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DESIGN RESEARCH ESSAY

Architectural Research in Hybrid Mode: Combining Diverse Methods within Design-Based Architectural Research Inquiry

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With the rapid increase in architectural research activities over recent years, the repertoire of research methods has grown and matured. This essay takes a closer look at the methods that rely upon explorative design as the central activity of knowledge creation. Its first aim is to provide a comparative overview and critical examination of the available methodological typologies to enable their future development. The second aim of the essay is to employ these design-based methods to devise a framework for architectural research as a 'hybrid method'. This framework promotes the simultaneous application of differently composed amalgams of design-based research methods based upon analyses and insights taken from a specific architectural research project led by the author.

The purpose of elaborating on the idea of the hybrid methodological mode is to help establish it as a part of the current repertoire of architectural research methods – today often framed from a 'mixed method' perspective that generally categorizes methodologies into either qualitative or quantitative. The essay proposes that the 'hybrid method' discussed herein covers a different typology of approaches, beyond this qualitative/quantitative distinction, and that its application in design-based research presents valuable opportunities for knowledge production and communication that should not be overlooked in the future development of architectural research methods.

Keywords: Architectural research methodology; hybrid methods; research by design; artistic research; scientific research; mixed methods

Observable yet overlooked: methodological hybridization in design-based architectural research

The rapidly growing complexity of contemporary research has led to a critical reassessment of the research methods employed thus far, to crosscheck their effectiveness. This has evoked criticism of singular methods of inquiry and yielded proposals for compound methods that seek to provide more robust and multifaceted ways of acquisition, analysis and synthesis of knowledge. Clark and Creswell are well-known proponents of one such an approach, termed the 'mixed method'. Their proposal is to combine quantitative and qualitative methods within one research endeavour, to provide a broader and more objective view of the issues being investigated [1: p. 59–62]. Due to its robustness, the mixed method has gained substantial attention and today proliferates in various fields of study from the arts and humanities to natural sciences and engineering.

In architectural research, the 'mixed method' has also been discussed and actively used, with Groat and Wang considering it as one of the most commonly employed research designs [2: p. 18]. However, a closer look at that field of architectural research known as design-based research, i.e. research employing architectural design and its creative outcomes as the main vehicles of knowledge creation, reveals that its methods do not easily fit into the qualitative/quantitative categorization. Considering this observation, the first goal of this essay is to identify the characteristics of design-based research methods that enable to classify them beyond the qualitative and quantitative distinction. In doing so, the aim is to legitimize the methodological uniqueness of design-based architectural research and to characterize more precisely its nature. Through the

formulation of characteristics of various typologies of design-based research methods, accompanied by an overview comparison, the purpose is to devise a framework that can aid further development and exploration of such methods.

The second aim of the essay is to employ the characterizations of design-based research methods as a foundation to promote the notion of a 'hybrid method' of design research in architecture, as a complement to the concept of the 'mixed method'. In the introduction to his 2013 edited book, *Design Research in Architecture*, Murray Fraser emphasizes this inherently combinatory aspect of design research:

In this regard it could perhaps be seen as a happy hybrid of the dominant methodological approaches of, say, science and history, but on the basis that it is the design investigations which constitute the core of the process. [3: p. 245]

Because this hybridization of methods in design-based research in architecture is so observable, yet is frequently overlooked, it is therefore important here to clearly outline its features, potentials and challenges so that it can be proposed as a fully-fledged part of the current repertoire of architectural research methods.

To achieve the above aims, a staged method of study was formulated and executed. Firstly, a comprehensive analysis of current literature on research methodologies in architecture and artistic disciplines was carried out to clarify and characterize three distinct typologies of methodological approaches within today's design-based research. Because research methodologies can obviously take a myriad of sub-forms in actual projects, the synthetic distinction that is proposed here between the three main categories – i.e. artistically driven, architecture-centred, and science-inspired – is primarily for purposes of differentiation and designation. It does not aim to be definitive or to delineate hard boundaries between these different methods. Rather, it serves as an instrument to formulate a proposed framework for architectural research in a hybrid mode (**Figure 1**).

In the next phase of the study, and part of the European Union's Erasmus+ research project 'Mapping, Reflecting and Developing PhD-by-Design Programmes', these three methodological characterizations were validated through the analysis of a range of design-based doctoral dissertations. The analysis included dissertations from seven institutions: Aarhus School of Architecture (Denmark), Bartlett School of Architecture (United Kingdom), Department of Architecture and Civil Engineering at Chalmers University of Technology

Design-Based Architectural Research Method Types			
	Artistically Driven	Architectural Design Centred	Science Inspired
Knowledge Drivers	<ul style="list-style-type: none"> - Artistic methods - Artistic expression means 	<ul style="list-style-type: none"> - Architectural design process theories, frameworks, approaches, routines - Architectural design outcomes - architectural projects, elements, buildings 	<ul style="list-style-type: none"> - Design and evaluation cycles - Scientific method - Empirical cycle
Inquisitive Goals	<ul style="list-style-type: none"> - Provoke - Reframe - Speculate - Question - Theorize 	<ul style="list-style-type: none"> - Question modes of practice - Propose alternative outcomes - Stimulate discourse within practice 	<ul style="list-style-type: none"> - Verify hypotheses - Develop viable theories - Explain phenomena - Solve problems - Deliver validated knowledge and solutions
Nature of Generated Knowledge	<ul style="list-style-type: none"> - Fundamental - Ambiguous - Inexplicit 	<ul style="list-style-type: none"> - Applicable architecturally - Comprehensive to practitioners - Tacit and explicit 	<ul style="list-style-type: none"> - Applied - Validated - Explicit
Knowledge Carriers	<ul style="list-style-type: none"> - Tangible artistic pieces - Abstract objects - Intangible artefacts 	<ul style="list-style-type: none"> - Architectural drawings - Architectural models - Architectural texts 	<ul style="list-style-type: none"> - Qualitative and quantitative data - Prototypes and demonstrators - Lab notes, tables, diagrams, schemes
Communication Channels	<ul style="list-style-type: none"> - Artwork exhibition - Installation - Performance - Artistic text - Other artistic media 	<ul style="list-style-type: none"> - Discursive monograph, essay - Architectural exhibition - Research article - Conference presentation 	<ul style="list-style-type: none"> - Journal article - Conference paper, poster, presentation - Peer-reviewed monograph and edited book

Figure 1: Comparison of the main features of the three methodological types of design-based architectural research [Table compiled by the author].

(Sweden), Faculty of Architecture at KU Leuven (Belgium), Harvard University Graduate School of Design (United States of America), Oslo School of Architecture and Design (Norway) and School of Architecture and Design at RMIT University (Australia). Overall, the examination of these doctoral dissertations served as means to cross-check whether the research methods that are being used in the field match the three characterizations identified through the literature study.

The research project looked in total at thirteen design-based doctoral theses from the seven institutions. Based on interviews with the authors of these dissertations, as well as on analysis of their stated research methods, three dissertations were then identified as model representatives that could undergo more detailed examination into whether the research methods declared by the authors matched the actual process of their investigations, the character of the final outputs, and the means of communication. By looking at the identified characteristics of design-based architectural research methods identified by the literature study, and the subsequent analyses of the doctoral dissertations, this essay will clarify the concept of the 'hybrid method'. Furthermore, the 'hybrid method' and the formulation of its various amalgams was also derived from a real-world example, a large architectural research project led by this essay's author. As a conclusion from all these analyses, a general framework for architectural research as a 'hybrid method' will be presented, accompanied by discussion of its potentials, challenges, and future applications for architectural research.

Design-based methodological approach (1): artistically driven

Architecture is frequently categorized as an artistic discipline and, for this reason, artistic research has often been presented as one of its key methods of inquiry, especially in studies involving knowledge creation through the making of architectural objects, design investigations and artefacts. At the same time, there seems to be a lack of clarity regarding which types of research inquiry fit into this category. To begin the discussion, it seems relevant to examine the features of artistically driven methods based on literature that presents them from a general perspective, regardless of artistic discipline. One of the leading theorists in this respect is Henk Borgdorff, who defines artistic research as an inquiry within and through any artistic practice, expressed in a variety of artistic activities, such as artwork creation or performance – all geared to generate and communicate new knowledge [4: p. 45–46]. Borgdorff underlines that, in contrast to scientific research which typically explains how things are, artistic research seeks for alternative understandings of encountered situations, therewith being discovery-led instead of hypothesis-led [4: p. 56]. Another theorist of artistic research, Catharina Dyrssén, additionally suggests that artistic research, through its questioning nature, has the unique capacity to unfold the non-verbal and the ephemeral – i.e. all that can only be understood through direct sensory, bodily or cognitive experience [5: p. 225–226]. From this, it can be inferred that an immersive encounter of the researcher and the receiver with the artwork and/or the process of its creation is an important enabler of such fleeting and difficult-to-utter knowledge.

Importantly, however, some other researchers, namely Mika Hannula, Juha Suoranta and Tere Vadén, emphasize that artistic research is not abstract or carried out in a vacuum. They explain that although such research operates from within the personal perspective of the artist, it is highly aware of a broad context – of past, present and future issues that have a tight relation to culture, technology and society – and it does so by arguing for a certain worldview externalized within the public context [6: p. 15–19]. Authors such as Lars Hallnäs and Jan Kaila additionally insist that these strong and deep connections to existing philosophies, theories, discourses, foundational concepts, and artistic practices are the main markers of artistic research that distinguish it from a large body of other, non-academic artistic activities [7, 8].

Methodologically, artistic research is often defined in literature as having no prescribed or established protocols of knowledge creation. This is evident from the writings of artistic researchers like Efva Lilja, who implies that inventing a tailor-made research method for each new project guarantees maintaining freedom of critical thinking and creativity [9: p. 55–58]. Thus, Lilja believes that artistic research should rely on the artist-researcher developing methods of study that are unique and unrepeatable, and as such fit one person's attitude, understanding and artistic sensitivity. This, however, does not need to mean it is entirely intuitive and random, or that it invents research methods from the very beginning for each new project. Rather, as Hans-Jörg Rheinberger and Michael Schwab point out, the methodological open-endedness operates within an artist's personal, purposefully constructed and constantly evolving framework of concepts, instruments of inquiry and modes of operation [10]. From this, it becomes clear that these elements serve as a scaffolding in flux, as a perpetual work in progress. The methods can be transferred between different projects while being allowed to take new form in each artistic inquiry.

In terms of research 'evidence' in artistically driven research, Brad Haseman notices that such evidence radically differs from the explicit, factual data generated using classical research methods. Namely, the evidence

produced via artistic research is usually highly symbolic, often ambiguous, and discretely embedded in artistic workflows, artefacts, still and moving images, music and sound, live action, digital code and other media [11: p. 150–151]. Haseman believes that this also necessitates a specific manner of communication of artistic research results, using channels extending beyond or even entirely bypassing the conventional academic text. Such channels can be installations, exhibitions, performances or other, often unorthodox and custom-developed, forms of artistic dissemination, enabling them to reach not only academic and artistic audiences for artistic research but also public audiences.

As a mode of architectural research which exhibits traits of fundamental research, the evidence and knowledge that artistically driven research seeks to generate is not targeted at and expressed in a form meant for immediate application in architectural practice. Rather, its tacit and often ambiguous knowledge offers a conceptual, theoretical and/or material foundation, which, after further probing and transformation, can provide an inspiration and springboard for practice. In this sense, artistically driven research broadens the boundaries of understanding and practice by provoking questions as well as challenging mainstream perceptions of fundamental architectural issues. This horizon expansion takes place by employing alternative concepts, theories, frameworks, methods and media from other artistic disciplines. The issues probed using the artistic approach are therefore released from the burden of solving practical problems, as would be expected of applied architectural research. Rather, the issues can be formulated or derived from the artist-researcher's personal attitudes, and developed into subjective observations, reflections and embodiments – all linked to contemporary architectural practice and/or its material artefacts. However, and reinforcing the views of Hallnäs and Kaila, to legitimize this personal attitude from an academic standpoint the artistically driven architectural research should be situated within a broader context, and should contribute to that context with new viewpoints, insights and knowledge.

In this sense, artistically driven architectural research is highly experimental, speculative, and questions the status quo in the modern cultural, societal and technological setting of human beings inhabiting the built environment. Its main vehicles of knowledge acquisition and knowledge carrying are digital and physical artefacts, objects, performances and other creative pieces, represented using a rich palette of media, extending beyond the older repertoire of architectural drawings, physical models and informative texts. Because as products of basic research these artefacts and pieces may appear abstract, they should strive to bear architectural features. These features should be relevant and recognizable to the architectural discipline, but not necessarily explicit. Instead, they can be tacitly embedded in the nature and form of the artefacts representing them. In this way, the fundamental and often intentionally isolated architectural issues expressed in these abstract artefacts can, through further application-oriented research, be made instrumental via explicit disciplinary knowledge applicable in daily practice.

An example of a doctoral thesis within the bounds of an artistically driven approach is 'The Photographic Absolute: An Architectural Beginning', by Pavlina Lucas [12]. This study investigates the role of intuition in creating the experience of architectural space, by employing a medium from another artistic discipline – photography – as a vehicle for generating architectural knowledge. Apart from using this medium for instinctive personal photography or for photography within a pedagogical context, other alternative, non-architectural vehicles of knowledge production are involved. These include poems, argumentative texts, a physical artefact whose design, material and making process built upon insights from the photographic inquiry, and a performance involving the artist-researcher's personal bodily encounter with this artefact. Lucas's research has a strong theoretical basis, expressed in the written part of the thesis that positions the work within a broader context of art-based practices, and unpacks its ontological and epistemological dimensions. According to the account provided in the thesis, the artist-researcher developed their research methodology on an ongoing basis. While applying various non-architectural artistic methods to provide outsider perspectives on the subject, the research question, formulated in exclusively architectural terms, acted as a steady point which helps to re-focus the inquiry for each phase of investigation.

Hence, one of the main potentials of an artistically driven research methodology is to accommodate a personal perspective on the chosen topic, alongside the freedom to develop unique methods of exploration. This unfolds an alternative path of thought and cognition for the researcher, welcoming and stimulating them to address the research issues from unorthodox, alternative viewpoints, and possibly leading to discoveries or insights that would not occur if more traditional forms of knowledge gathering and communication were applied. Another valuable trait is the employment of diverse, non-architectural media. By acting, creating, making and expressing through various carriers of knowledge, an artistically driven architectural researcher can broaden their disciplinary perspective by introducing concepts, theories and frameworks from other creative practices. In addition, the ability of the artistic approach to convey aspects of architecture that are

ephemeral and impossible to express using conventional means can create robust intellectual and conceptual conditions in which to produce new insights and to question paradigms and routines.

Conversely, the main challenge of adopting an artistically driven research methodology is in its non-compliance with the classical academic definitions of investigative activities, meaning that such research is often questioned and subjected to more extensive criticism than is usual. Because of the misalignment with the classical markers of academic research, such as reproducibility of experiments or publication in scientific journals, an artistic researcher needs to find other ways to ensure proper recognition of their work as a research enterprise – a task especially burdensome for junior artist-researchers. To deal with this challenge, however, there is an already vast and constantly growing body of research literature on the subject, with a few notable publications comprehensively discussing the criteria for research quality in architecture and other artistic disciplines [13, 14].

Design-based methodological approach (2): architecture-centred

This typology of design research focusses on the execution of an architectural design brief, or a series of such briefs, which are formulated by an architect-researcher to access and produce new architectural knowledge that Savchenko defines as operational, i.e. possible to immediately grasp by other architects and directly applicable in their practice [15: p. 32–33]. Known as ‘research by design’, this research methodology according to Johan Verbeke involves studies within the medium of pure architectural design, with the created architectural projects, the act of designing them, and the final reflection upon them forming the research method, result and conclusion [16: p. 137]. As concisely stated by Leon van Schaik, this method entails investigations of architecture through architecture [17].

Interestingly, Verbeke underlines that this research method can be used both in an academic context and in commercial practice. Verbeke also states that, regardless of context, the most important feature in this type of inquiry is the fact that the insights and conclusions of the architect-researcher are informed by their own knowledge and hands-on experience of design practice. In addition, he advocates a rather purist attitude towards the applicability of knowledge generated through research by design, arguing that it should generate insights of straightforward usefulness to the general practice of architecture [16: p. 145]. This suggests an orientation of research by design towards providing solutions and, thereupon, towards problem solving.

At the same time, however, according to other understandings of research by design, such as expressed by Richard Foqué, this specific type of problem solving does not need to be ultimately pragmatic: instead, it can involve a strong experimental or speculative attitude [18: p. 45]. Some authors, such as Nel Janssens, go even further along this trajectory of thought, arguing for ‘research by critical design’ which is geared towards providing and exploring alternative worldviews [19: p. 150]. The aim is to speculate, question and push the boundaries of what architecture is, how it is designed and materialized, how it operates, and how it influences people and the environment. As Janssens suggests, the critique of the status quo through the projection of alternative futures, imaginaries, visions, fictions and utopias are important cornerstones of such explorations [19: p. 155].

In terms of communicating research by design, Verbeke argues that its insights should be represented using formats and media understandable by architectural practitioners [16: p. 142, 148, 151]. Thus, knowledge should reside and be communicated in architectural sketches, drawings, models, prototypes, and auto-ethnographic or discursive texts. As can be observed from doctoral research in Europe belonging to this category, this results in specific research dissemination channels that embrace – apart from conferences and articles in scientific journals – a range of monographs, edited book volumes, essays in architectural magazines, and exhibitions at cultural events such as architecture biennales.

In terms of its kinship to artistically driven research, some authors, such as Dyrssén, suggest that research by design could be considered as an instance or a subset of artistic research due to the grounding of both in the practice of creation and making [5: p. 224–225; 20: p. 191, 194]. Although this categorization may seem appropriate and be legitimized by the historical traditions of architectural institutions such as the Beaux-Arts-type academies, the features of research by design are already so clearly defined that it is worthwhile regarding it as a standalone methodological approach. It is also relevant to make this distinction because of the focus of research by design upon the practices and media of architectural design, with its clear-cut purpose of producing knowledge that directly addresses architectural practice [21]. Conversely, artistically driven research in architecture, through its involvement with profoundly more abstract and ambiguous concepts, theories and media from other artistic disciplines, carries a different aim and purpose, and is naturally and inevitably embedded in a broader context of art, design, culture and society.

An example of a PhD thesis that is representative of research by design is 'Processing Imperfection: Exploring Creative Possibilities in the Digital Architectural Drawing Process', by Maya Lahmy [22]. Its aim is to investigate the relationships between architectural drawings made for digital fabrication and more explorative digital drawings. The thesis was carried out in three phases: firstly, a retrospective analysis of the researcher's own work from architectural practice based on three solo projects; secondly, explorations in the form of pre-planned architectural design experiments tackling the research theme from various angles in three new projects, solo and collaborative; and thirdly, pedagogic analysis of teaching workshops supervised by the researcher in which the research questions were explored through three student projects.

The main knowledge carriers and communication media in Lahmy's thesis were architectural drawings and photographs of physical models that represented typically architectural objects and elements. These were supported by auto-ethnographic, retrospective texts on each design project in terms of explorative goals, design development, results and insights generated. The writing also included an introduction in which the positioning and motivation of the subject matter – architectural drawing – was related to a broader technological context, and a concluding analysis for the study. Communication involved academic articles, an exhibition, the written thesis, and a final slide presentation at the thesis defence.

A clear potential for research by design is that it enables the architect-researcher to embed in the research inquiry the inherent cultures and ways of thinking and communication of architectural practice. Moreover, it enables the designer's wisdom and knowledge to be utilized for new knowledge that is directly relevant to a wider collegial audience of practitioners and educators – enabling architectural research to affect architectural practice and higher education curricula naturally and profoundly.

However, the main challenge of this methodological approach resides in communicating the tacit parts of the generated knowledge. To ensure recognition and value, such knowledge should be comprehensive and clear not only to architect peers but also to other academic disciplines that architectural researchers often collaborate with, such as engineering or the social sciences, as well as to members of the construction industry and society more broadly. A related issue is that of compliance with the standard markers of academic research quality, as there often tends to be a misconception that including architectural design as means of inquiry disqualifies it as research. Here it is recommended to resort to the substantial body of literature which presents frameworks and helpful criteria for assessing the quality of architectural research, such as writings on 'doctorateness' [15, 23]. Another important challenge is to provide not only a contribution to applied architectural research knowledge but also at the level of architectural theory to legitimize and position the individual investigations undertaken as research by design to broader discourses, both historical and contemporary theoretical. An interesting book from the neighbouring field of product design, written by Johan Redström, offers some insights into how active designing can be instrumental in building up theory [24].

Design-based methodological approach (3): science-inspired

It is difficult to find a comprehensive or exhaustive term to describe this third typology in design-based architectural research, due to the huge differentiation of its potential forms. For this reason, the synthetic designation of science-inspired method was adopted to be able to compare it with the previous two approaches and to develop the logical constructions to discuss architectural research in a hybrid mode later in the essay. This type of design-based research is characterized by reliance on established methods of academic disciplines that employ what in continental European academic terminology is called a 'scientific' method, such as the social sciences, humanities, natural sciences, and engineering. As such, these approaches are primarily geared towards either explaining phenomena or providing solutions to observable issues in the 'real world'. Within architectural research, the aim is often to quantitatively and/or qualitatively verify disciplinary findings to make them optimally suited towards direct application in architectural practice and the construction sector.

Therefore, in contrast to artistically driven or architecture-centred approaches, this methodological category encompasses the most structured, rationalized and systematic methods of design-based inquiry that seek to develop legit, verified, useful explanations, solutions or optimizations of problems. Hence the natural reliance of this typology on established means of knowledge acquisition, such as prototyping and testing, systematic experiments, user studies, surveys, and any other methods that help to validate research outputs derived through design. These outputs are developed through what Brian Lawson describes as a cycle of architectural knowledge through design analysis, synthesis and evaluation, iteratively leading to an optimized solution to the problem identified at the outset of the inquiry [25]. Consequently, research knowledge is embedded in tangible outcomes derived from this design-driven cycle, including technical drawings, physical models, full-scale demonstrators, pieces of open-source code and theoretical instrumental frameworks, workflows, toolkits and other types of explicit, tangible deliverables.

Another distinguishing feature of this category of architectural research methods is its interest in the empirical cycle described by Foqué [18: p. 31–33]. This empirical cycle, involving stages of observation, induction, deduction, testing and evaluation, is seen as engaged in the process of deriving broader theories or frameworks in a logical, orderly and systematic fashion. In line with this thinking, Groat and Wang accurately observe that architectural research undertakings in this category tend to follow the classically understood inductive, abductive or deductive pathways [2: p. 27–38]. Niezabitowska further emphasizes that the main carriers of knowledge derived specifically in the design evaluation phases are data and factual evidence, in qualitative or quantified form, collected using common data-gathering tools such as tests, experiments, observations, statistics, case studies, surveys and interviews [26: p. 125]. Therewith, ideas of reproducibility, verification, validation and evaluation are almost automatically present in design-based architectural research inspired by the scientific method, making it much easier to establish its quality, value and credibility in the wider research community – not least because its academic dissemination often takes the conventional form of refereed essays or scientific conference presentations in which the explanation progresses straightforwardly from aims and methods through to results and conclusions.

An example of a PhD thesis that employs methods from the science-inspired category is ‘Prestress in Nature and Technics’, by Alexander Sehlström [27]. This work, positioned at the crossing between architectural design and structural engineering, investigates how prestressing can drive the design of material-efficient, functional and aesthetically attractive construction. The research method follows the empirical cycle described above and includes a discussion of established theories and methods about prestressing in structural design. Induction then took place, embodied in a design framework for prestressing principles, followed by deduction in the form of a hypothetical description of mechanical and computational principles for prestressed design, along with an outline of basic objectives for design strategies to achieve it. Analysis was supported by a thought experiment in which the design of an existing bridge was reconsidered from the standpoint of knowledge developed in the deductive phase of the research – and then concluded with testing and evaluation of the hypothetical framework through numerical investigations and a design experiment for a large architectural structure employing prestressing as its leading design principle. Communication was through a thesis summary and a collection of research essays on different parts of the study.

The main strength of the science-inspired research method is its clear palette of data-gathering methods which rely on well-understood tools accepted by the general research community. Such research is not likely to be extensively questioned in academic contexts, even those extending beyond the researcher’s core discipline, which potentially increases its scientific impact. The criteria and conventions for scientific publishing are also well known and grounded, making it clearer and easier for junior researchers. Built-in logic, explicit hypotheses and research questions, and systematic nature of the inquiry, all support the process of generating and examining results, and drawing conclusions. And since the results can be implemented immediately in practice, industry or society, this too acts as a legitimizing factor.

Conversely, the key challenge is paradoxically related to its main strength – i.e. the presence of clear, structured methodology. Because research agendas and routines are so well specified, this may result in a somewhat reductive nature of inquiry, arising from the fact that a research hypothesis or problem needs to be clearly formulated so early on, with all research activity then dedicated to verifying that hypothesis or solving the problem. Given the straightforward application of established investigation methods, it means that extracurricular questions or alternative techniques of knowledge acquisition are usually excluded as irrelevant or distractive to the central focus. Under such strict conditions, the value of intuition and randomness that frequently spark unpredictable discoveries tends to be overlooked. Ambiguous data and tacit knowledge are thus often disregarded, narrowing down the perspective on the research questions at hand. Excessive reliance upon established methods also poses the risk of the researcher being insufficiently critical, while the limitation of dissemination primarily to academic media means that outreach to other end-users and stakeholders may also be compromised. One remedy against these drawbacks could be to introduce elements of the ‘mixed method’ approach, as proposed by Clark and Creswell, at least partly to help combine intuition and logic through analyses and syntheses of both quantitative and qualitative data. Alternative modes of communication, including popular science articles, exhibitions, educational videos and other forms of presentation, could also extend the reach beyond academia.

An architectural research project combining diverse design-based methods: ‘Architectural Convertibles’

In this section, to introduce and exemplify the concept of ‘hybrid mode’ research as being combinations of the three typologies discussed above, a set of methods will be examined from a large architectural research project led by the author. The project was titled ‘Architectural Convertibles: Towards an Alternative Artistic

Approach to Designing Interactive Architectural Environments', and it was funded by the Artistic Research Committee of the Swedish Research Council Vetenskapsrådet.

The 'Architectural Convertibles' project aimed to develop an alternative artistic approach to designing interactive environments through aesthetic considerations which were centred on user experience, in this way counterbalancing current pragmatic, technology-centred approaches. The research brief embraced knowledge development goals at three levels: architectural theory, methodology and practice. At the level of architectural theory, the ambition was to contribute to contemporary discourse on materiality, particularly in terms of concepts of architectural corporeality expressed in the notion of 'flesh' by Marcos Cruz, Ellen Lupton, Elizabeth Diller and Ricardo Scofidio. The goal was to broaden these primarily biologically inspired understandings by acknowledging 'flesh' as a profoundly artificial entity, derived using digital media and represented by an organic yet synthetic aesthetic vocabulary. An accompanying aim was to develop methods of materializing this new concept of 'flesh' by combining digital fabrication with handicraft techniques. At the level of methodology, the goal was to develop new artistic ways of exploring 'flesh' through the lens of its materiality, aesthetic expression and corporeal human experience. At the level of practice, the aim was twofold: firstly, to create alternative understandings and expressions of flesh-inspired materiality through interactive architectural constructs and environments; and secondly, to provide a speculative vision for responsive, multisensory architectural environments in the future that featured unorthodox ways of corporeal sensing and communicating with the new concept of 'flesh'.

To hybridize the research methodology for 'Architectural Convertibles', each of the sub-methods emerged from acts of filtering and modification. Filtering entailed selecting approaches from each of the abovementioned design-based research types, yet the chosen sub-methods were not applied in a straightforward manner. Rather, certain of their main conceptual traits or features were adopted based on their relevance to the inquiry, and then modified, often profoundly, to suit the specific examinations of each stage of knowledge development. Therefore, the resultant hybrid research method, in its entirety, exhibited a high degree of uniqueness which was tied to the project brief and the immediate needs of the research explorations.

In terms of sub-methods from the artistically driven category, these were inspired by Dyrssén's analysis of artistic research and thus included 'explorative experiments', 'modelling', 'simulation' and 'performance'. The 'explorative experiments' were chosen because, as Dyrssén notes, they provide the possibility of playful design experimentation, without being overburdened by expectations and predictions. Instead of striving for verification, she argues that such free experiments reveal hidden possibilities, framings and perspectives. According to Dyrssén, although the experiments feature creative improvisation, they should be pre-planned, guided by a set of rules, and implemented with a precision in their actions and using established forms of representation and communication [5: p. 229].

From the earliest stage of the project, the 'explorative' experiments were filtered and modified. For instance, in contrast to Dyrssén's recommendation, the rules, actions and representational media were intentionally kept unestablished. Only one element was defined as deliberately stable and verbalized at this stage, this being the research question: How can the corporeality of 'flesh' be expressed in the context of interactive architecture? From this intuitive search for possibilities emerged a loose compilation of spontaneous impressions, visions and embodiments. They were represented through diverse artistic media, extending beyond the typical means of architectural communication to include also epic narrative pieces, digital animations, and so on – all bearing partially ambiguous and partially architecturally relatable features (Figure 2). This tacit knowledge enabled the research team to identify architectural techniques and materials

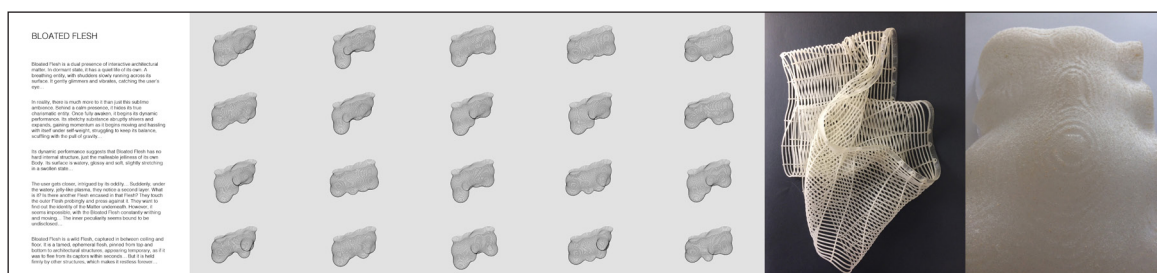


Figure 2: Examples of architectural artefacts derived through an artistic method of 'explorative experiments'. From left to right: written narrative; stills from digital animations; abstract yet physical entities conveying new material architectural qualities [Courtesy of the author].

with expressive and experiential potential, discover hidden possibilities and patterns for design expression and multisensory material reception, and identify materialization strategies to explore. It also created a knowledge foundation for more systematic design-based research experimentation.

Dyrssén's 'modelling' and 'simulation' were selected as another set of sub-methods from the artistically driven category because of their ability to abstract and recontextualize the subject matter of research by using fiction as a conceptual and inquisitive tool [5: p. 230–231]. As Dyrssén provides an open definition of these methods, a project-specific interpretation of what they meant and how they would be used was developed. Accordingly, 'modelling' was understood as the creation of fictional but physical objects, close to architectural scale but abstract in form, as well as digital animations representing surreal, dynamic aspects of matter constituting those objects. In turn, 'simulation' was defined as an approach for placing these fictional and abstract artefacts in certain discursive and physical contexts, such as informal conversations, brainstorming sessions, conferences (e.g. on user experience and interaction design), exhibitions and a question-and-answer session with an audience of academics and invited guests.

Finally, 'performance' was chosen as a sub-method due to Dyrssén's description of its active character – i.e. the opportunity for analysis through action that stages, provokes and inverts the hierarchies between the object and subject of the research [5: p. 226–227]. As a project-specific interpretation this meant, among others, inviting into the collaboration a performance artist who, through her dance choreography involving a carefully chosen artefact from an earlier research stage, created a personal temporal and bodily interpretation of the project's theme (**Figure 3**). By placing the artefact into a new, unfamiliar context of dance choreography, it was possible to make a conceptual move in rethinking the theme of 'flesh', and its embodiments, by considering them from inverted perspectives of bodily encounters and movements in slow motion and in continuous transition.

Turning now to sub-methods taken from the architecture-centred category, an approach of 'research by critical design' – as defined by Janssens – was adopted because it shifted focus from solving problems and finding answers to stimulating debate [19: p. 150]. Janssens defines this method as welcoming critical speculations on what could be, expressed as future design projections, scenarios and visions out of the ordinary [19: p. 154]. Hence, provoking questions pertaining to alternative realities were sought for and formulated for the 'Architectural Convertibles' project. For a start, the notion of interactive architectural elements commonly understood in the form of automated façades, floors and ceilings was challenged. A different notion was introduced, that of a shapeless para-building made from animate, voluminous substance, consisting of physical and electronic matter, and taking various material and spatial forms to adapt temporally to the intricate physiological, psychological and physical bodily states of its inhabitants. This, it was argued, would allow them to engage with the para-building through tactile interactions instead of verbal or written communications.

A series of accompanying questions were also asked. If the future architectural interiors and exteriors were made from a para-substance that is tangible, voluminous and could activate multiple senses, what would it feel like to dwell within? How could users interact with architecture's physicality in a state of true corporeal immersion, in all dimensions of space and time? What new behaviours and thinking patterns would users need to develop? These questions led to physical artefacts, epic-poetic stories and video animations that all presented glimpses of such an imaginary future. Dyrssén's 'architectural thinking' was also adopted as a sub-method due to its inclusion of architectural qualities embodied not only as physical design but also as ephemeral features of space, awakening multisensory experience [5: p. 224–225]. The project-specific interpretation of this sub-method explored the project's central concept of 'flesh' without the typical restraints encountered when designing functional objects. In this way, it was possible to conceptualize and express an

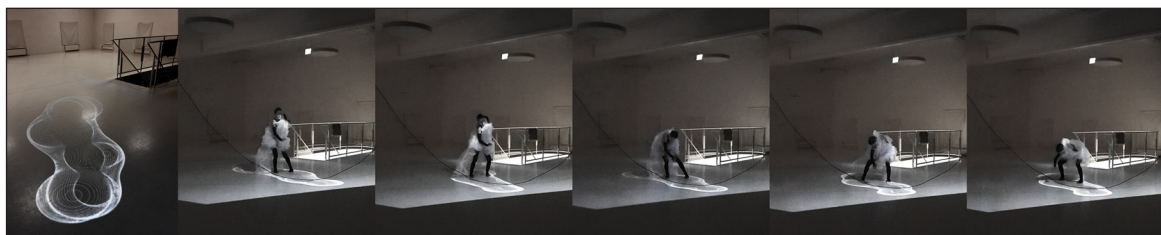


Figure 3: Artistic architectural performance by a dancer, Carmen Olsson, performing a choreographed sequence of slow body movements entwined with a moving projection of an animated architectural artefact [Courtesy of the author].

array of fundamental features of architecture, such as spatiality, materiality, tactility, visual impressions and emotional sensations through scaleless samples and abstracted models which envisioned distant possibilities playfully and freely.

When it came to research strategies inspired by methods from the natural sciences and design engineering, again adopted and adapted to suit the needs of the project, the first was the 'experimental method' characterized by Rheinberger [28]. Interest in this method was due to its capacity to systematize and organize the research process, which became very relevant in the project's second phase. It was concluded that a more rigorous approach was essential for design explorations that combine digital tools and handicraft to counterbalance the more intuitive and ambiguous findings from the artistically inspired methodology. Importantly, however, the experiments for 'Architectural Convertibles', while structured, were not hypothesis-driven but rather discovery-led.

These design experiments were exercised in systematic series of designing and making, underpinned by a custom-developed framework (**Figure 4**). The framework was inspired by Rheinberger's notion of an 'experimental system' – a large system of concepts, workflows and tools that enables maintaining both stringency

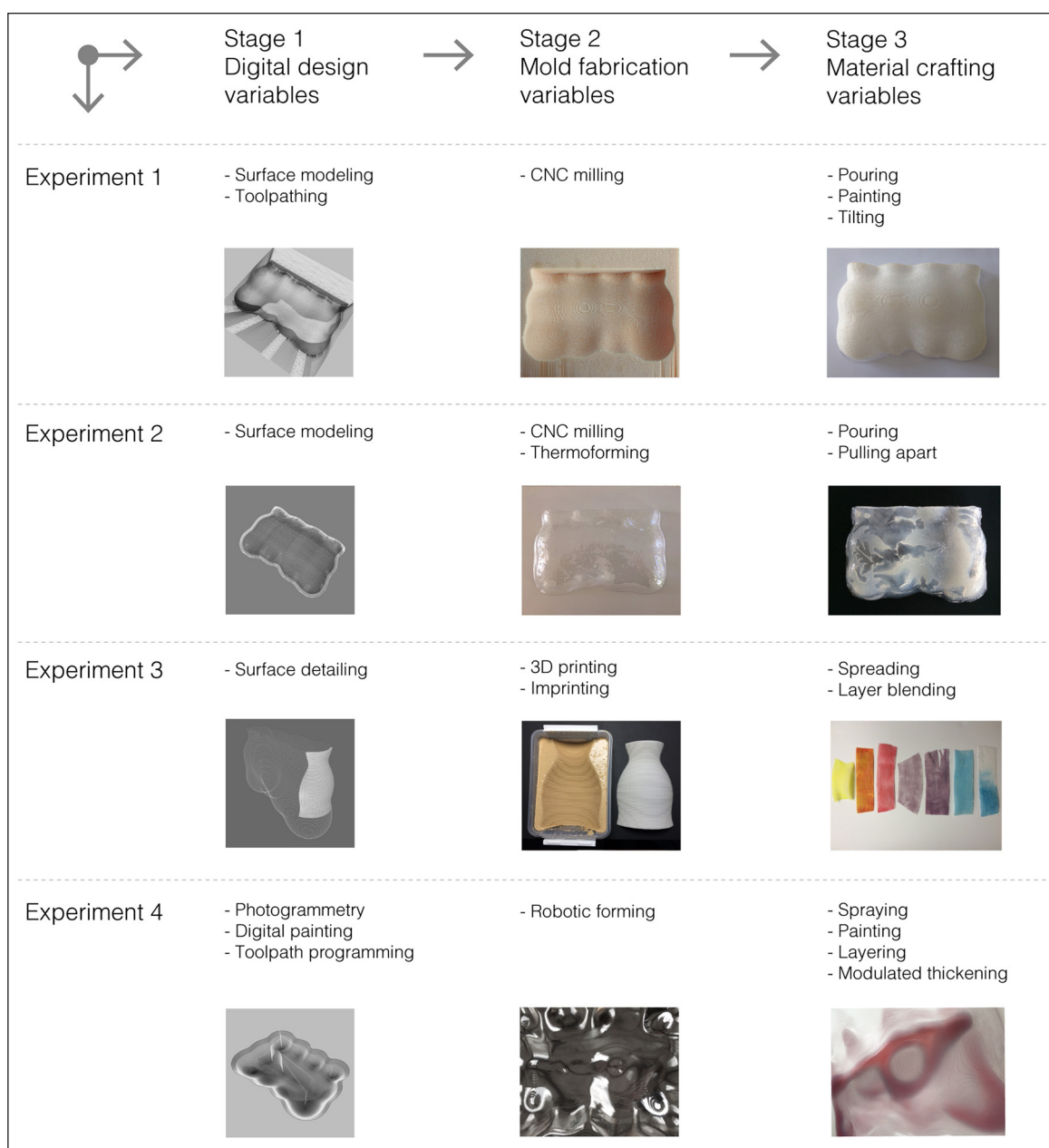


Figure 4: Conceptual and operational framework, inspired by scientific experimental method, to structure, guide and focus digital and physical architectural design experiments [Courtesy of the author].

as well as openness to discovery, suitable in his view for both artistic and scientific research. Accordingly, this framework was not as rigid as in typical scientific lab experiments which follow protocols for gathering mostly quantitative data; rather, it had an operational and qualitative nature, and was adaptable to allow for changes in design parameters.

As another sub-method in this category, a project-specific version of ‘prototyping’ – as used in engineering and industrial product design – was accommodated. According to the definition put forth by product designers Stephan Wensveen and Ben Matthews, prototyping as a research method, by placing focus on the production of tangible design prototypes, can explore research problems that are difficult or impossible to resolve using other forms of inquiry [29]. Although the purpose of the prototyping for ‘Architectural Convertibles’ was not as pragmatic as in ‘real-world’ product design, it did help to devise some very specific research insights for designing, expressing and sensing a new materiality of architecture. The results of prototyping were tangible yet quite abstract artefacts of an architectural scale and placed in architecturally recognizable spatial settings, supplemented with written scenarios in epic form. Therefore, prototyping intentionally did not yield verified, explicit solutions for the future. Instead, all deliverables of this research stage were conceived as abstract pieces, ambiguous in form and tone, meant to trigger new imaginings and provoke new questions.

Finally, a sub-method inspired by ‘user studies’ from another engineering science – product design research [30] – was also assimilated because it helped to shift focus from the artefacts themselves to their sensory experiencing and interactions of people with those artefacts. In ‘Architectural Convertibles’, however, the conventional principles of user studies were substantially modified. Instead of quantitative or qualitative data gathering through surveys or interviews, here it became a peculiar kind of situated observation featuring informal conversations with the recipients of artefacts. With that, the aim was to collect ambiguous impressions and opinions, expressed through spontaneous verbal communication and bodily interaction of the audience with the pieces (**Figure 5**).

Hybrid mode in action: methodological amalgams

A characteristic feature of the hybrid methodological mode in ‘Architectural Convertibles’ was that, in the various project phases, none of the sub-methods described in the previous section was used separately. Instead, they were clustered and applied as methodological amalgams, represented by pairs or triads of sub-methods picked from the three main typologies, with boundaries between them often overlapping or blurred.

The first of these amalgams consisted of two sub-methods: ‘explorative experiments’ from the artistically driven methods typology, and ‘architectural thinking’ from the architecture-centred category. In this combination, the artistic component prevailed while the architecture-centred element was less pronounced (**Figure 6**). This amalgam supported the earliest research stage in which the aim was to investigate the theoretical concept of architectural ‘flesh’ through artistic production, from an aesthetic and experiential perspective. The inclusion of artistic, partially playful, explorations enabled to express qualities of ‘flesh’ without the usual restraints of the architectural project brief, such as site conditions, function and programme. Therefore, instead of designing pragmatic architectural objects such as walls, columns or façade panels, it yielded a collection of abstract pieces, artefacts and other representations, digital as well as physical (**Figure 7**). Within this profoundly artistic framing, the architecture-centred ‘architectural thinking’ was



Figure 5: Reinterpretation of the classical scientific ‘user study’ method, augmented by informal, situated observations of people’s corporeal interactions with architectural prototypes [Courtesy of the author].

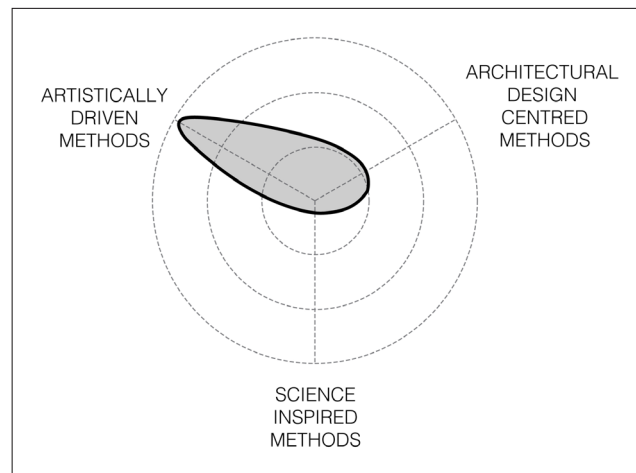


Figure 6: First amalgam of research methods used for the ‘Architectural Convertibles’ project [Diagram drawn by the author].

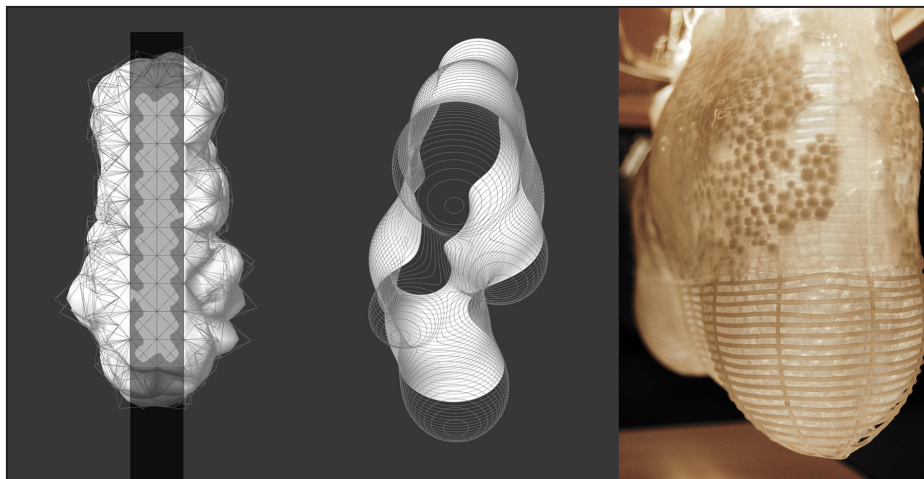


Figure 7: Architectural artefacts resulting from the application of a dual methodological amalgam of artistically driven and architecture-centred methods [Courtesy of the author].

present as tacit reinforcement, shining through the video-animations and physical pieces that expressed geometric form, colour and light. In other words, the artistic explorations were underpinned by architectural objectives and ways of understanding and perceiving space, to realize an alternative vision of architectural materiality.

The second amalgam consisted of three sub-methods: ‘explorative experiments’ from the artistically driven category, design experiments inspired by the scientific ‘experimental method’, and ‘research by critical design’ from the architecture-centred typology. In this threefold combination, the artistic and scientific methodological components prevailed, supported by the architecture-centred element (**Figure 8**). The use of this amalgam enabled research in the intermediate stage of knowledge development, in which the rich yet ambiguous body of findings from the earlier phase needed reflective channelling to investigate more deeply certain architectural aspects.

In practice, this meant conducting another series of design experiments, which at this stage were inspired by the scientific ‘experimental method’. The afore-mentioned conceptual and operational framework for material and aesthetic explorations was devised, with more systematic and explicitly expressed parameters guiding the experiments. More deliberate strategies for digital design, fabrication and material crafting were also developed to explore their role in triggering certain anticipated as well as unexpected aesthetic effects (**Figure 9**). The ‘research by critical design’ element then served to contextualize the aesthetic research in the ‘explorative experiments’ discussed above. This was achieved through the medium of written architectural discourse – namely, three academic research articles and one essay. In these publications, the project’s findings were positioned and discussed in relation to research, methods and practices in the field of

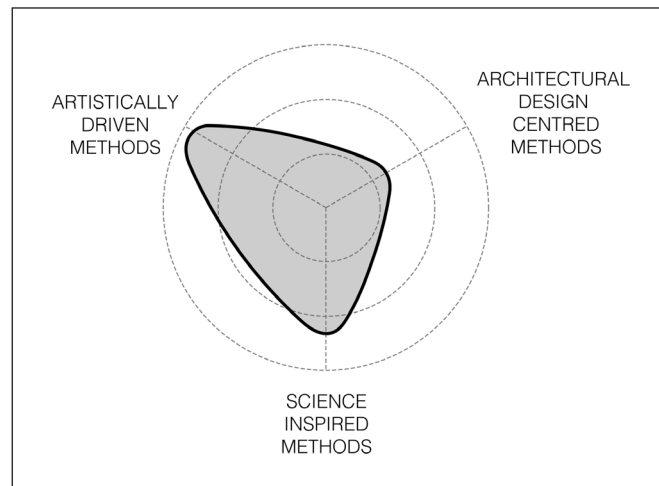


Figure 8: Second amalgam of research methods used for the ‘Architectural Convertibles’ project [Diagram drawn by the author].

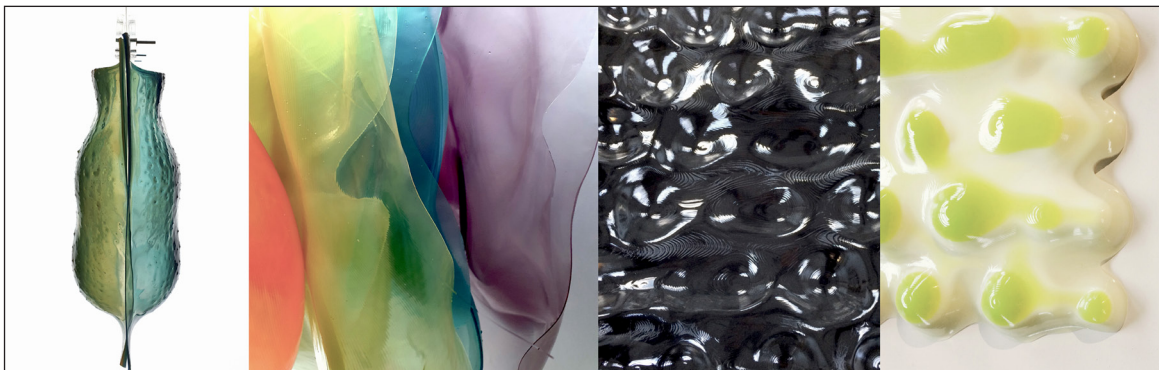


Figure 9: Architectural objects resulting from the application of a triadic methodological amalgam of artistically driven, science-inspired and architecture-centred methods [Courtesy of the author].

digital design. Furthermore, the current trend towards precision-oriented digital fabrication was challenged through a proposed new practice that deliberately employs imprecision in architectural computation and design materials to produce novel aesthetic vocabularies.

The third amalgam comprised the same three sub-methods as the second one but applied them with a different order of dominance: ‘research by critical design’ and ‘architectural thinking’ were taken from the architecture-centred typology, ‘modelling’ and ‘simulation’ from the artistically driven category, and ‘prototyping’ and ‘user studies’ from the science-inspired class. In this combination, the architecture-centred element prevailed, while the science-inspired and artistic components supported it (**Figure 10**).

The amalgam was developed during the final stage of the research, in which the findings from all earlier inquiries informed the creation of alternative architectural futures. These projections were expressed through three articulate physical artefacts of architectural scale, exemplifying three ways of experiencing and expressing visual-tactile human interactions with the new interactive architectural ‘flesh’. Written narratives describing the sensations and impressions of dwelling within an alternative materiality accompanied the physical pieces. Aspects such as the scale of the hand and the body, material details, and multisensory spatial and material perception were also developed at this stage, continuously underpinned by ‘architectural thinking’ about spatiality.

The artistic elements of ‘modelling’ and ‘simulation’ produce tangible samples of this new hybrid materiality, composed from digital devices and physical materials that sustain and emphasize the aesthetic expression and tactility of the ‘flesh’ (**Figure 11**). These two artistic sub-methods, further expanded through science-inspired ‘prototyping’ and ‘user studies’, enabled the collection of spontaneous reactions of the audience to the pieces, in this way gathering important outsider perspectives, disciplinary insights and artistic inspirations for how to develop the project’s architectural visions.

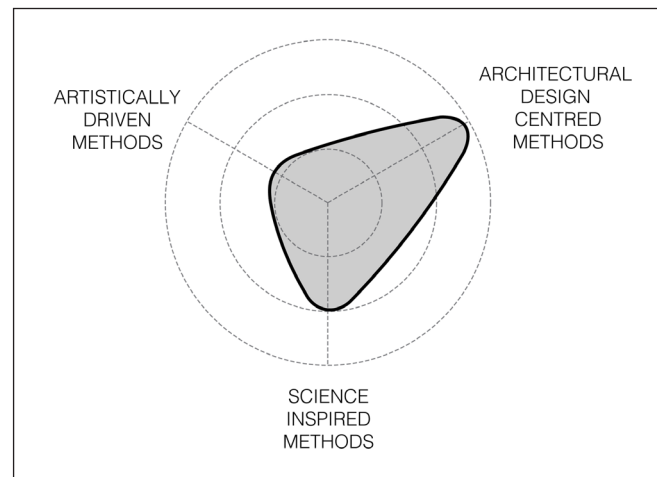


Figure 10: Third amalgam of research methods used for the ‘Architectural Convertibles’ project [Diagram drawn by the author].

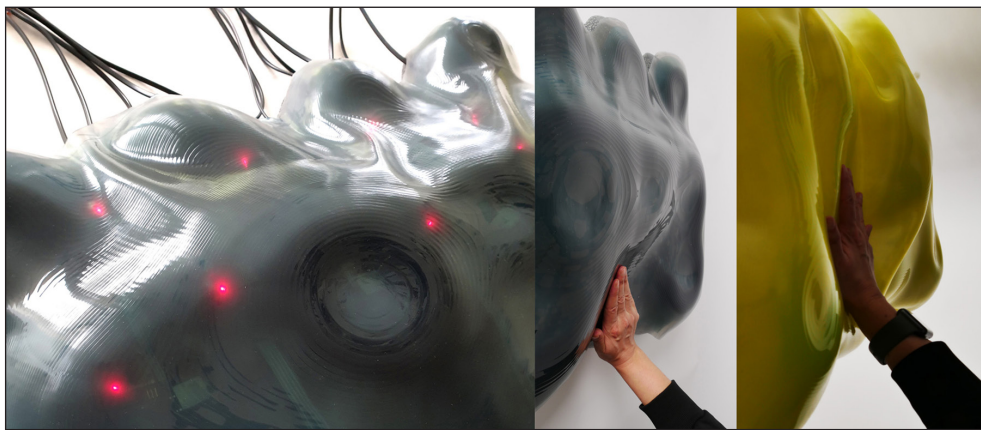


Figure 11: Architectural prototypes resulting from the application of a triadic methodological amalgam of architecture-centred, artistically driven and science-inspired methods [Courtesy of the author].

Conclusion: a framework for architectural research in hybrid mode

As mentioned earlier, the hybrid mode of design-based architectural research discussed in this study provides an outlook that extends beyond the qualitative/quantitative framing of the ‘mixed method’ approach. By combining elements of the three identified methodological types of design-based research – i.e. artistically driven, architecture-centred and science-inspired – it creates unique conditions for generating architectural knowledge, with interesting potentials that should not be overlooked. Each of these types offers its own interesting perspective as well as an enriched repertoire of potential approaches, which the architectural researcher can freely compose and merge together to suit the needs of their inquiry.

To achieve maximum flexibility and openness to discovery, the sub-methods within the proposed research framework should be mixed according to strategies that allow variation in the different stages. In other words, the function of the framework is not to prescribe specific method combinations. Rather, it is meant to provide a conceptual scaffolding to facilitate the formulation of individually developed methodological combinations, evolvable and fluctuating as the study moves forward. For example, it could be imagined that in the early research stages the logic for combining the methods could rely on the designer-researcher’s creativity, intuition and tacit knowledge. Those sub-methods assumed to be most interesting, effective or versatile could be fused. In the later, more advanced research stages, when the volume of produced knowledge has set a more specific tone for the inquiry, a more systematic methodological composition could be devised. For instance, it could follow a logic based on progressive, hierarchically progressive or hybrid method combinations, like proposals by Creswell and Clark [1]. The progressive strategy of combining the methods would feature a selection and application of single sub-methods from each methodological type in a particular order considered to be optimal by the researcher (Figure 12).

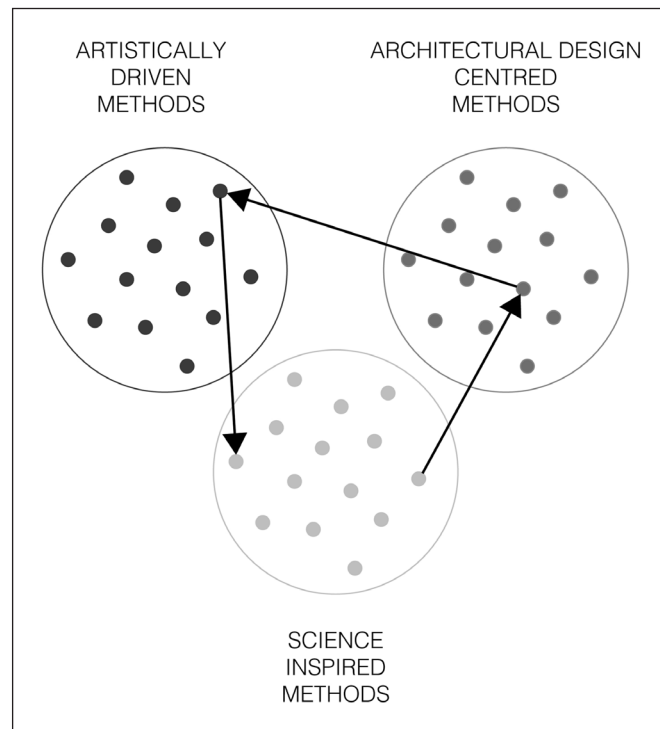


Figure 12: Progressive mixing of sub-methods within the 'Architectural Convertibles' project [Diagram drawn by the author].

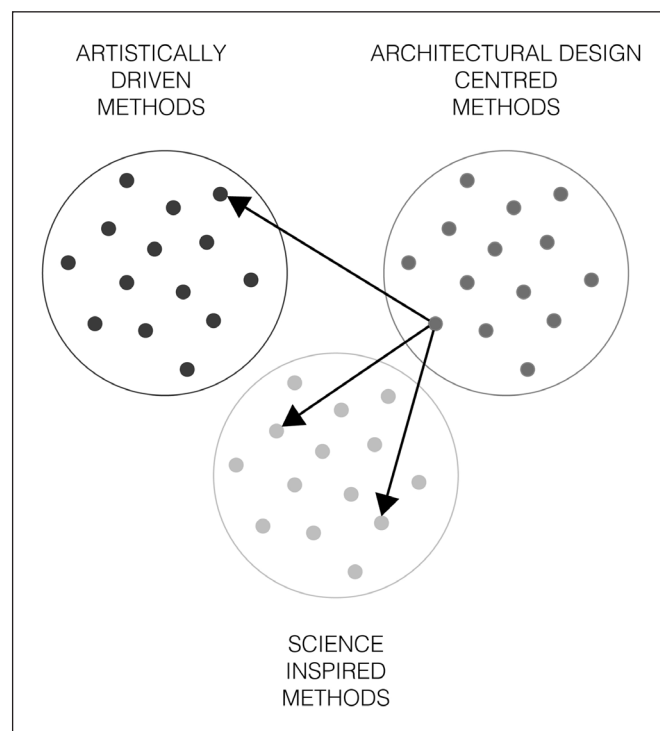


Figure 13: Hierarchically progressive mixing of sub-methods within the 'Architectural Convertibles' project [Diagram drawn by the author].

The second strategy of methodological combination – the hierarchically progressive one – could be based on applying singular sub-methods in a certain order along with an establishment of their importance, with certain methods being more dominant and others less so (**Figure 13**). This entails that the results derived from the most dominant method of inquiry will be decisive in drawing the research conclusions. In this case,

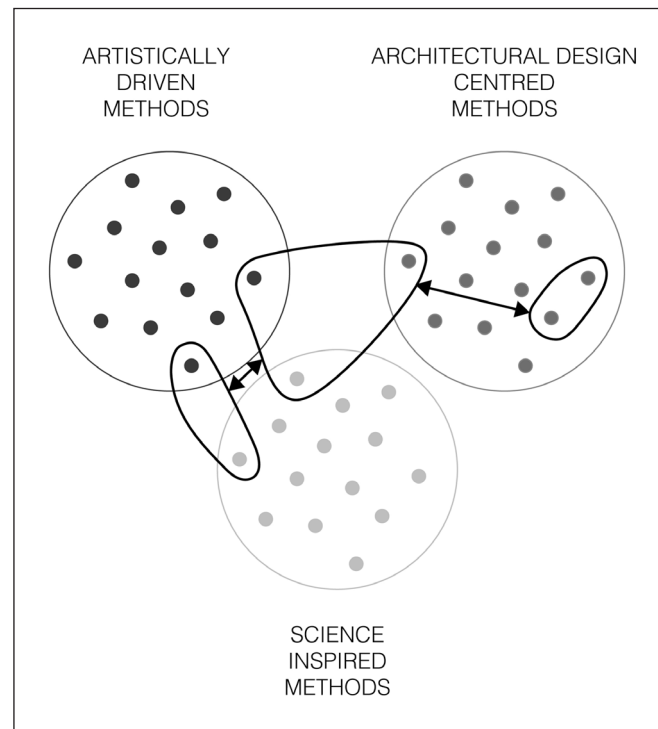


Figure 14: Non-hierarchical, hybrid mixing of sub-methods within the 'Architectural Convertibles' project [Diagram drawn by the author].

the less dominant modes of exploration will serve as supportive and supplementary means for comparison, reference, or even to gain a contrasting viewpoint on the research questions at hand. The hierarchy of methods could be either strategically pre-selected on a top-down basis or else emerge organically bottom-up based upon the emerging results of inquiries.

The third strategy of methodological combination – the hybrid one – would be based on sub-methods from each of the three main design-based research typologies, merged to form amalgams (**Figure 14**). A degree of dominance and hierarchy of sub-methods, and the order of their application, may or may not be set by the researcher. If dominance does occur, however, it should not be based on the weighted importance of results that is proposed in the 'mixed methods' definition of Clark and Creswell. Instead, it should be based on the degree of participation of the methodological elements. In such a case, one or two elements could be defined as the dominant ones, thereby setting a general tone to the inquiry. In the 'Architectural Convertibles' project, this strategy was in fact predominant in the research design: namely, the sub-methods from one or two methodological types prevailed, while others complemented them, which was geared to generate a broader collection of research insights and a larger number of alternative viewpoints while maintaining focus and direction in the course of inquiry.

Thus, while there are clearly many challenges in pursuing architectural research in a hybrid mode which combines artistically driven, architecture-centred and science-inspired approaches, its paramount strength resides in the rich milieu it offers for knowledge production, expression and communication. The diversity of perspectives, operational modes, ways of forming and exploring research questions, methods of data gathering, knowledge carriers, and dissemination media provide a powerful toolkit. At the same time, this strength also forms a major challenge. Working within such a complex methodological milieu requires advanced scholarship and experience of various approaches, and the ability to combine them into methods that can truly move architectural research forward. Ultimately, it needs the ability to navigate in and out of this complexity in a way that secures meaningful knowledge production.

Yet another significant strength of the hybrid mode of design-based architectural research is that its three methodological typologies – artistic, designerly, and scientific – align organically with the hybrid nature of the architectural profession, operating as they do at the crossing of art, design and technology. To many architectural researchers employing design as the central vehicle for generating new knowledge, the methodological elements of the hybrid mode will be natural to understand and implement. That is because they

are akin to the typical ways in which architects operate in practice, such as navigating between creative and pragmatic modes, and considering various – often disparate – perspectives of the design community, users, engineers, construction professionals, etc. Therefore, the hybrid mode creates favourable conditions for harnessing this breadth of perspectives. Through this it supports the essence of design-driven research in architecture: namely to question, explore and expand current practice and to provide bold, relevant proposals for future developments.

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Competing Interests

The author has no competing interests to declare.

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