Test (Arnold & Wade, 2015, pp. 676–677)

Several of these characteristics also apply to a method that Sevaldson (2017) termed giga-mapping. We utilized this method in earlier stages of the research. The various projects portrayed in this article deployed elements of the systemigram with different weighing and in different iterative configurations in the mapping and design process stages, depending on the way projects are informed in the pre-design and early design stages.

Overall, this entails that the research portrayed in this paper is based on research by design rooted in linked design and systems-thinking, facilitated by computational information-based design. Each of these three key aspects comprises a select range of methods and tools that are configured according to specific research and project needs along an interdisciplinary and practice-oriented trajectory.

Urbanism from within: Embedded architectures in urban contexts

Our research on the relationship between architecture and urbanization in an urban context focused on Oslo as a laboratory. This included current driving factors of urban transformation, such as demographic change, urban diversification and the problem of accelerating commodification that makes urban living increasingly unaffordable for a growing range of citizens. Likewise, urban climate transformation and ecological impact makes life for other non-human stakeholders increasingly difficult from an ecosystems perspective. We explored this theme in a series of master-level studio courses that investigated architecture and society relations through the theme of *24-hour Oslo – Architecture and Demographic Change*. Students selected sites, then undertook a broad range of analyses, data collection and computational simulations to pinpoint specific local problems and opportunities for intervention. Based on the insights gained through this process, the students subsequently identified probable stakeholders for possible projects and formulated possible responses starting from the design brief to the detailed design of projects. In this context, research is not limited to investigations leading up to the project brief. Instead, the design project is understood as a forward-looking speculative inquiry that can be strategized and analysed in its own right to help inform decision-makers about possibilities that otherwise may remain unnoticed. In order to examine whether this form of projective research was recognisable to possible stakeholders, we submitted one project to the Oslo Research Award committee in 2017. This award is typically given to researchers in

different disciplines to award research advances on topics such as demographic change, but design is not typically utilised as a form of inquiry. In 2017, Matteo Lomaglio's *Oslo Convergence* project received an Oslo Research Award. In the process, he was invited to present the work to the award committee, which included a range of representatives of the city planning department, as well as the educational and research environments.

Oslo Convergence was based on detailed multi-modal and multi-objective computational analyses that shed new light on how to obtain a more detailed understanding of urban demographic change and use of the city by its diversifying population. The analyses focused on seasonal and 24-hour circulation and activity patterns in the city context around the site; they took into consideration the different patterns of activities in relation to different groups of citizens, especially the younger generation and their respective needs (Figure 1). Consequently, the analyses informed a speculative design project that addressed the programmatic needs of a changing urban demography and proposed a mixed and multiple use building that combines institutional and public functions in a dynamic and adaptive manner over 24 hours of the day, thus catering to the needs of different parts of society, with an emphasis on a multicultural youth. In so doing, the project addressed population growth and change, and treated the multicultural community as an opportunity for the city's economic, social, cultural and environmental development; culture and architecture as driving forces in the city development; and innovation, value-creation and the city's ability and willingness to attract and manage talents and knowledge communities. In this way, design was used as a mode of speculative and projective research that produces tangible results that can deliver a basis for dialogue between stakeholders.

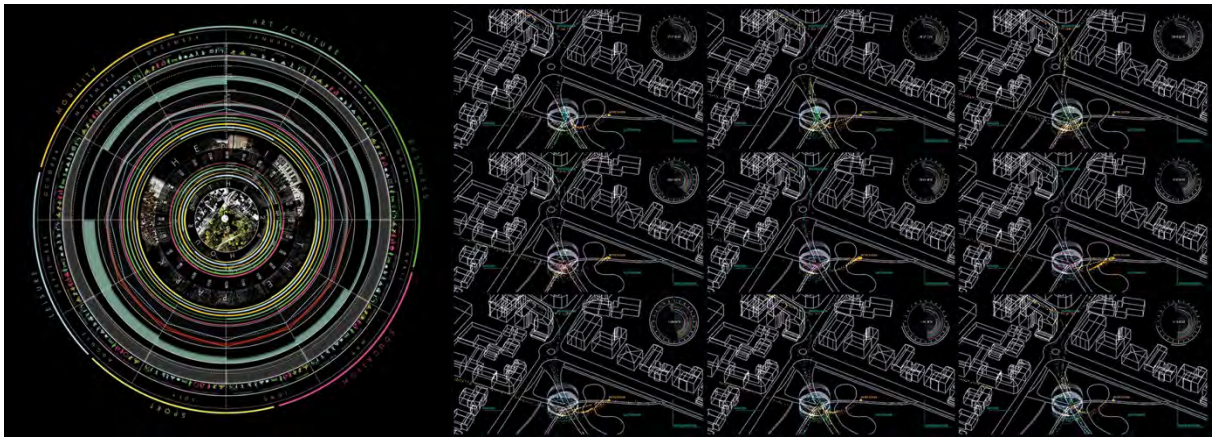

Figure 1. *Oslo Convergence*: analysis of seasonal and 24-hour cycles of programs and activities on-site and in an urban context (left); analysis and simulation of pedestrian, cyclist and vehicular circulation pattern on and around the site (right).

The project was developed through an associative computational model (Figure 2) that was presented as an immersive experience through advanced virtual reality visualization. In so doing, the project could be adapted through dialogue with the stakeholders in further development stages. As such, this approach demonstrated how the development of the contemporary city could not only respond to urban change, but also involve the agents of change and the various stakeholders in a transparent and participatory process. In this way, the designer can become an orchestrator of dialogue, while offering an urban and societal vision that is co-developed with the citizens of the contemporary city on its route to increased diversity.

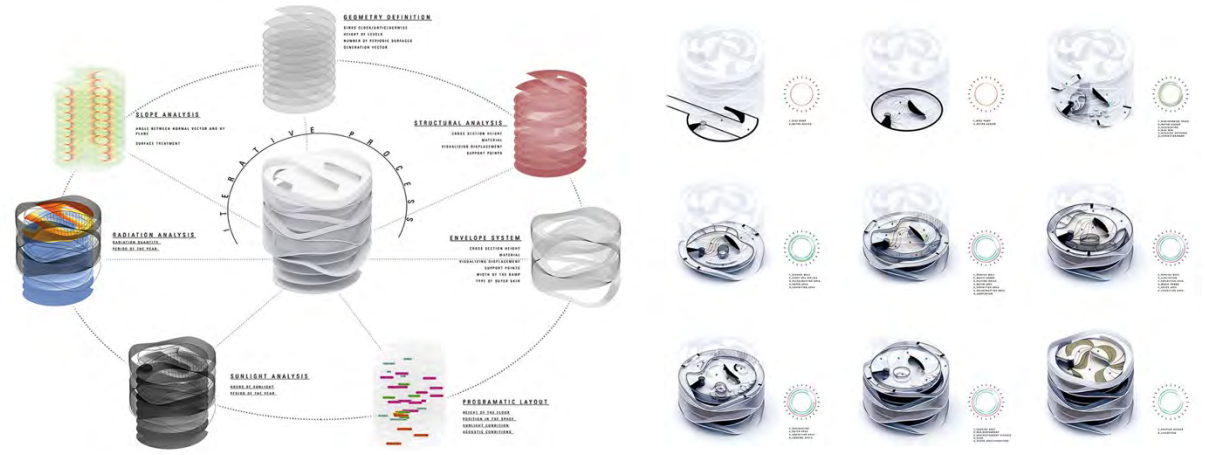

Figure 2. *Oslo Convergence*: associative computational model and computer-aided analyses (left); axonometric views of the computational model cut at different heights to show the continuous surface and placement of main activities of the project.

Oslo Convergence was a proposal for a 24-hour multifunctional building at the northeast corner of the Palace Park in Oslo above the subway line (Figure 3). The project is located at the edge of the Park at a busy car, bicycle and pedestrian route. The continuous and spiralling surface of the project taps into this flow, while distributing public programs and activities. The activities are correlated with a multiple envelope strategy, which provides fully enclosed, transitional and exterior spaces. The transitional and exterior spaces of the building offer the opportunity for the integration of local flora and fauna, to reinitiate and support ecosystems in an urban environment, benefitting from and linking with the surrounding Palace Park.

The integrated associative model served to ensure that the open interior space without subdivision would make suitable provisions for its intended public and collective activities and set out a vision for architecture driven by demographic changes and the diversifying needs of Oslo's citizens. Along the continuous path of the project, there is a succession of activities that are selected based on a detailed site analysis. These elements include walk-by kiosks, displays and other items, located along the path from the proposed new underground train stop to the ground floor, thus collecting and attracting different flows of movement. Farther along, a publicly accessible cooking school and an extension of the nearby music school are located together with a succession of exterior spaces to extend activities during the warm season. Located at the top of the building is a public garden. There are numerous choices of paths and experiences up and down the building that make it interesting to visit the project multiple times during the day as activities and their relations change over 24 hours. In this way, the project pursued an innovative approach towards attracting and managing talents and knowledge communities by way of 24-hour activities that emphasized a strong element of learning and exchange within a public setting. This approach made it possible for typically more removed and controlled access activities to be exposed and more open to participation, distributing knowledge through experiences to a wider and more diverse public. At the same time, the different levels of spectating and engagement are free of charge, except for the most central activities, such as specific direct participation in the cooking and music school events.

Figure 3. *Oslo Convergence*: aerial view of the project in context (left); detailed sections showing the continuous public surface as an extension of the public landscape into and through the architecture.

Tor Anders Sudmeyer's project *Makeriet* was based on a similar premise and analyses as the *Oslo Convergence* project. *Makeriet* was proposed as a large maker-space and a cultural meeting and production place at Vipetangen at Oslo's waterfront, a semi-industrial setting with an industrial history. The project establishes an alternative take on how to re-invigorate an urban waterfront, compared with the existing master-plan of the city that mainly projects high-end cultural institutions, touristic consumption and accelerated commodification of Oslo's waterfront. The potential human stakeholders in this project include all age groups who are interested in making or restoring items, whether related to the waterfront or not. Such a provision can help foster start-ups and also provide a substantial place for restoring or repairing of wooden boats, etc. The scheme projects an urban landscape in the form of a roof-scape and an interior landscape for production. The roof-scape, alongside a number of related design interventions in the vicinity, seeks to transform the perception of discomfort due to accelerated coastal winds into a varied experience of outdoor climate while also providing areas of improved outdoor comfort. Continuing along the quay, the project sought to secure public access to the water surface. The extended exterior surface can furthermore be planted with local flora to link the waterfront with the green area of the adjacent forest, thus providing an extended area for reinitiating and supporting a local ecosystem.

What is common to the above-described and other similar projects produced in the context of this research group is that design is utilized as a mode of forward-looking speculative inquiry; this inquiry also highlights the possibility of architects mobilizing towards unsolicited projects as a way of enriching urban transformation with proposals and interventions that otherwise can have no point of origin in current developer-driven urbanization and commodification. Furthermore, a related shared characteristic of these projects is that the public urban surface is continued in a landscaped manner through the proposed designs, and activities are projected based on a nuanced analysis of which provisions and programs exist and which might be introduced to the urban context, in response to demographic dynamics and change or ecological needs or opportunities. The range of activities typically includes some that allow free participation, to counterbalance activities that require payment for participation.

As such, these projects do not initially have an assumed client or brief, but evolve from an understanding of what might be missing and who might be the different stakeholders for a specific proposal. At the same time, all schemes are considered in terms of spatial progression and transitional spaces that enable a shared ground between exterior and interior. Given the climate, particularly during the cold season, this approach offers a new type of landscaped collective space with an extended interface between different activities, stakeholders and the city as a complex and dense assemblage of objects and systems.

Perimeters: Architecture, terrain and climate as a link between the urban and the natural

This part of the research on correlating and integrating architecture and the bio-physical environment focuses on the urban perimeter, where terrain, habitats and microclimates are either still intact or require urgent action due to pronounced disturbance. We utilize Oslo and its wider region along the Oslo Fjord as a laboratory for design-based inquiry. Focus is placed on developing the brief and designs for low-rise and high-density architectures on sites that are normally considered difficult, for instance, due to steeply sloping terrain, etc. The aim is to circumvent typical interventions such as levelling the site or interrupting the water regime, and instead seeking to provide or protect green corridors, reserve areas for natural habitat, and so on. We explored this theme in a series of master-level studio courses that investigated this issue through research by design and practice-based research. In terms of the former, students selected sites, collected data, and undertook a broad range of analyses and computational simulations to pinpoint specific local problems and opportunities for intervention. Based on the insights gained through this process, the students subsequently identified possible stakeholders for projects and formulated possible responses, from the design brief to the detailed design of projects. In this context, research was not limited to the investigations leading up to the project brief; instead, the design project was treated as a forward-looking speculative inquiry that could be analysed in its own right to help inform decision-makers about possibilities that otherwise may have remained overlooked.

Eskil Landet's project focused on developing a design system for a low-rise high-density settlement for the *Oslo East Fjord Project* (Figure 4). The steep slope, thin layer of substrate on bedrock, related above-ground water run-off and sensitive areas of vegetation on the site, as well as the path inclination analysis for circulation, were key parameters for the project and related associative model. Surface water run-off maintains existing trajectories and preservation spots for vegetation and listed buildings, and the lowest-inclination pedestrian circulation paths in the existing terrain were maintained and implemented as raised walkways. In this way, the scheme entailed a minimized impact on the natural terrain, water-regime and ecosystem. The dense low-rise residential fabric was interspersed with green corridors, communal spaces and provisions, such as shared greenhouses and office spaces for hot-desking to avoid extensive commuting, as well as some commercial and necessary shared social spaces. In the conception of this project, a new extensive public surface emerged both as a landscape above the built volume and as a social communication and circulation space. The units that constituted this fabric could be used individually or combined according to need. Each unit was further evaluated in terms of accessibility, daylight and thermal exposure. In this way, the design could unfold top-down from the settlement pattern to the individual units, and bottom-up from the individual units to the settlement pattern. Evolutionary algorithmic methods were deployed to evolve different arrangements that were analysed and rated. This could be done either for the overall settlement or, alternatively, for portions of phased development so as to accommodate change over time. As such, the projects aimed to cater to the multi-generational living of different income groups that could configure their specific number of units according to need and financial capacity. At the same time, multi-generational living could facilitate the various social and collective activities and spaces with 'caretakers' who have spare time and wish to engage in this mixed community instead of living in a segregated one.

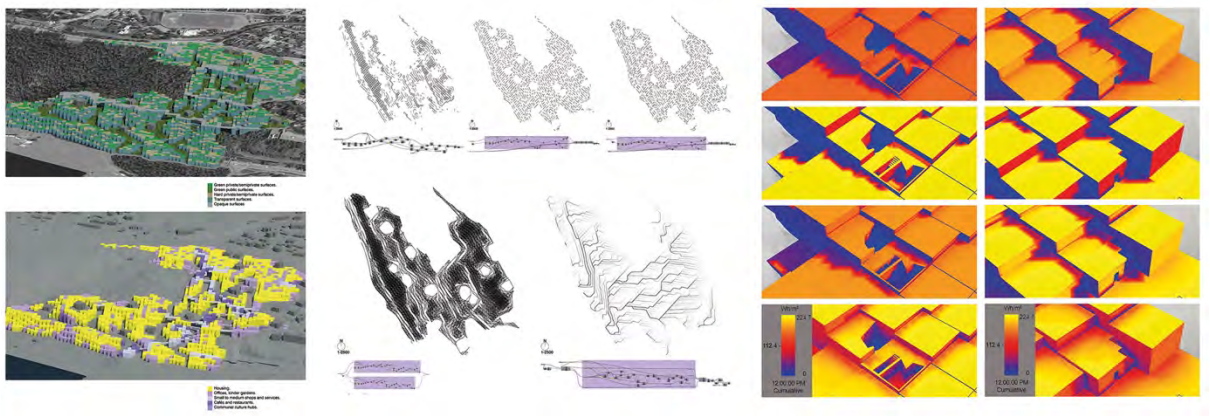

Figure 4. *Oslo East Fjord Project*: low-rise high density mass distribution with green corridors and maintaining the existing steep terrain (left top); dwelling units for different income groups and mixed-use collective spaces (left bottom); slope analysis and rainwater run-off analyses serve to design for the existing terrain (centre); daylight analysis of individual dwellings and collective spaces.

Kristoffer Sekkelsten's project CERO proposes a new *East Fjord Environmental Research Centre* for Oslo (Figure 5), located between the nature reserve of Ekeberg and the Oslo Fjord. The aim of this project was to overcome the problem of the automotive infrastructure that transects and divides the site, by way of a layered landform building that provides an extensive ecological surface that can be claimed by the local flora, fauna and ecosystem. Furthermore, the aim was to utilize tidal changes in staging varied interactions between the built and the natural environment, allowing part of the surfaces and infrastructure to be flooded and transformed over time. This constitutes a radical shift from the predominant approach towards minimizing the impact of both the physical and biological environment in architecture and suggesting a different way of thinking about sustainability, with a focus on staging and managing processes between the man-made and the natural.

Figure 5. East Fjord Environmental Research Centre: Tidal change animation (left); different stages of flooding of the site (centre); landform arrangement of the architectural massing scheme with integrated extensions of the local water regime and ecosystem (right).

These types of peripheral projects constitute a crucial link between inner urban locations with their specific set of circumstances and dynamics and the architectures with landscape characteristics. As such, this approach indicates how inner urban projects could construct landscapes that integrate natural systems to improve a number of aspects of inner urban environments. These projects can be further informed by landscape and agricultural land uses that are specific to the wider region, while taking local bio-physical conditions into close consideration. From these projects, continuous networks of green spaces can gradually evolve, starting from the areas surrounding the perimeter and eventually moving to the cores of cities. Existing studies of the value and contribution of green urban infrastructure can further inform

such approaches (Gill, Handley, Ennos, & Pauleit, 2007; Pauleit, Liu, Ahern, & Kazmierczak, 2011), but can be extended by different overlapping land use.

As in the previous research strand, a related and shared characteristic of these projects is that the shared public surface is articulated in a landscaped manner that is continuous throughout the schemes; additionally, activities and relationships to natural systems are projected based on a nuanced analysis of which conditions and latent provisions exist and which might be introduced into a dense setting of overlapping land uses that integrates the man-made with the natural.

Further potential in developing such projects arises from culturally specific practices related to public access to ground. In Scandinavia, regulations for the public access to ground can be located in the so-called *everyman's right*, which governs the public's right to access privately owned land for recreation and exercise. Here, the right evolved through what might be called *cultural practice* over centuries. In Norway, the everyman's right is an old customary law, laid out in the Outdoor Recreation Act (Ministry of Climate and Environment, 1957), which protects the natural basis for outdoor recreation and the public right of access to the countryside. Understanding the historical motivations and customary and common-sense-based implementation, as well as the contemporary version of such provisions and practices, could be of use for delivering access not only to the countryside, but also to peripheral and urban areas; this understanding could also help to formulate regulations for individual and collective rights to ground for various purposes, and to deliver specific requirements for the design of architectures that incorporate such use. This eventuality would serve to extend governing public access to the natural landscape outside of cities into a framework for culturally specific public use of constructed landscapes in inner cities (Hensel, 2018).

Urbanism from without – Embedded architectures and integrated land use in rural contexts

Today, the vast amount of architectural effort is focused on urban or peripheral environments, and relatively little attention is given to rural areas that have been cultivated for generations in a sustainable manner. As the latter are falling into disrepair or are rapidly replaced by industrial agriculture, invaluable resources, insights and valuable (land) knowledge is lost. Much can be learned from the way such landscapes are traditionally articulated, so as to yield crops in quality and quantity that are otherwise not possible. Often, such productive landscapes are shaped and facilitated by constructions, such as, for instance, terraced landscapes. In such cases, constructions and productive landscapes are not in contradiction but correlated instead. Such cases suggests that models for integrating architectures and productive land use are not in necessarily in contradiction, and that new approaches can be formulated based on analysing such examples. For this reason, this part of the research focuses on the question of how architectures and productive landscapes can be integrated with the goal of overcoming perceived contradictions in land use. This objective involves as a long-term perspective the development of novel ways in which ecosystems and agricultural use may be integrated in urban contexts. As such, this research addresses questions of environment, economy, productive landscapes and the related role of architectural design and architectures within the context of an expanded sustainability approach to human-dominated environments. It does so by focusing on diffuse heritage, which entails historically long-practiced means of altering landscapes for improved agricultural production.

We have focused our research initially on Italian historical terraced landscapes that utilize dry-stone walls for improving climatic conditions for agricultural production, especially in higher altitude locations with unfavourable diurnal temperature ranges. This research and the collected data are expected to provide some insight into this question, and to shed light on why the dry wall constructions that facilitate the terraced landscapes are deteriorating. The latter question is of major significance, since terraced landscapes are ubiquitous in Italy and have

fallen into disrepair. Terraces in a state of disrepair accelerate soil erosion, landslides and seasonal flooding. Well-maintained terraces prevent these issues and provide favourable local climate modulation that enables enhanced growing of produce, e.g., red grapes for wine production, at altitudes at which it is not normally possible. Terraces, in conjunction with different pruning strategies, orient plants in a favourable way towards the sun for increased photosynthesis. This effect believed to be further enhanced by the thermal performance of the dry-stone walls that are assumed to extend the temperature ranges for effective photosynthesis by up to two hours in the late afternoon, when temperatures begin to rapidly fall at higher altitudes. Since reliable data on the costs for maintaining dry-stone walls and their climatic performance is missing, detailed policies have not been established to help maintain terraced landscapes and to support the small-scale agricultural production often associated with it. If required data could be made available, maintenance efforts and costs could be established and made part of national policies that help develop viable business models for small-scale farmers that rely on terraced landscapes. When we realized that data-collection and analyses could help solve several interrelated problems, we configured an interdisciplinary team to pursue this task. We collaborated with the Department of Agricultural, Food and Forestry Systems and the Civil and Environmental Engineering Department, both at the University of Florence, Italy. As part of the site documentation, our team collaborated with the Laboratory of Geomatics for Conservation and Communication of Cultural Heritage at the University of Florence, as well as the Geographical Institute of the Italian Military. A drone and advanced scanning technology were used to document diffuse heritage in an interdisciplinary research effort.

In September 2016, the RCAT/ACDL studio installed a network of measure-stations on the site of the terraced Grospoli vineyard. This vineyard was reconstructed by the proprietor Paolo Socci in Lamole, Tuscany. The aim was to collect data for a period of two years in order to obtain micro-climatic data that could facilitate a more nuanced understanding of the terrace and environment interaction, which in turn would facilitate the production of red wine at altitudes of 600 meters and above. In our research by design approach, we then set out master-level studio courses to develop speculative projects for a research facility for the site. The requirement was that any architectural intervention on the site of the terraced Grospoli vineyard should not to alter the micro-climate that results from the terraced landscape and that the agricultural use and productivity of the site was therefore not altered. This was done with the intention of developing an information-based approach to architectural design that is finely attuned with its specific setting and thus sustainable above and beyond any established sustainable measures that are currently practiced or projected. Moreover, this principle points towards an approach to designing architectures that are finely attuned to required and decidedly specific local conditions. With the speculative design projects, it was possible to undertake succinct research by design effort geared towards this purpose.

In these projects, we correlated climate data obtained from the local meteorological station in Lamole with thermographic analysis of the terraced Grospoli vineyard provided by the Geomatics for Conservation and Communication of Cultural Heritage laboratory at the University of Florence; this information was also correlated with industrial grade and purpose-made measure-stations provided by the RCAT/ACDL studio. Additionally, we utilized computational simulation tools for local and micro-climate analyses and correlated the outcomes with the measured data. The climatic conditions required for the wine cultivation were established in collaboration with the proprietor, Paolo Socci, and Prof. Preti's team at the Department of Agricultural, Food and Forestry Systems Department at the University of Florence. For the indoor climate, we utilized established comfort charts for the specific building programs.

Master-level students Maria Lagging and Joar Tjetland pursued a design approach that located all required spaces for the *Grospoli Research Centre* and accommodation for six researchers in one building with most spaces located underground (Figure 6 and 7). The central space for the research laboratory opens upwards toward the sky and is marked by a larger

canopy, a landscaped entrance and a main space for collective use. The spaces for accommodation are located underground adjacent to the dry-stone walls, with large openings that permit physical access, daylight and ventilation. Various environmental/micro-climatic analyses (shading, solar radiation, etc.) for the exterior space adjacent to the projected building were conducted during the different design stages to ensure that the resulting conditions were within the permissible limits for growing wine. Concurrently, various interior climate analyses were carried out to assess the interior climate conditions during the different design stages to inform the spatial and material organisation of the scheme.

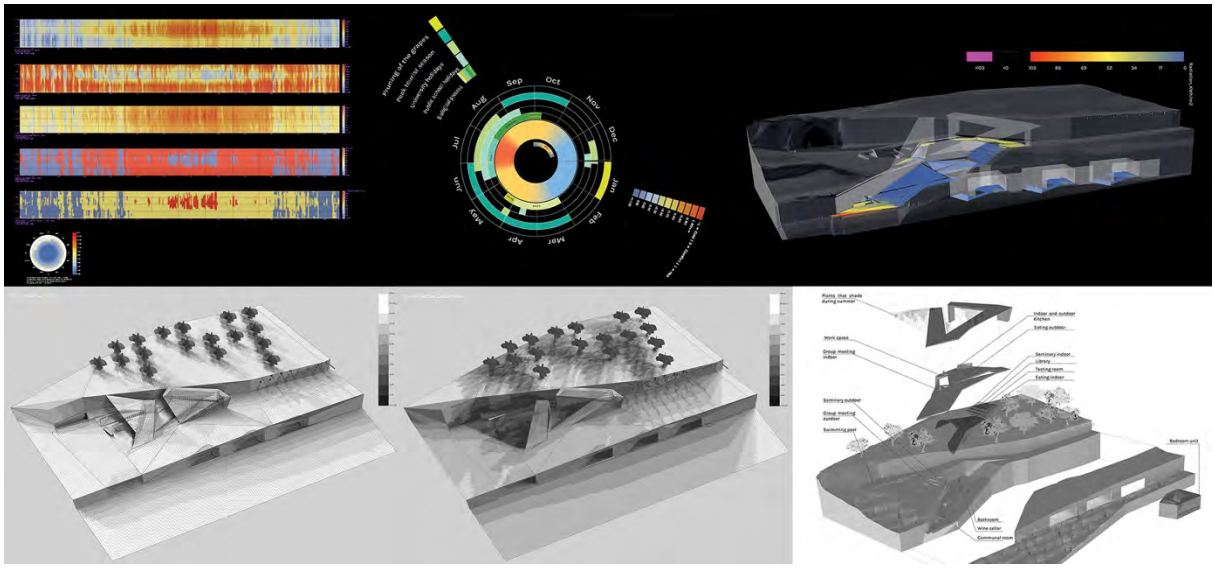

Figure 6. *Grospoli Research Centre*: local climate data (top left); seasonal and daily activity distribution on site in relation to local climate conditions (top centre); analysis of indoor climate conditions of a design instance (top right); shading analysis (bottom left and centre); exploded axonometric showing the program distribution of the scheme (bottom right).

Figure 7. *Grospoli Research Centre*: night view of the project (left); section showing the architecture and terrain relation (right).

Two projects pursued a different strategy for minimizing the micro-climatic impact of the proposed scheme. Master-level students Andra Nicolescu and Kristian Taaksalu (Figure 8), as well as Julia Anna Maria Eriksson, had projects that entailed a series of small buildings distributed along the historical downhill water drainage canal and pools of the terraced Grospoli vineyard. The distributed small spaces served for wine production, storage, tasting and related

research, interspersed with follies that offered atmospheric experiences related to the production of wine, including water, sunlight, gardens and specific landscape views and experiences. The specific quality of these two distributed projects arose from their combination of local dry-stone wall construction, spatial organisation and atmospheric conditioning of the individual architectures and the series of experiences.

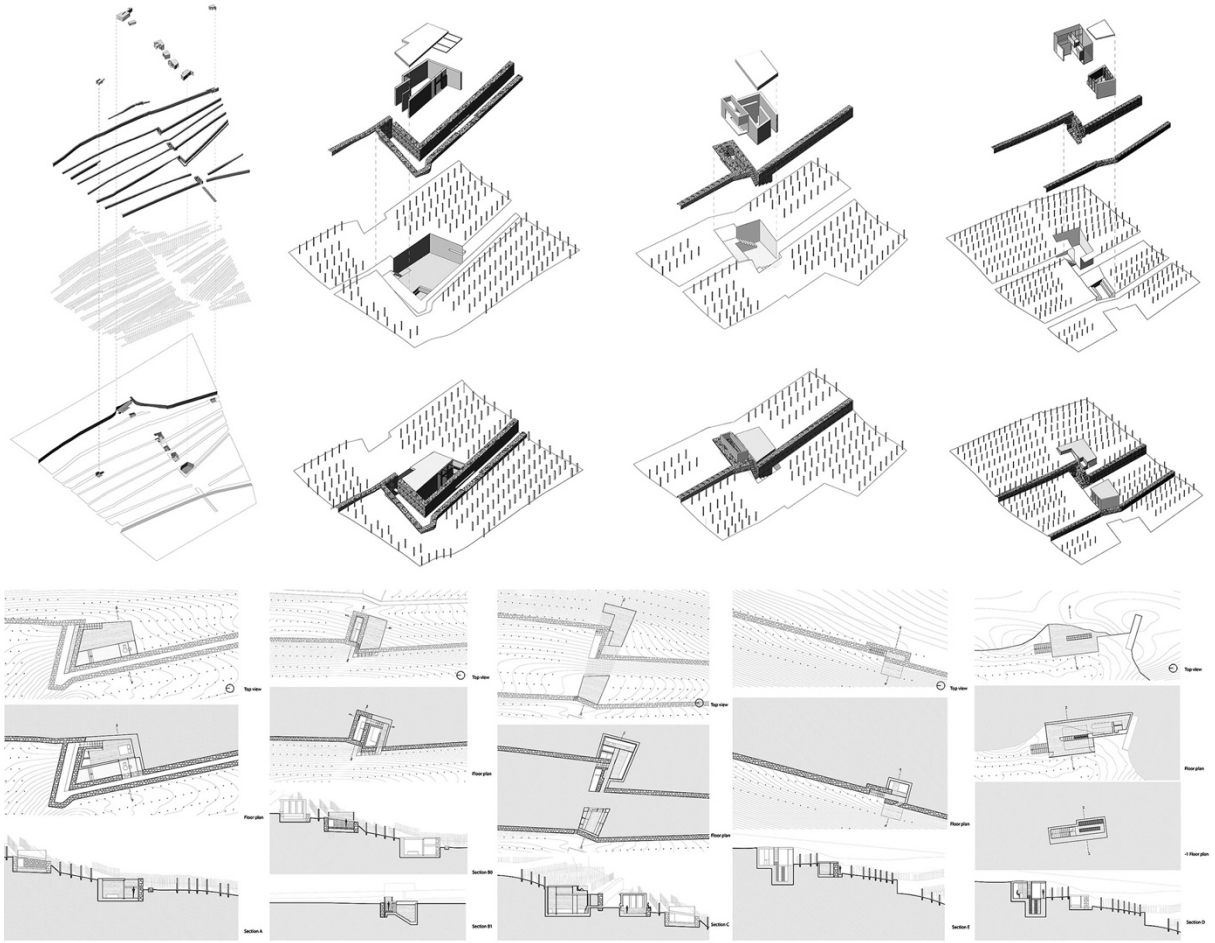

Figure 8. *Grospoli Landscape Centre*: Exploded axonometric showing the landscape systems and constructions and the integration landscape and architectures (top left); exploded axonometic views of individual locations that show the interlacing of architectures and dry-stone walls (top centre and right); plans and sections of five individual locations that show the integration of the architecture into the articulated terrain of the terraces (bottom left to right).

This type of research points towards an approach to the design of architectures that are finely attuned to local conditions above and beyond what is currently practiced or projected. With the addition of the speculative design projects, we were able to mobilize a succinct and projective research programme with design effort geared towards this purpose. The lessons learned can be applied not only to other rural settings and similar cultural landscapes or diffuse heritage performance analysis; this knowledge can also be applied to peripheral and urban settings in which architecture and landscape elements, geophysical situations and ecosystems can coexist (Hensel, 2018). However, these applications entail a variety of combined criteria that require an extensive systems-thinking based approach and will likely result in new architectural arrangements, with focus material and spatial organization related to environmental performances that are the outcome of negotiated requirements of new combinations of land use. The contours of this interdisciplinary undertaking are gradually taking shape as numerous

academic research efforts and land-related grant programmes indicate. As such, this line of research is still in its infancy but can be said to already show how the combination of systems-thinking and design-thinking can affect and facilitate the way forward.

Discussion and Conclusion

As discussed above, the need for the research portrayed in this article arises from increasingly complex design and sustainability requirements that are insufficiently addressed and resolved. This seems to be due to an inadequate underlying research and design approach, organized in sequential manner that can be characterized as post-design optimization. We seek to address this issue with an early design stage-integrated research by design approach. Three distinct lines of research, and more specifically research by design, are pursued with the goal of configuring an integrative performance-based approach to architecture and urban design and the integration of cultural, social and environmental sustainability:

1. designs for urban areas with a focus on demographic and environmental aspects;
2. designs for peripheral areas with a focus on local bio-physical conditions;
3. designs for rural areas that elaborate an integrative approach towards land uses that are typically seen as mutually exclusive.

This research is ongoing, and the long-term objective is to correlate and integrate the three lines of inquiry. Key to the three lines of inquiry and their eventual correlation is interdisciplinary early stage multi-criteria design specification, as well as analysis and synthesis in early design stages. While the work discussed above has made some progress in this direction, much remains to be done. From a method perspective, we aim for what we term computational information-based design. This concept entails multi-modal collection of data; the upgrading of data to information through data-structuring and related methods, such as computational ontologies (Sunguroğlu Hensel, 2008; Sunguroğlu Hensel & Vincent, 2015); integrative computational modelling and analyses and advanced computational visualization. The goal of working towards an interdisciplinary data and information-based approach to design is currently hampered by the lack of a multivariate approach that would be based on correlation between different conceptual approaches to models and that would extend to the integration of methods and tools. Due to this problem, current approaches remain frequently unconnected, and the cumulative effect of architecture and environment interaction often remains insufficiently understood. Besides further improvement of integrating systems- and design-thinking approaches, it is necessary to invest significant effort into pre- and early stage design interdisciplinary collaboration. Frequently, this entails starting from discussing basics, clarifying terminology and conceptual approaches before integrative methods can be set out with the aim of formulating and linking integrated approaches to sustainability. This, then, is the context for current and further research efforts and questions *en route* to embedded performance-oriented architecture and urban design by way of information-based design.

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Sareh Saeidi

Envelopes and exteriority

Local specificity and extended exterior as design criteria for architectural envelopes

Abstract
This article discusses the relationship of architecture to its surrounding environment. The objective of the article is i) to reposition the relationship of architecture and its surrounding exterior by expanding the understanding of architectural envelopes, and ii) to systematically define exterior space as design input. The notion of the envelope encompasses a spatial recognition defined by interactions between interior and exterior environments that affects an inhabitant's experience of architectural space. This research is organised in three sections: a) a literature review to systematically examine the terminologies of this research, b) selected case studies that consider exteriority as a design criterion, and c) research through design inquiry to combine a systematic approach with design thinking. The study applies both conceptual and method-oriented approaches to develop an integrated design approach focused on the climatic and atmospheric performances of architectural envelopes.

Keywords*:* Architectural envelopes, performance-oriented design, extended setting, extended threshold, in-between spaces

Introduction

This article examines the relationship between built forms and their surrounding environment with the aim of developing an integrative design approach to locally specific architectural envelopes through an extended threshold between the interior and the exterior. This is systematically approached using a number of case and design studies. Conceptual approaches are extracted from the case study diagrams that can act as a design guideline. The diagrammatic guideline constitutes generalised principles from locally specific designs. However, the intention is not to derive universal design principles that can be applied at any location. Instead, the goal is to derive principles that need to be re-contextualised and adapted to the specific settings they are positioned at. Therefore, these principles cannot be applied irrespective of the specific exterior environment of architecture.

A significant driver today in the disconnect between architecture and its settings in the industrialised parts of the world results from an exclusive focus on energy efficiency and modulated interior climates, which

> …tend to create an overall drive towards optimization, that is, towards the reduction of building to the maximizing of economic criteria and to the adoption of normative plans and construction methods reducing architecture to the provision of an aesthetic skin – the packaging, in fact, of nothing more than a large commodity in order to facilitate its marketing.
>
> (Frampton, 2007, p. 376).

In contemporary architectural practices there exist a great variety of approaches to designing the relationship between architecture and its setting. These include, among others, a continuation of vernacular architecture in various parts of the world that continue building structures such as courtyard houses; various forms of regionalist approaches that are – to a

lesser or greater extent – informed by vernacular examples; as well as contemporary designs that propose the addition of new technologies and solutions. In parallel, there exists a common trend that emphasises a separation of architecture from its setting by way of increasingly generic architecture and lack of consideration of local specificity. The architecture of the latter mainly results in a singularity of the architectural form that is ignorant of its context. Although varied in intentions and approaches, the resulting architecture of this type is designed to separate and be separated, resulting in "provisions of an aesthetic skin" (2007, p. 376). or operative boundaries of insulation that lead to blank envelopes (Moussavi, 2005). Rem Koolhaas's essay on *Bigness* (Koolhaas & Mau, 1995, pp. 494–517) is a primary example of affirmation of what might be termed the object-orientation of architecture. Koolhaas does so by positioning architecture as an object independent and often wilfully ignorant of its surrounding urban context, and as a creator of an emerging context through size and individuality. Contemporary urban fabrics increasingly adhere to Koolhaas's concept of Bigness with a distinct idiosyncratic diversity of unrelated architectural objects and their deliberate disconnect from context. The provocation of "fuck context" posits that Bigness, through its very independence of context, survives by "not [taking] inspiration from givens too often squeezed for the last drop of meaning". Instead, it finds its independence by "its own raison d'être" (1995, p. 515).

This article is a continuation of an ongoing research that is focused on developing an alternative notion of the architectural envelope (Saeidi Derakhshi, 2017) as a critique of the common practice of building skins or façades that represent a strict boundary condition. One cannot sensibly deny that the built form impacts its surroundings and interacts with them, thus "presenting itself as though [they] were coextensive" (Leatherbarrow, 2009, p. 39). This investigation aims to reposition the performance of architectural envelopes within the scope of local specificity and architectural experience. This is to examine the role of surrounding local conditions as an integrated criterion in designing envelopes with the purpose of creating atmospheric experiences. The investigation redefines the notion of architectural envelopes, focusing on spatial organisation as the factor for creating an extended threshold that is habitable, and with features of the exterior environment as its key design criteria (Figure 1).

The question that arises is how to define a performance-oriented approach in which the material and spatial constituents of the architectural envelope condition and are conditioned by the exterior environment. The notion of *performative envelopes* refers to envelopes that accommodate experiential effects through their constructs, allowing for interactions between architecture and its surroundings. To meet this objective, the investigations are pursued through two types of studies: case studies that focus on how specific aspects of exteriority have been designed or addressed in selected architectural projects and design experiments in a workshop conducted by the author in the context of an architectural master-level studio. The workshop aimed to explore methods that enabled assessing various performative and conceptual aims of the design projects. What evolved from these efforts is an attempt to reposition exteriority as a critical design criterion that encompasses the interrelations of architecture with its surrounding environments, generating a spatial extension of both the interior and the exterior. This article uses the term "exteriority" to refer to the exterior space outside an enclosure in its generic sense and "exterior environment" to represent the immediate surroundings of the built form.

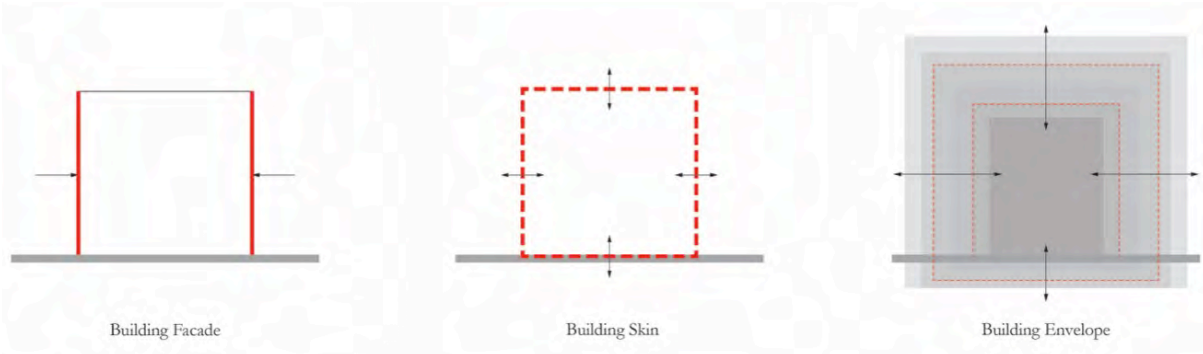

Figure 1. Diagram representation of this research's definition of building façade, building skin, and building envelope – produced by Sareh Saeidi, Spring 2018.

Literature review

The inattentive use of various definitions in the architectural discipline in referring to the outer boundary of the built form often obscures a clear distinction between the notions used and their inherent differences and characteristics. This is the case with the notion of exteriority. Although architectural forms are considered to be both space occupiers as well as space definers (Rowe & Koetter, 1984, p. 79), the discussions of architectural spaces are mainly focused on interior and, sometimes, transitional spaces. Although varying in approaches and focuses, this is apparent in the discourse of many modern and contemporary theorists and architects who discuss architecture mainly in terms of interior spaces, giving less attention to the exterior beyond the exterior expression. Le Corbusier refers to the exterior as a result of the interior, considering the process of architectural design as a plan that proceeds from the inside out (Corbusier, 2007, p. 216). In explaining his viewpoint, he refers to the similarity of a building to a soap bubble that is "perfect and harmonious if the air is evenly distributed and properly ordered from the inside" (2007, p. 216). The primacy of the interior thus overshadows both the role of the exterior in creating effects and conditions for the interior, as well as its potential in accommodating the spatial extension to the interior spaces. There are also other modern architects and theorists who attempt to establish a spatial realisation of architecture, defining it beyond the boundary of the outer wall. Two examples of these design approaches are "breaking the box" by Frank Lloyd Wright (Wright, 2010) and the approaches of Loos (Risselada, 2008) and Mies van der Rohe (Frampton, 2001), who pursued spatial continuity. Concepts such as "breaking the box", which opened up the corners of the intersecting walls to allow the interior to merge with its ambient surroundings, employ walls as means of spatial extension. As a result, architectural design provides a milieu for the built space that is "not only the building's immediate vicinity, but also the greater region surrounding the site" – an extended topography (Leatherbarrow, 2009, p. 145 on Frank Lloyd Wright's projects). Leatherbarrow uses the term *extended topography* to discusses *Raumplan* as an approach utilised for designing interior settings, but also in regard to the exterior. He analyses Adolf Loos's projects to expound on *Raumplan* as a mode of interpreting the relationship and connections between the building's interior and exterior, and enclosed and open spaces, as complementary in creating a unified whole. In his view, no room or collection of rooms in this unified whole is seen "in itself" but is understood or conceived with in respect to one another (Leatherbarrow, 2009, pp. 152–157). Some discourses have taken this discussion further by raising the point that architecture needs to "have an interactive relationship with nature" (Frampton, 2007, p. 383). Nature here doesn't only represent "the topography and site, but also climate and light […] to which built form is necessarily susceptible to a degree" (2007, p. 383). It can be argued that here architecture becomes more than the sum of its parts by incorporating the given context through creating a spatial extension of both its interior and exterior environments. Using Leatherbarrow's

extended topography as inspiration, this research uses the term *extended settings* to refer to design strategies through which the vicinity of the building exterior serves as a complementary extension of the interior spaces, as well as a space that demands attention in its own right.

This research distinguishes between three main approaches in creating an extended setting, based on how the emphasis on the relationship between the interior and the exterior is articulated. These approaches are: 1) *Inside-out*, 2) *Outside-in*, and 3) *Inside-outside* (Figure 2). The *Inside-out* approach emphasises the visual connection between interior and exterior environments, realising the architectural qualities of this relation by emphasising the focus from the interior to the exterior. This approach invariably seems to lead to object orientation of the built form. Similarly, the *Outside-in* approach tends to make the interior space subservient to criteria pertaining to the exterior. Common examples of this approach are semi-open structures that serve as sheltered spaces providing a temporary stay in architectural landscape projects. The *Inside-outside* approach, which underpins this research, emphasises built forms that shape their spatial qualities through the ways in which they meet, incorporate, and interact with circumstances of their local context as one integrated system negotiated by an extended threshold: the architecture envelope.

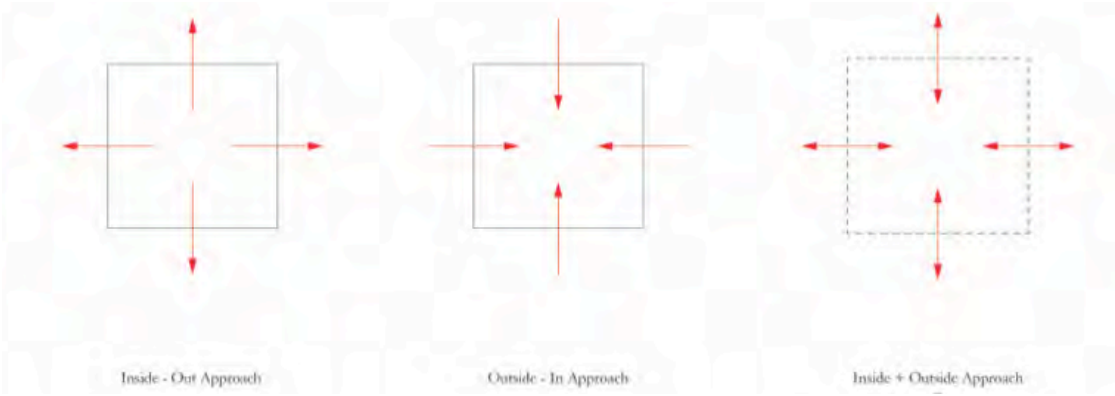

Figure 2. Diagram representation of prevailing approaches in creating an extended setting for the built form – produced by Sareh Saeidi, Spring 2018.

Architecture is “the spatial semblance of a world made visible” (Langer, 1953, pp. 97–98) in a field of invisible forces "that “give[s] shape and rhythm to everyday life of the body” (Kwinter, 2002, p. 14). When considered this way, architecture can be seen as a system of forces, on the one hand, pertaining to

> …‘micro-architectures’ [that consist of] those relations smaller than the object that saturates it and composes it, [and on the other,] those relations or systems that are greater or more extensive than the object, that comprehend or envelope it, the ‘macro-architecture’.
>
> (Kwinter, 2002, p. 14).

If we take this notion of correlated micro and macroscales a step further and define a scale in-between the two, that represents the relations between a selected number of microarchitectures, we could define a mesoscale. This is the scale through which we can discuss the role of architectural envelopes and their relationship with the exterior environment. As part of the mesoscale discussions in architecture, the following paragraphs seek to clarify the notions of milieu, environment, context, and local specificity as the commonly used notions in the discussions of the architectural context or environment.

Architecture consists of elements that affect and are affected by the environment in which it exists. It is therefore essential to first discuss what the definition of environment

entails. A term that is commonly used in various disciplines to refer to the surrounding environment of a subject is *milieu*. Historically imported from mechanics to biology in the 18th century, the notion of milieu has been used across other disciplines as well, including philosophy and physics (Canguilhem, 1980, pp. 1–17). In Canguilhem's view, "the environment [*Umgebung*] is precisely nothing more than a [hu]man's Umwelt", centred on and oriented by human perspectives and pragmatic experiences, which are relative to a living animal (1980, p. 11). Uexküll (1980) classified various realms within this notion of milieu by distinguishing between the environment of behaviour specific to an organism (*Umwelt*), the ordinary geographical environment (*Umgebung*), and the universe of science (*Welt*) (1980, p. 11). The concept of milieu today mostly refers to an "aggregate of influences or conditions which shape or determine the being, development, life, or behavior of a person or a thing" (Spitzer, 1942). This concept is associated with the theories of French philosopher Auguste Comte (1798–1857) and French critic and historian Hippolyte Taine (1828–1893).

An essential aspect of the physical environment is climate. One of the basic tasks of architecture is to provide climatically attuned living spaces. The word climate is "derived from the ancient Greek verb klínein [meaning] "to incline" [which] describes the tilt of the Earth's axis" (Hausladen & Liedl, 2012, p. 12). However, the term "climate" covers a wide range of life, as do many terms in Greek. One definition of the term is "the environment that conditions, ether, space, place – and the ocean embracing the earth" (Spitzer, 1942, p. 11). Another refers to a rather general term "as a protecting, embracing or encompassing thing" (1942, p. 11). In its more common use in contemporary culture, climate, as opposed to weather, refers to the "state of the Earth's atmosphere as established by statistics, over a period of time […] relevant to a location, a region or the whole Earth" (Hausladen & Liedl, 2012, p. 12). Climate is commonly classified in three scales: macroclimate, mesoclimate, and microclimate.

The architecture of closed-systems and steady-state design approaches "tend[s] to be deprived of its inherently mediatory capacity" such as natural ventilation, shading, utilisation of diurnal and seasonal use of space (Frampton, 2007, p. 384). The preoccupation with a building's energy consumption includes excessively relying on benchmarks with little or no discussion of adequate equivalent alternatives. An underestimated design aspect is the fact that "architecture […] has the potential to consciously modify natural microclimates" (Garcia-German, 2017, p. 172) and biological environments. Traditions in vernacular architecture that were adapted to their local conditions, climates, and cultures to temper both indoor and outdoor environments are usually overshadowed in today's architectural practices, while the dependency of buildings on mechanical add-ons has increased. Many of the buildings today are built using "imported abstracted knowledge insensitive to ethnic requirements and oblivious to the subtle wisdom gained by an intimate experience of the local nature and microclimate and architecture's potential for adaptation" (O'Cofaigh, Olley, & Lewis, 1996, p. 2). An effective built form within this definition "exists in the midst of an evolutionary process and is embedded in systems of all kinds, yet has choices and creative ranges about how to deploy itself" (O'Donnell, 2015, p. xvi) or can adapt to unpredictable changes and create atmospheres accordingly. A locally specific form is one that integrates and interacts with its surrounding environment in a unified way while sustaining specific microenvironments.

This research uses the notion of context to refer to the existing surrounding environment of the built form, including conditioned and natural circumstances which the architectural form responds to and interacts with and in which it exists. Context thus distinguishes itself from milieu by regarding not only the physical surrounding environment of the built form, resulting from various interactions and interdependencies, but also aspects of its perception. The definitions of environmental contexts, in their broad sense, have frequently been used to refer to aspects of sustainability and energy efficiency in the past five decades, disregarding the sensory and experiential aspects of the built space. However, before being overloaded with today's environmental and ethical responsibilities, they were focused around aspects of

increasing comfort and creating aesthetic and sensory effects in the immediate experience of architecture (Hardy, Martin, & Poletto, 2008, p. 14).

Of the most notable discussions around spatial moods and atmospheres in the architectural discipline is perhaps what Norberg-Schulz called "the spirit of place" (Norberg-Schulz, 1979) and its role in understanding architecture – a topic that was later picked up and extensively discussed by other contemporary architects. The spirit of place refers to *Genuis loci,* derived from a Roman concept that denotes what a thing is and what it "wants to be" (Kahn [1969] 2013); this defines "a living reality" – although Norberg-Shulz does not name it as such – in a given context (1979, pp. 18–23). However, this description of the spirit of place does not necessarily provide a clear definition of atmosphere and is rather abstract, perhaps intentionally, to make room for individual interpretations of the notion. On the other hand, although more pragmatic and less formally theorised, approaches such as those of Peter Zumthor or Renzo Piano, which define atmosphere through intuitive feelings and practiced-based experiences, are widely recognised as "atmospheric architecture" (Leatherbarrow, 2009, pp. 609–694; C. Borch, 2010, p. 8). Atmospheric architecture could be exemplified by projects such as Sverre Fehn's Storhammarloven or works by Zumthor, Gunnar Asplund, and Sigurd Lewerentz that create a specific architectural experience through their spatial qualities.

In defining architectural quality, Zumthor refers to the state that occurs when a building "moves" him – that is, the feeling it gives him (Zumthor, 2006, p. 11). Atmosphere is the mood of a space that produces a specific feeling in the person who experiences it. It is strongly related to a bodily engagement and to subjective perception. Thus, the atmosphere is perceived through one's emotional sensibility – "a form of perception that works incredibly quickly" (2006, p. 13). According to Böhme, "The notion of atmosphere always concerns a spatial sense of ambience" (Böhme, 2014, p. 43). It is not a singular moment of perception but rather a sustained presence in a situation – a continuum (Pallasmaa, 2014, p. 20). An essential aspect of atmosphere, according to Pallasmaa, is that "it is an immediate experience of the whole, the entity, and only later can one distinguish the details that are part of it" (Pallasmaa, 2014, p. 37). Therefore, the experience of atmospheric quality in architecture is by definition an embodied experience. Conversely, it is something of "the prototypical 'between' phenomenon" (Böhme, 2014, p. 43) that initially arises from the atmosphere – the materials and details of the built space – but is eventually experienced and felt through the individuality and perception of its occupant. Pallasmaa believes that atmospheres are emotionally experienced before being intellectually experienced, and this emotional architectural encounter is a multisensory perception that includes various senses as well as bodily memory (Pallasmaa, 2012). Through his built works, Zumthor shows that the perception of atmosphere is not confined to architectural interiors, but also how architecture and its surrounding environment integrate to form a certain atmosphere (Zumthor, 2006). Included in this discussion is the classical tradition in architectural practice of site visits, through which the architect tries to get a sense of the place. This provides a bodily experience through which he or she gains an understanding of how to position the project in relation to the existing circumstances that even today are an essential part of the design process. This given, or existing, surrounding is in itself a design material, something that the architect works with to capture a specific mood or a desired atmosphere.

The notion of atmosphere in the scope of this research engages with aspects of envelope design that create or intensify the experiences of architectural space by the inhabitant. Therefore, creating atmospheres focuses on *distances* through which the building is experienced and within which a defined environment is governed or conditioned. Leatherbarrow defines three kinds of distances (Figure 3) through which a building is experienced: "the local (even intimate) horizons of enclosure, the ambient surround of the building's immediate vicinity, and the distant reaches of its extended topography" (2009, p. 215). These definitions are employed in design studies and experiments of this research to reflect on the role of architectural envelopes in affecting and shaping not only the interactions

between architecture and its context, but also the experience of the environments and atmospheres of both.

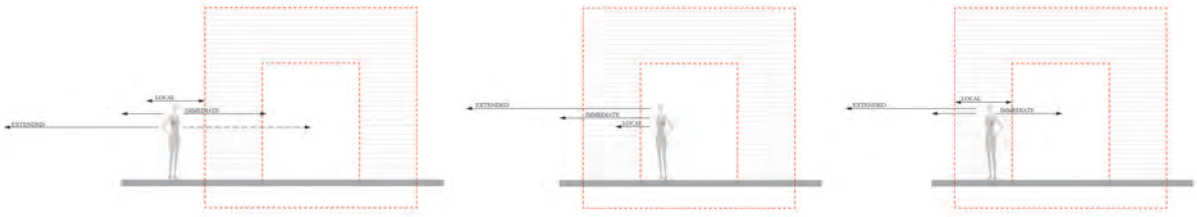

Figure 3. Diagram representation of distances through which a building is experienced based on David Leatherborrow's definition (2009) – produced by Sareh Saeidi, Spring 2018.

The two following sections discuss conceptual and methodological approaches through which the aforementioned scopes are addressed and analysed. The investigation first aims to define ranges of mutual effects and dependencies between interior and exterior environments by way of analysing historical and contemporary case studies. The chosen projects address the design of non-discrete envelopes, focusing on factors of local specificity and atmospheric performance. Non-discrete envelopes (see Hensel, 2013, pp. 31–44) identify built forms that are embedded in their surrounding contexts in such a way that the separation from their surroundings disrupts their architectural means, functions, and character (Saeidi Derakhshi, 2017, p. 16). Architecture's character here refers to the identity of the built form in relation to its local culture, materials, and construction techniques. Second, the studies aim to develop a method through which site-specific datasets and information are translated into knowledge for an informed design process of small-scale design experiments. The experiments were undertaken in master-level student projects in the Research Centre for Architecture and Tectonics (RCAT) and the Advanced Computational Design Laboratory (ACDL) studio at the Oslo School of Architecture and Design (AHO). The studies include identification, collection, application, analysis, and evaluation of context-specific data in correspondence with project-based conceptual approaches that together inform the design process of architectural envelopes.

Case studies

This section explores examples of traditional and contemporary architecture to extract principles that lead to designs which marry exteriority and interiority. The cases encompass integrated design systems that result from the combination of natural and human-made elements or provisioned and un-provisioned design strategies representing the building's flexibility in meeting future changes post-construction. The following paragraphs examine case studies focusing on two main approaches that consider the exterior environment as an integral part of architectural design: climatic and aesthetic. The climatic and functional aspects of the case studies showcase how design specifications create new exteriors in the vicinity of the built form that have an impact on the architectural experience. The outcome of these studies aims to map out conceptual approaches that can inform the development of a working method for the research.

In order to systematically approach and sustain the development of the notion of architectural envelopes, two taxonomies were produced: a) a systematisation of selected conceptual approaches to the notion of envelopes based on review of the literature within the architectural discipline, and b) a taxonomy of envelope types based on an analysis of built projects (Saeidi Derakhshi, 2017). The taxonomy of envelopes attempts to classify the approaches to envelope design by recognising different tendencies towards the emphasis on form versus performance in architectural practice. The analysis distinguishes between three approaches: *discrete* envelopes, *non-discrete* envelopes, and envelopes with a *dual* character.

Non-discrete envelopes are separated into three types: *extended thresholds*, *dissolved thresholds*, and *multiple envelopes*. Extended thresholds have been extensively discussed as transitional spaces that are shaped through multiple, articulated, and animated screens or layers of materials, or thick (wall) structures either through studies of historical cases (Hensel & Sunguroğlu Hensel, 2010a, 2010b, 2010c) or more contemporary examples and discussions (Hensel, 2011; Hensel & Turko, 2015, pp. 38–50 & 178–269). This research's definition of extended thresholds is elaborated in the following paragraph. The notion of dissolved thresholds was inspired by Kengo Kuma's book *Anti-Object,* in which he elaborates on his idea on erasing the architectural object through his works via an approach in which architecture closely integrates, and at times dissolves, into its immediate surroundings (Kuma, 2008). Multiple envelopes represent a design strategy in which envelope layers are arranged and positioned in proximity and in relation to one another to fulfil various design aims, i.e. from providing spatial effects to acting as insulation (Saeidi Derakhshi, 2017, p. 17). Kipnis terms the strategy of "form[ing] a collecting graft, usually by encasing disparate formal and programmatic elements within a neutral, modernist monolith" as *InFormation* (Kipnis, 2004, p. 43). The emerging spaces of this design strategy activate through "visual layering, programmatic innovation, [or] technological effects and events" (2004, p. 43) that define their relation to one another through these in-between spaces. Tschumi refers to the in-between spaces of his work as spatial organisers that, in the case of projects such as Le Fresnoy, have a strong experiential presence and are a "mode of spacing that gives room for the event" (Tschumi et al., 1999, pp. 33–44). These approaches represent a spatial realisation of the building envelope through material organisation, which defines it as an in-between inhabitable space, accommodating various uses of its spaces and atmospheres.

Extended thresholds conceptually represent built forms that provide various climatic and atmospheric conditions through their envelopes' spatial organisation and degrees of enclosure. The notion of extended threshold closely relates to the notion of free-running buildings (de Dear & Brager, 1998) as an integrated design approach that addresses issues of thermal comfort and climatic tolerance through spatial and material organisation. The free-running building method provides a variety of indoor climates due to the joint necessity of non-discrete architectures and the inhabitants' adaptation abilities (Saeidi Derakhshi, 2017, p. 11). Extended threshold is an approach in which the extent of exteriority and its effects on the enclosed lived spaces are more difficult to frame, measure, and analyse. In this approach, the threshold of the building envelope is treated as an extended space, which is either semi-closed or exposed. The envelope becomes a means of creating inhabitable spaces through degrees of shelter. The dissolved threshold is similar to the extended threshold, with the distinguishing difference being that here the definition of enclosure and sheltered space by means of walls is challenged and redefined through the abstraction and removal of wall structures. Among the five projects that are discussed in the following paragraphs, four are extended threshold types and demonstrate two different concepts of constructed exteriors and design provisions. The first two of these case studies are Persian courtyard houses and traditional Japanese houses, in which the constructed exterior environment fulfils the climatic and atmospheric needs of the interior spaces. The other two case examples include two contemporary houses (Lina Bo Bardi's Glass House and John Lautner's Sheats-Goldstein residence) that, through their spatial openness and arrangement, allow for future growth of the surrounding vegetation that co-modulates the microclimate of the built form. The last case study is the Inverted House in Japan. This study characterises the Inverted House as an example of the dissolved threshold. The design approach of the project defines a modulated climatic threshold in which the spaces are mainly exterior, but serve specific activities that are normally placed in fully sheltered interior spaces. The erasure of the exterior wall of the project creates exposed spaces that highlight the limits of a bodily experience by way of nearly full exposure to exterior conditions.

The necessity of architecture corresponding to its local climate has led to well-developed climatic design strategies throughout architectural history, in which "weather shapes

the built environment along with the designer and the inhabitant" (Hill, 2012, p. 3) and "traditional forms […] turn limitations into advantages" (O'Cofaigh et al., 1996, p. 22). Traditional Persian architecture considers the human to be the spirit of the space, and the built space as the body for that soul (Khaghani, 2012) – a body that is carefully adjusted to its local conditions. Iran is divided into four climatic zones, each of which has different architectural typologies and construction principles corresponding to regional weather conditions. Traditional Persian architecture also principally focuses on the strong integration of architecture in its local context, taking into account site conditions, available local materials, climate, and culture. The courtyard houses showcase the most developed design strategies that tame the hostile climate of hot, arid areas by focusing on such principles. Persian courtyard houses are walled-in plots that are surrounded by *Iwans* – the use of which is designed with considerations of the diurnal activities and seasonal changes (2012). Iwan is a vaulted space that is usually closed on three sides and open on one side, accommodating a semi-open inhabitable space adjacent to the enclosed rooms of the house. Iwans could be defined as extensions of open space into the enclosed space that are used, especially during the warm seasons, as autonomous living spaces to prepare for the transition from one condition to another, i.e. from open to closed or light to dark. The courtyard house has an introverted arrangement that is formed by rooms surrounding an inner open quadrilateral yard that integrates spatial, functional, and aesthetical aspects of the house. The most celebrated aspect of the courtyard is its seasonal and climatic design feature, which facilitates the demands of daily life. This seemingly simple form "implicitly [embodies] an intimate knowledge of the locality and its potential for sustainable life" (O'Cofaigh et al., 1996, p. 2). Courtyard houses could be of considerable size, depending on the wealth of the owners, consisting of living spaces, a business chamber, and sections for servants. The biggest inner yard is the private living zone, with smaller ones belonging to servants and the business sections of the house. The lowered courtyard also allows natural light into the basement of the house, which benefits from the ground's thermal capacity to provide a cooler space during the summer and a warmer one during the winter. The ground level rooms are mainly used for daily living activities and receiving guests, while the upper floor consists of smaller rooms that are used as private zones and sleeping areas, positioned in ways to allow the wind to breeze through small windows, which are in many cases covered with sunscreens. Islamic sunscreens or *Mashrabiyah* minimise the effects of intense sunlight and reduce heat while providing fresh air and needed privacy through perforated surfaces. (For further reading on this subject please refer to (Fathy, 1986, pp. 46–49). The inner courtyard of the house is a constructed microclimate and garden, open to the sky, that provides light and fresh air for the living spaces according to seasonal changes and climatic conditions. This microclimatic, conditioned exterior consists of vegetation and water basins that work together as an integrated system to fulfil the comfort needs of the inhabitants of the house. These integrated elements, along with considerations of orientation, avoid undesired climatic factors by blocking excess sunlight and surface reflections through vegetation, redirecting airflow, and evaporative cooling. The vegetation usually consists of deciduous trees that shed their foliage over the course of the seasons, therefore providing favoured seasonal conditions for the living spaces by allowing or blocking sunlight. This characteristic ascribes seasonal patterns of use for the enclosed rooms based on their location and their exposure to the sun and prevailing wind direction in order to capture the summer wind and avoid the undesired wind of the winter (Figure 4).

The spatial organisation of the house is based on increasing degrees of enclosure, starting from the courtyard as the core open space of the house and leading to semi-open Iwan structures that provide a sheltered extended space (Figure 5). The enclosed rooms, being the last of this spatial gradient, are open to Iwans and are provided with openable panels, the number of which varies based on the importance and seasonality of the room. For instance, the room in the summer zone is also usually the gathering space for receiving guests and has five or eight panels that, once open, extend the room into the adjacent Iwan area. The rooms around

the inner yard are interconnected, and the corners of the overall rectangular organisation of the house usually provide the space for service areas such as staircases to upper floor levels. Therefore, the built exterior of the Persian courtyards primarily depends on the aspects of climate and privacy, arranged in four zones around the quadrilateral yard, providing "a conduit for air and light in the midst of the crowded urban fabric while ensuring visual and spatial privacy" (Rabbat, 2010) through its controlled exteriority.

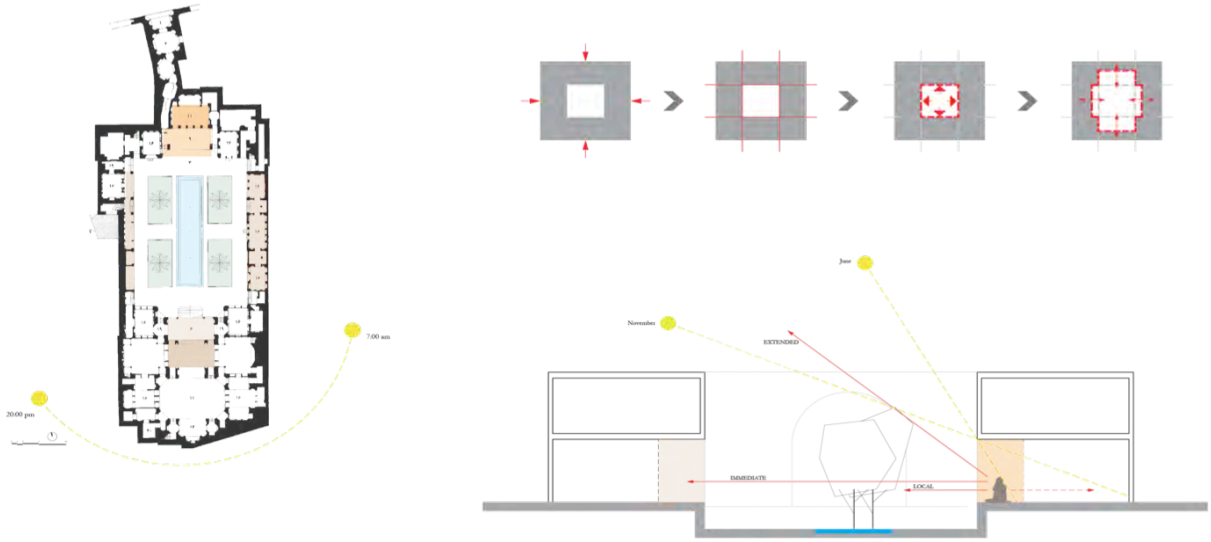

Figure 4. (Right) Plan drawing of Borujerdi's house (built in 1857) in Kashan, Iran. (Right top) The plan organization of traditional courtyard houses of Iran and (Right bottom) diagram representation of the spatial gradience in traditional Persian courtyards – produced by Sareh Saeidi, Spring 2018.

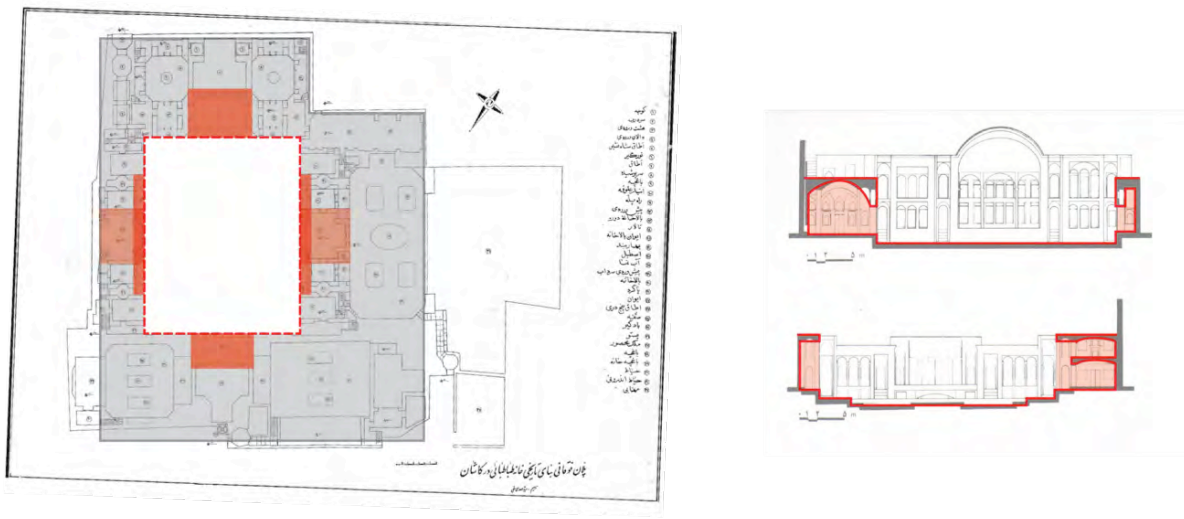

Figure 5. Semi-enclosed Iwans and the lowered courtyard setting at Tabātabāei's house (built in the early 1880s) in Kashan, Iran. The Iwans on the north-south axis in a Persian courtyard house are usually bigger and were used for hosting guests or holding events. These Iwans usually have finer decorations than the east-facing ones.

Similar to the conditioned exterior of courtyard houses, the garden of a traditional Japanese house is also a constructed exterior that is closely integrated with interior spaces. Inhabitants

of these houses are culturally accustomed to an environment intimately linked to nature. In a Japanese garden nature is reinterpreted, redefined, and abstracted to create beauty or to express spiritual or emotional value. Therefore, the garden does not represent nature per se but rather an idealised version of it (Keane & Ohashi, 2012, pp. 117–128). As such, traditional Japanese architecture is positioned in nature in such a way as to accomplish balance and harmony. This entails a certain sophistication that arises from the deep understanding and appreciation of the lessons learnt from nature. Though these gardens are designed to accommodate a range of phenomena, such as tsunamis and earthquakes, they also display the pacifying influence of Buddhism, which sees humans as an integral part of nature, and of the native Shintō religion, whose gods inhabit nature (2012, pp. 117–128). The traditional houses merge with nature rather than stand in opposition to it, treating the building and the environment as equal parts within an ensemble. The constructed garden of the house consists of various types of vegetation that correspond to their adjacent rooms. In other words, the atmospheres and characters of the exterior is meant to compliment the design intentions of the interior.

This could be regarded as an extended setting of the interior, the compositional choices of which correspond to various selections of materials, arrangements, and scales of the indoor spaces. The orientation of the enclosed rooms, which has an interconnected arrangement, is designed to complement the exterior scenery. The limit of the constructed landscape is defined by the garden wall that shapes a separate, enclosed area essential to the creation of a Japanese garden (Bring & Wayembergh, 1981, p. 180). The overall arrangement thus creates an exterior that obstructs undesirable visual aspects, protects the garden from physical intrusion, and allows for a designed miniature garden (1981). The height, orientation, aesthetics, and placement of vegetation, as well as the way the ground is treated and designed for strolling purposes, affect the experience of these environments from both an interior-exterior and exterior-interior point of view (Figure 6 and 7). Other essential elements that establish the close relationship between interior and exterior environments of Japanese houses that work together with this constructed exteriority are architectural elements that define extended spaces, such as Engawa, veranda, and Tsuboniwa. Engawa is a peripheral corridor between the enclosed rooms and the garden. This continuous corridor usually stretches along all sides of the building and provides a climatically sheltered space. Once the adjacent shoji screens are open, the Engawa and inner rooms form a continuum (because they have the same height and floor level) while maintaining the existing visual and spatial threshold conditions between the spaces. Being closed from one side by the interior spaces and sheltered by long eaves, the semi-open Engawa provides a pleasant space for enjoying the constructed garden and its seasonal beauty. Another defined space for enjoying the natural beauty of the constructed exteriority of a Japanese house is the veranda, which is an open platform raised from the ground and usually located at the edge of a small pond or lake. The veranda is specifically known as a moon gazing terrace – an interface between heaven and earth. The shoji screens in Japanese houses redefine the experience of the interior-exterior relationship in a fully enclosed space. The level of transparency of rice paper, when the panels are closed, diffuses the common impression of wall solidity and produces a sublime indirect connection to the outside – not only through the atmospheric ambience of daylight in the interior, but also through the interplay of light and shadow. The pocket garden or Tsuboniwa is a defined closed exterior that functions as an interface between different interior zones, providing access, light, and ventilation similar to the small inner yards of Persian courtyard houses. The Japanese garden is what Yoshinobu Ashihara calls a Positive-Negative space, referring to the positive space (P) as an intentionally planned space, while the negative space (N) is a more spontaneous one (Ashihara, 1981, pp. 20–41). As such, both the Japanese gardens and Persian courtyards can be regarded as P-N spaces due to their intentional separation from natural space for a particular function or quality, while remaining open to unpredictable conditions of the climate and the natural world. This reinforces the relationship between the constructed and the natural by way of spatial organisation.

Figure 6. Representing images of the role of the garden as an extended setting of the interior space in a traditional Japanese house. Photo: (Left) Sanbō-in, Kyoto, Japan, photographed by Haruzo Ohashi – (Right) Stepping stones from the Imperial Carriage Stop to the Gepparo pavilion at Katsura Imperial Villa, near Kyoto, Japan, photographed by Yasuhiro Ishimoto, 1954, gelatin silver print, Kochi Prefecture, Ishimoto Yasuhiro Photo Center.

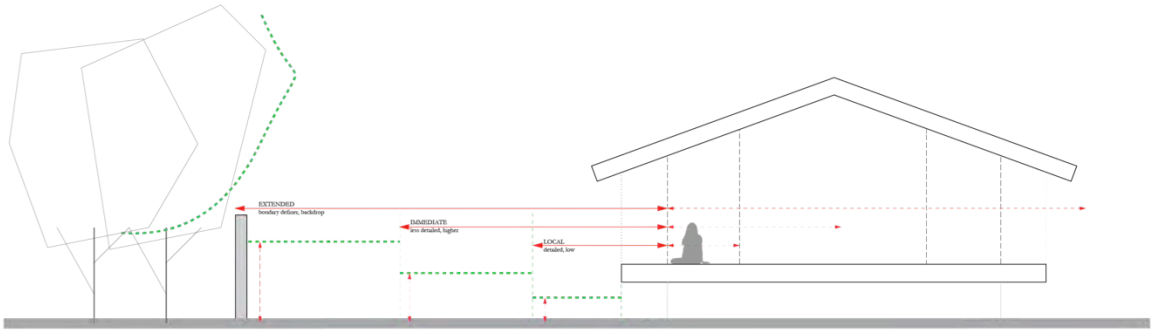

Figure 7. Arrangements of vegetation based on the visual aesthetics of different plants in relation to the spectator's proximity within the framed view. The placement of low vegetation in close proximity to the building allows for a spatial flow that is interrupted by the backdrop vegetation or the garden wall as boundary definers of the extended setting. The diagram is produced by Sareh Saeidi, 2018.

The Inverted House is the prize winner of the 5th LIXIL International University Architectural Competition in 2015, sponsored by the LIXIL JS Foundation, designed by the Oslo School of Architecture and Design (AHO) team, and was built the same year. The competition theme was to design a "House for Enjoying the Harsh Cold" in Hokkaido in Northern Japan. The idea of the design team was, as the project name indicates, to turn the house inside out to embrace the cold of the exterior environment. In this house, the exterior is not for contemplation or to be viewed from the warm interior space. In contrast, the house exposes the inhabitant to a climate that can reach −40 °C in the winter and turn into a mild and gentle environment during the summer (Figure 8). The building is a mediator that provides an inhabitable exterior, partially climatically sheltered by different roof slopes and floor levels. The daily life activities of the house include cooking, dining, taking a bath, or sleeping, which take place in semi-sheltered exterior spaces directly adjacent to the core structure of the house, with the option of sleeping inside during the worst weather conditions. These living spaces challenge the inhabitants' comfort and ability to adapt to the cold, to endure the cold, and what temperature they define as cold (Figure 9). The design illustrates how the architecture envelope, understood as a mediator between inside and outside environments, facilitates the inhabitation of a semi-

sheltered exterior. The Inverted House is an example of tackling flexibility of use and inhabitation, location specificity, extreme climatic conditions of the region, and the culture-related identity of the house as inherent design criteria for a radically different spatial and climatic organisation and experience. Although the house yields to its climatic context, it also shelters from it by redirecting undesired winds or shielding from rain through its roof structure.

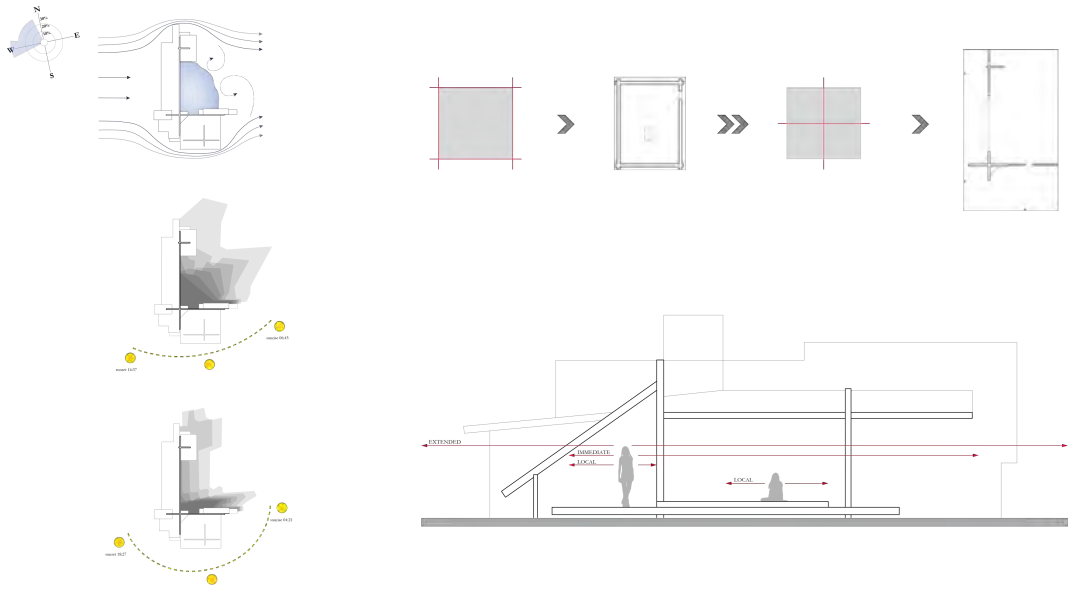

Figure 8. (Left) Diagram representation of the spatial arrangement, wind, and shading analysis for snow collection in the Inverted House in Hokkaido, Japan – by the AHO team in 2015. (Right top) Diagram of the design's concept illustrating the conversion of traditional Japanese introverted plan to an open extroverted organization. (Right bottom) Sectional representation of perceptive distances in the Inverted House's main outdoor rooms – produced by Sareh Saeidi, Spring 2018.

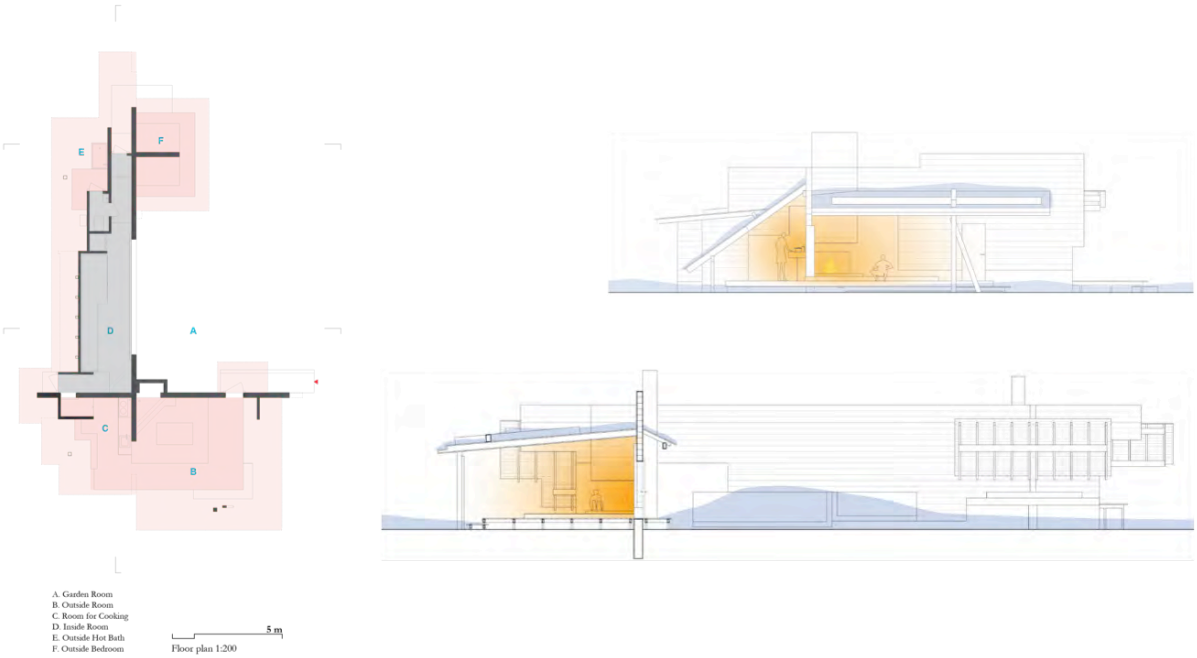

Figure 9. Plan drawing and sections of the Inverted House – produced by the AHO team in 2015.

Today's rapid environmental changes require flexible and adaptive designs that can provide a strong symbiotic relationship between architecture and its surroundings. The task of designing a complete environment could therefore be expressed as the goal to pursue "[t]he ecological balance of human and animal and plant life [to] be correctly adjusted both internally and to the given exterior physical conditions" (Alexander, 1964, p. 3). This includes both individual and collective dynamics of life, economical forces, infrastructure, and other influencing factors in a design in which "its own regeneration and reconstruction does not constantly disrupt its performance" (1964, p. 3). In such an environment, "architectural elements fuse themselves to the latencies of the ambient environment, adopting their capacities for change or movement" (Leatherbarrow, 2009, pp. 37–38). Therefore, spatial configurations of the interior in relation to the exterior need not only have permanent features, but also temporary ones, which allow for contingencies and unpredictable exchanges between the two over time. Indeed, there are various design approaches in architecture that allow for more spatial flexibility. One of these is spatial continuity, which enables the possibility of adjustments to future changes in the built space. Adolf Loos believed that architecture cannot be conceived in plans but through the relations and connectivity of spaces that give rise to a spatial continuum and facilitates certain types of perception (Risselada, 2008). This is clearly captured in the houses he designed, through the spatial order of walls and their wide openings which, while emphasising their phenomenological and structural importance, provide spatial continuity between rooms. In the context of this research, spatial continuity is arguably a well-fitting approach to the *extended threshold* typology. The connectivity of the spaces offers a freedom through which the built form can adapt to and harmonise with given conditions. Space, as such, becomes a lived experience within which change and adaptation define the notion of architectural performance. The following paragraphs examine two examples of buildings that take into account the capacities of architectural design to respond to changing environmental conditions over time.

The first example, the Glass House of Lina Bo Bardi, was constructed in 1950 in São Paulo. The vegetation on the sloped site was removed for the purpose of construction, which, at the time, offered distant views and aided in creating the iconic representation of the building. This condition changed as the vegetation grew back to its full height. The house has a spacious front side, a minimised footprint achieved through pilotis that lift the floor from the ground, and an atrium in the middle of the building that provides light for the core areas. It also gives space needed for the growth of the tree that is in the atrium. These are provisions that facilitate a new relation of adjacency and exposure, resulting in a different interior atmosphere due to the close proximity of the interior to the vegetation (Figure 10 and 11). However, this remains a visual experience separated by the fully glazed outer walls of the living areas. Nevertheless, the closeness of the surrounding vegetation provides an experience of living in a canopy, as well as creating a specific atmosphere through the interplay of light and shadow. This also improves the thermal comfort of the interior by providing shading and reducing solar penetration. Similar relations between the built form and the local climate in regard to vegetation can be seen in numerous historical examples, one of which is the Fin Kiosk in Kashan, Iran. In this garden, the type and height of vegetation is designed to accommodate thermal comfort for the semi-open and enclosed spaces of the built kiosk located in the centre of the garden (Faghih & Sadeghi, 2012, pp. 38–51).

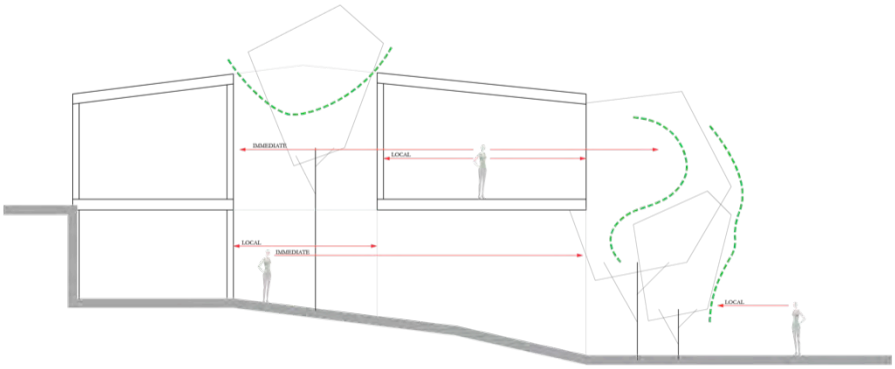

Figure 10. Diagram representation of the spatial relations in the Glass House of Lina Bo Bardi (designed in 1951) – produced by Sareh Saeidi, Spring 2018.

Figure 11. Glass House, Lina Bo Bardi, São Paulo, 1950. Photos of the Glass House after construction, showing the exterior of the house and the extensive exterior views from inside (left column), almost similar photos of these spaces in more recent photos taken from the house (middle column), and the middle atrium (right column).

The second example, the Sheats-Goldstein residence by John Lautner, was completed in 1963 in Los Angeles, California. Its spatial organisation is tailored to mediate between site conditions and design intentions. The house is located on a hillside, meeting the edge of the slope on one side, and dense vegetation on the other. The proximity of the vegetation to the north side of the building promotes specific strategies for material organisation and openness of form. The context is represented by the distant views, openness, and fluidity of the semi-closed and enclosed spaces that are in part framed by local rocks and vegetation (Figure 12). The boundary between the interior and the exterior is often diffused, especially in the way the boundary edges of the building meet the surrounding vegetation. This is achieved through considerations of material organisation, for example through the detailing at the intersection of glass panes and stonewalls, which, apart from obscuring the division between the interior and the exterior, allows for specific degrees of penetration of vegetation into the enclosed rooms. Design considerations that facilitate a unifying expression of spatial flow in the building include the detail of the building's edges meeting vegetation, site conditions, and the use of

glass to disrupt the boundary definition of the enclosure through both transparency and reflection (Figure 13). This provides the adaptability required to create a space in which the exterior and interior environments merge.

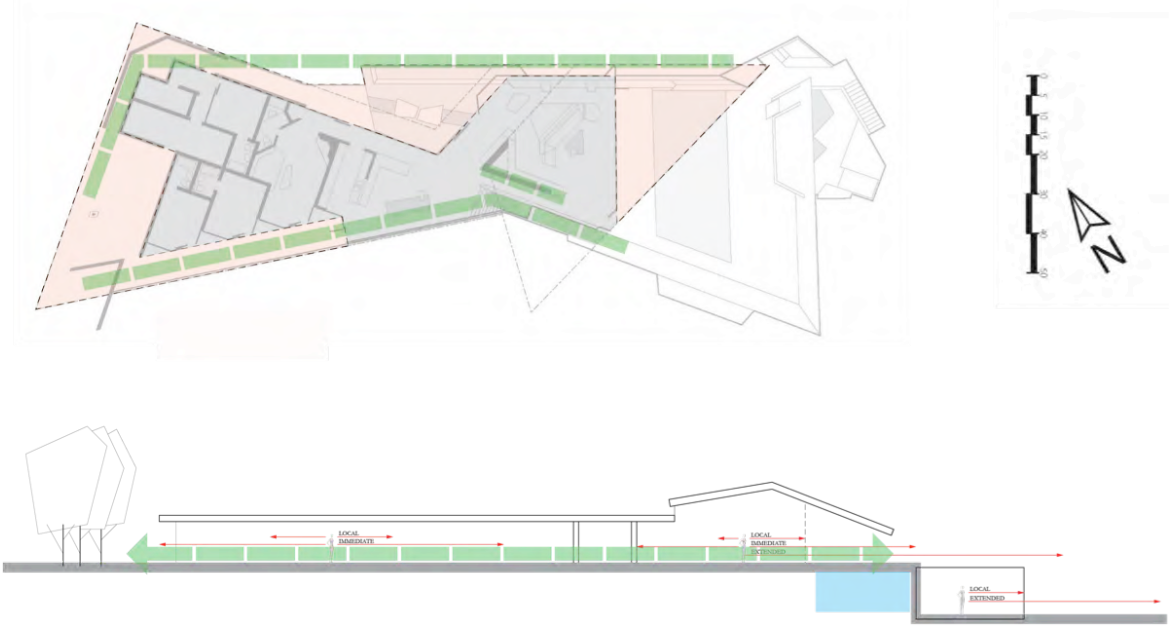

Figure 12. Sheats-Goldstein residence designed by John Lautner, built between 1961–1963 in Los Angeles, California. (Top) Plan drawing in which coloured areas are indicators of the enclosed interior (gray) and the semi-closed extended spaces between interior and exterior spaces (beige). The dashed lines indicate the vegetation growth along the building. (Bottom) Sectional representation of the spatial openness that allows for the vegetation growth along and across – produced by Sareh Saeidi, Spring 2018.

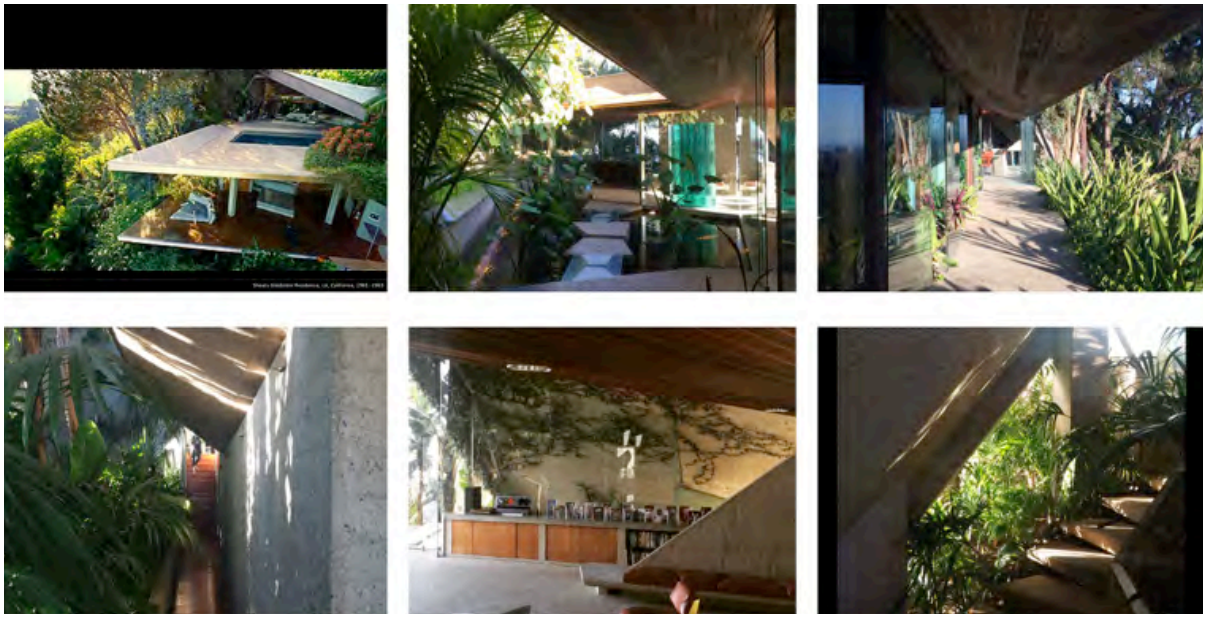

Figure 13. Photos of the Sheats-Goldstein residence, showing the house's main room in its surrounding topography (top left), vegetation growth in the interior spaces (bottom middle), and other photos capturing the close integration of the house with its surrounding vegetation in the extended spaces.

The aforementioned two case examples indicate that the temporary state of an architectural envelope can accommodate transitions between interior and exterior spaces that are both functional and experiential. The exteriority of the built form then becomes a powerful means for design provisions based on local specifications and conditions, which heightens the spatial experience of interior spaces through their exterior context.

Design experiments and developed methodology

In the context of this work, factors for defining suitable relations between interior and exterior environments include qualitative and quantitative analyses of design concepts; the atmospheric effects and climatic comfort aspects of the interior such as ventilation, shading, solar penetration, material organisation; and aspects regarding the proximity (visual distances) of contextual features. The investigations conducted in this section focus on the aforementioned parameters to achieve various climatic and aesthetic experiences of architectural envelopes through a tailored design approach. The experiments address determining factors for designing interior spaces in relation to the exterior environment based on the conceptual aims of the project, and the identification of relevant contextual information sets. This includes a discussion of ways that collected local data can be visualised, applied, and analysed in the design process. A major part of the design approach is comprised of site-specific data identification, collection, and processing based on the project concepts. The investigations include questions on how to correlate and interpret data while acknowledging the relative deficiencies of the collected data (related to the contextual conditions in which they were obtained). The aim was to identify an information-based design process for a locally specific architectural envelope design. The work was undertaken in the RCAT & ACDL master-level studio during the fall semester of 2016. The Advanced Computational Design Laboratory (ACDL) is the innovation laboratory of the Research Centre for Architecture and Tectonics (RCAT) at the Oslo School of Architecture and Design (AHO). The studio brief asked for the design of research facilities and accommodation for six staff members, which could be converted into a vacation home. The site is located in a terraced vineyard called Graspoli, which belongs to Fattoria di Lamole in Chianti, Tuscany, Italy.

Landscapes provide an environment for the co-existence of various species and organisms. Humans systematically constructed rural landscapes in the course of agricultural activity imposed on natural landscapes (Sereni, 1961 in Agnoletti, 2012). Experts frequently posit that cultural landscapes are the result of culture as an agent acting upon natural areas (Sauer, 1926 in Agnoletti, 2006). Such landscapes are therefore the locus of a historical integration of social, ecological, economic, and environmental factors that significantly influence their development and provide their surrounding context with a cultural identity.

Today, rural areas are often diminishing, and the cultural and national identity and knowledge that has been passed down and refined through generations is getting lost. Although some of the productive landscapes are currently regarded as sites of cultural heritage in Tuscany, many others are abandoned, resulting in dense re-forestation and loss of biodiversity. Currently, the layouts and agriculture of these areas are shaped by industrialisation and the use of machines. In the vineyards, these setups are directly dependent on how the owners want to grow the grapevines. Traditionally, the vineyards have been constructed in the form of terraced landscapes to account for steep slopes. Yet, the demand for the use of large machines to facilitate the workload and the maintenance of these landscapes led to the transformation of stepped vineyards into sloped landscapes. This transformation has led to a decrease in the quality of grapes and subsequently the wine. Among the most influential factors in growing grapevines are the altitudinal and thermal conditions of the vineyard. Therefore, the thermal variations between night and day must be carefully considered as one of the main impacts on the quality of the wine produced. Experienced vineyard owners believe that to tackle the questions of the lowered quality, terraced landscapes must be revisited and revalued. The elements and features of a terrace landscape such as dry stonewalls, terrace width, rainwater

management, and grapevine pruning all affect the quality of the wine produced. An example is the significant impact of the dry stonewalls on the photosynthesis of the grapevines and thus the matured grapes: "The [dry stone]walls have a heat-storing function that gives back thermic energy accumulated during the day, creating a peculiar favorable microclimate […] which thrive[s] in dry soil" (Contessa, 2013, p. 30).

The RCAT & ACDL studio engaged with a terraced landscape to contribute to developing an understanding of the current states of such landscapes and ways that architecture can be designed for and integrated with them on multiple levels. The architectural designs were meant to employ local resources and materials and utilise passive means for modulating the microclimate. The design task demanded built forms that emerged from interactions between architecture, climate, and agriculture, such that the proposed architecture would not interrupt the production of the wine and therefore not change the microclimate of the site. Thus, students were asked to investigate the current condition of the vineyard to be able to determine to what degree they could intervene with the existing microclimate of Graspoli's landscape. The design studies were framed around the notion of performance, including both climatic studies and the existing site analysis. The notion of performance within the focus of the author's PhD research emphasises aspects and strategies of architectural design by which the build form can tackle and respond to questions of climatic design and the design's adaptability to changing local conditions. The designs encompassed 200 sqm, one-third of which was used to form transitional spaces. Site-specific data was collected and informed associative modelling for an iterative process of development and analysis of the projects. The design process consisted of testing the concepts within an iterative process of parametric modelling, simulation, and evaluation through which initial ideas were refined and evaluated continuously until they fulfilled the aims of the projects.

The site-specific data included three months of measurements collected by weather stations mounted on site. This data included solar penetration, air and soil temperature and humidity, wind direction and speed, and precipitation. The data was cross-referenced with climatic data from the local meteorological station, which is located at a distance of approximately one kilometre from Graspoli. The orientation and positioning of the projects varied, with some directly positioned next to the grapevine rows and dry stonewalls, and others by the borders of the terraces. The design approaches pursued by the master's students included a) a designed journey through the site, b) proximity as the determining factor in framing views to the natural horizons or borders of the built, and c) climatic conditioning accommodating both human comfort and wine cultivation.

The variety of the design aims and concepts enabled different experiential design processes in the studio. The PhD research benefited from this as it aided in the understanding of the dynamics of the iterative design process. The process also provided the research with methods of identifying relevant tools of analysis and corresponding data based on design concepts. This included ways various focuses must be applied, analysed, and critically reflected upon during the design process, and how to develop the built knowledge further at each stage of the analysis. The design experiments aimed to closely engage with the local context on multiple levels, including both the existing microclimate together with the physical elements and the topography of the site. The three selected projects, which are elaborated on in the following paragraphs, contributed to the development of earlier methods of the research by focusing on the clarification of approaches on thermal comfort and distances in experiencing the aforementioned envelopes. The various skillsets of the students allowed for different modes of investigation, ranging from expressive hand sketches to data-driven simulation and analysis. These included a main methodological approach within each team, together with climatic and site analysis. Team one used hand sketches and photometric studies of the site as a storytelling method to visualise the existing atmospheric qualities of the landscape and how the design aimed to engage with these qualities. Team two utilised serial sections as an analytical tool for developing their integrated design sketches. Meanwhile, team three collected and employed

various datasets that provided information on factors regarding thermal comfort simulation and analysis, as well as algorithmic form optimisation.

The first two teams chose to design a path through which the visitor is guided to experience the site. Team one used hand sketches and sequential photographic studies to design the visitors' experience through a walking path in the vineyard. Their design focused on emphasising on various distances of the body to elements of the site in order to incorporate tactile experiences, along with capturing specific views within the designed path. The primary photometric studies were focused along the main path that led to the selected terrace on which they designed their building (Figure 14). The studies were focused on the atmospheric and perceptive differences of moving uphill or downhill along the slope, and the perceptive differences caused by the proximity of the visitor to the grapevines or distant landscapes created expansive vistas on the horizon. This storytelling method enabled the group to communicate and develop the experiential qualities they were aiming to achieve in their design project. The specific location-dependent features and collected information assisted in unfolding the notion of transitions as changing states of experience along the site. Design considerations included the differences of going uphill versus downhill. The close proximity of landscape elements such as grapevines, grapes, leaves, and dry stonewalls when moving uphill facilitated a bodily experience of the site on a human scale, while going downhill provided views of the valley (Figure 15).

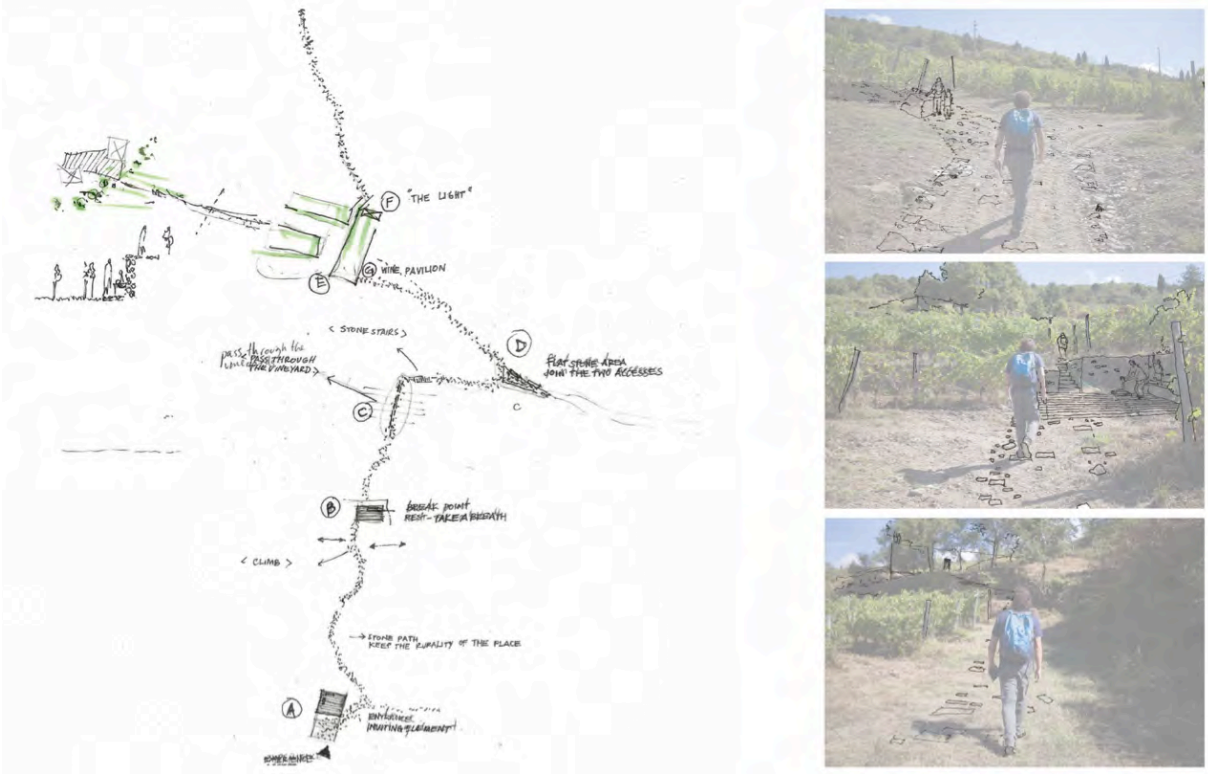

Figure 14. Hand sketches and sequential photographic studies to design the visitors' experience through a walking path in the vineyard. Their design focused on emphasising on various distances of the body to elements of the site in order to incorporate tactile experiences, along with capturing specific views within the designed path. Performative Envelopes II Workshop conducted by Sareh Saeidi at the Advanced Computational Design Laboratory (ACDL), The Oslo School of Architecture and Design (AHO), Fall 2016. The project was designed and visualised by students Ignacio Madinagoitia and Gunnar Sørås.

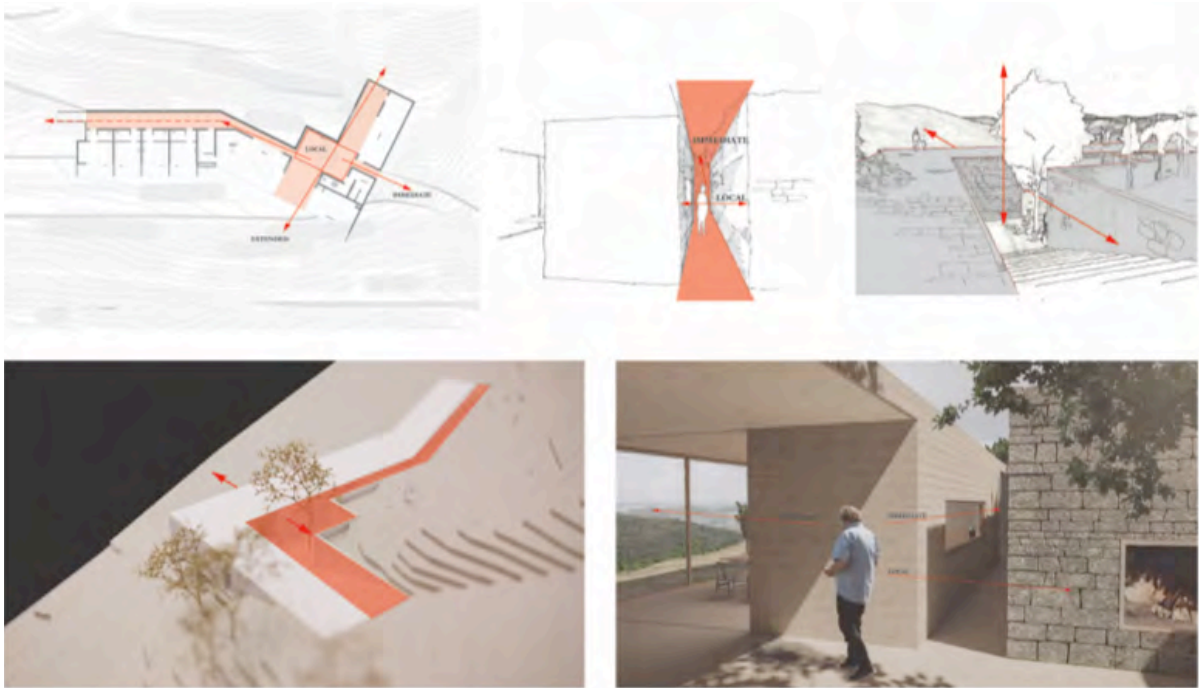

Figure 15. Diagram representation of spatial relations and perceptive distances of the project's extended setting. Performative Envelopes II Workshop conducted by Sareh Saeidi at the Advanced Computational Design Laboratory (ACDL). The visualizations are produced by the design team (Ignacio Madinagoitia and Gunnar Sørås) and the diagrams are produced by Sareh Saeidi, Spring 2018.

Team two aimed to create a continuous atmospheric effect for their built forms by incorporating the existing dry stonewalls in small semi-closed and closed spaces along, through, and in-between the walls. These integrations with the dry stonewalls were shaped along the main axis of the terraced landscape and slope. The designed interventions were arranged along the main axis of the site, and in the direction of the slope alongside the main downhill water drainage system. The experiences are achieved through the position and movement of the body in relation to the wall. The proximity of the visitor to the stonewall and the ways he or she moves through, along, under, in, or on these structures is designed to activate an experiential understanding of the built interventions and the terraced landscape (Figure 16). These experiences correspond to Leatherbarrow's ways of experiencing architecture in terms of distances between the body and the built form. In this case, local distance is the close adjacency of stonewalls to the body, which provides a tactile experience, while framed views of the surroundings in the immediacy of the walls heighten the experience and understanding of the vineyard. The extended topography, on the other hand, goes beyond the farthest views of the site and reveals extensive vistas of the Tuscan landscape. Another factor from which the designed semi-closed and closed rooms benefit is the thermal inertia of the dry stonewalls, which provides a cooler interior during the day and a warmer one in the evening.

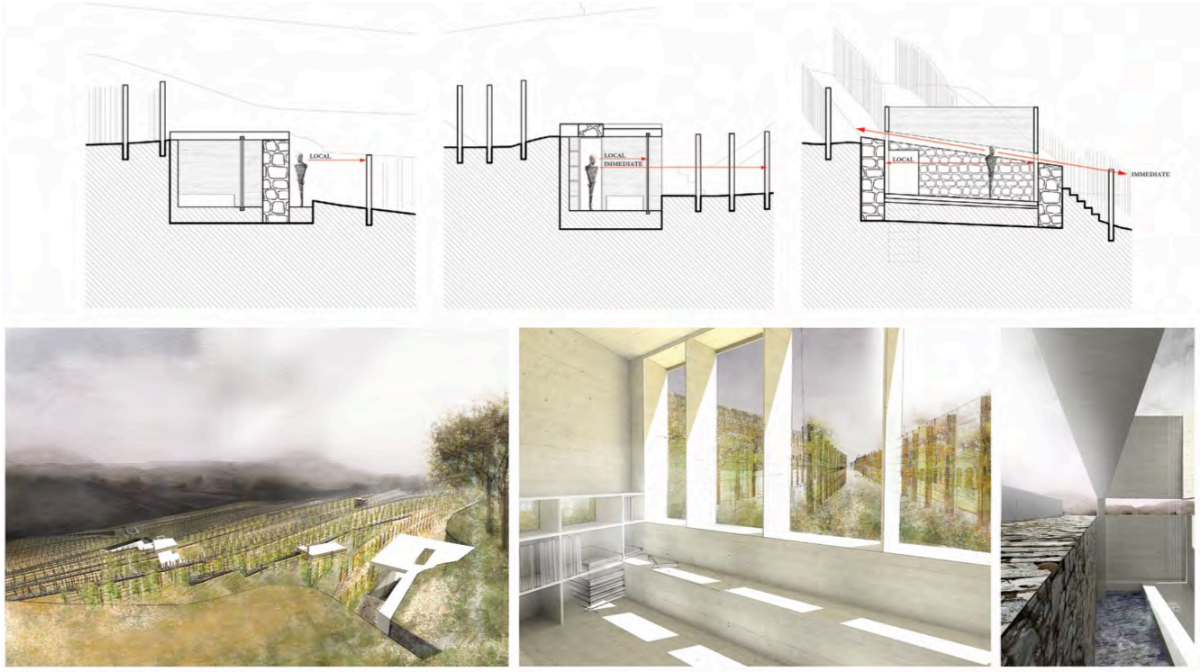

Figure 16. Sectional representations of the perceptive relation of the inhabitant to the existing dry stonewalls that are closely integrated in the terraced landscape, and the visualised views of the distances from and in the designed interventions. Performative Envelopes II Workshop conducted by Sareh Saeidi at the Advanced Computational Design Laboratory (ACDL). The diagrams are produced by Sareh Saeidi, Spring 2018. The project was designed and visualised by students Andra Nicolescu and Kristian Taaksalu.

The third team put the emphasis on spatial provisions within the thematic focus of thermal comfort and human adaptation. The project aimed to create a built form that responds to its microclimate by way of an explicit free-running building (FRB) approach by providing climatically adaptive living zones. FRB provides a variety of indoor climates through implementing strategies related to the topics of inhabitants' acceptance, forgiveness, expectations, and adaptive capacities using clothing, spatial arrangements, thermal inertia, and flexible use of space. The project utilises local climatic conditions to enhance thermal comfort for the built space by focusing on two aspects. The first aspect focuses on ways by which the building integrates with its surrounding landscape and affects its immediate climatic context. This was assessed by extensive solar gain and shading analysis for comfort studies, consisting of temperature, humidity, and wind speed. The other aspect focuses on indoor comfort requirements relative to the inquiries of a research facility and accommodation for researchers. The influencing factors regarding perceived comfort temperature were environmental and human-based. The environmental factors consisted of air temperature, radiant temperature, air velocity, humidity, and related inhabitation factors, including individuals' clothing, activity, and metabolic heat (Figure 17 and 18).

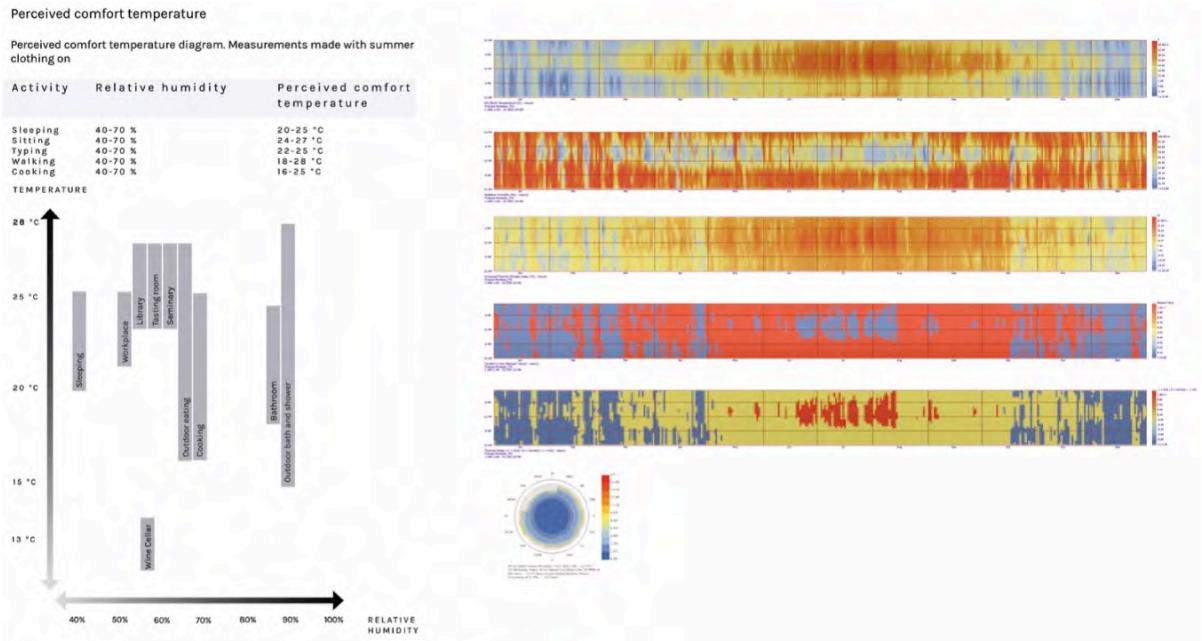

Figure 17. Diagram representation of perceived comfort temperature (left), estimated with summer clothing on, based on the literature review. Visualisation of yearly climatic data (right) for thermal comfort analysis, including relative humidity, dry bulb temperature, and factors of thermal comfort. Performative Envelopes II Workshop conducted by Sareh Saeidi at the Advanced Computational Design Laboratory (ACDL). The project was designed and visualised by students Joar Tjetland and Maria Lagging.

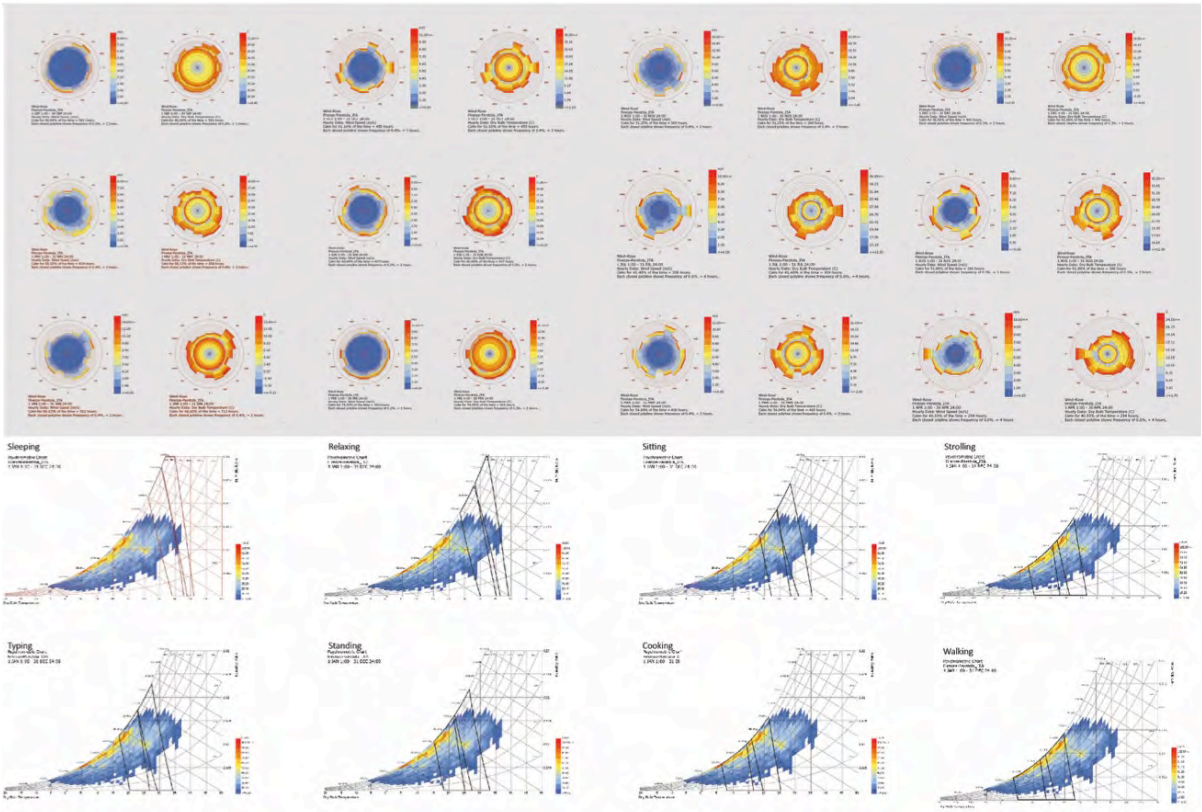

Figure 18. Visualisation of yearly wind analysis and psychometric charts of various activities based on the building's program, which informed the design project and placement of various spaces of the building together with solar radiation studies. Performative Envelopes II Workshop conducted by Sareh Saeidi at the Advanced Computational Design Laboratory (ACDL). The project was designed and visualised by students Joar Tjetland and Maria Lagging.

This project is located on the highest possible altitude of the terraced site, connecting two terraces through a sequence of above- and below-ground spaces. The form optimisation and inclination of the surfaces results from the analysis conducted to ensure a minimal degree of shading by the surroundings, such as grapevines and trees. The required gradients of microclimates are designed using architectural modifiers consisting of walls, flooring, screen walls, roofs, and designated activities of the inhabitants in different spaces of the project. Factors such as materiality, heat storage, shading, natural ventilation, and precipitation are applied as design drivers.

South-facing surfaces are minimised to avoid the impact of solar radiation and the resulting heat gain for exterior and interior spaces. The optimisation analysis was conducted using the *Galapagos Evolutionary Solver*, with the indoor peak temperature in summer as the highest value for the generic optimisation. Galapagos is an open source plugin for *Grasshopper,* providing a generic platform for the application of evolutionary algorithms that can be used for a wide variety of problem solving by non-programmers. Grasshopper is a graphical algorithm editor developed by Robert McNeel & Associates; it is tightly integrated with *Rhinoceros* 3D modelling software. Material choices in various zones of the building correspond to considerations of ventilation, heat gain or release, humidity, and solar gain to fulfil each zone's climatic demands. Considerations of the programmatic distribution and climatic design of various zones mainly accounted for climatised interior and exterior zones that were supplementary to one another in maintaining the overall microclimatic design of the project. On a conceptual level, the semi-open rooms and transitional spaces provide the spatial continuity of the exterior into the semi-sheltered spaces. The bedroom modules, located below ground, follow the course of the terraced landscape, while the rooms for social activities and gatherings are partly integrated on the step between two terraces and are partially embedded in the lower terrace. The below-ground zones benefit from the thermal insulation of the soil and also employ thermal inertia and user-based adaptation (Figure 19).

The design process was based on the extensive use of mind maps and iterative associative modelling, analysis, and simulation. Comfort analysis and simulations were conducted using *Ladybug* and *Honeybee,* two open source plugins for Grasshopper that help explore and analyse environmental performance by evaluating a building's energy consumption, comfort, and daylighting (Sadeghipour Roudsari & Pak, 2013). In order to finalise the design concept, these analyses included shading, airflow, solar gains, and the materiality of the exposed surfaces. The mappings also incorporated aspects such as adjustable seasonal use of various spaces.

The utilisation of advanced digital tools provided an informed mode of design within which various microclimates were iteratively assessed and analysed, resulting in an effective inhabitation model. The main design driver in decisions regarding spatial organisation in relation to comfort temperature was dependent on factors of program, activity, and clothing. Common approaches that have a high focus on energy efficiency can be criticised for utilising standards of human comfort and excluding other influencing aspects, such as the cultural background and its impacts on the perception of thermal comfort. In contrast to this, FRB provides enough flexibility for allowing patterns of adaptations based on individual needs, while also having the capacity for post-occupancy changes.

The various focuses of the aforementioned experiments enabled the research to map and identify the effective relations between the datasets and tools of analysis required for the design concepts. These mappings facilitate an understanding of the workflow and the development towards a synthesised approach for designing with multiple criteria, as well as conceptual approaches to architectural performance and performative envelopes.

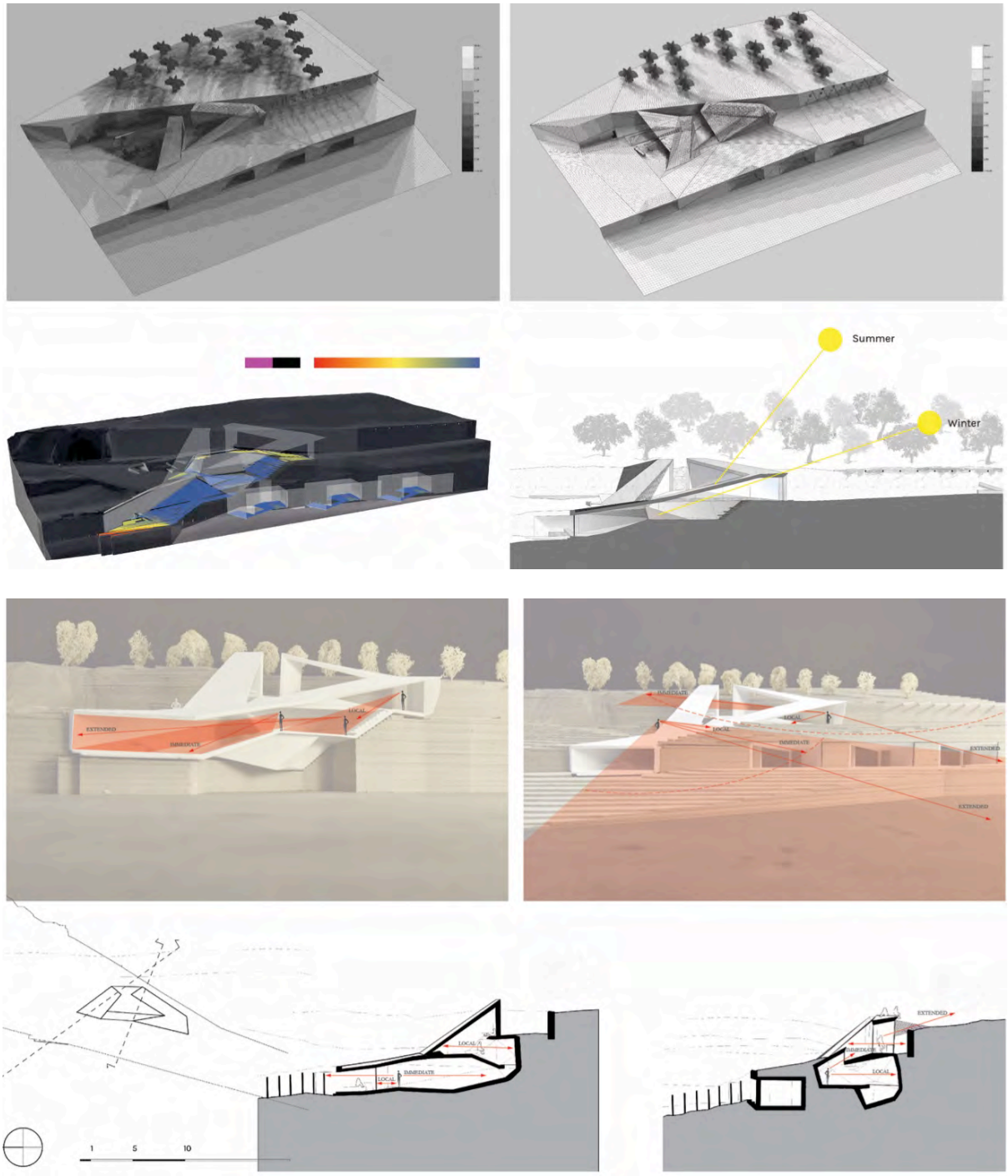

Figure 19. Comparative study of shading analysis and solar radiation between winter (December – top left) and summer (June – top right). The studies were decisive for pairing various activities to programs of zones based on the required thermal comfort (2nd row from top). The four images at the bottom represent the diagrammatic representation of the project's extended setting in relation to enclosed and semi-closed spaces that define the building's threshold. Performative Envelopes II Workshop conducted by Sareh Saeidi at the Advanced Computational Design Laboratory (ACDL). The project was designed and visualised by students Joar Tjetland and Maria Lagging, and the diagrams are produced by Sareh Saeidi, Spring 2018.

Discussion and conclusion

The importance of the role of building façades has been a significant topic within architectural discourse. The discussion tends to fall under four thematic approaches: structural and static; expressive and representational; socio-political and economical; and environmental analysis and issues of sustainability (Saeidi Derakhshi, 2017, p. 33). This research aimed to initiate a repositioning of the relationship between built forms and their surrounding environment with the goal of advancing the role of the locally specific exterior in the conceptual perspective and method. This was systematically approached through a number of case and design studies. The conducted studies demonstrate a design approach that utilises the exterior environment to create climatic, atmospheric, and adaptive qualities for the interior.

The design process of architectural envelopes as extended settings was developed through digital modelling and analyses to facilitate design iteration and application of collected contextual data, such as climatic datasets. Contemporary technological advances, open source platforms, and available tools have enabled architects, engineers, and others in related disciplines to access and gain insight into various data sources easily. The role of information-based processes is to provide a preliminary base for design iteration and analysis that can assist a better understanding of locally specific conditions. The process of translating gathered contextual information into applicable knowledge for the design process includes various steps, starting from the identification of relevant datasets that correspond to the programmatic and conceptual aims of the project. After parsing the relevant information, quantitative and qualitative analysis can be conducted using the available data. Visualising and mapping the interconnections and relations between different sets of information enables a better systematic understanding of the existing conditions. This elevated understanding allows for an informed design process in which design considerations closely incorporate, respond, and interact with the acquired knowledge of the project's contextual circumstances.

However, in the backdrop of open source datasets, modelling and simulation are the prevailing tendencies within current architectural design education and practice, shifting architecture towards data-driven, computer-generated methods. The resulting architecture, therefore, is frequently based not data, with little further critical or reflective thinking, often not formulating and exploring alternative concepts. In addition, the main portion of the conducted analyses is focused on the impact of the buildings' forms on urban microclimates (such as wind tunnels, shading, and solar gain analyses) which is conducted by environmentalists and urban planners. While these big-scale analyses are essential for understanding the bigger context of design, finer analyses and evaluations that examine ways of intervening with microenvironments and the immediate exteriority of the built form remain underexplored. The conducted workshops required the researchers to reflect on and gain insight into the aforementioned concerns of the data-assessment process. The design process clarified various stages of site-specific data handling. It facilitated the understanding of how to parse the needed data in correspondence with design ideas, and consequently assisted with the identification of analytical and simulation tools based on the project inquiries. In addition, it informed this research how to develop a flexible methodological frame to correlate data with design concepts and how to repurpose them in case of unsatisfactory results.

The rising awareness in today's practice of problems of computational and data-driven designs has led to the engagement of architects with questions related to the identification of contextual information and ways of analysing data. Gaining an understanding of information, empowered by interdisciplinary insights, facilitates the transformation of data into applicable knowledge for the design process. What should be emphasised is that implementing contextual knowledge can significantly benefit from recursive thinking and reflection on the subjective realisation of the context, which includes aspects such as social and cultural insights. It is also necessary to bear in mind that although designing in this way results in a built form that corresponds to its local atmospheric and functional needs, the design would still be dependent

on latent contextual changes and must therefore provide a flexible structure to adjust to future needs.

The sections on case studies and design experiments help to clarify this research's definition of performance by distinguishing it from the common definitions of energy efficiency and technological focuses, instead favouring functional aspects of the built form that emerge from the interactions of architecture with its surrounding context. The discussions specifically facilitate identifying the differences between the approaches of the non-discrete envelopes typology, thus further developing the earlier studies of the author's PhD research on the taxonomy of envelopes (Saeidi Derakhshi, 2017, p. 15). These approaches are identified as dissolved threshold and extended threshold, and they articulate the building envelope in ways that provide intermediary semi-open spaces between the interior and exterior environments. The main difference between these two approaches is their degree of enclosure in relation to their adjacent exterior environment, which is considerably higher in dissolved thresholds. This typology refers to design approaches that provide exteriorised interiors, in which the removal of a building's outermost wall forms extended spaces that are considerably exposed to exterior conditions while providing a degree of climatic shelter (such as the Inverted House). Extended thresholds, on the other hand, provide a well-defined microenvironment (formed by a void in the core of the building or a roofed veranda in case of the presented examples) with certain limitations regarding the spatial depth. Furthermore, they are also sheltered and affected by their adjacent enclosed spaces. Within this domain, a considerably difficult task is to define the means of designing extended settings through building envelopes.

This investigation proposes a guideline for designing extended settings as an extension of the notion of the exterior of the built form, based on the findings of the conducted case studies and design experiments. In light of this investigation, the following points need to be considered within the design process of architectural envelopes, including both design approaches and concepts framed in the scope of designing non-discrete architecture and its typologies. The three typologies of non-discrete envelopes consist of: extended thresholds, dissolved thresholds, and multiple envelopes, which are all discussed at length in the case studies section of this article. The typologies provide a spatial extension, which is emphasised either in the interior or exterior realm, by representing various approaches in integrating these two environments through means of building envelopes. In designing an extended setting for the built form, design considerations must articulate functional, aesthetic, and experiential aspects in correspondence with contextual circumstances, or specifically single out one aspect based on the particular aims of the project. The functional aspects mainly incorporate programmatic, climatic, and comfort design factors, while aesthetic ones include strong visual connections between the interior and the exterior. The integration of these two aspects can intensify the experience of the extended setting through a conscious design of emerging atmospheres and spatial interactions.

Various design concepts that assist in designing the immediate exterior of the built form as an inherent extension of the interior are: graded enclosure (interstitial/ transitional spaces providing spatial sequences), controlled spatial continuity (interiorised exteriors accommodating microenvironments through semi-open spaces), and spatial openness (exteriorised interiors acclimatised to the exterior environment, challenging the notion of interiority as a spatial enclosure). As conceptualised in the case studies section of this article, each of these concepts includes architectural elements that shape the envelopes' spatial definitions in different typologies. Two main design approaches for creating the gradient of spatial enclosure are the material organisation of envelope surfaces and positioning multiple layers of envelopes in correspondence to one another, forming a visual or permeable gradient. Elements and design approaches that develop a controlled spatial continuity also provide semi-open spaces between the two architectural realms of the interior and the exterior. These spaces are usually defined through a kind of mass subtraction of the building form to generate a conditioned space, such as courtyards or pocket gardens, Iwans, Engawa, veranda structures,

or even niches, as an inhabitable extension of the exterior environment. Another design strategy, which creates both a controlled microenvironment and sequential degrees of enclosure, is the elevated ground – or pilotis – that allows an intermediate space through an uninterrupted exteriority. The last design strategy is spatial openness, which is similar to the other two but is differentiated by challenging the notion of building envelopes through the erasure of a building's outermost wall to accommodate a semi-open transitional space. In this approach, various interrelated aspects of the exterior directly affect the inhabitation patterns of these interiorised spaces, the experience of which is highly dependent on subjective perception.

This article contributes to advancing the earlier discussions of the research in architectural envelopes, which explained their role towards the interior environments, by defining their close relations with the (locally specific) exterior environments. The studies indicate design strategies for articulating spatial extensions that provide conditioned exteriors which are supplementary to interior spaces. These strategies marry experiential and functional concepts by extending the spatial relation between the interior and exterior environments. The presented research thus seeks to further develop the earlier proposed conceptual approaches by identifying challenges and ways of integrating conceptual ideas and specific contextual knowledge for creating atmospheric qualities through the climatic conditioning of architectural envelopes. These efforts led to a design process for architectural envelopes, the spatial qualities of which emerge from iterative processes and discussions, rather than preconceived ideas of designing locally specific architecture. The diagrams extracted from the case studies can serve to expand the conceptual approach and act as design guidelines. As such, the diagrams constitute generalised principles that need to be re-contextualised and adapted to specific settings. Therefore, these principles are not generally applicable regardless of context and the specific exterior environment. On an overarching systematic level, the diagrams also serve to illustrate and embody concepts and approaches that can serve to advance and refine the architectural envelope concepts and taxonomy produced in an earlier stage of this research. The next stage of the research will test select diagrams and architectural envelope taxonomies in a design project conducted by the author with the aim of refining the methodological approach to architectural envelopes.

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Landscape of participatory city makers

A distinct understanding through different lenses

Abstract

Today, citizens, professionals, civil servants, social enterprises, and others form different types of coalitions to overcome the challenges facing our modern cities. In this paper, the particularities of these types of groups are characterised and categorised into ten different types of city makers. Generally, these types of city makers bring value to cities, but we conclude that this value could be enriched through more participatory approaches that stimulate crossovers and accelerate the transition towards sustainable futures. Therefore, we characterise the different identified types as potential 'participatory' city makers. However, these participatory approaches and the networks between them still need to be developed, while improving conditions and dynamics that can enable and enhance innovation in urban environments. Design and systems thinking could contribute valuable methods and perspectives to the development of these participatory and systemic approaches. Finally, the categorisation presented in this paper must enable a better understanding of the transformative capacity of these different types of city makers, necessary for flourishing and sustainable communities.

***Keywords*:** Urban planning, participatory design, sustainability transitions, Rotterdam.

Introduction

At present, different types of coalitions represent innovative ways of urban insurgent activism that aim at transformation, calling for new answers to citizens' needs (Linders and Mayer, 2002). Typically, social entrepreneurs, civic volunteers, local activists or civil servants represent these new city makers. The new city makers are active on various topics and challenge the existing social and cultural structures through which urban services, spaces and buildings are managed. They respond to rising urban issues with new approaches, focusing on better quality of life and sustainability. In this sense, the city makers that take responsibility and lead new practices can be seen as front-runners of urban sustainability transitions (Frantzeskaki et al. 2016). However, the fact that some front-runners collaborate in different and innovative ways does not necessarily produce a broader collaboration or change of practices among all actors. Scholars in different domains have tried to describe the nature and potential of practices of frontrunners, focusing on different aspects that characterise them: for example, as place making in urban development (Palermo & Ponzini, 2014), as transformative social innovation (Avelino et al., 2017), as self-organising bodies (Rauws, 2016), or as tactical urbanism (Lydon & Garcia, 2015).

Many scholars as well as citizens and institutions, express a need for arenas to transition towards sustainable cities and new forms of collaboration across sectors, interests and contexts (Mantysalo, Balducci, and Kangasoja, 2011). The coalitions described in this paper are, in a way, a form of cross-boundary collaboration. The strength of these coalitions is characterised by an inherent collaborative nature that bring different types of knowledge and expertise together. However, it has not yet been demonstrated whether and how they contribute to changes in the overall system. These coalitions do not yet seem to affect the current prevailing planning, design and cultural practices.

Innovation within cities and its impact on systemic change for sustainability depends on a combination of factors that do or do not exist within a specific context. These factors are shaped by the structured frameworks (such as existing policies or rules) and by the social and cultural environment (such as entrepreneurial culture, existing city maker initiatives or activism) (Puerari, 2016). These conditions characterise the urban landscapes in which innovation might happen. In this perspective, a further exploration of the characteristics of such an urban landscape is needed.

This paper aims to go beyond a general description of the value or characterisation of societal groups as a whole. Instead, the focus is on the specific qualities and interactions happening within those environments that might lead to knowledge production and learning aimed at a broader systemic change. Specifically, the characteristics of different types of city makers are studied within the city of Rotterdam, the Netherlands (for more details on the selection of the case study city, see the context paragraph). It is not often that these new types of city makers are categorised or captured in particular. The overall aim is to enable a more detailed understanding of the transformative capacity of these city makers, which is necessary for flourishing and sustainable communities. Practically, this is expected to help in recognising particular niche innovations in cities as well as to understand whom to involve in the future activities of participatory city making. More generally, the understanding that follows from this categorisation must enable the promotion of settings and institutional environments that can deliberately create space for 'short-term innovation and long-term sustainability visions linked to desired societal transitions' (Loorbach, 2010, p. 163).

In short, this paper studies new coalitions, initiatives, niches or city makers by treating them not as one group with similar characteristics but by recognising their diversity. The goal is to understand the activities and roles within the larger landscape of urban socio-technical change. Because of the sought-after understanding, perspectives from both sustainability transitions and design are presented in the theoretical background. The combination of these two perspectives is expected to aid in recognising the places and spaces for innovation and participation in urban contexts. In the following section, the framework of analysis for city maker niches is developed by elaborating on five different theoretical lenses from the two domains of study: sustainability transitions and design. Next, the method section discusses the data collection and the context of the case study city of Rotterdam. The results section then presents the actual categorisation of the different city makers, analysed with the five different lenses. Finally, the discussion and conclusion sections reflect upon how city makers can move from a landscape of isolated niches towards a participatory network for systemic change.

Understanding city makers from a sustainability transitions perspective

In the domain of sustainability transitions, different conceptual models have been developed to understand the dynamics of socio-technical and systemic change. Examples include the multi-level perspective (Geels, 2002), the x-curve (Loorbach, 2014; Loorbach et al., 2017) and the s-curve (Schumpeter, 1934). These models depict a change or transition from one state to another. Often, the subject of change in transitions is a *regime*, described as 'the semi-coherent set of rules carried by different social groups' (Geels, 2002, p. 1260). Niches are the counterpart of regimes. Niches can be considered 'protected spaces' for experimenting with alternative socio-technical configurations, liberated from the selection pressures of the regime (Smith and Raven, 2012). Niches represent a critical source of new ideas and practical solutions for system innovations (Wolfram, 2016a). The actors within niches often act as front-runners of innovation both within their own organisations or social groups as well as for other organisations and groups (Puerari et al., 2017). In the case of this study, the new coalitions of city makers can be considered niches, calling for and acting towards change in the urban regime. They represent innovative ways of managing and dealing with new issues as well as current problems.

One critique of the understanding of transitions is that there is a presumed bottom-up, niche-driven bias (Geels & Schot, 2007). However, niches in our study are not understood as only coming from actors outside the main existing power-structures (i.e. proactive citizens); they may also form within other groups (i.e. among civil servants, public bodies, and other existing power-structures) and be innovations within existing regimes. Even more so, coalitions between bottom-up groups and regimes might trigger the development of niches between them.

Strategic niche management has been suggested as a crucial form of policy intervention to enable the creation of robust and influential niches (Kemp et al., 1998; Schot and Geels, 2008). Based on this suggestion, most analyses of niche dynamics have focused on market-oriented technological innovations that feature industry and state actors. However, cities have recently become recognised as critical hotspots for transitions towards sustainability, incubating and catalysing socio-economic and environmental change (Wolfram, 2016b). A growing amount of literature addresses sustainability innovations driven and implemented by civil actors (Mokter, 2016; Wolfram & Frantzeskaki, 2016; Lydon & Garcia, 2015; Mayer, 2013; Seyfang & Haxeltine, 2012; Seyfang & Smith 2007). To make innovation happen, certain conditions are needed, such as the presence of physical and mental space for learning and experimentation (Avelino et al., 2017), the diversity and richness of experiments (Rotmans & Loorbach, 2009) as well as the presence of norms and agreements that allow for experimentation (Moroni 2015). From this perspective, it is clear how urban niche dynamics are strongly embedded and linked to the urban contexts in which they reside.

More specifically, to shape the development path of niches, three basic conditions have been identified: (1) expectations of the innovation need to be widely shared among members, (2) networking is needed, also beyond members of the niches, and (3) learning should be experiential and occur in the wider social context of communities (Wolfram, 2016a). These three conditions confirm the need for a better understanding of the particularities of different types and offer the first lens for analysis. All three conditions contain a strong indication towards more participation within and between city makers. Participation should occur within groups of city makers to align expectations, but also between as well as beyond city maker boundaries to allow networking and learning. When the city makers are understood in their particular forms, the expectations of each particular type can also be more easily shared beyond their members. The identification of the particular types could also help in recognising network possibilities and opportunities between the different types. Finally, the identification of different city makers could support learning between the different city makers as well as beyond.

Understanding city makers from a design perspective

In general, the field of design is concerned with creating value through the act of designing and making something new. Design can be considered a way of gathering resources to create value (Nonaka & Konno, 1976; Ramaswamy, 2009). Therefore, design can help in understanding city makers' activities towards sustainability transitions. Second, for the studied city makers, design can also be a source for new methods, activities and participatory practices.

An important scholar at the cross-roads of design and sustainability transitions, Ezio Manzini, makes the value of using the broader perspective of design apparent and with that, the value of a design perspective for city makers. In this study, city makers are understood as niche actors in urban contexts. Manzini, while also criticising the current state of design and its lack of debate, proposes a new way to interpret design and designing. In contrast to what he refers to as the currently limited culture of *solution-ism* and *participation-ism* (Manzini, 2016, p. 52), he proposes to distinguish between three different types of design: *diffuse design, expert design and co-design*. Expert design is performed by 'professional designers who should, by definition, be endowed with specific design skills and culture' (Manzini, 2016, p. 53). These skills are needed for the type of activities that designers are formally trained to do; hence also referred to as formal design or traditional design. Skills or activities associated with expert design are, for

example, dealing with uncertainty, thinking about systems, a human-centred focus, transdisciplinary skills, participatory inquiry, visual communication, iteration, experientialism or prototyping. For different sets and combinations of these (expert) design skills or activities, see e.g. Cross (2004), Dalsgaard (2014), Lawson (1980) or Dorst (2011).

However, it is Manzini's understanding of co-design and diffused design that makes it clear how the field of design is useful in understanding the activities of niche actors in the city; particularly towards their activities of participatory city making. Manzini describes co-design as 'the overall design process resulting from the interaction of a variety of disciplines and stakeholders—final users and design experts included' (Manzini, 2016, p. 53). He further states that 'every design process is co-design, and therefore it must provide space for the point of views and active participation of many different actors' (Manzini, 2016, p. 57). This statement makes clear that it can be valuable to look at the field of design and its methods as a potential source for developing participatory methods for other fields, such as city making. Furthermore, Manzini describes *diffuse design* as 'the natural human ability to adopt a design approach, which results from the combination of critical sense, creativity, and practical sense' (Manzini, 2016, p. 53). This description of Manzini is in line with the most inclusive definition of designers by Herbert Simon (1997), who states that 'everyone designs who devises courses of action aimed at changing existing situations into preferred ones' (p. 112). In relation to city making and urban planning, the understanding of diffuse design is quite interesting. The understanding of diffuse design shows that the actions the city makers take to change the course of action for sustainability transitions in the urban context can also be considered design activities, or diffused design activities. City makers naturally perform these activities in their process of problem solving. However, it is these types of diffused design activities that are not as well understood as that of expert design or co-design. There is a substantial body of literature on expert design versus novice design, but here novice design is more design expertise in training. Diffuse design should rather be understood as non-design experts (nor in training) naturally engaging in design and co-design activities.

Four more lenses for the analysis of city makers

Traditionally, design is considered to be concerned with products. However, the understanding of the word 'product' has widened significantly over time. Attention is shifting to more systemic solutions that are developed in a participatory way (e.g. Brown & Wyatt, 2012; Manzini, 2016; Buchanan, 1992; Margolin & Margolin, 2002). The product of a design process is no longer necessarily tangible, and the processes are nowadays more concerned with transitions towards sustainable societies. In 1992, Buchanan described four orders of design: signs and communications, material things, (inter)actions and environments and thoughts and systems. Buchanan argues that these orders are places for discovery, rather than categories. These places for discovery make up the second lens our analysis.

Nowadays, many design scholars agree on the benefits of applying the design process to a wider range of problems. This understanding of the value of design for wider purposes makes that 'Design Thinking is now seen as an exciting new paradigm for dealing with problems in sectors as IT, Business, Education and Medicine' (Dorst, 2011, p. 521), to which we add the sectors of urban development or 'city making'. This shift in attention or expansion of focus is crucial when considering design practices as a possible foundation for transitions towards sustainable societies.

However, a side note is needed here. In some ways, design has also developed into something of a gospel that can concern anything, leading to criticism of the current expansion of the field. Some frame it as 'dilution of the field towards meaningless' (Badke-Shaub, Roozenburg, & Cardoso, 2010). In a critical article, these authors distinguish between 'traditional design thinking' and the 'new movement of design thinking'. The latter is considered more of a management strategy and is mostly criticised for suffering from an ambitious and too general concept. However, the conclusion of these authors is also that both

approaches have reasons for existence and could gain from each other in different ways. Tonkinwise (2011) also criticises the changes in design, arguing that over time one of the core qualities of design and designers has been repressed: style and the role of aesthetic judgement. He argues that current changes, it is these traditional qualities that design and designers are in danger of losing. Therefore, in this study, we take both the 'traditional' and the 'new' design movements into consideration for city making.

The relation between the 'traditional' and 'new' movements of designing is often still shown in categorisations of different levels of design. For example, this relation is clear in the useful categorisation of design in societal change processes that range from the *product-technology system, product service system,* and *socio-technical system* to the *societal system* (Joore & Brezet, 2014). This categorisation provides the third lens for our analysis.

Specifically, regarding the crossovers between the domains of design and sustainability transitions, there are a few active, scholars. The scholars that do seek this combination focus on activities of expert design as well as co-design, but less so on diffused design, to use the terms of Manzini. Gaziulusoy and Ryan (2017), scholars on these cross-roads, describe the different design roles in sustainability transition projects. The roles they describe are very similar to the skills and activities attributed to formal or expert design, as noted above. More interestingly, Gaziulusoy and Ryan also describe three dimensions of the design challenge in sustainability transitions: the *creative*, *technical* and *political* dimensions. These dimensions make up the fourth lens for our framework of analysis.

Last, the fifth lens is constituted of three types of activities required for transitions and system innovations: *strategic*, *tactical* and *operational* activities (Loorbach, 2010). *Strategic activities* are concerned with the formation of long-term goals and visions that will lead to changes in the culture and structure of a socio-technical system; *tactical activities* are directed at implementing a transition agenda towards the desired goal and relate to interactions between actors that can build and align the new vision into the regime level; *operational activities* are related to the experiments and learning-by-doing at the niche level, often with an emphasis on radical and disruptive innovations. This last definition might suggest that niches only perform operational activities. However, this is not the case. Niche actors can perform all three types of activities. For example, many niches in city making are using flexible and short-term projects to advance long-term goals, i.e. related to street safety, public space, and other issues. These actions have been called *tactical urbanism* (Lydon & Garcia, 2015) and refer to a city, organisational or citizen-led approach to neighbourhood building, using short-term, low-cost interventions to catalyse long-term change. Small actions are used in this case to catalyse the attention of existing regimes, within the different stakeholder groups, or on a problem or a specific intervention. In this case, niches are enacting activities at different levels, such as operational and tactical. Sometimes they can also contribute at the strategic level while developing long-term goals and visions to solve or develop specific issues.

To conclude, the five lenses provide a framework of analysis for city makers: (1) the three basic conditions for niche development, (2) the four orders of design or places of discovery, (3) the four levels of design in societal change, (4) the three dimensions of the design challenge and (5) the three transition activities (see Table 1). The combination of these lenses from the domains of design and sustainability transitions will enable a detailed understanding of both the different types of city makers and their activities as well as their collective constitution towards systemic changes regarding sustainability transitions in cities. Also, the different lenses will aid in identifying possible networked actions across the different city makers, stimulating more participatory approaches to city making.

Table 1. Five lenses for understanding city maker initiatives.

	Theoretical lens	Factors	*Authors*
1	**Niche development**	Expectations shared, networking beyond niches and experiential wide social learning	*Wolfram (2016a)*
2	**Places of discovery, orders of design**	Signs & communications, material things, (inter)actions & environments, thoughts & systems.	*Buchanan (1992)*
3	**Design levels in societal change**	Product-technology system, product service system, socio-technical system, societal system	*Joore and Brezet (2014)*
4	**Dimensions of the design challenge**	Creative, technical and political	*Gaziulusoy and Ryan (2017)*
5	**Transition activities**	Operational, tactical and strategic	*Loorbach (2010)*

Method

Inclusion criteria for city maker initiatives

For this study, the inclusion criteria for city maker initiatives are purposely kept broad to allow for a rich pool of data and an inclusive understanding of the activities in the context. Many different terms for the studied city makers are available, such as bottom-up initiatives, grass roots, voluntary citizen initiatives, civil society, social enterprises, non-profit organisations (NPO) or non-governmental organisations. The boundaries between these different terms are often blurred and used interchangeably (Corry 2010). In this article, the rather vague term 'city maker initiative' is generally used. For this study, it is the preferred term because it indicates a certain newness and promotes the inclusion of a broad range of niches, independent of their organisational origin. The term covers all groups with very clear and social driven values that are both partly or completely initiated by state or private actors. Evidently, within our study of city maker initiatives, organisations that are neither state nor private form the largest part. However, this study also includes initiatives that others may not include or consider 'fringe' organisations. There is a second inclusion criterion: a focus on contributing to sustainability transitions. The sustainability transitions criteria included contributions to environmental and social sustainability of cities, people and systems that connect them. Again, this was considered in the broader sense and used more as an inclusion than exclusion criterion.

Context

This study of city maker initiatives has been performed in the Netherlands, where the third sector is characterised by highly active initiatives that are visible in various policy fields and domains (Pape & Brandse, 2016). The urban scale represents the system boundaries and is often the scale that the initiatives operate within, ranging from streets to neighbourhoods, parts of the city or the whole city and sometimes beyond. Rotterdam, the second largest city in the Netherlands, is the specific case study city. Rotterdam is currently receiving attention for its transformative energy and as a breeding ground for new city maker initiatives. Several conditions enhance the rise of city maker initiatives, with a density of groups and coalitions active on different topics. These favourable conditions have led to a great diversity and richness of experimentation of practices and a fertile ground for proactive social entrepreneurship, fostered by a diffuse culture of entrepreneurship typical of the context. Over recent years, policies were also developed in response to this emerging culture as well as in anticipation of the growth of this culture and its associated practices, aiming to stimulate the rise of new city maker initiatives. Some policies that facilitate this experimental culture are, for example, the subsidy lab *Citylab010* where one percent of the municipalities' yearly budget is allocated to city makers and their initiatives; the development of the *Omgevingsvisie* where a more holistic approach for projects in the built environment is developed; the *Right-to-challenge* policy, where citizens can challenge the municipality on managing urban services; and the

experimental co-creation process *Mooi Mooier Middelland*, where a neighbourhood initiative managed to get the municipality budget for their neighborhoods to be opened up to the inhabitants, a lage amount of seven million over four years could be spent. These examples show that old conditions are being unfrozen, making the city of Rotterdam an interesting case of fertile and rich ground to understand the niche dynamics and pathways of city maker initiatives.

Data collection

Between October 2016 and March 2017, the researchers gathered information of 152 city makers, documented in an Excel file. The data collection was done in a systematic and organic way, using various methods. The methods included (i) internet searches that led to databases or previous mappings of initiatives done by other projects or organisations; (ii) attending city maker initiatives' events, openings or initiative networking events; (iii) knowledge and networks of initiatives based on the researchers' previous experience; and (iv) through interviews that were conducted with key stakeholders for a deeper understanding of the different actors in Rotterdam. The interviews were conducted for a related in-depth study (De Koning et al., 2018), but during these interviews, other initiatives (as partners, competitors or examples) often came up.

The goal of the data collection was to gather basic information about the city makers. First, this basic information consisted of the general characteristics (such as the name, the website, when it was founded and the involved partners); second, information was collected on the theme or sustainability goal to which they contributed; and third, descriptive information was added to help identify the type of initiative (a community group, an event, a network and so forth). In the latter category, it was difficult to make a clear distinction between some initiatives. The initiatives, as cited above, are extraordinarily diverse. This diversity made the need for a detailed characterisation, as proposed in this article, even more clear.

Results

Overall, the data on the 152 initiatives in the city of Rotterdam enabled the identification of ten different types of city makers. These ten types of initiatives or ten 'types of city makers' can be found in Table 2 as well as in Figure 1. The icons of Figure 1 are an attempt at visually showing the different city makers. The types that have a geographical base are shown with a solid bottom or a building. The small rectangles in the types represent initiatives that deliberately work on change and innovation. This information, regarding the goals or themes, is based on how the initiative, in person or through their different communication channels, expressed it. The presented categorisation is non-traditional and includes actors beyond the default urban developers concerned with sustainability transitions. The categorisation also shows directly that the field of citizen's initiatives is extremely diverse.

Table 2 Categorisation of ten types of participatory city makers.

Nr.	Type of city makers
1	The community building
2	The community garden/playground
3	The community platform/group
4	The supporting platform/institute (often on a specific theme or topic)
5	The network initiative, connection makers (often in a specific geographical area)
6	The building with room for events, experiments, artist hosting, and other uses
7	The maker space/lab building
8	The collective entrepreneurs/event building
9	The bright idea/innovation
10	The alternative system (monetary, energy, water, food, and other needs)

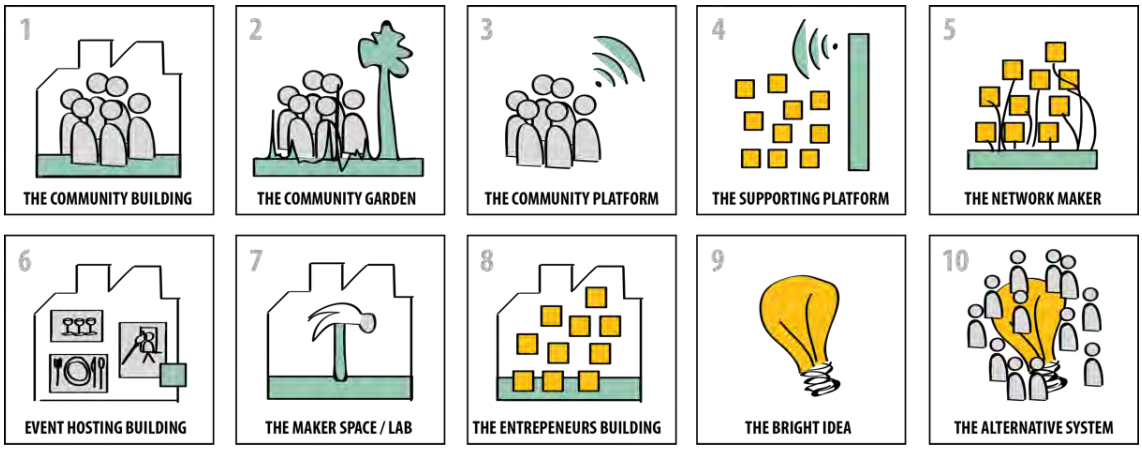

Figure 1. Categorisation of ten types of participatory city makers.

The community types (1, 2, 3)

The community types include *the community building*, *the community garden* and *the community platform*. These types are closely related to a more traditional understanding of citizen initiatives. Often, their focus is on bringing people together, producing (inter)actions and environments. That they bring people together is important as it contributes significantly to one of the conditions for niche development: networking the ideas citizens have. Often these types are in close connection with local civil servants or local politicians, which also makes them interesting places of hybrid meeting grounds by contributing to networking activities beyond their niche. These types might not directly be apparent actors in sustainability transitions, nor is it often their focus. They do not focus on a specific product or system innovation but are concerned with the smaller societal system in their surroundings. However, they are important as places for participation and potential co-design in cities because they offer physical spaces where people meet. In particular, the community building and community garden are seen as some of the few places where tactical and operational activities clearly meet. In addition, the community garden also provides space for contributions towards sustainability transitions in the form of green spaces, improving air quality or experimenting with food production and gardening. The community platform does not offer this physical space; it is more a virtual connector. However, when the network of these platforms is large, their possible influence on the tactical and political level of cities is substantial through sharing and producing thoughts among a wider audience.

The special buildings (1, 6, 7, 8)

Within the ten types of city makers, four types can be identified as specific spaces or places for niche innovations: *the community building*, *the event hosting building*, *the maker space or lab* and *the entrepreneur hosting building*. These buildings are important as they all provide physical spaces for different stakeholders to meet. Again, the value of these meeting spaces is creating (inter)actions and environments for people to connect and possibly co-design. The interaction in these places is often focused on either product-technology innovation or social cohesion and providing network places for niche actors active on these topics in cities. The function of the community building was discussed before and has a greater focus on social cohesion.

Similarly, the event hosting building is a place for like-minded people to meet. Often the initiative aspect of these buildings is not their main function, but they engage groups through certain related activities; such as museums hosting network events, shops providing gatherings for a community on a certain ideology, or galleries organising lectures.

On the other hand, the entrepreneur hosting building and the maker space or lab, focus more on facilitating product-technology innovation. These innovations can, for example, come from the 'bright ideas', a type that will be discussed later. The entrepreneur hosting building offers spaces to work and work together; it is a space for others to perform their operational activities. A maker space is similar in a sense; they attract different kinds of people and stimulate them to perform operational activities. These two types clearly bring together specific actors that engage in the creative and technical dimensions of the design challenge. Although individuals or groups within these building often focus on the product-technology or product-system level, together they sometimes form a community of collective actions around a topic or ideal. This community may help in connecting individual operational activities to more tactical and strategic ones, which would make their space and actions even more interesting and networked towards sustainability transitions in the city. If these buildings indeed host people with a common ideology, stipulating visions towards different futures, they might also have more leverage for the creative and technical dimensions and possibly affect the political dimension of the urban design challenge. In this way, the collective strength of the product-technology systems could trigger a broader change in the societal system.

The network maker and the alternative system (5, 10)

The network maker and *the alternative system* stand out for their focus on participation and inclusion, and the latter as well for a focus on innovation, systemic change and sustainability. Because of the involvement of a large network, the activities of these two types are largely in the operational domain, combined with strategic activities. Often, network makers and the alternative system deal with the creative and political as well the technical dimension of the design challenge when setting up and running their alternative system or network. However, the qualities of both types share in the combination of being able to engage different people as well as providing a strategic vision for the future. The two types are a connector between the four levels of design, providing a strategic framework for the operational and tactical activities of the people with whom they engage. For example, the alternative system brings people together around, a new recycling system, a new food producing system or a collective energy producing system. The alternative system engages people mostly as individual participants to broaden the system and make it grow. The network maker has a different approach, as it often connects to different groups of people (that can also be characterised as city maker initiatives) to strengthen the positions as a collective towards the common goal, not towards the networker maker's own goal. Instead, the network maker is the one that recognises transformative power in others (often on the product-technology level) and tries to support others by strengthening the network towards changes on a societal systems level. In contrast, the alternative system tries to make others part of their own transformative (often product-technology or product-system focused) action for change.

Supporting platform and bright idea (4, 9)

The last two types are *the bright idea* and *the supporting platform*. The supporting platform contains and sends information to the other types of city makers. They do not actively engage people but contain specific information useful for the transition activities of the others, such as knowledge and data on certain topics, tools for different activities or information about particular subsidies in their thematic field. This way, they often provide a platform for sharing, contributing to the wide social learning development path of niches. The actual activities can be rather operational, such as sending information, providing signs and communications. However, with these activities, they might empower others to take more strategic and tactical action.

Last, the bright ideas often focus on creating material things, such as innovation on a product-technology system or product service system level, by tackling the creative and technical dimension of the design challenge. In more traditional socio-technical transition

theory, when niche innovations are mentioned, this type of initiative is often the one mentioned. The number of bright ideas is higher than for other types, much more than, for example, network makers. The bright ideas are extremely important; however, it is also important that bright ideas do not act in a vacuum but are connected to the other types of city makers. They need many of the other nine city maker initiatives to step onto the development path of niches towards a more systemic sustainability transition in cities. For this development, the categorisation helps in identifying and recognising the possible crossovers between different types, beyond the type of bright idea, to make a system flourish.

Discussion

Niches or city maker initiatives were studied in detail, categorised and described according to five lenses. The ten types of city makers show that the landscape of niches is rather diverse. In this discussion, we argue from the different types to a landscape of participatory city makers, and how the five lenses and their factors could enable city makers to bring value to systemic change.

The goal of the categorisation is dual: first, to show the variety and second, to understand the gaps that need to be addressed to reach systemic change. It is believed that a discussion about the specific and particular is useful in understanding real-world phenomena; by understanding the different particulars, their contribution to the complexity of the larger system can be explored. If all the different city maker initiatives or niche actors were aggregated under one general term (such as the third sector), they would be addressed according to the same criteria. In that case, the specific qualities of each type could be lost. In sustainability transitions, the need for diversity in experimentation is often stressed (Loorbach 2010, p. 176); therefore, understanding and capturing this diversity is important to nurture diversity.

The different theoretical lenses contributed to showing the particular variation in qualities and activities of the types of city maker initiatives. They showed that each type of initiative was involved in all three transition activities, contributed to the three dimensions of the design challenge, worked on different design levels or places of discovery and contributed to several actions towards niche development. These variations make it apparent that all types in the broad landscape are needed, complementing each other in working towards systemic change in the urban context. Despite the considerable variation, it was found that many of the city maker initiatives focus largely on operational activities and innovations of the product-technology or product-system level. However, it is important to understand that this finding came out of how the initiatives described or presented themselves and related to the activities that they purposely act out, not the ones they might unintentionally provoke. Indeed, some initiatives might not aspire to contribute to greater systemic impact and can also not be expected to do so, since they are often voluntary actions and have few formal positions. However, However, for example, an initiative could perform operational activities to start a community garden, but the local government could be triggered by this to invest more in green areas in that neighbourhood. Therefore, even without purposely addressing sustainability goals, initiatives can have an impact on larger sustainability transitions and show transformative qualities.

Specific types (such as the network makers) have a great focus on participation and networking. They help in connecting individual niche actions to a broader group and connecting operational activities to tactical and strategic action. In the case of Rotterdam, a network of community gardens was set up based on a route through the west side of the city. This network helped to increase tactical leverage for gardens as well as putting green spaces on the political agenda. These network types increase leverage but generally, the city maker initiatives seem to lack connectedness to regime actors. Real systemic connections are needed in the existing structured frameworks, planning structures and institutions and consequently, to the existing cultural practices (Puerari et al., 2018). Too often the niches of city maker initiatives are only loosely supported in an ad hoc manner by policy, instead of being strategically supported as part of a broader agenda of transformative change. Initiatives are often locally oriented, do not

have intrinsic wider transformative ambitions and do not reach a critical mass. More collaboration, not only between the city maker initiatives in the landscape but also between the landscape and the regime actors, should enable development towards actual systemic change for sustainability transitions. Collaboration should foster networking and mutual learning to create more holistic, participatory and systemic approaches to creating solutions. This call for participation also comes from the interdependency and complexity of the regime and the different niche city makers. From a transition perspective, we argue that sustainability transitions could emerge and be accelerated by stimulating interactions: on the one hand, between an increasingly entrepreneurial and networking government, and on the other hand, between the landscape of emerging and developing initiatives.

For this study, the combination of the field of design and sustainability transitions proved useful to understand the types of actions present in the urban context. The potential of crossovers between the two fields in the urban context should be explored in future research. Also, the collaborative approaches for more interaction are yet to be developed and further researched. It needs to be understood what constitutions of city makers could form desirable constellations or systems, which people to include and in which ways that could best be done depending on the specific contexts and conditions. To do this, the specific roles and activities of people involved in the initiatives must be understood, both their personal motivations as well as for their cities at large. To further the understanding of design in these contexts more studies are needed to bring understanding of the activities and competences of diffuse design. Second, how these activities are similar to or different from expert and co-design activities (besides their untrained origin) in order to further the understanding of design in these contexts. Research should be done to understand the skills of a diffuse designer that is necessary to take part in urban sustainability transition processes.

Furthermore, when collaboration and participation in urban contexts are discussed, the issue of inclusion is often mentioned. The inclusion of a variety of citizens and the different approaches to do so needs ample attention in the future. In this perspective, new methods should be developed to include a broad range of people from the entire society. Systems thinking and design can provide a great foundation for developing these approaches; based on the existing knowledge and methods of co-design, diffuse and expert design. The combination of different lenses from systems thinking and design, as presented in this paper, could contribute to the development of these new systemic and participatory approaches.

The categorisation presented here, regarding the landscape of participatory city makers, can be seen as a starting point for more participatory approaches to trigger systemic change and innovation towards sustainability. The categorisation should enable others to recognise particular activities of diffuse design in urban contexts and to identify possible stakeholders and partners that can act, collaborate and further contribute to sustainability transition processes in urban contexts.

Conclusions

To conclude, the different types of city makers generally bring value to cities. However, so far, the majority of these solutions struggle to capitalise on that value. They act in the operational domain, looking for space of action, searching for funding or struggling with rules or legalisation of their organisational forms. The potential strength of their contribution lies in stimulating more citizen engagement and a greater diversity of solutions for sustainability transitions. Connecting the city maker initiatives more and promoting interactions in between as well as with state and private actors could help in mounting their potential. However, the value of the individual types of city makers as part of the collective search for sustainable cities must not be overlooked and still needs to be understood in all its potential. This study suggests that more participatory approaches to city making that stimulate crossovers and accelerate the transition towards sustainable futures could unlock this potential. These future participatory approaches to city making need to be developed and enriched with a better understanding of

the necessary skills. This understanding would allow for city maker initiatives to strengthen their efforts towards systemic changes and innovations. These skills must not only include those of expert-designer but also of diffuse design, to spread and include a broader range of city makers in transition processes. To develop these new ways of 'participatory city making', it is important to understand with whom and for whom these approaches need to be developed. Therefore, this landscape of city makers can be seen as a trigger as well as a starting point for innovation and systemic change in the urban context.

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Crafting futures in Lebanese refugee camps

The case of Burj El Barajneh Palestinian camp

Abstract

The initiative at the Burj El Barajneh camp is run by a network of local associations and aims at improving living conditions, services, infrastructure and livelihoods for the inhabitants. Burj El Barajneh has a large number of active associations and many highly educated professionals. However, in this complex hyperdense context, any kind of change needs to be carefully considered; there are no simple recipes, and existing professional expertise does not necessarily match the specific conditions of the locality. By working with collective design and collaboration between the camp's inhabitants, it becomes possible to envisage larger coordinated efforts and to solve issues that remain blocked at an individual level.

***Keywords*:** research, architecture, systemic design, refugee camps, social environment, sustainable models

Systemic design as situated and socially positioned practice

In an early discussion of what design is and what it can be, Buchanan (1992) contrasts theoretical approaches with practical approaches to design. The former tends to pursue a particular idea systematically in order to clarify the ultimate implications of different models or stances. Practical approaches, Buchanan argues, instead tend to be more pragmatic and open to contributions from various sources, since they are action-oriented and, above all, interested in finding concrete solutions that work in the real world. Following Buchanan, we here consider design as a practice, but additionally as a practice that is situated. We further argue that design work in communities differs from other types of design approaches in several ways. Design professionals typically receive tasks from companies or public institutions. The mission is limited in time and framed as a 'project' (cf. Dorst, 2017). Costs are covered, and modes of implementation are assured by the entity that employs the design professional. Additionally, in commissioned design projects, the 'problem' is already formulated and framed (although it may be complex and fuzzy, lacking clarity and completeness, or impossible to disentangle and 'solve'). The design professional can develop professionalism over time across different projects and can additionally draw on an extensive body of relevant experience from the profession (cf. Dorst, 2017).

In community settings, by contrast, nothing is given in advance. The design process must therefore not only work on improving conditions for a particular situation that is perceived as problematic in the community, but in parallel consider strategies to continually mobilise resources, maintain momentum in the processes, build a body of relevant experience, and develop capacity in the community itself (designing design). Only with time can such processes become self-sustaining, if a local culture of design develops. Professional expertise is, in this case, not located primarily in the individual practitioner but is distributed. Developing professional expertise involves gradually expanding the number of people interested in systemic design who live in the community and finding ways to strengthen capacity for collaboration and initiative.

The Burj El Barajneh initiative draws on existing associations and networks as a platform for action to enable community engagement. However, in a turbulent environment like

Lebanon, associations are constantly forced to reassess priorities as new emergencies appear. Particular strategies, therefore, need to be developed to work with this inherent instability. Developing methods of working with collective design in the context of the Burj El Barajneh refugee camp can contribute not only to similar contexts in Lebanon but also help to address crises in other Middle Eastern countries. It is important to bear in mind, however, the differences that exist between the various national environments and how they impact the scope for community-based action. The various armed conflicts in the region have, on the one hand, created a climate of deep distrust between religious, ethnic and political factions and on the other hand have promoted strong mechanisms of military and political control. Governments support religious organisations that advocate resignation and submission, maintaining the status quo rather than mobilisation for change. These factors limit opportunities for collaboration across wider groups and instead enhance defensive reactions. A succession of failed attempts for political reform coupled with economic dysfunction has also generated a general climate of hopelessness and fatalism.

Action-oriented design approaches in community settings

The open nature of design thinking and systemic design compared to more conventional systems approaches have been discussed in the literature as both an asset and a potential weakness. Dorst (2003) talks about design as oriented towards problems that are not completely defined from the outset and which necessitate (objective or subjective) interpretation by the designer. Working with problems that are not fully defined or understood carries the risk of reaching solutions that are limited to an immediate or partial understanding of issues. Also, design solutions do not pretend to represent absolute qualities of reality but rather constitute concrete suggestions for possible ways to deal with a reality that cannot be grasped in its totality, and which is experienced differently from various positions. Sevaldson (2013) thus underlines the advantages design thinking has in working holistically and openly with complex issues. Any particular way of framing problems in a situation is informed by the values and interests of the stakeholders and must be negotiated. A process of investigation is required to gain a better understanding of both material aspects and stakeholder perceptions. Such aspects are particularly important in community settings, such as the Burj El Barajneh camp. At the same time, Sevaldson argues for drawing from both design and engineering traditions for gaining stronger vantage points, since in focusing a problem at hand, systemic qualities and the longer-term developments may be backgrounded. Systemic design thus has the advantage of making it possible to combine a holistic view of the dynamics of the larger context involved, an explorative open-ended approach, and concrete work with a particular issue.

Synthesising much of the work in the field, Jones (2014) points to some of the fundamental assumptions that underlie design, and conventional systems approaches, respectively and theorises on how the two families of traditions relate to each other. He mentions that a potential weakness in design thinking is that, through its orientation towards action and producing 'solutions', such approaches may neglect a more analytical or deeper understanding of causalities. Jones concludes, however, that addressing major challenges in our societies requires social methods at the overall level, rather than as a detached add-on at the stage of applying solutions emerging from natural science. Much of the theoretical work on transitions to sustainability also points to the intrinsically social and value-based nature of societal shifts (see, e.g., Waddock et al., 2015). This stress on the integrative function of design, together with the potential to negotiate diverging interests and perceptions, appears as one of the most fundamental strengths of the approach.

Besides the question of how to relate or integrate the holistic and analytical qualities of design and systems thinking, various objections can be raised from a theoretical standpoint towards uncritical 'social engineering' approaches, including issues of uncertainty, the ways systems modelling is used as a representation of reality, and the consequences the use of simplified representations can have in decision-making. However, with respect to the concerns

of the present study and the issue of developing livelihoods and infrastructure in local communities, the main arguments for systemic design relate to democracy, locus of control and the destructive impacts that mainstream policies may have on local communities.

The case of Burj El Barajneh

For the past few years, Lebanon has been strongly affected by the crisis in neighbouring Syria. Faced with hopeless conditions in the countryside, many try to find jobs in the cities (Sanyal, 2017). The arrival of Syrian refugees has added to the strain on infrastructure and services (Boustani et al., 2016; Fawaz, 2017) in low income neighbourhoods of Beirut. In areas like Burj El Barajneh, the high cost of materials for repairs, the practice of building additional floors to house the influx of Syrians, and pressures on infrastructure that was overtaxed already before the arrival of the newest refugees, have all led to rapidly deteriorating conditions for the camp inhabitants.

Like the other inhabitants of Beirut, people in Burj El Barajneh suffer from the effects of economic forces at the societal level, over which they have no influence (cf. Fawaz, 2009). Local production is outcompeted by cheap imports from China and other Asian countries, which reduces available jobs (Said, 2017). The large number of Syrian refugees desperate to find work has pushed wages down even further, particularly for the already poorly paid occasional jobs in service or construction. Both the influx of people hoping for a better future in the city and the housing speculation driven by financial and political logic, combine to push rents up and increase the cost of living (Sakr-Tierney, 2017). Local authorities strive to make the city attractive to the wealthiest and to entice investors. Speculation affects newly constructed apartment blocks, as well as older buildings in attractive central locations. At the same time, not only housing, but also prices for many services and commodities are driven up by rich visitors from the Gulf, as well as by Lebanese from other countries, who can pay with stronger currencies. These tendencies create vulnerable conditions for large segments of the Lebanese population. As in other countries, refugees and undocumented migrants are even more exposed. Unfortunately, also, the crisis which affects poor Lebanese is fuelling resentment towards the even weaker groups, who are ready to work for wages far below subsistence levels.

Another, less obvious effect of the economic disparities in Beirut is how it affects the competence profile of professionals in design, architecture and engineering. Since it is less rewarding to serve the needs of the poor than to cater to the tastes of the richest, educated professionals will typically aspire to find employment in activities oriented towards the very rich. Their professional qualifications and specialisations, therefore, tend to be oriented in this direction. Since these are the qualifications with which educated young people can hope to find employment, the higher education institutions and the teachers who teach there will also have such profiles. The large income disparities and the reliance on foreign capital have not only affected the kind of education that is available: it also has effects on the policies of policy makers, concerning infrastructure, public services or urban planning (Nucho, 2016; Verdeil, 2017). Many types of municipal services are lacking or inadequate (Mourad & Piron, 2016).

The economic and social dynamics of the city have thus created a situation where professionals with university degrees simply do not have the skills needed to address the needs of poorer segments of the population. At the same time, very few employment opportunities exist in sectors of public interest. Since young people are driven by the hope that they will succeed and find jobs, the combined effect is that there are many highly educated professionals in the city, including in the Burj El Barajneh camp, who are unemployed or employed in jobs that do not match their qualifications (see Khazaal, 2015, January 04).

Figure 1. Left: Residential building by Bernard Khoury Architects versus right; a residential building in Shatila Palestinian camp. A comparison of professional market versus the needs market. All photos and illustrations in this article are by Nihal Halimeh.

One of the starting points for this project is that these young people could potentially be a valuable resource for their communities if only their competence better matched the needs of the inhabitants. The situation in Beirut described above is just an extreme case of a more general tendency. Across a variety of contexts worldwide, we can observe that urban planning and infrastructure choices, as well as the orientation of higher education, are generally managed and conceptualised by the larger actors and are consequently structured by considerations of governance and markets. Professional qualifications, policies and planning practices are therefore not primarily oriented to serve the needs of neglected communities or informal settlements, and often policies are instead directed towards containing and controlling the negative effects of social disparities. While negative social impacts may be mitigated by welfare policies in countries of the global north, welfare in Lebanon is, to a large extent, left to charities and non-government organisations (NGOs). Also, in Lebanon, the cost of university drives students to opt for the most profitable career options. Structural factors thus combine to shape cities like Beirut into socially partitioned segments with sharp divides and chronic inadequacies in infrastructure.

Even potentially positive planning initiatives, such as attempts to green the cities, are not always adapted to local social conditions (cf. Makhzoumi, 2015; see also Verdeil 2010 for a history of Beirut's urban development and social tensions leading to the war). The mismatch between available professional knowledge and existing needs is aggravated by the fact that neighbourhoods like Burj El Barajneh have specific conditions and features that make it difficult to apply standardised solutions. Finding workable practices to address challenges in such contexts is not easy to achieve for outsiders, who would have difficulties perceiving the multiple layers of signification, the complexities of social relationships, and the unspoken functions of various features in the built, organisational and technical structures (cf. Halimeh, 2014; Halimeh & El-Daccache, 2014).

Palestinian camps in Lebanon

The lives of Palestinians in Lebanon are regulated by special laws, which restrict their lives in many ways (Al-Natour, 1997; Hanafi & Long, 2010). For instance, Palestinians are prohibited by law from working in 78 professions. Similarly, an array of restrictions applies to Syrian

refugees, intending to prevent a permanent settlement of the displaced (Sanyal, 2017). Syrians need a sponsor to be allowed to work. Work and residence permits are expensive, wages are low and employers sometimes exploit the extreme vulnerability of the refugees to refuse payment altogether.

Many neighbourhoods in Beirut are built in conditions of informality (Fawaz, 2009; Sanyal, 2017) or semi-formality, which exposes them to demolition. Compared to the newer settlements, the old Palestinian camps like Burj El Barajneh are relatively privileged in this respect since the land is officially allocated for the establishment of these camps, although the residents do not own it. The United Nations agency for Palestinian refugees (UNRWA) is responsible for the Palestinian camps and provides a wide array of services to the inhabitants (Mcloughlin, 2016; Hammoud, 2017). Nevertheless, these services and social projects do not suffice to meet actual needs. The scope and applications of measures organised by UNRWA are further limited by government policies aiming to 'contain' the refugee populations.

On the other hand, Burj El Barajneh is home to numerous NGOs and community associations. The number of associations operating in the camp could be a very valuable asset to the community, but coordination is lacking. Importantly, each association focuses on a limited goal while insufficient attention is given to the overarching questions, such as infrastructure or the structural and systemic aspects of the local economy. Crucial issues are the electricity grid (cf. Ghanem, 2017) and water (Yamout & El-Fadel, 2005; Khoury, Graczyk, Burnham, Jurdi, & Goldman, 2016), but also underlying conditions for livelihoods. Infrastructure is therefore here understood in the wider sense given by Edwards (2003), not only as elements of the built environment but as underlying structures enabling other activities. Infrastructure in this sense includes developments in technology and the social structures that develop to match a particular technical system.

The Palestinian presence in Lebanon dates from the Nakba in 1948. The community is best described as one of protracted (long-term) refugees rather than refugees fleeing from recent conflict. Despite their longstanding presence in Lebanon, Palestine refugees remain excluded from key aspects of social, political and economic life in the country. Indeed, they are barred from owning property or practising in numerous professions, of which many are liberal professions. Recent changes in labour regulations have yet done little to change this. Chaker Khazaal, a journalist originally from Burj El Barajneh, writes: 'Disillusioned with the system, most young people drop out of school, supporting themselves and their family any way they can … All free-lance jobs were perfect, construction, plastering, painting, tiling, polishing and pouring concrete, mechanics. Everything is easy to be done by hand, but it was only for the purpose of surviving, and not to create and build success' (Khazaal, 2015, January 04). By contrast, Palestine refugees residing in Syria and Jordan can work in all professions and own property. Additional tension is created by the fact that the Lebanese army controls access to Palestine refugee camps, restricting refugees' mobility. This social exclusion physically extends to camps, the space inhabited by about two thirds of Palestinian refugees.

Camps are enclaves which lie outside the responsibility of the Lebanese state. However, the surface area of the camps has not increased with the population, and many have become cramped shantytowns, offering little privacy to residents and exposing them to health hazards. Although a total of 46 Arab organisations and 20 foreign NGOs assist Palestine refugees in Lebanon, the volume and scope of their assistance pales in comparison to services delivered by UNRWA. Within camps, UNRWA provides housing, water and electricity. These services do not extend to gatherings and camp surroundings, also mostly inhabited by Palestinians, and which suffer from irregular waste disposal and water and electricity supply since these are officially the responsibility of the Lebanese Government outside the enclaves. UNRWA also provides education, health care services as well as some additional welfare services to Palestinians living in camps as well as those living in 'gatherings' (neighbourhoods with a high density of Palestinians, but without camp status).

The current situation is changing, however, and funding for services provided by UNRWA is shrinking due to global political changes. In 2018, the US government initiated a series of cuts to UNRWA funding (Aljazeera News, 2018, 17 January). In a letter, the State Department said that additional US donations would be contingent on 'major changes' by UNRWA. Unfortunately, the UNRWA has always been the lifeline for all registered Palestinian refugees in the occupied territories and Jordan, Lebanon and Syria. In the case of the Burj El Barajneh camp, many basic services are in danger, not just because of the reduction in funding but also due to the lack of other sources of expertise and know-how relevant to the refugees' life situation. Against this background, empowering networks in the camp on educational, health and economic levels appears more urgent than ever.

Networks and structures in the Burj El Barajneh camp

The camp corresponds to a unique structure that has evolved according to the everyday needs of its community through vernacular adaptation to political and social constraints.

Figure 2. Visual representation of Burj El Barajneh camp.

Being limited within less than 1 square kilometre, more than 30,000 refugees are hosted in a compound virtually bounded and physically limited by the surrounding context (Figure 1*)* (as a point of comparison, see Rae, 2018, March 22, for an overview of the morphology of the densest European city areas). Understanding the ways people live at a micro scale leads us to discover a hidden network at the scale of the camp as a whole. Mapping the various networks, their interconnections, and physical distribution over the area provides a better understanding of core issues for the camp: dead spaces versus a lack of space, poverty versus limiting laws and existing skills but with a lack of know-how.

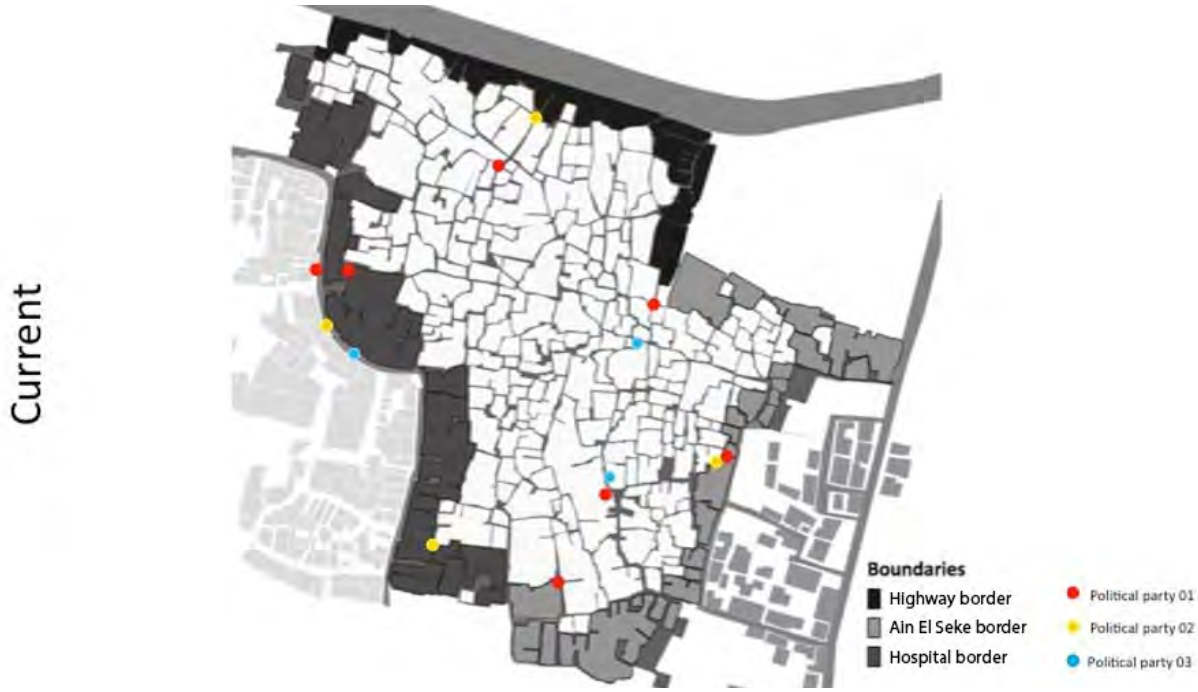

Figure 3. Camp boundaries and distribution of political parties.

Figure 4. Saha and commercial market network.

Many generations of the same family live in the same building or, more commonly, in a cluster of buildings, forming a private courtyard for the buildings bounding it. As ground level space is used up, stories are added to accommodate the growing family.

Observed weaknesses are largely a result of fragmentation: lack of connectivity between certain programmes of the same kind within the camp as well as limited connections between the camp and its surroundings. Lack of coordination and lack of connecting structures keep these programmes from reaching their full potential. In instances where they are connected more efficiently, such as the case of Sahat Palestine (where the souk in it has a connection to the neighbouring souk), the marketplace is strengthened to become an integral part of the city's souks.

There is an extreme lack of space within the camp, with most rooms shared by three people or more. There is also a lack of public space. The only spaces in which people could gather are the residual spaces around markets and between buildings. These Sahat (open squares) are scattered around the camp and include spaces created by a souk on the periphery of the camp and spaces adjacent to institutional buildings. The average size of a Saha is not more than 16 sqm (that is, corresponding to 4X4 metres).

Other breathing spaces are 'dead spaces' within the building blocks that are left unused or used for technical reasons since elevating them to the roofs is rather challenging. These spaces could be transformed into more usable spaces since open space is so scarce, and could serve the communities around them (Figure 4).

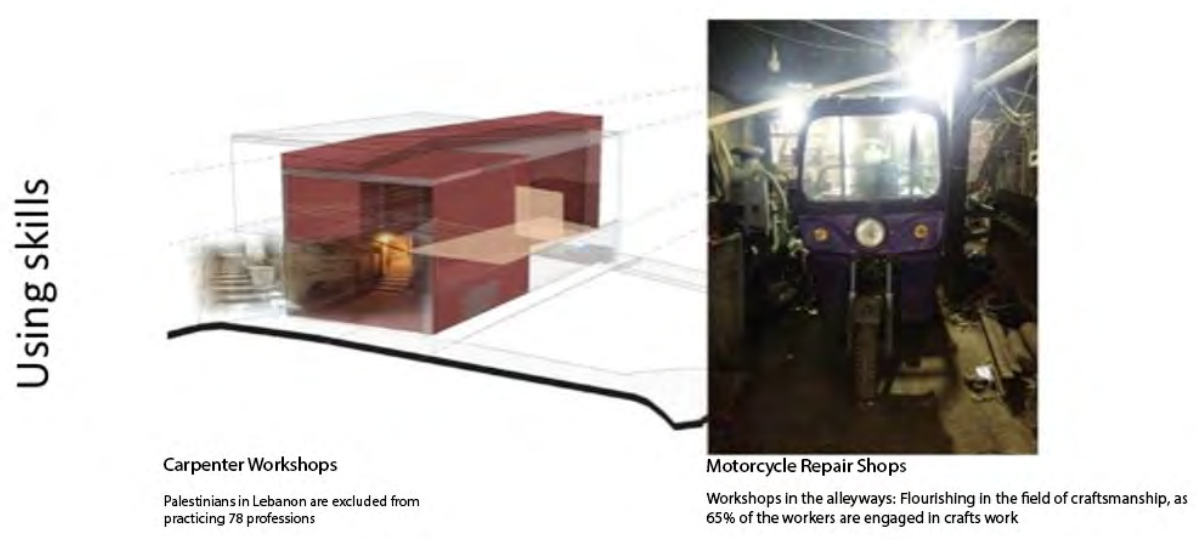

Figure 5. Metal and wrought-iron workshop exploring the creation of a motorcycle out of a Ferris wheel cabin and other elements in the Burj El Barajneh camp.

The principal strength and resources of the camp derive from trust, a strong social fabric and solidarity. However, physical structures do not always support coordination and necessary connections. For example, the commercial streets that are ample in and around the camp are strong in their immediate locations, yet are disconnected on an urban level. Disconnection and fragmentation become a bottleneck, preventing existing programmes from developing further for instance, by networking with other organisations and receiving positive impulses (Figure 5).

Figure 6. Syrian spread in Burj El Barajneh camp.

With the influx of Syrian refugees, the camp population has more than doubled, placing a huge strain on infrastructure. The strain is not only social, also the rising structures piercing through the urban fabric are negatively affecting the area. The spread of the Syrian refugee residency is found most notably on the peripheral areas. Most housing used by Syrians in the more interior areas of the camp has seemingly followed the area around a path leading to a Saha.

The mechanism has created a piece of the city born out of the functional needs of everyday life and developed from elements that are part of images and memories. These memories are there, hidden in the narrow alleys, between the walls and tiny glints of soft lights that define their type of public passages and make way to a very active and economic market, that is however only limitedly connected to the city of Beirut.

The Burj El Barajneh Souk Project

The Souk project aims to empower an existing network of talent and craftsmanship among the camp inhabitants, thereby creating a metaphorical bridge that connects and brings together segregated divisions on the political, social and urban levels. Based on an ethnographic and spatial mapping of existing networks, flows and structures within the Burj El Barajneh Palestinian camp, the Souk project aims to use architectural methods to address the economic and social relationships within the enclosed city and its surrounding neighbourhoods *(*Figure 7*)*. By working together with artisans and other residents on the Souk project, professionals from the camp are developing skills relevant to the context. A new kind of knowledge is created through collective design processes. At the same time, by connecting academic environments in Lebanon and abroad with different professionals, as well as with some of the other camps locally, the group can share experiences and draw on new techniques and ideas.

In hyperdense urban contexts like Burj El Barajneh, space does not function as a neutral or open empty expanse within which new structures can be freely imagined and constructed. Each microspace already serves and negotiates multiple functions, affecting social relationships, livelihoods, health and wellbeing. Even small modifications will, therefore, have multiple impacts on vital aspects of society. The vision for transforming the current Souk is to renovate it into a space that connects the camp to research circles in Lebanon for collective design and socially oriented urban planning. The initiative will mobilise and utilise the camp's

local talent while developing and expanding on the current knowledge and concepts needed to support a sustainable economy (Figure 8).

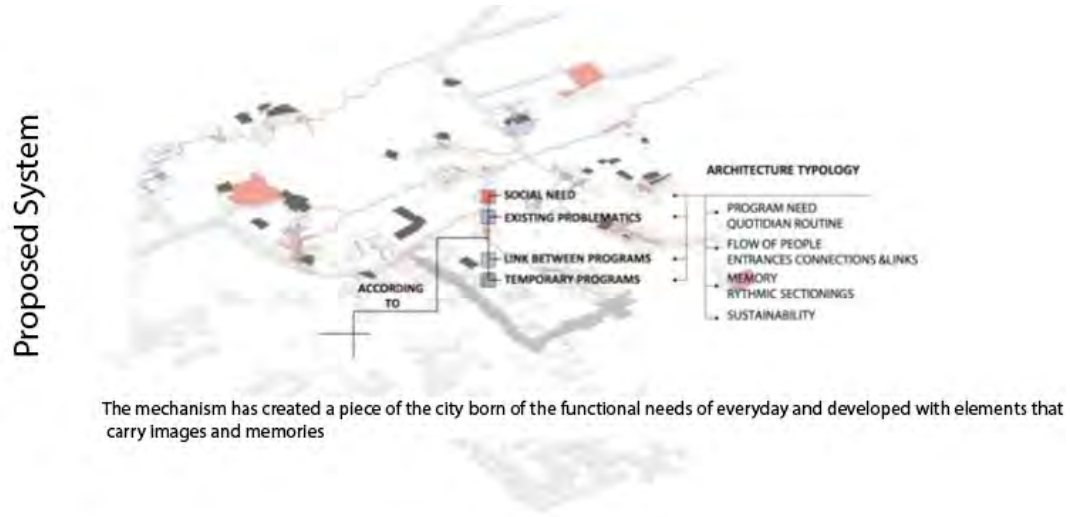

Figure 7. Using the city elements drawing on the systemic analysis of Burj El Barajneh camp.

Figure 8. Collective system strategy.

Change as risk and opportunity

Strategies for innovation and development regularly frame change as something positive. 'Interventions' are made to achieve 'improvements'. Typically, such initiatives start at policy levels, to be implemented and applied in different settings. Even when the interventions are based on needs assessments or comprise a participatory element, key aspects of the processes and agenda-setting are driven by people who are not themselves part of the concerned communities. However, in hyperdense urban settings, such as Burj El Barajneh, any intervention is more likely to produce disruption than empower transformation. There are several reasons for this. Even under the most favourable circumstances, any innovation is a risk since the short- and long-term impacts are not entirely foreseeable. However, poor communities do not have margins to operate within. With residents living at or under subsistence levels, even minor losses can lead to the collapse of entire families or trigger a breakdown in systems of dependence and interdependence. Fragile balances between groups are destabilised. The surroundings are no longer comprehensible, predictable and safe. Changing the place can be

lived as place destruction, with loss of identity (cf. Dixon & Durrheim, 2000; Bevan, 2016) as well as loss of sense of coherence, resilience and agency. When the setting is hyperdense, two additional risks arise: first, every space is already multifunctional, enabling highly complex networks of social relationships, supporting vital activities, shaping physical flows or protective boundaries. Spaces are so tightly interlocked and enmeshed that any act is likely to impact the camp as a system. There is no open space to 'move into' if anything is built or demolished. Waste or disruptions cannot be easily evacuated or externalised. The camp thus functions like a living organism, where changes affect homeostasis and the integrity of vital functions.

The second risk is that since indoor and outdoor spaces have been collapsed into an ambiguous in- and outdoorness, boundaries between the private/intimate/ personal and the collective/neighbourly/public are also at stake. Interventions cut right into the intimacy of residents' lives, and there is no protective personal home-space available to cushion the shocks. A final risk is that the larger the scale of the intervention, the more likely it is to be accompanied by corruption. Involving large sums of money will typically increase the divide between the haves and the have-nots, further weakening the position of the weakest. The complexity of the ways every element of space interrelates and functions make it vital to understand the implications of any change fully. Even more importantly, all changes need to be coordinated within the community. Processes have to be negotiated, but also controlled by the community, so that any necessary micro-adjustments or reversals can be made. Expertise needs to be developed from within the concerned community itself (cf. Lindhult, 2016).

Crafting the future for flourishing communities

Design as a profession has to a great extent been shaped by an industrial paradigm (cf. Skjerven, & Reitan, 2017, p. 20 ff). Concerning contexts such as Burj El Barajneh; however, there could be arguments for new forms of craftsmanship. Craftsmanship in this sense is not a question of reverting to earlier modes of production, but rather of exploring how to use contemporary economic systems and technologies in more empowering ways.

It is frequently maintained that industrial paradigm lowers costs, and thereby gives the poor access to commodities that they could not otherwise afford. However, in the context of Burj El Barajneh, we observe needs that are not met, coupled with unsatisfactory employment conditions. Some inhabitants have multiple jobs, struggling to make ends meet, but no longer have the time or energy to take care of children or the elderly. Many inhabitants have emigrated or aspire to do so since their present living conditions appear hopeless. Other inhabitants are unemployed and lose motivation and sense of self.

Hornberg (2016) has argued that technologies as well as the corresponding artefacts co-construct social relationships, power structures and economic paradigms. Within the industrial paradigm, the enormous investment required to establish competitive industries creates insurmountable thresholds, so the technologies and modes of production determine not only the flow of profits and accumulation of capital, but also the ability to do the work that needs to be done – or even work at all. Authors, such as Miriam Glucksmann (2014), have discussed how the division of labour can shift in various economic configurations, moving between paid and unpaid work. She also points out the shift from *making* to *buying*, giving the example of food preparation. Revalorising craftsmanship would instead lower initial investments and enable shifts from buying to making. In a context where gaining any income entails disproportionate sacrifice, such shifts become significant.

Industry is based on economies of scale, mass-production and technologies that place the locus of strategic control in the hands of the large commercial actors (Hornborg, 2001). Craftsmanship is instead characterised by adaptability, creativity and sensitivity to the specific characteristics of the client. This is why craftsmanship can provide a better quality of life for the people benefitting from the craftsman or woman's work, but also a sense of agency and accomplishment for the craftsman him- or herself. By placing the locus of strategic control in a relational space where dialogue is possible, within the community itself, a crafts-based mode

of designing and producing can also empower the community as a whole. Importantly, it allows collective reflection and decision-making on the larger issues. While both consumers and sub-contractors in an industrial model are reduced to accepting or rejecting the commodities or services that they are offered, developing designing capacity within the community opens possibilities to coordinate actions, envisioning and putting into action ideas for better structures.

Finally, the industrial paradigm is geared to the production of goods, and people are drawn from the sphere of 'reproduction' – including caring and nurturing – to be placed at the disposal of the labour market. Even caring becomes part of the formal economy when services are bought. Thus, paradoxically, services become 'expensive'. People need to leave the camp to earn money to pay for the work they no longer have time to do. Older adults are left alone while their children emigrate.

Meanwhile, other camp inhabitants are unemployed and become dependent on charities or remittances for survival. Here, Khazaal points to the potential of new technologies, changing possible forms of work: 'As another generation of Palestinian refugees succumb to personal and academic dead ends, we must explore alternate options, with a view to leveraging our resources with "like minded" business models.' With the rapid growth of technology in the digital landscape, 'remote' employment is a lucrative alternative. Advertised positions in medical billing and coding, textbook writing and editing, project management, fashion, web design or virtual instructors, present a vast array of options" (Khazaal, 2015, January 04). However, even such emerging forms of work are affected by the limitations in available space, infrastructure and constant power outages. Internet connection is adequate for social media and snatching pieces of entertainment but does not provide a reliable basis for work.

The area of research and as well as practice of systemic design has produced a wide array of powerful tools, such as Gigamaps (cf. Sevaldson, 2015), that allow groups of people to collectively vision, solve complex issues, negotiate and reach meaningful agreements, reframe problems and collaborate across professional or other boundaries. For the context of Burj El Barajneh, key aspects are that effective teams can be rapidly formed, that the complexity of issues and causal relationships can be taken into account and that creativity is supported. To be able to search for more fulfilling and dignified life opportunities, an overview is needed of the intricate systemic relationships involved. Systemic design can here play a catalysing role.

In the context of collective design work in settings such as Burj El Barajneh, the fluid, open and holistic aspects of systemic design compared to 'hard' systems approaches, are not only valuable features in terms of creativity for problem-solving but indispensable characteristics. There are several reasons for this. Firstly, the purpose is not to provide models or elaborate forecasts that can be used by decision-makers who already can implement choices in governance or strategy but to provide lightweight tools that enable local inhabitants to improve their conditions of life. The action-oriented dimension of design thinking is therefore central to the purpose.

Second, conventional modelling approaches depend on a vast and costly apparatus for collecting data. However, harvesting data on inhabitants' lives in this manner is intrusive and places the locus of control far outside the reach of ordinary citizens. The large scale of systemic solutions that tend to be proposed in such planning approaches creates a lock-in effect, inertia, rigidity and commitment to particular solutions and pathways, that often also are sponsored by large actors. Such tendencies in planning are illustrated by several of the climate engineering solutions currently under discussion, as well as being visible in in the area of transport systems, water management or energy systems for instance. Such large-scale choices engage entire systems and tend to preclude alternative options. They are risky, difficult to reverse and the large scale and complex entanglements make piece-by-piece remediation or adjustment difficult. Uncertainties concerning alternatives, lack of capital for sudden massive change, and difficulties in mobilising consensus for change can turn such commitments into costly dead ends.

Third, and importantly, optimisation seen from the vantage point of large actors may not correspond to the interests of the communities, even in the general orientation of interventions and in long-term goals. Supposing that decision-makers are well-intentioned, in their concrete realisations, large-scale optimised solutions will still not match the specific needs of the individuals. This mismatch arises because effectiveness in governance (perceived from the vantage point of decision-makers) involves structurally tightly coupling (cf. Orton & Weick, 1990) sets of dependencies, thus rendering structures less responsive, malleable or permeable to action and initiatives at individual or community levels. The large scale of interventions will also socially and geographically distance points of action and the places where effects are felt, systematically evacuating issues of empathy (Sustar & Mattelmäki, 2017) and caring from the considerations. When faced with major changes in society, groups with wider margins of action can adapt or even profit from the new situation, changing location or means of earning their living. By contrast, vulnerable groups have a limited set of options. They are already balancing multiple constraints to survive, and even minor changes and unexpected events may lead to the destruction of the basis of existence.

Structural pressures also affect the individuals involved in design projects, forcing them to fragment their time and respond to various demands that cannot be foreseen or integrated into conventional planning. Working with communities living with these pressures, arranging meetings of several people becomes difficult. Methodologies, therefore, need to be organised in ways so they can be used "in the moment". It has been argued that facilitation and the creation of shared open, but 'safe', environments for negotiation, visioning and coordination offers pathways to catalyse collective action and begin to address the challenges inherent in contexts with numerous stakeholders and sometimes conflicting interests. Clearly, drawing on experiences of guided bottom-up development has relevance for the dynamics of processes in contexts such as Burj El Barajneh, although it requires a delicate balancing within existing relationships of power. Allowing sufficient time for negotiations and navigating tensions with sensitivity are therefore crucial elements in building capacity and education for design.

Conclusion

The territoriality of domains of influence of associations, groups and families within the camp provides physical localised points of departure as well as the personal and relational basis for any action. At the same time, territoriality generates resistance towards coordination across larger areas. Starting points, therefore, must respect boundaries and use various spaces already allocated for communal action (schools, senior citizen activity centre, clubs), or build on existing ownership. Places for action include the craftsmens' workshops in the Souk, parts of family-owned buildings facing towards the alleyways, 'dead space' between buildings and the connections between family properties (electrical lines, lighting of the alleyways, waterpipes and flowing water). A key aspect is to build on the property owners' immediate interests, as well as engaging visible public space. Making repairs and adding features to the built environment is already a source of employment for young people. Introducing a collective design approach serves to give these activities a direction: widening available skills, strengthening synergies, building new relationships, providing continuity and vision.

Which associations are involved in particular actions depends above all on the precise location and existing territorialities, but also on technical considerations, such as the expertise of UNRWA engineers. The network, therefore, works with shifting and fluid alliances, depending on the action. An important feature is networking between camps, to learn from experiences with similar challenges.

Creating bridging artefacts and visual support through work on infrastructure is not only a way to coordinate joint reflection in ad hoc teams or construct new vantage points but can serve to maintain continuity in reflection and continuity of action in fragmented settings. Scales of action need to be adapted to the local needs. Simple elements of methodologies should be conceived and organised so they can be quickly learned and applied in practice from the outset

to widen the circle of inhabitants who acquire design skills. Actions thus need to be structured in a step-by-step fashion, at the same time that each step has to ensure sufficient functionality in itself so that it does not require disproportionate maintenance efforts. Each step needs to be perceived as a success in some sense so that it can motivate further steps later on.

Considering minimal actions and changes that are easily reversed is also important from other points of view. Maintaining a status quo has many functions in vulnerable environments exposed to turbulent surroundings. Reversibility of action is, therefore, a way to experiment carefully with changes that might have disruptive effects. Small-scale actions have the further advantage of demanding less coordination to be initiated, and therefore also lower the threshold of action. At the same time, introducing a systemic perspective makes it easier to think about questions before proceeding to action, which is crucial in environments where the community cannot afford to make mistakes.

Thus, work can be undertaken with the maintenance of infrastructure while also looking for new and more sustainable solutions to serve the needs of the camp as a whole. Knowledge and know-how can be developed that are better suited to the context. Beyond technical problem-solving, the lives and aspirations of the inhabitants become central to the way issues are addressed. At the same time, networking with other camps as well as with academics, professionals and organisations in Lebanon and abroad creates opportunities to share experiences, thereby opening up alternative ways to approach the local issues. Systemic design methodologies can provide powerful tools for collective reflection and action, involving multiple actors. Not only do these methodologies allow participants from diverse backgrounds to grasp interconnections between issues and identify points of entry, but they accelerate processes towards developing new ideas and evaluating possible consequences.

While the approach that has been initiated in Burj El Barajneh is promising, considerable challenges remain. Actions have to operate at micro-scales, and sufficient time is therefore needed for negotiations with all concerned parties to effect changes that are perceived as legitimate and relevant by inhabitants of the camp. However, action has to gain credibility through visible action and to acquire momentum for structural change at larger scales. Therefore, action has to lead to quick and tangible results. There is thus a tension between responsiveness and efficacy. Additionally, differences in vision exist concerning what is desirable and possible for the Palestinian camps in the long-term, and no agreement can be reached within current discourses concerning such divergent ambitions.

Further research is therefore required on issues of time-lines, horizons and sequencing actions, to support capacity-building as well as agility. An additional challenge is how to maintain sufficient continuity, focus and operational resources to maintain the viability of the network as a functional initiative. Sponsoring could compromise independence and credibility, but without resources, little impact can be achieved. More reflection and empirical studies are consequently called for concerning possible modalities for guided bottom-up approaches in community settings.

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Architecture as a system and innovation design discipline

A retrospective on architectural programming and its implications for the strategic extension of the discipline of architecture

Abstract

Talking about architecture means talking not only about buildings but also about processes or systems. In the latter context, architecture is a way of thinking and looking at people, spaces, interrelations and interactions. Proclaimed by IDEO's Tim Brown as one of the best system design forms of education available, architecture has potential in fields beyond the physical. In keeping with the views of renowned systems thinker Russell Ackoff, who graduated in architecture before focusing on operations research, the question arises whether the skills of architects can be applied more broadly in system and innovation design. This paper describes how architects deal with context and complexity from the perspective of the practice-oriented architectural programming method. From its early days in the 1960s, it offered architects a viable basis for an applied architectural design thinking method, but did not receive widespread attention from practitioners and academics. The method is critically assessed and compared to the known forms of design thinking from the viewpoint of industrial design. By describing a real-life project and students' work from a newly created seminar in a department of architecture, the paper investigates the current and future relevance of an advanced version of architectural programming for architectural practice and education. It stresses the desirability of reinforcing the core skills of architects by developing a design thinking method rooted in architecture, which needs to be taught, developed and disseminated. In the long term, it is argued, architecture should be considered and integrated as a 'systems and innovation design discipline' in the fields of systems thinking and innovation research.

***Keywords*:** innovation design, architectural programming, architectural design thinking

Working with context and complexity

Common conceptions of architects and architecture relate to the planning and design of buildings or physical structures. While industrial design disciplines have extended their field of influence, architecture has remained mostly in its traditional realm (Luebkeman 2015). Specific skills of architects, as well as architectural training, can be considered as viable bases for systems thinking and be transferred to systems analysis and design. Architects' understanding of systems is, in the words of Russell Ackoff, the best among all professions, but has been mostly pooled with other design disciplines and not explicitly described (Ackoff 1994; Hershberger 1999, pp. xvii-xviii; Burke & Tierney 2007; Lawson 2005; Dorst & Lawson 2009; Cross 2013; Fisher 2015b). The skills of architects are ideally inculcated in higher education and honed through project work in practice. Apart from varying quality and performance in reality, the skills are distinct from other design disciplines and need to be outlined separately. Architects abstract and reframe socio-technical complexities to a workable degree (Burke & Tierney 2007; Samuel 2018). They process obtained information on a problem visually and critically reflect in action on the state of their work (Schön 1983; Rowe 1987; Lawson 2005; Dorst & Lawson 2009; Cross 2013). Their "problem-solving mentality" looks "beyond the obvious for the profound – for understanding, not just description" (Hershberger 1999, pp. xvii-xviii). Architects deeply understand context, interactions and interrelations, and empathically

immerse themselves in a long-term perspective for their clients, while considering the changing usage of space over time (Nelson & Stolterman 2012; Pallasmaa 2016; Samuel 2018). They are constantly moving between problem and solution while analysing, synthesising and evaluating their approach, in order to create a state that "ought to be" (Lawson 2005, p. 49; Nelson & Stolterman 2012). They apply their non-linear thinking to handling wicked problems, using a broad range of methods and tools such as sketching, diagramming, modelling, prototyping and parametrising (Rowe 1987; Dorst & Lawson 2009; Gänshirt 2012; Cross 2013; Schumacher 2016). Furthermore, the architects' ability for synthesis relates to the real (world) and seeks ultimate application. This means that architects are used to constantly thinking at different scales from abstract diagrams, from drawings at 1:1000 to real solutions executed at 1:1. Prototyping in the case of architecture is the final result, and in most cases not a pre-state for scalable production. The models made prior to execution are representations of a final building or parts of it, but not the building itself. An architect has always to imagine, foresee and think of the implications and consequences when a design is going to be built. He has "no right to be wrong", as Rittel and Weber pointed out, and must retain a holistic perspective (Rittel & Weber 1984, p. 143; Dorst & Lawson 2009; Mäscher 2018). The action-oriented work of architects to create a new reality is combined with a systems-thinking approach for a larger context (Jones 2017; Keeley et al. 2013, p. 116). Finally, architecture is a social process, depending on interaction and collaboration with engineers, consultants and authorities. In this regard, architecture acts as a cross-discipline integrating different viewpoints into a new whole (Gharajedaghi 2011; Carraher et al. 2018).

In the starting phases of building projects especially, when vision, goals, requirements and needs are not clearly specified by clients, architects can play a strategic role and develop alternative directions that do not necessarily require a physical solution (Cherry 1999; Koolhaas 2004). With their dynamic, interactive and iterative design approach, architects can offer disciplines as management new approaches in the early phases for dealing with complexities, uncertainties and wickedness (Boland & Collopy 2004, p. 4). "By treating a wicked problem as a tame problem, energy and resources are misdirected, resulting in solutions that not only are ineffective, but also can create more difficulty, because the approach used is an intervention that is, by necessity, inappropriately conceptualized" (Nelson & Stolterman 2012, p. 17). But as the scopes of projects in the built environment and their contents are mostly developed before architects become involved, it may happen that the real challenge is not addressed (Figure 1) (Deamer & Bernstein 2010; Czaja 2017). Uncovered needs and processes, different user perspectives and changing demands over time from the markets and society may become apparent during the design process and architectural work. The lack of recognition of reality is caused to some extent by architects themselves, focusing on a minimal share of projects and special typologies such as museums, offices or single houses, while most new buildings are realised by construction, development and real estate companies. Projects thoughtfully designed by architects count only for 5–10% of new buildings in the United States and for approximately 2% globally (Deamer & Bernstein 2010, p. 9; Czaja 2017).

To enter the decision-making zone and deal with wicked problems of planning projects in a structured way, architects have developed different approaches, which are rarely made explicit or shared (Cross 2013). One of the few practice-oriented and published methods for an efficient and effective client interaction is called architectural programming (Faatz 2009; Bachman 2012). With this method, architects bridge the communication gap between clients, other stakeholders and consultants to reframe the complexities of building tasks, creating a common understanding on vision and goals and developing a new content prior to the design and planning (Cherry 1999; Henn 2004; Faatz 2009; Bachmann 2012). In contrast to a scientific approach to complexity or the consideration of messy complexity, architectural programming focuses on ordered complexity (table 1). It pursues all project-relevant information in order to uncover the essential problem to be solved by design in an institutional or real-life assignment with a client (Bachman 2012; Peña & Parshall 2012).

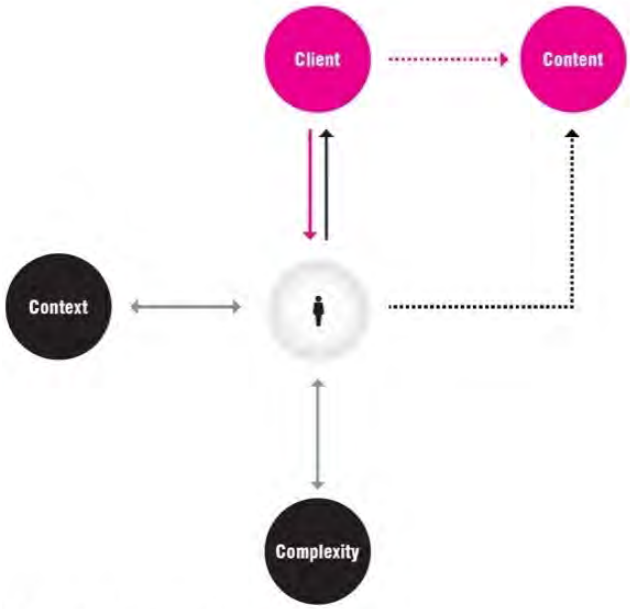

Figure 1. The architect communicates and engages with the client, while analysing the context and complexity of a project. The predetermination of the content by the client may lead to "bad" solutions, as the real challenge is not understood by design attitude (Boland & Collopy 2004, p. 4).

Table. 1. Complexity science and four modes of complexity as encountered by architecture (Bachman 2012, p. 74).

	Scientific	***Wicked***	***Messy***	***Ordered***	***Natural***
Proponents	Ackoff, Arnheim, Churchman	Simon, Rittel, Bell	Jacobs, Venturi, Alexander	Peña, Sanoff, Preiser	Geddes, Kepes, Olgyay
Postwar landmarks	1957	1957	1961	1965	1963
Realm	Cosmology	Society	Culture	Institution	Organisms
Objective	Adaptation	Intelligence	Spontaneity	Essence	Responsive
Organization	Dynamic	Cybernetic	Organic	Collaborative	Holistic
Order	Interactive	Managed	Authentic	Discovered	Emergent
Problem	Evolve	Bounded rationality	Identity	Reduce data	Flow
Agents	Systems	Decision makers	Citizens	Stakeholders	Systems
Application	Behavior	Organization	Urban	Definition	Design

Development of architectural programming

The term programming, i.e. setting up the project programme and brief, is familiar to architects to a greater or lesser extent. Architects do it unconsciously or consciously in the course of designing, in a phased way. As a structured and repeatable method applicable to a broad range of different tasks, architectural programming evolved in the late 1950s in the US, based on specific principles of action and understanding. Large, complex building projects required the integration of multiple stakeholders, as users, clients and clients' consultants. When commissioned to design a high school facility, the architectural firm Caudill Rowlett Scott (CRS) developed a process model to structure the information, needs, requirements and goals

and simultaneously involve the stakeholders in a participatory way (Duerck 1993; Cherry 1999; Hodulak & Schramm 2011). The method helps raise the level of required information prior to the start of creating a building design by questioning the task, pursuing a shared vision for the project and creating a common understanding (Henn 2004; Faatz 2009). Regarded as a "research and decision-making process that defines the problem to be solved by design", architectural programming integrates elements of scientific research, project management and the architectural thinking process (Cherry 1999, p. 3; Duerck 1993). This process follows a strict separation of problem statement and solution, in order to avoid "trial-and-error design alternatives" and to prompt a rational architectural way of working: "Programming precedes design just as analysis precedes synthesis" (Peña & Parshall 2012, p. 10). Additionally, architects can apply methods and tools to analyse and design processes and systems beyond the physical. "The goal of architectural programming is to define problems to be solved by design. There should not be an underlying assumption that the solution must be the design of a building, and only a building" (Cherry 1999, pp. 229f).

In the decades since CRS (later CRSS) was established, the method was developed further in varying forms by HOK and other architectural practices. It became listed as an additional service by the American Institute for Architects (AIA), and was synonymously known as pre-design, brief design or facility programming (Duerck 1993; Kumlin 1995; Cherry 1999; Faatz 2009; Hodulak & Schramm 2011). In Germany it is mostly perceived as requirement planning and partially reflected in additional preliminary designs linked to honorary fee tables for architects and engineers (HOAI) or specific German standards and specifications (DIN). Few practices implement programming as a conceptual and integrative approach with architectural design (Henn 2004).

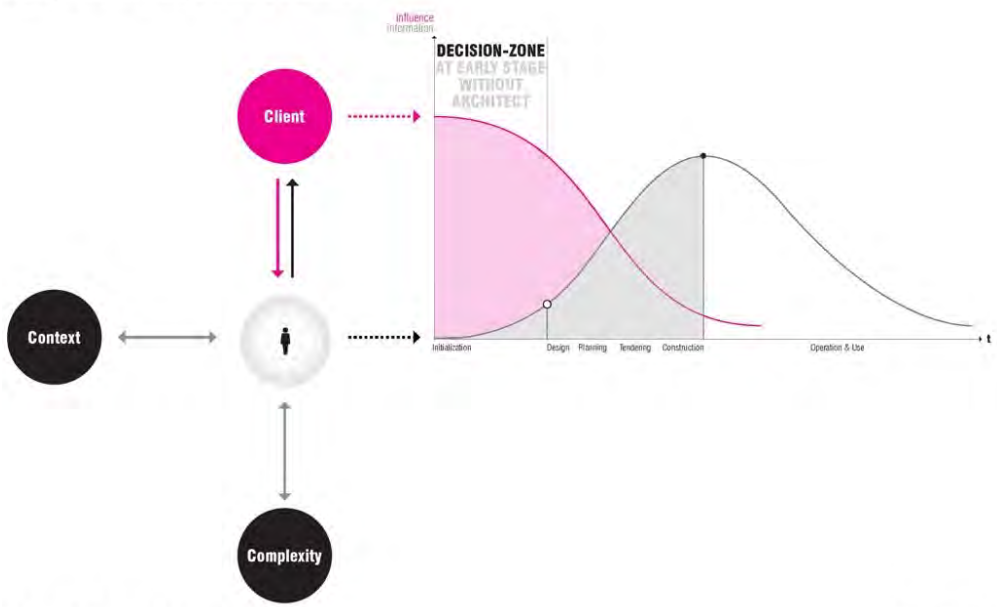

Figure 2. Normal distribution and progression of information and its influence on a building project. Architects approach the early-decision zone mostly within a smaller decision zone area (grey). (Own representation, drawn from Faatz (2009), p. 82; Henn (2004), p. 42.)

With architectural programming, architects act internally and externally in a co-creative and integrative way. Internally, architectural programming supports clarification and understanding for the design and planning team, which in many cases consists of further consultants, engineers and contractors or construction companies. Externally, in the interaction with clients and other stakeholders, the method allows architects to structure complex tasks, to order and separate information and to communicate in a comprehensible way with design- or architecture-distant

disciplines. By uncovering project-critical questions, architects can step into an early stage of decision-making and engage with clients and stakeholders, where the influence on the project's direction is high and the goals as well as the content of a project have not yet been identified (Figure 2 and 3).

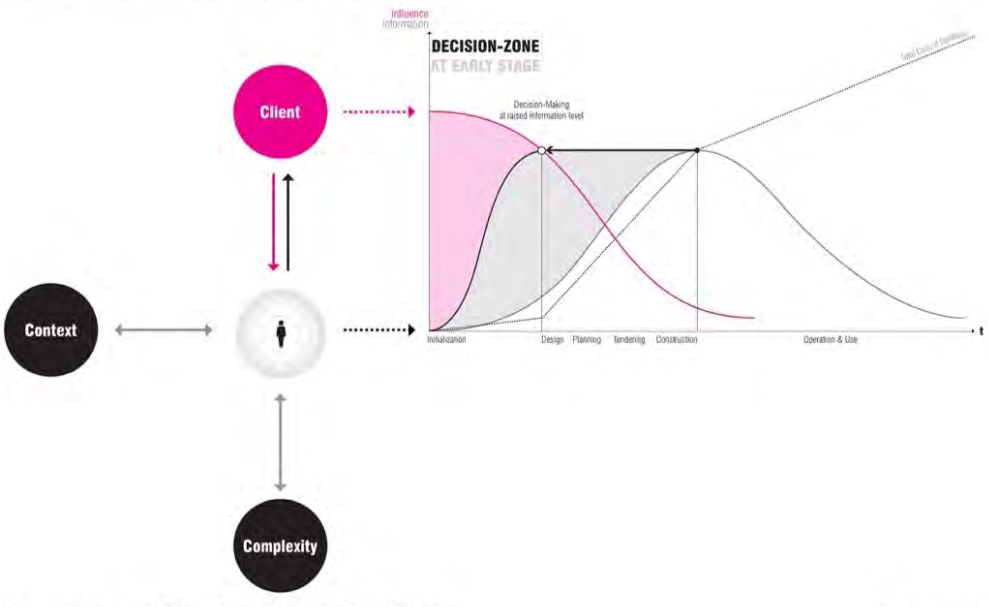

Figure 3. Applying architectural programming allows the information level to be raised before building design starts and offers architects greater access to the decision zone area (grey). (Own representation, drawn from Faatz (2009), p. 82; Henn (2004), p. 42.)

Problem seeking – basic process and principles

Fundamental to architectural programming is the process of staging in six to eight steps (Sanoff 1977). The starting phase entails clarifying the research to be undertaken, along with stakeholder co-ordination and project schedule set-up. It is followed by a preliminary workshop and an interview phase to clarify the vision and establish goals. An intense period of collecting and analysing facts and determining needs and requirements constitute, respectively, steps three and four (Peña & Parshall 2012; Cherry 1999; Hodulak & Schramm 2011). After having structured the information gained through research, interviews, workshops and submitted data, the concept phase begins. In this stage, graphic representations, diagrammatic sketches and models are created on a systemic level, and are compared with the initially developed vision, goals and needs. The final stage of the process is the statement of the problem or challenge that has to be solved by design. The steps or phases can be placed in a different order according to the needs of the project and on the basis of the high involvement and participation of the client, user and other stakeholders (Figure 4) (Peña & Parshall 2012; Cherry 1999).

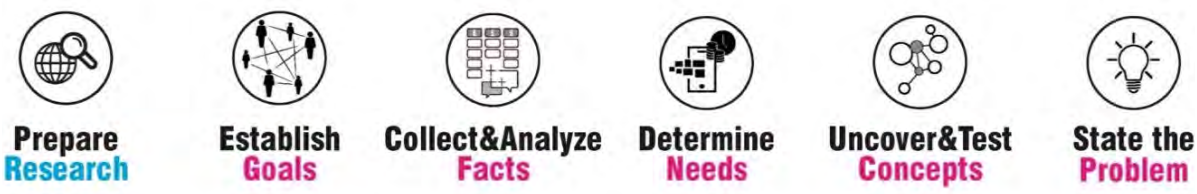

Figure 4. The basic process according to Peña & Parshall (2012, p. 2) and Cherry (1999). (Own representation.)

By describing this programming process as "problem seeking", the initial project statements by clients are questioned and challenged. The architects, called programmers in this context, are separating the analysis strictly from a synthesis through architectural design (Peña & Parshall 2012). The programmers follow a set of principles which are vital for successful understanding and reframing. "Programming is the definitional stage of design – the time to discover the nature of the design problem, rather than the nature of the design solution" (Hershberger 1999, p. 1). Further principles the programming architects consider are continuous client involvement, effective communication through visual and graphical depiction and a comprehensive structuring of data and information. The programmers apply an abstract, holistic form of systems thinking, conceptualise processes and the arrangement of functions and operate efficiently with iteration and loops to confirm the results and agreements of each step of the process. They focus on quantitative as well as qualitative information and precisely record, calculate and forecast demands in terms of square metres and areas, as well as collecting and listing the kind of technical equipment needed for the project and the mechanical, electrical and climate requirements (Peña & Parshall 2012; Cherry 1999).

Critical reflection in comparison with Design thinking

The rational approach of architectural programming helps to structure complex building projects, while retaining a holistic view on vision and context. The outlined ideal process of architectural programming requires, on the one hand, the client's commitment to proceeding through the steps of the project and, on the other hand, skilled, experienced and method-trained architects. Though methods and principles have been integrated and altered in practice, only a few architectural offices are explicitly offering programming as a service. One major criticism has been the reliance on organising, collecting and categorising the information and the strict separation between programming architect and design architect, which impedes a continuous overall design process and especially the iteration and learning loops needed for dealing with wicked tasks (Harrigan & Neel 1996; Noenning 2007; Peña & Parshall 2012). As the nature of the problem reveals itself over time and circumstances perhaps change, the division between architects as programmers handing over a project brief to architects as designers marks a break in team performance and a possible loss of design knowledge. The method remains a means to the end of planning functional buildings, without being developed further in its potential application to tasks beyond physical solutions. The rigid and formalised way of obtaining and visualising information does not evolve into a dynamic system design approach, although the graphical depiction of space, functions and stakeholder interaction provide a promising basis. Focused on frameworks and matrix analysis, architectural programming is seen more as a method of moderating and communicating with clients to clarify quantitative requirement planning, instead of an integrating concept for systems and design thinking. In the quantitative realm of facility management, it is framed in Germany in DIN 18205 "Brief for Building Design" and in ISO 9699 "Performance standards in building – Checklist for briefing – Contents of brief for building design" (Hodulak & Schramm 2011). The agile, systemic approach of architectural programming is not conveyed in this. Accordingly, only a small number of courses are available in higher education architectural faculties. What little consideration had been given to architectural programming in academic circles and in practice, which happened mostly in the US and the UK, petered out around the millennium. With few exceptions, architectural programming received minor attention thereafter among architects, students and researchers in Europe (Henn 2004; Faatz 2009). The principles and process steps of architectural programming are pursued more freely and in a constant transition between problem and design space (Henn 2004). With rising possibilities offered by digital tools and the increasing emphasis on other design thinking methods, architects have started to adapt their approaches for dealing with complex tasks. However, while design thinking as a method for creative innovation and collaboration has grown in importance and acceptance among diverse industries and management disciplines since the 1990s, awareness of architectural program-

ming and its experience in built projects, principles and process steps has dimmed (Buchanan 1992; Martin 2009). Surprisingly, architectural practices started to look at design thinking methods rooted in industrial design instead of leveraging the design thinking basis within their own discipline's body of knowledge. Comparing architectural programming with the design thinking method rooted in industrial design by its applied version for management and innovation processes reveals the existing knowledge (see Table 2).

Table 2. The architectural programming process, principles and skills, compared to industrial design thinking and extended by architectural system design. (Own representation after Cherry (1999), Lawson (2005), Lawson & Dorst (2009), Peña & Parshall (2012), Ambrose & Harris (2010) and Lewrick et al. (2017).)

		(Industrial) Design Thinking Method	**Architectural Programming Method**	**Programming Principles**	**Architect's Applied Skills**	**Level of Detail**
		research	prepare research	separation client involvement	questioning interviewing	**Abstract**
		understand	establish goals collect facts analyse facts	effective communication comprehensive structure abstract & system thinking	understanding formulating integrating interpreting	
		observe define	determine needs	efficient operation iteration & feedback	reframing sketching	
		ideate	uncover concepts test concepts	quantitative information qualitative information	layouting diagramming modelling parametrising moving forward evaluating	
			state the problem	problem resolution	synthesising	
	+		**Architectural System Design**			
		prototype	design system integrate requirements		designing layouting drawing planning parametrising	
			model build		modelling managing building	
		test	evaluate show		reflecting presenting	
		implement	design solution		applying	
	=		**Architectural Design Thinking Method**			**Concrete**

Architectural programming provides a viable basis for architects to interact at early stages – in Phase 0 – with clients and apply architectural skills for the understanding and design of strategic contents and systems. If a stronger integration with the architectural design process is to be fostered, an applied architectural design thinking method can be developed, which then can be independently practised for designing systems and innovations beyond a building context. The

structured process of industrial design thinking applied as fast-track innovation or a co-creation method in business environments is facing criticism on other grounds. By expelling intuition and aesthetics from its stages, it loses the innovative drive to contemplate the unexpected (Nelson & Stolterman 2012, p. 132; Verganti 2017). Yet, an architectural design thinking method can maintain the designer's freedom and agility to construct the way towards a solution (Buchanan 1992; Verganti 2017). As Lawson suggests, "good designers tend to be at ease with the lack of resolution of their ideas for most of the design process" (Lawson 2005, p. 154). This is part of the magic in the process, when the parts come finally together in the end and reveal the resilience architects may display when controverting or confronting the client's wishes, all in the cause of reaching a better state (Lawson 2005; Gänshirt 2012). The problem-seeking attitude that manifests itself in continuous questioning of the existing could be beneficial to innovation design (Figure5). The thinking of architects in a larger context and over longer periods of time is leading beyond obvious or short-term solutions. A quote dating back to English architect Bryan Lasdun explains what the job of an architect is: "Our job is to give the client [...] not what he wants, but what he never dreamed he wanted; and when he gets it, he recognizes it as something he wanted all the time" (Cross 2007, p. 52).

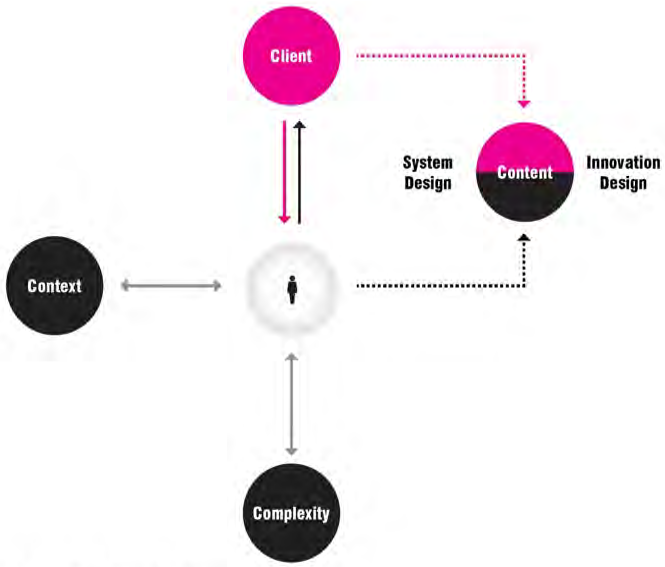

Figure 5. Content creation in integrative and co-creative work between client and architect, consisting of system design (ideation and invention) and innovation design (implementation).

Architectural programming in practice

An architectural office is still commonly conceived of as characterised by informal, less transparent or less structured ways of working. Few offices integrate the method and communicate it explicitly to clients or third parties. Their scope of work ranges from strategic to building design, as can be seen in the services of the global architectural firms of HOK or Gensler. In 2015, the author conducted a study on one example from practice, the architectural programming project for a research & development headquarter in nanotechnology. The case study description and analysis are based on the author's notes and reports, presentations and models handed over by the company (attocube & Henn 2015).

The nanotechnology start-up, founded in 2001, was in a transition phase from a grown structure of 90 people to a company of more than 175 employees. The main questions in 2015 were: how to grow as a company while maintaining the spirit of a community and start-up; how to integrate management departments with innovation, research and highest-precision production; and how to communicate a mindset and values and remain attractive to researchers

and high-potential employees. The research followed the programming process through several steps: (1) goal definition through workshops and interviews, (2) collection of facts and requirements, (3) the determination of needs, (4) conceptualisation of new work processes, and (5) the modelling of a system for the new building as a statement to be transformed into a building design (6).

Through architectural programming, the company reflected their vision, values and processes. In graphical depicted and recorded interviews, the core of the company's activities was made explicit: first, to serve human beings with products from investigating space to analyse matter beyond human recognition; and second, to focus on the employee 1:1 as the source of creativity and innovation beyond hierarchical settings. The visualisation created after several iterations became elemental for the final system design. It integrated the scales in which the products of the company are operating, with the cycle of life connecting theses scales and the purpose of the company to actually produce what has been theoretically thought (Figure 6). Making the invisible visible resulted in a statement of the vision, spirit and innovation of the company.

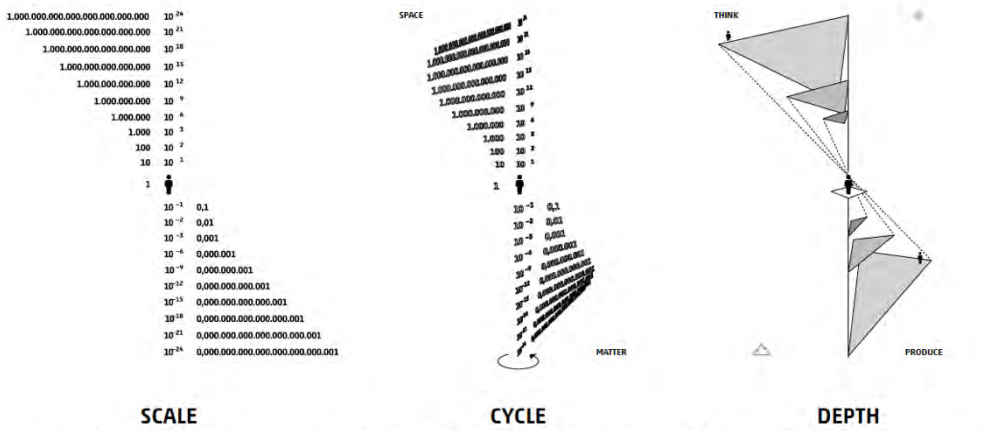

Figure 6. Scale, cycle and depth describe the contexts in which the company is located. Central to all endeavours, inventions and developments is the human being, as user and employee (Source: attocube systems & Henn (2015) and Henn (2016)).

The available reports and documents on the company were processed visually by sketches, drawings, parametric simulations and physical models and enriched by the information gained throughout the workshops and interviews with the executive board, researchers, developers and administrative staff. The process of business and production was mapped in plan views and sections and brought together in a three-dimensional diagram of the organisation. Employees, distance and proximity, as well as process allocation and spatial functions, were considered in the model. The digitally rendered visualisation was then viewed from different angles and revised in order to show the flows of interaction (Figure 7).

By cutting through the model, a cross-section of the entire company structure was created, which additionally displayed the values and mindset of the company. The diagrammatic section served as a structure by which to translate between narrative and organisation. In extruding the section in different directions, the innovation process space evolved, balancing out awareness, functions and project flows of the company (Figure 8).

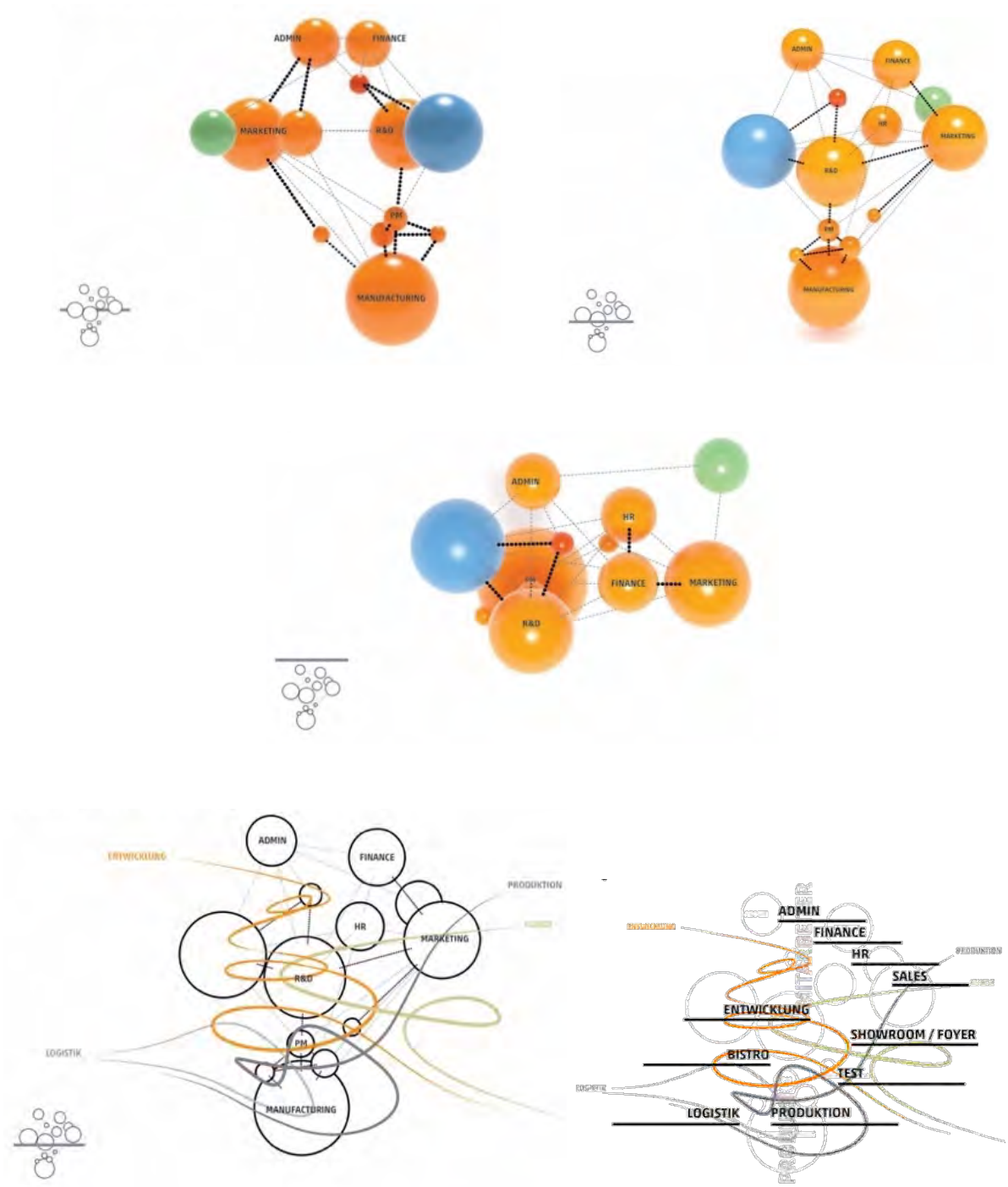

Figure 7. Three-dimensional model of employees, relationships and spatial organisation (Source: attocube systems & Henn (2015) and Henn (2016)).

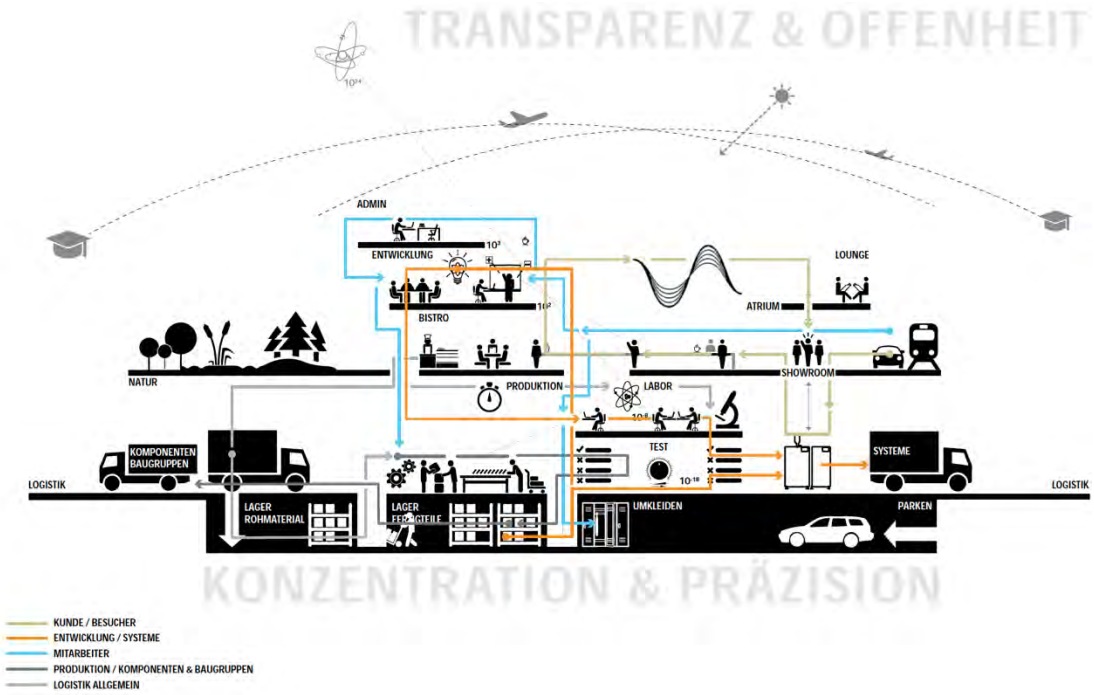

Figure 8. Concept diagram section of values, employees, relationships and spatial organisation (Source: attocube systems & Henn (2015) and Henn (2016)).

Architectural programming and Design thinking in higher education

Despite its potential for complex problem-solving, architectural programming is rarely taught in architecture faculties in European institutions. In the Winter semester 2016/17, the Department of Architecture of Technical Univeristy of Munich started a course to foster awareness of the relevance of new approaches at the intersection of client, architect and society. The main goal is to leverage the potential of architectural thinking and its tools to fields beyond the physical and empower students to communicate, apply and integrate their expertise and creativity in new areas and widen the perspective of architectural education. The course took architectural programming as the basic method, but continued as architectural design thinking in Phase 0, to overcome the building focus and educate architects on their future roles in facing the challenges of the built environment, such as mobility, work, innovation, construction, resources and consumption. It outlines the opportunity for architecture and architectural education to engage with questions in management, economics, sociology, information technology and data sciences and develop itself as a system and innovation design discipline (Boland & Collopy 2004; Shamiyeh 2007; Burke & Tierney 2007; Hyde 2012; Fisher 2015b; Luebkeman 2015). Thomas Fisher concluded that, “by 2050, leadership could become one of the most recognized and well-rewarded skills that architects have to offer” (Fisher 2015a, p. 45).

The students of the course define their individual task in four iterative steps: understanding context and complexity, reframing the problem, developing a concept and designing a system. The following projects emerged in the next semesters, showing how architectural students have applied their talents and skills to new fields of interest. For the students, the absence of a stated problem in the beginning was unusual and difficult to cope with. In contrast to the traditional architectural programming courses, which were teaching the method in relation to a real or fictitious building project, the students in the course in question were asked to discover a problem and to solve it by themselves.

Mobility Guide – Interactive system for personalised mobility / Andreas Beigel

This student's project (Figure 9) started by analysing modes of transport and the future of mobility. It soon led to the question, why the modes of transport are not individually chosen according to an individual set of criteria and preferences. The existing offers seemed to be mostly supply-driven and not demand-driven, without a reliable comparison of sustainability issues or personal trade-off options. This led to a second consideration on a systems level, where an individual's decision could influence the decisions of others. In the future, it is hypothesised that transport will not be a single transport vehicle but a user-centred and individually generated transport system. The system concept for a mobile application to serve as a mobility guide was researched further in the student's master thesis.

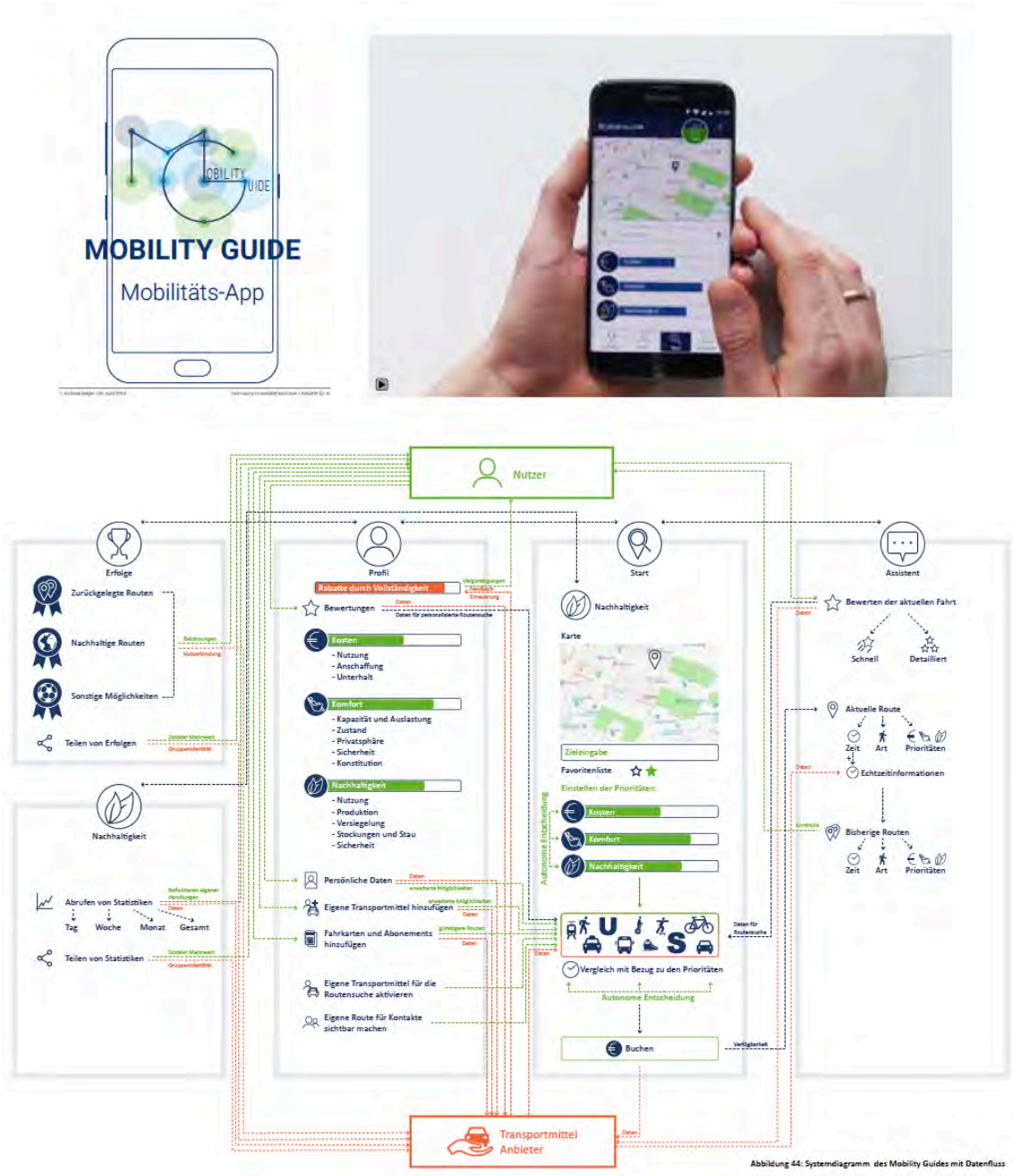

Figure 9. Application architecture for an individual mobility guide with a set of criteria for the selection of the individual transport mode. (Visualisation by Andreas Beigel (2017), p. 89 and acc. presentation.)

Bringing Design thinking to school / Sara Hozzánková

Questioning the sources of misconceptions and miscommunication between architects and laypeople, one student discovered a crucial gap in early design education. Although children are taught mathematics, languages, geography and later on physics, chemistry and other subjects, design is neglected in school. The student's work visualises, in a playful way, what keeps neighbourhoods of thoughts and education apart, and shows a way to achieve better understanding (Figure 10). By nurturing design thinking in school, especially for use in the field of architecture, the children would better understand this way of thinking and collaborate as grown-ups in the development of a liveable built environment.

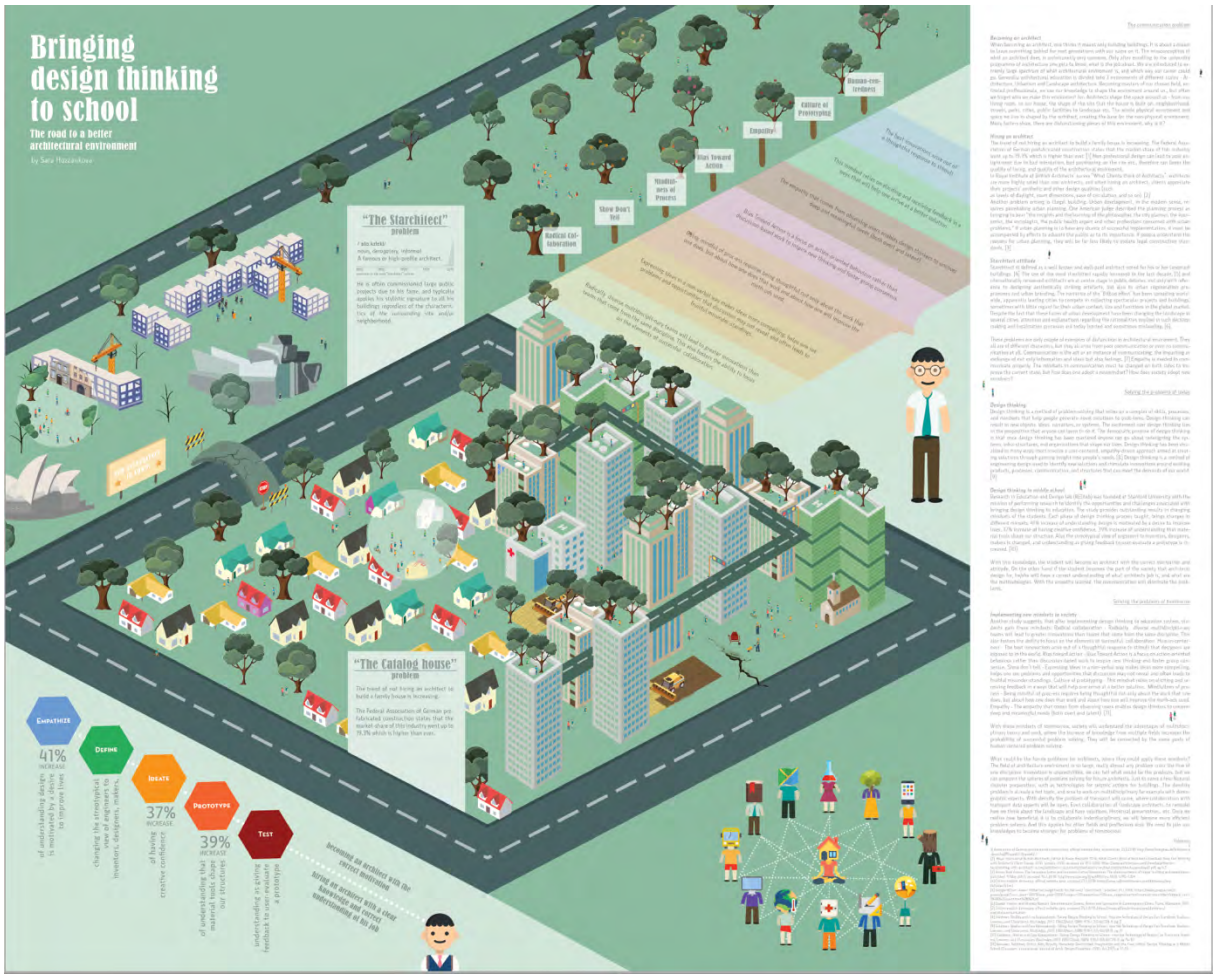

Figure 10. Bringing design thinking to school – map explaining misunderstandings and misconceptions on design and architecture and offering playful roads to a better architectural understanding. Visualisation by Sara Hozzánková.

Liveable Smartness - A strategic Proposal for Architects to improve. Liveability through Smart City Implementations / Yonne-Luca Hack

After laying the foundations during the course for synthesizing liveability and smart city concepts, the student analysed in his master thesis about 200 scientific papers, screened the most successful tech companies, evaluated existing city concepts and extracted contributions from architectural magazines. In his results he revealed a strong focus on technology and organization, and a non-focus on space. He subsequently conceptualized an integrative approach of categories considering equally the social, the organizational and the spatial realm. He concluded with a strategic proposal for architects to improve liveability through smart city

implementations, and re-integrate themselves as actors in Phase 0 for the future planning of urban settings (Figure 11).

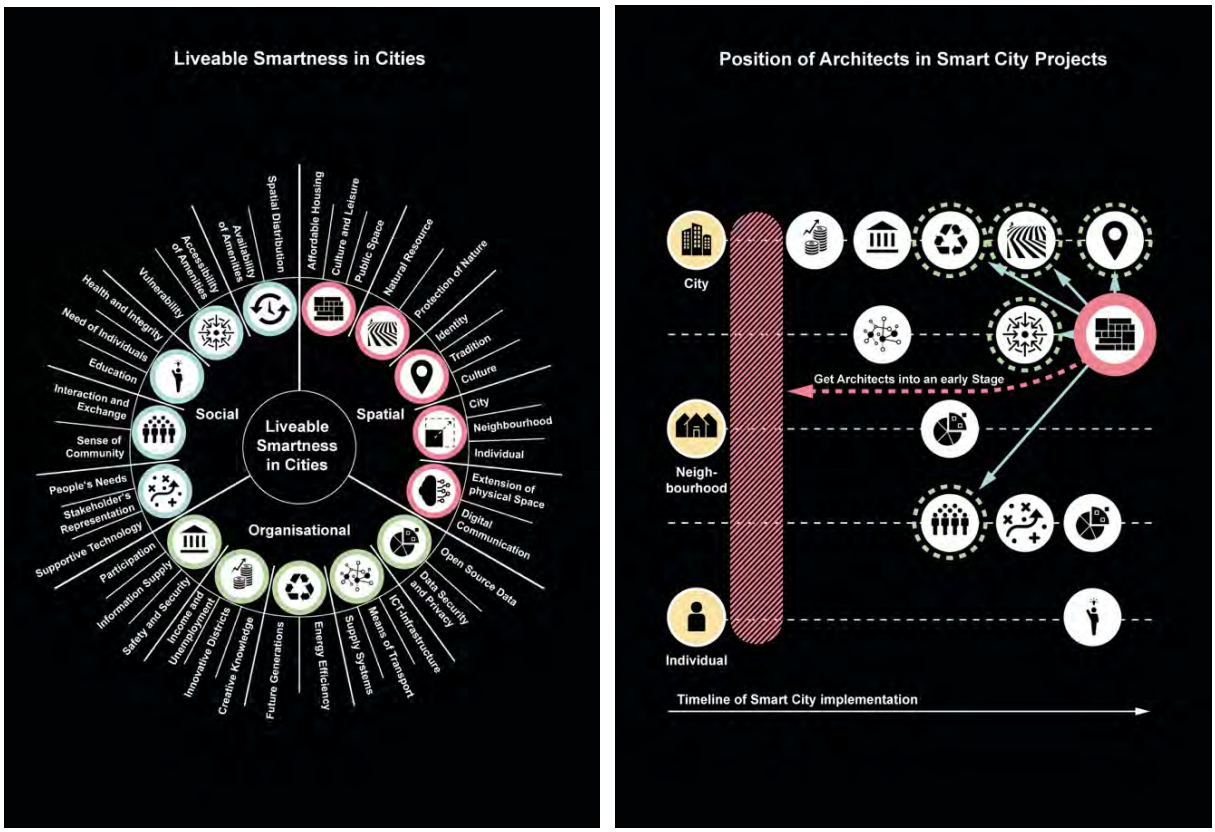

Figure 11. The Liveable Smartness model as a three-layered classification tool by balancing social, organizational and spatial dimensions. In a potential smart city implementation process the late integration of architects could be transformed by shifting towards a mind-set of system thinking in digital space. (Visualisation and description by Yonne-Luca Hack (2019), p. 56-71.)

Outlook and further steps

Architects have their specific way of design thinking and are capable of extending it into systems thinking and system and innovation design. The links to real life, the laying of foundations at a human scale and a tangible understanding of human interactions, paired with creative, abstract and diagrammatic thinking, are viable means of entering new fields. But for architects to be aware of these skills and ways to act on them they need training, both in academia and in practice. The present paper is a first approach to raising awareness of existing methods such as architectural programming and its further integration into higher education. The deficiencies of the ideal programming process explained here need to be addressed by comparing it with other successfully applied design thinking methods (e.g. design sprints, scrums or hackathons) and considering new ways and tools for collaboration and co-creation. To elaborate a concept for architectural design thinking as a method, research and exchange with other design disciplines will be necessary. The present evaluation of the courses observed yields important insights into the opportunities for adjustments and additions. The overall rate of satisfaction by the participants in the courses was very high, based on the anonymous evaluation conducted by the Department of Architecture. It was extremely valuable for the students to have the opportunity to develop questions and a topic independent of building constraints and in a structured way. Learning to communicate complex problems as well as relating them to a larger context was important for the students, and encouraged them to think

of future roles for architects in the fields of mobility, resources, digitisation, smart cities, construction and work. This is of major importance, as the primary focus of architectural education and practice is still building design, which represents only a small share of new constructed projects around the world. By leaving aside the building plan, the potential of architectural education and practice could be made accessible to other fields. This direction requires an understanding and training in the principles and process steps in order to engage with other disciplines and develop common projects or research questions. In the long term, architecture could become not merely building design but also a system and innovation design discipline.

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