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Membranes and Matrices: Architecture as an Interface

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MEMBRANES AND MATRICES:
ARCHITECTURE AS AN INTERFACE

A Thesis Presented

By

NAYEF MUDAWAR

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ABSTRACT

MEMBRANES & MATRICES: ARCHITECTURE AS AN INTERFACE

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What are the implications of digitalization on the role of architecture and our understanding of space? The digital experience is one that is highly customizable, responsive, and interactive. Physical buildings strive to become more connected to their environments and their users, by incorporating these same qualities. Traditional building methods and design principles produce static structures with a defined function and program, an approach which is in conflict with virtual space where functions which once were separated now easily flow and merge into one another. Buildings have the potential to become even more situated within their local by incorporating ideas of interactivity and responsiveness as they become uniquely shaped by their users and local climates. Digitalization therefore has ironically brought the design industries closer to the fields of biology and chemistry as information is seen to be at the core of everything. My proposal is for a public innovation space situated in the new innovation district in downtown Springfield, and will explore issues of privacy, openness, materiality, transparency, and the integration of technology with architecture such that the space itself becomes an interface for exchange.

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CHAPTER 1

ARCHITECTURE IN THE DIGITAL AGE

Physical Space vs. Cyber Space

The fixity of the built-environment and the disembodied virtual existence of the internet present us with two contradictory visions of the world. While architecture has traditionally offered a mostly rigid, pre-programmed experience of space, the internet offers an existence which is seemingly detached from the physical and is highly multi-functional and customizable. While architecture builds physical boundaries and segregates spaces, cyberspace consistently blurs more boundaries and merges spaces. Is architecture losing the battle with virtualization, or are these new technologies introducing a paradigm shift in how spaces can organize our lives? This chapter looks at how Architecture is undergoing a fundamental shift as buildings adapt to their new roles in the hyper-connected world of the digital age. The internet has defined space as the nodal point connecting disparate sources of information, where movement constitutes connections or “links” between various nodes. Can architecture adapt its established language to embrace these new definitions? How can architecture maintain its connection to the physical while engaging with the information flows of the virtual?

Dystopia or Utopia?

Those who embrace a complete shift towards virtualization, take an idealistic view of the kind of society it could produce; a kind of "global village" (Horrocks 2001, 45) as envisioned by Marshal McLuhan that transcends geographic boundaries, where all parts are integrated and equally represented. McLuhan saw digital media as an extension of one's sensory apparatus, enabling its users to experience a heightened sense reality because of its fully immersive nature. He saw such a reality as ultimately blurring the lines between what is real and what is virtual, allowing communication to become transparent, direct, full, and immediate. Technology would then allow humans to transcend the constructed barriers of the physical world, which only segregate and differentiate us from one another (Horrocks 2001, 48). Virtualization, according to McLuhan, becomes the final step in a three part narrative of human evolution beginning with initial unity in the primitive oral cultures, followed by fragmentation with the emergence of writing and print, and finally reunification through electronic media; a return to a state of collective tribal consciousness (Horrocks 2001, 47).

Weibel's Essay *Architecture: From Location to Non-location, From Presence to Absence* identifies emerging commonalities in the realms of architecture and virtual space, among those are the ideas of non-location,

dislocation, de-materialization, and simultaneity. Weibel sees the traditional role of architecture as focused on place-making and ordering. Building programs are intended to contain and place objects, functions, and people. The digital revolution however is undermining the view that everything must have its place in the world by showing that a change in location does not necessarily involve the movement of the physical body. The experience of navigating through cyberspace introduces the concept of moving space with bodies rather than the customary movement of bodies through space.

According to Weibel, the postindustrial age, with the advent of the internet and information technology, has unleashed a revolution in the understanding of spatial experience. This is because digital media has disembodied the sign from the object. Navigating the web thus becomes a movement through signs, which divorces the user from his/her physical body. Weibel sees non-location as a metaphor for this sign-focused spatial experience as opposed to one that is centered on the machine or the body as in previous eras. This new understanding completely undermines the traditional definition of architecture "*which has been defined as a spatial art and has always been tied to the body-oriented spatial experience*" (Weibel 2005, 267). Weibel believes that architecture's new role is to engage this new condition of bodiless traveling signs rather than resist it. He points out to the new trends in contemporary architecture which heavily incorporate elements

of dematerialized, disembodied spaces of varying degrees of transparency. Digital media causes the individual to experience himself in a multitude of places all at once, the individual is “decentralized and eccentric”, Weibel sees this eccentricity as manifest in the blurring of boundaries between interior and exterior, allowing for a rapid movement in and out of virtual space, and consequently in and out of one's physical body. Reality becomes a mixed experience of the virtual and physical unbound by time and space (Weibel 2005, 270).

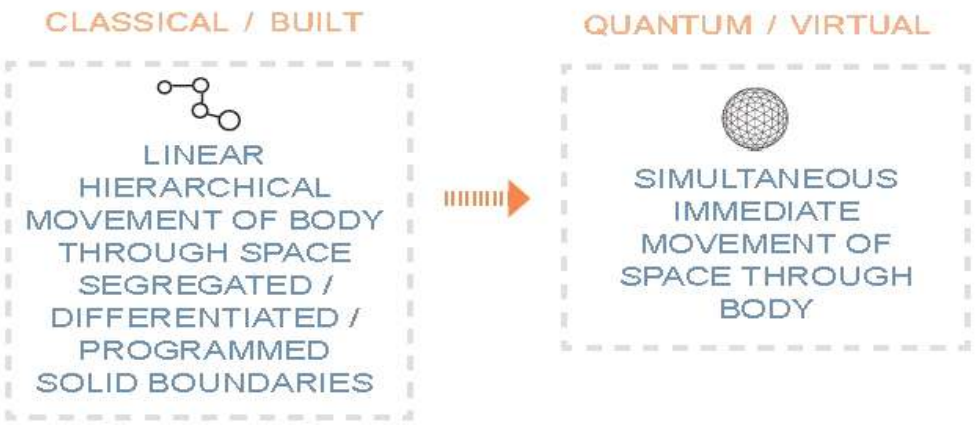


Figure 1. A comparison of the built, or physical, with the virtual (by author)

Others take a defensive attitude towards virtualization, viewing it as a threat to physical reality and the built environment. The global network is regarded as having creating a condition of heightened conflict and dis-unity due to the unregulated clashing of opposing views and ideologies it allows.

The lack of privacy and ease of exposure to unseen actors with immediate access to personal data add to the sense of disempowerment and loss of control. Virtual reality is seen as unethical with respect to personal representation; identities are easily constructed and deconstructed, completely separating the "true" individual from his / her false external image. Nothing can therefore be verified in cyberspace, everything must be taken at face value. This inability to distinguish between the real and the virtual produces a superficial culture that is addicted to the image. Urban life is at risk of being superseded by cyberspace leaving behind neglected, blight-ridden city centers which were once vibrant theaters of true social exchange (Chaplain 1995, 410). At the base of this is a fear of the loss of local community, identity, and interdependence between individuals as everything merges together in an undifferentiated global network. The dissolution of boundaries through cyberspace is seen as a threat as it brings with it the dissolution of local cultures and belief systems, replacing them with a consumption-based, globally homogenized virtual existence (McLuhan 2001, 45).

Figure 2. The digital future: a dystopia or a utopia? (By author)

From Duality to Unity

The problem with both of these views is that they regard the relationship between the virtual and the physical as a binary one; neither tries to envision a world that can accommodate both simultaneously. Sassen in her essay *Scale and Span in a Global Digital World* argues that the rise of digitalization has occurred inextricably along with a rise in urbanization, leading to a world with significantly larger concentrations of population and wealth in cities. We see the emergence of an extremely mobile "transnational professional class" while immigration is at an all-time-high (Sassen 2010, 184). These phenomena undermine the argument that digitalization has led to the removal of all time- space barriers, making locality obsolete. If this were the

case we would find that the need for travel and immigration has significantly diminished as all interaction would be taking place online, the growth of major cities would slow down as location becomes irrelevant. Sassen points out that this is not the case because an immense physical framework is a precondition for virtualization. Products need to be developed, manufactured and transported using factories, infrastructure, human power and ingenuity. These all require an extensive physical structure that can gather the varied components to make it all happen. To say that digital technology will allow life to become divorced of the physical is therefore an unrealistic view. She cites the example of financial markets which have become almost completely digitized and yet Wall Street remains as central to this activity as ever. Similarly with real-estate markets; although the internet has greatly facilitated trade, the market is still based on physical places whose values are determined by the desirability of the location: "*It takes capital fixity to produce capital mobility*" (Sassen 2010, 180 - 183).

Sassen argues that the view of the virtual and physical realms as two separate entities is a flawed one. We are not facing an either-or scenario where our lives are either purely focused in the physical or purely in the virtual, but it is rather a complex intertwining of both where one condition gives rise to, and enables, the other. Therefore, Sassen sees the city and the building as becoming increasingly the sites where the virtual and the physical are

encountered simultaneously, where the physical acts as the supporting infrastructure for the virtual (Sassen 2010, 184). The building therefore becomes the interface between the user and the various types of media available through the digital realm. This intertwining of the physical and the virtual brings up the possibility of creating hybrid environments which cannot be classified as one or the other. Architecture becomes the interface through which the two domains can seamlessly merge together allowing people to interact directly with the information flows of the web (Bouman 2005, 261).

CHAPTER 2

ARCHITECTURE AS AN INTERFACE

Architecture as an Open Platform

The built environment is becoming the interface between the physical world with its flows of bodies and products, and the digital world with its flows of information. This concept is the focus of Flachbart's book *Disappearing Architecture: From Real to Virtual to Quantum*, where architects, designers, programmers, artists, etc. are imagining ways in which the building becomes the interface, or an "an open platform" for the heightened sensory experiences offered in the digital realm. This new type of building must be highly interactive and responsive to both its users and its environment. It cannot have its program dictated by an architect and solidified within fixed boundaries. This new architecture must enable the nomadic existence of cyberspace which Hagan describes in her essay. This type of existence cannot be bound and directed by a solid framework. Rigid definitions of how a building or a city is experienced become a striking contrast to the highly individualized experience of online reality (Flachbart 2005, 10-17).

Hagan references the New Babylon project, a proposal by Constant Nieuwenhuys, as a type of building which reflects the experience of virtual reality. This is a structure which can grow and contract indefinitely. It does not

have a predetermined form, concept, or program. It can be changed by anyone who comes into contact with it and choses to modify it. It also exists within the physical structure of a city and thus intersects with and interrupts its established flows. These types of interactive installations test the concepts of non-hierarchical, individualized architecture which does not really have any predetermined design. They are the beginnings of what Flachbart refers to as "architecture as a running process" where the building is no longer a static form forcing a singular experience on its users, but is instead a state of constant becoming, responding to inputs from its users and environment and morphing in accordance.

Figure 3. New Babylon (Constant Nieuwenhuys)

Architecture as an Undefined Container

Bouman in his essay *Building Terminal for an Architecture without Objectness* sees the potential for architecture to expand by conquering new fields of activity in

the digital era. He sees the future role of architecture as the point of merging between the virtual and the physical realms, and considers hybrid environments to be the next step in achieving this state (Bouman 2005, 262). Such spaces are not definable and cannot be categorized into a single program type, but are flexible and can accommodate a wide array of activities simultaneously:

> "The crossroads which architecture finds itself sees it moving away from its traditional spatial language to embrace the new visually-based world that is no longer bound by the enclosing box. Architecture can now become more theatrical and immersive as it engages new technologies of media display and interactivity to truly blur the line between the physical and the virtual world." (Bouman 2005, 263)

We can see such types of spaces taking shape today where much of the activities that were formerly confined to specifically designated single-purpose office and school environments have moved out into public multipurpose spaces. Mitchell in his essay After the Revolution_ Instruments of Displacement calls such places "fusion spaces"; architectural spaces which have been enhanced using electronic instruments that enable people to interact and communicate in ways that were not previously possible. The seminar rooms at MIT fuse together two previously distinct activities: group discussion and web surfing. The students have their open laptops during lectures and group discussion during the discussion. This access to the internet heightens the amounts of information exchanged, and ideas encountered in class. By having access to the web the students take away some of the authority of the professor who no longer has the privilege of being the most knowledgeable one in the group. The professor becomes a mediator in a lively and productive exchange of ideas

(Mitchell 2005, 22). Research has shown that creating fusion spaces in student dormitories reduces isolation and increases opportunities for peer support. These spaces combine study and work areas to create lounges that are wirelessly connected while offering more secluded corners for quiet studies. Other such spaces can be found in today's cafe's, hotel rooms, high-speed trains, and airline-lounges which come equipped with the technology that support electronically based work, moving such activities from the realm of the office building with its cubicles into public spaces that support multiple activities:

> "The architect's role today is to conceive of creative fusion spaces that can accommodate multiple uses simultaneously that surprise and delight us through digitally enabled combinations of the unexpected." (Mitchell 2005,23)

The benefit of such spaces is that they reduce the overall footprint of a building by condensing its program, consequently decreasing the amount of energy and materials required for its construction. But what is the implication of this trend on the future of architecture? Technology is not only shaping our buildings by creating new types of spaces which cannot yet be categorized, but it is also reducing them by aggregating their programmatic components into singular blobs of undifferentiated space. Can such spaces illicit within us the same emotional response that the dramatic play of physical light, mass and void are capable of? It appears that technology is quickly taking away architecture's role in shaping our experience of reality, reducing it to that of a simple container. The big-box store, despised by architects and planners alike, is arguably the most relevant type of building today by functioning as a general container of people, goods, and media (Betsky 2005, 256).

Figure 4. Typical “big-box” store (public domain)

Architecture as a Nexus Point

What are the new potentials that immerge when the physical and the virtual worlds intertwine? Can the experience of physical space be augmented with the introduction of a new dimension to its articulation? In his essay *From Box to Intersection*, Betsky describes architecture's role as shifting to that of providing “moments of intensification” (Betsky 2005, 253) within the larger structures of a system. He does not only refer to existing systems of circulation, product, energy, and resources in a city, but is mainly referring to the system of

information flow which defines cyber space. Architecture then is to act as a node in such a system, becoming the space where the virtual and the physical systems intersect:

> "This does not mean that architecture is becoming superficial, but that it understands itself more and more as a cloak thrown over the unstable intersection of human beings, goods and information." (Bestky 2005,257)

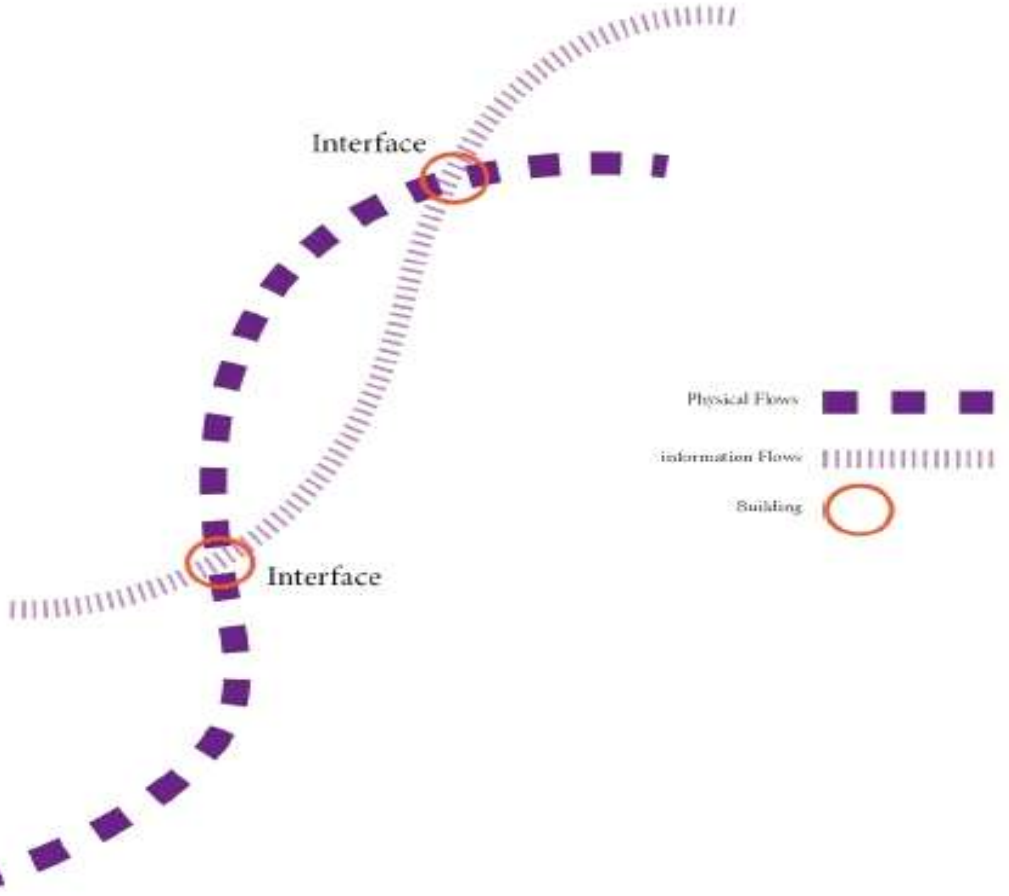


Figure 5. Interfaces (by author)

Betsky sees architecture's future role as the place which enables users to experience fleeting moments of coherence in a hopelessly fast-paced and transient digital world. He criticizes the current state of architecture as attempting to relate to existing urban systems by creating an interpretive collage that is frozen in a final form. He identifies this process as architecture's attempt at “realizing the network”, yet regards it as static since it cannot adapt to changes in these systems but is rather only a depiction of them. This leads to the type of architecture which produces “blobs” and “machined architecture” which are just as alienating as any traditional types of monuments since they do not relate in any way to the daily experience of their users (Betsky 2005, 255).

Instead, Betsky advocates a process of architectural design that is centered on the ordering and intensification of formerly disparate experiences into one location, where the building “*has no final realization, no final form, and no final image, but to let the building exist as the almost chance intersection of different programmatic elements on a site*” (Betsky 2005, 255).The building is what grounds the unstable information flows in place, making them accessible for the user by providing the physical framework that situates that which is non-local and in constant flux. The building becomes an interface; an advanced computer where the user’s

navigation through the flows of data becomes an immediate and fully immersive experience.

CHAPTER 3

THE NEW WORKSPACE

Collaborative Spaces

Protospace is the name of an ICT-Driven Collaborative design working space installed at the Delft University of Technology, Faculty of Architecture:

> "It is a space for research as a "multi- player" interactive design laboratory where rapid virtual prototyping is possible. It creates an environment that fosters group decisions and design. It is an educational space, a workshop which connects virtual with physical realities. It is a space that allows digital workshops, lectures with multimedia access, and communication between students and expert staff online and interactively. Commercially, it can be used for initiating pilot projects with building partners, cities, community members allowing for an open and participatory decision making process." (Oosterhuis 2005, 224)

Protospace allows the collaborative design experience to become much more direct and highly sensory. The curved screens immerse the users with the media by physically surrounding them. The space itself is embedded with an array of sensors including pressure sensors, infrared sensors, touch sensors, voice recognition, bitmap tracking, 3D wireless mouse, position pattern tracking input devices and others. These transmit multidimensional data from the users into the running programs of the space thus allowing it to respond and adapt

directly with them. Instead of navigating the web using a mouse and keypad while looking at a computer monitor, the user is freed to roam around and interact on a more direct level with the information and with other users. Each player constructs his own view of the world, a view is a specific way of representing or interpreting the data from the database. The building takes on the task of navigating the web, sorting through information, and transmitting the signals of other users.

The collaborative design process in Protospace is based on a parametric 3D model. This model is digitally shared and is editable by all involved participants. Because each player is able to respond to his/her neighbors and is connected to the whole via open-source data sharing there is both a local awareness of immediate conditions and a direct access to the overall state of the project. Oosterhuis in his essay on Protospace describes this as the state when the project "develops a self-conscious view of itself", transforming it into a "self- executing set of rules". It can be compared to a living organism constituted of individually specialized units in constant communication with each other; an entity that is "owned by itself":

> "In the end none of the stake-holders own the project (not even the client); the project is owned by itself, and has acquired certain rights to be, to be evolved, to be used, and to be torn down with respect." (Oosterhuis 2005, 231)

This emergent complexity is a result of a design process that is focused on creating connections for information flows between all components. Kolatan and McDonald in their essay *The Impact of Network Logic on Space and Meaning* describe this approach as the following:

> "While the former [standard] approach uses a reductive logic with regard to systems and their constituent elements, the latter [networked approach] recognizes that the emergent-adaptive behavior of complex systems is more than the sum of its parts, and thus has to be examined as a whole." (Kolatan ad Mac Donald 2005, 200)

If the same principle of imbedding information within networked components is applied to the components of the structure, the building itself can then behave as a living organism, capable of responding to the needs of its users, constantly changing as a result of external inputs or stimuli creating an architecture in a state of continuous reconfiguration, producing unpredictable complexity in real time.

The Public – Private Interface

A-World, a proposal for an urban multimedia center by Allianz Group, sees the notion of architecture as the interface developing when the contents of the building's interior spaces-the media spaces, events and activities- are communicated to the external urban context through its dynamic outer skin.

The media center is essentially a glass box with multiple floor plates suspended from its roof supporting galleries, entertainment units, and cafe/restaurants. In the core is a giant organic form that contains the interactive media exhibits and which intersects the floor plates of the building on all levels. Its translucent skin also acts as a projection screen, allowing the changing visuals of the displays to be broadcast to the outside world. The form itself expands and contracts changing its shape in response to the users' activities, reconfiguring the outer public spaces on the intersecting floor plates in the process. (Veech 2005, 183)

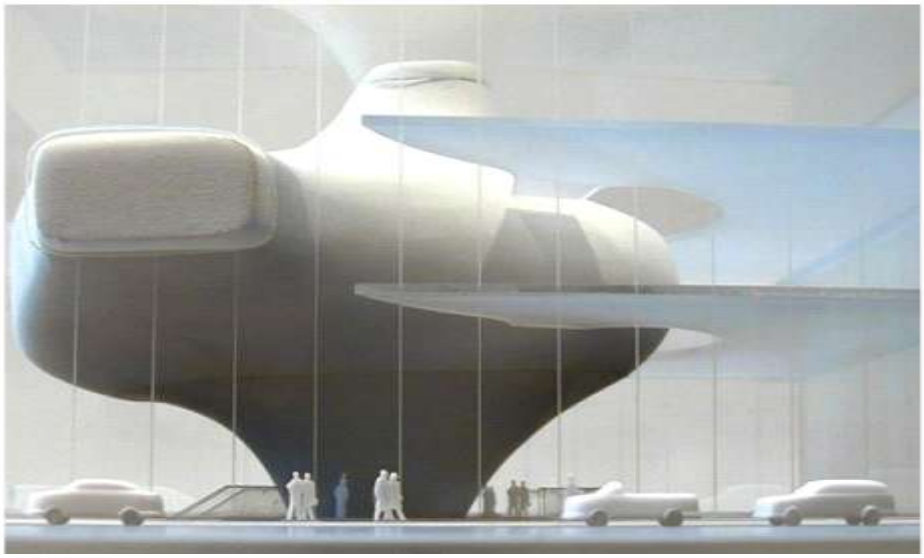


Figure 6. A –World (VMA Veech Multimedia Architects, Client: Allianz Group, 2002)

A-World demonstrates that the concept of architecture as an interface does not imply a loss in the spatial experience of a building. Rather than a simple open box, A-world represents the potential for form and space to be constantly re-shaped through the flow of

information within. The building connects with the virtual realm while remaining highly situated in its local physical context. Through its dynamic skin, it visually communicates internal activities to the outside, while physically reshaping the external public spaces surrounding it as it changes form. This exchange of information connects private and public on a more intimate level while still maintaining a degree of separation. A-world demonstrates that an interface can produce forms that are highly dynamic and interactive, introducing the concept of the user shaping the physical urban environment directly as they navigate the virtual realm. Such buildings have the potential to go beyond the traditional static forms we identify with architecture by having interactive components that can respond to their users more directly. The building truly becomes a running process, ever changing, never reaching a final form. (Veech 2005, 179)

New Spaces of Innovation

With The shift from a production based economy to the information economy, space no longer dictates work. A new wave of mobile workers have emerged which consider the office to be a state of mind. The office has been extricated from its traditional physical environment, and has morphed into an abstract network of players. The pervasiveness of digitalization has also

allowed for the work force to become significantly more mobile, workers are no longer confined to a desk inside a cubicle. Digital technologies have enabled new forms of collaboration and organization where the work is increasingly project based, virtual, and offers open access to all entities involved. Cities around the world are capitalizing on the economic potentials of these new spaces; entrepreneurial incubators, innovation labs, media labs, living labs, co-working communities, and hacker spaces are popping in cities all over the world. These spaces offer their users the benefits of working in an urban center with a significantly reduced cost of use since all the resources which these spaces offer are shared. These environments differ significantly from the traditional office in the way space is structured and used. This in turn created a new dynamic for the users by encouraging social interaction, changing the ways and methods that work is done, and creating a new work culture, which emphasizes exchange and sharing of resources and ideas. The following research is obtained from a report titled *New Spaces of Innovation: The Emerging Landscape of Workplaces in the (Omni) Presence of Technology* sponsored by Herman Miller Inc. in which these new workspaces are categorized, and their qualities further described:

Coworking Spaces are shared workspaces where collaboration happens through cohabitation and sharing of physical space and resources for

mutual benefit. Coworking is a self-directed, collaborative, and flexible work style that is based on mutual trust and the sharing of common core objectives and values between members (Forlano, 5).

Hackerspaces are community operated physical places, where people can meet and work on their projects. (Source: hackerspace.org) In other words, Hackerspaces can be viewed as open community labs incorporating elements of machine shops, workshops and / or studios where hackers can be viewed as open community labs incorporating elements of machine shops, workshops and/ or studios where hackers can come together to share resources and knowledge to build and make things (Forlano, 6).

Innovation Labs are centers of innovation within organizations symbolic of everything that is new and progressive that guide the future path of the organization. People from myriad disciplines inhabit and work towards a central cause that is specific to the organization. As spaces that support pioneering work practices within an organization, they organically grow to take different forms and perform varied roles (Forlano, 7).

Design Consultancies: Offer professional creative expertise to other organizations that seek innovative solutions. The nature of this space is often casual. Flexible, multi- disciplinary and fast paced. The work is project based and team oriented with little hierarchy and open communication. A design consultancy may have a specific area of expertise such as a product, or a communication and innovation strategy which it specializes in (Forlano, 7-8).

Office as a Concept

These emerging typologies of work spaces, based heavily upon networking and digitalization, are indicative of a paradigm shift in the way the "office" is understood. The office is no longer a static, privately owned, single-use environment. Rather it has become a concept, or a process, it is the process of working collaboratively on a project, something which is no longer bound to the cubicle thanks to the internet. These spaces demonstrate a breaking free from the traditional office and an embracing of new forms of production through exchange, collaboration, and movement:

> "With the rise of new work cultures there is a noticeable increase in dualities. Dual- identity defines the conflict of belongingness of the person to the organization they are working for. The emerging mobile work culture makes an individual think of whom they identify themselves with, and where they belong." (Forlano, 9)

The report describes the needs of the users of such spaces as differing from the typical office worker (Forlano, 9-12):

- Preference for more flexible and customized work-style and the need to not have a fixed office
- Users who have tried to work from home but have found it hard to stay inspired and productive.
- The need for frequent mode change is achieved by changing physical location, customization of environment/space, new contacts with a diversity of individuals.
- The digitalization of office supplies.

Ownership vs User-ship

- Innovation spaces users are for the most part members and not owners of the space.
- Instead of renting an entire office individuals can rent a desk for part of the week.
- The Lack of division between private and shared resources creates opportunities for more contact with other members using the space.

- Community oriented vs individual Oriented. Although most users are self-employed, there develops a sense of community between the users of a co-working space.

Routinely in Flux

- Openness to feedback, evolution through feedback from components
- Growth through constant iterative testing
- Spaces are defined by their people, “they are a true embodiment of thought”.
- Users find their own meaning in the resources provided to them. Some resources naturally run their course and are no longer used.

Openness and Privacy

How is privacy negotiated in an open, shared public space? Certain degrees of privacy or separation remain very much in need while working. Not all work processes benefit from complete openness and collaboration. Individual users may not wish to be bothered by a rowdy group brainstorming session nearby, social interaction might even be detrimental to productive

work if it is unregulated. So how can a space maintain its openness and connectivity while still allowing for degrees of temporary privacy when it is needed?

> "The open layout and culture of these new spaces of innovation unveil a new kind of tension between 'the private' and 'the public'. From aspects of personal space and territory to issues of intellectual Property; from the defiance of hierarchy and the emphasis of community spaces to the critical play of noise. The rules of engagement within these new spaces are aimed at supporting a culture of flux." (Forlano, 12)

Investigations through Design Proposal

These concepts shall be considered and tested in my proposal for an innovation center in the proposed Innovation District of Springfield Massachusetts. The building will explore ways in which an open public workspace can foster innovation while allowing the users to customize their environment according to their changing needs. The design aims to embody the three main concepts outlined in this research:

Architecture as an Open Platform: The building will be a predominantly open space, a stage on which the users are free to act, the internal organization of such a building will be predominantly shaped by its users, and therefore a high degree of flexibility and customizability is required. The intention is to show that an open platform, although seemingly lacking in any

architectural features, can allow a more performative architecture to emerge as the spaces are constantly being shaped by their users.

Architecture as a Running Process: The building will demonstrate that the design of a building does not necessarily imply a finished static form, but that rather the physical appearance of a building could remain an open, ever-changing process, reflecting the networks of ideas, people, and products housed within which are also in constant flux: A rigid structure cannot sustainably house that which is ever-changing.

Architecture as a Nexus Point: The architecture should itself become the enabler of unexpected connection to occur; that is how innovative ideas are discovered. Through the juxtaposition of previously segregated functions, and the encouragement of open and transparent communication, a fertile ground for the intersection of ideas is provided. It is those intersections which become the architecture; the changing connections, the formation and dissolution of nodes, the activity involved in production and exchange, all coming together under one roof.

CHAPTER 4

DESIGN PROPOSAL FOR A PUBLIC INNOVATION SPACE IN SPRINGFIELD MA

Program Analysis

Springfield Innovation Center aims to become the anchor public institution for the innovation district in downtown Springfield. It is a place where entrepreneurs, innovators, independent workers, craftsmen etc. can come and co-mingle in a place that offers an array of resources that foster innovation and the development of new ideas. The space is primarily intended to create a fertile environment for new intersections to occur between people of highly varied backgrounds. By welcoming people from all types of disciplines fresh perspectives and insights could emerge through collaboration and the cross-pollination of ideas.

Site

The chosen site is the newly proposed Innovation District in downtown Springfield. A report outlining the plan to reconstruct and redevelop much of the area that had been affected by the gas explosion in 2012 has been released recently by the Sarno administration. The plan for the Innovation District focuses on increasing density in the area to attract new residents and potential entrepreneurs. The plan promotes the idea of creating a mixed-use downtown

with plenty of retail, restaurants, and most importantly, residential buildings so that an active and healthy public life can flourish in the streets. The plan details how the streetscape can be improved to create an inviting pedestrian environment while making room for bikes and a clear system for parking cars. The plan also points out that the district could become an important hub in the greater valley region as it falls within the "knowledge corridor" of western Massachusetts. With the Union train station scheduled to be renovated and expanded soon in anticipation of the casino moving in, the city has the potential to attract plenty of residents, investors, and tourists. The reason this district has been designated as an innovation district is due to the emergence of a few anchor institutions within its neighborhoods which focus on fostering entrepreneurial skills and connecting individuals with local job opportunities (Utile 2014, 1-72):

Nascent "Homegrown" Tech-based Activity:

- Presence of Baystate Innovation Center creates an anchor and partner for health technology start-ups (business accelerator)
- Emerging support system in Valley Venture Mentors, Springfield Angels and River Valley Investors
- Tech Foundry to act as training ground for maintaining local skills and filling job openings

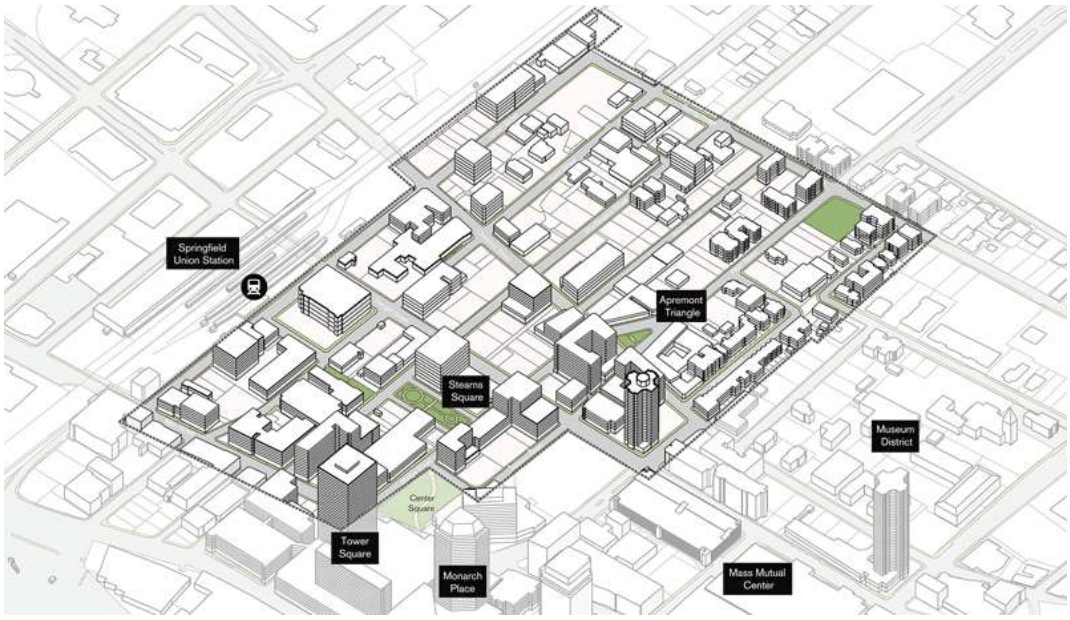


Figure 7. Springfield Innovation District (www.utiledesign.com)

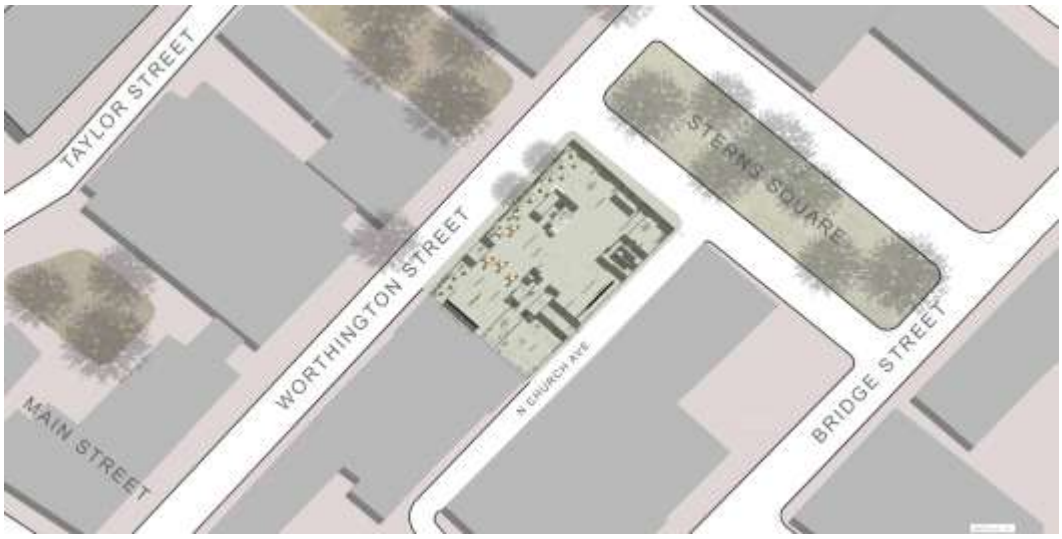


Figure 8. Site plan (by author)

Figure 9. Panoramic views of site (by author)

Usership

In order to gain a deeper understanding of the institute's programmatic requirement, I began by understanding the users which the space intends to serve. The diagram below illustrates the general division between public users and those who are specifically using the innovation space as an entrepreneurial resource.

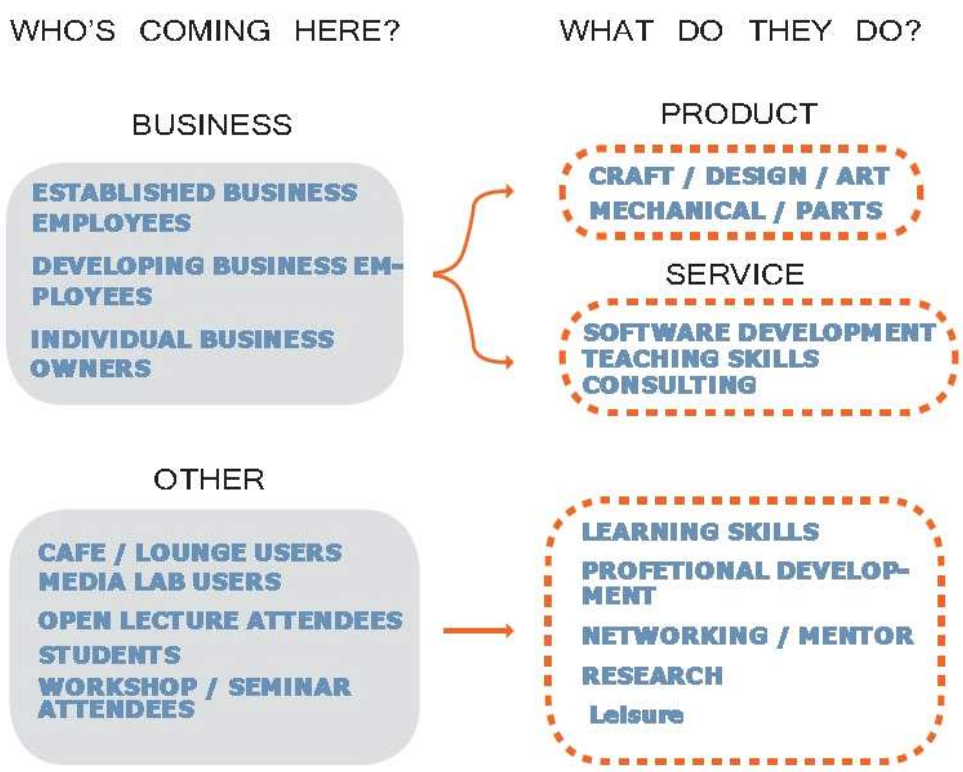


Figure 10. Usership Diagram (by author)

An Ecosystem of Innovation:

Ideally an innovation space would offer a rich ecosystem which could support the development of a new business by offering it the appropriate resources it needs for growth as it develops. From the initial stage of finding a worthwhile idea, through the development and prototyping phase, to production and marketing, whether it is a physical product, an app, or a service, this space must be able to offer resources to carry out this process from start to finish.

Edison combined workspaces that had never existed side-by-side before. He integrated a machine shop, a chemistry bench, woodworking and lathing equipment (for prototyping), and office space for individual and team endeavors. Edison's lab combined open, shared spaces in addition to private, quiet areas that catered to multiple thinking styles and work requirements:

> "While he could not possibly have known what a 'spontaneous dyad' was, Edison did recognize that having two people bump into each other unexpectedly offered a huge boon to innovative dialogue, and disruptive thinking. Edison's Menlo Park Lab is an early example of systems thinking in an innovation lab, where widely different disciplines where placed side-by-side in a single workspace with the intended purpose of interdisciplinary collaboration.
>
> Decades ahead of his time, Edison preferred networks over hierarchies, building no corner offices of any sort. Edison's revolutionary combination of workspaces sent the message that it was important to move back and forth between collaborative and solo efforts. Every employee knew they were to contribute as stewards of innovation, regardless of their role, educational attainment, or title.
>
> Before management science became a discipline, Edison realized that the ways people connect hold the power to transform their environment from a merely task-oriented workspace to a learning-oriented one. This difference lies at the heart of driving an innovation mindset across an entire enterprise. What Edison knew intuitively has now been confirmed by research from Steelcase and others. Organizations that fail to embrace the innovation power of collaborative workspace risk winding up in the digital dustbin." (Coldicott 2014, 2)

Figure 11. Second floor workspace at Thomas Edison's Menlo Park Laboratory (relocated by Henry Ford to Greenfield Village). (Photo credit: Wikipedia)

What are the needed components in an ecosystem where nascent ideas can flourish to become established businesses? I have outlined four main steps to the process; Idea Finding, Design Development, Production and Marketing. Each of those steps requires its specific types of inputs, skill sets and resources. The chart below illustrates possible pathways and feedback loops which an innovation spaces would need to encourage for it to function as an incubator and accelerator of ideas into businesses.

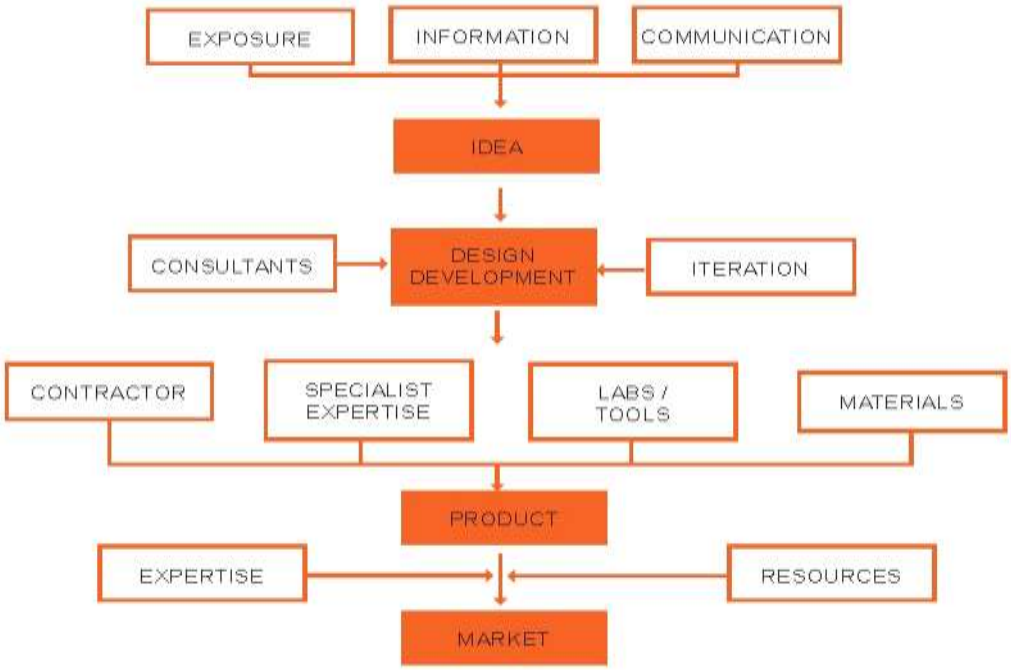


Figure 12. An Ecosystem of Innovation (by author)

Programmatic Components

In order to flesh out the program a generalized conceptual understanding of the activities that would take place needs to be defined. Three main groupings were established based on these activities:

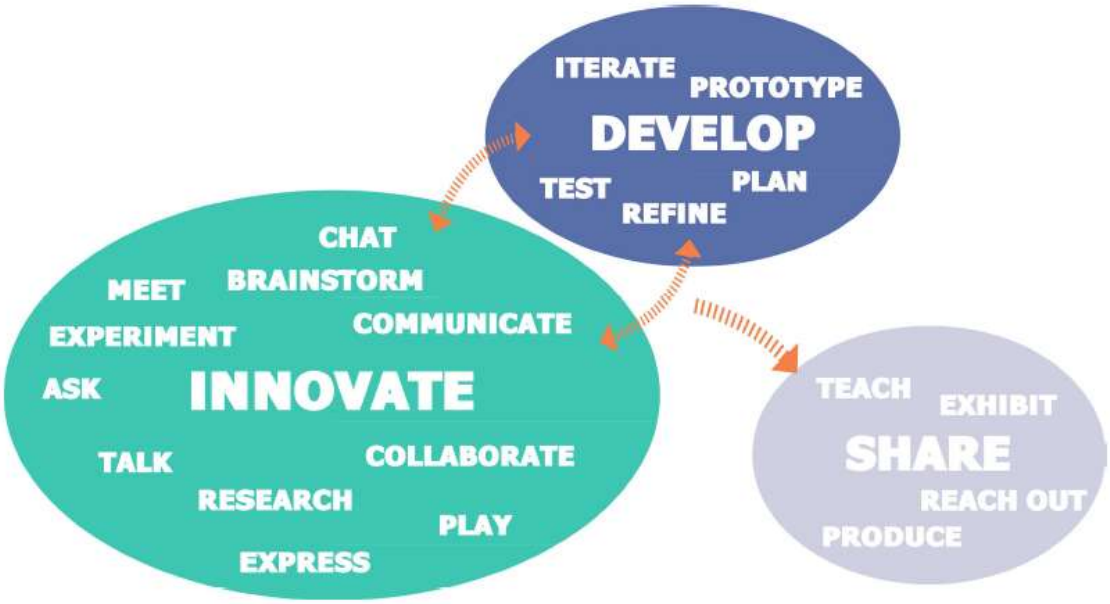


Figure 13. Programmatic components (by author)

INNOVATE: this is the main feature of the innovation space that would be directly accessible to the public, acting as the core space where ideas are generated and exchanged in a very dynamic environment. This space needs to be very flexible, offering ample opportunities for group interactions and solitary activities, and quick and easy access to information through a variety

of media. This is a casual environment that emphasizes communication and interaction for the generation of new ideas.

DEVELOP: Worthy ideas need focused development through research, prototyping, planning, iteration, and testing. This is the back end of the process where all the technical work happens. Specialized equipment and resources are required depending on the specifics of each project. This part being more specialized in nature and requiring a certain level of skill and expertise is more segregated and not necessarily open to anyone.

SHARE: Once an idea, product, innovation is ready it needs an appropriate platform to broadcast and share from. Lecture halls, exhibition spaces and classrooms fulfill this need and connect the innovation space and its users directly with the community outside.

Understanding Adjacencies

With the general categories in mind each program element can begin to fit in its appropriate grouping. To reach a more nuanced understanding for possible layouts and needed adjacencies, I created the following two diagrams. The first one plots out the spaces on a graph with two axes'; the horizontal indicating degrees of privacy, and the vertical showing digital vs physical types

of work. The second diagram places the different program elements along a continuum of flexible to rigid. Flexible spaces are those that need a high degree of adaptability to a wide array of arrangements and those whose furnishings and other resources are highly customizable. Rigid spaces are those that require fixed systems and / or furnishing, such spaces cannot be customized and have rigid procedures that must be adhered to when being used. These tend to be the more specialized spaces that house technical equipment such as the woodshop and digital fabrication.

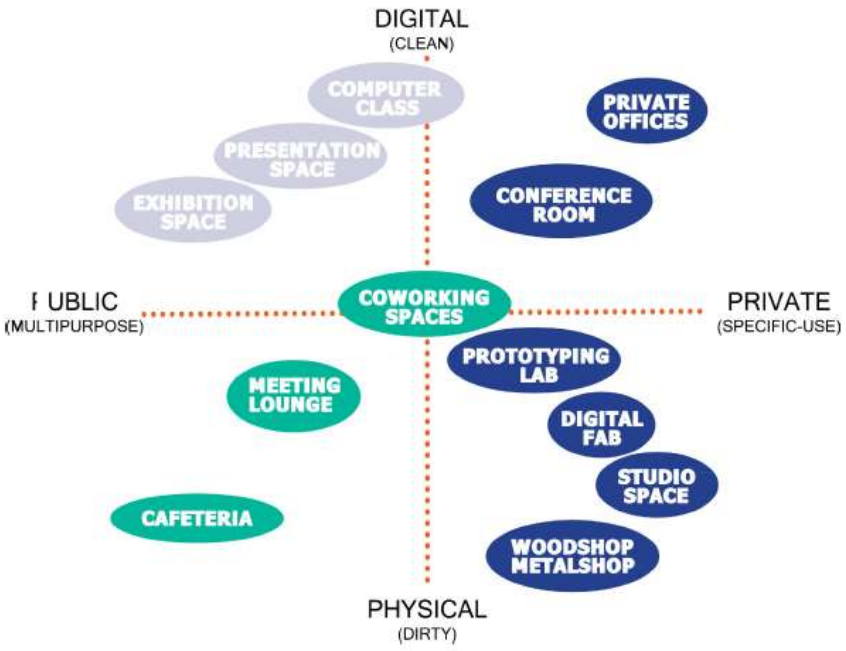


Figure 14. Program adjacencies 1 (by author)

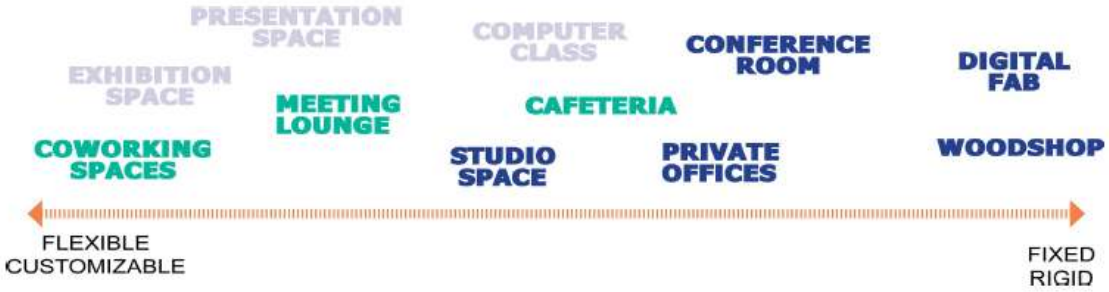


Figure 15. Program adjacencies 2 (by author)

The overlaps between the programmatic parts are central as they become the interfaces between each of the various groupings of parts within the overall system. The following diagram maps out the groupings of the programmatic elements and shows the most likely intersections:

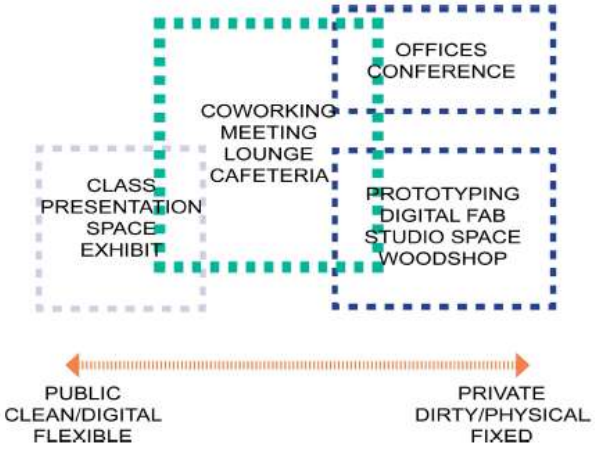


Figure 16. Program adjacencies 3 (by author)

Public programmatic elements need to engage directly with the public realm along the sidewalks. The site is at a corner facing a public park, this allows for ample opportunity to engage with the flow of pedestrians and vehicular traffic along the two adjacent streets. Placing the Fabrication labs

closer to the back alley makes sense in terms of providing ease of access for loading and unloading materials and supplies, as well as for limiting exposure to loud noises. The site's integral role in determining the relationship between Public / Digital and Private / Dirty becomes clear as outlined in the following diagram:

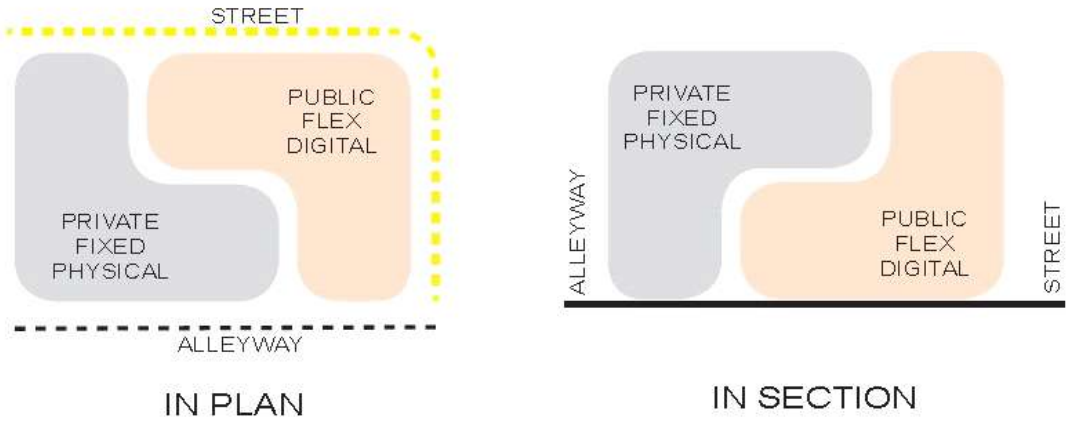


Figure 17. Public and private space (by author)

Conceptual Design

Membranes & Matrices

The central aim of this exploration is to look at architecture in terms of a series of interfaces. An interface is a membrane that regulates the transmission of information between two mediums that differ significantly in their properties. A membrane therefore can be thought of as a barrier that allows for exchange to occur without disrupting the properties of each medium. A wall is not a membrane but a barrier, separating two distinct regions from one another, but forbidding any kind of exchange to occur. The idea of the membrane is central to this building because it is a space which puts emphasis on the process of production rather than its end results. The intersections of the physical with the digital should be celebrated and enhanced rather than dreaded. This space must demonstrate the richness that is possible when physical architecture meets the abstract architecture of networks. The building must also show that connections lead to greater innovation and sustainable growth

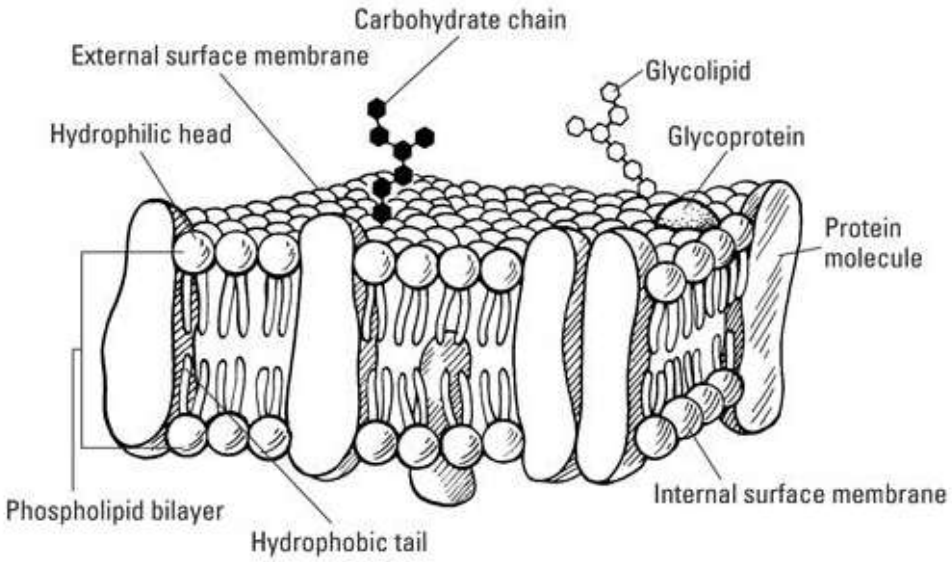


Figure 18. Cross section through a cell's membrane (https://www.studyblue.com/notes/note/n/biology-101/deck/10072093)

The structure of the cellular membrane offers an insightful precedent for an architecture that acts as an interface. The cell membrane allows the cell o become highly pliable and connects it to its environment through the presence of a wide array of channels for different types of communication. Below is an illustrated section through the double membrane of a cell.

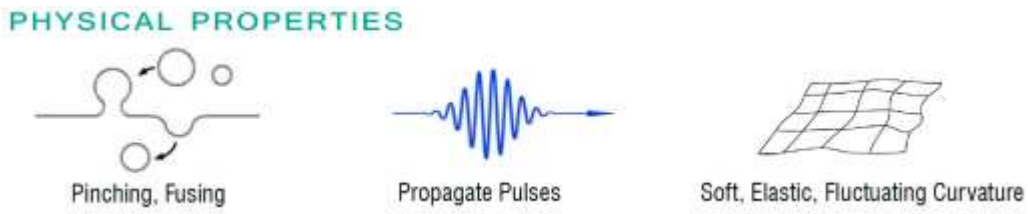


Figure 19. Physical properties of cellular membranes (by author)

It is clear that the membrane is a very complex structure; it acts as the cell's defense mechanism, identifying foreign and desirable substances and selectively regulating the passage of molecules through it, becoming the medium through which the cell interconnects and communicates with its environment. Various types of proteins are embedded within the membrane, each with a highly specific role; some proteins allow for passive transport of nutrients, others, known as ion channels, are activated by a change in electric charge due to the presence of specific ions, others act as receptors for specific proteins which when locked in, activate or inhibit articular metabolic pathways within the cell regulating the production of other proteins and enzymes. The Physical properties of the double membrane allow it to be flexible and adaptable. Its ability to pinch and fuse into smaller vesicles, individuated "bubbles" of membrane, allow it to become the vehicle of transport and absorption of molecules as needed. The ability to conduct electricity is the foundation of the nervous system, allowing impulses to travel across the membranes of individual nerve cells within seconds across the entire body.

The cell provides a great example for an architecture that is designed for flexibility. The cell in its entirety has to be able to perform a multitude of functions while it grows and reproduces itself. Membranes are the predominant architectural component defining the boundary of the cell

itself, as well as all of the internal organelles operating within it. How does the cell maintain its form if everything is made of flexible membranes? The cell's cytoplasm, the gel-like fluid in which all the organelles "float", is actually a highly complex soup of molecules, a group of which constitute the cytoskeleton. These filament-like proteins create a highly dynamic "matrix" which gives the cell its form and its mechanical resistance to deformation. The rigid structural aspect of the cell's architecture is reduced to a network of filaments dispersed throughout the cytoplasm. In between this filamentous skeletal structure are the spaces within which the organelles and transport vesicles, predominantly membrane structures, exist and develop.

How does this relate to building? The cell's architecture is predominantly based on membranes for creating specialized spaces or organelles, the membrane is also what defines the cell's external boundary, its interface with the outside world. These membranes are characterized by their ability to fuse, pinch off, bend, fold, stretch, and conduct electrical impulses. The rigid structural components of this architecture are composed of filaments dispersed within the space of the cytoplasm giving the cell its overall structural integrity, allowing the membrane-based organelles to anchor in place within the cell. The rigid aspects of the cell's structure, the cytoskeleton, are reduced to a network of filaments, the

actual architecture of the cell through which boundaries are created is the membrane. If buildings took this attitude towards their construction, the result is an architecture that allows flexibility, adaptation, and communication.

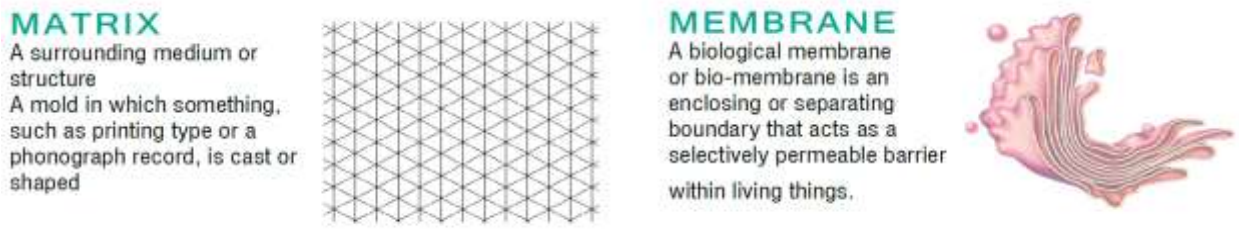


Figure 20. Matrix vs Membrane (by author)

Today's buildings are predominantly matrix oriented, in that the walls and the structure tend to meld together and dominate, creating a matrix of solid compartments that are segregated and act as a fixed boundary which inhibits communication. The architecture thus determines what happens within it through its rigid structure. If the matrix qualities of buildings receded to the barest minimum required, then a predominantly open and flexible space can allow the membranes, or flexible partitions, to move freely within. The architecture of the cell becomes a model for an architecture of adaptable, responsive buildings which are shaped by the needs of their users. For this to occur buildings must become significantly

less matrix-dominated; their rigid components should recede and give way to their impermanent, flexible components; the membranes.

The idea of the membrane is central to this building because it is a space which places emphasis on the process of production rather than its end results. The intersections of the physical with the digital should be celebrated and enhanced rather than dreaded. This space must demonstrate the richness that is possible when physical architecture meets the abstract architecture of networks. The building must also show that connections lead to greater innovation and sustainable growth.

The set of diagrams below show the evolution of the spatial organization of the program beginning from the conceptual sketch showing the idea of the fixed matrix components between which flow the membranes. The middle diagram shows the transition from public to most private where the public connects to the street while the private connects to the back alley for transportation of goods. The third shows the placement of the program elements within the space accordingly:

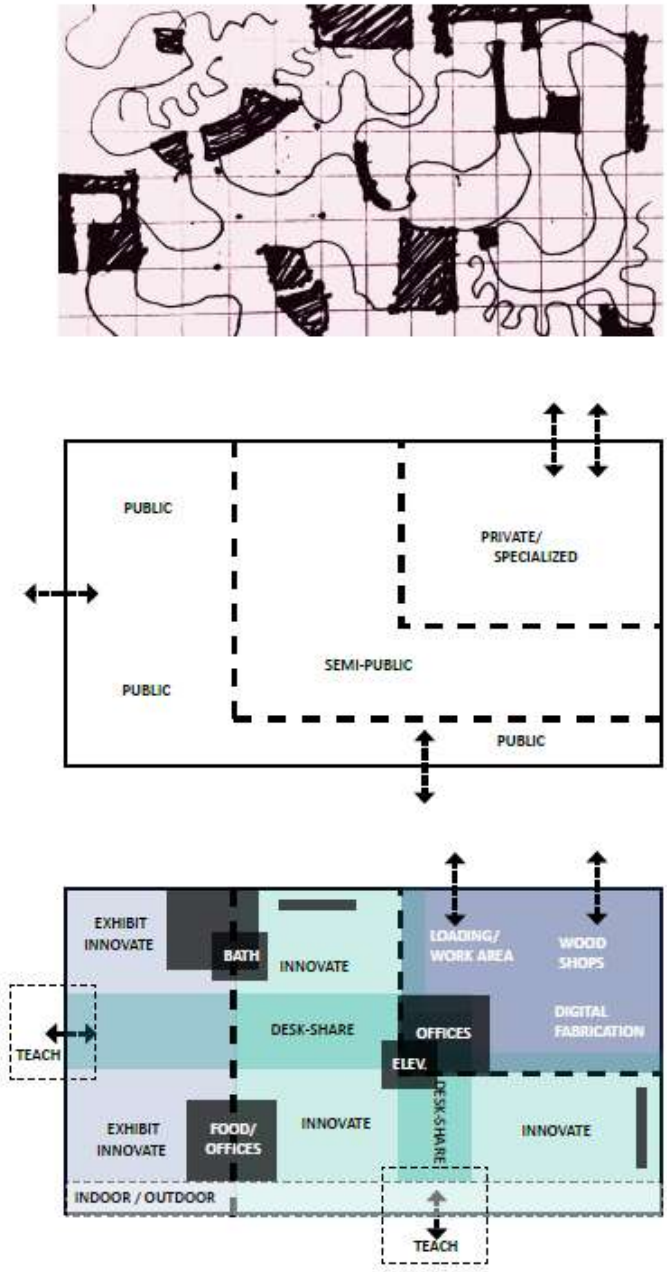


Figure 21. Concept development (by author)

How such a degree of internal flexibility can be allowed to exist becomes the next central question. The design firm Molo offers a wide array of innovative products which do just that. Their line of flexible walls and furniture based on honeycombed paper, or other synthetic fibers, allows users to custom design spaces quickly and easily by simply unfolding flat stacks of paper to form luxuriously textured undulating walls, seating, tables, and even lights. These products allow the user to design the space according to their immediate needs. These changes are temporary and transient, as well as highly flexible and modifiable. The design of the internal architecture of the space is now handed over to the user. The architect's role has shifted to designing the general container, the matrix, which allows the membranes, the soft walls and furniture, to exist within. The result is an architecture that responds directly to the needs of the user, and one that is highly dynamic and ever-changing. Below are images and diagrams which illustrate the use of the Molo products which will be heavily featured in the proposal as the main "membrane" component.

Figure 22. Softwalls, Soft-Seating, Soft Cloud lighting from Molo (images and drawings by Molo, from www.molodesign.com)

The idea behind using this furniture system is to demonstrate how a flexible responsive architecture can serve the changing needs of the users. The open layout of the space will allow the easy utilization of the partitions and seating systems to carve spaces of varying degrees of privacy. The architecture takes on a performative quality where its use determines the form it takes upon the open platform of the innovation space.

The matrices are the structural components, such as the columns and exterior walls as well8, as the three solid “towers” which house the offices and the fixed service components such as the cafeteria service area, the bathrooms, the elevator, and the stairwells. The offices are the most private component of the space. The towers also hold up the desk-share component on the second

floor as well as the presentation spaces which cantilever over the entrances at the east and north facades. The Desk-share space is semi-private; it is removed from the main innovation space on the ground floor yet overlooks it through a wavy slatted railing which provides a degree of privacy to those using the desks. The undulations of this story provide semi-differentiated spaces that contain each desk space. The slatted railing has a movable part that rotates to enclose the desk space thus pinching it off from the main desk-share space to provide a sense of privacy and enclosure if so desired.

The façade is meant to reflect the idea of architecture becoming a box of intersections. It is a simple curtain wall glazed facade on the interior of which hang large translucent curtains that can be adjusted for privacy or shading. The part of the façade fronting the sidewalk has operable sliding panels to enable the transformation of the public spaces into semi-outdoor spaces during the warmer months, allowing a greater degree of connection with the pedestrian realm while also providing the building with a source of natural air flow. The fixed grid of the façade is meant to reflect the idea of the matrix, a light framework defining the space, while the flowing curtains reflect the idea of the membrane, in constant motion and responsive to change. The diagram below illustrates these two aspects of the building, the one on the right shows all the solid components comprising the matrix, the one on the right shows the flowing, interactive components making up the membranes:

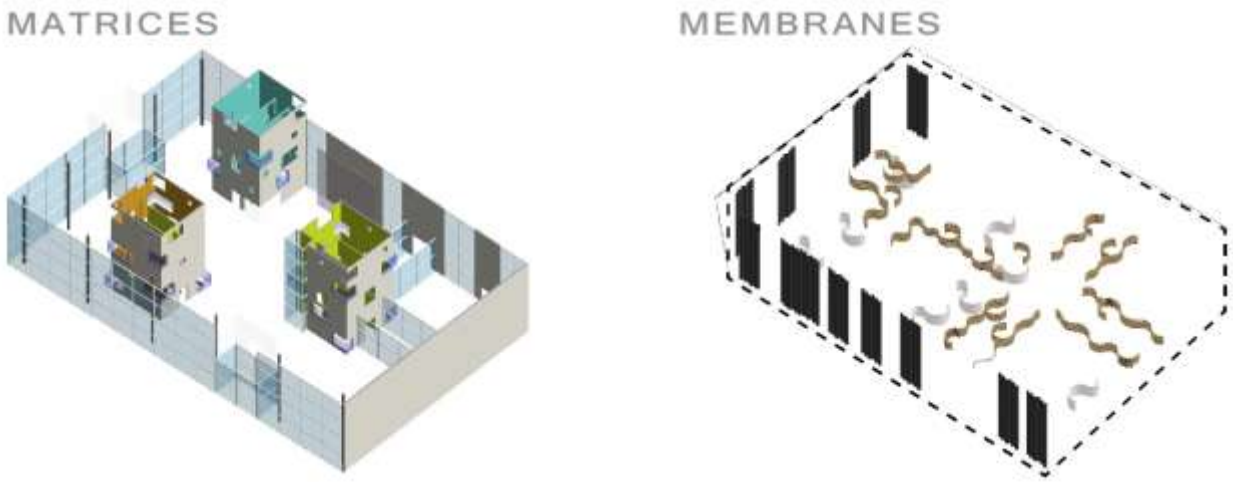


Figure 23. Membranes and matrices within the proposed innovation center (by author)

The change from public to private is intended to cater to the needs of businesses on all levels of the ladder; the public innovation space would predominantly serve startups in the very nascent stages of idea development. As this idea takes off and becomes an income generator for a very small business the individual or group may choose to move up to the more reclusive desk-share above and rent a desk for part of the week. If this business develops even further the group or individual may then choose to relocate into one of the rentable private offices within one of the three towers. Eventually a company would grow enough to be able to move out of the innovation space entirely and into a privately-owned space making room for the next up-and-coming startup. This process is illustrated in the diagram below:

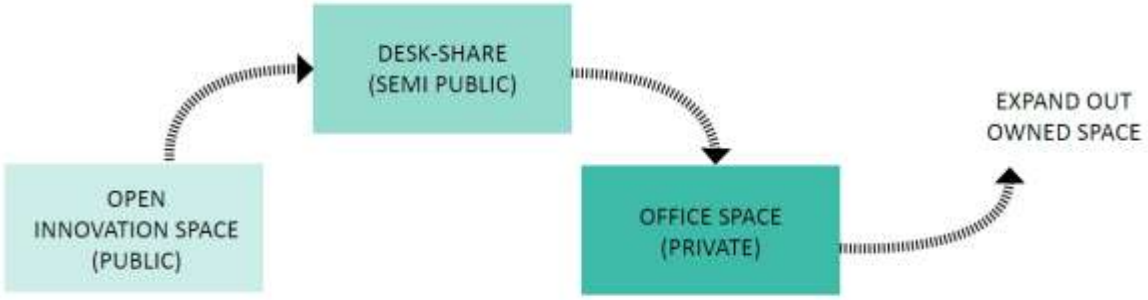


Figure 24. Degrees of privacy and business development (by author)

Transitory Membranes

The membrane components used throughout the building closely reflect the three physical properties of cellular membranes. The first type consists of the soft furniture used mainly on the ground level public innovation space. These elements reflect the flexible, elastic aspect of the membrane, able to contract, expand, and fold upon itself.

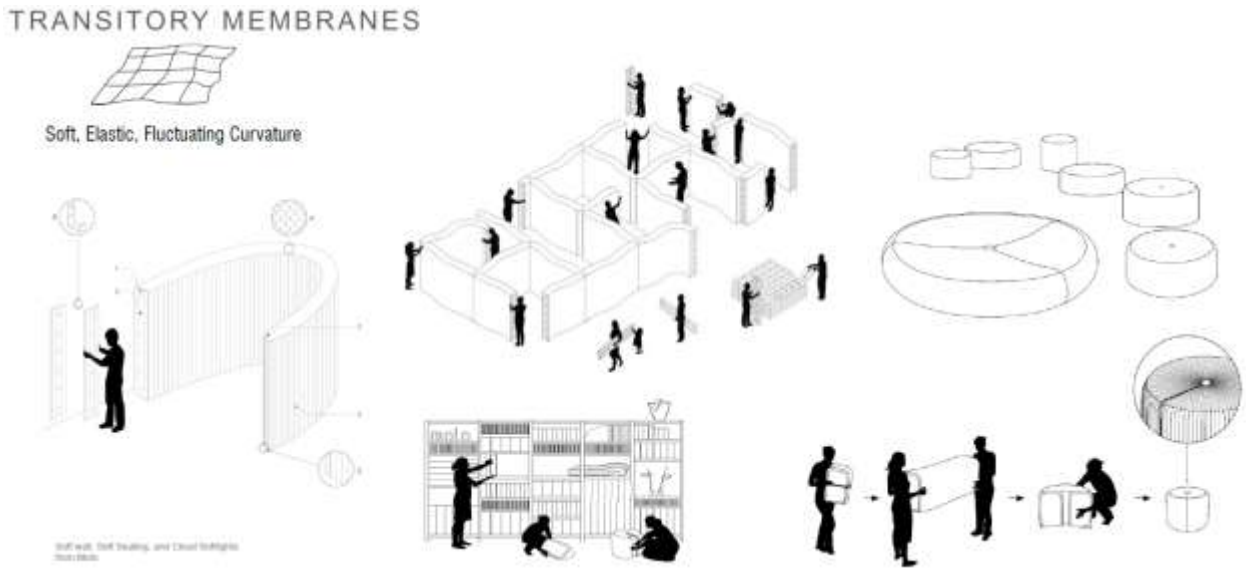


Figure 25. Molo Softwall and Soft Seating diagrams from product catalogue

Semi-fixed Membranes

The floors of the innovation spaces are equipped with circular plugs designed to receive the movable columnar lights hanging above. The idea behind this device is to provide the users with the option of creating semi-permanent fixed partitions for the purpose of accommodating longer term projects. The lights can be brought down through the push of a button; the light when at ground level is then fixed to the ground in its appropriate receptacle. The sides of the column have strips of LED bulbs and are designed to attached to the soft walls which themselves are designed to accommodate lighting at their edges. The fixed partitions then light up when in use sending an electrical signal to the outsiders communicating the fact that this space is now occupied, and privacy is therefore needed. The moving lights also are meant to offer users the choice of adjusting lighting levels as desired.

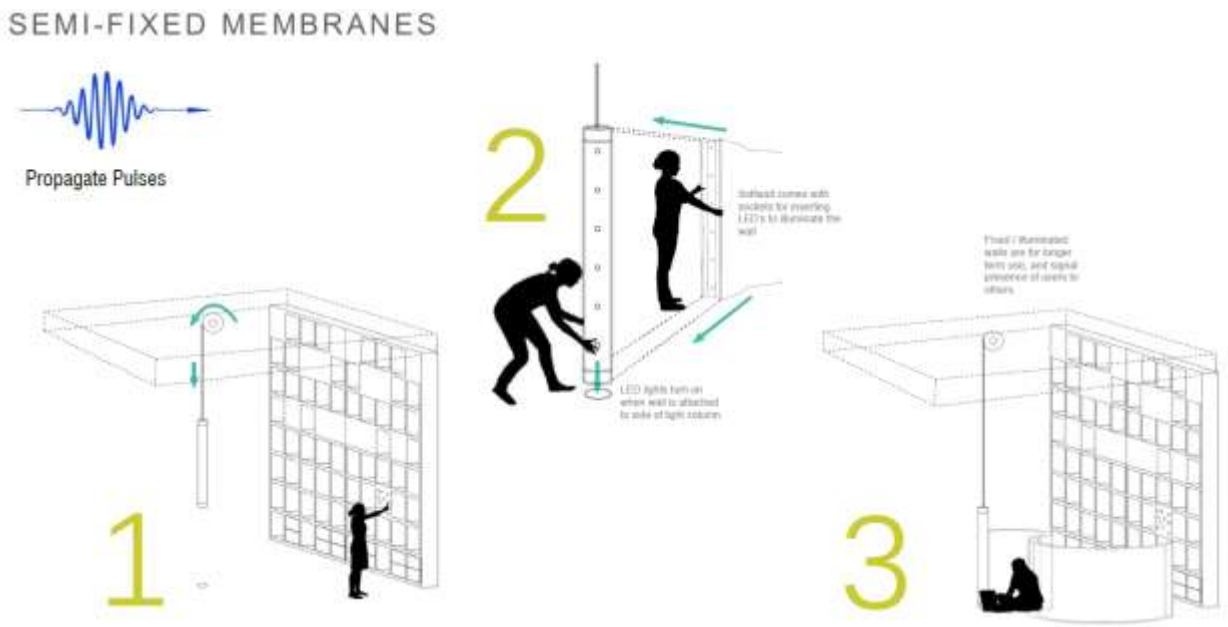


Figure 26. Adjustable columnar lights operation (by author)

Another example of this is seen in the translucent glass of the lecture rooms which project out of the main facades. The idea behind this gesture was to have a means of communicating to the outside world what is taking place within. The projection screens in those spaces are the glazed translucent walls themselves. When a presentation takes place the images being projected become part of the façade of the building, an electrical signal of sorts, giving ambiguous hints as to what takes place inside to the public outside.

Figure 27. Projection screen façade

Fixed Membranes

The slatted curved screens that form the railing for the second floor desk-share space constitute the third type of membrane, demonstrating the ability to pinch and fuse into smaller compartments of private space when needed.

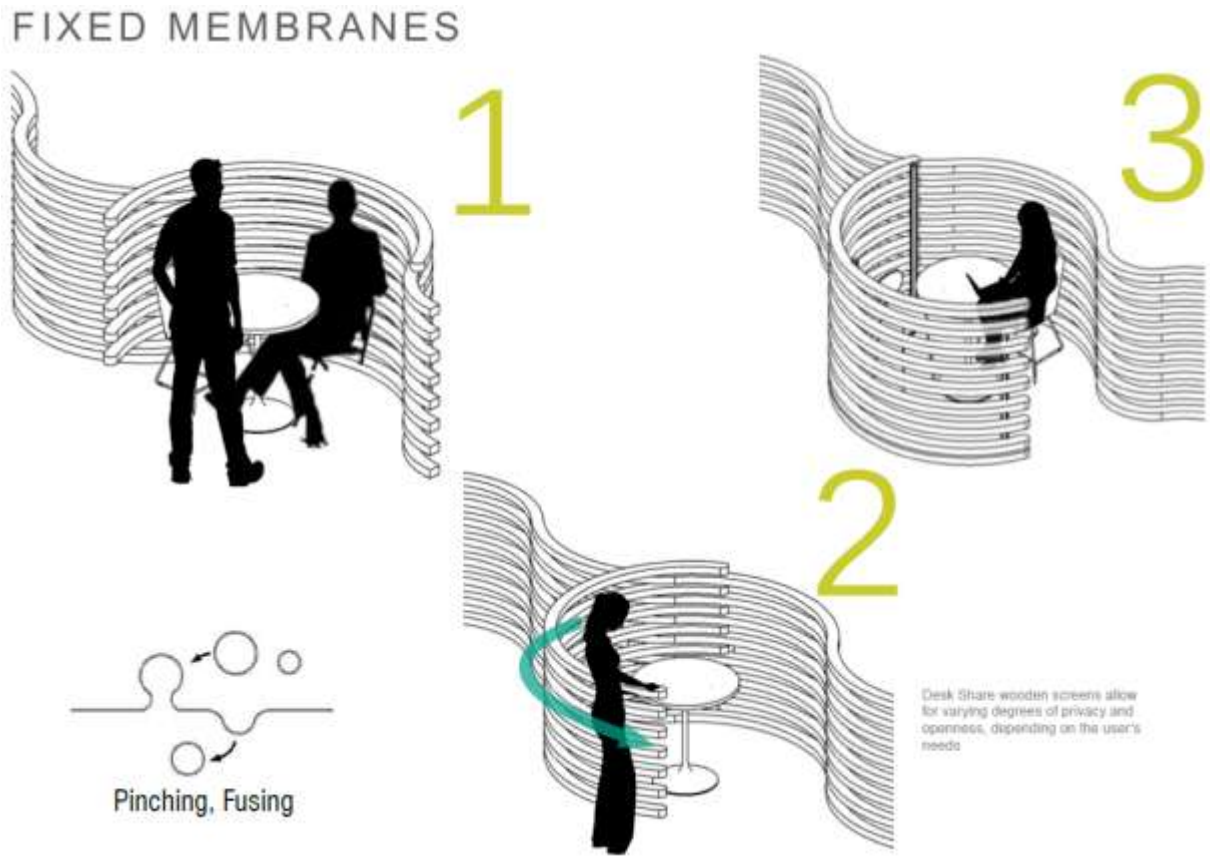


Figure 28. Adjustable slatted screens at desk-share space (by author)

Figure 29. Interior perspective showing café / exhibit area


Figure 30. Exterior perspective from corner of Stearns Square and Worthington St

Figure 31. Exterior perspective from Worthington St


Figure 32. Interior perspective showing main innovation space

Figure 33. Interior perspective showing main innovation space

Figure 34. Interior perspective from third level desk-share space

Figure 35. Interior perspective showing main desk-share space

Figure 36. Exterior night time view of northern facade

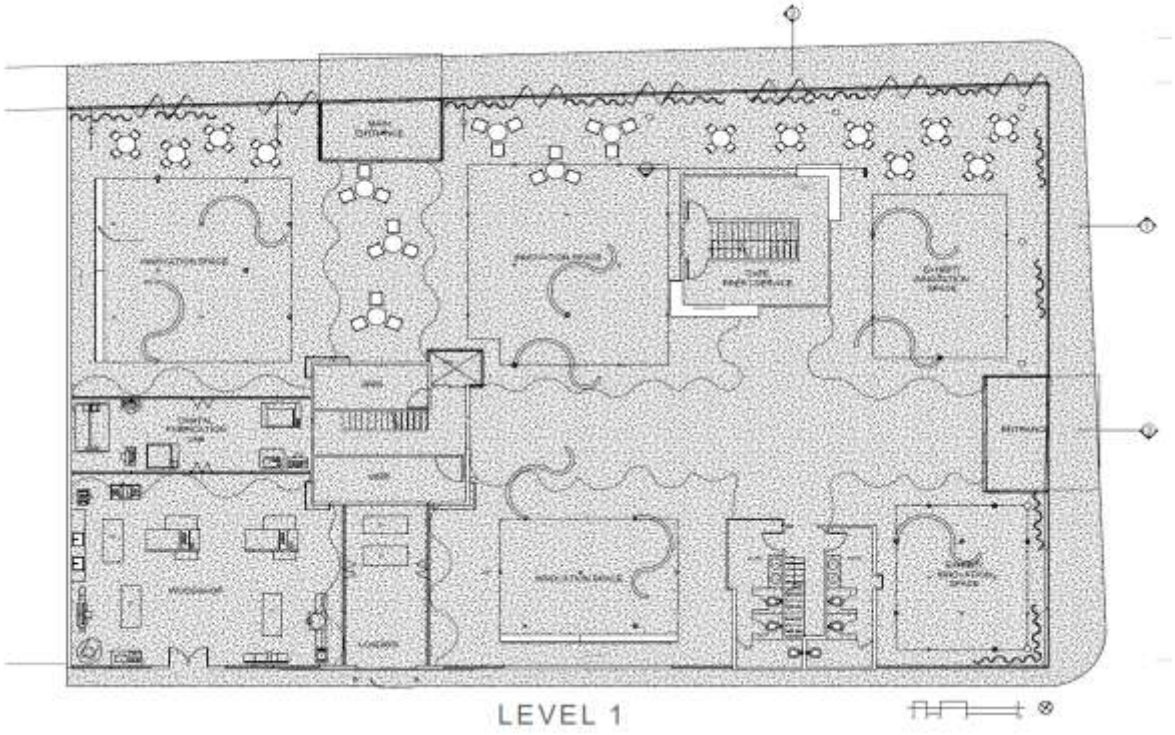


Figure 37. Level 1 plan

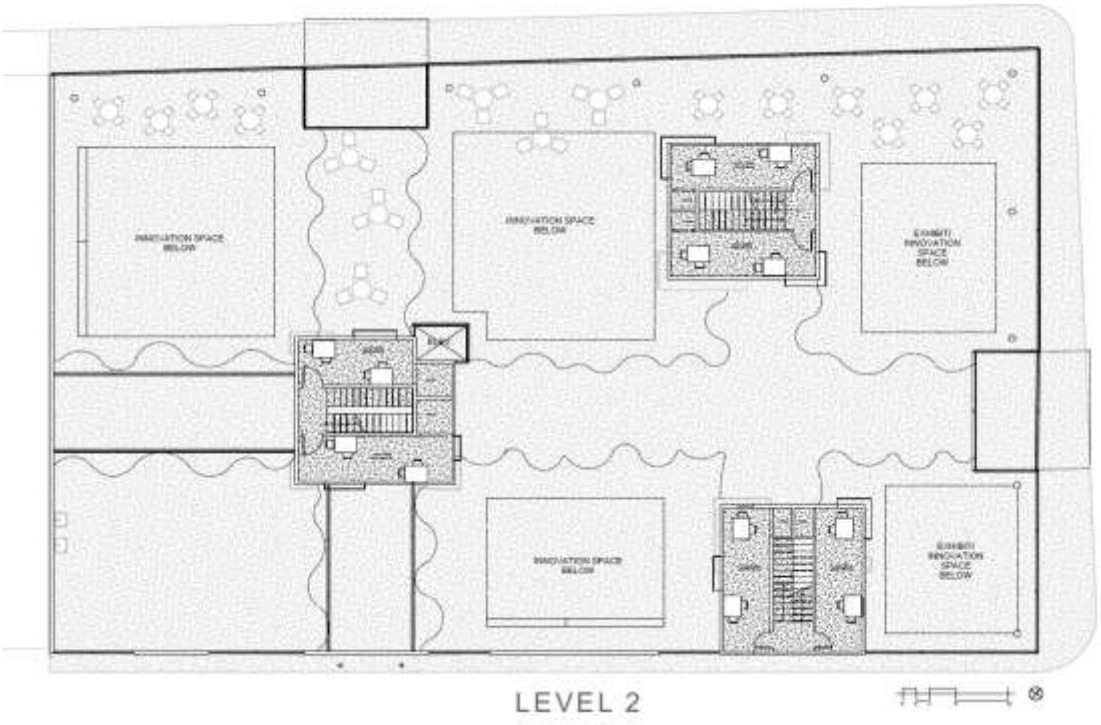


Figure 38. Level 2 plan

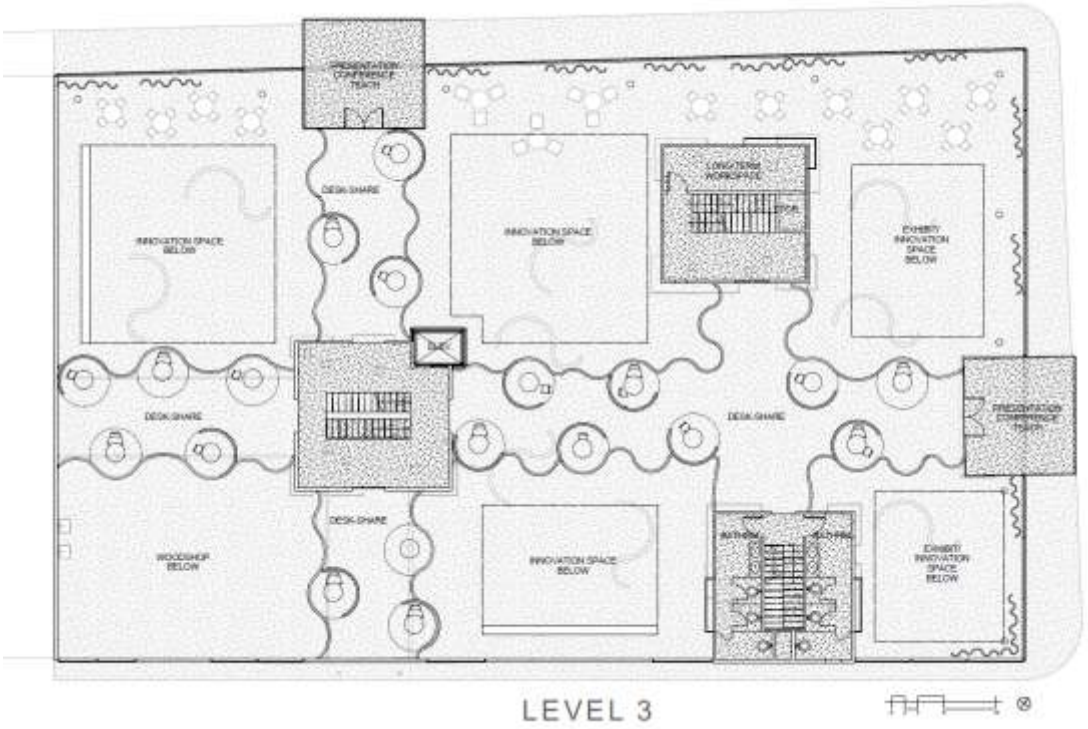


Figure 39. Level 3 plan

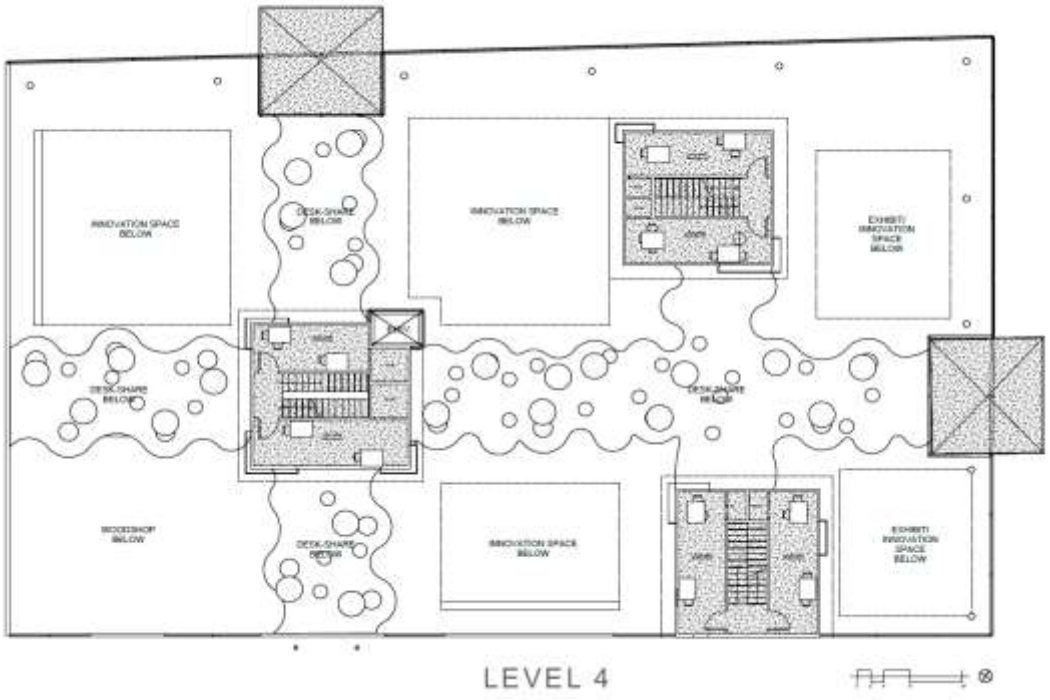


Figure 40 . Level 4 plan

Figure 41.South elevation

Figure 42. East elevation

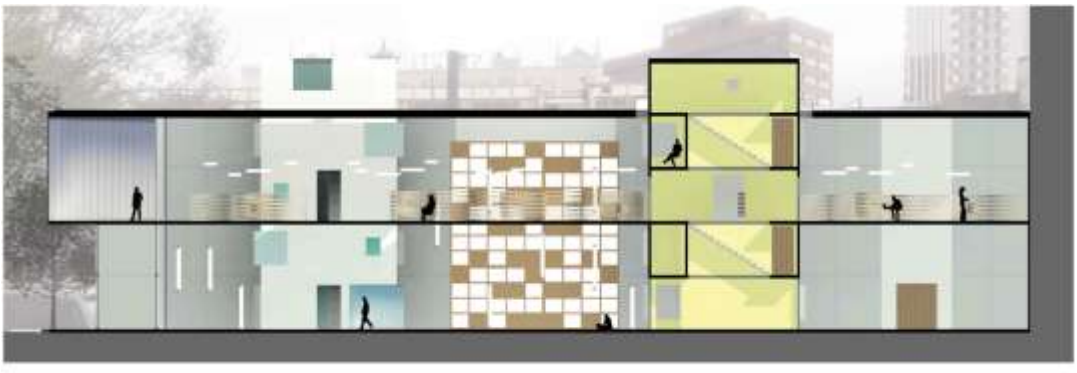
Figure 43. North elevation

SECTION ONE

Figure 44. Section 1

SECTION TWO

Figure 45.Section 2



SECTION THREE

Figure 46.Section 3

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