CREATING INTENTIONAL ENVIRONMENTS FOR IMPROMPTU COLLABORATION: DESIGNING FORMS WITH AFFORDANCES TO SUPPORT ENGAGEMENT AND COLLABORATION IN THE ATRIUM OF A HIGHER EDUCATION FACILITY

BY

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THESIS

Submitted in partial fulfillment of the requirements
for the degree of Master of Fine Arts in Art and Design
with a concentration in Industrial Design
in the Graduate College of the
University of Illinois at Urbana-Champaign, 2018

Urbana, Illinois

Adviser:

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ABSTRACT

The impact of a single object's presence within a space can be immense. This fact alone, calls to mind the power and responsibility of designers as they influence the creation of these objects directly. The idea that the affordances of designed forms can create beneficial opportunities for interaction has inspired the method for designing intentional environments that is discussed in this paper and a larger research exploration: studying the ways in which the affordances of designed forms influence perceptions of and interactions with material landscapes in various contexts and at various scales.

The designed forms found within the material landscapes of our lives create a network of objects and spaces. Environments that we repeatedly interact with have the potential to influence and shape our identities and overall wellbeing. The affordances of a single designed form within a material landscape have the potential to shift a visitor's understanding of that space and inspire, or warn against, specific interactions. As creatures of habit, these affordances become particularly important in areas where people spend the most time; leading to our homes, workplaces, and learning environments having a drastic influence on our behaviors, decision-making, and socialization patterns. Fortunately, designed forms not only have the ability to create spaces, they can also adapt spaces -- transforming existing structures through a user-centered design process.

This paper details the research and design development of a flexible workstation pod, designed to create an intentional environment that engages users in creative creation and collaboration through the use of affordances and symbolism. This product was designed as part of the re-imagination of the atrium of Beckman Institute for Advanced Science and Technology, on the University of Illinois Urbana-Champaign campus. This re-imagination project began as an interdisciplinary exploration of concepts to refresh the facility's vast atrium space. From that research and ideation process a product opportunity and research method arose; utilizing an understanding of human cognition and perceptions of the affordances and symbolism of a designed form to create intentional spaces that shape opportunities within a building that is world renowned for advancement through collaboration.

ACKNOWLEDGEMENTS

This project would not have been possible without the guidance and support of my amazing thesis advisor, Dr. Deana McDonagh. Her insight and awareness of my research interests made this project possible. Having the opportunity to be a part of the Beckman Atrium Re-imagination team along with Dr. McDonagh, Professor Sara Bartumeus-Ferre, Nineveh Rasho, and Shashi Gajare was an exceptional interdisciplinary collaboration learning experience. Additionally, working with the brilliant faculty, staff, and students at the Beckman Institute for Advanced Science and Technology to complete my thesis project has been an incredible experience. I would like to make special thanks to the Director of the Beckman, Dr. Jeff Moore, for his willingness to embrace user-centered design to create positive change at the Beckman Institute. I would also like to thank Professor Simrun Sethi, Professor Suresh Sethi, Professor William Bullock, Dr. Patricia Jones, Kara Johnson, Dr. Robb Lindgren, and Dr. Matthew Peterson for their contributions and guidance throughout this research project.

I would also like to thank my family and friends for their love and support throughout my graduate school experience; with a special thanks to my parents, Bill and Jodie Henderson and my sister, Nikki – couldn't have done it without all of you!

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CHAPTER 1: INTRODUCTION

This project was inspired by an overarching research interest in gaining an understanding of how designed forms change human perception of a spatial environment; with the ultimate goal of creating spaces that allow people to feel comfortable and knowledgeable interacting with their surroundings. Designed forms have the potential to influence the ways in which people interact with and relate to their environment, which can create opportunities that encourage specific and prescribed behaviors to occur in the space. The designed forms that create an environment have the potential to inspire interaction, communication, and a sense of wellbeing in the space or, conversely, a sense of isolation, unrest, or trespassing.

As designed forms have the opportunity to shape experience, it becomes important for designers to understand the full scope of impact their designed product may have when placed in a larger context or environment. In order to further explore this topic and gain a better understanding of which elements of a designed form create opportunity for or dissuade interaction, the work completed in this project focused on the smallest aspect of a design form: the human perception of a single affordance of an object. By starting at this focused point, it was possible to gain a better understanding of the layers of attributes that each designed form brings to an environment, attributes that ultimately converge to create an intentional environment that shapes human behavior in that space.

Throughout this paper, the term "designed forms" is used to mean any elements within a space that are not permanent or structurally integral within a space. While other design details play a role in the functionality of environments, the particular interest of this project is in the unique influence designed forms provide, creating or reframing perception of intended interaction with a space. Each intentionally designed environment provides a unique context, with specific goals for functionality and interaction. The objects that populate an environment create a material landscape, this landscape is intended to support the goals for the space, encouraging or discouraging specific human behaviors within that environment. This scaffolding (figure 1.1) for interaction is built upon understood affordances and symbolic meaning inherent in each object within the space. Each designed form provides visual and tangible cues to visitors, indicating possible opportunities for interaction and encouraging specific behaviors.

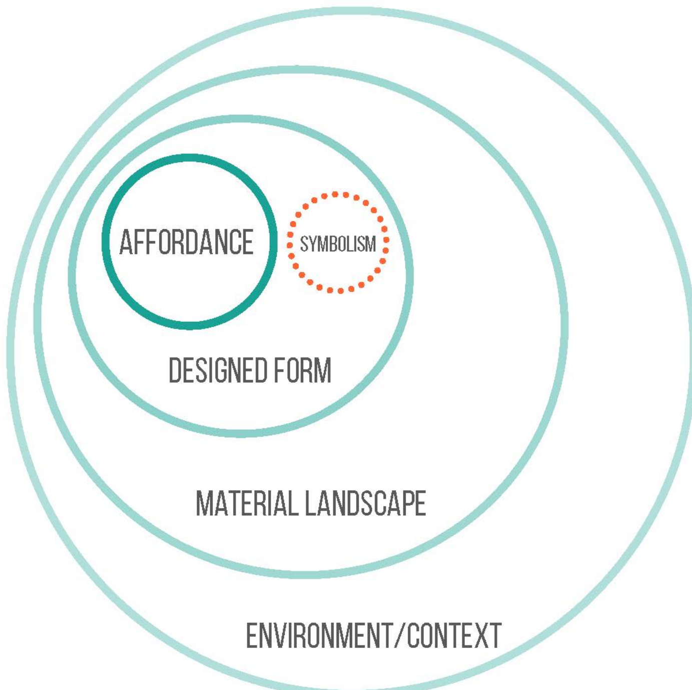

Figure 1.1: This figure illustrates that designed forms can contain both affordances and symbolic meaning, and that these forms exist within the material landscape of a specific environment or context. All of these factors come together to guide visitors of the space to engage in actions and interactions within the space.

PROJECT INTRODUCTION

The research for this project began with a series of questions, each question evolving from the findings of the last and becoming more focused. As the design direction began to take shape with each phase of the project, a product opportunity and context were identified. The project began exploring the idea that a designed form in a space could create a physical intervention with a positive impact. Specifically, there was potential in designing furniture with incorporated affordances that might support conversations and the sharing of ideas. This phase of the project was focused on creating a form that may help to break down communication barriers through the use of low-tech, designed affordances that allow for cognitive offloading. It may be possible to reduce communication barriers by providing forms within an environment that have designed affordances for cognitive offloading and distribution of cognition, easing the verbal communication process.

This concept took on the form of a familiar designed artifact for gathering, a table, in order to facilitate a natural starting place for communication. The incorporated affordances allow visitors to the table to reduce cognitive load and distribute their cognition in order to encourage a flow state in general discussion, educational explanation, and creative idea generation; while aiding in expression through moveable tangible elements. The design development and research process indicated that designed forms could improve communication, when used as temporary symbols. Early user testing with the table and objects provided encouraging feedback, as people engaged with the moveable elements, creating and building as they talked with other visitors, demonstrating interaction.

As the interactive table seemed to encourage conversation and collaboration within the gallery show where it was displayed, it begged the question how would an interactive table influence visitor interaction in a setting with a more intentional context? In considering the type of space where the table was currently displayed, there was increased potential for observations in a space with a multitude of daily visitors; people passing by that were drawn to interact.

An opportunity arose with the Beckman Institute for Advanced Science and Technology to work with an interdisciplinary team of Industrial Designers and Architects to re-imagine the atrium space of the building. This project was the perfect opportunity to continue exploring the impact that designed forms can have, creating a material landscape within a specific environment or context. The clear mission of the Beckman Institute for Advanced Science and Technology, an academic facility on the University of Illinois Urbana-Champaign campus, is to:

> "foster interdisciplinary work of the highest quality, transcending many of the limitations inherent in traditional university organizations and structures. The Institute was founded on the premise that reducing the barriers between traditional scientific and technological disciplines can yield research advances that more conventional approaches cannot."
> (About Beckman, 2018)

This new project created a prime opportunity to further the research surrounding the creation of furniture with designed affordances to support conversation and collaboration. In providing a context for the forms being design, the Beckman Institute gave specificity to a thesis question: How can designed forms create a material landscape within the atrium of a higher education facility that support and encourage interaction and collaboration? Changing the question instead to 'How can designed forms within the atrium space represent and support the interactions and collaborations occurring at the Beckman Institute for Advanced Science and Technology?'

The research conducted surrounding this project is crucial as the environments in which we work and socialize can impact our productivity and a sense of wellbeing (Huisman et. al., 2012). Work environments are changing and the value of a positive and productive user experience in these spaces is immense. This experience is shaped by the designed forms and affordances incorporated into the environment. There has been a rise in collaborative workspaces, both in designated office environments and remote working spaces, creating a physical change in the sense of place that matches the industry shift away from single-discipline expert teams to interdisciplinary teams. With this in mind, attracting the new generation of researchers and scholars to the Beckman Institute will require thoughtfully designed, intentional environments. These intentional environments will refresh a research facility that was established in 1989, prior to the advent of personal computers – a factor that has reshaped offices and lab environments.

In today's work climate, work and play need to be blended to ensure a positive user experience. Productive workspaces of the future will be determined by the outcomes of design research; filled with designed forms that are engaging, interactive, and sensorial experiences for users, coming together to create unique, thriving environments. The goal of the Beckman Institute Atrium redesign is to create and intentional environment that invites residents into the space to collaborate; this space will provide opportunity for connections in order to elevate thought, inspire new veins of research, and allow for technological advancements.

CHAPTER 2: USING AFFORDANCES TO CREATE INTENTIONAL ENVIRONMENTS

The literature reviewed for this project has been imperative in gaining a better understanding of how the forms in an environment may influence visitor behavior, specifically forms within the Beckman Institute Atrium. While this project is rooted in the field of industrial design, the concepts explored from other disciplines have acted as both guide and support in the research process and design development. Exploring theories from education, psychology, architecture, and engineering has revealed potential underlying causes of human behavior in designed intentional environments; providing insight into the capacity of human cognition and it's relationship to our environments, the role that affordances play in our understanding of opportunities in our surroundings, and how cognitive offloading allows for the formation of temporary symbols that influence our memory.

Within the profession of industrial design, and in the broader field of design as a whole, the experience had by someone interacting with a designed artifact is at the forefront. The designed artifacts in our surroundings come together to make up our material landscapes, which shape our daily, lived experience. This impact is substantial and a significant responsibility for designers, as the choices made throughout the design process have the potential to create or destroy perceived opportunities surrounding a designed artifact. While designers are able to gain insight into current and impending human needs through methods of design research, additional methods and considerations are necessary when designing an array of forms that will come together to create a material landscape in a specific environmental context.

In the specific instance of the Beckman Institute for Advanced Science and Technology, the goal of the environment is for researchers and visitors of the institute to participate in and collaborate on interdisciplinary work. The designed forms that populate the atrium space and create a material landscape for visitors to interact must support this goal. The current atrium space does not support this goal, and in order to obtain insight into why it does not the architecture-based process of post occupancy evaluations was utilized. Conducting a post occupancy evaluation of the atrium space allows for the consideration of the original goals set by the created architectural structure and interior design. How well are they meeting the goals for interaction and visitor flow that were originally set? Do people use the atrium space in the intended manner? Are the aesthetics and forms of the space representative of the intentions of the space? (Ziesel, 1984) In the case of the Beckman Institute the answer is no, and considerations beyond those typically found in user-centered design process must be made in order to better understand why. What scope of impact is the environment having on the visitors of the space?

In order to create an intentional environment for impromptu collaboration, considerations need to be made regarding how people process their surroundings. Visitors to the Beckman atrium will be more likely to participate in the intended activities of the environment if the design takes into account a more holistic view of cognition and how people process elements of the designed environment. By exploring theories from education, psychology, architecture, and human factors engineering, insight into the visitors reliance on the environment for information about behavior and possible interactions with the space can be gained, as their understanding of the opportunities found in the affordances of their surroundings shape their mental representations of potential bodily interactions with the designed forms in the space.

Our perceptions of the designed forms in our material landscapes influence our cognition in context. As such, we must first consider the underlying mental structures that support our understanding and perception of designed forms and our environments, and how they influences our actions and interactions. By acknowledging the grounded nature of human cognition, that it is situated and embodied, and that it has the potential to be distributed to others and our environment; design decisions can be made in order to create an environment that reduces cognitive load – making engagement with the intentions of the environment clear and more available to visitors.

As Lawrence Barsalou recognizes in his 2008 paper on grounded cognition:

> "Grounded cognition rejects traditional views that cognition is computation on a-modal symbols in a modular system, independent of

> the brain's modal systems for perception, action, and introspection. Instead, grounded cognition proposes that modal simulations, bodily states, and situated action underlie cognition." (Barsalou, 2008, p. 617)

He notes that while recognitions of grounded cognition and situated action date back as far as allusions by Emmanuel Kant (1787/1965); more recent work has begun "accumulating behavioral and neural evidence supporting this view." He reviews this evidence throughout the paper, drawing on research from "perception, memory, knowledge, language, thought, social cognition, and development" (Barsalou, 2008, p. 617).

Based on the idea that "simulation is the reenactment of perceptual, motor, and introspective states acquired during experience with the world, body, and mind" (Barsalou, 2008, p. 620); one can surmise that past experiences and familiarity with an environment can influence the mental representations a person may hold about their environment. So, when designing a space with intended interactions, considering how simulations influence cognition is very important. As each experience transpires, visitors to a space will cognitively work with their familiarity with a given physical opportunity in their environment or potentially experience and create a new cognitive simulation, which will become part of their cognition moving forward. Barsalou also shares that grounded cognition influences human perception of space, that this perception is "shaped by the body, the body's relation to the environment, and the body's potential for action (Franklin &Tversky, 1990)." Additionally noting that:

> "Longo & Laurenco (2007) found that people's perception of near space extends further outward as their arm length increases, suggesting that individual differences in bodies produce individual differences in space perception." (Barsalou, 2008, p. 625)

In the paper *Six Views of Embodied Cognition*, Margaret Wilson states that "there is a growing commitment to the idea that the mind must be understood in the context of its relationship to a physical body that interacts with the world." (Wilson, 2002, p. 625) She notes that this idea has been growing for some time, referencing the ideas of 19th century psychologists who did not believe in the concept of "imageless thought" (Goodwin, 1999), Jean Piaget's developmental psychology work on cognitive skills growing out of sensorimotor activities, and J.J. Gibson's theory of affordances – the cognitive awareness of opportunity for interaction with elements of the environment. Wilson even goes on to mention that linguists have taken interest in the role the body plays in the understanding of the mind, as metaphors for abstract concepts are often rooted in bodily, or physical ideas (e.g. Lakoff & Johnson, 1980) Finally, she refers the reader to plethora of references – all supporting the idea that, "Cognition is not an activity of the mind alone, but is instead distributed across the entire interacting situation, including mind, body, and environment (see, e.g., Beer, 1995; Greeno & Moore, 1993; Thelen & Smith, 1994; Wertsch, 1998; see also Clark, 1998, for discussion).” (Wilson, 2002, p. 630)

Within the six claims regarding the embodied nature of cognition that Wilson discusses in her paper, she engages with the idea that cognition takes place in real-world environments, which involve “perception and action.” These perceptions and actions take place in real time, influencing how people engage with their surroundings, which ultimately become a part of their cognitive system as they use their environment as an opportunity for cognitive offloading, and relying on it to hold that information until such a time as they need to collect it. These thought processes guide a person’s actions throughout an environment, as they influence perception and memory, helping people identify “situation-appropriate behavior.” One claim cites that “the flow between mind and world is dense and continuous” making it difficult if not impossible to analyze the mind as an individual factor of cognition (Wilson, 2002, p. 626). While Wilson explores each claim with an analytical mind, Mark Johnson reaches this conclusion in his book *The Body in the Mind*:

> “As animals we have bodies connected to the natural world, such that our consciousness and rationality are tied to our bodily orientations and interactions in and with our environment. Our embodiment is essential to who *we* are, to what meaning is, and to our ability to draw rational inferences and to be creative.” (Johnson, 1987, p. xxxviii)

Human bodies exist in real and varied environments, and by designing these environments with the intent that they will be perceived with certain affordances for interaction, designers have the opportunity to create intentional experiences and foster interactions.

How people behave or perform in an intentional environment is largely based on design and human factors. From the standpoint of a human factors engineer, human performance is key and determining the impacts of the system design or environmental differences on overall ability to complete a task properly and efficiently is crucial. They ask questions to determine how well a person completed a task such as: How quickly did they perform the task? How accurately did they perform the task? How much attentional demand did the task require of them to perform it properly? (Wickens et. al., 2015) As designers, these same considerations for human factors are important, but instead of focusing on how quickly or easily a task can be completed; we are concerned with the opportunity that is created by the design. What functions might the design serve? How does it create an experience for the user? Will engagement with the design create opportunity for a beneficial, productive, or enjoyable outcome?

All of these factors are influenced by the way in which the human brain processes our environments and information. As our five senses take in information about our environment, our brains begin working to process the information. The observed senses are stored in our short-term sensory storage, as we perceive their existence, before moving them into working memory cognition and determining whether they are relevant or necessary to our long term memory or if we need to make a decision about how to respond to the environmental stimulus. Our long term memory and past experiences play a roll in what our decision may be about how to respond to the perceived sense, and whether we have existing prior knowledge or not, our human response to the stimulus will create an impact in our surroundings, impacting our future perception of our environment. This continuous feedback loop of taking in sensory cues processing them and making decisions or storing them in our memory uses our attentional resources. (Wickens et. al., 2015)

The working memory plays a pivotal role in our considerations of our environment and the potential actions and interactions available. While the working memory, as it's name implies, is always working it can become overloaded with stimuli making it more difficult to complete a task (i.e. navigating an environment, writing a paper, flying a plane, etc). When designing an intentional environment it is important for designers to take this into consideration in order to determine the most appropriate and effective stimuli that can be introduced into a context in order to reach the desired goals for the space. Factors such as the salience of visual cues, noise, and proximity of key elements should all be taken into consideration in order to create clear opportunities that are easily processed within the working memory, maximizing the intended actions and interactions within an environment.

Each person's life is unique, as a result, the past experience and individual differences that play a role in their decision making in their environment are also unique. As people encounter an environment their working memory taps into their long-term memory, looking for similarities to past experiences in order to provide information about expectancies within the space. This method of top down processing makes certain people predisposed to certain reactions, as phenomenology shapes their perception of their surroundings. Many of these prescribed reactions are based on something the person has learned over time and now holds as mental representation of information, such as the meaning of a 'STOP' sign while driving. (Wickens et. al., 2015)

The majority of people store many mental representations and reactions such as this in their long-term memory, but one key thing to acknowledge is that this reaction had to be learned over time. Learned through out their life time: the symbolization of the color red, the shape of each letter, the meaning of the word 'STOP', the social and legal expectation to obey the sign in their surroundings, and in what circumstances to disregard the visual cue of the sign. All of this information was acquired through bottom-up processing, the act of perceiving the world around us and then associating additional information with the sensory cue in order to process it with the desired outcome in our working memory. Each new additional to our peripheral field is processed through bottom-up processing as we attempt to distinguish between the new and familiar attributes of our environment. (Wickens et. al., 2015)

When creating an intentional environment, it is the responsibility of the designer(s) to have a well-rounded awareness and understanding of the functionality, goals, and expectations for the space. Whether creating an environment from scratch or working to revive and reshape an existing space, the needs of the visitors and the goals of the facilitators of the space need to be used as guidelines. In gaining a better understanding of these guidelines, the design can begin to consider both the potential similarities and individual differences between visitors interacting with the space. Designed forms can then be implemented to provide physical and visual cues that shift perceptions of the space, and inform opportunities for intended uses of the space.

Overtime and with repeat interactions, the human brain begins to categorize information by creating schemas. Meredith Davis defines schemas in her book Graphic Design Theory as: "mental structures that contain general expectations and knowledge about people, social roles, events, and places." She goes on to say that place schemas specifically "support particular kinds of human activity in built environment." (Davis, 2002, pp. 80-82) This means that when creating an intentional environment the designed forms have the potential to influence and be influenced by the visitor's place schemas, that inform their understanding of acceptable and expected interaction within a space – how to behave, interact, or socialize in their specific environmental surroundings.

In a way, this allows designers the begin encoding environments with information, shaping visitor expectations when they are met with specific perceptual stimuli. Creating repeated visuals cues through form, color, lighting, and space; builds a mental representation of opportunity for potential behavior, interaction, and outcome from a given environment. Roy Pea elaborates on this idea in a chapter focused on the practices of distributed intelligence and designing for education:

> "The environments in which humans live are thick with invented artifacts that are in constant use for structuring activity, for saving mental work, or for avoiding error, and they are adapted creatively almost without notice. These ubiquitous mediating structures that both organize and constrain activity include not only designed objects such as tools, control instruments, and symbolic representations like graphs, diagrams, text, plans, and pictures, but people in social relations, as well as features and landmarks in the physical environment." (Pea, 1993, p. 48)

In creating a space that is structured to support interaction, collaboration, and discussion designers have the potential to support these activities by taking epistemic actions. As Andy Clark writes, "epistemic actions, it should be clear, build designer environments – local structures that transform, reduce, or simplify the operations that fall to the biological brain in the performance of a task." (Clark, 1998) In order to work towards taking these epistemic actions, towards creating an environment that supported the mental processes necessary in collaborative discussions, further exploration of the concept of cognitive offloading was necessary. If visitors to an environment could use elements of their environment to hold information as they generated new thoughts or explained complex theories, they could reach a level of mental flow and more easily retain the contents of these conversations.

Returning to Wilson's *Six Views of Embodied Cognition*, where she addresses cognitive offloading with her exploration of the third view:

> "We offload cognitive work onto the environment. Because of limits on our information-processing abilities (e.g., limits on attention and working memory), we exploit the environment to reduce the cognitive workload. We make the environment hold or even manipulate information for us, and we harvest that information only on a need-to know basis." (Wilson, 2002, p. 626)

According to Kirsh & Maglio, humans utilize the information that they have cognitively offloaded in two ways. One way is "relying on preloaded representations acquired through prior learning." The second way is focused on utilization of "novel stimuli" or new experiences and our capacity for relaying information onto the environment, "accessing as needed...using epistemic actions to alter the environment in order to reduce the cognitive work remaining to be done (Kirsh & Maglio, 1994)" (Wilson, 2002, p. 628). In order to do this people take part in activities that are:

> "…both situated and spatial, in the sense that they involve the manipulation of spatial relationships among elements in the environment.

> The advantage is that by doing actual, physical manipulation, rather than computing a solution in our heads, we save cognitive work." (Wilson, 2002, p. 629)

In determining the best way to provide opportunities in the environment that support cognitive offloading, one theory held great potential: ecological psychologist J.J. Gibson's theory of affordances. Affordances are the qualities of an object that influence a person's "understanding" of how to interact with the object; including all potential interactions with an object or environment. These understandings can be innate, instinctually understood, or learned through repeat interactions – engaging with a space or object can reveal the true and potentially surprising affordances available (e.g. observing a chair that appears to be light and moveable, and then realizing it is immensely heavy and cannot be carried). Once a person is aware of these perceived opportunities for interaction, they have a better understanding of how they might interact with their surroundings, what actions might be performed on the object (Gibson, 1979). This concept brings to mind the potential as a designer to create things or design situations that suggest certain types of actions, creating environments that have affordances that encourage people to interact. By incorporating specific affordances into the forms being designed to fill in the Beckman atrium spaces, it is possible to fill the space with opportunities, which visitors should learn over time are encouraged behaviors within the space.

A variation of Gibson's theory of affordances was brought to design by Don Norman, who suggested that only the immediately perceived affordances of a designed object could guide someone's interactions (Norman, 1988). This notion, while not fully encompassing the range of possible affordances that can be built into a space, inspires consideration of the first impression of designed objects within the atrium space – do their immediate perceived affordances encourage interaction and engagement? If not, the visitor may never reveal additional affordances and supported behaviors within the intentional environment.

Designers have the ability to create opportunities for users through designed affordances, engaging users and encouraging behaviors. Affordances can also be created to discourage certain behaviors within a space, by creating forms that limit specific types of interaction or make it impossible to safely engage in opportunities in the environment. By discouraging specific interactions designers can begin to address and resolve problem of "misuse" of an environment. This process is referred to as 'hostile design' and it is frequently used in the design of city landscapes to prevent interactions that are seen as detrimental to elements of the environment (e.g. putting spikes on the median of a road to deter drivers from taking the opportunity to cross, creating a textured edge on a wall to prevent skateboarding tricks). By carefully honing the encouraged and discouraged behaviors within a space, designers have substantial power to craft an experience (Yudina, 2015).

Barsalou wrote that, “Following Gibson (1979), theories of situated action propose that the environment plays central roles in shaping cognitive mechanisms. Additionally, these theories focus on the close coupling of perception and action during goal achievement (e.g., Clark, 1997; Prinz, 1997; Thelen & Smith, 1994; Steels & Brooks, 1995), and increasingly on social interaction (e.g., Breazeal, 2002).” (Barsalou, 2008, p. 621) So, as people are entering the atrium of the Beckman Institute, what they perceive in their surroundings and their personal goals in entering the space will be influenced and can by supported by the environment. This means that any designed forms implemented in the space should support the goals for engagement for the space as well as the individuals who enter or pass through the atrium.

As visitors move through the atrium space, their perspective will be shaped by individual differences, influenced by their physical stature and capacities as well as their position in the room. Their understanding of objects in their surroundings will be understood based on “phenomenal terms”, in that the further away an object is the smaller it seems, and “pragmatic terms” as their mental representation of the object allows them to simulate potential interactions with the object. While perspective shifts perception of a distant object, it does not influence the viewers understanding of the affordances of a familiar object (Gallagher, 2006). Additionally, Glenberg posits that when a viewer senses an object that they are familiar with, affordances for action are brought forward from their long-term memory (Glenberg et. al., 1998).

In assessing what interactions should be encouraged through the affordances of the designed forms in the material landscape of the Beckman Institute atrium, it was important to return to the goals of the context. As the mission of the Beckman Institute is to support and promote interdisciplinary collaboration, opportunities for discussion and collaboration should be present in the environment. Spaces should be created that allow for ease of communication and mental focus in conversation, opportunities to offload cognition onto the environment need to be provided in order to allow for shared and distributed cognition among visitors.

This line of thought brought me to the area of semiotics: the study of symbols. Of particular interest is the influence of symbols in an environment, how temporary symbols are created, and how they might support discussion and the sharing of ideas. Within a material landscape objects have the potential to not only have apparent affordances, but also can be or become symbols of intended interaction; creating physical and visual cues for visitors. Salient visual cues within the environment become representations of information over time, whether that information is public knowledge or a private memory associated with the space, our environments can act as reminders.

The symbols that exist in our daily environments come to support our understanding of expected and appropriate behavior in those environments. Witnessing others interacting with the surroundings supports our understanding as well, as mirror neurons are triggered in social situations. As we watch someone participate in an activity we are familiar with, the stored simulation and understanding of affordance is triggered in our own brain creating a redundancy that allows for empathy to be established (Barsalou, 2008). So, in watching people participate in interdisciplinary interactions in the atrium and using the environment to support those discussions, visitors may gain additional understanding of potential interactions in the space as they are familiar with collaborative actions in other areas of their research.

In the book *Things that Make Us Smart*, Don Norman writes about the nature of the human brain to utilize our surroundings to support our cognition:

> "The power of the unaided mind is highly overrated. Without external aids, memory, thought, and reasoning are all constrained. But human intelligence is highly flexible and adaptive, superb at inventing procedures and objects that overcome its own limits . . .It is things that make us smart. Some assistance comes through cooperative social behavior, some arises through exploitation of the information present in the environment; and some comes through the development of tools of though - cognitive artifacts - that complement abilities and strengthen mental powers" (Norman, 1993, p. 43).

Human rely on 'things' for cognitive assistance, and while there are many cases where people use an object simply as a representation of itself, as the object is "its own best model" (Brooks, 1991a, p. 139), things can also be used to represent other information. The practice of imparting information onto an object - using it to represent something that it is not – allows that object to become a physical token that stands in place of something else. This transfer of meaning is called symbolic-offloading, and it can be utilized in spatial and non-spatial tasks. Wilson writes that, “When the purpose of the activity is no longer directly linked to the situation, it also need not be directly linked to spatial problems; physical tokens, and even their spatial relationships, can be used to represent abstract, non-spatial domains of thought.” (Wilson, 2002, p. 629) Our capacity for utilizing objects as symbols for other information inspires an interesting opportunity to design affordances with that exact purpose in mind.

In order to better understand what features and affordances an object that is intended to be used for symbolic-offloading might have, it is important to understand the process by which an object becomes a temporary or cultural (more permanent) symbol. It is also crucial to understand that gesture plays a role in our symbolic offloading, as:

> “…symbolic off-loading need not be deliberate and formalized, but can be seen in such universal and automatic behaviors as gesturing while speaking. It has been found that gesturing is not epiphenomenal, nor even strictly communicative, but seems to serve a cognitive function for the speaker, helping to grease the wheels of the thought process that the speaker is trying to express (see, e.g., Iverson & Goldin-Meadow, 1998; Krauss, 1998). (Wilson, 2002, p. 629)

Both the use of objects and gesture in symbolic-offloading help move cognition forward, they help us share our ideas, create explanations, and form memories. So, if designed forms with affordances for these behaviors were available in the Beckman Atrium they would increase the likelihood of supported discussion and interaction.

In a paper entitled "How to do things with things," Jurgen Streek discusses the process by which an object becomes a container of meaning over time, through interaction and discussion. Objects can begin to hold information when through "a series of 'acts of meaning' (Bruner, 1986) [an object] is established as a sample, which embodies a number of qualities, and it also becomes an indexical sign to be used in future occasions" (Streek, 1996, p. 368). This means that objects put in place within the Beckman atrium might be used to represent information in conversations, creating placeholders for the content they represent, which in turn allows them to act as a "continuum of symbolization" which changes the objects "semiotic status" (Streek, 1996, p. 371) throughout a conversation, and later allows them to act as memorable cue for the information shared. By giving physicality to concepts in interdisciplinary discussions, collaborators have the ability to literally and metaphorically build upon ideas, organizing and holding thoughts within their immediate environment. These constructed discussions not only have the capacity to be stored as a memorable occurrence in the distributed cognition of the group, but also can be documented through photography for future reference.

While both objects and gestures can be used for symbolic-offloading, Streek says, "Gestures are naked, fleeting, and symbolic; things are material, enduring, and real." (Streek, 1996, p. 382) When provided with objects in the environment that are without "preordained function" but have the main goal of acting as on means of symbolic-offloading, these forms can be used "creatively in the structuration and conceptualization of new, unrelated, secondary contexts," creating metaphors for the information they are discussing (Streek, 1996, p. 367). In the continuum of symbolization, the object continues to retain the imparted information causing an image schema transformation (Johnson, 1987) and again supporting memory. Susan Goldin-Meadow counters Streek's conception regarding gesture, writing that "…evidence is mounting that gesture not only presages learning but also can play a role in bringing that learning about. Gesture can cause learning indirectly by influencing the learning environment or directly by influencing learners themselves. We can thus change our minds by moving our hands." (Goldin-Meadow, 2011, p. 595) This notion of influencing the learning environment and learners through gesture is especially important in interdisciplinary discussions where one member of the group is an expert and another is a novice in a particular topic. By supporting discussion with both gesture and objects with affordances for cognitive offloading, learning and collaboration are more likely to occur.

In instances where conversational content is vast, people can also rely on other human's within their environment and discussion group to hold information. This distributed cognition amongst a social group hinges on awareness of the general scope of information each person holds. This distributed cognition also applies to available technologies as people rely heavily on search engines to support their daily cognitive processes, as it is unnecessary to "know" information if you know where to refer to in order for it to be found.

Affordances for symbolic-offloading in discussion can help people connect and collaborate; metaphorically and physically building upon concepts discussed using designed forms in their surrounding. These interactions have the potential to change a visitor's memory of a space, and improve their memory surrounding specific discussions because episodic and long-term memory:

> "…is tied in certain ways to our bodies' experience with the world…episodic memories are a class of memories defined by their content – they consist of records of spatiotemporally localized events, as experienced by the remember. Phenomenologically, recalling an episodic memory has a quality of 'reliving,' with all the attendant visual, kinesthetic, and spatial impressions" (Wilson, 2002, p. 633).

While genetics certainly make some people more predisposed to situated memories (Barsalou, 2008), all humans rely on their perception and sense of surrounding in the support and creation of lasting memories. We can rely on "imaginal memory" to organize our thoughts and support or refute understandings of the world around us (Spoehr & Lehmkuhle, 1982, p. 220).

Language plays a crucial role in utilizing our surroundings to cognitively offload and distribute cognition. Without the ability to share verbal or written representations of thought, collaboration would be far less likely to occur. As such, the designed forms in the Beckman Institute atrium need to create spaces where conversation can occur. These conversations need to be sheltered from the general environment to prevent noise reverberation and lack of focused work within the space. Andy Clark writes:

> Language is perhaps the ultimate artifact: the one responsible for our apparently unique ability to think about the nature of our own thoughts and cognitive capacities and hence to seek to deliberately alter our world in ways that allow us to press maximum effect from the basic computational capacities of our biological brains (Clark, 1997, p. 510).

The idea of language as an artifact brings to mind the imprint that interactions occurring within the Beckman Institute atrium will leave.

Creating affordances that encourage the building of forms, drawing, and writing explanations during conversation incites an unpredictable quality in the atrium space. As people gather, discuss, and then leave the created spaces, the objects and written elements they leave behind have the opportunity to act as inspiration or visual cues that bring memories, associations, and other ideas to the surface. In *The Craft of Thought*, Mary Carruthers asserts that memories should not be thought of as information held in the mind that may be regurgitated at will, but as:

"…matrix of a reminiscing cognition, shuffling and collating "things" stored in random-access memory scheme, or a set of schemes -- a memory architecture and a library built during one's lifetimes with the express intention that it be used inventively" (Carruthers, 1998, p. 4).

The potential for inventively derived concepts and collaborations at the Beckman Institute is incredible with the population of residents that pass through the facility every day.

While this potential is immense, it must also be noted that much of the population at Beckman Institute comes form science minded backgrounds, a populous that too often has developed a body schema (Gallagher, 2006) that does not include a propensity for creative activities (e.g. drawing). By incorporating opportunities and facilitating creative action in discussion, affordances designed into form within the atrium may help to revise this thinking, allowing residents of the Beckman to work, think, and express themselves in new ways.

Through reviewing literature surrounding human cognition, education, architecture and engineering it has become apparent that by creating affordances and opportunities for symbolic-offloading on designed forms that make up a material landscape, designers can create intentional environments that achieve the goals for action and interaction within a given context. By taking the time to design affordances into products that create the material landscapes of various environments, designers can create opportunities for intentional interactions and behaviors.

CHAPTER 3: DESIGN DEVELOPMENT

INTRODUCTION TO METHODOLOGY

The research for this project was based in user-centered design and qualitative design research methods, supported by concepts from grounded theory methodology, situated cognition, and phenomenology. As each phase of the project progressed theoretical sampling was used as study outcomes were reviewed and a path forward was determined, each building upon the last and refining towards a conceptual design solution. Multiple research methods and purposive sampling were considered at each stage to determine a feasible best practice and most promising data collection outcome. (Glaser & Strauss, 2010)

Considering the individual experiences of each user interacting with the interactive tables or visiting the Beckman Institute was imperative in identifying key themes throughout their experiences. The constant comparative method was used to identify emergent coding schemes in collected survey data and common themes in researcher observation throughout the project (Glaser & Strauss, 2010). All data and observations were collected and reviewed by the researcher. The qualitative design research methods used helped to develop evidence-based prototypes in response to the research question. This process takes into account the user's perception and assesses what is provable (McDonagh, 2015).

This project followed an iterative creation process that progressed through multiple stages (Butler et. al., 2003). These stages focused on researching the human experience, creating prototype solutions, and extensive user testing. These steps are repeated throughout the process, to allow for the creation of conceptual solutions, eventually refining a chosen concept to its final form. The design development phase of this project provided an opportunity to explore unmet needs and imagine the possible future impact an implemented designed form might have on visitor interactions in the atrium of The Beckman Institute.

All research for this project took place on the University of Illinois Urbana-Champaign Campus throughout various academic buildings (e.g. Temple Hoyne Buell Hall, Business Instructional Facility, Education Building). Visitors to those buildings are primarily students, faculty, and staff, but there are no limitations to the age or physical ability of people engaging with the prototypes discussed throughout this project as the general public also has access to the atrium common areas of these academic facilities. The primary environments analyzed were located within the Beckman Institute for Advanced Science and Technology on the University of Illinois, Urbana-Champaign campus, in the atrium on the first floor.

FURNITURE WITH AFFORDANCES TO SUPPORT CONVERSATION

Prior to working with the Beckman Institute, a design development process was completed to create a piece of furniture with incorporated affordances that may support conversation and collaboration in various contexts. The form of a table was selected as a familiar discussion area and sizes and shapes for the table surface area were compared. Acknowledging tabletop interaction zones and how people perceive ownership over areas of the work surface was considered – zones were identified as personal versus those that were considered more communal (figure 3.1). Additional considerations were made for the American Disability Act (ADA) regulations for seated reach for persons in wheelchairs. This measurement allowed for a reach depth of 20 inches and began to inform the maximum possible table width for a table with a central communal zone featuring affordances to support conversation.

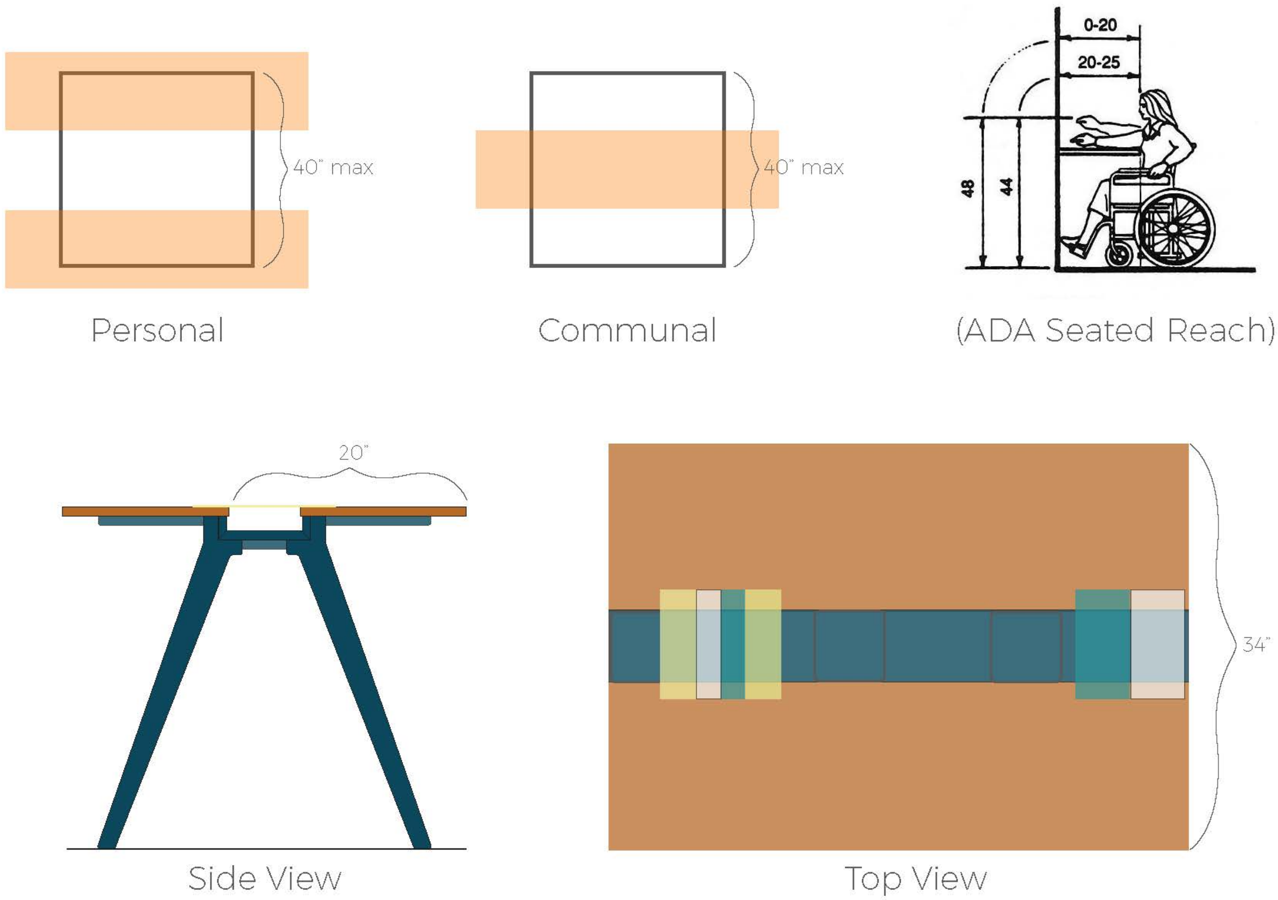

Figure 3.1: The design of the interactive table surface takes into consideration the ADA Seated Reach distance of 20" to create personal and communal zones and a maximum width for the tabletop. The embedded affordances for cognitive offloading are stored in the communal zone to allow easy access for all users.

The table surface was designed to incorporate small non-symbolic objects that provide an opportunity for users to move, build, organize, and position the items as they hold a conversation or tell a story. These objects allow conversations around the table to be supported by the objects when they are used as representations of information or create an opportunity for users to keep their hands busy, potentially relieving stress and creating mental flow in conversation. Figure 3.2 shows how an object takes on information, becoming a container of meaning over time (Streek, 1996).

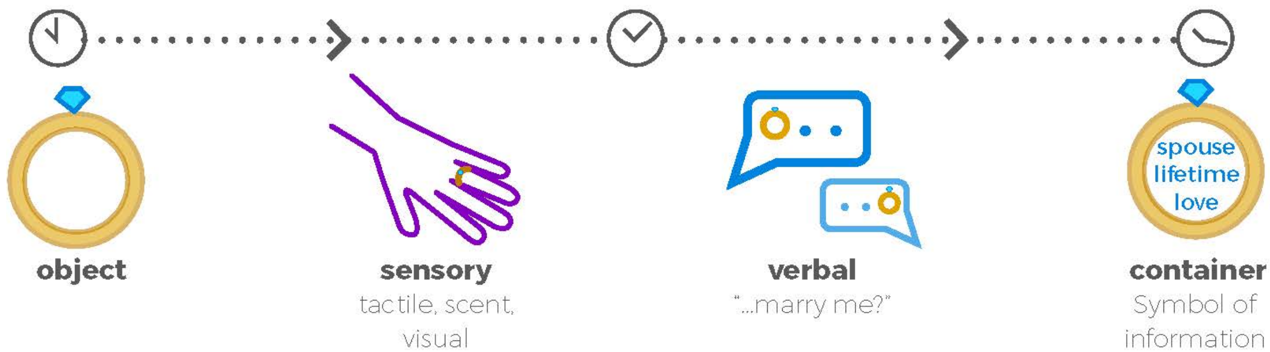

Figure 3.2: This figure provides an example of the proposed method by which an object becomes a container of information or a symbol (Streek, 1996). The author created this illustration for the purpose of demonstration in this paper.

Low fidelity versions of these objects were created and tested prior to the final model and key qualities for ideal 'thought objects' were identified (Figure 3.3). These objects needed to be tangible, with affordances for a range of motions, providing opportunities for movement similar to those allowed by the human body. The objects needed to be able to connect and build in order to facilitate more dynamic interactions and collaborations. Lastly, the objects needed to have memorable qualities (e.g. color, shape, texture) without having recognizable, cultural symbolism. This lack of existing meaning provided an opportunity for users to impart their own thoughts onto each object, creating temporary symbols or thought containers (Streek, 1996), representing information that was communally understood in the current conversation.

Figure 3.3: Low fidelity versions of 'thought objects' were tested in a group brainstorm setting. Preferred objects for interaction and symbolic-loading were discussed, leading to the identification of ideal qualities for objects that could act as temporary symbols.

The table was first tested in an open gallery space in the University of Illinois Urbana-Champaign School of Art + Design. Visitors to the space wandered in to see the table and instinctually began to engage, starting conversations and asking questions when others were present (Figure 3.4). Existing in this space without greater context the table peaked curiosity and enticed visitors to begin manipulating the small objects featured in the table surface. An opportunity then arose to present the interactive table in a more formal gallery setting, The Link Gallery, a space which physically connects the University of Illinois School of Art + Design to the Krannert Art Museum. This new area for display began to shape an environment and context for the table, observably impacting visitor interactions with the space and the interactive table.

Figure 3.4: Curious visitors to the empty gallery spaces housing the interactive table engage and build with small objects while discussing and requesting information about the table itself.

The Link Gallery Show provided a material landscape and context for the interactive table. As a result of the function of the gallery space visitors had existing expectations about acceptable behavior within the environment. Many of the pieces within the show met their expectation and warned against touching or interaction, but the table presented a break from the norm and displayed a small sign inviting visitors to engage. The table was placed in a semi-enclosed location in the gallery between two moveable exhibit walls; this placement provided a sense of privacy for users and encouraged prolonged interaction. Each day the table was observed and photographed as documentation of what visitors had built and left behind on the table as a result of their interactions (shown in Figure 3.5). These check-ins allowed opportunities to either clean up or curate the creations in order to further encourage interaction.

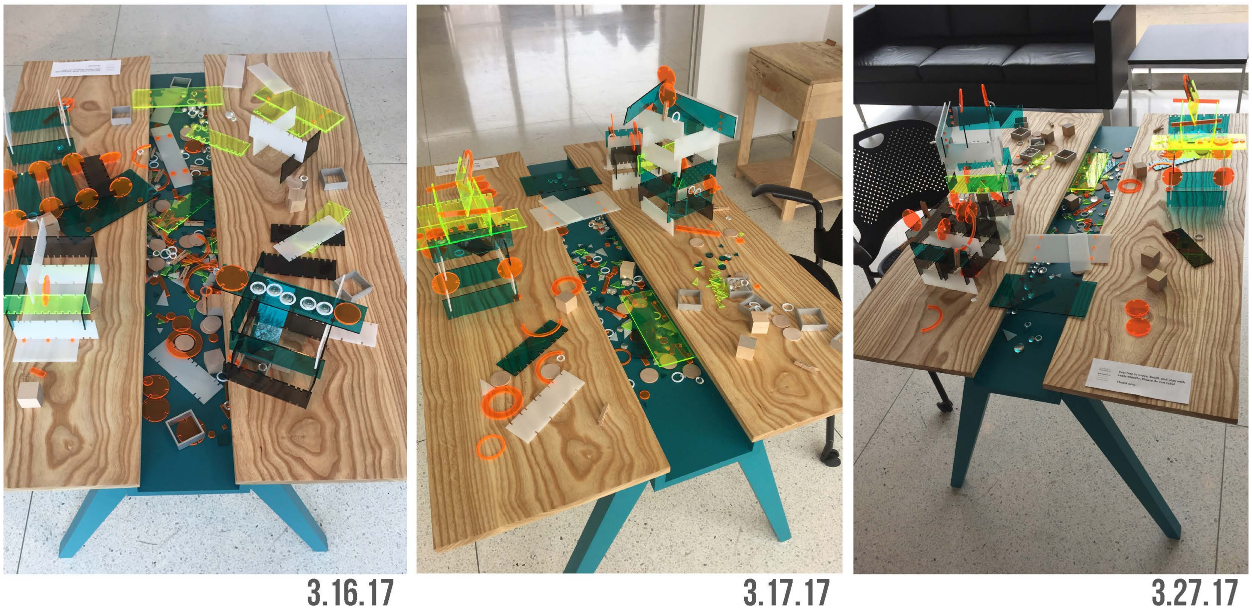

Figure 3.5: These images are examples pulled from the collected documentation of built artifacts left behind on the interactive table during the Link Gallery installation.

While the Link Gallery primarily functions as a location to display works of art and design, its function is also influenced by its unique location, shown in Figure 3.6. As a result of adjoining two buildings and creating an entrance and thruway to either, the Link Gallery also functions as an atrium. In considering this added functionality, questions about the diverse patronage and who was actually engaging with the interactive table were brought to mind. In speculating, based on its location on campus and buildings in proximity to the gallery, likely visitors may have included students, faculty, and staff from Art + Design, Education, Law, and Business. Additional visitors may have included community members, Krannert Art Museum visitors and employees, school groups, prospective students with families, and museum donors.

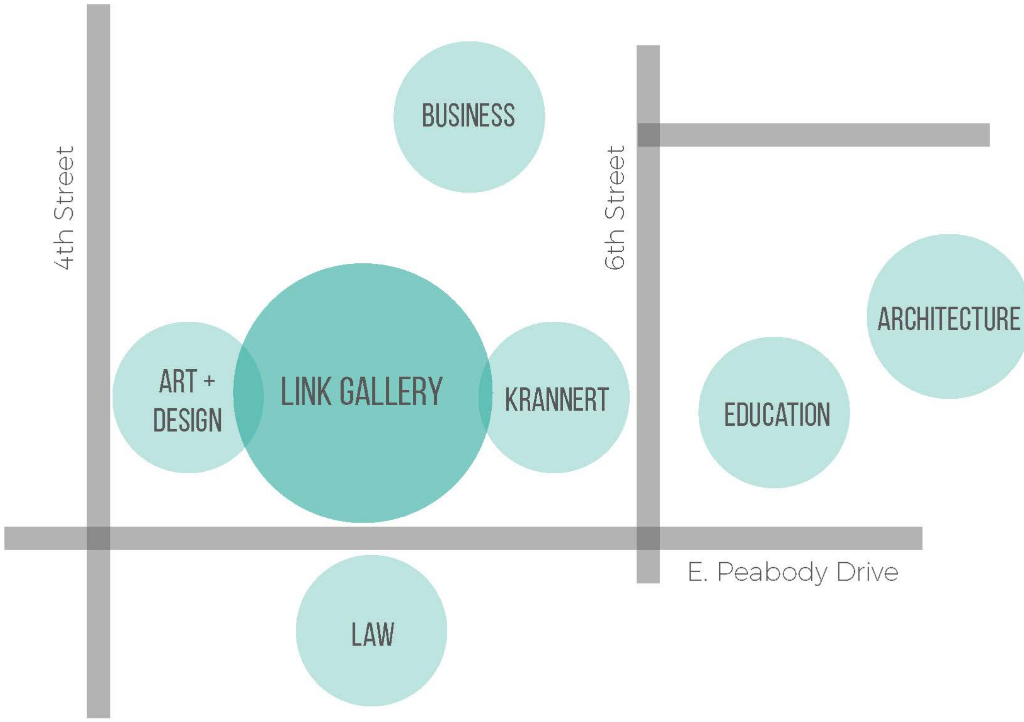

Figure 3.6: This map shows the unique position of the Link Gallery in relationship to surrounding academic buildings (not to scale).

The broad range of visitors who may have passed through this pseudo-atrium space, brought to light an opportunity being missed across campus. How can designed forms (such as this interactive table) begin to reshape atrium spaces in order to promote discussion and collaboration in those spaces? The diverse populations passing through and encountering these campus spaces on a daily basis may be missing opportunities for interdisciplinary idea sharing and collaboration, simply by choosing not to spend time in or engage with these spaces.

RE-IMAGING THE ATRIUM SPACES OF THE BECKMAN INSTITUTE

A team comprised of Industrial Designers and Architects was brought together to re-imagine and collaboratively design for The Beckman Institute for Advanced Science and Technology, on the University of Illinois Urbana Champaign campus (Illinois, USA), a facility that is world renowned for interdisciplinary breakthroughs in science and engineering. This structure is home to a unique blend of graduate students, faculty, and staff; completing research projects that are shaping the future. The nature of the work requires dedicated Beckman Institute community members to spend a significant amount of time within this building. This environment needs to provide areas effectively designed for connection, collaboration, and reflection. The design of an environment can be directly correlated with its overall effectiveness; and when it comes to a facility such as the Beckman Institute the impact of this design research process could prove to be invaluable.

The initial stages of this building revitalization project focused on the re-imagination of the atrium of the Beckman Institute. This communal area, intended to welcome visitors and residents alike, currently acts like a long thoroughfare from one end of the building to the other, splitting the floor plan of the five-story building to create an indoor street. This long space has walkway bridges overhead that divide the perceived space into three distinct sections. Despite the 'city street' appearance, the space is often deserted. This is a result of the lack of environmental affordances for comfortable nesting in order to work or socialize. Despite the number of daily visitors arriving to participate in research projects or to frequent the mealtime specific cafe area, the substantial three-part atrium feels vacant and still.

This empty space leaves an impression that misrepresents the true nature and mission of The Beckman Institute, to foster interdisciplinary work. The goal of this re-design project was to extract key information from the design research process in order to create a space that better embodies the mission; creating an atrium that fosters connections and community in order to create additional opportunity for advancements.

In order to identify the best methods for reshaping the space, an interdisciplinary team of architecture and industrial design graduate students was assembled to undertake the task of determining the value of various potential paths of design research, led by a faculty member in each respective area (figure 3.7). The intent of this core team was to explore and generate conceptual solutions that comprehensively integrate the accumulated research and design. The team developed a strategy called 'social triangulation' in order to access the most efficient data. This strategy involved bringing together the key users impacted by the eventual design and experts from multiple disciplines capable of re-imagining the space. The initial stages of exploration and analysis were completed by three distinct contributing groups; members of the Beckman Institute community, Undergraduate Students in

Architecture, and the Interdisciplinary Graduate Design Team. This method of social triangulation aimed at providing the most cohesive and effective re-imagination plan, honing in on recurring focal areas and concepts.

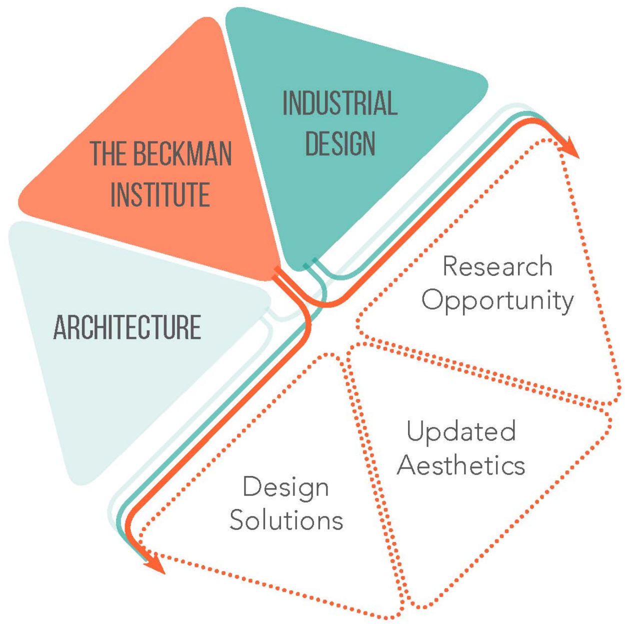

Figure 3.7: This visual illustrates the three distinct teams that worked separately and together to identify design solutions, updated aesthetics, and research opportunities within the atrium of the Beckman Institute.

In order to gather reactions regarding the effectiveness of the current atrium space, a survey requesting feedback was collected from residents of the Beckman Institute research community. This survey was distributed by the administration of the Beckman Institute prior to the start of the project. Survey data acquired from people who work in the building on an everyday basis highlighted issues and opinions for consideration and provided an integral platform from which to assess the space. An undergraduate architecture seminar group completed their own observations and began to envision changes that could influence visitor interactions with the space. Additionally, the graduate student design team observed, analyzed, and documented the space. This process also allowed the graduate team to make comparative observations between the self-reported behaviors of the survey participants and how they actually behaved within and interacted with the space (figure 3.8). The feedback in contrast with the lived experience provided valuable insights into potential impact of future design elements.

Figure 3.8: Visitors to the Beckman atrium explore and engage during a Beckman Open House Event.

Each of the teams conducted post-occupancy evaluations of the space; observing and documenting how the atrium is used, compared to the function it was built to serve. The undergraduate design explorations along with the early analysis completed by the interdisciplinary graduate design team helped to establish clear goals for overall aesthetics and user interactions with the space. From these goals the core graduate and faculty team began to develop potential strategies to change the perception and use of the space. In order to identify value for the diverse research interests of the interdisciplinary team, a shared language needed to be established in order to organize and focus the value of research outcomes.

The architects' research focus was on the personal cartography of the space as perceived by the visitor, while the industrial designers' focus was on an empathic understanding of the user's needs as well as the visitors' ability to interpret and understand the intended interactions with the environment, which lead to the development of a mind map. The mind map, shown in figure 3.9, acted as a touch point of understanding for the graduate design team as well as a way to communicate the observations and potential improvements for the science, technology, engineering, and math (STEM) based researchers working at Beckman Institute. Together the team agreed on the most valuable commonalities that arose from triangulated assessment of the space.

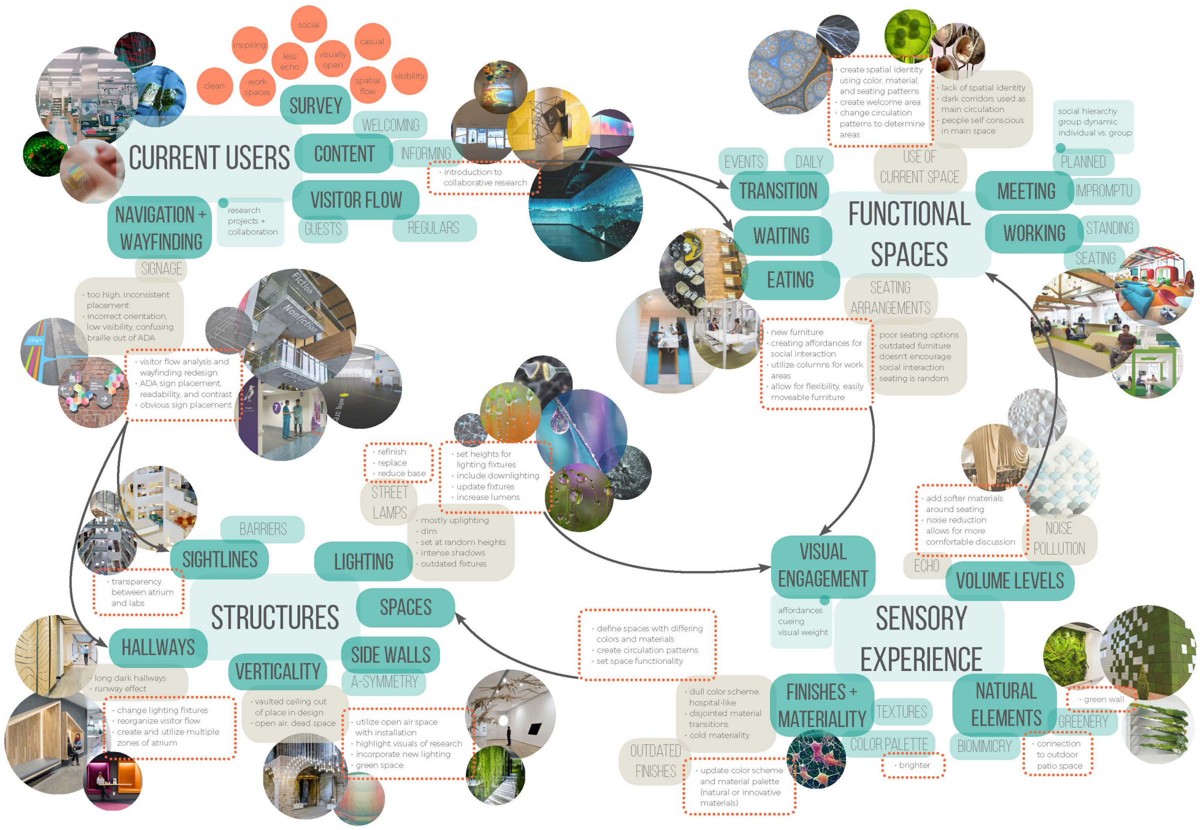

Figure 3.9: The mind map was used to express an understanding of the current state of the Beckman atrium along with potential areas of improvement. Categories, keywords, and notes are accompanied by mood and inspiration visuals to encourage understanding of the potential for change in the atrium space.

Once the strategies for change were determined, graphic icons were created to represent each individual strategy. These symbolic representations, illustrated in figure 3.10, highlighted areas of anticipated beneficial change for members of the Beckman Institute Research Community, helping them to clearly understand the intended impact of each potential design element. Additionally, each icon notes a distinct area of promise for future research and design development; allowing the team to visualize the potential research trajectory, organize the scope of design work, and project the value of exploring each area. As a multistage project, this documentation provided key touch points to organize feedback from the Beckman Research Community about the individual proposed changes while maintaining overarching design intent.

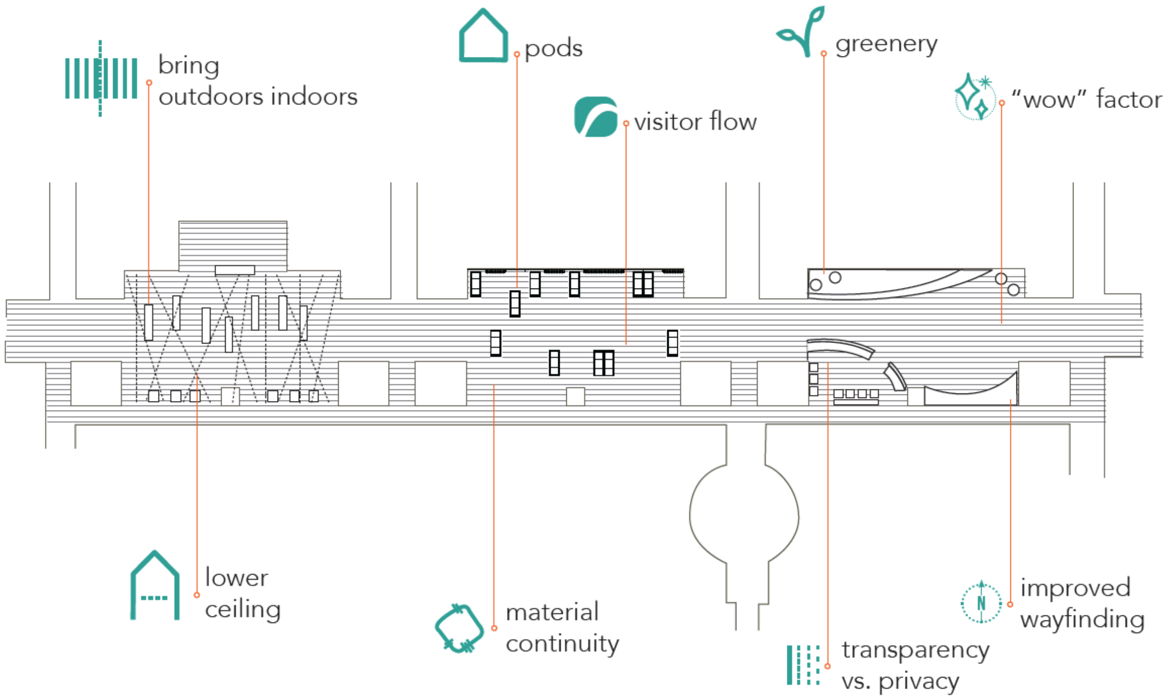

Figure 3.10: Icons created to indicate goal areas for change were incorporated into an early floor plan of the space.

By approaching the re-imagination of the space with the social triangulation research strategy, the team gained a better understanding of the current perception of the atrium space as well as common goals for a new design. This collaborative method of development allowed the design researchers to find the most influential aspects of the atrium; areas that shape the way in which visitors perceive and understand how to interact with the space and plan for change. The floor plan shown in figure 3.10 and the mood board shown in figure 3.11 demonstrate the visual organization of goals identified by the team. Mood boards are a tool, composed of multiple images, used to create a visual representation of the overall 'feel' of an object or space.

Figure 3.11: The mood board for the redesign of the atrium plays on ideas of organic growth, fluidity, and connection.

Focusing on these goals for change individually allowed for the determination of research strategies that can meaningfully address the impact of each unique proposed change. These methods also allow for the future designed forms within the space to shape the visitor experience through affordances for intended interaction, making it a more effective environment where the Beckman research community can thrive. Through the identification of areas for continued research and design, the iterative interdisciplinary redesign project of the atrium in itself became representative of the Beckman Institute Mission, while revitalizing the facility to provide a positive and productive space for future generations of researchers (figure 3.12).

Figure 3.12: The interdisciplinary graduate design team discussing, sketching, and collaborating on concepts.

USER-CENTERED DESIGN IN THE BECKMAN INSTITUTE

After working on the initial stages of the Beckman Institute re-imagination, the project became more focused on the user-centered, industrial design aspect of the redesign. This design direction was determined based on the foreseeable impact of this user-centered, affordance-based design approach moving forward, working to improve and create the visitor experience without drastically changing the architectural structure of the building. As this shift was initiated, the project itself began to grow as the administration at the Beckman Institute saw the potential for positive change throughout a network of intentional environments throughout the building (figure 3.13). These spaces included the atrium, research neighborhoods, meetings areas, café, administration suite, lab spaces, and hallways. The initial identified goals for the atrium space provided inspiration and insight to begin creating designed forms that could reshape the existing atrium space. They also brought to light a product development opportunity that will be discussed in depth in this paper.

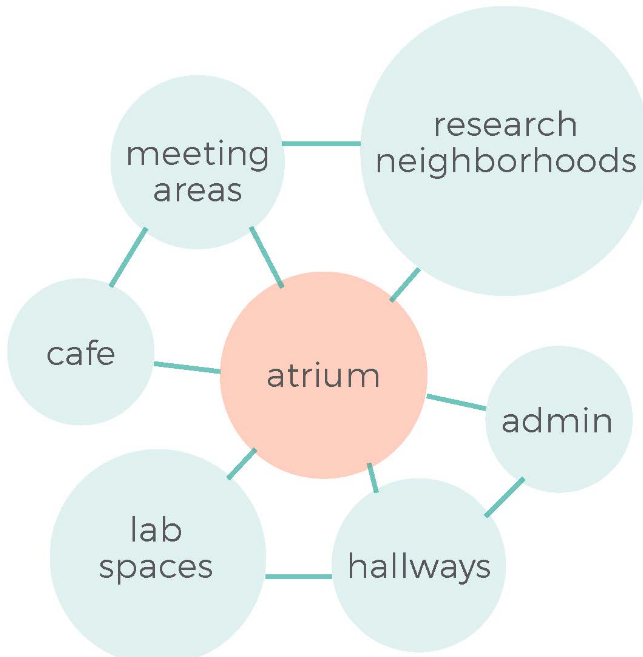

Figure 3.13: The redesign project that began with the Beckman Institute atrium grew into the redesign of a network of spaces throughout the building.

The new path forward required the consideration of the research that had already been completed and what data collection methods might be used moving forward. It was integral to gain insight into the stakeholders of the Beckman Institute, including faculty, staff, and students; while also acknowledging the more silent stakeholders – anonymous visitors to the Beckman Institute who were there to participate in a study. Observations of visitor flow through the atrium space had been completed during the early phase of the project, as well as observations of other atrium spaces across campus for comparison. While some functioned more efficiently than others it was clear that most of these spaces were underutilized. These spaces had the potential to create opportunities for collaboration and connection, while putting on display the inspiring work that was going on behind the closed doors of each of these academic buildings.

By implementing a physical intervention into atriums of academic buildings, these spaces could be transformed into lively hubs of interaction, socialization, and collaboration. The affordances provided by the designed forms within the space had the potential to attract people to these spaces and encourage them to stay. In order to begin exploring effective solutions to this design problem in the Beckman Institute more information about the motivations and lived experiences of the residents who might utilize the space was needed. A new survey would help begin to guide the research exploring how designed forms might create a material landscape within the atrium of a higher education facility that support and encourage interaction and collaboration.

Prior to the start of the project an initial survey had been issued to Beckman Residents by the administration, but based on the team’s observations and the newfound goals for the atrium space it seemed appropriate to issue a more focused Institutional Review Board approved survey. This survey would be sent out to the entire Beckman community and focused on whether they use the common areas of Beckman currently, how much work Beckman residents could complete outside of their assigned office and lab spaces, and what positive or negative impacts they anticipated surrounding the idea of 'change' at Beckman. These questions were asked in order to gain a better understand of what might inspire them to engage with the common areas, while uncovering more of their lived experience in the building. By asking about and expectations or fear they had of change, there was hope for accessing a deeper truth about the changes residents were imagining for the space as well as key factors that would influence their interactions with the space.

IRB APPROVED SURVEY

The first few questions of the Institutional Review Board approved design survey were intended to provide a better understanding of where the anonymous participant was situated within the Beckman Institute community. After providing their consent and understanding that the answers and information the participants (n=102) chose to provide would be protected data used to drive a research project, participants were asked to disclose their position at Beckman (figure 3.14), the number of years they had worked there (figure 3.15), and what subject matter or department their research or work falls within.

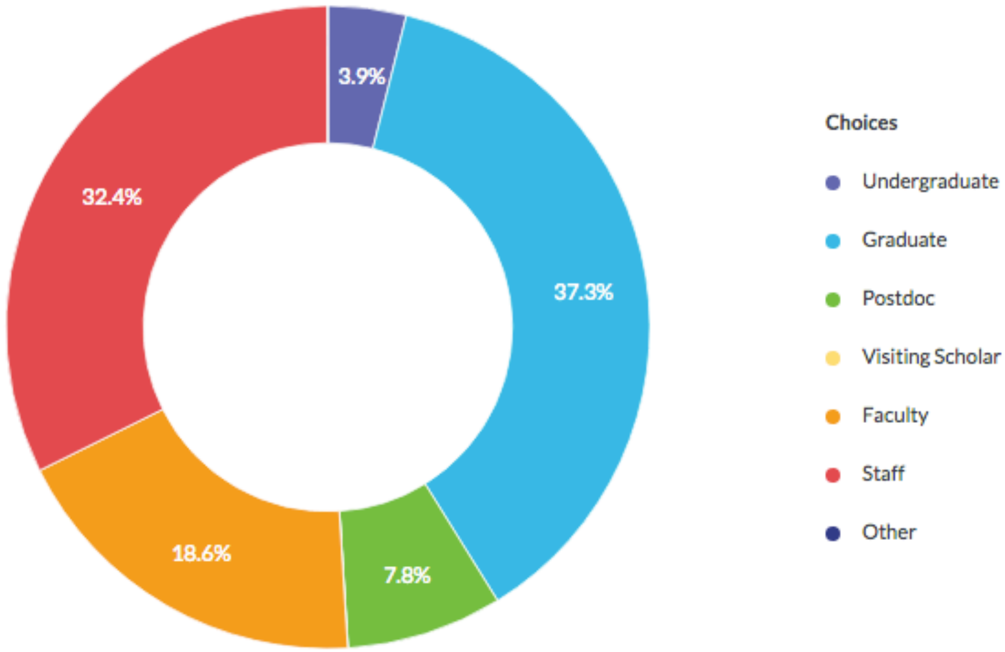

Figure 3.14: Position at Beckman Institute (Undergraduate n= 4, Graduate n=38, Postdoc n=8, Visiting Scholar n=0, Faculty n=19, Staff, n=33, Other n=0)

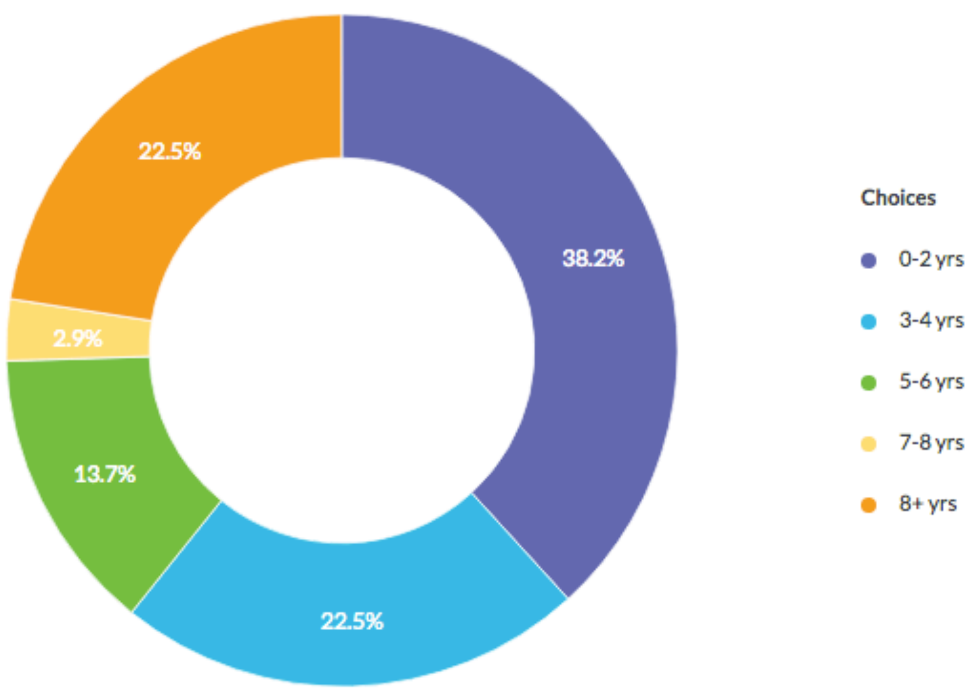

Figure 3.15: How many years have you worked at the Beckman Institute? (0-2yrs n=39, 3-4yrs n=23, 5-6yrs n=14, 7-8yrs n=3, 8+yrs n=23)

Once the diverse group of participants was better understood, it was crucial to find out if any of the work that they conduct has the potential to be completed outside of a designated lab or office environment (figure 3.16). Additionally, it was important to know how much, if any, of their work could happen in a communal area (figure 3.17). These factors are particularly influential because the work completed at the Beckman Institute is in developing break through advancements in science and technology, meaning a portion of the work is of a sensitive nature and may need to be conducted in private in order to protect intellectual property and the advancements of research teams. This information began to provide clues as to why some Beckman residents were not utilizing common areas in the building, but a large portion indicated that they were able to compete work outside of their designated workspaces in the building.

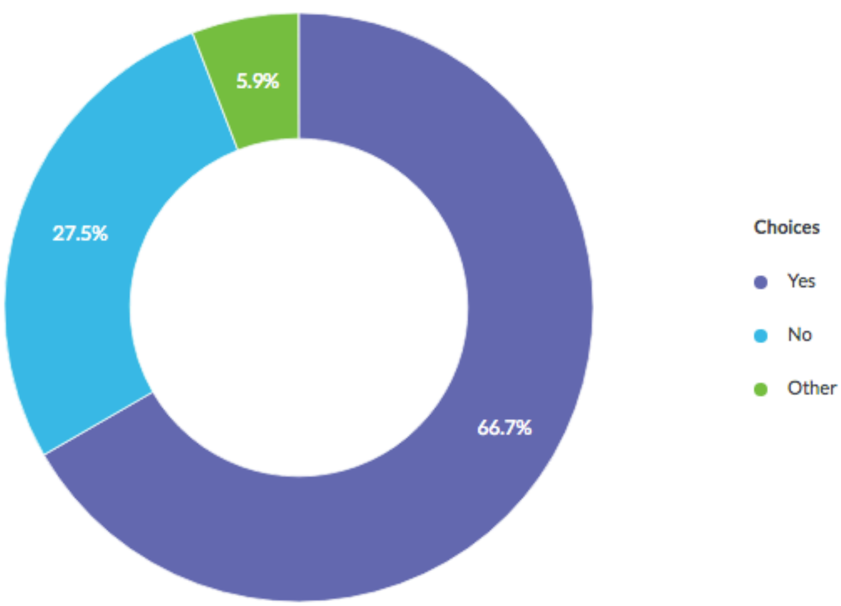

Figure 3.16: Do you have any work related activities that can take place in communal areas? (Yes n=68, No n=28, Other n=6)

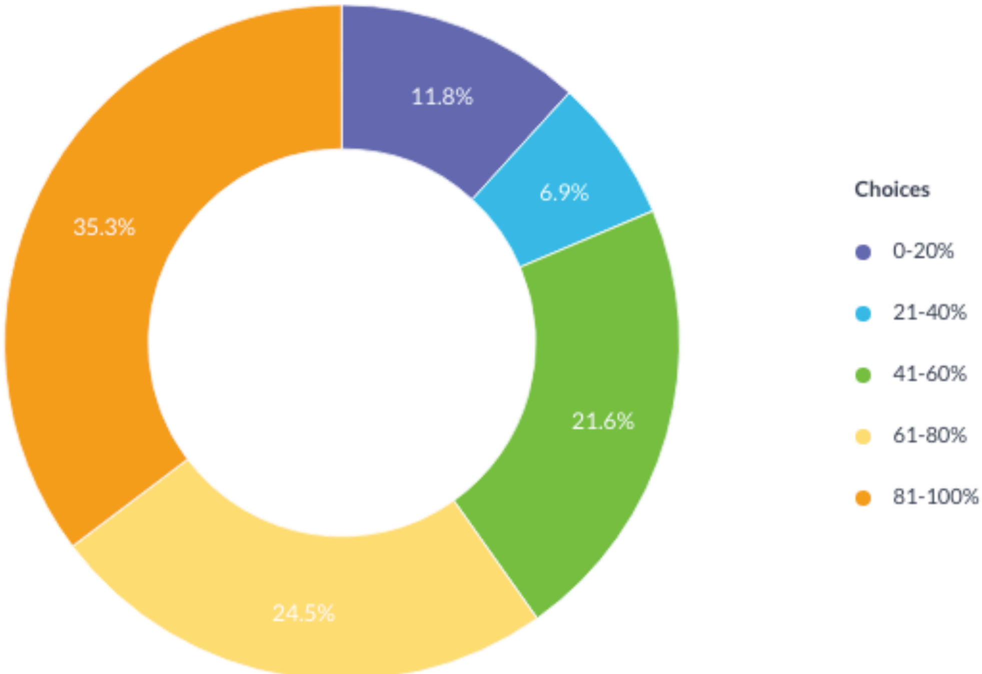

Figure 3.17: How much of this work needs to be completed within a designated lab or office environment? (0-20% n=12, 21-40% n=7, 41-60% n=22, 61-80% n=25, 81-100% n=36)

The following questions in the survey asked participants to anticipate potential positive and negative impacts of undefined "changes" to the common areas of the building. These questions were intentionally vague, intended to get an idea of how people's imaginations and individual differences impacted their receptiveness to the intangible concept of "change" in their environment, and how they felt these "changes" would impact their work at Beckman. Their willingness to accept design concepts could be highly driven by the nature of their reactions to these questions.

Emergent coding schemes were developed for both the positive and negative feedback, based on trends and common themes that occurred in the submitted answers. Regarding positive impacts of change the themes of connection, functionality, atmosphere, aesthetics, and "welcoming" arose. Survey participants reported that changes to the space could have a positive effect on the sense of community at Beckman, opportunities for collaboration, locations for meetings, and overall inspiration from the space. They also indicated that changes towards furniture adjustability, power access, improved seating, and beneficial affordances would positively impact their experience. They hoped that changes to the atmosphere would limit noise pollution, allow for privacy, provide a mood to indicate appropriate behavior, incorporate greenery, and feature plenty of light. These positive changes had a common idea in mind of making Beckman Institute a welcoming place that is easy to navigate and somewhere you want to spend time.

The emergent coding scheme that arose in response to the question about negative impacts, dealt with similar themes: functionality, atmosphere, aesthetics, and "welcoming", but in this case they saw the potential welcoming nature as a negative that could cause overcrowding. The idea that there might be too many people in the building seem to worry participants, as spaces would no longer feel private. Participants were also greatly concerned with too much noise in their atmosphere, both from too many people in the space and during the phases of building renovation. By gaining insight into these hopes and fears, considerations could be made as each design element progressed in order to meet or avoid the participant's anticipated renovation outcomes for the Beckman Institute.

In order to better understand the participant's current workflow, participants were asked to describe how their research group or team utilizes collaborative work environments within or outside of the Beckman Institute. Responses indicated that research groups currently do try to utilize the atrium, bridges, café, and conference rooms within Beckman Institute. Some participants also reported that they use the collaborative area in their neighborhood space, as their team has already put thought into the layout and functionality of that space. While many of the responses indicated that research groups attempt to work within the Beckman Institute spaces, some answers revealed that groups are relocating to nearby coffee shops and academic buildings to hold collaborative meetings.

They were also asked to discuss the strategies they use to explain their research and discuss concepts with others. These explanations may take place in a collaborative, instructional, or presentation setting; and the methods used are important to consider for the design of future co-working environments. Emergent coding of the survey responses indicated that the most predominant methods used included: talking (e.g. in person, phone, radio, discussion, brainstorm), drawing (e.g. white board, black board, iPad, glass surface, drawing pads), technology (e.g. Computer, iPad, Software, internet, VR), artifacts (e.g. print papers, posters, physical models), projection (e.g. projectors, large monitors), and gestures (e.g. talk with hands, pointing, using references in visual field). The use of gestures to express ideas and reference visual aids, provides a particular point of interest as these explainers are using embodied cognition and symbolic-offloading; using elements of their surroundings to hold and support knowledge that they are sharing with the listener.

Next it was important to identify how Beckman residents spend their break times, in order to recharge and return to work refreshed and ready to work. It is particularly important whether they need to leave Beckman to participate in this activity, because these activities could be missed opportunities for Beckman to promote community, collaboration, and interdisciplinary interaction. When the faculty, staff, and students temporarily stepped away from their work within the Beckman Institute they reported walking the halls of the building, going for coffee in the café, spending time in the garden area, socializing with peers, and indulging in computer-based entertainment. While many residents (n=59) of Beckman said they found a way to take a break in the building it was more common that they left Beckman (n=66) to go for a walk outside, walk to other campus buildings, or engage in other activities. They reported visiting local coffee shops in the area, going out to nearby restaurants, going to the gym, taking part in hobbies, and going home to rest and relax.

Participants were then asked to again imagine changes to areas of the Beckman Institute. It was requested that they describe the appearance of the workspace of their dreams. The phrase "If you could instantly have…" was used in the question to imply that in the imagined scenario it could be theirs without the perceived pains of renovation (e.g. potential displacement, noise, waiting). Asking Beckman residents to idealize their work environments brought to light individual and unique functional and aesthetic goals of the varied participants. While the responses were unique, common ideas and areas of change began to emerge, they included: a desire to bring the outdoors in with plants and natural elements, more comfortable furniture, aesthetically "nicer" furniture, more white boards and writable surfaces, natural light, noise control, multifunctional workspaces (i.e. sitting to standing desks), "comfortable" temperatures, and private areas for work that allow easy access to collaborative areas

After considering their optimal private workspace, participants were asked what activities they would participate in, if Beckman Institute had an area for fun, fitness, or leisure. Again, the answers to these questions highlight the diverse population that makes up the Beckman Institute Community, as the responses were widespread. Themes among the activities were identified and the most prominent goals for community activities became evident. The most popular ideas involved having a gym or physical fitness area, yoga or meditation spaces, tabletop games (e.g. ping pong, board games, foosball), and having a multi-purpose area for general relaxation and socialization.

The last set of questions in this survey was created to uncover the existing impression and experience of the Beckman Institute atrium spaces. The descriptions requested in this segment were open ended, allowing participants to free write on their opinions and individual experience of each space. These responses were analyzed for emergent coding themes, which helped establish key considerations moving forward on the redesign project. Participants were also encouraged to provide any additional comments or concerns, in order to draw out any additional thoughts that might enlighten us to additional factors impacting residents of the Beckman community.

The identified emergent coding themes that arose were identical to the themes identified in the questions regarding potential positive and negative impacts of change. Participants were again most interested in the ideas of connection, functionality, atmosphere, aesthetics, and welcoming; as they provided their individual memories and experiences of entering, spending time, and eating in the Beckman Atrium. The information provided for these questions brought light to positive and negative qualities of the existing space and reiterated desired outcomes for the redesign expressed in previous questions.

One particularly interesting factor that played into these responses was the self-identified differences between experiencing the Beckman Institute Atrium for the first time and experiencing the space on a regular, even daily, basis. As a space that is host to such a diverse group, spending such varied amounts of time within the building it became clear that designed forms within the atrium needed to connect with the range of visitors to the space. Any implemented designed forms must create an environment that is engaging in order to draw in new visitors while also acting as a comfortable home base for daily residents. Any designs within this space also need to have the ability to be renewed and refreshed, creating a reason for return visitors to reengage, and spend time in the familiar but ever-evolving space.

FOCUS: PRODUCT OPPORTUNITY

The survey data provided evidence to direct and inspire the next stages of the project. The atrium environment needed to be created with a very specific set of goals in mind; the forms within the space need to support the intended functions for each area of the space. As each of the three distinct areas of the atrium required disparate affordances for functionality, it became important to begin focusing in on singular areas in order to work through a design process for the specific forms within that atrium space. This focus allowed for the research question to narrow; now looking at how a single designed form within the atrium of the Beckman Institute might create opportunities that support and encourage interaction and collaboration.

Creating unique intentional environments has become more popular throughout up and coming companies and university facilities. These inspiring spaces often use bright colors and interesting form to create areas for lounging, eating, working, and playing. Time was spent exploring a variety of these environments through imagery research, resulting in an awareness that while many of these environments possessed a "wow factor", once their novelty wore off their affordances for functionality determined their usefulness. Each intentional environment considered was installed for a unique reason, but further evidence was not provided as to the success of the space in supporting the mission of the environment.

The Beckman Institute's mission of interdisciplinary breakthroughs is clear and is at the forefront of their administrative decision-making. Introducing designed forms into the atrium may help structure intentional spaces; causing visitors feel welcome and encouraging them to spend time in the space, but these forms could also do more to support the mission. They could create a spatial identity, while amplifying sensory experience, and bring the vast perceived space down to human scale. These designed elements could create multiple functional spaces that bring people from unrelated disciplines together; they could provide affordances that would help support discussions, idea generation, and collaboration.

FLEXIBLE POD WORKSTATION DEVELOPMENT

In the interest of creating something both custom fit for the Beckman Institute but also marketable as a product line, the concept of 'pod' products arose as a potential intentional space creating solution. Within this document a 'pod' is defined as a designed form that can be brought into a space in order to create perceived divisions of space and a sense of privacy. These designed elements can be custom build for a space or purchased as a preset or semi-customizable design. In exploring images of both custom and purchasable pod products certain trends became apparent. The function of the internal space determines the relative size of most of the products, but all created contained spaces within a larger environment. Many drew organic form inspiration from plant seedpods, from which their name is inspired, while others took on a more of a geometric aesthetic.

Among the pod product's varied forms, aesthetics, transparencies, and functions one common theme was clear: the pods frequently had the traditional roofline of a house in western culture. They appeared to be a three-dimensional version of the iconic symbol for home; a hollowed-out version of the traditional monopoly game piece, or the cleanly constructed frame of a house a young child might draw (an index of their mental representation of their actual home). This common form inspired an interest in how cultural symbols in an environment may increase understanding of affordances and influence the behavior of visitors to that space.

Designing a pod for this research project was appealing as it had many benefits, both in meeting the needs of the Beckman atrium and allowing for the design development process to occur through the growing research and conceptualization. By creating a pod, the project would focus on a single designed form that could be created for production and marketed for any atrium or open floor plan space. The pod could be created as something that was modular and flexible, that could be set up and put away to meet the needs of the space. The pod could also incorporate symbolism and affordances for collaboration and discussion. Lastly, by designing a pod, a testable proof of concept could be created to explore and iterate upon the form.

In considering the best way to incorporate symbolism into the design form, it was identified that the Beckman Institute lexicon revolves most prominently around the idea of community. The architect of the building intended for the atrium to feel like an outdoor city street, complete with lampposts. The areas and offices occupied by the research groups are referred to as neighborhoods. The faculty, staff, and students are referred to as residents. This common thread influenced the idea of incorporating the symbolism of home into the pod design, creating an opportunity to observe whether bringing symbolism that indicated affordances for nesting into an environment might influence behavior, by welcoming visitors and encouraging them to spend time in the pods of the Beckman atrium.

The early sketch development phases of the pod concept were focused designing a pod that could function in multiple ways and be set up to meet the needs of the Beckman Institute. Considerations for the types of activities that occur within the atrium space were made, taking into account that the space is available for use by individuals and groups, it can be reserved for class gatherings, host presentations and poster sessions, and it can be cleared out to create space for events and receptions. All of these functions meant that the pod needed to be able to open up and create spaces for work and interaction, but also needed to be able to transform into a more consolidated form to be tucked away when the atrium was being used in a more open format. One concept that was developed functioned by having different elements of the frame fanning out from a central structure, allowing for multiple setup options, customizable to the needs of the space. The affordances designed into the pod need to increase visitor time in the atrium, support cognitive offloading, encourage interdisciplinary interactions, incorporate moveable parts, offer privacy, and provide adaptable lighting (figure 3.18).

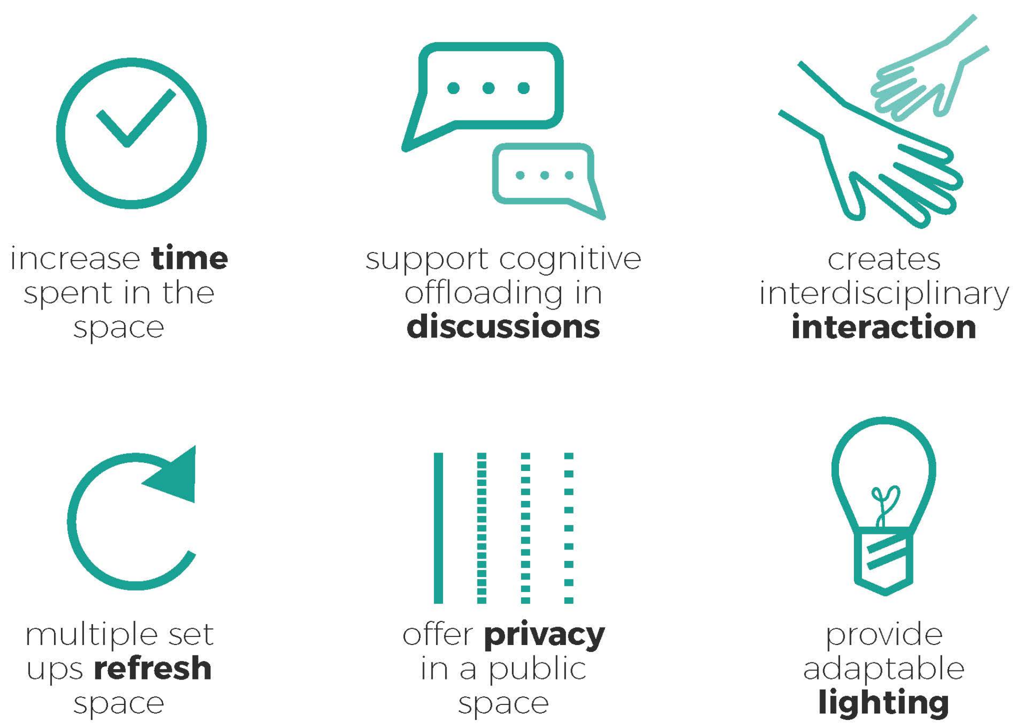

Figure 3.18: Icons were again used to allow focus on goals for the functionality of the pod.

The designed concept focuses on having different spaces created by framed forms, these frames predominantly used the simplistic roofline, symbolizing home, but had varied structures and opacities. Some of the frames come together to create a shelter with coverage overhead, some create walls to divide space or create rooms, and a few suggest created spaces using only a "floating" roofline overhead. These elements allowed for the creation of three distinct types of space where people may interact and spend time. To further invite and encourage engagement additional designed forms with affordances for working, seating, and discussion were considered.

In order to create opportunities for engagement in the created spaces of the pods, low fidelity versions of the interactive discussion table previously designed were incorporated. By placing these tables in differing created spaces a comparison could be drawn between how much time people spent in each type of space at the interactive tables that aesthetically and functionally provided the same affordances for interaction. Testing the impact of these pod structures on visitor interaction with the Beckman atrium space (figure 3.19), was crucial in determining which types of created space best supported interaction and collaboration. Multiple options for study were considered at this stage including creating a 3-dimensional virtual experience of the space for visitors to move through, using eye tracking to document the elements they observed in order to understand the function of the space, and creating physical low fidelity models to document visitors interacting within the space.

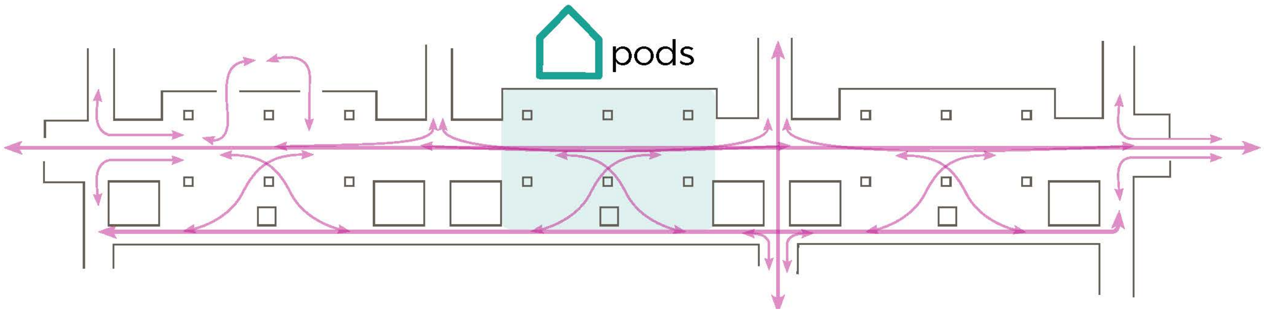

Figure 3.19: The low fidelity pods would be set up in the middle section of the Beckman atrium for observations. This floor plan shows current visitor flow through the space and highlights the location for implementation.

By building low fidelity models of pods to create intentional spaces within the atrium a physical intervention could be made in the existing space, providing an opportunity to observe and document the impact on visitor interaction and flow (figure 3.20). Two low fidelity pods were built to create a variety of interactive spaces for visitors to engage, these pods would be installed in the atrium space for two weeks (figure 3.21). Low fidelity interactive tables with affordances to support discussion and collaboration were placed in three of the created spaces (figure 3.22). During the installation Institutional Review Board approved observations would be completed in person as well as through the collection of surveillance video documentation of visitors in the space. The surveillance video allowed for observations of the space from offsite; it also allowed for portions of video be played back in order to better analyze interactions.

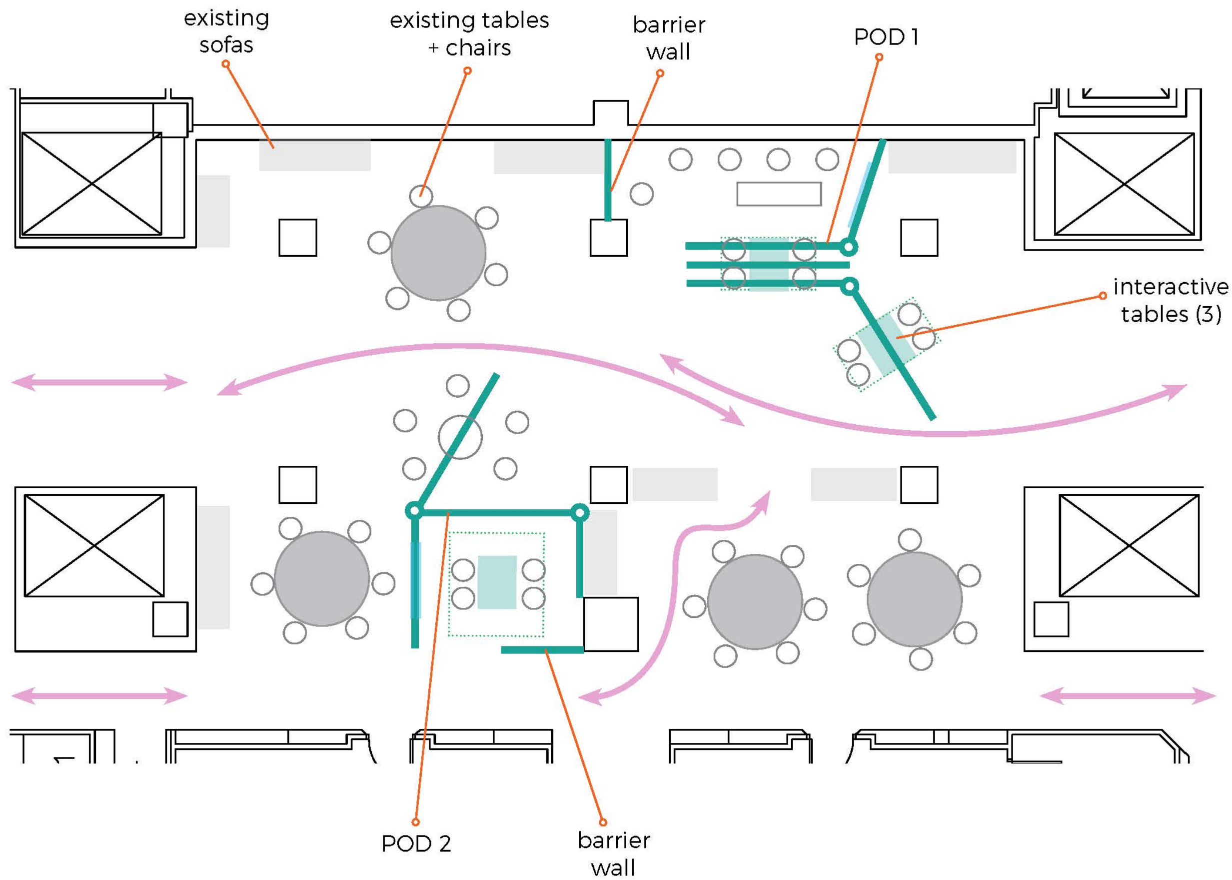

Figure 3.20: This floor plan indicates the pod locations as well as potential influence on visitor flow in the atrium space.

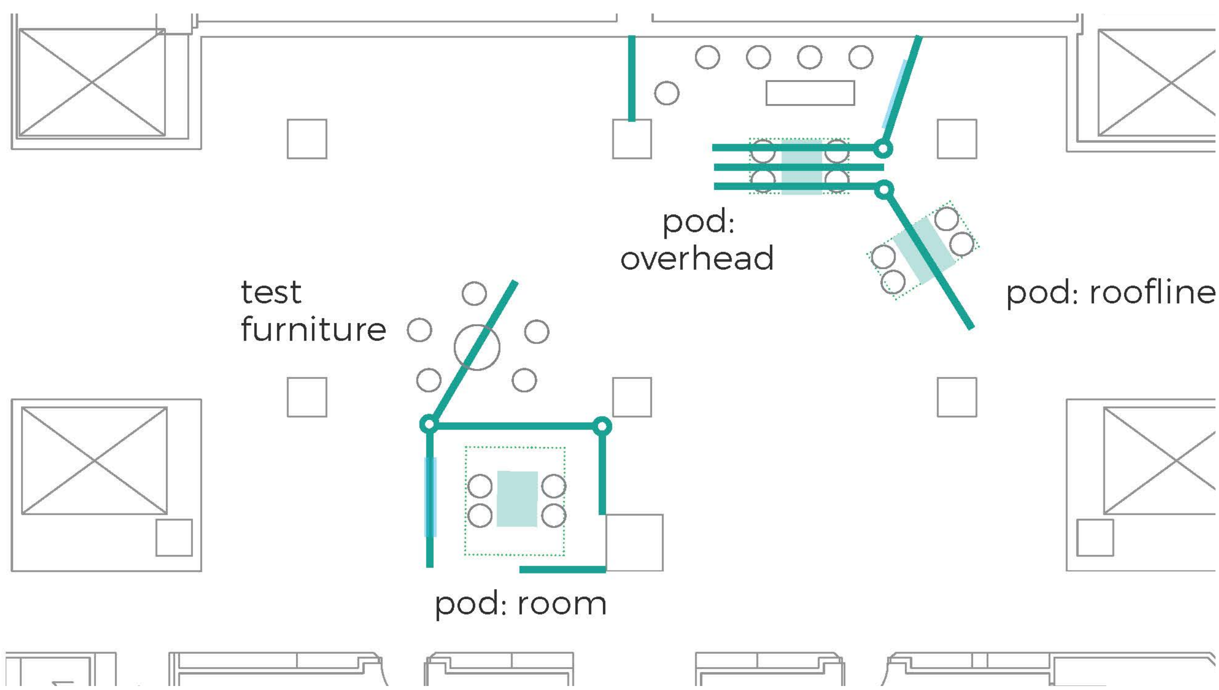

Figure 3.21: This floor plan highlights the pod and interactive table placement.

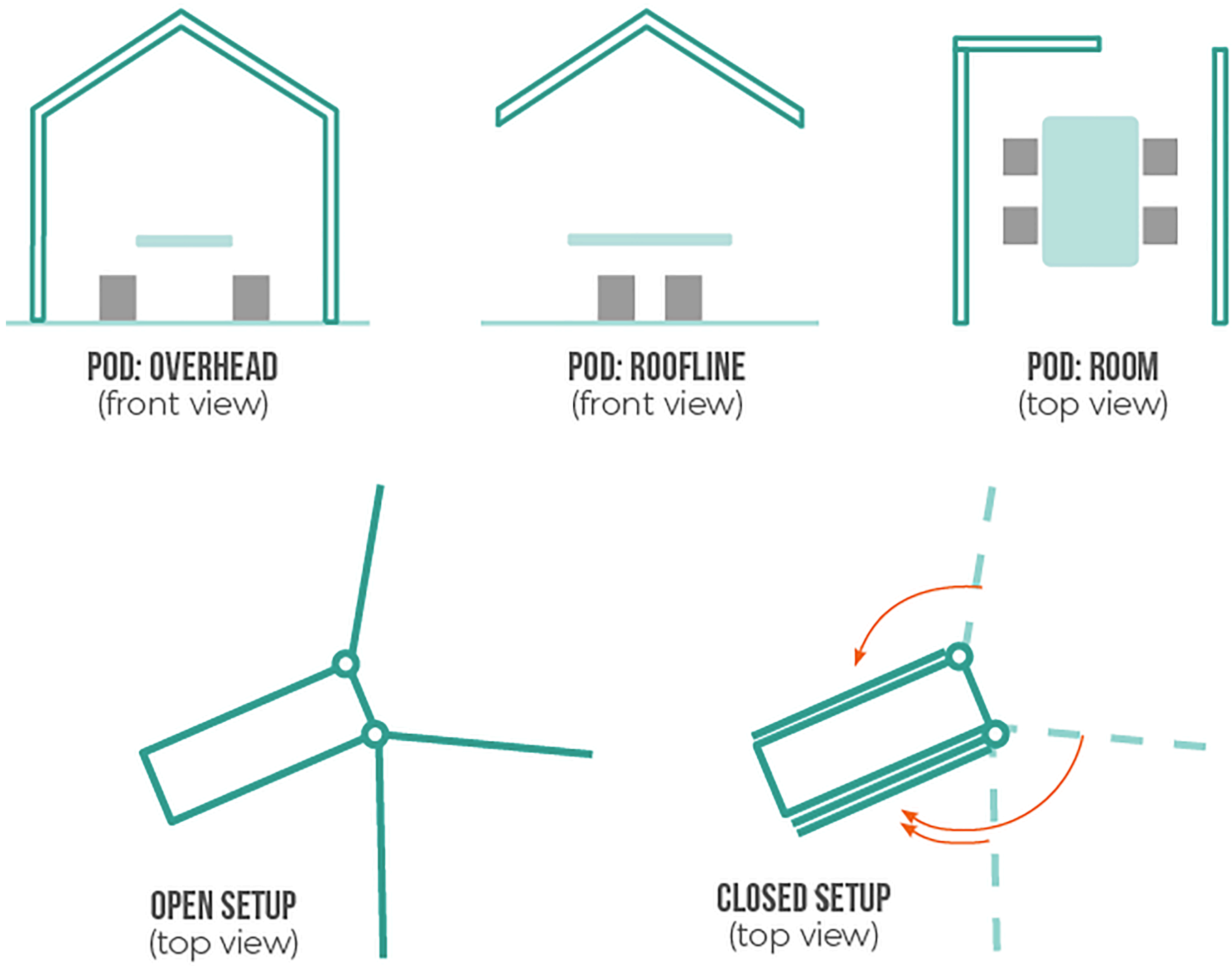

Figure 3.22: This figure illustrates the three types of space being created by the pods for comparison. It also highlights the locations of the interactive tables within those created spaces. Additionally, a visual of how the pods may open and close to change in the space is provided.

The three spaces that were compared during this low fidelity installation were a pod structure with coverage overhead, a roofline that suggested a space for interaction, and room-like space create with multiple wall portions (figure 3.22). In each area there was an interactive table with the same objects provided to support interaction and discussion. Each of the tables, shown in figure 3.23, featured post-it notes, pens, paper, pipe cleaners, and brainflakes (a purchased building toy set made up of small plastic discs with the capacity to connect and build). These table objects were intended to support cognitive offloading in discussions and provide opportunities for impromptu collaboration within the space, making the atrium a lively campus location.

Figure 3.23: Three low fidelity interactive tables were created. They each featured items similar to the ones shows in this image.

Prior to construction, sketches, illustrations, and three-dimensional CAD drawings were produced in order to determine material sizes, measurements, and placement in the atrium space (figure 3.24). These visualizations allowed for the creation of intentional sightlines throughout the space, encouraging visitor engagement and creating areas with an increased sense of privacy.

Figure 3.24: Examples of the illustrations and three-dimensional renderings created prior to the fabrication of the low fidelity models.

The low fidelity pods were constructed out of 2” diameter PVC pipe and white fabric, shown in figures 3.25 and 3.26. Throughout the two weeks of observation common interactions and impact themes became apparent. Visitors tended to engage for longer periods of time in the more enclosed pod areas, where barriers created a sense of privacy. While all three interactive tables were used, people sitting under the pod overhead structure appeared to be the most comfortable, while the people in the created room tended to be too loud for the space (assuming they had more privacy than the low fidelity model actually created). The balance of having a roofline or pod structure overhead with open sides seemed to encourage people to behave in the appropriate manner for the atrium, interacting while maintaining a reasonable noise level. As these areas supported an understanding of best practice in the space, it was decided that these two structure types would be used in the final design.

Figure 3.25: These images show the pod pieces prior to assembly, the fully assembled space and a cropped view of the pod that featured two interactive tables (with visitors seated at the more enclosed table).


Figure 3.26: These images show the two pods set up in the Beckman atrium space, the image on the left shows the pod overhead and roofline over interactive tables and the image on the right shows the created pod room surrounding one interactive table.

Many visitors who stopped at the tables appeared to be on a “coffee break”, pausing on their way to the café to investigate the objects on the tables and then going to get coffee and returning to sit and interact. Visitors spent time building and creating at the tables both alone and with others. It was unclear based on the video surveillance whether the discussions revolved around the objects they were creating, but they were engaging none-the-less. Depending on the size of the group of visitors, it seemed as if the table area needed to be adaptable or larger. This installation also inspired a need for people working at the interactive tables to be able to indicate to passersby whether their meeting was open for others to engage and chat or a closed more private discussion.

Large portions of the observations of this installation were completed in person, allowing for visitor opinions and impressions to be overheard and documented. One common impression when visitors first encountered the tables was that the tables were for children, because they had ‘toys’ on them. While the brightly colored objects may have given a first impression of being for kids, people of all ages spent time creating with the objects at the tables (figure 3.27). Some children and school groups who were visiting the Beckman Institute returned to the tables multiple times throughout their visit, often bringing new adults to share in the experience.


Figure 3.27: People interact with the interactive tables and pods during installation.

Adults who spent time building at the tables left their creations behind, sometimes leaving information on the available post-it notes about what they had chosen to build. As the installation time went on it was interesting to observe the types of things being created: catapults, non-functional fantastical machines, patterned sculptures, DNA structures, and iconic forms of people, animals, and elements of nature. The first of the iconic forms was built early on in the installation, from that point on a selection of assembled items were left on the tables when they were cleaned up and reset every few days.

Over time, the table with the first styled iconic structure gathered a little scene of iconic forms including a person, a tree, a sun, and a flower – all built in the same style (figure 3.28). Visitors to the table seemed to be inspired by what had been there previously, and this provided some evidence toward idea generation based on cognitive offloading into the environment, as the original builder left a thought behind in the space that another builder could then elaborate upon. This activity shows some potential for Beckman to stage brainstorming activities in this manner in the future, creating cumulative concepts in public spaces throughout the building.

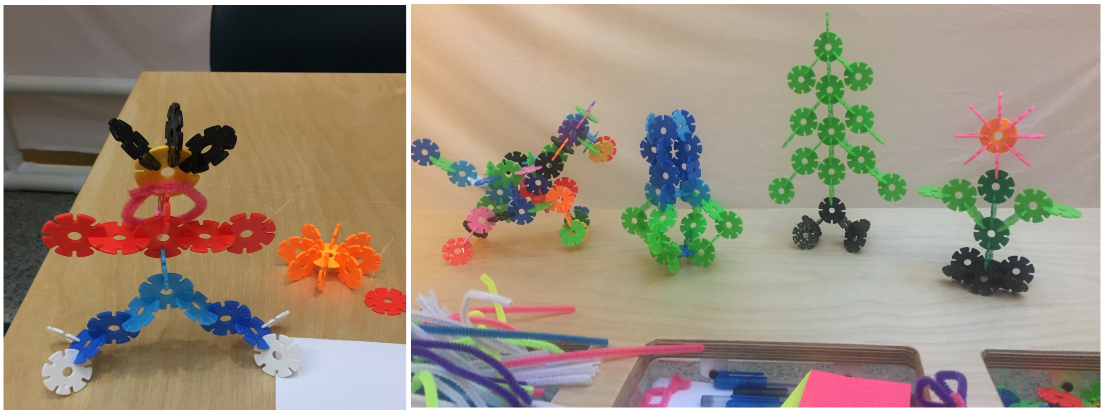

Figure 3.28: Iconic figures created over multiple days at one of the interactive tables.

CHAPTER 4: DESIGN OUTCOME

The final design outcome for this project is a fully constructed prototype of the flexible workstation pod. This functional design was created to increase the amount of time that visitors are spending in the Beckman atrium space and create opportunities for interdisciplinary interaction. This design has multiple setup options to refresh and renew the space based on the functionality goals of the Beckman Institute. The newly designed interactive table is centered under the main pod structure. It has drop leaf sides to adjust to groups of various sizes. The objects featured in the sliding dome dishes in the central area of the table can be used to support cognitive offloading in discussions as visitors interact and share ideas. The final prototype also features adaptable lighting, with each moveable frame featuring a single Edison style bulb to create ambience and a sense of space. The base of the interactive table has installed LED lighting that can be set to various colors, in order to provide the potential for coding colors by types of meetings occurring in the pod space (ex. red = private meeting, blue = welcome to join).

This refined prototype has taken into account the data collected in the IRB approved survey and IRB approved low fidelity model installation observation. By collecting this data and gathering feedback throughout each phase of the project the design has evolved, taking into consideration the wants and needs of the Beckman Institute and its residents. The final model was drawn in AutoCAD and constructed out of ¾" Baltic Birch Plywood that was CNC cut into pieces that can be flat-packed for transportation and then easily assembled and disassembled as needed (figure 4.1). This method of production allowed for the least amount of material waste to occur. Detail elements were created out of corrugated plastic, acrylic, and steel lathe to provide varied transparencies, creating privacy and reducing noise for various areas of the pod. The steel lathe also acts as a presentation space for graphics to be hung on small 3M brand hooks for display.

Figure 4.1: After designing the pieces in CAD, all structural elements were cut on the CNC out of ¾" Baltic Birch Plywood. These images show the dry-fit assembly of the final prototype in various stages.

The final prototype was put on display at the Krannert Art Museum on the University of Illinois Urbana-Champaign campus as part of the Class of 2018 Masters of Fine Arts Exhibition (figure 4.2). Throughout the installation visitors to the museum engaged with the spaces created by the pod and interacted with the table objects. For this installation the objects included in the table used a reduced color palette, to remove some of the ‘toy’ impression that was given by the previous selection. Dry erase markers were also included as an added interactive for visitors to write on the corrugated plastic walls of the pod space. Many visitors chose to write on post-it notes and leave them behind as a memento of their presence and interaction with the pod.

Figure 4.2: The pod was featured in the Masters of Fine Arts Exhibition 2018 at the Krannert Art Museum on the University of Illinois Campus, Urbana-Champaign. These images show visitors interacting with the prototype during that installation.

CHAPTER 5: DISCUSSION + CONCLUSION

Building the final functional prototype of the flexible pod workstation for this research project created an opportunity for tangible interaction, observation, critique and reflection. The prototype allowed visitors to interact and respond to the form and aesthetic, while demonstrating their intuitive understanding of designed affordances within the environment created by the pod. The various areas created by the pod each offered a sense of place with varied amounts of privacy, but the area under the main pod structure, around the table, was the most popular interaction point. Visitors to the Krannert Art Museum appeared to be drawn to this area, spending time exploring the items on the table, building and creating with various available items, and testing the LED lighting colors.

The design critique surrounding the prototype and potential future iterations garnered excitement. The feedback was positive overall, as members of the critique engaged with the interactive table and explored the created spaces. There was particular interest in taking the affordances for creative play and idea generation in adult workspaces further. Additionally, ideas for aesthetic changes involving the intentional use of color, lightweight materials, and hanging support structures were all discussed; with acknowledgments of possible improvements to the overall functionality of the structure as a mobile product; including the possible incorporation of a base structure and wheels.

At the end of the installation, the pod was inspected for marks of wear and tear. Issues with the drop leave table hinges were resolved and marks left behind by marker bleed-through were cleaned off the table surface. Notes were made regarding potential future design material choices, as the wooden joints reinforced with dowel pins proved to be somewhat problematic, with changes of temperature and humidity. Additional considerations were also made about noise reduction materials, as the corrugated plastic siding did not absorb as much sound as intended.

After the Krannert Art Museum Exhibition the final pod prototype was installed in the east atrium of the Beckman Institute for further observation and visitor testing (figure 5.1). As this iteration is an approximate functional and aesthetic prototype, it provides an opportunity for visitors to interact and engage with the new created workspaces in context, providing insight into the effectiveness of the pod's functionality. In order to support visitor understanding, signage was developed to hang on the display wall of the pod, figure 5.2 shows the graphic's illustration representing the multiple functions the pod provides in various potential setups.

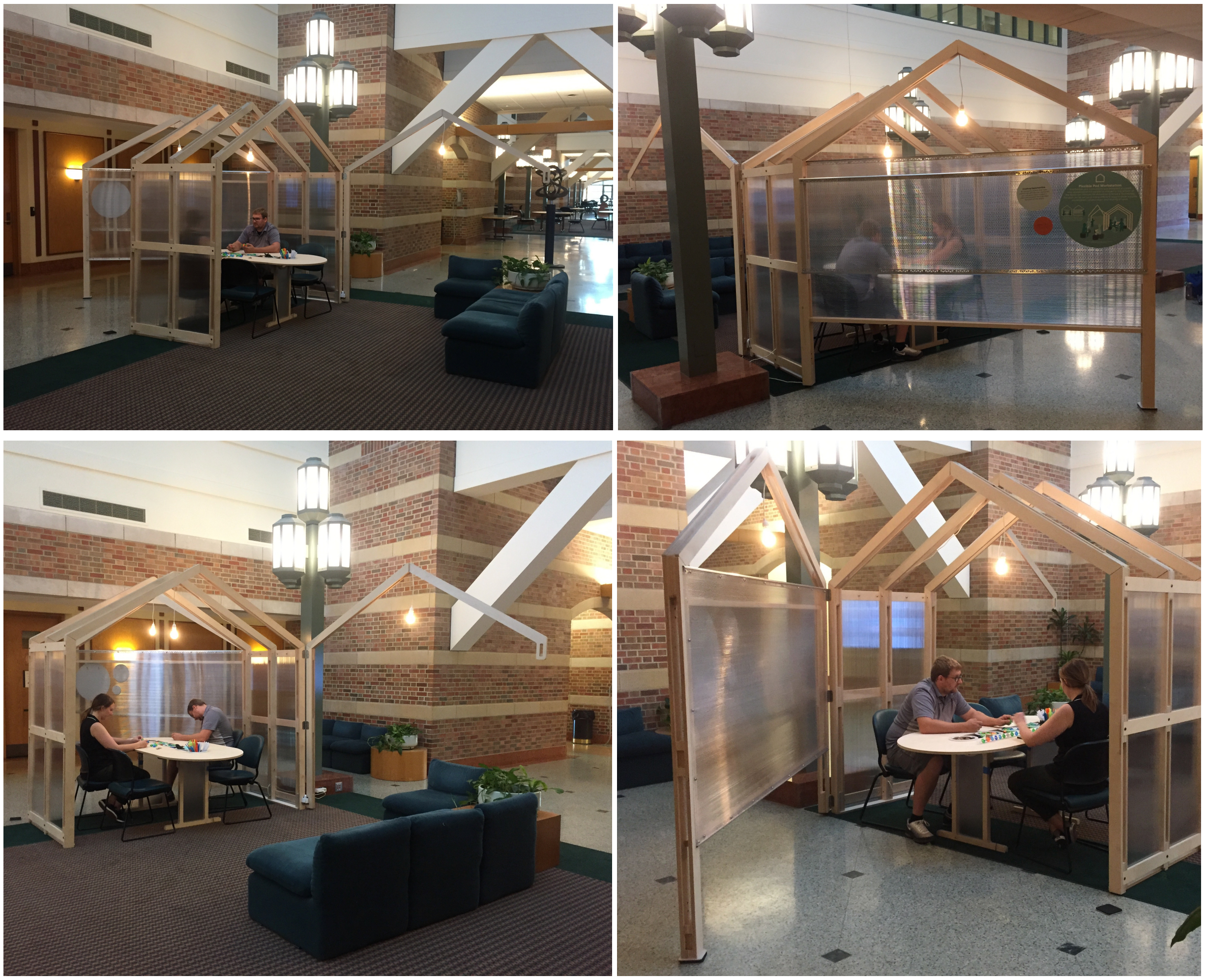

Figure 5.1: The final pod prototype installed in the Beckman Institute east atrium. The pod creates three distinct interaction zones in this set up. Existing furniture from the atrium was used to create seating areas in the various zones. Graphics are hung on the display wall to provide support information for visitors curious about the installation.

Figure 5.2: This image was created as a support graphic for the pod prototype. Each illustration depicts a functionality and user interaction made available by the pod in various setups.

At the time of this installation the Beckman Atrium redesign project is ongoing, and testing the impact of designed prototypes within the atrium space provides an opportunity for any novelty surrounding the implementation of new designed forms to wear off, allowing for more genuine interactions with the designed forms. Observations and insights regarding visitor interactions with this prototype will help to guide the next stages of design for the pods. Moving into the next phase of design for the atrium spaces the pods may be refined and incorporated into the aesthetic and functionality of the atrium redesign. One conceptual rendering (figure 5.3) shows how the pod may be incorporated into a larger interactive space within the atrium, while the affordances, symbolism, and aesthetics are used as inspiration to create flow and understanding of intended interaction throughout the space.

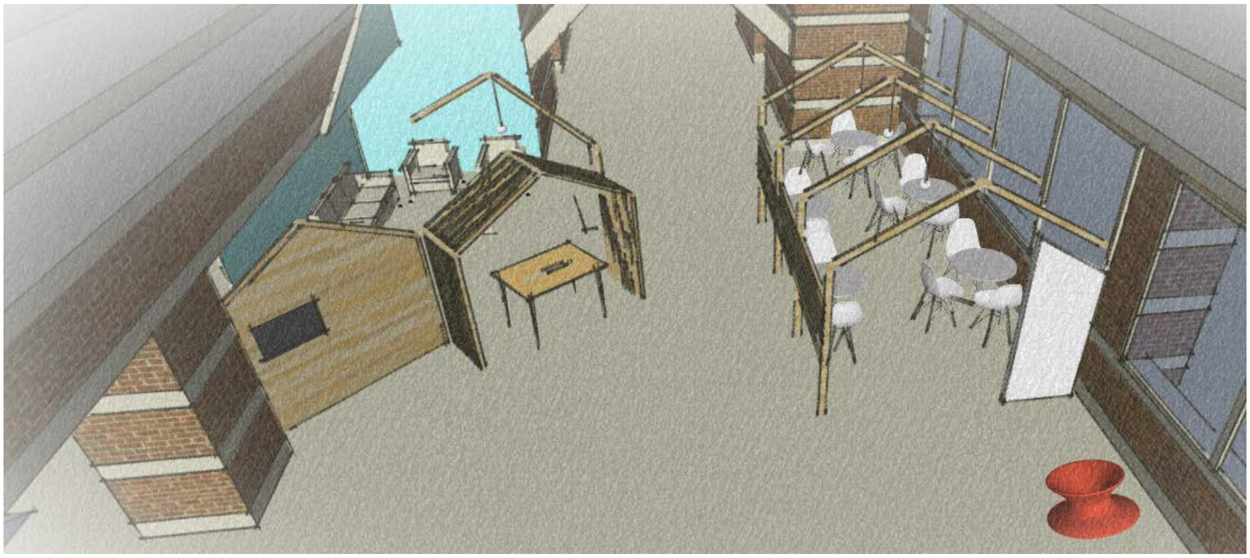

Figure 5.3: This image provides an example of how a pod structure may be incorporated into the future design of the Beckman atrium. This rendering is not final, as observations of the pod prototype currently installed within the atrium space will inform the eventual final design.

As the research question evolved throughout this project, it shifted focus from a broader area of interest to focus on a single designed form within a specific context. Working within the context of the Beckman Institute atrium, the single designed form of the flexible workstation pod provides an opportunity to observe the ways in which people relate to and learn from their environment, based on their understanding of the form's affordances; both intrinsically understood and learned over time. The interactive table incorporated in the design also provides visitors with opportunities for cognitive and symbolic-offloading onto physical forms, allowing visitors to utilize their environment to share information and support collaboration.

While the scope of the question changed, the research interests remained rooted in exploring how our perception of elements in our environment contribute to our understanding of potential and encouraged interactions within our surroundings. Through deliberate research, methods for supporting and encouraging collaboration through the affordances of a designed form were identified. In considering the context of the designed form being created, it was crucial to remember the context and goals of the Beckman Institute atrium within the larger network of intentional spaces being designed for the building. By taking into account the affordances and symbolism of designed forms, the greater material landscape, and environmental context, a balance was established between designing a form that is both functional for the Beckman Institute atrium space and a product flexible enough to be mass-produced and situated in other open atrium environments.

This project illustrates a method for designing intentional environments, starting with an understanding of human cognition and perception in context. Through exploring the influence of affordances and symbolism on the human ability to cognitively engage with an environment, more effective designed forms can be created to populate the material landscape of an intentional environment. With these methods, designers have the potential to create spaces for communication that increase creativity and build community. By working through the design process with these considerations in mind, designers can create intentional environments that achieve the goals for action and interaction in a given context, and in the case of the Beckman Institute: create a designed form that fosters opportunity for new, interdisciplinary scientific and technological breakthroughs.

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