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Architectural Laboratories: Expanding the Field of Practice

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Abstract

This paper examines the emerging role of the laboratory in architecture, investigating how the "lab" framework has transcended its traditional scientific connotations to become integral to creative, practice-based fields. Historically understood as a controlled environment for producing reliable scientific facts, the laboratory has now been appropriated in interdisciplinary contexts, particularly in architecture, where the focus extends beyond the replication of scientific methods to the development of new research methodologies. This shift has been driven by architecture's inherent dualities—science vs. art, theory vs. practice, and living vs. non-living—compounded by increasing complexity in production. Through a detailed exploration of laboratories in universities, the paper situates architecture within a possibility of a new practice supported by research. By engaging with thinkers like Bruno Latour, Karen Barad, and Bernard Stiegler, this study highlights the dynamic possibilities of architectural practice when rethinking material agency, data, and human/non-human relationships. It argues that architecture's appropriation of the lab framework reflects a deeper engagement with the performative systems of matter, technology, and epistemology. Furthermore, the paper underscores the necessity of reconfiguring architectural practice to address contemporary challenges, by fostering new forms of action that transcend conventional boundaries of the laboratory. Ultimately, this paper reveals how the laboratory in architecture is not merely a space for the application of scientific methods but a fertile ground for speculative practices and experimental methodologies that challenge established epistemological frameworks. Through this lens, the architect-agent becomes a connector, facilitating a process that resists total control and embraces open-ended, interactive systems, contributing to the creation of new forms of knowledge and practice.

Keywords: laboratories, architectural practice, architectural research.

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INTRODUCTION

The laboratory is conventionally understood as a controlled space where scientific facts are produced. Modern science is often represented by the laboratory, which has become synonymous with epistemological authority and reliable knowledge. Despite ongoing debates about the knowledge produced within it, the term lab has increasingly been adopted by interdisciplinary practices within the soft sciences. While discussions highlight various forms of agency involved in knowledge production, reference, and application, the use of the -lab suffix in fields like art, architecture, and technology denotes a practice distinct from traditional scientific laboratories, studios, workshops, or offices, offering an emerging paradigm. Therefore, it is essential to closely examine the concept of the laboratory as an emerging framework in practice-based fields, particularly in terms of research methodologies and the ways in which scientific knowledge is produced. Beyond observing or applying existing scientific methods, designers and architects may be seen to build their own methodologies, shaped by shifting definitions of matter and the deeper logics of the laboratory-work. This study examines motivations behind this trend, exploring why architects refer to their workspaces as labs.

Like other creative knowledge-producing fields, architecture accommodates a wide range of dualities—science vs. art, site vs. office, theory vs. practice, natural vs. artificial, living vs. non-living—spanning material and social dimensions. A significant reason for these dualities lies in the diverse outputs and formats of data, coupled with the widening gap between different systems of knowledge, which often struggle to communicate effectively and, as a result, fail to mutually enrich one another. It is intriguing to observe how the duality present in creative fields, both in terms of knowledge production and methodologies, is being transferred to the laboratory environment.

After the mid-twentieth century, we witnessed various interventions that challenged this dualism and opposition, addressing it through the lens of scientific knowledge. Modern science has been critiqued for the disconnect between the agents within the isolated environment of the laboratory and the external world. This critique stems from the laboratory's emphasis on objective, reproducible experiments that bypass the subjectivity of the scientist. Early twentieth-century developments in physics, particularly in the field of relativity, shook confidence in the reliability of experimentation. Soon after, Thomas Kuhn's concept of paradigm shifts paved the way for methodologies that recognized social practices as legitimate modes of knowledge production (Kuhn 1996). By the late twentieth century, scholars like Latour, Woolgar, and Galison expanded critiques to include the laboratory's internal dynamics and its isolation from broader societal contexts (Latour and Woolgar 2013; Galison 1998). Rather than focusing on scientific disciplines themselves, these critiques examined the media through which knowledge is created and the implicit practices and representational techniques involved in its transmission.

Given these shifts in how data is obtained and translated as knowledge, the laboratory is much more than an epistemological engine. With the rise of modern science and the perception of natural phenomena as inherently uncertain, architecture has transitioned from a discipline reflecting an idealized version of the world to one engaged in releasing the performative systems that reflect its inherent instabilities.

The adoption of the lab suffix by architecture and other creative fields cannot be explained solely by the borrowing of technologies, techniques, methods, and tools from the laboratory. Instead, this appropriation signifies the emergence of a new space of interaction, where the process of scientific formation directly influences design and production practices. Architecture, especially with the rise of digital technologies, now transcends the naïve formalism of past analogies, as suggested by figures such as Picon, Frampton, and the stylistic approaches of architectural offices (Galison and Thompson 1999). In line with Latour and Woolgar's constants and Galison's call to incorporate expertise from other domains, contemporary architecture strives to develop a new language between the laboratory and design practice (Latour and Woolgar 2013; Galison and Thompson 1999). The maps, diagrams, and texts emerging from this fertile intersection represent a rich cartography of possibilities where scientific research, through subjective effort, can contribute to a body of stable knowledge.

Today, knowledge production, oscillating between such dualities, is reimagined in the context of posthumanist and new materialist thought, as an interconnected whole where boundaries dissolve. The reintroduction of technologies and agents in this context proposes a fresh starting point for rethinking these divides and exploring new collaborative possibilities. Consequently, the search for a space where the radical shift in the relationship between matter and knowledge—emerging from the redefinition of knowledge—can be applied and tested also surfaces within architecture and creative fields. This space must facilitate the transition from digital to analog, and back to digital again, where the agents involved need to be continually reintroduced. The need for a practice that incorporates a new interaction between data and knowledge is essential for shaping the evolving relationships between the digital world and new agents.

ARCHITECTURE AS PENDULUM BETWEEN ART AND SCIENCE

It is impossible to consider the influence of the laboratory and scientific knowledge in shaping architecture without its historical context. Etymologically rooted in the meanings to work, to produce and to cultivate, the term laboratory refers to a space integral to the emergence and formation of scientific knowledge. While in the eighteenth century laboratory was used to describe the studios of painters, sculptors, and printmakers, it also referred to spaces where influential families brought together professionals from various fields.

Workshops that blended art, science, and craft often operated under the guise of alchemy, conducting a wide range of investigations. For instance, the Uffizi workshops, funded by the Medici Family, are among the earliest well-documented spaces, with archival records dating from the seventeenth through the mid-eighteenth century. These workshops became a center for innovation, ideas, accumulated expertise (know-how), and scientific discoveries. The activities of the Uffizi workshops played a critical role in the formation of modern scientific knowledge and the emergence of cabinets of curiosity (Bofill 2013).

Today, the term laboratory is applied across various domains, such as photography labs, language labs, film labs, art labs, and cultural labs. More recently, new spaces and departments have emerged, and novel approaches have been practiced: Medialab, LivingLab, ArtLab, RoboLab, and others. These environments foster the convergence of scientific motivations with creative and independent disciplines. With the support of cultural institutions and financial actors, these new convergence models have led to the creation of frameworks designed to unite art, science, and technology. The aim is to facilitate mutual learning and decentralized production through organized interaction (Bofill 2013).

A common thread persisting into the present is the pursuit of innovation and the desire to work with digital technologies in spaces that recognize all agents as active participants in the learning process. Unlike traditional laboratories, spaces such as Living Labs tend to be monitored, reshaped, and expanded by all participants. An example of this convergence can be seen in the works of Tokyo-based TeamLab, which has been active since 2001. TeamLab's projects demonstrate the interplay between technology and artistic and spatial practices. By manipulating contemporary media, they enable both a spatial experience and the sharing of that experience across multiple platforms with different agents. Such works engage the audience (others) as active participants, using technology not merely as a tool but as a medium to create new relationships. This highlights the distinction between producing and using technology, especially in creative fields like art and architecture.

Although laboratories are often understood as producers of epistemological knowledge, they are also sites of unique constructive activities (Latour and Woolgar 2013). In this context, construction refers to the experimental processes where art and science converge, building realities through these interactions. Therefore, as Latour and Woolgar suggest, the laboratory is a space for constructing relationships between agents (Latour and Woolgar 2013).

NEED FOR A LAB

The architecture establishes active connections. The (new) material relationships of the practice, as well as its responsibilities in addressing the positioning of new and old agents within the practice, and how it responds to the crises of today's world, have driven architecture, along with other disciplines, into a state of inquiry. The challenges posed by the climate crisis—such as what kind of world we will inhabit, what ecological models we can propose in the face of resource depletion, and under what conditions and with whom we will seek shelter due to phenomena like migration—present a new set of data that architecture can no longer ignore or solely address through the building act. This necessitates abandoning previous modes of operation and generating new frameworks via architecture (Frichot 2023).

Academia and independent practice locate numerous research-driven architectural laboratories and collectives. These spaces are not merely external expert additions to architectural design, but rather the varied habitats where all processes of architecture are maintained. Unlike traditional modes of integrating perspectives from other disciplines and new technologies as external inputs, these labs fully incorporate them into their activities from the outset (Galison and Jones 1999). The first person to conceptualize architectural practice as a laboratory for intellectual and data production was Frederick Kiesler. The Biotechnology and Correlation Laboratory, which explores the potential of the laboratory itself with inter-relational contexts rather than applying or producing standard methods at Columbia University. Initially, the laboratory aimed to analyze the dialectical relationship between humans and nature (Kiesler 1939). Kiesler examines this duality through "biotechnical" aspects, exploring psychological, physical, social, and mechanical relationships. Although Kiesler's early enthusiasm for establishing a social laboratory is influenced by concepts borrowed from Mumford and Francé, his approach

in the Correlation Lab reveals a distinct trajectory compared to his contemporaries. Kiesler's research focuses not on producing forms but on discovering relationships between things and beings. For instance, the concept of correlation is used in Kiesler's worldview to explain atomic and cellular similarities.

Positioning that aims to seek partnerships enabled Kiesler to research both humans as active designers and nature by ignoring preconceived notions within agents. Kiesler does not strive to be the controlling subject of scientific knowledge but instead designs a negotiation space where variables are recorded rather than fundamental conclusions reached (Wihart 2015). For Kiesler, the human agent is the shortest-lived component within the natural, social, and technological environment (Kiesler 1939). Consequently, humans are incapable of transmitting their experiences to the next generation. In his laboratory, Kiesler attempts to externalize human agency using various machines and tools developed in the lab (Phillips 2017). In the laboratory, diverse specialists such as physiologists and psychoanalysts measure and record data, and the laboratory operates by testing agents and cataloging new (im)materialities. In doing so, this space, referred to as the laboratory, establishes a workshop or studio framework that invites the integration of new agents into the system of architectural practice. At a time when practice fully embraced the concept of the laboratory— engaging in full-scale, 1:1 experiments with new technologies and the integration of digital-analog elements—we encounter key examples such as Buckminster Fuller's workshop, Cedric Price and Joan Littlewood's Fun Palace, and later, towards the end of the century, the MIT Media Lab established by the Architecture Machine Group.

Confronting the Lab

Today, the laboratory surpasses its past influence on architectural practice, and operates more actively under this paradigm than before. Various ruptures in the field of architecture may have set the stage for the emergence of the laboratory as a new operational mode. The positioning strategies of critical theory and the quest for new modes of making—beyond theory—through apparatuses tied to next-generation technologies, have called architecture toward new spaces like the laboratory workshop, encouraging new modes of communication with materials (Haraway 2001; Speaks 2005; Frichot 2023).

One key reason for this shift toward new spaces within architectural practice is the increasing need to test speculative models and multiply agents capable of transforming the field, ensuring the involvement of numerous nomadic actors (Braidotti 2011). In social contexts where mass-scale truths fail to resolve divisions, there arises a need to open the door to a thoughtful and soft discipline where singularities can be organized. Furthermore, the integration and practice of emerging technologies introduce a praxis that differentiates itself.

In post-theory, post-human, or new-materialist debates in architecture, a shared and significant mission is to revive the structure that forms and organizes connections. Moreover, architectural practice aims to move away from the inertia of theory, embracing current technologies and integrating active agents into the process: agents that can generate differences, operate experimentally, establish unique material connections, produce testable prototypes, and include non-human participants, while also presenting alternative operational phases and incorporating new languages, such as coding. Michael Speaks highlights that post-theory architectural practice is speculative and experimental, with spaces resembling workshops where prototypes and tests are conducted under what he calls the "knowledge table" method (Speaks 2005). He emphasizes that "making" is separated from theory, portraying design knowledge—or "design intelligence"—as the result of thinking through making.

Speaks' theory from 2005 suggests that the post-theory discourse in architecture draws architectural agents and inter-agent possibilities into a quest for new spaces that the field had not previously inhabited. This search leads to numerous small research units — laboratories—within academia, independent research institutions, civil initiatives, and architectural offices. While architecture had previously operated within spaces labeled as offices, studios, and workshops, from the first decade of the twenty-first century, it began adopting the term lab to designate spaces that are not solely focused on material research, but where agents can collaboratively design.

However, naming architectural spaces of practice as labs while distancing from theory and prioritizing making alongside technology presents inherent contradictions. This is because laboratories, as spaces traditionally linked to scientific knowledge production, share common ground with critiques of knowledge production systems and discourses centered on establishing new relationships between humans and matter amidst the climate crisis. New materialist and post-human concerns address the displacementof relations between humans and non-human entities. Laboratories, with their capacity to process extensive data sets, offer a means of bridging these disconnections and fostering new relationships. This approach holds the promise of generating singularities where experimentation connects scientific and creative domains.

At the same time, laboratories integrate models that engage all active participants, positioning theories as complementary to the process. The epistemological constructs developed within the laboratory are

both experimental and products of self-validating mechanisms (Barad 2007). While experimentation in the lab functions as a practice to generate difference, scientific data ensures that these differences consistently produce the same outcomes when repeated. Thevalue of this knowledge lies in its ability to yield reproduceable results under varying conditions (Haraway 2001). This research seeks to understand why architecture, despite its foundational critique of scientific research methods, adopts the 'lab' label to designate a "making" practice, with a particularfocus on contemporary architectural labs.

Interpreting the Laboratory: Positioning as a Methodology

Latour and Woolgar (2013) examine the process of knowledge production within the laboratory (in vitro), by recognizing it is a space where scientific facts are actively constructed Their fieldwork (in situ) reflects this acceptance, and they approach their research as anthropologists, meticulously considering every historical and contextual connection. The term anthropologist positions them as outsiders, observing the laboratory from a foreign perspective. This vantage point enables them to decipher the practices of a different discipline and discern the modes of scientific knowledge production. Their methodological approach to studying scientific activity is as compelling as the research findings.

In this context, architecture laboratories will similarly be examined as a phenomenon. The duality of practice and discourse identified by Woolgar and Latour serves as a starting point for this paper, specifically the comparison of laboratory groups, their discourses, and their actions. The aim is to uncover the spaces in which laboratories are situated and the conditions that contribute to their normalization within these environments.

One of the primary objectives of this research is to explain how architectural laboratories, which serve as a transitional phase between design in education and the act of construction, present themselves as the closest approximation to scientific (objective) knowledge within the context of research project funding. Positioned at the intersection of education and research, these innovative apparatuses are central to this exploration. The main aim is to understand what architectural laboratories aim to accomplish, what they produce, and how they legitimize themselves through their practices with contemporary debates.

Latour and Woolgar's work differs from this study by focusing solely on a single laboratory. In contrast, this study acknowledges the plurality of laboratories and aims to explore the various reasons behind their emergence, offering a partial historical and theoretical discussion of these contributing factors. The theoretical framework will be built around the instruments, experiments, observations, and techniques that emerge in debates on objectivity in research and laboratory studies. Additionally, the comparison will address how the field, situated within a spectrum of scientific, experimental, and artistic endeavors, contributes to (pure) objective research.

The exploration is based on two premises: First, while it is challenging to narrow the definition of laboratory within these frameworks, the historical emergence of laboratories, starting from Kiesler, has been explained. Secondly, it is accepted that the laboratory functions as the platform for current research in architecture, serving as a proto-field for digital architecture, shaped by new forms of data. Furthermore, the study examines why contemporary architecture relies on laboratories as the preliminary space for production, where materials and the objects are redefined within new, fluid knowledge systems. These places have the potential to form new fields of practice by enabling agent-based interactions that reconstruct pre-existing relationships anew. The selected examples are expected to demonstrate the laboratory's crucial role within its host institution, significantly shaping practice.

Collecting Data

The collection of laboratories focuses on the top five architecture schools based on the QS World University Rankings and Times Higher Education indexes, highlighting institutions where spaces designated as laboratories are established. These institutions include MIT, Harvard, UCL, ETH Zurich, and TU Delft. The research targets these schools due to their academic excellence and innovation in creating new research spaces within the field of architecture. These laboratories are primarily founded as extensions of postgraduate and doctoral programs in research and practice.

These places are analyzed within the following frameworks: laboratory's objectives, the main problems addressed, proposed solutions, scales of inquiry, key research themes, published papers, funding sources, and financial support for ongoing research for comparative analysis across various criteria. The primary aim of this list is to assess the discursive, academic, and practical positionings of these laboratories while also assessing the consistency of their stated objectives through the projects they undertake.

In addition to these formal laboratories, many schools house independent, informally operating workshop spaces—such as FabLabs and DesignLabs—where students work with digital models and produce physical outputs using equipment like 3D printers, laser cutters, and CNC machines. However, these spaces are not included in the current list. Similarly, traditional

laboratories associated with engineering departments that conduct material and performance testing and search for optimal structural materials for industrial applications are also excluded.

The following table categorizes the research and applications based on scale, defined problems and solutions, and information from the laboratories' websites. Furthermore, an effort has been made to extract information about interdisciplinary and transdisciplinary working principles, established collaborations, and partnerships with private industry, as detailed on these websites. In summary, this table serves as a framework for examining how contemporary architectural laboratories operate, using an approach similar to that of Bruno Latour and Steve Woolgar, where laboratory practice is viewed and compared through the statements and discourses of the practitioners themselves.

Moreover, some labs, which are not explicitly listed on university websites, function as part of student groups or art centers. The first aim is to explain the institutions influencing the concept of 'lab' and how these institutions affect architectural practice.

Institutions and Labs in Detail

The Massachusetts Institute of Technology (MIT) website lists sixty-five research units across the university, excluding laboratories within the architecture faculty. Specifically, within the architecture department, research activities are categorized into two main areas: six active working groups and eleven research laboratories, each explained in detail. At TU Delft University, the research infrastructure includes twenty-nine laboratories, The Design Labs link in the list is not directly related to the architecture department. However, the Faculty of Architecture hosts eleven research labs.

Figure 1: List of Labs from Five Different Institutions. Source: Author, 2024.

These research units, affiliated with the architecture, art, and design faculties of the respective universities, have been individually analyzed through their institutional websites. With this motivation, the selected examples must demonstrate that the laboratory plays a crucial role within its host institution, significantly shaping practice. Additionally, these labs should pursue common objectives aligned with their goals, and be defined through similar relationships with education.

In recent years, numerous universities in Europe (particularly in Switzerland, the Netherlands, Denmark, and Germany) and the United States have integrated laboratory practice into a substantial portion of their architectural education and research activities. The term lab has become widely associated with creative, art-centered fields and is increasingly common in architectural education and research (Figure 1).

University College London (UCL) organizes its research infrastructure under two categories on its website: initiatives and networks and people and teams. The research unit at UCL does not reference a physical space or entity; instead, the focus is on individuals and partnerships, suggesting a networked approach to research organization. The architecture department does not feature a research lab dedicated to specific expertise, but relevant information is accessible under the research subheadings. Nine active interdisciplinary research groups operate within the department.

ETH Zurich's research strategy diverges somewhat from other institutions. Similar to UCL's researcher-centered structure, ETH Zurich's research webpage emphasizes technological infrastructure and research protocols. Among the listed facilities are three interdisciplinary laboratories and eight units affiliated

institution	MIT	MIT	MIT	MIT	MIT	MIT	MIT	MIT	MIT	MIT	MIT
name of the lab	**Architecture (Un)certainty Lab**	**Design Intelligence Lab**	**Digital Structures**	**Future Heritage Lab**	**Future Urban Collectives**	**Leventhal Center for Advanced Urbanism**	**P-REX: The Project for Reclamation Excellence**	**Self-Assembly Lab**	**Sustainable Design Lab**	**Urban Risk Lab**	**Virtual Design**
aims / motto	Against the (lately) problem solving nature of architecture	Need for human-machine interaction	New structure technologies	Historical preservation	Creating active-digital-participatory citizen model	Urban pianing advance	Design a sustainable environment	Inventing self-assembly and programmable material technologies	Evaluate the environmental performance of buildings and neighborhoods	Hub of design research and climate action	Conduct cutting edge research on emerging digital technologies
keywors	speculative practice	human-machine collaboration	digital structure	preserve	sharing (economies) and collaboration	digital urbanism	landscape	self-assembling systems	develop	community resilience	immersive technology
	speculative pedagogy	interaction	fabrication	cultural artefacts	digital collectives	equitable resilience	sustainable	(new) structure-material	validating	climate change	AR/AI
		digital fabrication	BIM, CAD	participatory process	urban	cities initiatives	environment intelligent	interaction	testing		machine learning

institution	MIT-Research Areas	MIT-Research Areas	MIT-Research Areas	MIT-Research Areas	MIT-Research Areas	MIT-Research Areas
name of the lab	**Aerogel Insulation**	**Composite Architectures**	**Digital Design and Fabrication**	**Platform for a Permanent Modernity**	**Shape Grammars**	**The West Philadelphia Landscape Project**
aims / motto	Developing high-performance thermal insulation panels	Highly automated and lightweight base-building methodology	Application of digital fabrication	Collective organization for architecture, urbanism and systems	Shape representation at the theoretical level	Restore nature and rebuild community
keywors	aerogel	composite material	CAD/CAM Models	productive use of space		top-down (comprehensive)
	thermal insulation	automation	rapid prototyping	sustainable		bottom-up (grassroots)
		digital fabrication	design automation			

Figure 2: MIT Architecture Faculty and MIT Research Department Laboratories in detail. Source: Author, 2024.

with the architecture department's academic programs. However, a unified page listing these units does not exist. The eight listed units are those with publicly accessible activities.

Harvard University features over fifty laboratories, reflecting its larger academic population. Laboratories and research centers are categorized separately on the Graduate School of Design (GSD) Research website. Based on this classification, the Architecture Department at Harvard University has thirteen active research units. These transcriptions have the potential to offer comparisons between the research infrastructure at various universities and highlight the relationship between architecture departments and their research labs.

Comparing Laboratories

From the institutions listed, the Massachusetts Institute of Technology (MIT) defines its research units as focused on establishing new theoretical and applied research platforms, engaging in speculative research, integrating scientific advancements, developing novel systems, exploring new natures, and fostering collaborations between existing and emerging agents (Figure 2). They also emphasize programming matter and creating self-assembly systems as key areas of investigation. The use of speculative methods and immersive technologies in research projects further supports these objectives.

At TU Delft, the laboratories prioritize experimenting, testing, and prototyping design and materials, focusing on technology application, material scale performance, and human-robot interaction. Additionally, these labs are promoted as spaces where students and researchers can experience cutting-edge technologies firsthand. The objectives of the labs are closely tied to the technical equipment and infrastructure they offer (Figure 3).

At UCL, the research focuses on the relationship between technology and humans, as well as collaboration between agents through interaction and performance. A defining feature of UCL's research is its commitment to creating an interdisciplinary environment. Unlike institutionalized laboratories, research groups at UCL consider the environments their projects create as laboratories in themselves (Figure 6). Their work spans areas such as improving quality of life, reducing carbon and energy consumption, and addressing diverse cultural balances**.**

Similarly, ETH Zurich supports interdisciplinary, cross-disciplinary, and transdisciplinary research that advances the integration of digital technologies within architectural practice. Their laboratories focus on digital fabrication, carbon reduction, decentralized digital systems, and on-site robotic construction (Figure 4). They also investigate the potential for a new aesthetic through the reorganization of matter via digital systems, exploring additive manufacturing strategies, and the application of information technologies and AI to the future of architecture.

At Harvard, research is characterized by a forward-looking, speculative, and imaginative approach. Beyond technical issues, the labs tackle socio-ecological problems, focusing on questions of justice and injustice in spatial environments and developing human-centered solutions (Figure 5). They also explore modeling new forms of cultural communication and design knowledge systems that facilitate interactions between agents.

Across these universities, as derived from their

institution	TUDelft	TUDelft	TUDelft	TUDelft	TUDelft	TUDelft	TUDelft	TUDelft	TUDelft	TUDelft
name of the lab	**Sense LAB**	**Chair Collection**	**Model Hall**	**The LIGHTVAN**	**Bucky LAB**	**The Product Development Test Lab**	**VR Lab**	**Laboratory for Additive Manufacturing in Architecture**	**Robotic Building Lab**	**Heritage & Technology Laboratory**
aims / motto	Testing buildings, designing healthy and confortable buildings	Design chair collection	Model making facility	Mobile daylight research	Building construction related prototypes	Test product innovations	Collaborate and explore the endless possibilities of VR technology	Additive manufacturing applications	Robotic production and operation	Conservation of historic buildings
keywors	IEQ factors	archive	workshop	sun/artificial light	CAD/Cam modeling	digital construction	VR	manifacturing	human-computer -robot interactions	conservation
	experience-test rooms	chair	camlab	energy	structural analysis	circular economy	comp. design	sustainable materials	cyber-physical systems	testing inorganic materials
		models			prototype	energy saving		3d printer/robotic arm	internet of things and people	

Figure 3: TU Delft Architecture Faculty laboratories in Detail. Source: Author, 2024.

institution	ETH (Research)	ETH (Research)	ETH (Research)	ETH	ETH (ITA)	ETH (ITA)	ETH (ITA)	ETH (ITA)	ETH (ITA)	ETH (ITA)	ETH (ITA)
name of the lab	**Future Cities Laboratory (FCL)**	**NCCR Digital Fabrication**	**ETH Wohnforum ETH CASE**	**Arch_Tec_Lab (ITA)**	**Architecture and Digital Fabrication (GramazioKohler)**	**Architecture and Structures (BRG)**	**Digital Building Technologies**	**Digital Architectonics**	**Construction Heritage and Preservation**	**Architecture and Building Systems**	**Structural Design**
aims / motto	Sustainable cities and settlement systems through science, by design, in place	Development and integration of digital technologies with architecture	Interrelationship between people, society and the built environment in housing	Digitization and zero-emmision architecture	Changing conditions in production on architecture	Develop new algorithms and accessible tools for structurally informed design	Seamless integration of computational design methods	Understand digital challenges and realm	Questions of buildings value as monuments and challenges concerning their conservation	Active and passive systems for the energy supply and climate control of building	Ideas, concepts, and utopias for a new generation of load-bearing structures
keywors	future of the cities	digital fabrication	socio-spatial approach	robotics in architecture	digital and robotic fabrication	geometry-based approach	additive manufacturing	IT experts, biologists, and philosophers	methodical collecting	CO2-neutral built environment	structure
	designing liveable systems	interdisiplinerl/crossdisiplin er production	trans- and interdisciplinary approach	compartmentalised and decentralised systems	large-scale application in architecture	computational form finding	material-geometry related productions	digital architectonics	assessing and preserving	climate control	future of building and materials
	science focus	effective labor force	governence	long-term value	material assemblations	less wasteful-sustainable	robot-3d print	AI-information	future development		

Figure 4: ETH Architectural Research and ITA Departments Laboratories in Detail. Source: Author, 2024.

institution	GSD (Design Labs)	GSD (Design Labs)	GSD (Design Labs)	GSD (Design Labs)	GSD (Design Labs)	GSD (Design Labs)	GSD (Design Labs)	GSD (Design Labs)	GSD (Design Labs)	GSD (Research Program)
name of the lab	**Laboratory for Design Technologies (LDT)**	**Computational Geometry Lab**	**Critical Landscapes Design Lab**	**Healthy Places Design Lab**	**The Just City Lab**	**Material Processes and Systems Group**	**Responsive Environments & Artifacts Lab**	**metaLAB (collaborates)**	**Laboratory for Design Technologies (LDT)**	**Zofnass Program for Sustainable Infrastructure**
aims / motto	Develop prototypes for a more resilient, responsive and productive future	Intersection of design and the science of shape and form	Ecological issues across the postcolonial and Islamic worlds	Created and synthesized the evidence base linking landscape, urban design...	Design and planning contribute to conditions of justice and injustice	Advances the aesthetic and functional agenda of materials in the built environment	Pursues the design of digital, virtual, and physical worlds as an indivisible whole	Modeling new forms of cultural communication, creative and critical practice	Leverage design research to understand the architecture	Develop and promote methods, processes, and tools
keywors	sensing, adaptive and smart material systems	computational tools	social inequality	healty environment	equality-equity value	novel materials	information infrastructures	creative and critical practice	collective platform	sustainable project planning and design
	robotics and additive manufacturing	scalable architecture solutions	political ecology	cross-disiplıner colobration	just city	robotic & CNC design	mediated matter	idea foundry	speculative, and imaginative research	sustainability of infrastructure
	computational design and modeling		climate change	public health		adaptive living environments	augmented interfaces	knowledge design	improving the human condition	

Figure 5: Harvard GSD Laboratories in Detail. Source: Author, 2024.

institution	UCL	UCL	UCL	UCL	UCL	UCL	UCL	UCL	UCL
name of the lab	**The Interactive Architecture Lab**	**(Research) Interdisciplinary Design Practice**	**(Research) Sustainable Urbanism and Landscape**	**(Research) Building for Wellbeing**	**(Research) Computation and Craft Technologies**	**(Research) Histories and Theories of Architecture**	**Material Architecture Lab**	**Space Syntax Laboratory**	**Person Environment Activity Research Laboratory**
aims / motto	Build and test new spaces of performance & interaction	Collaboration as a strategic aim for creating new spaces	Strategic aim of carbon and energy reduction	Quality of life and architecture	Integrating craft, computational design, digital fabrication and robotics	Creating multidimensional debate and mutual understanding between cultures	Transform the everyday and the ordinary with new material set-ups	Understanding of the relationship between spatial design and the use of space	To explore the how people interact with environment
keywors	networked and responsive technologies	collabration	sanitaiton	neurosscience, anthropology, health, art,	digital craftmen	multidimensional debate	material	social, organisational and economic performance	testing the env.
	behaviour and Interaction of Things	intrdisiplıner practice	food resources	wellbeing	transformative technology	mutual understanding between cultures	collabrative research	VR-AR-machine learning	colour, lighting, sound
	performance & interaction		colonialism and postcolonialism		contextualises digital approaches		experimentation	syntax	

Figure 6: ETH Laboratories in Detail. Source: Author, 2024.

institutional objectives, there is a consensus that laboratory practices focus on addressing technology and new technological environments while adapting to material and cultural changes. The emphasis is on investigating emerging fields of collaboration and the need for pioneering approaches. However, it is important to note that the themes explored vary, ranging from technological to creative concerns, from material to immaterial, from autonomous architecture to practice that creates distinctions, and from the objective to the subjective.

A closer examination of the research frameworks in these universities' architecture departments reveals their positioning within the architectural discourse and their engagement with the material conditions of practice (Figure 7). However, while research outcomes are influenced by funding providers and sponsors—often hidden but significant factors—these laboratories operate within a broader context of institutional expectations, national research incentives, and educational strategies. When viewed as a collective through the lens of fifty-seven laboratories, several common orientations emerge (1) research that fosters speculative architecture focusing on new relationships between agents, (2) the application and adaptation of new technologies in architectural practice, and (3) the promotion of interdisciplinary methodologies that accommodate new agents.

EXPANDING THE FIELD: RESEARCH AND LABS

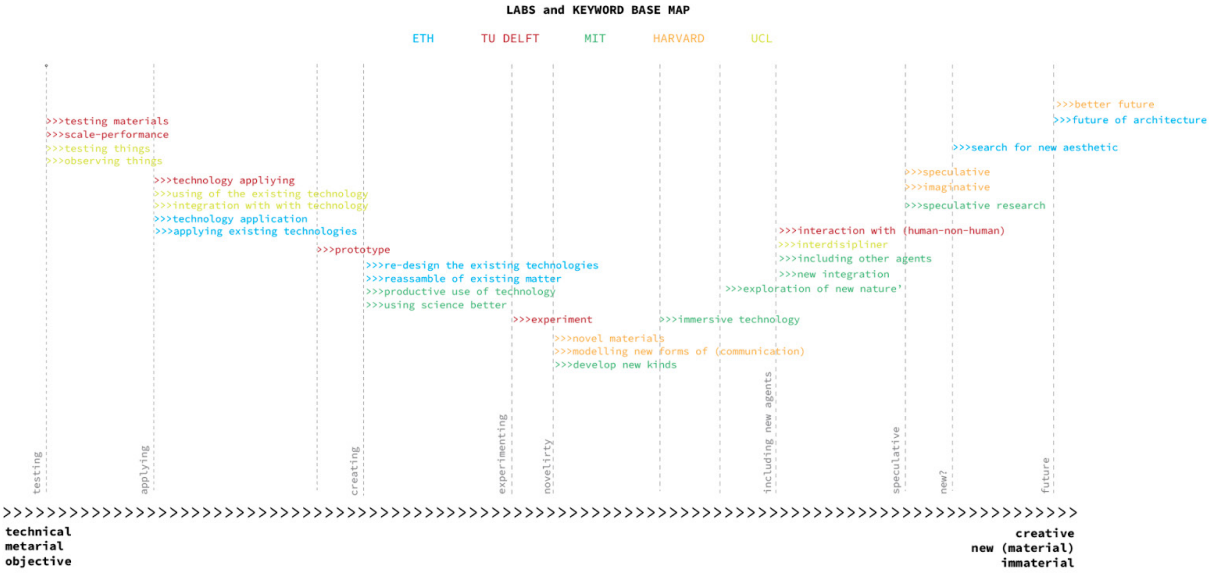

Figure 7: Labs and Aim of the Labs on a Spectrum. Source: Author, 2024.

The expectations of the laboratories oscillate between a wide range of objectives, from socially and technologically driven problem-solving for today and the future to speculative research. In this context, the laboratory emerges as a common response to architecture's diverse motivations for exploring new areas within research frameworks. Architects and architectural practice must inevitably develop new approaches to technology and materiality for today's conditions. However, can architecture as a discipline, in this framework, make decisions independent of utility-driven solutions and respond to central problems purely as intellectual endeavors? In other words, is it possible to generate a practice independent of the laboratory's intrinsic discussions, mediated by the laboratory itself?

Skylar Tibbits, founder and director of the Self-Assembly Lab at MIT, draws attention to the impact of state and government-affiliated institutional support on research and the existence of laboratories in his book Self-Assembly Lab: Experiments in Programming Matter. Tibbits seeks to clarify the relationships between architectural practice and the chain of activities involved in conducting research, being scientific, and producing objective knowledge. For Tibbits, laboratory research is divided into "basic research" and "applied research." He defines "basic research" as state-funded, isolated inquiry (Tibbits 2017). He explains the fundamental discoveries and physical productions he conducts in his own laboratory through specific examples and addresses "applied research" as a method of experimentation in architecture.

For Tibbits, one of the most pressing issues of our time is the possibility of research that transcends disciplinary boundaries. At the same time, he emphasizes the importance of experimental research and cross-disciplinary communication for the architecture and design sectors. However, Tibbits does not fully explain what architecture as a field is or why he wishes to conduct this research under the name of a laboratory. The ultimate aim of his research is to reveal the potential benefits of design thinking for the industry and to propose an architecture that can contribute to this sector.

While discourses supporting utility and industrial production in practice may seem familiar, earlier examples of addressing these issues within the framework of the academy, and referring to such spaces (laboratories) can be identified. Gropius, relocating from Europe to America, made a similar reference when he described the Bauhaus educational system as a laboratory (Gropius 1965). He aimed to align the logic of industrial production with the needs of high-quality architecture (Staub and Geiser 2008). Gropius referred to laboratories to introduce their practice based on standardization in Bauhaus, while Buckminster Fuller guides biotechnology in his laboratory practice and creates "experimental and accurate" forms with universally adopted geometry and shapes. The laboratory serves as a convergence point for education, scientific inquiry, and architectural practice, enriching the concept of mass production. Architecture, standardized and idealized, finds the possibility of widespread dissemination through specific materials. In these examples, the laboratory operates as a user and consumer of scientific knowledge. Scientific codes and connections are accepted, and the formation of architecture builds based on these assumptions.

Walter Gropius named the first year of the studio in the Bauhaus as Basic Design. Gropius meticulously explained the educational and creative process through a circular diagram: from the outermost circle inward, the steps are the study of form, study of nature, study of materials and tools, materials (wood, metal, stone, clay, glass, color, textile), and finally, at the center, the act of construction. This diagram facilitates both the educational process and the practical methodology. The architectural practice, as outlined, sequentially produces form, selects tools, and ultimately employs materials.

However, in today's cycle of scientific research and utility, establishing the type of causality described above and defining it solely in terms of industrial benefit seems somewhat naïve. A recurring critique emerges: Is architecture merely an executor or selector of existing technologies and materials? When we look in detail at the work of the Architecture (Un)Certainty Lab at MIT, founded by Mark Jarzombek and Vikramaditya Prakash, next to Skylar Tibbits' lab, we encounter a different paradigm. While these labs are housed within the same institution and subject to similar dynamics, their approaches diverge significantly. Jarzombek and Prakash, in their lab, question the current stance of research in architecture, as well as where architectural research should stand today (Jarzombek and Prakash 2020).

On their website, where they outline their practice through seventy-six statements, they propose that the architectural theorist should occupy an anti-teleological position. Their final statement highlights a narcissistic relationship between reducing inputs and solving problems in architecture. Instead, they argue for radically increasing the input, rendering the situation more complex. Here, multiplicity implies new disciplines and new challenges. Through research, practice transforms the scope and texture of the pool from which it draws its questions, redefining itself as a field with an expanded dataset. Rather than a form of applied architecture, what emerges is a new space positioned on the right-hand side of the chart (Figure 7)—one that, instead of simply utilizing technology, blends new possibilities across disciplines to open pathways for novel formations.

In recent years, numerous academic initiatives have expanded the scope of research and methods within this framework. In LabStudio: Design Research Between Architecture and Biology, Sabin, and Jones describe this emerging field in architectural practice as a laboratory seeking to establish not only a new domain but also new processes, perspectives, and pedagogical models. Architects and scientists, they argue, do not merely collaborate within a shared space (laboratory or studio) but engage as equals in research projects. Crucially, they aim to create a hybrid space where knowledge is exchanged across and between disciplines, benefiting not only the new field but also the architects and scientists involved.

Similarly, Francois Roche, founder of the architectural group R&Sie, describes the architectural practice in the introduction to Log 25 as a place where science and architecture evolve into the unknown by utilizing the tools and apparatuses of the laboratory (Roche 2012). Roche's laboratory is non-hierarchical and non-deterministic, charting a path where architectural protocols merge bottom-up and top-down, contingently and simultaneously, as though ingredients were shaping recipes and those recipes were altering the nature of the ingredients. These spaces coordinate apparatuses of exchange, transforming the game of power and the knowledge disseminated through that game. Moreover, new research increasingly tends toward creating a type of panorama that is reactive, complex, dynamic, and alive—formed with technological and environmental elements.

SHAPING THE NEW FIELD

The above cards and links convincingly demonstrate how laboratories have been integrated into architecture under the banner of research. In architecture, as in the natural sciences, collaboration across disciplines and sectors is encouraged within laboratory spaces. To fully understand the role of 'labs,' we must examine the relationship between research and architecture, how research emerges in the architectural domain, and the underlying reasons driving the need for such research. Architecture, traditionally practiced in studios and workshops, has been called into the realm of the laboratory through the lens of research. In the twenty-first century, research has revived the act of making within architectural theory and practice, fostering direct interaction between agents while distancing itself from historical and self-referential frameworks. It also embodies the reunification of long-standing dichotomies such as theory-practice and education-practice, which have oscillated throughout the history of architecture. As suggested by the list above, academia and practice are engaging in a dynamic exchange through the lens of research. This new and energetic domain—hovering between the natural and social sciences and manifesting as a continuation or alternative to the studio or workshop—embodies itself as the laboratory.

While research has always been part of architecture, the rise of laboratories has catalyzed the emergence of a new, timeless space in contemporary architecture—one that forges

connections between diverse agents. The 'laboratory' approach to research represents a natural departure from the historical-theoretical contextualization of architecture and a response to the top-down principles and policies of institutions and universities that shape educational models (Ockman 2001). Scientific and social inquiries are applied through practice-centered environments like studios, workshops, and laboratories, with the latter as a fluid interface between research and education (Staub and Geiser 2008).

Despite the critiques of objectivity and experimentalism by philosophers of science and new materialist critics, architecture—constantly oscillating between art and science—remains insistent on positioning itself within this experimental domain. However, architectural practice is impervious to criticisms leveled at the natural sciences concerning the production of data. At its core, architecture is interdisciplinary and operates through a hybrid mode of making that cannot be fully explained by epistemological or teleological reasons alone. Nonetheless, it remains directly linked to science, particularly concerning the teleological and vitalist discussions that emerge from the nature-matter relationship. Throughout history, architecture has consistently sought to address these issues in theory and practice.

In the laboratory environment, architecture allows us to forge a new relationship with matter, aligning with the principles of new materialism. It can implement technologies of mass production, conduct controlled experiments to avoid errors at a 1:1 scale in a world with rapidly depleting resources and generate prototypes. Although laboratories are often isolated spaces, they can test possibilities through digital models and diverse techniques of making, using vast datasets to account for complex variables. Any architectural production can be idealized, with the potential to replicate its outcomes under different conditions. In this context, the term 'laboratory' raises the fundamental question: Is architectural research expected to generate objective reality, producing consistent results under all circumstances?

The second question pertains to the position of the architectural laboratory within the framework of research, particularly its role between theory and practice. How can we conceive of a new mode of practice that responds to large data flows and anticipates non-replicable labor forces?

The role of laboratories and research in architecture is more complex than simply likening them to studios, offices, or kitchens—common metaphors for spaces of architectural action. It is crucial to recognize that the architect, who has transformed into a curator or researcher (Ockman 2017), must navigate an innovative and technologically advanced landscape funded by major investors while engaging with urban stakeholders in decision-making processes. Meanwhile, the laboratory's operational diversity makes it a mythical space that becomes the hidden object of the academic-practical partnership. We are surrounded by an atmosphere shaped by new forms of data (digital) that simultaneously drive practice. In this sense, the laboratory acts like a rubber band, holding together the collective need for ongoing research.

CONCLUSION

In the twenty-first century, architects, artists, and scientists have become aware that instead of copying existing forms and designs, they have the potential to create new singularities. Alternative, theory-resistant attitudes have paved the way for discovering new forms of connection through practice and craft-based knowledge. The power of experimentation in fields like architecture and art has merged with the rich environment of scientific knowledge. Additionally, the increasing use of digital technologies and media has sparked the need for transformation. Theories from Bruno Latour's Actor-Network Theory and Graham Harman's Object-Oriented Ontology, which recognize existing connections and explore the possibilities of adding or expanding them, have become critical references for new practices (Harman 2018). Object-Oriented Ontology, which completely rejects forms of connection that interpret objects solely through human experience—like correlationism—highlights the significance of intermediary forms like proto-objects, epistemological things, which are soft and open rather than serving a final function, as emphasized by thinkers like Bruno Latour and Michel Serres.

These theorists argue that the feedback loop between our relationships and objects is never-ending, as newly created social relationships generate new objects in each cycle. For Bernard Stiegler this is a type of externalization, in which humans connect to their environment through apparatuses and transform the inorganic or lifeless into an organized substance (Stiegler 1998). On the other hand, Michel Serres, focuses on creating temporal elements on the stage of life today, self-contained, rotating with their own logical consistency, and incomplete, calling them "active subjects" (Serres 2006).

While these theories help to establish connections in social sciences, responding to the more complex relationships in fields like art and architecture are challenging. In particular, architecture, material, and construction properties are inseparable. This raises a significant question of how materials are physically handled, organized, and incorporated into architecture through new modes of production. The data and the new networks between agents established by the laboratory have the potential to accomplish this. On the other

hand, the climate crisis, which has disrupted material cycles, requires new forms of action in architectural practice. It becomes unavoidable to rethink the relationships between matter, human, and nonhuman. As Karen Barad's concept of the "agential cut" suggests, it is crucial to have a critical look at modern conditions that have solidified the sharp divide between the living and nonliving, exacerbating their separation (Tuin and Dolphijn 2012).

The laboratories discussed above demonstrate how the research motivations of such spaces have the potential to respond to new and speculative practices. This type of practice distances itself from criticisms specific to laboratory environments, becoming aware of contemporary architectural issues, positioning itself uniquely in response to these challenges, and, in doing so, establishing a space that generates its own distinct singularity.

The sequence of singular actions described by Stiegler can be likened to the chain reaction created in Peter Fischli and David Weiss' work The Way Things Go (URL-1). The architect, as a connector, must transform these actions into a careful yet chaotic sequence of events—without seeking total control—thus creating a practice where neither the architect nor the material objects are masters of the process. The potential lies in the open-ended nature of the processes, much like the power of an open-ended world map. Rather than an epistemologically rigid and self-repeating research process, architectural practice should be conceived as a system that engages with the physical and chemical processes of materials, encouraging interactions that are not fully autonomous but are not dominated by solely human needs.

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URL-1 Solomon R. Guggenheim Museum, “Peter Fischli and David Weiss’ Work The Way. Things Go,” accessed December 23, 2024, https://www.guggenheim.org/artwork/32552.