ABSTRACT

Title of Thesis: PROJECT.IONS: INVESTIGATING OPERATIVE NETWORKS

Adam W. Louie
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Thesis Directed By: Lecturer Brent D. White, School of Architecture, Planning, and Preservation

Corporations and enterprises have embraced the notion of shared experiences and collective workplaces by incorporating coworking places. A great deal of the methodology carries from the studio culture that architecture schools foster as well as think tank culture. Maker spaces and incubator spaces are prime examples of places that engender creative thought and products. This thesis seeks to explore the impact that architecture has on collaborative spaces with a focus on augmenting to their generated learning and design activities. The investigation explores the collaborative design process as a series of interactions between groups of individuals. This involves the impact of technology and its implications on those interactions. The goal of this thesis is not to further the use of a tool or systematic procedure, but to use architecture as a framing device to form places for collaborative processes.

PROJECT.IONS: INVESTIGATING OPERATIVE NETWORKS

by

Adam W. Louie

Thesis submitted to the Faculty of the Graduate School of the
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Advisory Committee:
Brent D. White, Professor, Chair
Brian P. Kelly, Professor
James W. Tilghman, Professor

Preface

This thesis proposal and its culmination are a representation of the never-ending design processes that we architecture students eagerly engage. Though this paper primarily looks at design development from a technological standpoint, the true moments of learning and experience occur in the physical world. We cannot avoid the Internet of Things as digital technology more seamlessly integrates into our social lives. However, we can leverage and use those technologies to augment to our interactions between the physical and digital realms. In this time and age, communication with one another is no longer hindered by technology; for a design activity, there is no excuse not to assemble and collaborate.

As students who have honed multiple skill sets, we tend to see each of ourselves as a Swiss-army knife, in which we have tools from multiple disciplines. Our profession and services have expanded and made strides into multiple fields, ranging from engineering, landscape design, social sciences, and the fine arts. Rather than specializing, our architectural design activities encourage delving into multiple facets for more personalized and creative views. Those realizations best manifest from collaborative design processes as we exchange ideas and thoughts between one another. We then actualize them as soon as we lay our pencils down on trace or even append a plane to our maquette. With people serving as the catalyst, this proposal looks into the transition from reality to actuality using architecture to frame the collaborative activities.

Dedication

To my graduating studio mates in the Class of 2016

For their cordial comradery and continuous support over the last six years

Acknowledgements

For their mentorship and debate:

Brent D. White

Brian P. Kelly

James W. Tilghman

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Introduction

"We need to develop and disseminate an entirely new paradigm and practice of collaboration that supersedes the traditional silos that have divided governments, philanthropies, and private enterprises for decades and replace it with networks of partnerships working together to create a globally prosperous society."
- Simon Mainwaring[1]

In the conventional design process, a disconnect between *what is* and *what we think is* occurs; we cannot truly experience what we design before construction. Designers draft the drawings, model them with CAD, and walk through with a virtual camera, but an invisible perspectival hinge[2] occurs in which we try to imagine ourselves within the machination. In addition, every individual builds different interpretations of the design that may conflict with the design's intended goals. In effect, key moments become the selling points and attractors to the overall design. The designer and associated parties become enraptured in that constructed reality of our intents and dwell in that realm.

Collaborative and cooperative design mitigate that entanglement by open-sourcing the design process. Having multiple constituents allows for a greater number of viewpoints to refine the project; however, in actuality, collaborative networks do not contain individuals with the same skill sets. Then how do participants in a network progress and work effectively? While investigating network operation, Craig Applegath claims that "the virtual office is held together by both the common sense of purpose and the mutual trust and competence of its members."[3] Though the virtual

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[1] Simon Mainwaring, *We First*, New York: Palgrave Macmillan, 2011.
[2] Alberto Pérez-Gomez, *Architectural Representation and the Perspective Hinge*, 1997.
[3] Pressman, *Professional Practice 101*, 281.

office does not require all members to be physically in the same space, operators in the network are bound and driven by shared goals of the project.

More importantly, the shared experience is of growing value. Many places have embraced the notion of shared experiences and collective workplaces by incorporating coworking places. A great deal of the methodology comes from the studio culture that architecture schools foster as well as think tank culture. Maker spaces and incubator spaces are prime examples of places that engender creative thought and products.

This thesis seeks to explore the impact that architecture has on collaborative spaces with innovative, next-generation design tools. The investigation explores the progression from reality to actuality to compare and evaluate conventional means of collaborating. This involves virtual/augmented reality and its influence on the design process. The goal of this thesis is not to further the use of a tool, but rather to incorporate its implications and influence methodologies behind collaborative processes. Using the interactive, responsive feedback from those technologies will aid in the ability to make collective design decisions more efficiently and effectively.

Chapter 1: Virtual Culture

Impact of Technology

Peter Rowe, former Dean of the Harvard University Graduate School of Design, stated that the “rapid deployment of new information technology within the realm of design fundamentally promises to alter the very way in which we perceive and therefore make physical environments.”[4] Since that statement made in 1992, the advances in technology have far surpassed any expectation from the time. Our current culture can be attributed to the widespread availability and communication of information via digital media. The rapid transmission of data accelerates the traditional paces of work; namely, the development of computer-aided design (CAD) and building-information modeling (BIM) software has revolutionized the architecture industry. Moore’s Law projects that with increasing availability and development of technology, the innovation and output grows exponentially. In the architecture field, that claim is reflected by the diversity of high-performance and aesthetically designed buildings of today. While Moore believes that his law will have saturated and falter within the next decade[5], the implications to the architecture industry have yet to be realized.

The development of the Internet and server-based connections have opened opportunities of communication within the workplace. The idea of virtual offices came to fruition in the latter part of the twentieth century as data could be more easily

[4] Andrew Pressman, *Professional Practice 101: Business Strategies and Case Studies in Architecture* (Hoboken: Wiley, 2006), 285.
[5] Rachel Courtland, “Gordon Moore: The Man Whose Name Means Progress,” *IEEE Spectrum*, last modified March 30, 2015, accessed October 26, 2015, http://spectrum.ieee.org/.

transmitted and shared. In essence, the practice becomes networked as teams of specialists are assembled to pursue a project. Craig Applegath, principal at DIALOG, describes the transformation of his studio into a virtual practice as an improved project delivery system. Team members and consultants are linked by computers and phone lines, but meetings became more energized and collaborative events became more personal. He asserts: "the decision to go virtual was more evolutionary than revolutionary."[6] Though the medium of project delivery was changing, Applegath and his team remained cohesive as they accommodated to a practice that did not involve direct contact with others. Their success relied on the careful planning and collaboration set up to frame the activity occurring within their network of team members and clients.

While Applegath demonstrates the success in a traditional architecture firm, other industries have also adopted the notion of virtual offices. Animation studios, such as Pixar and Bully! Entertainment, have consistently practiced with virtual offices by nature of their work. Those studios are in constant dialogue between collaborators and clientele in order to run their practice. Though their line of work differs from architecture, animators have similar skill sets and means of collaboration like designers. Animation studios pioneered the extension of "virtual" to the digital realm as a means to communicate more effectively with one another. Borrowing from the game industry, the use of avatars or proxies into a virtual environment allowed users to interact freely from the boundaries of the physical world. Granted that simulated environments would house the virtual meeting, business could be

[6] Pressman, *Professional Practice 101*, 281.

conducted without one being in an office. These developments led to the current types of widespread hobbies; specifically, social media games and simulated online chatrooms grew more prevalent from the notion of meeting without physical presence. The trend shows that the general public enjoys the activity of assembling at their leisure.[7]

Due to the nature of the design process, numerous variables complicate quantitative measure of efficiency and productivity for the architecture industry. By looking into other fields for precedence, the architecture field may be able to find examples to incorporate into practice. Research studies show that the more successful examples of networks and coordination come from the manufacturing industry. In Mezgár and Kovács study of small and medium-sized manufacturing enterprises, the authors note philosophical theory as a paradigm that modeled their studied enterprises: "The holonic manufacturing systems are an approach for a theoretical framework for autonomous and decentralized manufacturing organizations based on the classical holonic theory[8] introduced by Koestler."[9] This claim finds that complex systems are evolutions from simple systems as individual parts behave as sub-wholes. Such a proposition implies that individual parts function, but together as a system, they bring about a more efficient and productive system.

> In a distributed manufacturing environment the production planning has a key role. The co-ordination of the orders, the optimal assignment

[7] Carlson Bull in discussion with the author, October 2015.
[8] Holon theory was proposed by Arthur Koestler as a philosophical theory in finding order to complex systems.
[9] I. Mezgár and G.L. Kovács, "Co-ordination of SME Production Through a Co-operative Network," *Journal of Intelligent Manufacturing* 9 (1998): 167.

of the different resources is a very difficult task in a co-operative production environment of a closed group of several SMEs. The main characteristics that have to be preserved are the independence of nodes (SMEs) and the stability of the network…Thus, one of the major requirements for network co-ordination is the availability of information and methods for workload distribution among the nodes[10]

As in all industries, success depends on coordination between involved members and parties. Progress is made as each part collectively works as a whole, but also each individual part acts as a whole to advance its own self. In order to unify and make progress, educated decisions must be made that impact the entire system of parts. Applying this mentality to collaborative groups, advancing the design process occurs as all members contribute to the overall completion of a project by satisfying their own individual responsibilities and obligations related to the task. Developments that enable shared delivery, such as cloud capabilities of CAD and BIM software, allow for greater access and versatile workflow among individuals of a group (Figure 1. 1). Technological advancement must serve to aid the process of making design decisions.

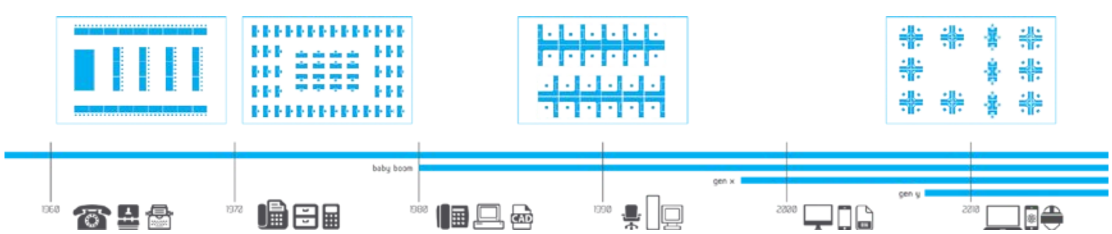

Figure 1. 1: Evolution of technology and office through time (source: author)

[10] Mezgár and Kovács, "Co-ordination of SME Production," 168.

Figure 1.2: (top) users experiencing virtual reality; (bottom) immersion in virtual space (source: superarchitects)

Reality to Actuality

reality (n.) *an event, entity, or state of affairs; the totality of things and events*
actuality (n.) *the quality or state of existing in act and not merely potentially*

Merriam-Webster Dictionary

In the conventional design process, a disconnect between what is and what we think is occurs; we cannot truly experience what we design before construction. Such is a demonstration of the constructed realities in which designers may delude themselves; renderings and illustrations of a design often bias the design toward a desired ambience and expression. As taught in architecture schools, bringing the design to the real world often sheds light to new perspectives on a project. This act can be interpreted as the preliminary steps to actuating a design; that is, the design manifests from the constructed reality of the designer's conception to the real world. Maquettes and physical models bring the conceived two-dimensional projections to third-dimensional form. The 3D representations broaden the possible audience from solely practitioners trained in reading drawings. The notion of expanding the audience allows for greater pooling in potential collaborators.

Using SHoP Architects as a case study, the firm attributes their success to the large collaborative process that integrates traditional architectural design with creative techniques of other disciplines.[11] Their work exemplifies the reiterative process of design by extending the architect's responsibilities and involvements with consultants. Rather than a linear fashion where the architect passes a drawing set to an engineer or contractor to validate and revise, SHoP chooses to engage with their consultants in real time and to prototype in house to test their designs. "SHoP began to realize that practicing digitally relied upon traditional methodologies for executing built work…Utilizing rapid prototyping, CNC milling, and 3D printing, they began to research a method of extraction that allowed for a more seamless connection between virtual simulation and analog production" (Tim Castillo, 313)[12] By reducing the time between an idea's realization and actualization, a greater number of iterations can occur to allow for further refinement.

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[11] Kimberly Holden, *SHoP Architects: Out of Practice* (London: Thames & Hud).
[12] Pressman, *Professional Practice 101*, 313

“The real is not opposed to the virtual but the possible, and the virtual is not opposed to the real, but to the actual.”[13] Gilles Deleuze, a twentieth-century philosopher, establishes the definitions of real, actual, and possible through polar comparison. While the concept of “virtual” is opposite to “actual,” “virtual” is closely related to “real.” The concept of virtual and augmented reality can then be explored philosophically, and its implications to the physical world can be seen implemented in new technology.

Chapter 2: Virtual Technology

Virtual Reality

Virtual reality (VR) technology immerses users into virtual environments via interactive technologies such as head-mounted displays (*see Appendix I: Devices Guide*). As Peng investigates the growing digital interaction at the close of the twentieth century, he found that VR technology was limited as a design tool due to the lack of two-way connections between VR systems and conventional CAD tools.[14] Now a decade later, that two-way connection has been established by the interoperability of CAD software. Translation between CAD tools has become increasingly more fluid as software corporations standardize their file formats to allow for greater distribution.

[13] Gilles Deleuze (translated by Paul Patton), *Difference and Repetition*
[14] Chengzhi Peng, *Design through Digital Interaction* (Portland: Intellect Books, 2001), 6.

With greater advances in hardware, VR technology has become further developed and widespread in its implementation. The majority of experiences have reached consumer culture, namely the entertainment industry as the technology attempts to appeal toward a larger audience.

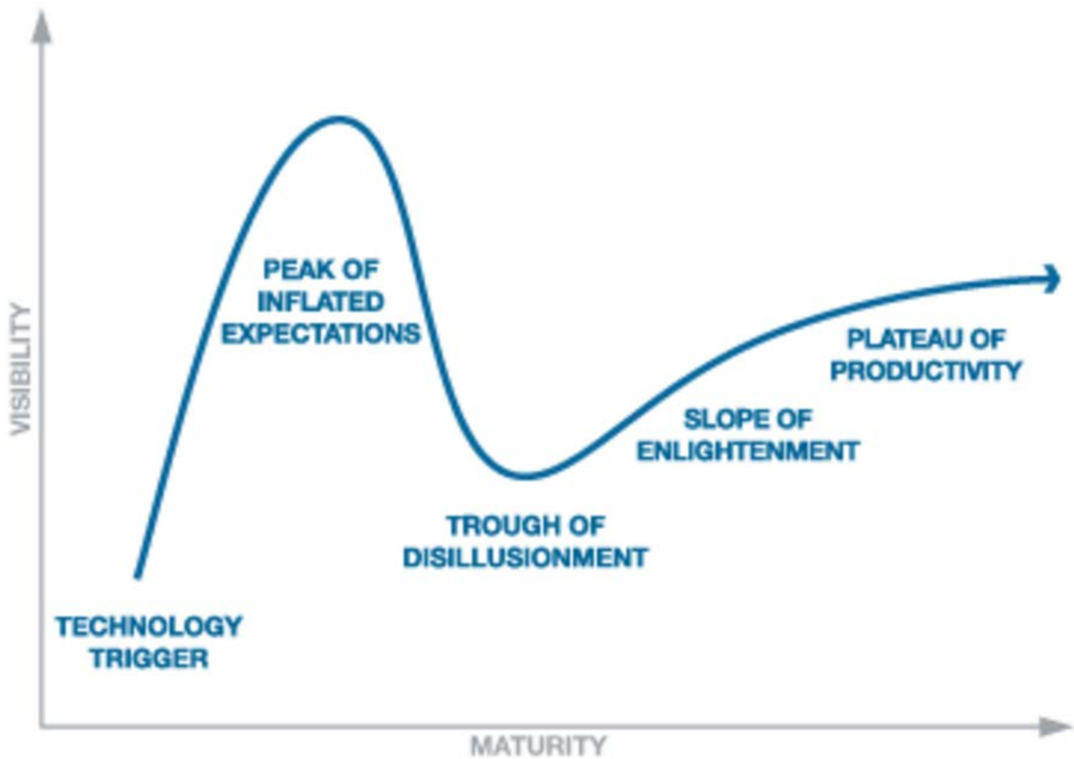

Figure 2.1: New Technology Hype Cycle (source: The Gartner Group)

The Gartner Group, a leading information technology research and advisory company, uses a curve (Figure 2.1) to illustrate how consumers shift their views of developing technologies over time.[15] At the time of writing this thesis, VR technology is slowly approaching the peak of inflated expectations as a number of original equipment manufacturers (OEM) have begun releasing their devices to the consumer population, namely the HTC Vive and Oculus Rift. The onset of VR

[15] William Sherman and Alan Craig, *Understanding Virtual Reality* (San Francisco: Morgan Kaufmann Publishers), 2003.

technology indicates a need of creative means and methods for consumers to engage in consumption, which lends to a building's re-programming of assignable spaces.

As an example of VR implementation, the groundbreaking of the new Brendan Iribe Center for Computer Science and Innovation was conducted in VR with the new Oculus headset.[16] This event marks a milestone for VR as a step from merely individual consumer devices to a collective audience for a shared experience. The Brendan Iribe Center intends to provide a hub for VR development and new computer science classes at the University of Maryland campus. The new center for the computer science discipline should encourage greater collaboration and advancement of new technologies.

Current Capabilities

Where Georg Flachbart conveys a translation of physical to virtual, this thesis traces the process from the physical to metaphysical and explores the impacts upon physical space and interactions. Flachbart envisions the future of architecture as mixed-reality environments where the virtual is seamlessly embedded in the physical[17]; these environments embed the virtual in the physical, and weave it seamlessly into urban daily life.[18] This notion implies that any space possesses and processes ubiquitous streams of data that can be collected when desired. Flachbart builds this theory as a result of two existing systems:

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[16] Lindsey Feingold, "UMD officials virtually break ground for Brendan Iribe Center," *Diamondback* (College Park, MD), May 1, 2016.
[17] Georg Flachbart, "Disappearing Architecture – From Real to Virtual to Quantum," *Disappearing Architecture* (Basel: Birkhäuser, 2005), 13.
[18] William Mitchell, "After the Revolution – Instruments of Displacement," *Disappearing Architecture*, 18.

a) an interconnected information technology infrastructure for open, distributed and heterogeneous application environments based on quantum information processing

b) an architecture which integrates this interconnected information technology infrastructure in a way that enables one to conceive buildings as quantum objects (i.e. objects able to be literally in two states at once – on and off, 1 and 0, real and virtual)

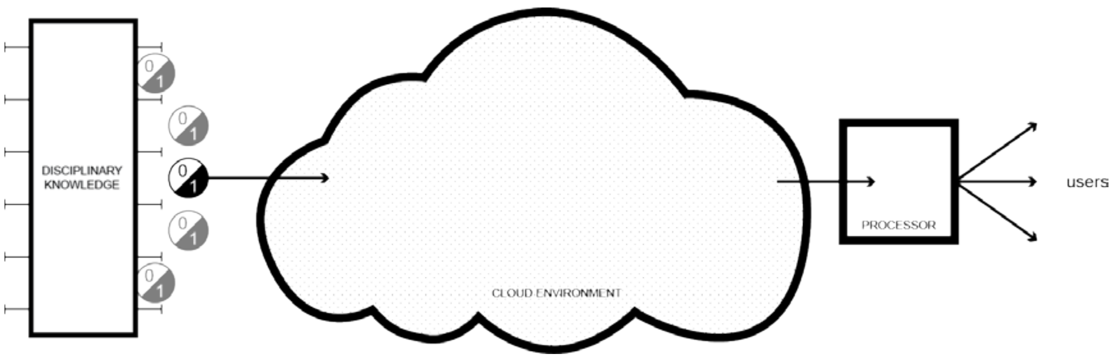

Figure 2.2: Diagram of existing infrastructure (source: author)

An interpretation of how those two systems communicate is represented in Figure 2.2. Cloud sharing and networked information would be the open, distributable environment while real-time processing applications serve as facilitators to the "quantum objects" being processed. As such, this frames the process of tracing the translation from the physical to the virtual and metaphysical.

What occurs in the physical reality? For the purposes of this thesis, we focus on the design processes that involve physical presence such that interaction is necessary. In terms of architecture, the interactions are not limited to between team members and other collaborative groups, but also interactions with the buildings and spaces surrounding the subject. The vast amount of information that occurs is interpreted by the parameters and processes that we assign to that information. Figure 2.3 below illustrates an example of how one may identify a brick through a series of familiar parameters. In physical reality, the five senses categorize the types of information processed in everyday life. The acts of sharing and communicating that information depend on the media that individuals use to relay. The typical architectural office houses a document control room or document library to contain the widespread knowledge collected within the office. That space allows for a passive, communal sharing of the collected information regarding various topics. In essence, such a library frames the physical cloud environment (pictured earlier in Figure 2.2) that precedes the processing between users. Therefore, those processes require an architecture or space that can facilitate those interactions.

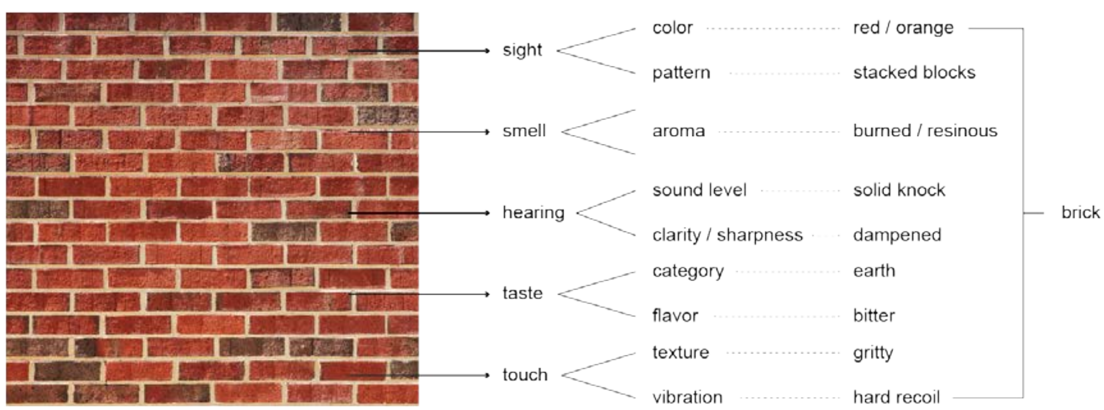

Figure 2.3: Physical interpretation of an object (source: author)

How does one experience the virtual? Mitchell explains that the instruments of spatial displacement through remote connection already embed the virtual into the physical, seamlessly into daily urban life.[19] Mobile smartphones and pocket electronics are a small subset of examples that are casually used. However, because

[19] Ibid., 20.

of their ubiquity, every user is virtually tied and connected together via communication networks. As Flachbart described earlier, those instruments of spatial displacement serve as quantum objects; endless streams of data and information make themselves available upon activation, and flow is arbitrarily determined by the user. Users determine which pieces of information to gleam from various sources and which to process and use.

The act of using that virtual information begins the construction of a virtual reality. Virtual information streams rely on data and quantitative values, such that they can be distributed and connected among various users. The virtual office described from Appegath and Pressman[20] relies entirely on the constant flow of their information streams. Continuing the brick example, the brick depicted in Figure 2.3 shows but a small subset of information required for one to understand that a brick is being perceived. For that specific brick to be represented and comprehended in the virtual reality, more parameters must be set so that the same physical properties in the real world can be conveyed in the virtual (see Figure 2.4). Invisible data is understood and assigned in the real world, but carried into the virtual; the only limitation is the amount of information to be transmitted.

[20] Pressman, *Professional Practice 101*, 283.

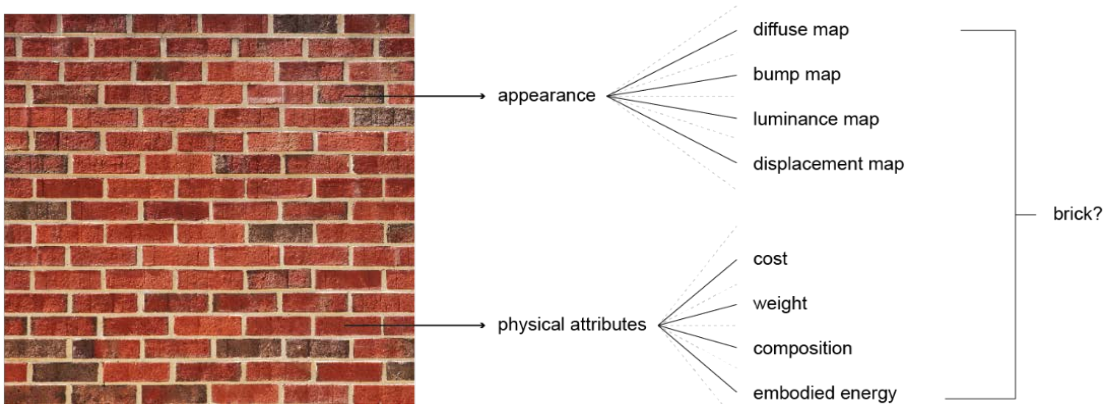

Figure 2.4: Virtual interpretation of an object (source: author)

How does that information render into virtual reality? As those who in the field of architecture are trained, designers automatically embed their visuals with information to convey their ideas and thoughts. Whether the designer intends to convey an issue with a design proposal or cost estimate, the field of architecture relies greatly on visual communication. The ability to communicate visually and effectively determines the success of designers to clients. The virtual realities to be discussed in the next section delve into first-person guided walkthroughs, like those generated by Revit, and full-immersion applications giving the user full control and manipulation of virtual stimuli.

As technology advances at a staggering pace, the seam – the perspective hinge[21] – between physical reality and virtual reality continuously blurs and fades from realization. Many industries have taken the initiative in incorporating this concept and built new media around the notion of blurring the real and virtual. Most notable is the New York Times following the film industry in its embracing virtual

[21] Alberto Pérez-Gomez, Architectural Representation and the Perspective Hinge, 1997.

reality technology to more effectively communicate to their audience.[22] By "effective," the New York Times journalists sought to make a larger impact upon their readers by immersing into readers into live-action scenes that the journalists were reporting. Journalists determined their impact with discussions on social media platforms and monitoring the feedback generated from the implementation of the virtual reality media.

Collaborative workspaces can begin to implement virtual reality methodologies into their activities. Figure 2.4 demonstrates the objective parameters needed in identifying the visual representation of an object in the virtual realm. This sort of quantification then allows for objective sharing of information among various users in a connected network. Virtual reality can provide the efficiency, uniformity, and objectivity (depicted in Figure 2.5) to convey real-time data.

[22] Lorne Manly, "A Virtual Reality Revolution, Coming to a Headset Near You," *New York Times*, November 19, 2015, accessed December 8, 2015.

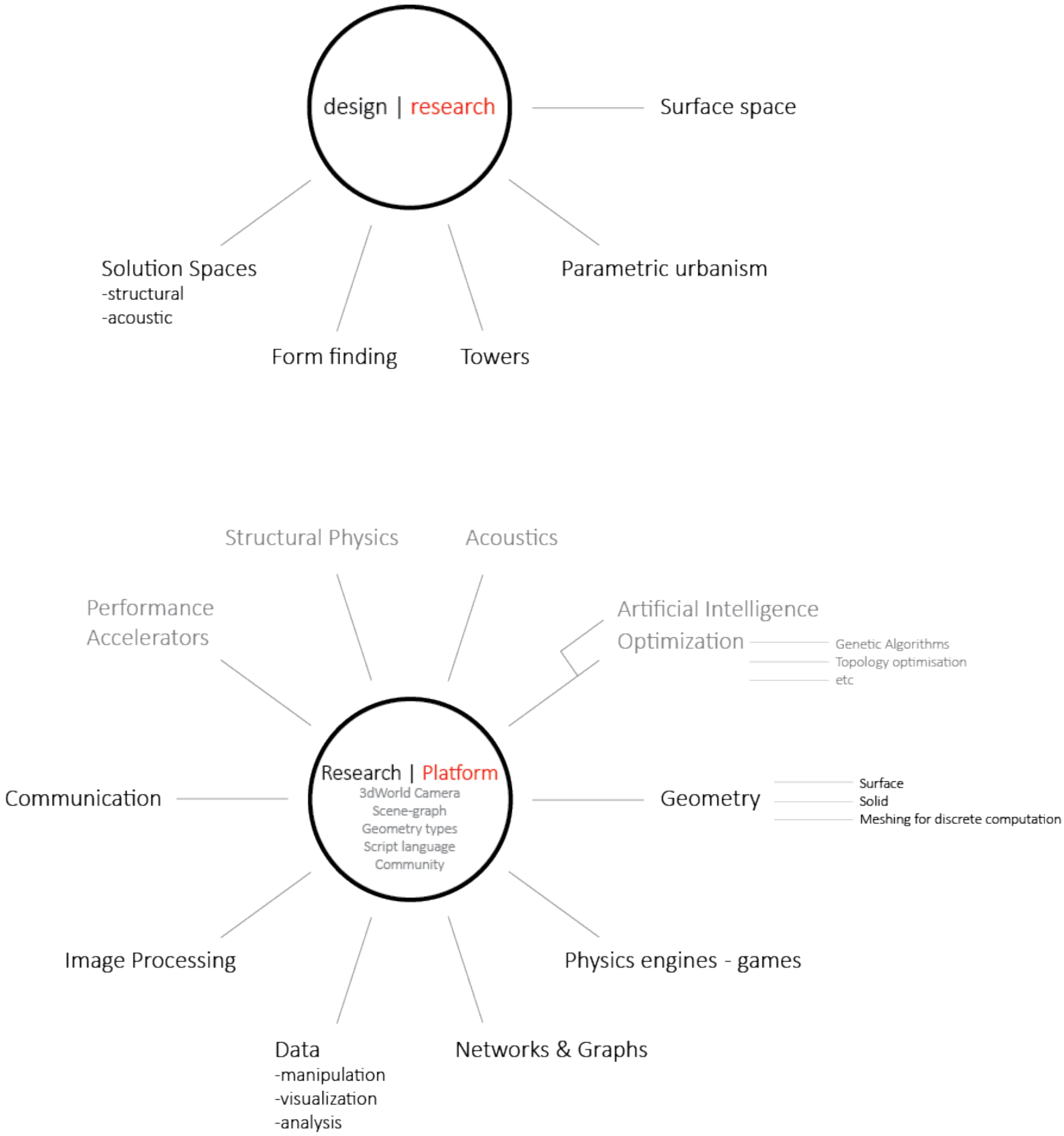

Figure 2.5: ZHA-CODE Manner and Medium (source: Shajay Bhooshan in *Paradigms in Architecture*, 37)

Chapter 3: Virtual to Physical Space

Design Proposal

Figure 3.1: Steelcase's representation of different job types as a function of collaboration v. mobility (source: Steelcase in *Benching*, 3)

Steelcase, a manufacturer of furniture for offices, hospitals, and classrooms, promotes this graphic as a map to determine where different disciplines fall into in regards to an individual's necessity for interaction and movement. For the purpose of this thesis, the targeted audience will be directed toward young entrepreneurs and start-ups. The activities that occur within the targeted audience can be viewed as following the process of a design problem (Figure 3.2). The current trend shows that these young companies have a direct need for shared spaces as well as the businesses to engage in methods for higher productivity.[23] This design proposal seeks to advance the field of collaboration with a focus on incorporating digital media.

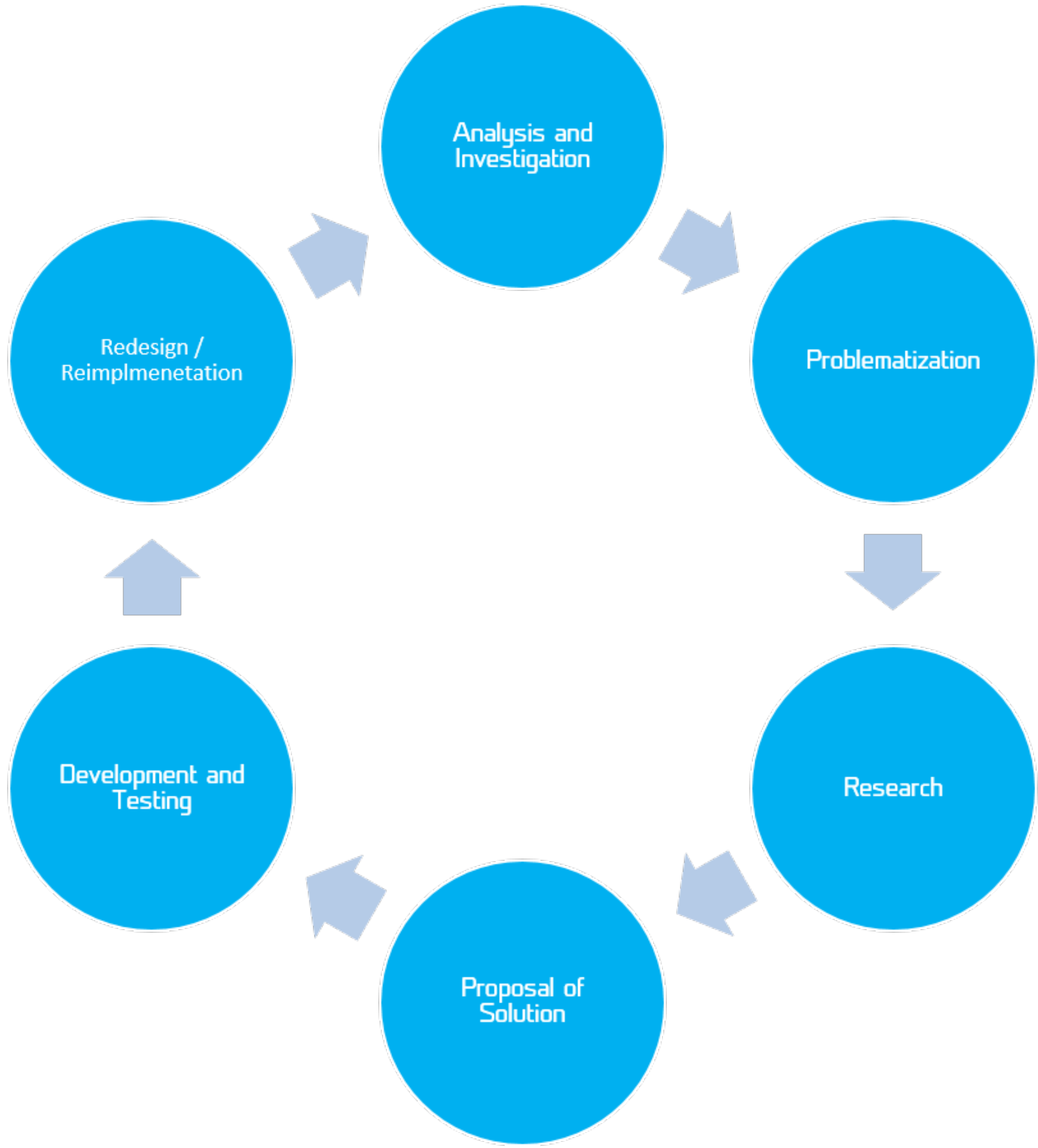

Figure 3.2: Design Problem (source: author)

[23] "The Next Office: Why CEOS are Paying Attention" Steelcase 360. Issue 63.

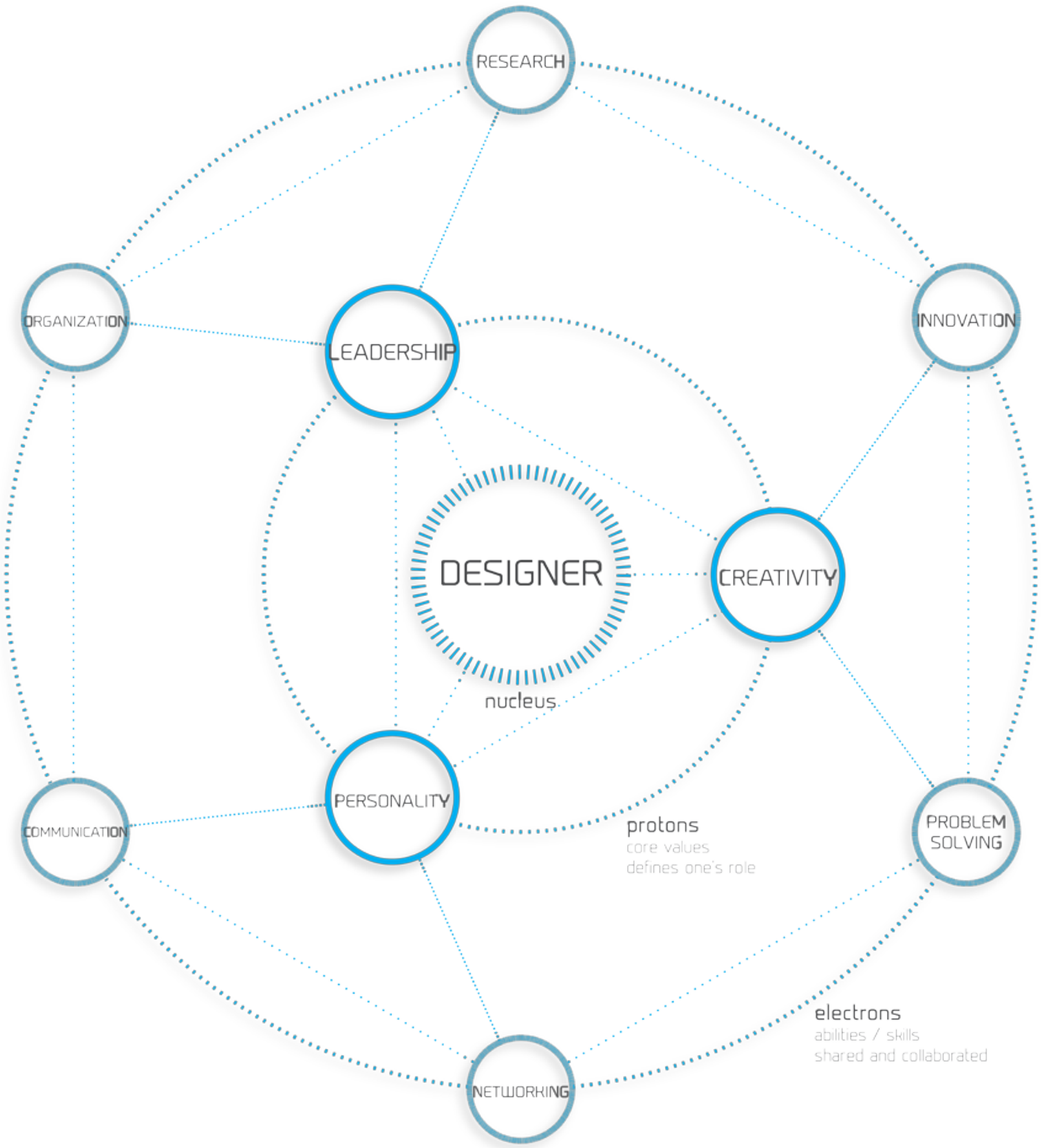

Figure 3.3: Mapping the designer (source: author)

Before designing a collaborative space, we begin by identifying the need to collaborate. A designer can be decomposed (illustrated in Figure 3.3) into various parts that classify one as a designer: the person as the nucleus, the classification's characteristics as protons, and the skills and talents as electrons. Imagining that multiple designers come into play, they revolve around a design problem that maintains their bonds. An individual can then be portrayed as an ion within a larger system of other designers and design problems.

The design problem can be interpreted as a system center while collaboration acts as a membrane that maintains the bonds between the free roaming ions. Figure 3.3 shows a depiction of the designers' ability to share their skills and talents with one another through collaborative processes. Digital media and technology has aided in this connective act as individuals are no longer limited to physical space and interactions.

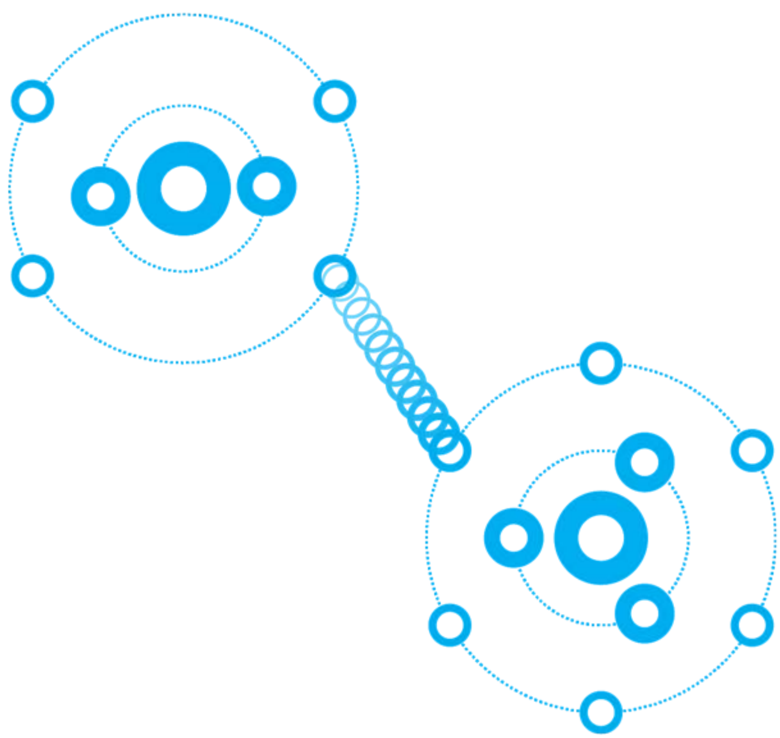

Figure 3.4: Connection (source: author)

Once those abilities have been acknowledged and shared, ideas and activities become able to be re-conceptualized as various solutions are considered and proposed. This diffusion (Figure 3.5) lets other potential collaborators join the process and conversations to further the design process and allow for greater depth into the design problem at hand.

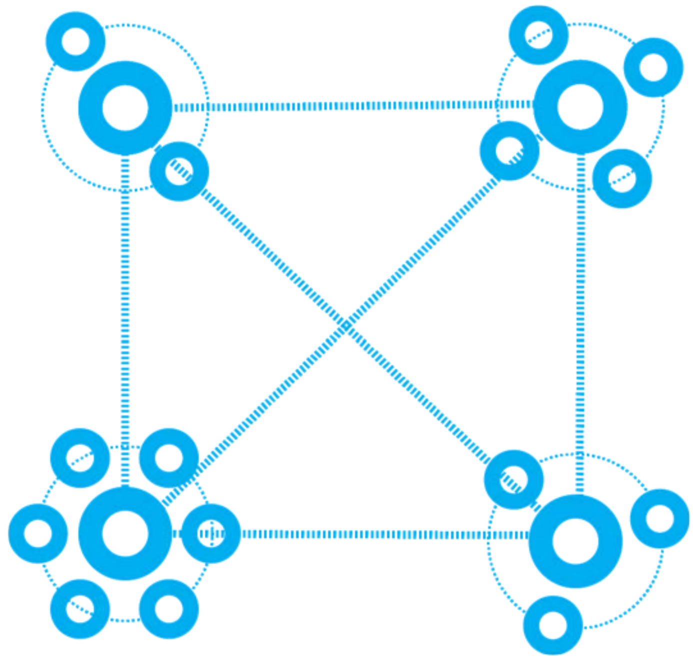

Figure 3.5: Diffusion (source: author)

The question that this thesis investigates then is: what are the impacts of architectural design on collaborative spaces (Figure 3.6)? For the architecture proposed, the activities to occur within the structure should not be limited to individual actions, but rather to house and frame interactions among multiple persons.

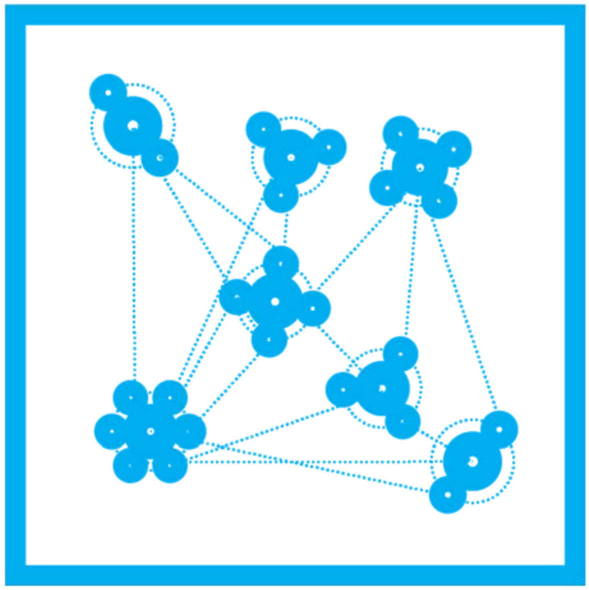

Figure 3.6: Architecture framing collaboration (source: author)

The purpose of this building is to house the physical and virtual activities of a collaborative process. Sizing of the necessary rooms and purposes will dictate the overall size requirement of the building, while site features will depend on the location chosen for the design proposal. The activities that occur in this building should not be limited to the specific purposes; rooms should be open and flexible to allow various configurations of space so that purposes change as technology changes.

Client Considerations

This section looks into precedent studies of current startups and small businesses that delve into virtual developments.

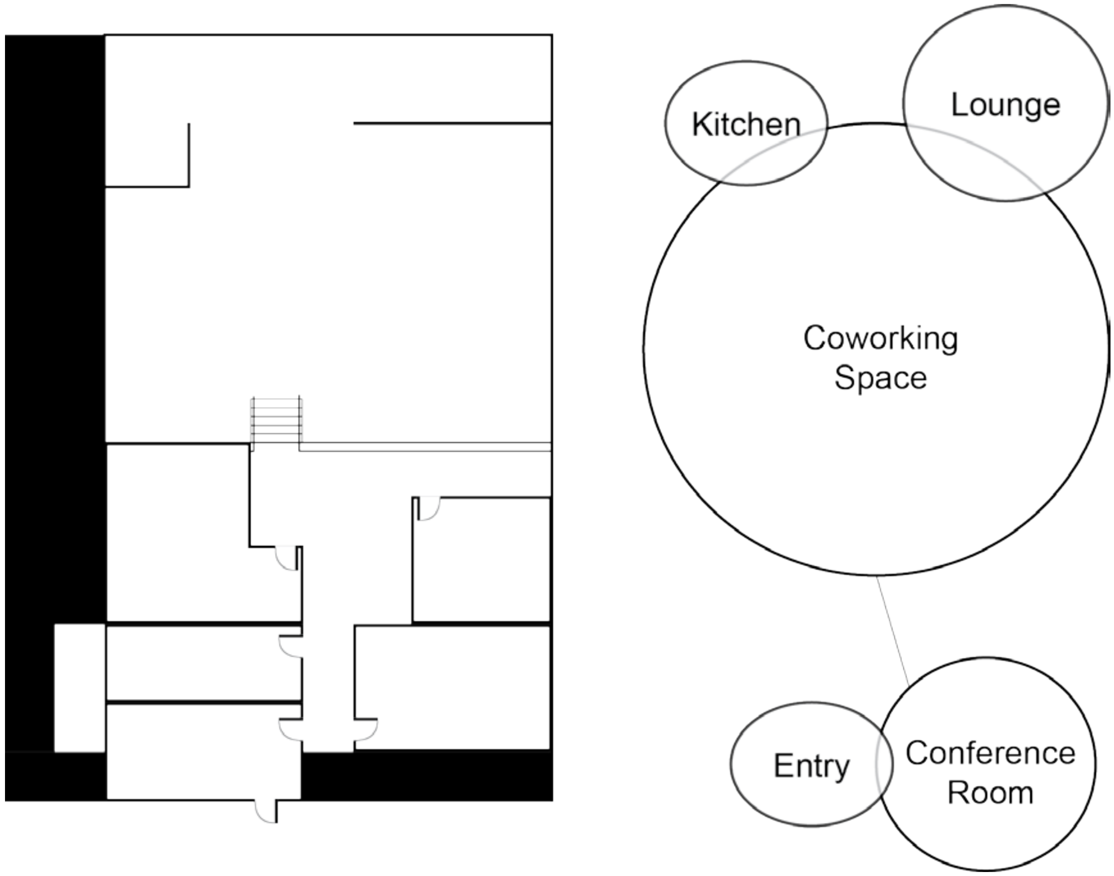

Figure 3.7: Bully Entertainment's Office Plan (source: author)

Bully! Entertainment is a production studio that promotes itself on creating innovative brand experiences, mainly directed toward the entertainment industry. Though their work primarily occurs in a digital workspace, their office space requires that team members be in close proximity to one another (Figure 3.6). Their workflow follows closely to that of a typical design process in which ideas are generated and diffused for refinement before the animators render and finalize their content. Figure 3.7 demonstrates the various actions that may occur in each of their spaces; however, the overall organization centers around their coworking space where the animators and content creators freely share and communicate their productions.

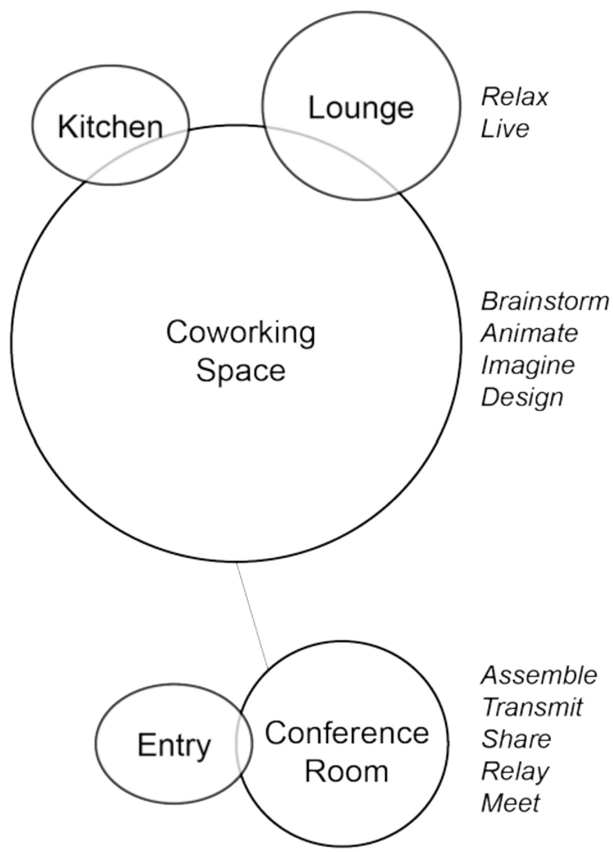

Figure 3.8: Diagram of Bully Entertainment's program arrangement (source: author)

The office's arrangement depicts a clear distinction between private space and public space. Where the back end of the office loads itself with the private program, the large coworking area allows for communal broadcasting of ideas. Connection and diffusion of ideas occur without hindrance, which are even furthered with Bully! Entertainment's fluidity with social media. Their primary means of communication occur via Trello and cloud-based services to promote ease of accessibility among clients and collaborators. The office's organization provides an example to follow for clarity of spatial reading and function.

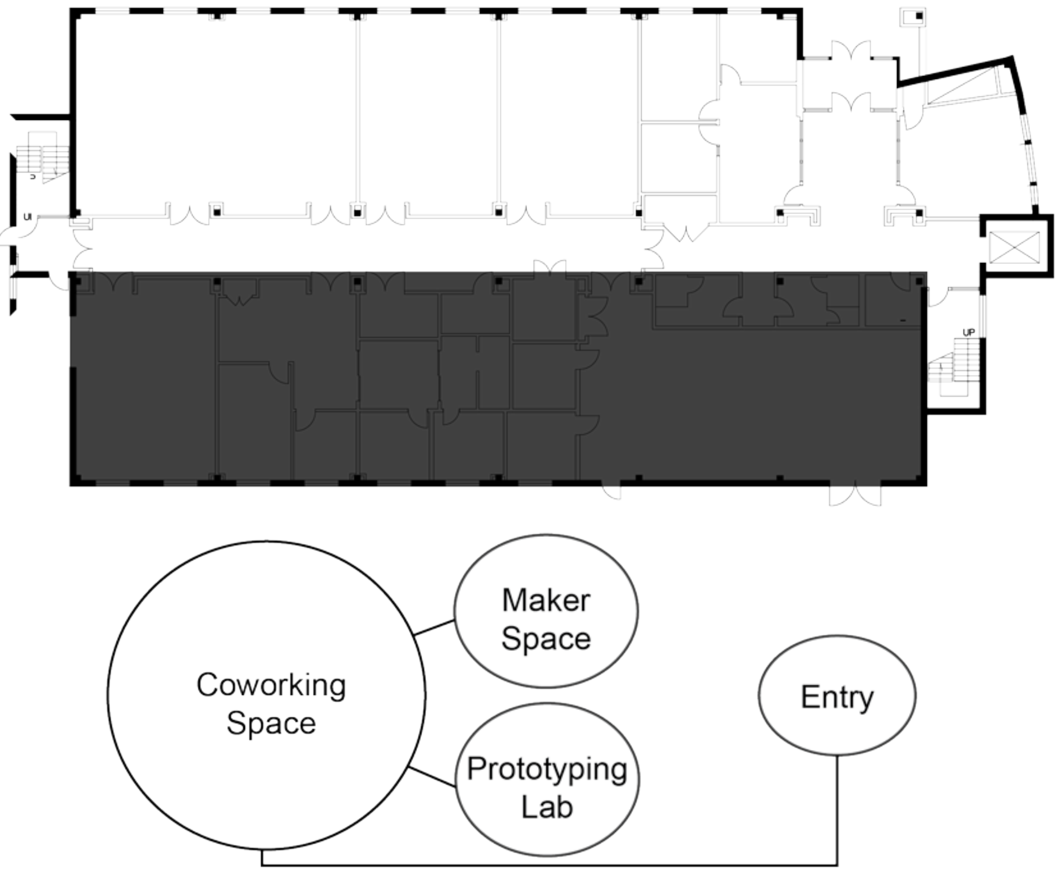

Figure 3.9: Start-Up Shell's floor plan at UMD's Technology Advancement Building (source: author)

The start-up culture at the University of Maryland has been furthered with the activity from the Maryland Technology Enterprise Institute (Mtech). As a result, Startup Shell was founded on becoming an independent student organization that fostered the entrepreneurial spirit of students and emerging professionals. Located in the Technology Advancement Building, their spatial organization simplifies that of Bully! Entertainment's to solely a large corridor (Figure 3.9). The main space, which is a double-height incubator space, houses a simple lounge and workstations to allow for multiple re-configurations depending on the event. This flexibility allows for intimate work sessions ranging from twenty students to large corporate events housing greater than two-hundred persons. As students are the primary users of the space, Startup Shell also houses a maker lab for prototyping of various startup products. Though the space was planned ad hoc, the clear connection between the spaces allows for ease of access and function for all purposes (Figure 3.10).

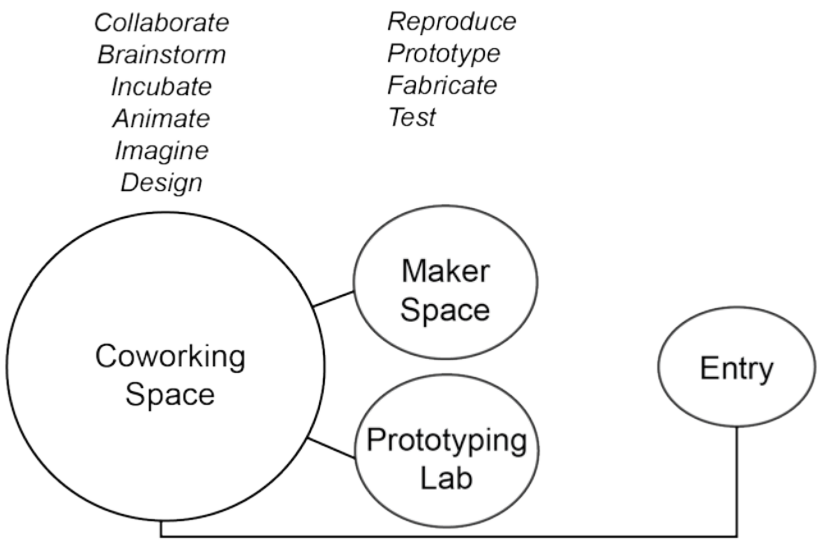

Figure 3.10: Diagram of Start-Up Shell's program arrangement (source: author)

Figure 3.11 shows a comparison between the two aforementioned spaces. The efficacy of those layouts can be evaluated based on the activities that occur: brainstorming, illustrating, and producing. Much as these activities can be performed individually, Bully! Entertainment and Startup Shell requires that they be performed in a collaborative environment to further develop the ideas and to test them via prototype or drafting among others. Looking beyond the product and outcome, those spaces perform best as they generate community and comradery between the collaborators. Those spaces engender collaborative spirit, which then lend to the innovative design that they seek.

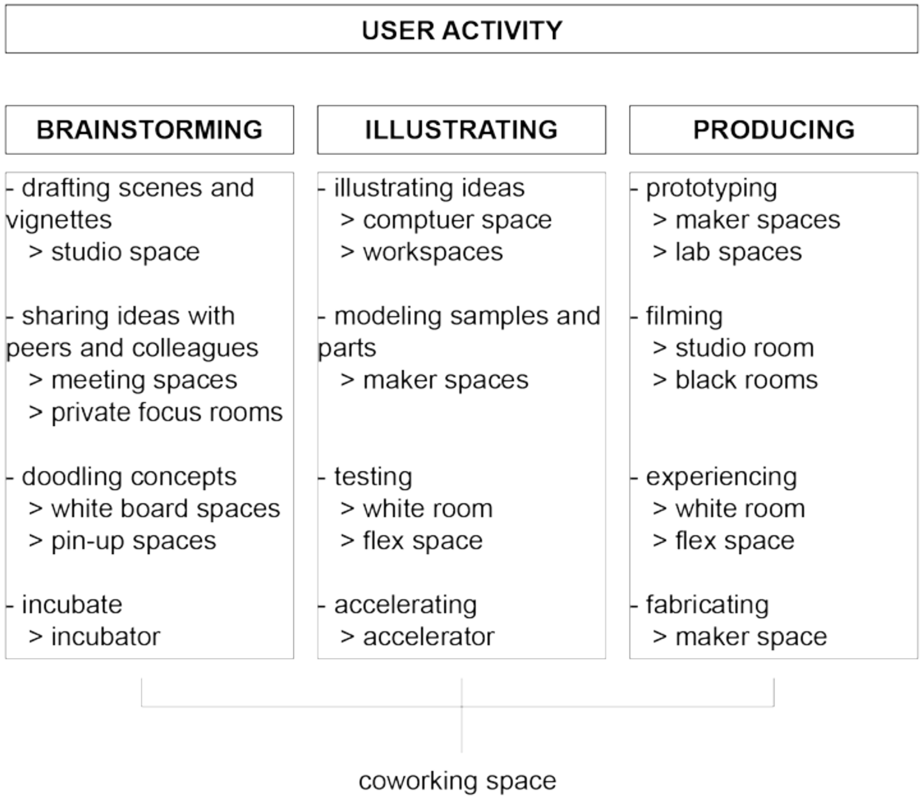

Figure 3.11: Diagram of similar user activity between Bully! Entertainment and Start-Up Shell (source: author)

Chapter 4: Site

Site Selection

Site selection is determined by criteria that will impact the building's goals of community and livelihood. Considerations of demographics and culture influence the feasibility of the intended site. Variables of building function and mechanical efficiency will be withheld until discussion in Chapter 5: Actuation. The table below delineates the evaluation for site feasibility:

Intended Users	Expected Demographics Accessibility to Public Transportation
Access to Capital	Proximity to Investors and Decision Makers Proximity to Users of Space
Cultural Implications	Nearby Infrastructure Satellite Operations

Intended Users: depending on the location, the demographics will vary. This will impact the uses of the building as its flexibility molds with the usage of the space. The nature of this thesis leans toward fledgling companies and start-ups. Places already developed with infrastructure for digital applications and virtual technology will require less supplemental equipment and space than other places. An example would be that of Baltimore's Foundry; while a building proposal may include small spaces for fabrication and rapid-prototyping, larger fabrication projects could be outsourced to the Foundry in order to build relations and economic benefits. Concerns of accessibility and neighboring populations will be considered in site analysis.

Access to Capital: this criterion shapes the building's scale and ability to approach the surrounding community. The building's community should be able to reach out to the general public and to garner attention when the occasion arises. As the space opens toward the public, investors and lobbyists would be able to visit and observe the activities housed within the site. This targeted audience is primarily intended to cater to business goals desired by intended users, as well as serve the site owner's goals of maintaining an attractive location. The methodology of targeting audiences follows after think-tank approaches in seeking action. For the community, the location becomes a beacon to interested individuals and gathers like-minded groups together to the site. In effect, the location harbors the surrounding intended users with those in power to build a cohesive area community.

Cultural Implications: as the nature of this thesis delves into studies of collaborative work and emerging technologies, the resulting effects of a design following those subjects will influence site selection. Locations where similar ideas and goals already exist will have variable degrees of change and feedback from the surrounding community compared. This assumption is made when considering the potential competition a new site owner may introduce. If a site already consists of similar start-ups and groups, then the building use is less likely to be innovative and new to the site, which may result in beneficial cooperation or rivalry between groups. A comparison can be made between cities that heavily embed digital, technological culture and those that do not, as will be depicted in the subsequent diagrams.

The subsequent figures identify possible sites for this thesis.

Site A: Jonestown, Baltimore, MD

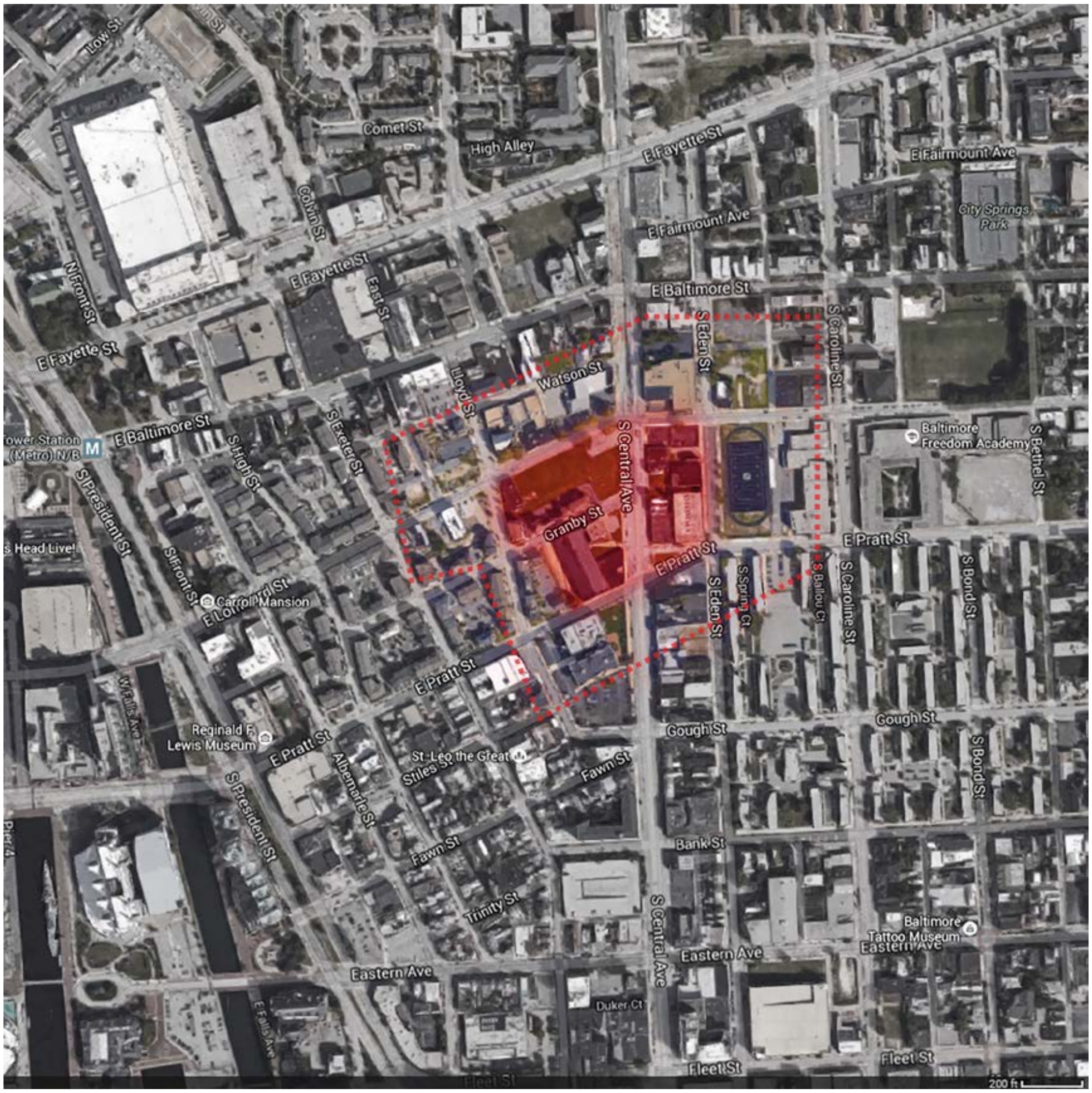

Figure 4.1: 1181 East Lombard Street, Baltimore, MD 21202 (map source: Google Maps)

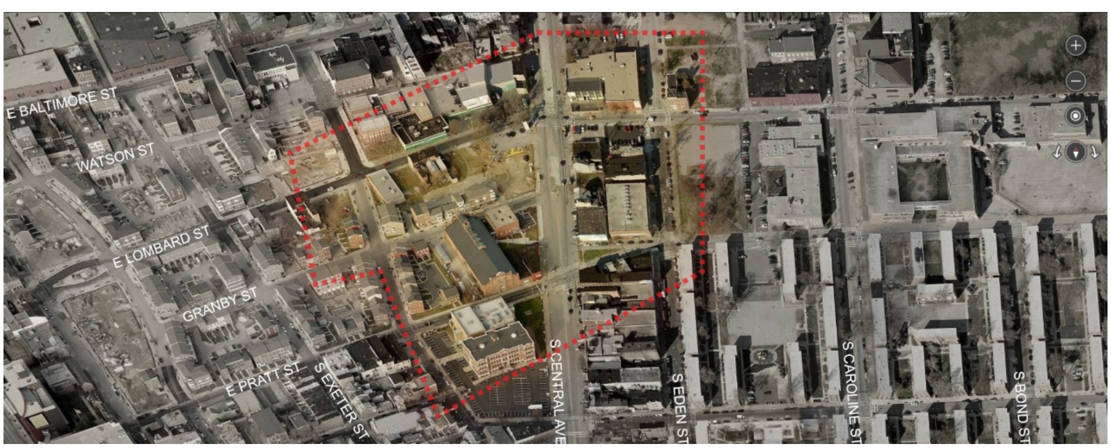

Figure 4.2: Existing photography of proposed Baltimore site (map source: Bing Maps)

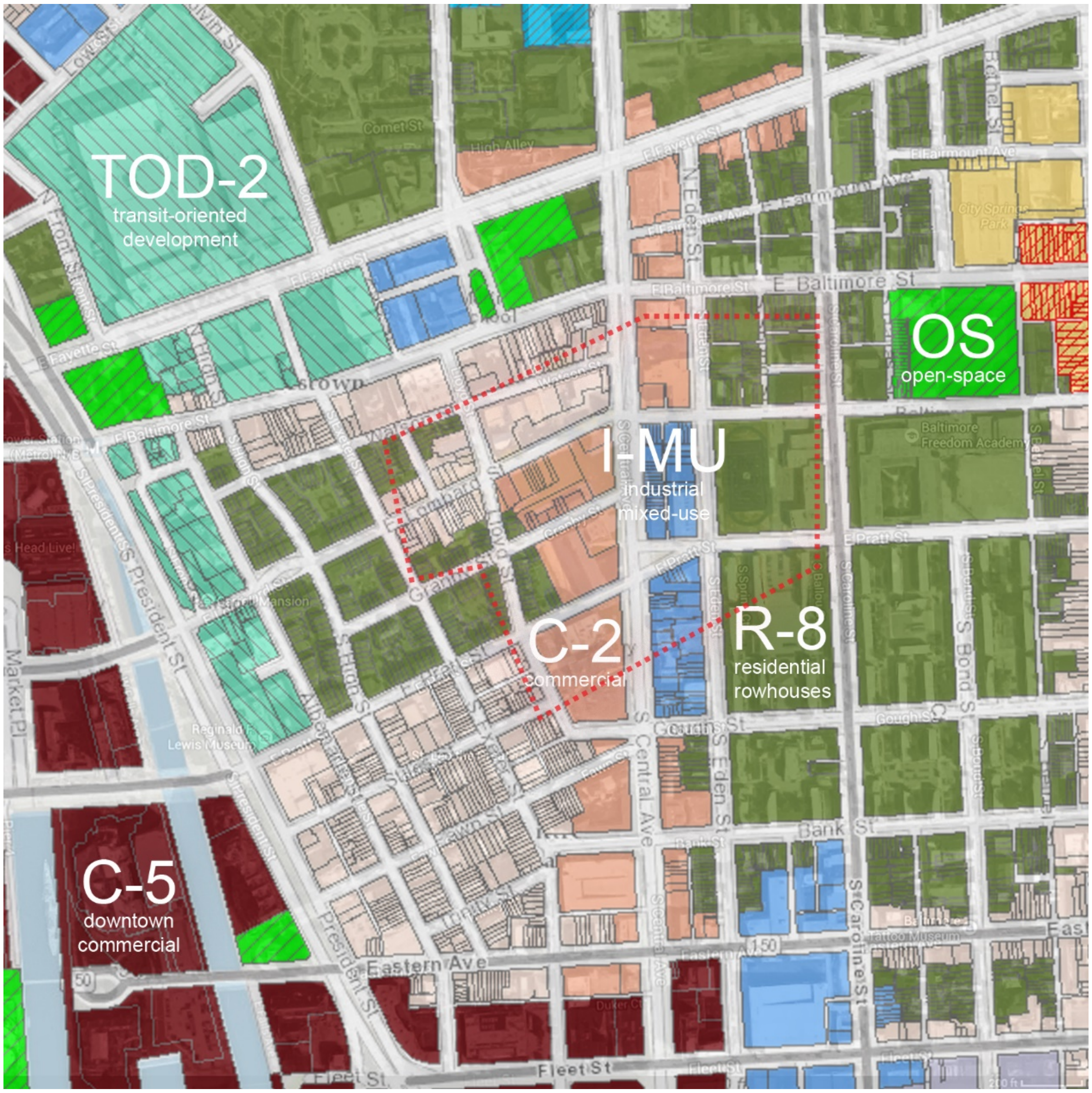

Figure 4.3: Zoning map of proposed Baltimore site (map source: Baltimore City View)

Intended Users: this location in Baltimore lies between a residential district and commercial zone (see Figure 4.3 above). Intended activities will cater toward the local population of residents and small-medium business owners. The residential and commercial zoning indicate that this side of Baltimore defines its character as a live-where-you-work with job opportunities and blue-collar and white-collar populations nearby. The proposed building could serve as a community center for where instructional courses and community classes may take place.

Figure 4.4: Nearby institutions and locations to proposed Baltimore site (map source: Google Maps)

Access to Capital: a number of institutions make themselves local to the selected site of Lombard St. and Central Ave. The location serves as an outlet to the central business district of Downtown Baltimore while also providing convenient access to the amenities of Little Italy. The intersection of Lombard Street and Central Avenue depicts the crossing of various school campuses: Stratford University, City Springs Elementary School, and Baltimore Freedom Academy. This indicates a large portion of the population and potential investors will come from student bodies and

STEM fields. Namely, potential prospects may stem from University of Maryland and Johns Hopkins in their goals of building innovative districts.

Cultural Implications: as Ray Gindroz, FAIA, describes innovation districts:

> It's another important breakthrough to be able to go into neighborhoods which have deep problems and propose solutions which are simultaneously dramatic enough to attract new investment and yet consistent with the historic traditions and character of the place.

This region of East Baltimore characterizes itself as a transition point between the industrial workplaces of the harbor to the residential rowhouses of Harbor East. As I-83 ends at this location, so too does larger scale development. The majority of development occurs toward the central business district along West Pratt Street. Using this site as a seed to spur innovation-district building would incur a more balanced business corridor around the harbor. In effect, neighborhoods become revitalized and invigorated with new opportunities for learning and skill development.

Site B: University of Maryland, College Park, MD

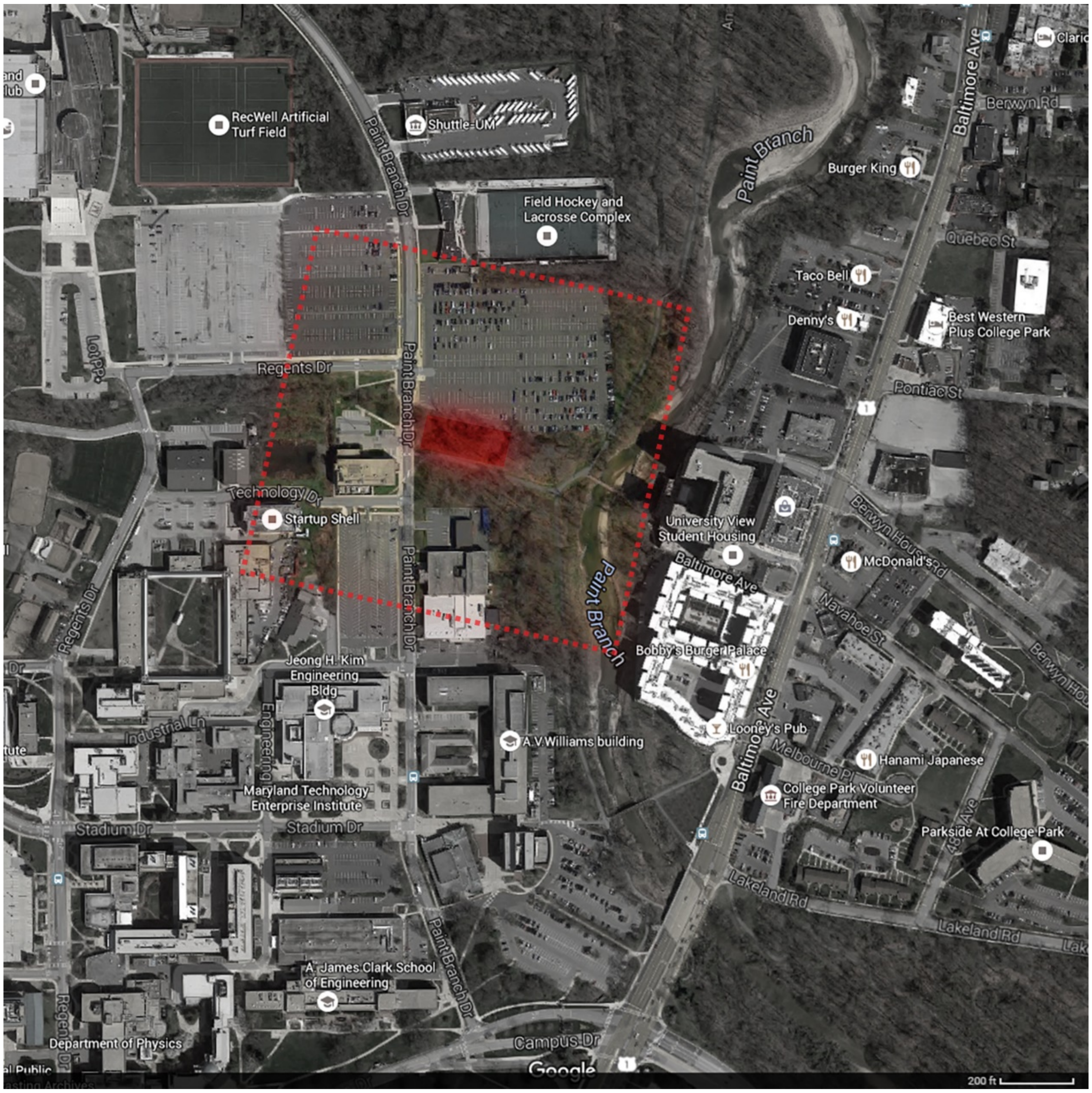

Figure 4.5: 8537 Paint Branch Dr., College Park, MD 20740 (map source: Google Maps)

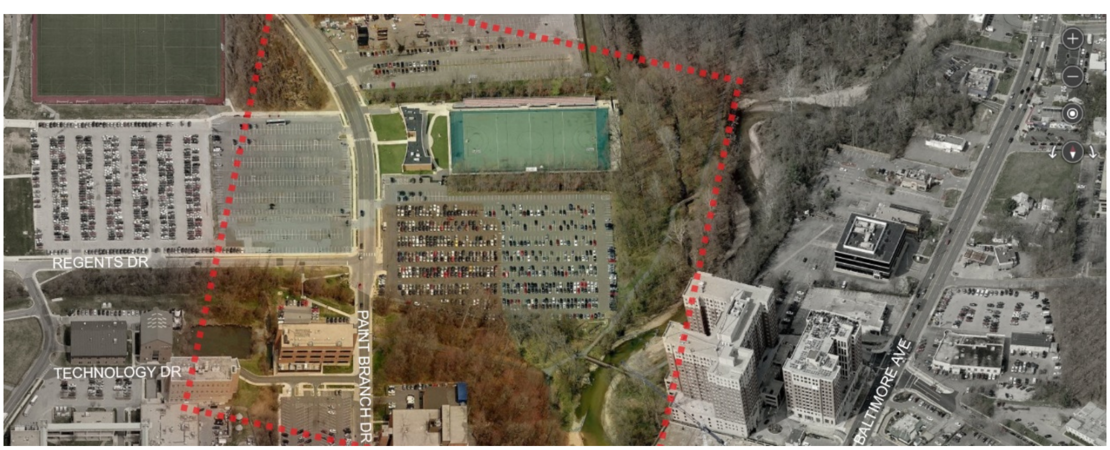

Figure 4.6: Existing photography of College Park site (source: Bing Maps)

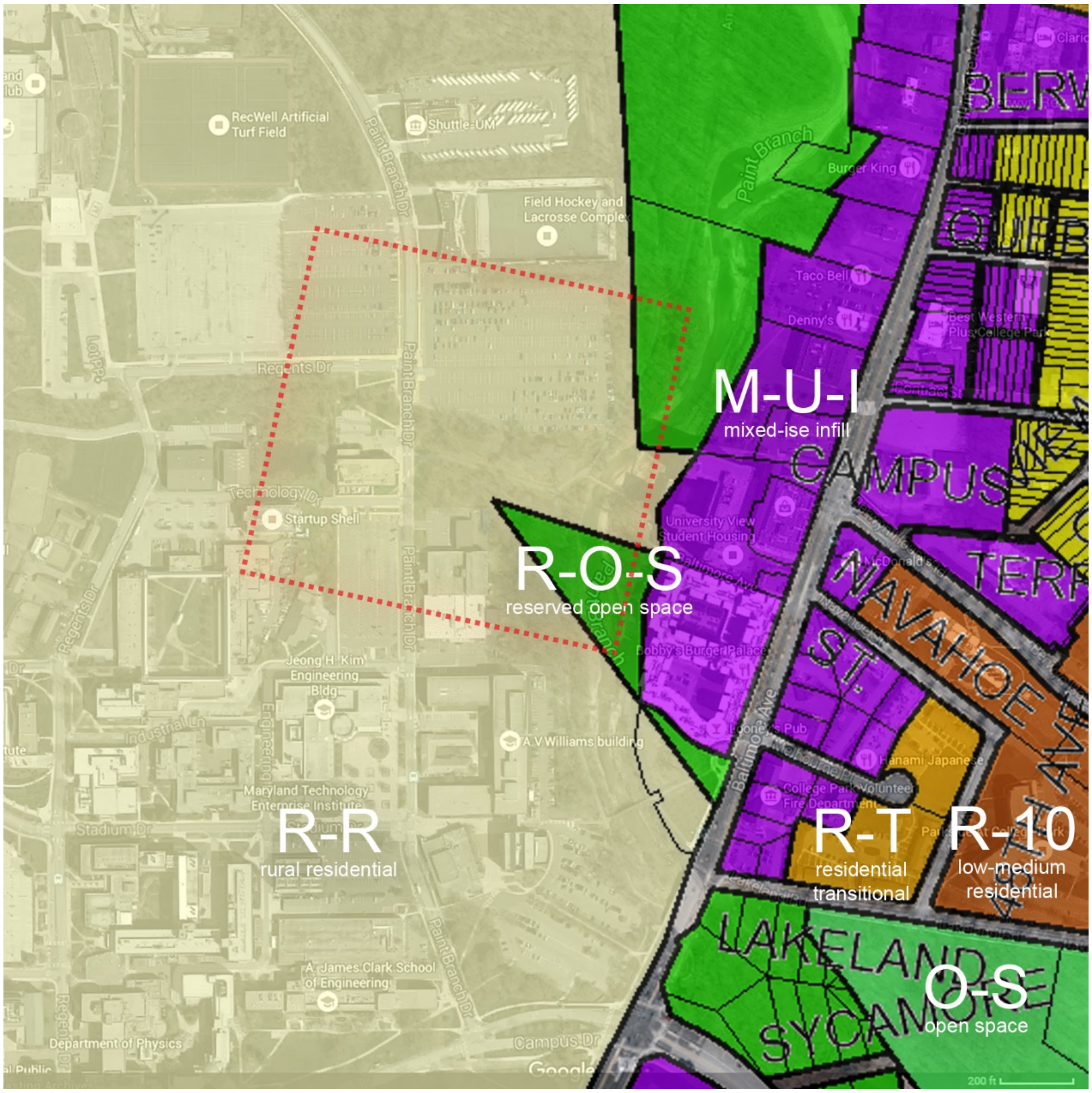

Figure 4.7: Zoning map of proposed College Park site (map source: PGAtlas)

Intended Users: as the location is a college campus, the majority of expected users will be students and emerging professionals. Faculty and students will be able to collaborate with others unassociated with the university due to proximity to the US Route 1 transit corridor. The proposed building will serve as a community center for where instructional courses and community classes may take place.

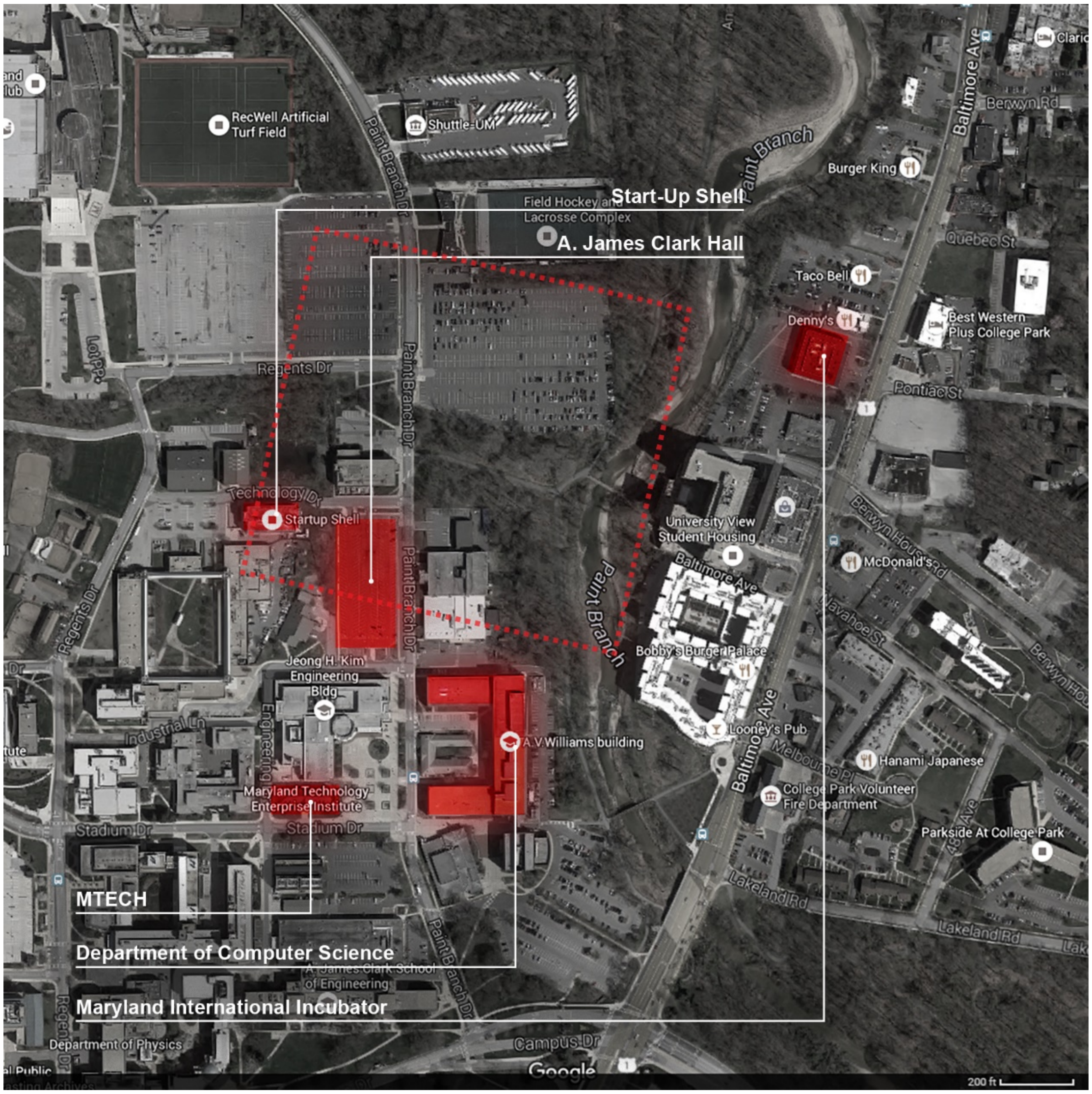

Figure 4.8: Nearby institutions and locations to College Park site (map source: Google Maps)

Access to Capital: the close proximity of University of Maryland's many technical departments allows ready accessibility to resources that the building proposal will offer. As University of Maryland provides most funding to the developments in this area, the site proposal would be directed toward appeasing university officials and addressing needs from the establishment. However, with those considerations, the proposal must also take into account of incentives to drawing crowds outside the university. Initiatives such as Maryland International Incubator

(MI2) have begun that endeavor by encouraging start-ups and small businesses to inhabit their offices, located just on the periphery of the university's campus.

Cultural Implications: compared to Jonestown in Baltimore, this location possesses a greater deal of infrastructure and resource availability than the central business district of a city. The larger accessibility to experts and facilities on-campus benefits the users of the building as they become more connected to the campus. Community and interdisciplinary activity would build among the commonalities and shared resources. The value of the design proposal would lie in the bonds built among current departments as opposed to new relations.

Site C: 15th Street, Washington, DC

Figure 4.9: 1133 15th St NW, Washington, DC 20005 (map source: Google Maps)

Figure 4.10: Existing photography of proposed Washington site (map source: Bing Maps)

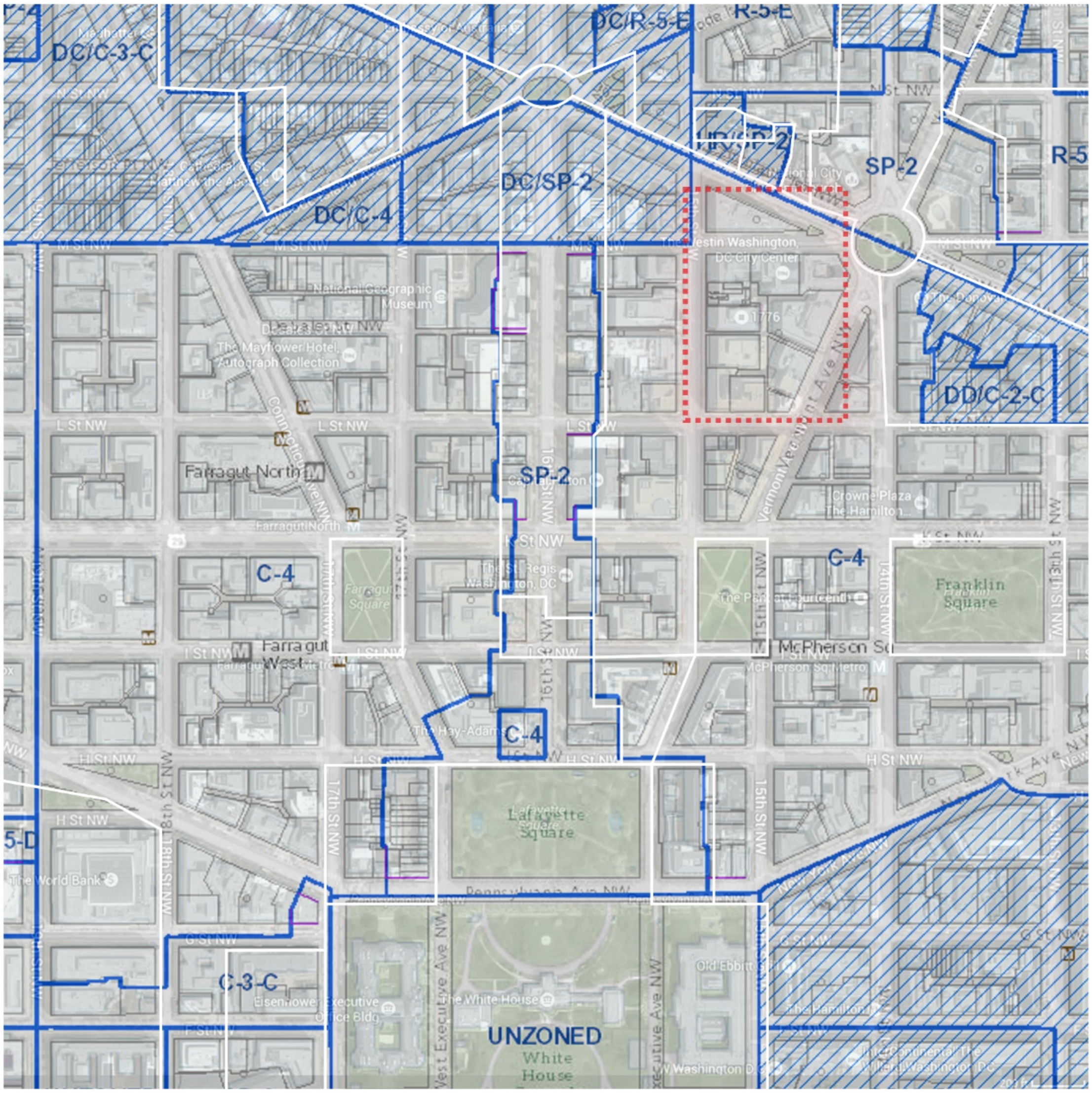

Figure 4.11: Zoning map of proposed Washington site (map source: District of Columbia Zoning)

Intended Users: with a large amount of foot and vehicular traffic in this area, the intersection of Massachusetts Avenue NW and 15th Street NW serves as a location for a number of attractions. The C-4 (commercial retail and office) and SP-2 (medium/high-density residential and office) allows for large scale development in this region. As a result, majority of denizens to this area are likely white-collar workers and local residents partaking the nearby amenities. Nearby educational facilities – George Washington University, Thomson Elementary School, University of California, and Fordham Institute – may be particularly interested in taking advantage of incorporating programs with the building proposal. The building proposal will have goals of serving community development as well as augmenting to the existing land uses.

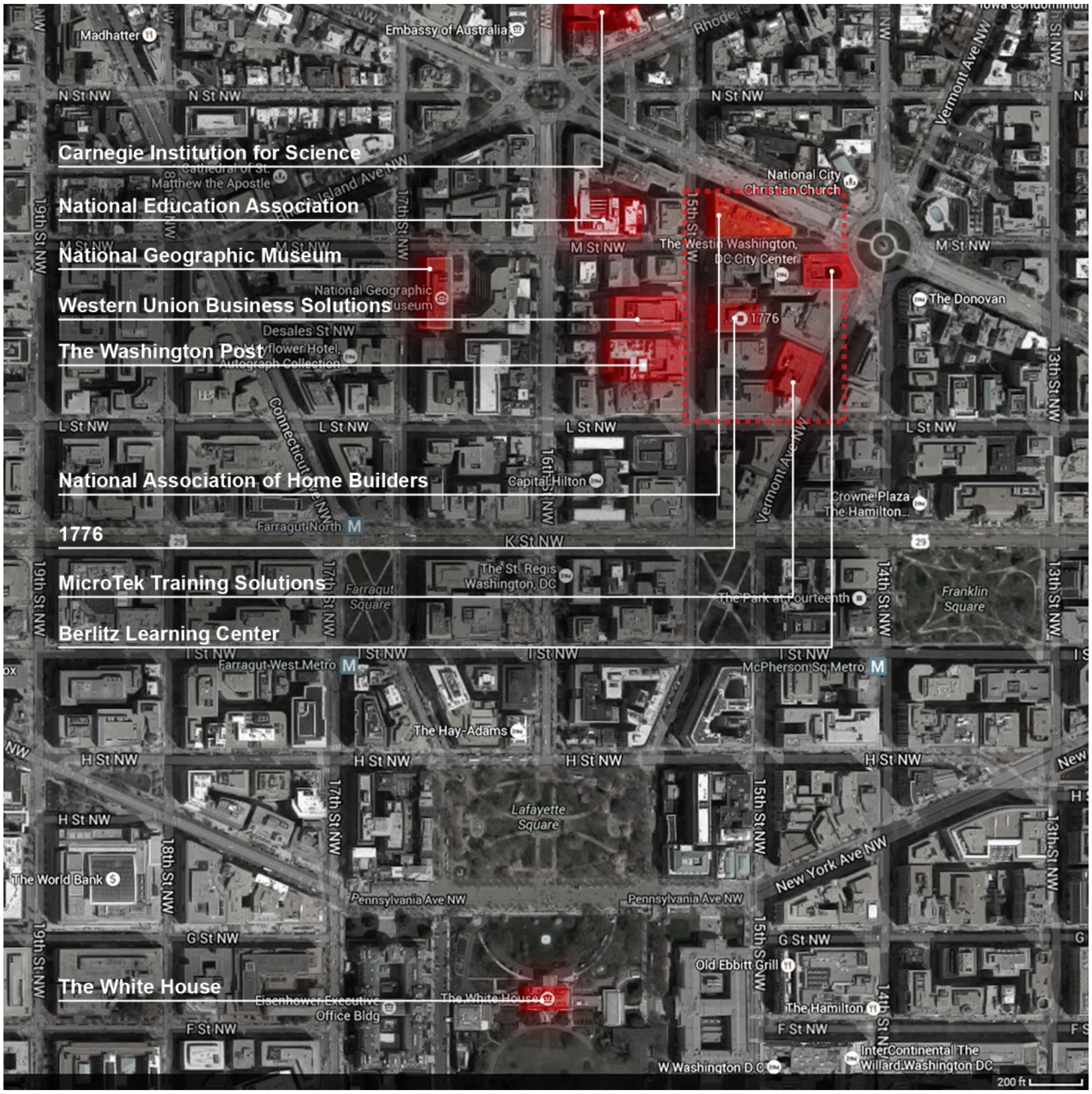

Figure 4.12: Nearby institutions and locations to proposed Washington site (map source: Google Maps)

Access to Capital: the surrounding area consists of office space for institutional spaces or educational uses. The majority of buildings of Thomas Circle Park follow zoning with height limits set at 110 feet to allow for high-density blocks and diversity of commercial space. As the political institutions lie due south of this area, many companies have set their headquarters in this location, making for valuable and highly-trafficked properties. A number of educational and technological firms have located themselves to this area. This may indicate a trend toward building district innovation zones that were incentivized in mid-2015[24].

Cultural Implications: startups and small-medium sized businesses have proliferated themselves along the Massachusetts Ave NW corridor. The intersection with 15th Street may have attracted larger businesses, such as the Washington Post and National Association of Home Builders, due to the accessibility to the White House and political hotspots to the south. Proposing an institution would cause a cultural shift in defining this area's character and purpose. As institutions like 1776 and Berlitz Learning Center have initiated, this area serves as a location for refining skills and sharing resources among peers and colleagues of D.C.

[24] "Mayor Announces 'District Innovation Zones' and New Arts Mapping Tool," *mayor.dc.gov*, 2015.

Location

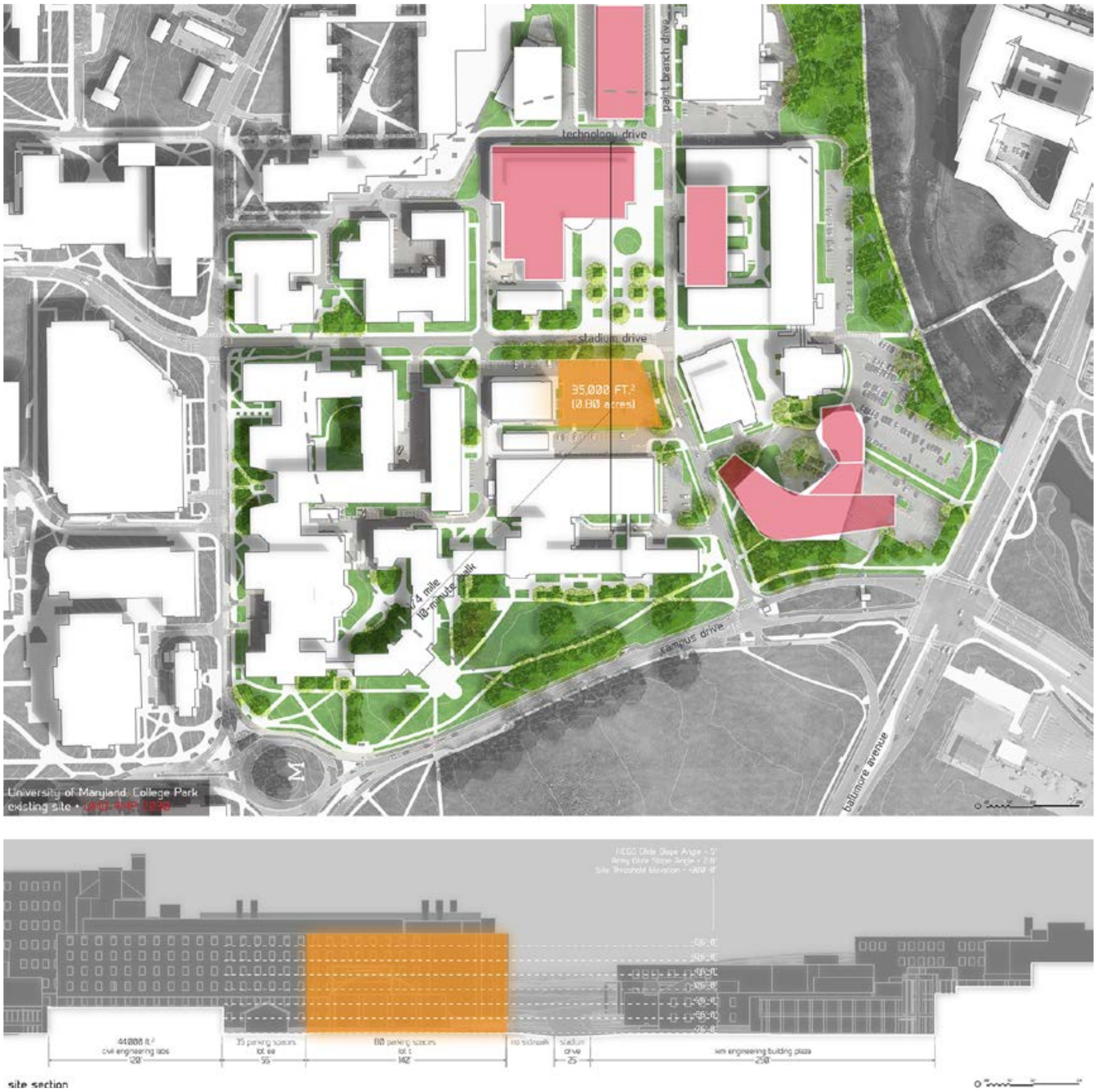

Figure 4.13: Site Plan and Section - Lot T (source: author)

The intended site was decided to be on Lot T of University of Maryland campus. Projecting the growth and trends from Facilities Management Master Plan 2030,[25] the choice of proposing an intervention on campus allows for expansion and evolution over time. Figure 4.13 illustrates the existing site plan with the projected

[25] "Facilities Master Plan 2011 – 2030: A First Class Campus for a World Class University, an Academic Park in the City." University of Maryland, College Park: 2010.

developments based on the UMD FMP 2011-2030 plan. Also noted in the figure are the slope glide paths to establish the vertical bounds of this region of campus in regards to the College Park airport located one mile southeast. The location of Site B demonstrates the campus's intention of centering the STEM and Innovation Districts along the Route 1 corridor for greater access and future development (Figure 4.14).

Figure 4.14: Site Connections, red as shuttle and bus stops, while purple indicated the proposed Purple Line (source: author)

More so, the site locates itself at the center of where multiple departments and disciplines are able to share their knowledge and facilities with one another (Figure

4.15). As the connections are not bound by physical proximity, the departments share similarities in their education of physical and digital sciences.

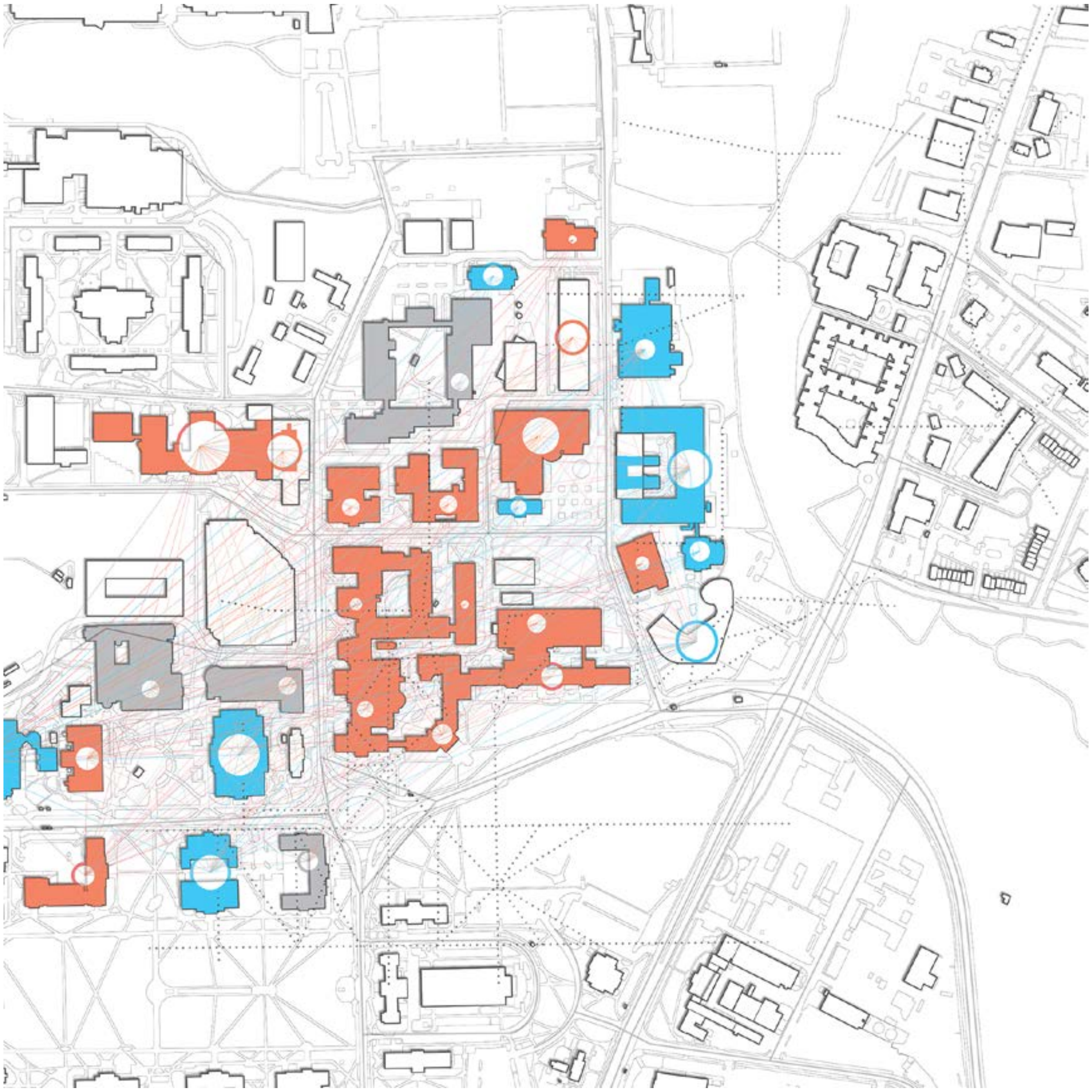

Figure 4.15: Connections between departments. Red represents physical-based sciences while blue represents digitally-based sciences (source: author)

Figure 4.16: Coworking spaces in red, gathering/lecture spaces in orange (source: author)

Looking into a larger scale of the intended site, Figure 4.15 identifies the provisions of assembly spaces local to the site. While the Civil Engineering labs (located toward the south) and the A.V. Williams (toward the northeast) have limited spaces to assemble, the new Kim Engineering building and slated Brendan Iribe Center contribute large portions of their program for collaborative purposes. The sporadic distribution of those spaces calls for an intervention that aids in tying the isolated places of assembly to a common area and to allow for diffusion of interdisciplinary communication.

Figure 4.17: Urban edges (source: author)

Figure 4.17 and Figure 4.18 illustrate the site as a center for which activity may occur on campus. With the primary users of this location as undergraduate students attending class from north campus, faculty coming from off-campus, and young entrepreneurs interested in collaborating with Maryland students, this location identifies itself as prime real estate for development. Aspiring engineering and computer science students will enjoy the direct benefit of having close proximity to the intervention, but the intention is to incorporate students of multiple disciplines. An example of how this may occur could involve a students' founding a start-up company. An engineering student may wish to market a product, but lacks the business acumen a business school student has honed. The architectural intervention should then allow for such a meeting and collaborative work experience to occur.

Figure 4.18: Location as a hub for STEM and innovation (source: author)

Impacts on Design Proposal

The architectural intervention must effectively establish a collaborative environment to house the design activities of multiple disciplines. The design process follows five goals to serve as guidelines for the architectural design process. The architecture must:

1) *Build communities*: the architecture must support the transient nature of university activities, such as classes and assemblies. However, building a location as shelter for community allows for students to return to an identifiable place.
2) *Allow for flexibility*: with technology and lifestyles always changing, the proposed spaces must allow for re-configuration and opportunities for shifts in the interior spaces. This component allows the environment to thrive and be dynamic.
3) *Increase productivity*: the nature of this area is industrious and productive. Though some spaces should allow for free roaming and exploration, other areas must stimulate a productive culture for students to immerse themselves into their work collectively or individually.
4) *Encourage innovation*: collaboration allows for multiple perspectives and views to assemble and reiteratively approach a design problem. Facilities included in the proposal must allow for multiple facets of exploration for any type of problem.
5) *Enrich experiences*: though not limited to the participants in the intervention, the architecture should be inspiring and didactic to all.

Chapter 5: Actuation

Design Validation

The architecture on the University of Maryland campus incorporates traditional red-brick Georgian characteristics to preserve the campus's history. As the work and classroom culture has evolved over time, the campus architecture has begun to evolve to reflect the changing views on student activity. The Facilities Master Plan 2030 identified various areas of development, but does not delineate how the architecture should be articulated. The buildings identified in this section demonstrate the views and values of the recent classroom culture and how the architecture reflects upon those perspectives.

Figure 5.1: Edward St. John Building (source: Teaching & Learning Transformation Center)

Designed by Ayers Saint Gross, the Edward St. John Building (Figure 5.1) seeks to establish a multi-purpose center along McKeldin Mall. The inclusion of a wide-array of various classroom types and collaborative space allows multiple configurations and flexibility based on student needs. The building balances between non-configurable spaces for more permanent arrangements and flexible spaces to allow for expansion and contraction to suit various events and activities.

Figure 5.2: Clark Hall (source: UMD Right Now)

Ballinger's proposal for Clark Hall (Figure 5.2) encompasses a vast assortment of flex labs and flexible spaces to be customized by students. This building served as one of the first buildings to break from the traditional Georgian mold of Maryland's campus design. Showcasing collaboration as an attractor, the building supports the notion of pushing collaborative spaces toward the visible areas shrouded in glass curtain walls. As Craig Spangler stated, the building seeks to promote student and work culture as an extension of the office as a place for convergence, rather than traditional benching and neighborhoods.[26] His team's design seeks to promote the innovative culture encouraged by the engineering students and faculty while providing an effective place to gather and work.

Figure 5.3: Brendan Iribe Center (source: Computer Science Department at UMD)

Brendan Iribe, former UMD student and founder of Oculus VR, donated $31 million to the University of Maryland in 2014 to establish a new center for computer science and innovation. HDR's proposal (Figure 5.3) further breaks the traditional Georgian mold with a glass structure that further enhances visibility to the collaborative activities occurring within the space. The design incorporates a large variety of micro research labs and collaborative spaces for various users to attend and collectively work with others. The only visually enclosed space is located as an addendum to the glass structure, which houses the lecture hall and main instructional space.

[26] Craig Spangler, "Clark Hall" (presentation, Tour of the New Clark Hall, College Park, MD, April 26, 2016).

Figure 5. 4: Lassonde Studios (source: CannonDesign)

The prime example for a collaborative space occurs outside of the University of Maryland, and instead on the University of Utah campus: the Lassonde Entrepreneur Institute. CannonDesign's proposal incorporates living quarters with workspaces so that all a students' needs are met within the same building. The central space is an incubator to foster creative work, but includes maker spaces for prototyping and real world testing.

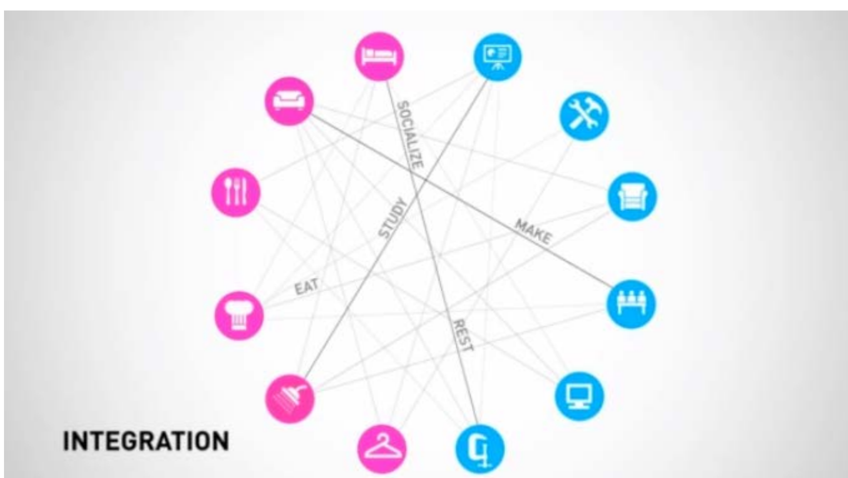

Figure 5. 5: Cross-connections between programs (source: CannonDesign)

Programming

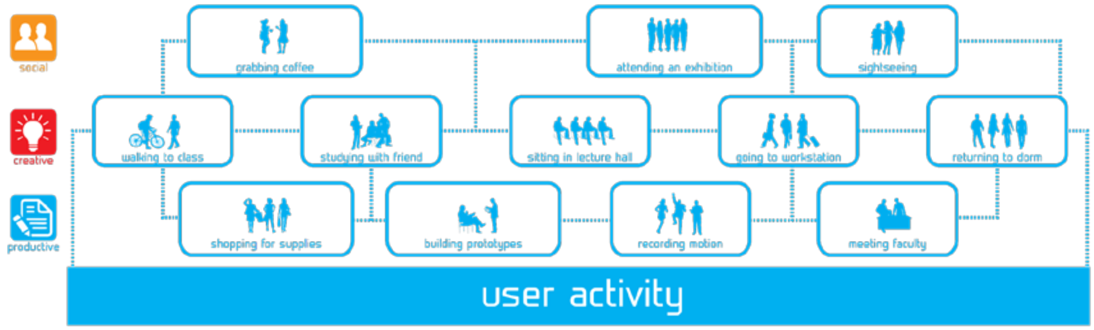

Figure 5.6: User activity map (source: author)

Beginning first with a map identifying the various activities a student may partake (Figure 5.4), the program of the desired intervention can begin to take shape. The typical student quartered to an on-campus dorm has one task required weekly: to attend class. However, for the balanced life that the campus promotes, students are encouraged to participate in extracurricular activities that broaden and enrich their academic experiences. More so, the clubs and groups sponsored by University of Maryland promote collective and collaborative acts for greater impact upon both individuals and communities.

Table 1 shows a preliminary tabulation of the necessary program to house the envisioned activities on site. The collaborative spaces, such as meeting spaces, flexible classrooms, and prototyping spaces, are derived from the precedents mentioned in the above section. Spatial requirements were approximated based on the typical classroom size of the nearby buildings to Lot T, as well as spaces planned from the precedents.

Table 1: Preliminary Program (source: author)

Coworking Space	
Focus Rooms (400 ft.2 x 6)	4 people / room
Flex Space (800 ft.2 x 2)	16 people / room
Student Lounge (1000 ft.2)	20 people / room

MakerLab / HackerSpace	
Wood Shop (800 ft.2)	6 people
Staging Area (1200 ft.2)	25 people
Digital Fabrication (600 ft.2 x 2)	4 people / room
Simulation Lab (1200 ft.2)	8 people
Micro Sim Labs (200 ft.2 x 8)	1-2 people / room

Instructional	
Lecture Hall (1500 ft.2)	60 people
Classrooms (800 ft.2 x 8)	24 people / room

Administrative	
Offices (250 ft.2 x 12)	1-2 people / room
Shared Offices (400 ft.2 x 4)	4 people / room
Conference Room (600 ft.2 x 1)	12 people / room
Faculty Lounge (1000 ft.2)	12 people / room

Service	
Cafe	Storage
Lobby	Bathrooms
Lounge	Mechanical
Kitchen	Fire Egress
Vertical Circulation	

Schematic Design

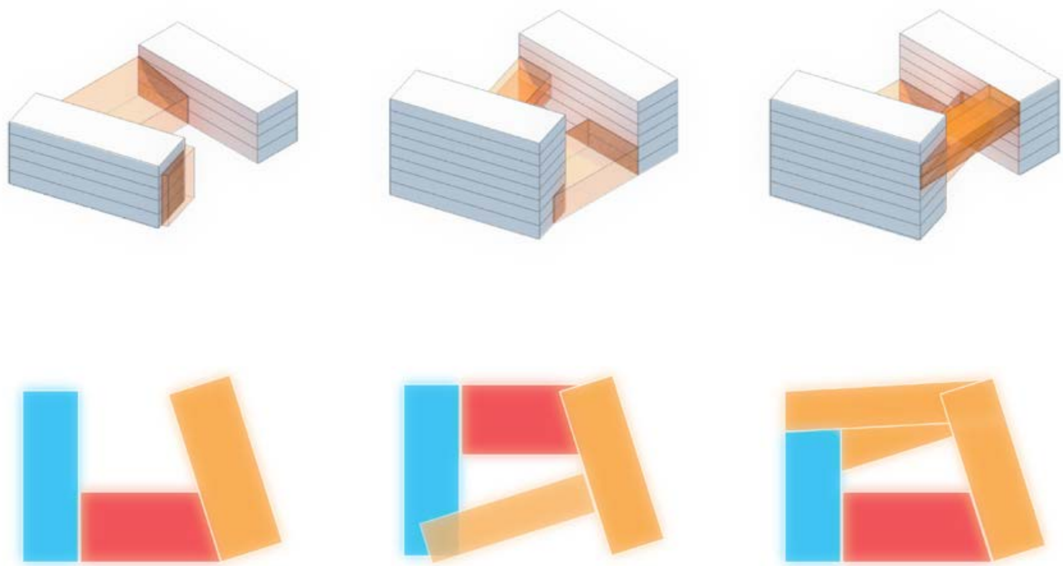

Figure 5.7: Schemes 01-03 (source: author)

These schemes (Figure 5.7) were designed based on the separation and connection between permanent students and ephemeral students of the building. With students who solely attend class and leave, they are only required to enter the west third of the building to promote their efficiency of time; however, should those students choose, the rest of the building allows for exploration and exhibition. The Maker and Hacker Space, filled in red, serves as the bond the holds the collaborative and instructional spaces together. These schemes attempt to spatially arrange the program around a courtyard for flexibility between the interior spaces and exterior, especially to engage the landscape of the nearby Kim Engineering Plaza. Schemes 02 and 03 attempt to add circulatory elements to demonstrate connections above the ground plane. The limitations to these schemes were made apparent by the lack of actual connection within the spaces, despite the exterior elements demonstrating a physical linkage between building sections.

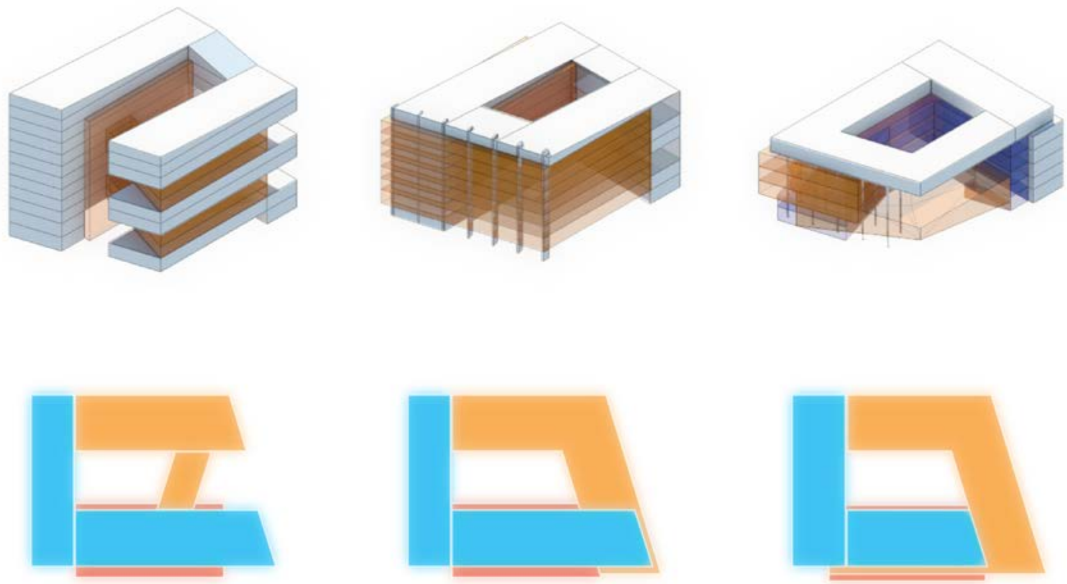

Figure 5.8: Schemes 04-06 (source: author)

Schemes 04 – 06 attempt to draw in organizational strategies from the Brendan Iribe Center and Lassonde Studios precedents. The partis follow a similar looping arrangement as in Schemes 01 – 03, but call for more specific program adjacencies. With the exterior courtyard now shrouded by levels above, all spaces within receive a unique glimpse of the outside. The spaces appear to wrap as continuous volumes from translucent masses to solid, opaque volumes of the instructional spaces. The arrangement of the program encourages a site connection based on orientation; where the southwest façade faces the traditional views of campus, the material and expression must reflect the nearby Georgian brick characteristics. Toward the east and north facades, they face more contemporary expressions of architecture, which call for freedom and diversity in its execution.

Figure 5.9: Exterior of Scheme 07 (source: author)

Figure 5.9 illustrates an early iteration of Scheme 07 exterior toward its final expression. Scheme 07 evolved from a hybrid of Scheme 01 and Scheme 06 as the cantilevering structure provided a difficult challenge for feasibility, as well as clarity in its architectural reading of form. The brick serves as an anchor for the glass to protrude and extend into the landscape, but also to provide smaller, light-controlled spaces for instructional use. The subsequent figures illustrate interior perspectives of the space and its relation to nearby context.

Figure 5.10: Motion capture room on Level 2 (source: author)

Figure 5.11: Lecture hall and corridor (source: author)

Figure 5.12: Hacker Space
(Top) the meeting and breakout rooms on the mezzanine above.
(Below) furnished example of spatial arrangement as a workspace
(source: author)

Design Development

Further exploration of site relations and programmatic concerns led to the branding of the building as a center for collaboration and innovation. The main considerations after Scheme 07 became an investigation of architectural expression between the collaborative activities of the interior and a means of generating attraction from the exterior of the building (Figure 5.13). With the collaborative hacker space and maker space located on the ground floor for ease of access, the specialized and instructional spaces can be lofted to the levels above. The ground plane acts as a large flexible space customizable by the building's exterior, as seen by the projection from the façade to the ground. Not only does this moment serve to enhance the experience from the interior, but also to the plaza due north of the site. This element can then become a landmark and serve as an identifier of this region of campus from beyond.

Figure 5.13: Exterior rendering (source: author)

Table 2: Tabulation of Used Program (source: author)

Coworking Space (ft.^{2})	
HackerSpace	3200
Lecture Hall	1300
MakerSpace	400
Meeting Rooms	2000
Motion Capture	1200
Exhibition	1150
Projection Rooms	800
Graduate Studio	800
Classroom	700
Graduate Lounge	500
Meeting Rooms	950
Projection Rooms	800
Lounge	700
Meeting Room	400

Administrative (ft.^{2})	
Office	1700
Office	1700
Faculty Office	300

Instructional (ft.^{2})	
Computer Lab	2400
Classroom	3250
Classroom	2250
Classroom	2250

Circulation (ft.^{2})	
Circulation	2100
Circulation	2000
Circulation	3000

Service (ft.^{2})	
Café	1300
Reception	1000
Lobby	900
Bathroom	400
Mechanical	360
Storage	400
Bathroom	400
Bathrooms	400

Total	**41010 ft.^{2}**

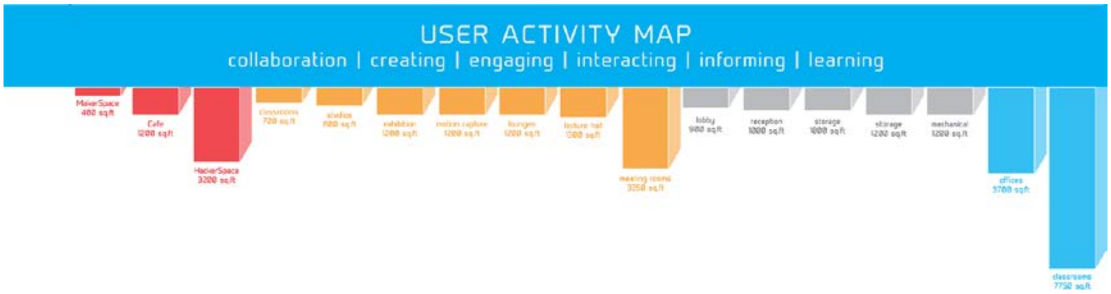

Figure 5.14: Diagram displaying program demands in relation to other spaces (source: author)

The actualized program demanded less of the original space demands due to the exploration and breakdown of space requirements. Table 2 details upon the tabulated square footages used in the final scheme of the building while Figure 5.14 graphically depicts the relation of those spaces. Each type of space retains one large, main typology while supporting smaller spaces that support the larger. For student usage, the coexistence of bot sizes builds a hierarchy within the building and calls for sharing between various spaces. The more significant larger spaces can then be assignable and cycled through a sign-up list for the administrative staff of the building to facilitate. Figures 5.17 – 5.20 depict the furnishing and layout that students may choose to house within those spaces.

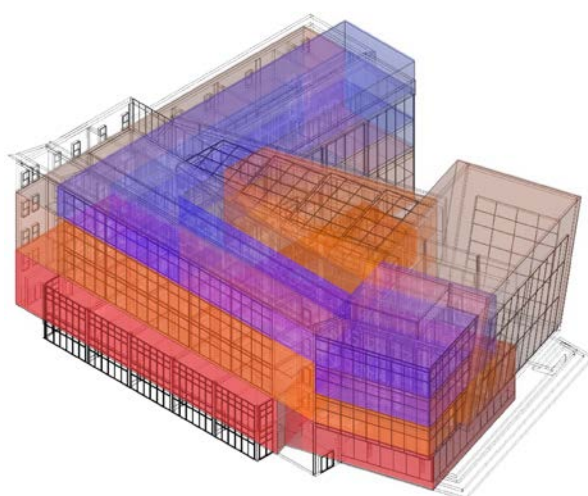

Figure 5. 15: Massing of program, viewed from southeast isometric (source: author)

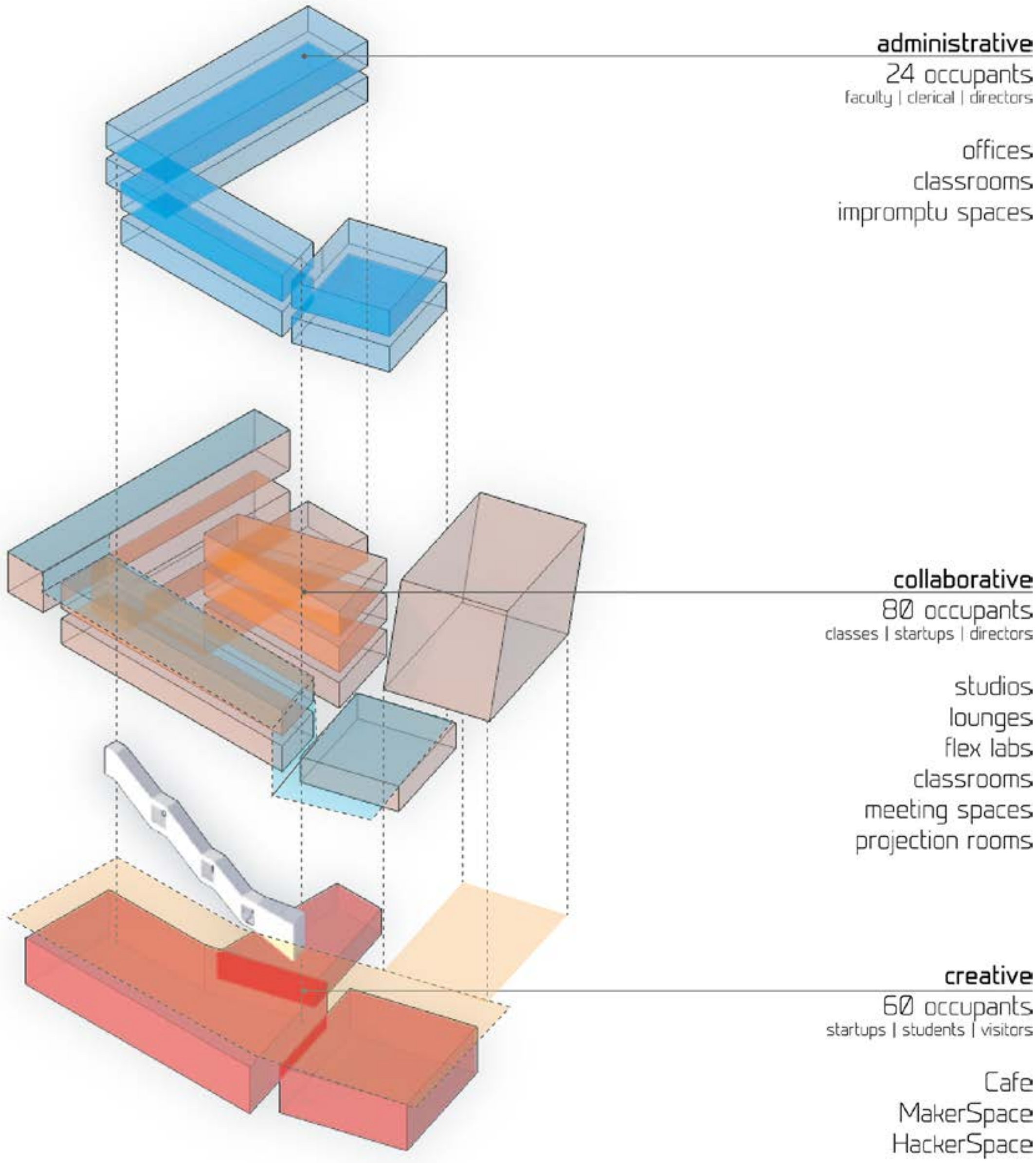

Figure 5. 16: Exploded axonometric of spatial arrangement (source: author)

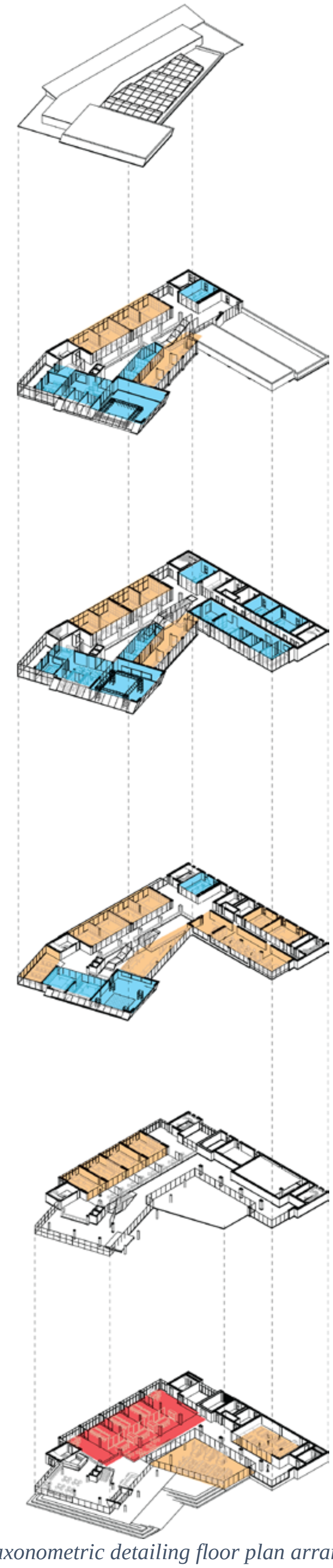

Figure 5.17: Exploded axonometric detailing floor plan arrangements (source: author)

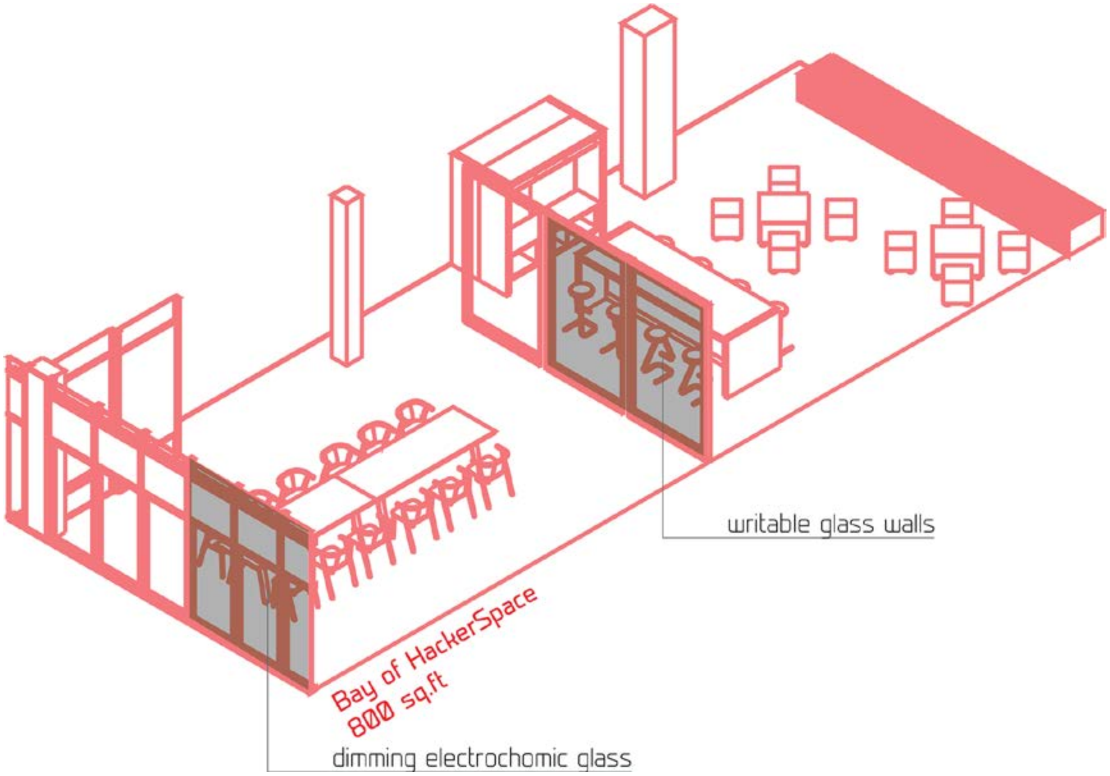

Figure 5.18: HcakerSpace detailing (source: author)

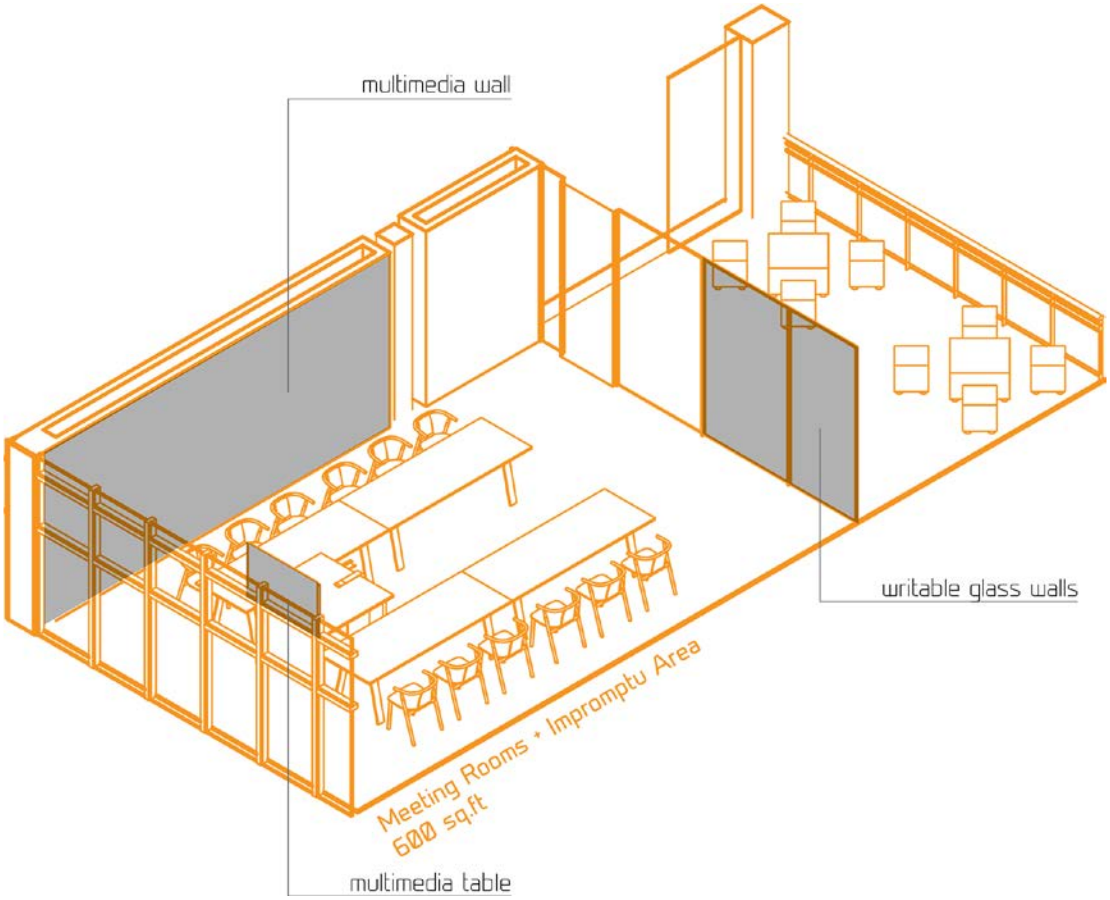

Figure 5.19: Meeting room detailing (source: author)

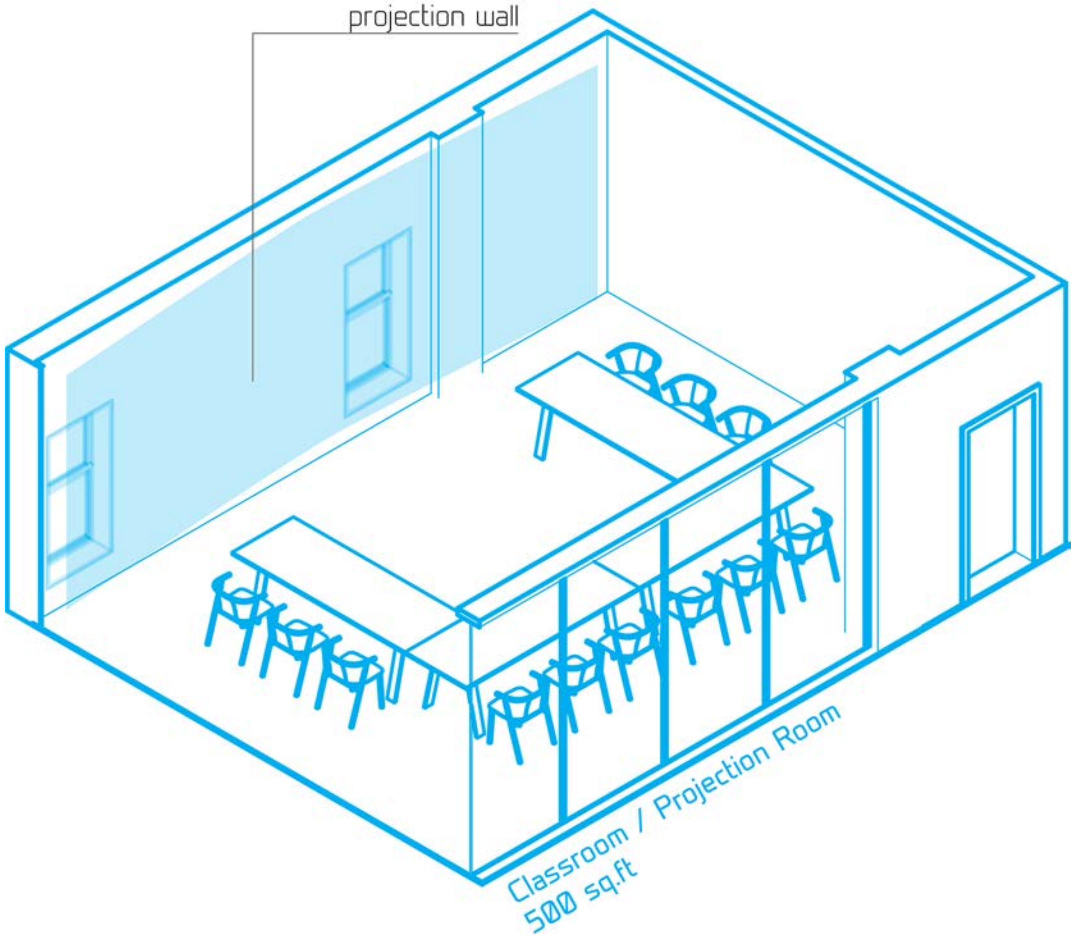

Figure 5.20: Projection room detailing (source: author)

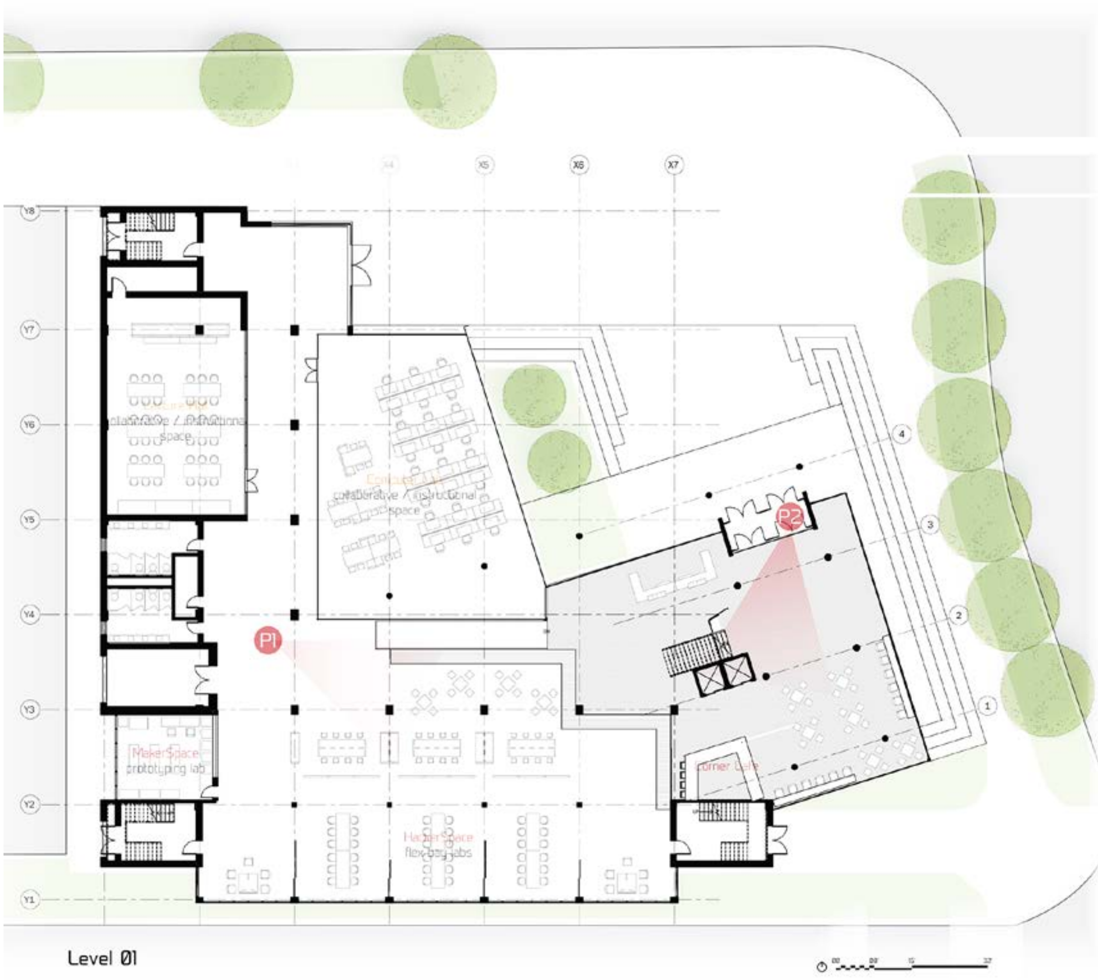

Figure 5.21: Ground floor plan (source: author)

Maker and Hacker spaces are housed on the ground floor with provided amenities of an instruction computer lab, café, lounge, and lecture hall.

Figure 5.22: P1 perspective of collaborative space (source: author)

Figure 5.23: P2 perspective of entry to cafe and lounge (source: author)

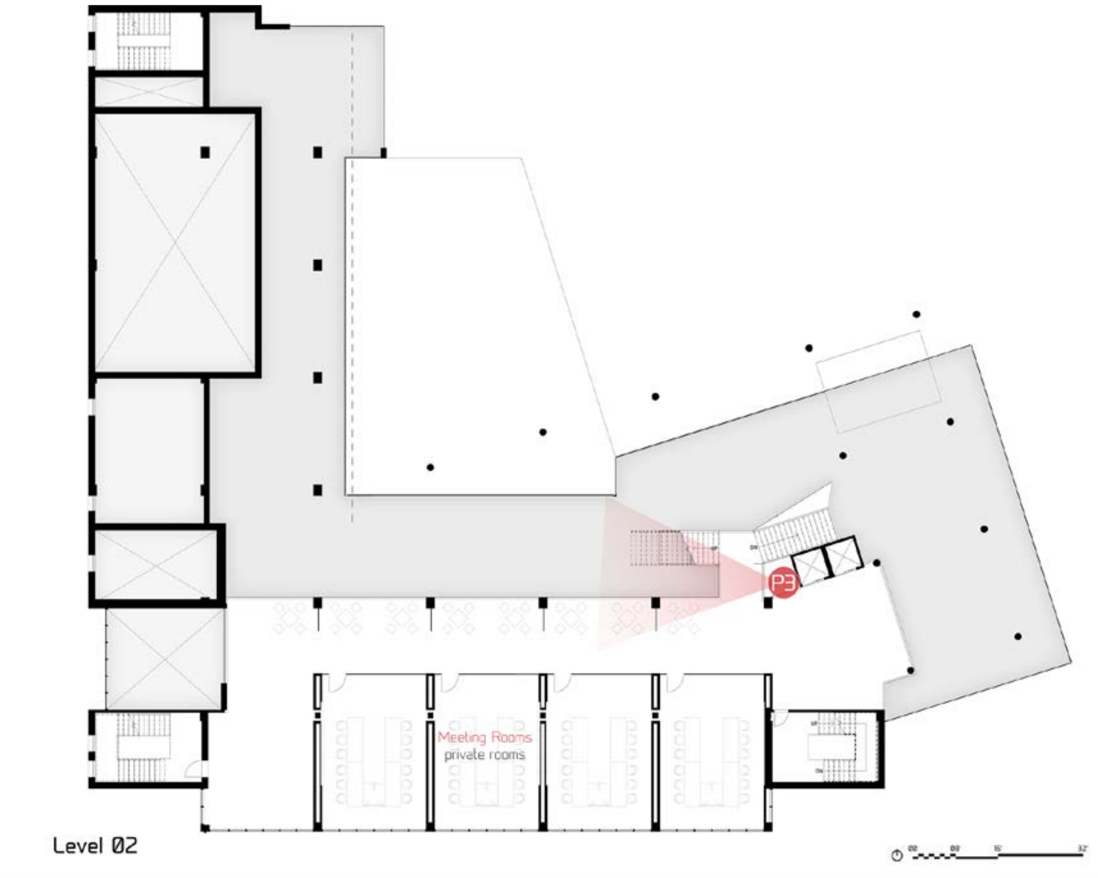

Figure 5.24: Level 02 floor plan (source: author)

Level 2 serves as a mezzanine area to provide a clerestory level for the ground floor. As a result, this floor acts as a mezzanine for breakout sessions and meeting rooms overlooking the hacker and maker spaces below. This also provides the connective floor for the main circulation element from the east side to the west side of the building.

Figure 5.25: P3 staircase element on level 02 (source: author)

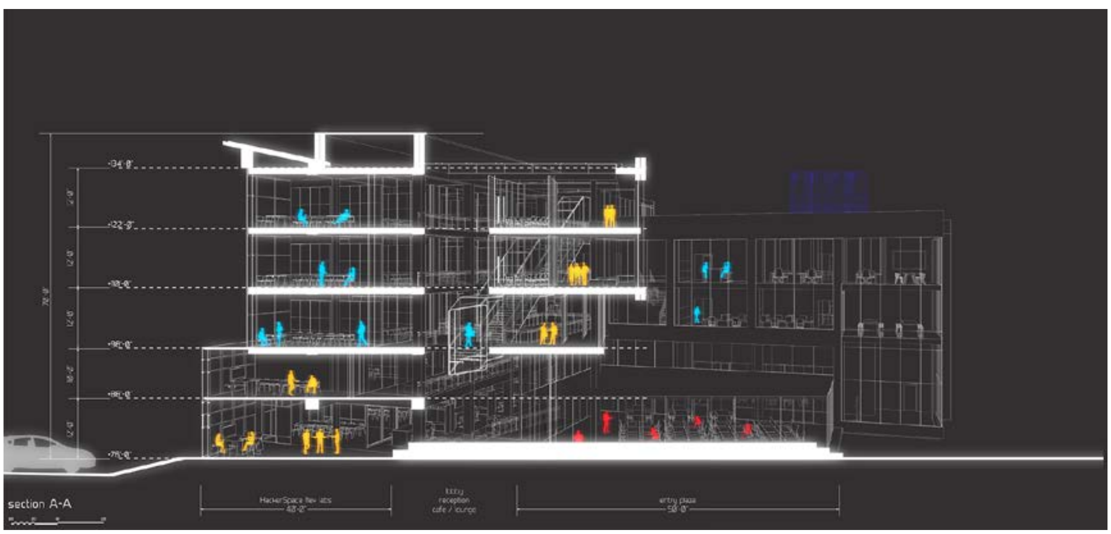

Figure 5.26: Cross-section along north and south axis (source: author)

This section was studied in depth due to the determination of floor plates and sizing for various activities to occur. The colored silhouettes indicate the intended types of activity to occur. Not pictured is the motion capture lab on Level 03 (Figure 5.27) that promotes the new virtual reality activities occurring in the STEM district of campus.

Figure 5.27: Level 03 (source: author)

Figure 5.28: P4 perspective of lounge area (source: author)

Figure 5.29: Longitudinal section through east and west axes (source: author)

The staircase element is best visualized in the longitudinal section (Figure 5.29) as an element that ties the building and its activities together.

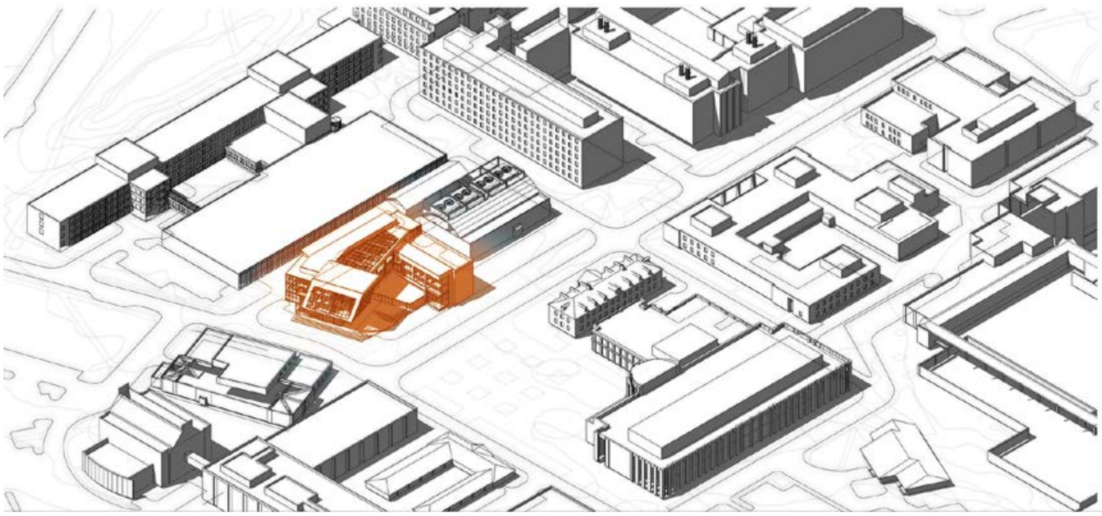

Figure 5.30: Site axonometric and context (source: author)

Conclusions

As designers, the best designs and products come from a design process shared with others. More importantly, the process of reaching a result should be given higher significance in multiple fields. This will push a motion toward more collaborative activities to oppose the result-driven basis of many industries. The architecture executed by the proposed center for collaboration and innovation seeks to immerse users in a collective space while engaging them into team projects that should not limit interactions. We designers have been and must be the example to set forth in producing processes that innovate and generate results. The digital culture proves itself as the vehicle for this notion to be made widespread; the architecture is the establishment to house such.

Appendices

<u>Devices Guide</u>

Figure 1: Oculus Rift Development Kit 2 (DK2) (source: https://www.oculus.com/)

This thesis will be primarily exploring the VR environment using the DK2 headset and related software. HDMI input feeds two lenses in the unit, which provides an immersive, stereoscopic view of the virtual environment. The DK2 requires a direct PC-connection and is limited by its hardwire connection to the CPU. Oculus provides the widest VR community support and content for this headset, which will prove beneficial upon commercial release in 2016.

Figure 2: Google Cardboard (source: developers.google.com/)

The Google Cardboard project seeks to make widespread availability of virtual reality technology with an affordable, simple apparatus. Using smartphone devices, one only needs to install the Cardboard app to begin immersing oneself into virtual environments. The technology and development is open-source and intuitive to use.

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