Thinking through the Design of Workspaces:
A Participatory Design Tool for Space-creation in Offices

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ABSTRACT

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Architects often rely on verbal narratives of spatial needs to curate and design the spaces we see today. However, our needs and ways of living and working are rapidly changing, especially now. The pandemic has created paradigm shifts in professional setups, where there lies a need for flexible and multi-purpose spaces- A space once serving as a home now serves as a home office, and so on. There is also gravitation towards online tools for spatial visualization and the need to alter our existing working environments.

This investigation aims to identify how a participatory design tool can help users break down the elements of a workspace and create spaces for specific activities in an office. The tool includes a physical probe— comprising movable modular furniture elements seen in the 21st century office and a mobile application. The mobile app gathers user inputs on the type of space they need and provides sample activity-based-working (ABW) configurations for the user to choose from for their ideal space. Some examples of these configurations include spaces for brainstorming an idea, creating, hosting an event/meeting etc. Users can plan their spaces in advance with this tool.

The research-creation combines the transforming capacity of spaces with flexibility and becomes a blueprint for end-users to become designers themselves. The physical probe facilitates personalization, model-making and scaling, and quick visualization while the mobile application serves as a user-manual and database for future community design practice.

Keywords: interaction design, cultural probes, activity-based working, actor-networks, community building

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

FOREWORD

My perception of space and surrounding environments changed drastically after the pandemic came into existence. In the past year, the world experienced a standstill after the outbreak of the Covid-19 pandemic[1]. Things are yet to return to normalcy. The pandemic has inspired me to develop solutions and innovations that can help people establish the connections they once shared or had forgotten over the past year.

Being confined indoors for over two years has led to an urge to step outdoors for me, my friends, and my family. I wish to help people return to their places of work, reunite with people, and rebuild their lost connections. Working remotely has helped some achieve the work-life balance they once craved, including me, while others see the pandemic as a constant obstacle to their workplace success. What is missing is a balance in our daily routines and a healthy ratio of in-person and remote activities. Nonetheless, an assurance of safety in public spaces along with meaningful conversations could be comforting to many. I wish to address this concern by designing and making spaces available to many, one space at a time, with close attention to safety, work needs, and new spatial arrangements. My design considers existing proxemics standards for the covid-19 pandemic with an occupancy limit of 10 individuals at a given time.

Shifting to 2022 in Montreal, the pandemic is no longer a serious concern; however, in other countries, it continues to impact the lives of many. We must prepare for the future and learn from our past mistakes. Resilience is key; hence, this project attempts to retain our past learnings and build safer futures and better lifestyles in a workplace setup. From personal experience, hybrid working methods have helped me accomplish my goals. Studying the MDes course remotely for a year has been an eye-opening experience, and I am thankful to see my learnings contribute to the relevance of my project. With workplaces changing their regulations and accommodating changed ways of working and living, there is indeed a new design practice that I aspire to contribute toward.

Montréal, September 2022

Sanjana Shivakumar

CHAPTER 1: INTRODUCTION

The Coronavirus, first identified as an infectious disease in 2019, is a pandemic defining a global health crisis [2][3]. With the number of positive cases on the rise, public spaces like malls, restaurants, offices, and parks are at risk of being infected with the virus's aerosol particles, which remain in the air for a long time [1]. Scientists have come up with the concept of social distancing as one of the principal successful measures against the spread of the virus [4]. Although protocols and rules of maintaining minimum distance have been implemented in public spaces to control the transmission of the virus, many involve the use of physical barriers that obstruct closeness and connectedness.

During the onset of the virus, many working individuals and students had tested COVID-19 positive, and companies and universities mandatorily shut down their operations to prevent further virus transmission. The thought process for the project began by drawing from my situatedness as a resident of Bangalore, the IT Capital of India. The work culture of many individuals was affected during the pandemic, forcing them to adapt to new working lifestyles, such as working from home[5]. These antisocial lifestyle alterations (living in isolation or staying away from friends and family) slowly began to be considered a 'new normal[2]'. The methods of working and interacting gradually shifted towards an online space, leading to fewer physical interactions. Stepping out was a risk not everyone was willing to take, especially during the initial stages of the viral spread.

Human-human interactions are important for channeling conversations as a joint action or feedback [6]. A recent survey revealed that 59% of regular office-goers wanted to return to their physical offices and complained of decreased productivity and social engagement while working from home [5]. The remote working conditions lack human-human interactions that are important for channeling conversations as a joint action or feedback [6]. At the same time, there is a need to create a safe space as employees would be unwilling to risk their safety by stepping into a contaminated office environment [7]. For employees and students to stay motivated and encouraged to return to their offices and universities, respectively, certain systems of public spaces need changing[8].

The outlook toward working has changed over time for many. The rise of Activity-Based Working (ABW) brought new methods and ways of co-living, co-working, and co-dining. However, the staticity of these spaces may not suit ever-evolving hybrid situations and user needs over time. There lies a need for multi-purposeful spaces and modularity within space. In this project, I wish to dive into the topic of multi-purpose spaces. This term includes a spectrum of spaces for professional needs, also regarded as third spaces. The thought of combining dichotomies of connectivity and distancing in space came to mind as it would be interesting for users to create and co-design their ideal workspaces from the comfort of their homes. Having chosen offices as my surrounding environment because they bring in varied audiences throughout the day, I would like to propose a framework for working without compromising on productivity.

The proposed design would cater to audiences responsible for planning and designing a workspace:

> 1. On the prototyping/designing end: the user, employees, team leads, and speakers.
> 2. On the assembly/execution end: stagers, staff, and interior design professionals

The problematic I am trying to explore here is the generative question of how working styles and employee needs could be jointly catered to by exploring a new participatory tool for workspace configurations. Combining the aspects of ABW, Flexibility, ease-of-use, communication, Multi-purpose spaces, and social interactions, my research creation attempts to create a tool that sets new working practices in office spaces. The project tries to see how a physical toolkit, user manual, a mobile application can come together to help end users participate in a design process and bring their creations forward in an office environment. The tool would combine the making abilities of a physical prototype and the flexibility of a digital prototype to provide users with the spaces they need, consulting them and gathering their feedback throughout the design process. It would help users reimagine their workspaces and potentially improve and influence employee health [9].

In my thesis, I explore using a physical probe and a mobile application for building interior working arrangements. My project aims to initiate a new community-focused design practice that encourages employees to become designers, where they can participate, build, grow and learn from their peers in a fast-paced hybrid working environment. Employees in offices continue to work and their ways of adapting and creating keep changing. Currently, a majority of workplaces operate using a hybrid approach and have virtual workspaces in addition to physical spaces. Working individually is a practice of the past as offices today encourage employees to participate and collaborate on various projects across various fields. Team activities and employee participation has led to the exploration of assistive physical and digital tools for productivity and co-ordination among teams. Participation is key in understanding and analyzing various design practices and methods of working.

With close reference to spatial design and architecture, it is often noticed that intentions of the designer don't necessarily match the needs of the user. Hence the participation of an end user in a design process is essential to match their expectations of a product/service and to test its behaviors with users. In my research, I attempt to develop a tool that addresses participation and includes participation from end users to see how employees may create within a space that complements their working style.

My research addresses the question:

'How can a flexible, participatory tool help users plan and envision their workspace?'

In response to my research question, my thesis is structured by initially drawing from literature and a case study that determines the differences in how users and designers think. The findings from the study laid foundation for my research creation practice. The second section of my thesis looks at the use of cultural probes and existing tools for designing spaces. The third section discusses a few mini-research projects that contributed to the final research creation. The last section discusses final reflections on theories and projects, and feedback and learnings from professors and peers at the exhibit.

Chapter 2 discusses short-term and long-term public space protocols for covid-19 protection, theories, and the general evolution of office space.

Chapter 3 discusses the methodology for the study through a case study analysis and a use-case analysis of cultural probes.

Chapter 4 discusses case study conclusions and the rise of ICT technology and tools for spatial visualization.

Chapter 5 discusses a few mini-research projects for my research findings.

Chapter 6 extensively discusses the final research creation process and reflections on theories.

Chapter 7 concludes the study.

CHAPTER 2: BACKGROUND AND CONTEXT

PUBLIC SPACE PROTOCOLS FOR COVID-19 PROTECTION

Public Spaces bring in a significant percentage of revenue and thereby contribute to a country's financial capital [10]. The COVID-19 pandemic was an unexpected external crisis that left business owners perplexed with no direction on how to move forward [11]. In addition, the present COVID-19 crisis brought in a mandatory lockdown in several countries, which has not happened in the past[11]. This heavily impacted organizations and offices across the world.

Many public spaces opted to close temporarily, while others had to shut down their operations permanently due to a lack of economic capital and high rental costs[12]. While some closed public offices downsized their units [12], most continue to operate via hybrid and in-person communications [13]. Even a year later, the pandemic carries uncertainty of operation concerning commercial establishments. [14].

Users' spatial experiences have changed after the world employed contactless services. Moreover, staying indoors for almost a year has increased customers' demands for new and safe in-person experiences. Businesses have tried to address these needs by employing short-term and long-term designs and protocols in space. Short-term protocols are temporary solutions authorized by the government for simple and flexible working. Long-term protocols, on the other hand, strive for permanence.

Over the last two years, there have been attempts toward re-designing for the pandemic arising from public expectations. COVID-19 has called for a shift in how we design space, interactions, and installations. Based on some of the research projects I have explored, here are some of the public expectations:

1. Creating flexible and adaptable spaces that are easily reconfigurable to suit multiple user needs
2. Incorporating spatial features that promote social distancing and help users maintain a safe distance from each other
3. Accommodating different working setups and living arrangements
4. Planning to incorporate e-tools and technology to improve remote work, social interaction, and productivity.
5. Considering the use of shared public spaces as alternatives to traditional working and living spaces.

The following section describes some of these spatial attempts, both short-term and long-term protocols for redesigning office spaces.

SHORT-TERM PROTOCOLS FOR OFFICE SPACE

An office is a room, floor, or component of a building/ an entire building that operates to build business initiatives. Face-to-face interactions with clients and colleagues are essential for a business's growth. Shared physical work environments and collaboration are critical to an

individual's long-term productivity and personal well-being. An office is a building or a space/room that provides all these facilities for employees to work safely [15]. Statistics show that 50% of employees are employed in offices, with an average of 8 hours spent at the office daily [16].

In some countries like India, where the viral strain became weaker [17], offices and educational centers initially operating remotely had been granted authorization to resume in-person activities, given they abide by health and safety standards issued by the Ministry of Health and Welfare[18]. There are many standard protocols for minimizing viral spread, as seen in commercial establishments and offices. These include masked guests and employees, periodic sanitization of table tops, rearranging tables within a 6 ft distance, and using QR code scanners for activities like online ordering, food delivery, and payments[19]. In a recent study, 71% of surveyed consumers stressed the need for regular sanitization of tables, kiosks, and other equipment people were likely to touch.

Recently, a few offices resumed operations. However, sanitization and social distancing rules were breached, leading to a sharp rise in COVID-19 positive cases. Studies have proven that air flow and ventilation can affect how diseases spread indoors. Other short-term protocols include effective building ventilation systems to restrict the movement of pollutants indoors to limit the spread of infection, pests, and mold (control of moisture and odor in indoor spaces). Those with allergies are at an increased risk as they react to endotoxins produced by dead bacteria and are prone to coughing, wheezing, and asthma conditions[20]. Crowding in existing indoor areas with poor air circulation can also promote viral spread and should be monitored closely. Keeping all these factors in mind, the management of an office building needs to make extra efforts to invest time and money in the maintenance and regular sanitization of office buildings.

A few office spaces have tried to reduce the proximity of guests by using physical barriers such as plexiglass barriers on table surfaces[21], mannequins, and cross symbol stickers placed on certain chairs[22]. Although studies have explored ventilation strategies within office spaces, these concepts are only a part of the overall design of office space. They do not address design particulars like productivity, repurposing spaces, and the social needs of employees. A compromise of productivity and health is as good as an economic loss to the organization.

In addition to short-term protocols, some companies identified the need to dedicate time to plan their designs for unexpected scenarios in the long term to suit the ever-changing needs of employees during the pandemic and also for post-pandemic realities.

LONG-TERM PROTOCOLS FOR OFFICE SPACE

Many studies have predicted how the antivirus-built environment would look with social distancing protocols in office environments[23]. A study has revealed that paying attention to overcrowding in interior spaces is the most significant step in designing modern workplaces [24]. Some suggestions include conducting a deeper assessment of the total number of current and anticipated employees within that space and the type of space (i.e., open office spaces, enclosed cubicles, private meeting facilities, conference areas, etc.), spatial requirements, and entry and exit points. The workplaces must fundamentally consider health and sustainability to be more functional and fulfilling for employees [24].

Most offices include an Open plan, Team spaces, Cubicles, Private and shared offices, a study booth for reading, and video conferencing. Office spaces should include varied spaces, activities, and zones for socializing, meeting, networking, and eating with peers [24]. Hybrid arrangements and open offices could help struggling organizations by making spaces more flexible. A study on COVID-19 office transformations [24] has discussed the impact of touchless technologies, open plans, and flexible furniture to prevent viral spread and bring a behavioral change in an office space. Moreover, these guidelines can change our understanding of sustainability in the built environment. Individual office areas need to be given as much importance as collaborative spaces.

As the hybrid working lifestyle is here to stay, more companies are providing personal digital terminals for employees' phones, tablets, laptops, and PCs. Another protocol that companies need to consider is providing adequate bathroom facilities as they control crowds and prevent disease transmission. These spaces need automation with touch-free technology. Network-connected devices, apps, and IoT networks can improve our office working experiences. It helps employees minimize physical contact with surfaces, biometric scanners, entry security points, etc.

In the 20th century, only a mere 5% of the American, Japanese and European population sought employment at offices compared to the present-day scenario with a staggering 50% of daily office-goers. To meet their expectations, buildings must benefit from an integrated design approach that meets a list of objectives. Through integrated design, a new generation of high-performance office buildings is beginning to emerge that offers owners and users increased worker satisfaction and productivity, improved health, greater flexibility, and enhanced energy and environmental performance. Typically, these projects apply life-cycle analysis to optimize initial investments in architectural design, systems selection, and building construction.

The following section describes some theories that laid the foundation for my research creation and methodology.

THEORETICAL FRAMEWORKS

SITUATEDNESS AND SPACE

Henri Lefebvre [25] relates the action of 'Being' with situatedness or context where spaces carry a feeling and a sense of 'Being' within a larger entity. The emotion associated with being or belonging within a space was taken away when the pandemic came into existence. Social interactions were lacking, and the mind was in a state of hollowness or nothingness. People who stayed outdoors to work had an overarching goal of being motivated by surrounding themselves with others.

'Nothingness is, but only relatively, within Being itself, within each being and each degree of Being…'[25]. 'Nothingness' is significant in architecture, bringing a spatial perception of hollowness to convey situatedness or historical relevance to the user. Tackling the dichotomies between connectivity and distancing with a space that holds 'Nothingness' may also serve as a design principle for user experience and interaction.

Based on Hegel's Dialectical method (only in mind)[26], I associate 'Being' with an alteration of one's state of mind arising from a new spatial experience. Further, adopting a barrier-free design

concept signifies the elimination of physical barriers in space to improve social interactions and friendships while working in groups. Space as a medium to convey concepts of materiality, minimalism, and empathic design can result in interactive and aesthetic moments for users.

Being 'situated' within a space or simply experiencing comfort and familiarity with a space helps an individual become more efficient and productive. That's how activity-based working (ABW) came into the picture, where spaces are designed keeping in mind what users can gain from these environments and experiences. ABW is a method of allowing space to accomplish specific tasks and activities. The research-creation adopts the construct of situatedness as well.

A few examples of Activity Based Working (ABW) in offices and large organizations are discussed to identify links between situatedness and context for specific activities. ANZ, a bank in Melbourne, has 14 workspace configurations for its various departments. The ABW model, called the "Playbox" project, scatters different furniture and technology within these 14 workspace grids. Instead of having employees go into separate allocated spaces, the environment within the grid changes based on employee needs. The study found an improved decision-making speed (a project was completed six months earlier than the scheduled deadline). These configurations can also be helpful for companies that have various departments or many types of workers doing specific tasks. Costa Coffee accommodated its frontend employees and plant workers by creating breakout spaces between the two departments. The office space has reported an increased sense of belonging after the new design. Many employees are okay with giving up their individual desks if they gain access to the whole office. A study found that two-thirds of employees already used multiple workspaces, 91 percent felt excited about ABW's flexibility, and 92 percent found ABW fun.

WeWork, an American real estate company, is one of the largest flexible space providers for companies and start-ups. They give users a template for activity-based working (ABW)[27]. In this scheme, employees can select the type of spaces they want from visual cues or interior design layout options based on their activity or work. For example, an employee may want a space for Brainstorming with colleagues, so they can choose from a set of visual cues, identify the space that works best for their task, and have a productive work session[27]. These spaces allow employees to be comfortable and efficiently perform tasks and generate a sense of empowerment to work. They may not otherwise be available in a typical office or home setup. LOCO SPACE, a community-focused co-working space in Toronto, has 6000 square feet of playful spatial configurations, each catering to specific tasks and activities. Some configurations include Meeting rooms, event spaces, private offices, hot desks, virtual rooms and more.

Many organizations have been adopting activity-based working. However, not many companies are open to employees designing their own spaces on a need basis.

My project explores how employees can become designers and break down the configurations of the workplaces we see today. It is not just an activity of drawing from one's situatedness, but it also helps users visualize spaces in new ways that their ways of thinking start becoming organic. In this study, I would like to use principles of materiality, minimalism, and empathic design to make spatial experiences more engaging and reflective for users. This theory also draws on some biomimicry theories by Donna Haraway, discussed in the following section.

BIOLOGICAL ONTOLOGIES

Biomimicry derives solutions to human problems by studying biological analogies, natural designs, processes, and organisms. However, it is often forgotten in a world encapsulated by 'human-only histories' [27]. We have become a major force of nature in an Anthropocene epoch, and only by designing organically can we identify constraints in the built environment and derive meanings from 'form follows function' perspectives through the resilience of natural systems [28]. Considering an organism's structure as a system of connected nodes seemed relevant for this project, where many parts or elements come together to create an operating system [29]. By designing organically, we can identify constraints in the built environment and derive meanings from 'form follows function' perspectives through the resilience of natural systems [28].

I look at 'tentacular' and 'organic' as terms that don't always have to relate to a space's physical form or physical aspects. They hold deeper meanings within a system in itself. They also mean bringing fluidity and flexibility to existing frameworks and tools we see around us. In my research, Biological ontologies hold a deeper meaning in the reflective process of using the probe. Here are my interpretations of the term that aligns with the aim of my research.

1) Biological ontologies as a description of form and architecture within a space

2) Biological ontologies as an entanglement of configurations

3) Biological ontologies as a growing ecology of practice. Re-using components and reproducing better versions of previous configurations and documentation of designs helps grow a 'forest' of configurations from a single tree. An ecosystem with many communities and collaborative networks is created, setting a community for future design practice.

4) Biological ontologies also suggest that the state of permanence is no longer valid and flexibility is the new way of life, bringing in concepts of fluidity, movement, and shape-shifting spaces.
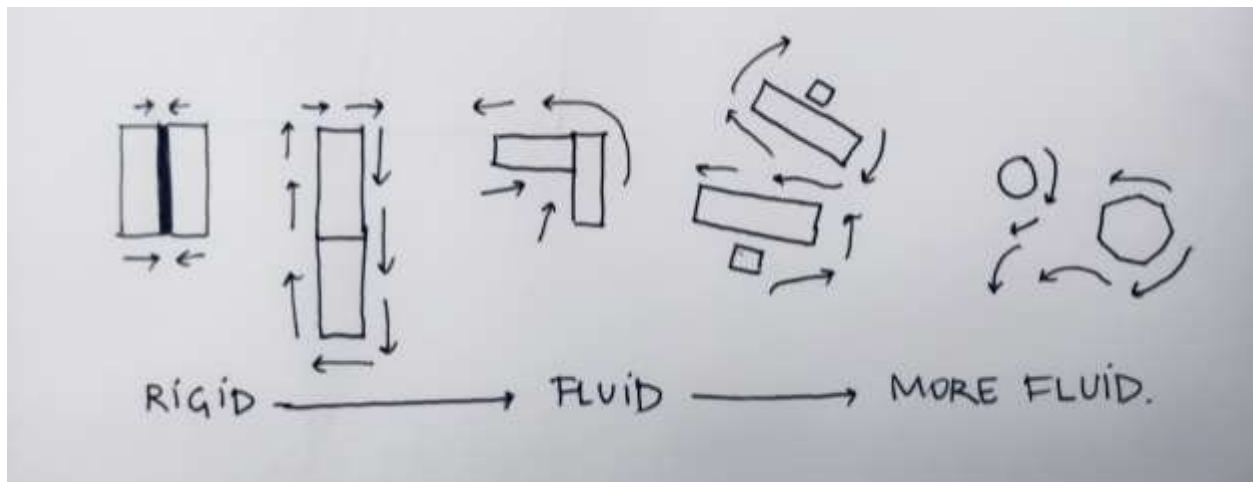
Figure 2.1: Fluidity in form

Some configurations might work well for multiple activities. This theory brings to light how fluid and flexible we can make spaces and how we, as designers, can push the boundaries between

working, living, and thinking. Biological ontologies not only operate within the physical realm —the physical probe—but they can extend into the digital prototype— a mobile application with new designs and cross-collaboration. Users can share their creations to improve or learn from their peers. Subsequently, there are new dimensions to visualizing the space, and new configurations may arise (fig. 2.1), with more fluid forms like hexagons, circles, and ovals (circular tables vs. rectangular tables).

My design tries to incorporate not just literal meanings of biomimicry like form and function but also deeper and well-rounded meanings of tentacular thinking. This includes identifying actors and elements that can work together to create a dynamic, well-performing operating system. The next section discusses Bruno Latour's actor-network theory and some interlinking aspects of space, actors, and organizations performing together. Bruno Latour's actor-network Theory addressed how spatial configurations could be incorporated within more extensive networks.

Bruno Latour's actor-network theory[30][31] emphasizes the primary resources for overcoming obstacles in vast systems and networks. Primarily, linking systems to nature leads to ecological literacy and eco-evolution with a space. The previous section discusses parallels between biomimicry and the tentacular nature of designs.

The second principle is to promote sociality and cooperation through community building and weaving together of various social fabrics. A thorough analysis of social contexts and socio-cultural assumptions[30][32] may result in a well-executed systems framework. In my research, I am looking at ways to engage through space and multiple user groups from various cultural contexts within a single system. The numerous user groups would be potential employees, colleagues, and team leaders in organizations working together and individually to stage their spaces. The activity-based-working concepts in my project revolve around the second principle of Latour's theory of community building. Employees can collaborate in person and on the mobile application to plan their workshops, brainstorming, and meeting spaces. These activities require group participation and encourage collaboration and synchronous learning.

The third principle is to allow actors and participants to exercise their choices and use reflection-action as an explorative way to convey meaning from their selected actions [33]. An analogy is presented in the text, where just how components of a DNA molecule are difficult to split, the same applies to differentiating between three resources. I attempt to establish connections between the three resources in my research[31]. The resources are defined in relevance to my project.

Resource 1: The Tool-The Probe, mobile application, and Instruction Manual

The Space- A room/space kept aside in the office for redesigning purposes

Resource 2: The actors- The Employees and the Stager appointed by the Company

Resource 3: The Network at large- The Company trying to incorporate new learning and building practice

In my research-creation project, the actor-network theory holds significance as the kit allows actors; users to play, create and work with their hands (fig. 2.2). The actors and their affordances are shown in a system's context. The figure explores these actor-network relationships and their meanings concerning the probe. The tools and the space are the medium for designing, while the

employees and stager are the actors in the system, responsible for using the medium and bringing their thoughts into action.
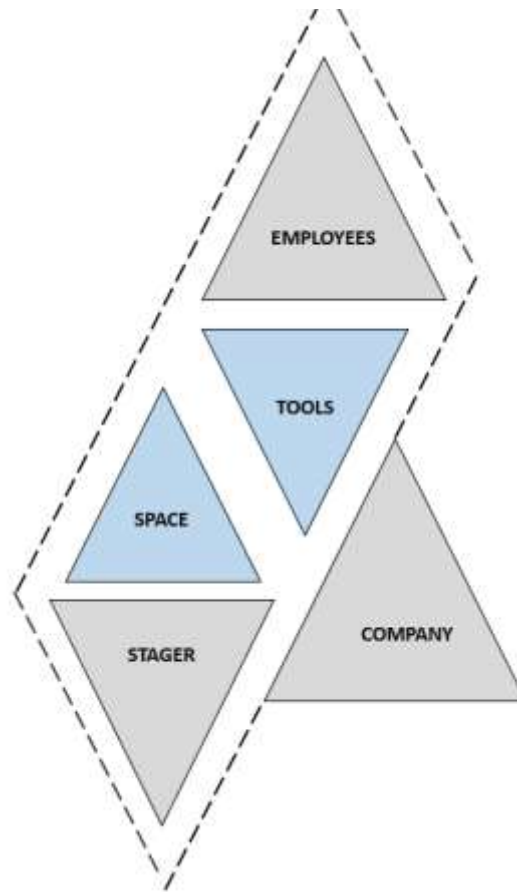
Figure.2.2: Representation of ANT integrated into my research

Fig. 2.2 shows the complete network, with people as actors who use the tools and the space around them to create and work for an organization at large. The allocated space and the tools highlighted in blue indicate the project's focal points or the elements that define the relationships between the various actors of the space. The dotted line indicates a boundary for all these elements— the employees, the tools, the space, and the stager—enclosed and controlled by the organization. The space for building and tools for making are placed together. The employees and stagers are responsible for using these tools and creating an output. Lastly, the organization has the highest affordance among all the actors as it is responsible for all the internal relationships and the system's functioning.

I am also drawn toward designing with the actors' situatedness and behavioral patterns in mind. I disseminated my work at a physical exhibit at the 4th space at Concordia University to understand how these actors can play and engage with the toolkit. The actor-network theory is relevant in my display as it demarcates the user's role, the toolkit, and the relationships between the designer, user, and organization. The aesthetic experience of my physical exhibit is discussed in the next section, drawing from Bruno Giuliana's perceptions and Theory of aesthetic experiences and Phenomenology.

Aesthetic Experiences and Phenomenology

Bruno Giuliana's thoughts on the role of a perceiver in a space[34] using phenomenology as a principle seemed relevant to my study. In my thesis, I am looking at ways to make public spaces more accessible and engaging for users. I want to plan and create meaningful spatial and sensory experiences for them. Although designing and prototyping need to follow a practical approach, the 'fun element' makes users gravitate towards it. Of course, it has to serve its function of usability, but people today are looking for experiences via interactive media. I believe the future of public space design combines reinvention and retrofitting automation into physical spaces to create engaging and meaningful spaces for users.

My research aims to identify how an interaction design tool can help users build activity-based spaces in advance. The staticity of existing workspaces is analyzed, and a new tool is proposed to plan and personalize workspace designs. As a result, more pleasurable user experiences are encouraged by combining the power of physical and digital tools for user learning and play.

The next section discusses the mobile application and some affordance theories. User Boundaries, usability extents, and the toolkit's design potential are discussed.

Agency and Affordance

Tom H. Fisher's text 'What We Touch, Touches Us'[35] suggests that we do not perceive the function of things in the abstract by itemizing their particular qualities, but we perceive their "affordance"—what they particularly allow us to do[35]." I see a connection between Gibson's perception of affordance[35] and Jenny's Mechanisms of Affordance [36]. The former text discusses the relationship between the perceiver and a material, drawing from plastic as a material to identify its affordance. The latter tries to perceive an object's affordance through use. Considering that a post-pandemic vision has to ensure that elements are restrictive and relaxed simultaneously, a controlled environment is necessary to handle many incoming users. Objects and applications that the system revolves around require a careful calculation of affordance for user restrictions and relaxations. An object's affordance brings with it an instruction of whether you can or cannot do something[35]. Gibson hence suggests identifying these affordances and agents to further identify relationships between actors and objects. Recent understandings of agency describe them as dynamic[37], where they allow actions between actors and components in a working system. Moreover, agents lead to emergences and invite new user behaviors through each action.

The built environment— an extensive system— consists of smaller spaces or systems containing agents and affordances. Through the design of well-defined spaces, I would like to create sensorial experiences for users and help them explore spaces containing objects of varied affordances. To understand how the non-human actors can talk back to the designers, I would like to introduce a mobile application as an agent in the system. From my understanding of the text, awareness of an object/entity's affordance leads to a consensus between the user and object, followed by a decision on whether they wish to continue to use the product. An object's affordance can increase or decrease the user interactivity with it.

Seeing users at the physical exhibit shows some new post-pandemic emergences of space, combining the material and the digital. So the next section discusses some of the latest technologies and spatial interventions that have changed how we live and work.

MODIFYING SOCIAL CONSTRUCTS, SPACE, AND PROTOCOLS THROUGH EMERGENCES

Emergence is an idea or a process of co-creation that brings with it new complexities and introspection of existing theoretical frameworks[38]. Kagan is not merely trying to convey the idea of emergence as a complexity in itself, but more of a process that takes place within existing rooted perspectives of complexity and broad spectrums of theoretical frameworks. Kagan's ideas on ecological literacy highlight the complex relationship we have with nature and the possibility of emergence as a complex, unpredictable force that alters existing systems. It is unpredictable as implemented theoretical frameworks may either bridge non-human and human elements or harm surrounding environments. It may either be an agent of harmony or disharmony.

In a broader sense, emergence is also a 'research creation' that lets one situate themselves in a theoretical framework, further leading to emergences or contributing to existing emergences. In my research, emergence could play an important role in my systemic mapping of processes. This includes mapping the experimentation phase of protocols/changes to public spaces over time and comparing pre-pandemic, pandemic, and post-pandemic scenarios in urban living. I would like to include Bruno Latour's[39], Yaneva's[40], and Kagan's[38] theoretical perspectives as an integral part of my literature review, as I am looking at the complexities and controversies in cities and municipalities paying close attention towards temporality. By creating social distancing tools in public spaces, I am also trying to evaluate their performance based on the 'aesthetic experiences' they create within social contexts.

In the theory of emergences, my project also discusses a few spatial visualization tools like rendering software, physical toolkits, and more. Most existing offices are focused on interventions tackling HVAC and Sanitization. However, these are short-term and could be potentially static as they do not address the long-term factors like user behaviors, creative reuse, and systemic design.

Although mobile applications are abundant [40], specific workspace building configurations for organizational activities have not been explored in depth[22]. Hence, I wanted to combine the positive aspects of working ─socialization, connectedness, and user experience─ and planning online─ accessibility, convenience, and machine intelligence─ to create a controlled environment for users. A few existing spatial and systemic design concepts have evolved over time, influenced user behavior, and encouraged flexible work cultures in offices.

EXISTING OFFICE INTERVENTIONS AND PROTOCOLS (NON-COVID-19 CONTEXT)

The 21st Century Office[41] has brought about a lot of new ways of visualizing our spaces and working productively within these spaces. A study looked into the organization and classification of workplace archetypes[42] that we have seen over the years, from historical designs in the 20th century to modern workplace interiors in the 21st century.

The study tries to create its own typology of working space by bridging gaps between the environmental psychology of space and the aesthetics of space. It considers materiality, texture, lighting, human needs, and spatial application for these needs. A total of ten workplace 'Intypes'

are discussed, drawing from evolving workplace designs of the past. The first five draw from previous workplace designs, while the other five are new upcoming proposals for productive working.

Workplaces in the 20th century were becoming increasingly stationary with permanent-looking fixtures and furniture. It became difficult to distinguish between the interior elements of the space and the architecture of the space due to its permanent and heavy aesthetic (fig. 2.3).

Figure 2.3: Permanent and Heavy fixtures in Office Spaces[43]

Figure 2.4: Experimentation of Frames and color [42]

Experimentation with the scale, thickness, material, and color of interior elements began in 1990[42] when frames and partition walls were integrated into office workplace designs (fig. 2.4). Eventually, designers experimented with open panels and parbolas for community and semi-outdoor spaces [42].

Figure 2.5: Light Seams in Offices [42]

The study also identifies 'Intypes[42]' —past design elements that have influenced modern design because of their effectiveness. One such example is a 'light seam[42].'A light seam is the effect of a ceiling down-lighter lamp/light fixture that lightly washes wall surfaces with light. This phenomenon emulates a natural light and improves worker satisfaction and productivity. From 2000 until 2010, designers began to integrate light seams into corridors, and workspaces to highlight colored, textured, and stone-cladded walls, to complement existing furniture and provide a glow across the workspace interior (fig 2.5). Today, many study spaces, libraries, and co-working spaces use light seams as a workplace design strategy[42]. These workplace strategies aim to achieve relevance in workplace design practice. The referred work is an encyclopedia/repository for future research and professional practice. The methodology for the study is purely practice-based and classification-based, with close attention to work environment assessment, where a few comprehensive surveys are used for demographic purposes. The shift toward informal workspaces for fostering creativity, productivity, and stress-free zones for working were also identified, laying the foundation for Activity-Based-Working (ABW).

Activity-based Flexible offices (A-FOs) are a new working style that allows for individual preferences; choosing from a variety of settings according to the nature of what they are doing, combined with a workplace experience that empowers them to use those spaces throughout the day. A-FOs are preferred over other office types as they improve creativity and enhance productivity[42],[44]. Many studies use scientific evidence to support the growing need for co-working spaces that employ A-FO models. Systems thinking, ergonomics and investigations

around existing working conditions lay the foundation for this study[44]. This thesis also looks into how active workstations are better than open-plan office spaces, drawing from personal experiences, human interactions, and the need for privacy. The study compares A-FOs with open plan offices, where productivity scales are compared.

A mixed methods approach is adopted where working condition factors are identified, changes after moving towards A-FOs are observed, taking existing use cases from multi-national companies. The study[44] uses individual interviews, documented plans and layouts, photographs, and observations. In addition, a cross-sectional study was conducted with seven additional cases with more than 100 questionnaire responses. The results showed that work environment satisfaction and perceived performance could increase after relocation to A-FOs.

Other Studies have also stressed the importance of a holistic sociotechnical perspective for A-FO implementation and the role of employees in the involvement and participation in these spaces for creating workspace diversity and motivating those around them. The thesis also looks into a long-term business plan and develops a framework that proposes design processes for employing A-FOs on a large scale. It includes desk-sharing ratios, workspace diversity, speech rules, enclosed spaces, segregation of areas for speaking on the phone, verbal interactions, and interruptions. The only limitation of the study was the lack of potential collaboration and cohesion between two individuals. However, the entire workplace system design needs to be modified, and this study suggests ways in which we can address these issues.

The transformation of the Concordia Webster library[45] is a great example of an activity-based-working design process that incorporates light seems and other design elements that help students complete their tasks (fig 2.6). The library, which had static workstations and nomadic setups before 2018, now encloses 22 study environments, including activity-based-working spaces like collaborative spaces, dissertation lounges, standing workstations, silent reading rooms, and more.

Figure 2.6: Group Study spaces at the Concordia Webster Library[45]

According to Gensler's 2019 U.S. Workplace Survey, "mostly open" environments tend to perform highest on both effectiveness and workplace experience. Unlike completely open settings where an employee's only option to get work done is in a meeting room or desk, "mostly open" environments provide ample on-demand areas of enclosure. These spaces can support privacy and individual work.

The pandemic has brought many spatial changes in offices. The history of the modern office has been defined by a push and pull between openness and privacy, tearing down walls and putting up partitions. Despite headlines that the open office is dying as an office trend, a modified version of the traditional layout, supported by activity-based working, is emerging.

Drawing from these theories helped me arrive at my problematic, addressing how users and designers think differently in public spaces. The pandemic helped me identify specific protocols and designs catered to the public to help identify differences in how we think.

The next chapter discusses the methodology for my research thesis.

CHAPTER 3: METHODOLOGY AND DATA COLLECTION

The theoretical frameworks have allowed me to expand on an analysis that helps me address the research question of 'How designers and users interpret their surrounding environments differently.'

The first part of my framework includes an in-depth case study analysis of a shopping mall in Bangalore, India. The case study is my main methodology, aiming to identify whether public interventions help users respond to spaces more efficiently. I use a mixed methods approach, combining my experiences and a practical, real-time study of observations.

In the second phase, I discuss the uses of Cultural Probes and address gaps in user thinking and designer thinking.

CASE STUDY ANALYSIS

As defined by Robert Stake, Case studies are findings from intensive analysis of an individual unit, person, or community[46]. These studies analyze developmental factors within a surrounding environment and are widely adopted in many research fields. Today's validity and relevance of a case study go against its old commonsensical definition of 'studying in detail or analyzing and comparing a single phenomenon with a broader class[46].' In scientific studies that prove a hypothesis, case studies are seen as a deductive approach to research, where a single case study is compared and assessed with others. Here, case studies are considered subordinate to investigation, contrary to the field of design, where they become a principal investigation for a research activity[46].

Case studies hold significance within the realm of design and innovation as they are regarded as a preliminary stage of an investigation [46]. They are multi-dimensional, bring in contextual inquiry, and generate new ideas through abductive reasoning. Abductive reasoning (fig 3.1) is a method that provides a more logical and practical foundation to design[47], with many ideas to reflect on.
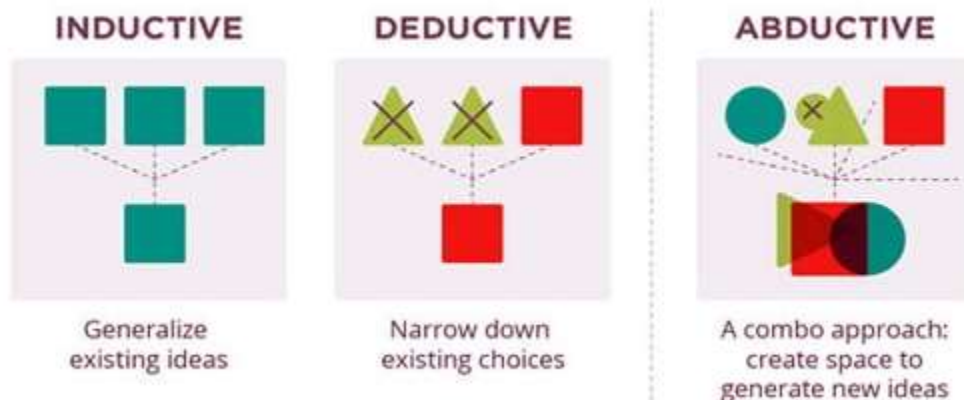
Figure 3.1: Abductive Reasoning [48]

PROJECT I: IDENTIFYING PUBLIC INTERVENTIONS IN A MALL

I conducted a simple observation-based study of a shopping mall in Bangalore, India, in 2020. The aim was to identify glaring gaps in the way designers and users interpret things around them. I also wanted to understand public space proxemics in a covid-19 context and how users recognize and respond to social distancing signs in a mall. These symbols were created by designers during the pandemic in a mall for user navigation. In the study, I propose a new public intervention with the help of low-fidelity sketches and concepts. The outcome of this study identifies simple design interventions and potential design elements for my toolkit. I documented the findings to reveal some glaring gaps in designing for end-users. The project's overarching goal was to understand how various audiences interpret visuals and protocols laid out by designers. I wish to answer the following question:

'What are the existing 'social distancing' signs used in malls, and are they well-received and recognized by users?'

DIRECTION AND LITERATURE

Existing research in the COVID-19 context recognizes the critical role of distancing oneself to curb the viral spread. The preliminary steps adopted to curb viral spread are creating and designing social distancing tools and signage by estimating the amount of space needed in various retail environments[49]. A study by N. Ntounis et al. [14] has shown that a minimum distance of 2 meters is to be maintained between individuals conversing in public spaces such as malls, restaurants, and plazas. I identified similar protocols in the mall context and the effects of their implementation on various users. N. Ntounis et al. also discuss a few challenges and issues that are usually overlooked; traveling in groups of two or more, moving around as a couple, and as a family while distancing [14]. The problem of calculated movements while traveling in groups is highlighted in the study, which may be impractical in the long run. People must move in unison for these configurations to work. There is a possibility of reducing the social distancing space to less than 2 m, followed in most public spaces.

An additional resource for my study is a blueprint discussing preventive measures through signage for controlling the viral spread in shopping malls by the Government of India [50]. Signage has been suggested and used as a tool for behavioral change in public spaces [51].

My initial method to approach the problem space and collect data was to formulate a set of questions and gather responses from the public on their views on social distancing protocols and signs around them. I included questions such as 'Have you visited a mall recently? Yes/No? If yes, was your experience safe?' 'Do others around you socially distance?' 'Do you think existing signs need to be bolder and easily readable?' 'Do you think the use of brighter colors on the floor and less text will help?' and so on. Although this method could provide a general understanding of signs and social distancing, it did not address the problem space directly. The new method chosen for this study was a real-time observation of people at specific locations in a mall using Context, Data collection through observation, findings, and Retrospection.

1. **Context:** Documentation of an existing social distance sign in a mall in the form of photos

2. **Data collection through Observation:** Observation of subjects and their actions around existing signs in a mall
3. **Findings**: Analysis of the research questions and objectives
4. **Retrospect:** Conceptual sketches for a redesigned intervention

RECORDED OBSERVATION OF SUBJECTS AND SURROUNDING ENVIRONMENT

I visited Orion mall on a Friday evening and situated myself at a few crowded locations of the mall. With the holiday season going on, crowding was at an all-time high. I could easily identify signs located across the mall, but I collected responses for two signs; the most conspicuous and the least conspicuous. The most visible signs were digital screens at every floor's stair landing, while the least visible signs were floor graphics on escalator boarding and landing areas. The objective of these observations was to see the effectiveness of these existing social distancing signs on display based on users' actions and redesign them or suggest alternatives to that space.

FINDINGS

I positioned myself near the functional escalator and documented my observations from 6:00-7:00 pm. There were two signs at the base of it, placed one after the other (fig. 3.2). The first indicated that one must maintain a distance of two steps, and the other mentioned 'please stand on the steps without the cross markings.' Before boarding the escalator, people immediately looked down at these two floor graphics. Most users stepped onto the cross marked steps even when instructed not to. Users would rather identify with an instruction on what they should step on rather than what they shouldn't step on. I believe this could be because people identify with symbols and figures and are usually given an instruction 'to do' rather than 'to not do' [51]. In addition, they might try to get onto the escalator quickly as others may be waiting to board behind them. Colors, signs and symbols play an important role in human psychology and behavior. Familiarity with signals and symbols can help with user recognition [51]. This finding would be an integral design principle for my toolkit and mobile application.

Their actions made me wonder if there was a misinterpretation of the instruction or whether they were just ignorant. As I started to see more people try to read the sign at their feet but still step on the cross-marked stair, I realized there could be a flaw in the floor graphic design itself. Even if the instruction were altered to 'please stand on the plain steps,' it would not be the best idea. I soon discovered why. After using the escalator and making a couple of trips up and down, I noticed that the cross marks painted onto the steps were no longer visible. The paint lines must have worn off due to continuous stepping and use by the general public.

There was a mixed user response to the floor graphics. Some nonchalant users stepped onto the escalator, unaware if they were standing on the right step. However, they still maintained a few steps' distance with the person standing before them. Most users attempted looking down at the instructions but were confused as they had to process two instructions one after the other in a few seconds. The instructions were difficult to comprehend in such a fast-moving scenario. Secondly, placing the instruction sign right at the base of the escalator was unwanted and dangerous, as it could lead to accidents if one tries to read and control their leg movement simultaneously. More specifically, this could impact unaccompanied senior citizens.

A few studies mention that it is always better to provide a sign at eye level[52] and, in this case, placed at least 2 metres before the base. A sign on the floor is not visible or readable unless one stands very close to the base of the escalator.

Figure 3.2: Existing escalator graphics

To effectively send a message, an instruction should be clearly illustrated to make understanding easier or the text should be straightforward and simple to read [53]. An experimental study by the University of Greenwich proved that only 38% of people view conventional signage in front of them [53]. From my observation of the escalator base signs, there was neither a clear text-based instruction nor a clear visual identification. Only a very faint yellow cross marking was painted on certain stairs for people to avoid stepping on. As per the hypothesis, an infographic with minimal text/no text with a good color balance would have been attractive and worked well in this situation. People would have been able to follow protocols more effectively.

OUTCOME

This method gave me an overall view of the sign's effectiveness in conveying a message. Observing, analyzing, and documenting user behavior led to the creation of two sketches, as shown below (fig. 3.3 and fig. 3.4). The first sketch depicts a Batman-based intervention that can encourage kids and teenagers to learn to socially distance themselves in a mall. As many are familiar with the bat signal associated with DC Comics [54], they would easily be able to recognize the symbol and its yellow light on the steps and follow the Batman mannequin's non-textual instruction to step on it. Cartoon characters from books and movies significantly influence children, and using these characters as a positive role models can make a child happy, attentive, and aware of their surroundings [55]. Following their role model's footsteps, children could indirectly follow the social distancing protocols. Instead of using paints or stickers, LED strip lights can be placed within the grooves of the steps and on the sides. The possibility of damage is lower, and it has better adaptability. Lights can attract users, navigate them through a space, and

can be easily controlled and monitored. Different colored lights can be used according to seasons. For example, red and white can be used during Christmas. In fig. 3.3, the mannequin's speech bubble indicates the symbol and color of the stair that people must step on while ascending.

Figure 3.3: Existing escalator vs. suggested intervention

The second intervention (fig. 3.4) is a simple 'go green' instruction using the familiarity of the green signal. This sketch is simpler with minimal text and a straightforward message; 'step on the green' situated at one's eye level. Although the green light originally indicated 'caution,' its role in lighting has changed over time [56]. Today, a green signal indicates moving ahead for traffic, pedestrian crossings, and navigation in general. From an emotional perspective, green is also a symbol of safety and reassurance [56]. The color was chosen as a navigating tool for users to cross obstacles. Similar to the previous concept of character familiarity, the green color used here indicates staying safe by socially distancing. The floor graphics are removed, giving the user a wide and clear passageway free of text.

Both the concepts use familiarity to facilitate interaction and bring in positive responses from the users. The observations brought in an understanding of what is missing or what the public requires to maintain safe interactions with each other. Using familiar symbols and signs can bring about a psychological change in behavior [51]. I wanted to use symbols that people could identify and relate with.

The design process helped me rethink the use of colors in the best possible way and how it could attract various age groups. Exploring new ways to design from a user perspective also led to exploring cultural probes, another great way to help users design for their daily activities and further address design thinking, which is discussed in the following section.

Figure 3.4: Existing escalator vs. suggested intervention

CULTURAL PROBES

I wish to design and develop a cultural probe for spatial planning for the second component of my methodology. It is a simple tool for end users to create their ideal workspaces and get their working configurations to life. An integral part of designing with probes is involving the end user. Cultural probes are agents of participation[37] and allow end users to freely express themselves through design. User participation is always essential to convey new ideas, designs and feedback. The cultural probe that I develop too, explores how users can build configurations for space using a hands-on approach. The probe is developed to encourage participatory design practice in the workplace. The participation is not just limited to individuals building with the probe, but extends to sharing ideas, and discussing new designs with other individuals and employees at the workplace. Moreover, the making abilities of the user, their design thinking and aesthetic sense, furniture and interior design suggestions are explored through the use of a probe. The next section discusses the general components of cultural probes and a classification of probes through the lens of activity-based planning and spatial planning. Generally, probes are used to build applications but in my project I wish to use them as agents of reflection in a post-making phase. The participatory practice must extend after building a space as users can reflect on past creations and improve their ways of communicating their designs and needs.

As the name suggests, cultural probes are a compact set of physical/digital elements that probe user participation at the beginning of a design process. It uses open-ended activities[57] over fixed instructions to provoke user behavior and playfulness with participatory elements[58]. It usually includes cards, packages, and maps to help users share their stories, inspirations, and daily routines (fig. 3.5). These inputs positively impact the final design deliverables of a project by addressing and accommodating varied user behaviors, dilemmas, and design needs[58]. They can be used as both an interaction design Method and Design Research Method. In the context of Interaction Design, they lay the foundation for designing wireframes for mobile applications. But in the context of Design Research, Cultural probes are unique and qualitative research tools as they provide a high level of subjective user feedback/ information that may not be accessible through

surveys, interviews, and questionnaires[59]. They often lay the foundation for a design process by gathering adequate user data and inputs before the final prototype design.

Cultural probes familiarize beginners or unfamiliar users with new design processes. Their unrestrictive nature allows users to design with tasks rather than fixed instruction. They are a great way to encourage reflection-in-action[60] in design and lead a group of people in the right direction without dominating or manipulating designs and feedback. Probes don't necessarily guide a solution or lead a design, but they have the potential to influence a design process and encourage self-reflection and awareness before formulating a solution[58]. A few use cases of cultural probes are analyzed to reshape our daily activities like dining and working and our surrounding spaces.

Figure 3.5: A Cultural probe[57]

USE CASE ANALYSIS OF PROBE FOR ACTIVITIES

A recent case study testing a cultural probe on a mixed user group brought in 'exceptional engagement[57].' The probe was designed to analyze people's food habits and philosophies within a 20-30 year age bracket. The first step of the design process was to list the main questions that the probe would be able to answer, such as identifying some of the food aspirations of participants in comparison to their realities and understanding if certain foods illicit any emotions in participants. The next step was to identify activities that incorporate users' daily routines and set

certain tasks to motivate users in the participation process. The next step was to incorporate these ideas into the visual identity of the kits through mock-ups (fig. 3.6).

The next step was to understand the user behavior, create multiple kits and distribute them to users. The kits need to look user-friendly and less refined, encouraging users to explore and become part of the design process. The response from using the kits was remarkable[57], with many interesting insights and explorations to their research questions, such as eating outside brings in deeper habits of eating the same meal at the same place, difficulty in making assumptions about other's food habits, etc.

Figure 3.6: Mockup [57]

There are a lot of online tools and toolkits for users to visualize their ideas; however, there are limitations to these tools. The user can only use existing shapes and objects from a digital sandbox, and most of the time, exporting these tools is chargeable or require subscriptions. Although our ways of creating have moved towards online platforms, the essence of creation is by using a hands-on approach and creating what you wish to see. Cultural probes allow for this unrestrictive, physical approach to designing with form and function. Probes can be used for various user needs and activities and pursue design for pleasure (fig. 3.7). They help bring in empathic, user-centric interpretations to design and make users' lives easier and more pleasurable by solving everyday complexities. Users are also exposed to a new design perspective where they can be designers themselves.

Figure 3.7: A Cultural probe for planning general daily activities[57]

Cultural probes can be adapted to various design projects, user groups, and scenarios. Recently, cultural probes have been used for building tools in design education and professional practice[58][61].

USE CASE ANALYSIS OF THE PROBE FOR SPACES

After identifying the types of probes and their use in an activity-based context, it was just as essential to understand their use in a spatial context. The Probe allows users to create various activity-based configurations that suit their working needs.

I. FORMAL USE-CASES

WAR ROOMS

As the name suggests, war rooms were first introduced in 1901 for discussions, strategies, and tactics on how to win wars (fig. 3.8) [62]. These rooms were primarily located in Military headquarters, where military officials and generals would come together to strategize how to win wars. Winston Churchill used the first war room to plan tactics around World War 2. The efficiency of these rooms has come back in the 21st century offices we see today [41]. These rooms are widely used for business and client meetings across organizations and companies.

Figure 3.8: War rooms[62]

The furniture arrangement in these rooms is a coherent way of having a principal speaker who opens the door to discussions, opinions, and quick problem-solving decisions. War rooms have evolved considerably over the years. However, their use cases have changed over time, primarily used for decision-making and business plans [62].

In my physical toolkit, I plan to include a few furniture elements seen in these war rooms, such as tables of varying lengths based on the selected occupancy of the space. To maintain the relevance of this kit in a post-pandemic setup, I have assumed the maximum occupancy of the designed space as 10. The occupancy in offices today is still maintained at ten persons per room. Furniture arrangement plays an important role in the productivity that a space can bring. The right furniture arrangement can improve a space's customizing and personalizing quality. War rooms are one example of my use case, where users would be happy to choose the furniture they require, choose if they want it to be more informal or formal, and choose other accessory elements in the space.

FOCUS ROOMS

While remote meetings have been preceding in-person meetings lately, the current trend is the coexistence of both. Every meeting agenda requires logistics and expectations from employees.

Moreover, with mask mandates slowly disappearing, likely, employees might soon be asked to return to their workspaces in offices [63]. Whether being physically present in the meeting or joining a meeting virtually, many employees seem to gravitate toward attending meetings in their respective offices [7]. In this context, users can opt to build a focus room to attend their meeting from a PC for maximum concentration and attention (fig. 3.9). Focus rooms combine the tranquillity and knowledge production of a library and the productivity of a study space. As a result, focus rooms pioneer concentration and self-awareness to complete tasks within a stipulated time. These spaces are designed to make users focus and become mindful of their work. They also strike a good balance between serenity and social dynamics [64].

Figure 3.9: Focus Rooms[64]

Focus rooms are private and are suited for individuals who prefer to work in isolation to get their tasks completed quickly. A few activities that this room can be used for are video calls, studying, writing, emails, meditation, performance evaluations, etc. It allows working within their private bubble that is often difficult to replicate within one's home. These rooms also require thoughtful design and furniture elements to foster the productivity users seek. The main furniture elements of a focus room are a desk, chair, Built-in power units and USB ports, accessory rails like hooks and shelves to declutter their space, and a whiteboard.

However, the users of these spaces would use these spaces for different tasks. Some users who can focus on writing tasks in this room may not be able to create in the same room. Hence, asking users to participate in planning and arranging the furniture they wish to use based on the task at hand would be more effective [64]. And since employees might find it difficult to focus on their tasks and move around furniture physically, we ask them to simply create a layout with a smaller scaled toolkit and have their space ready to use on the day they schedule it. The function of a study room as a space has changed over time. We require simple furniture, fewer distractions, and a sense of focus and productivity for these types of rooms.

To go about this, I propose a toolkit that combines concepts of modularity and minimalist workspaces[65] that users can play around with to create a layout that works for them. I thought it would be interesting to give users the freedom to design their own space and see what works for them. This process of designing-in-action helps them become more self-aware as users while understanding the value of design, spatial perception, and self-learning. Occupancy is also important to keep in mind as some users like to work in isolation while others work better in groups. Hence the relevance of designing or making accommodations within a common space is an interesting challenge for users to solve.

PRESENTATION ROOMS

Presentation rooms are spaces where multi-disciplinary teams come together to focus on client services. Within this space, there is an exchange of ideas, skills, and knowledge that brings in solution-based discussions. Presentation rooms have evolved over the years, from more static and monochrome layouts to more semi-formal and lively environments (Fig. 3.10). These spaces have to be welcoming and less distractive at the same time. As the design of this space can be dictated by how people use it, I have considered two primary determinants for its design: the type of presentation and the stage of a project.

By making spaces more nomadic, users can move things around suited to their preferences. I would similarly like users to play around with objects in the toolkit and change the meaning of presentation space. I would like to include specific furniture elements from a presentation perspective: food tables, coffee kiosks, snack bars, and water dispensers. This room also accommodates periodic breaks in conversation. Client discussions usually last around 4-5 hours. So these spaces need good planning to make users comfortable. Tables, chairs based on occupancy, whiteboards, projectors, and podium elements will be included in the toolkit. Technological interventions have played a very important role in the evolution of these spaces. What started as a simple room with a blackboard and chalk to brainstorm has transformed into active board rooms with touch pads, TVs, and projectors. Lighting also plays a very important role in these spaces. Privacy and concentration are key aspects of the space when considering its design. Presentation rooms can have open e too, depending on the project stage or discussion.

Figure 3.10: A Presentation room's static nature

II. INFORMAL/SEMI-FORMAL USE CASES

APPRAISAL ROOMS

Performance assessment rooms or Appraisal rooms are spaces where employees and managers get together to have casual conversations about their work, progress, and plans for the coming years (fig. 3.11). I have put appraisal rooms under informal spaces as they bring comfort to communications. Conducting these performance reviews in person has been challenging and static[66], and due to Covid-19, they have been taking place remotely. Although the comfort of one's home is enough to make the employee feel comfortable, I wanted to explore the possibility of having these meetings in person. The typical performance appraisal rooms are more static, so I wanted to look into how these spaces can be more personalized and fluid with a tinge of playfulness. I wanted to include informal sofa elements, chairs, and food stations in my toolkit to engage or invite managers and employees to create their own space.

Figure 3.11: Informal Spaces for formal Use-cases[66]

OVERNIGHT ROOMS

These meeting rooms serve informal meeting purposes outside a professional setup. They are useful for informal group activities throughout the day, such as team-building events, workshops, conferences, potlucks, parties, ice breaker sessions, or movie nights. Team events are integral for office employees to feel valued in a company. A few common elements here are food and larger occupancies. So to cater to this, certain furniture elements like food tables, projectors and whiteboards can be used to create the theme or set up of their choice. These meeting rooms need to be more lively and customizable for a variety of events to take place. For the furniture elements, I am looking into more playful furniture like sofas, bean bags, cushions, food serving tables, vending machines, and partition walls.

The next chapter discusses discoveries and conclusions that stemmed from my methodology.

CHAPTER 4:RESULTS, DATA ANALYSIS, AND DISCOVERIES

CASE STUDY CONCLUSIONS

The pandemic has impacted millions of lives, and an antivirus built environment is still on its way. I could draw a few conclusions from Project I, the case study in the Mall. Malls bring in people from all over the city. Public interventions and propositions are essential to ensure safe interactions and disinfection protocols. Careful observation of user behavior around these signs proved to be more effective as a methodological framework to begin my thought process for this study. Not only was I able to identify their mannerisms in real-time, but I also visualized a solution and possible intervention by being present in the same space. The face-to-face experience gave me more answers than I was hoping to find. Due to safety precautions and travel restrictions, I conducted the study at the mall and recorded observations only for an hour. I saw potential in redesigning and changing existing escalator signs.

Moreover, I was able to identify and attempt to design for various audiences like children and the elderly while educating them about the importance of social distancing through fun interventions. This project helped me analyze their needs and design for them. This case study also laid a foundation for my second mini-research project that could lead to social and community engagement within public spaces. Soon, physical barriers may be necessary when people become less conscious of the virus' presence. However, interlinking empathic and participatory design within these systems looks promising.

As designers, we must always think of alternative ways to make everyday life interactive and interesting, especially when our outdoor activities have reduced considerably. Exploring these recent developments during the pandemic has helped me articulate the problem space. Contactless working has changed how we think, create and talk, whether at home or work. The existing approaches focus on contactless methods and aim to minimize human contact using social distancing protocols. However, these solutions may not achieve social satisfaction and human connectedness in the long run. It might distance people further. I wanted to develop a tool that can develop spaces that could function during the pandemic and still be relevant in a post-pandemic world. Although mobile applications are abundant [40], specific workspace building for organizational activities has not been explored in depth[22]. Hence, I wanted to combine the positive aspects of working ─socialization, connectedness, and user experience─ and planning online─ accessibility, convenience, and machine intelligence─ to create a controlled environment for users. In addition, I would like to develop an ICT-driven smartphone application that would provide users with workspace configurations suited to their needs.

Exploring the use of probes resulted in some conclusions as well. From an interaction design perspective, probes go a step ahead by assessing how the digital and physical can merge. They help create wireframes and considering that my project explores both the use of a physical and digital tool, the use of cultural probes would also help in the wireframe development for my mobile application. Moreover, it helps with understanding the role of personalization within space, building with a hands-on approach, and witnessing the endless possibilities and experimentations. With a physical probe, there lies zero to no restrictions.

The cultural probe in my project would include a combination of materials like paper and wood blocks that users can create their ideal spaces with, along with a user manual for assistance. Designing a cultural probe seemed relevant to my design process, and it had the potential to engage users with simple tasks. Moreover, users can interact with the probe, write their thoughts and visualize their creations with the physical elements in the toolkit.

Studying cultural probes and spatial protocols for COVID-19 in depth led to discovering new ICT technologies such as interaction design methods and tools for spatial perception. The next section discusses some of these tools that further resulted in the growth of digital, physical, and hybrid tools for spatial visualization.

AMPLIFYING SPATIAL EXPERIENCES WITH ICT TECHNOLOGY

The incorporation of COVID-19 protocols—sanitizing our hands, wearing masks, isolating and contactless communications, to name a few—in public spaces, have made us more health conscious. However, some also argue that it has negatively impacted audiences, who now reprogram themselves to suit the nature of their surrounding environments. Moreover, social distancing, stringent spatial occupancy, and capacity monitoring are barriers to human experiences within these spaces. There is a need to rekindle participation and interaction in these spaces by incorporating tools, technologies, and interfaces within the built environment that audiences can reconnect with. Participatory design holds relevance in spatial design, especially public spaces, and some tools can potentially deliver enriched experiences in public spaces. Understanding spaces through phenomenology or activating the five senses are a great way to address spatial perception.

ICT infrastructure refers to Information and Communication technologies— hardware, software, networks and equipment that are used for monitoring and operational purposes in a larger system. The emergence of these technologies led to an integration of ICT and data processing technologies called IoT (Internet of things), that aims to embed technology into our daily life[67]. The main objective of Iot is to 'Plug and play' smart objects[67]. It was estimated that in the world, 28 billion smart devices will be connected, with a single person owning 6-7 devices on average[67]. The world has seen a massive growth of mobile applications and interaction design tools like Touch tiles, RFID technologies, Sensors, QR codes etc. Nevertheless, these technologies have made virtual communications a possibility within office spaces. They have also lead to the development of automated homes, smart cities, smart buildings and more[67]. Certain companies and organizations have already made efforts to incorporate new interactive technologies and automation into space, and the transition into participatory tools in space has been rapid. The pandemic has definitely acted as a catalyst to speed up the process of rebuilding digital tools for hybrid working. Here are some of the technologies adopted for better engagement and public experience in 2022.

1. QR Codes: QR codes or Quick response Technologies are two-dimensional images where data is stored both horizontally and vertically on the image (fig. 4.1). The first QR code was developed at Denso Wave, a company that needed a method for tracking their vehicles during manufacturing [68]. QR codes can potentially transform public spaces into digital museums and improve public experiences in a contactless post-pandemic context [68]. A study analyzed multiple visitor perceptions of a museum space by scanning QR codes and learning more about the objects

on display. The study concluded that QR codes could maximize the impact on visitor engagement compared to traditional large display screens[68]. QR codes have also been used for gamification in public spaces —dining spaces (digital menus and contactless dine-in services), and university grounds (enrolling for workshops, events, and classes). QR codes placed in common meeting spaces within universities and offices have helped participants meet and interact with each other before the start of their classes or projects, respectively[69].
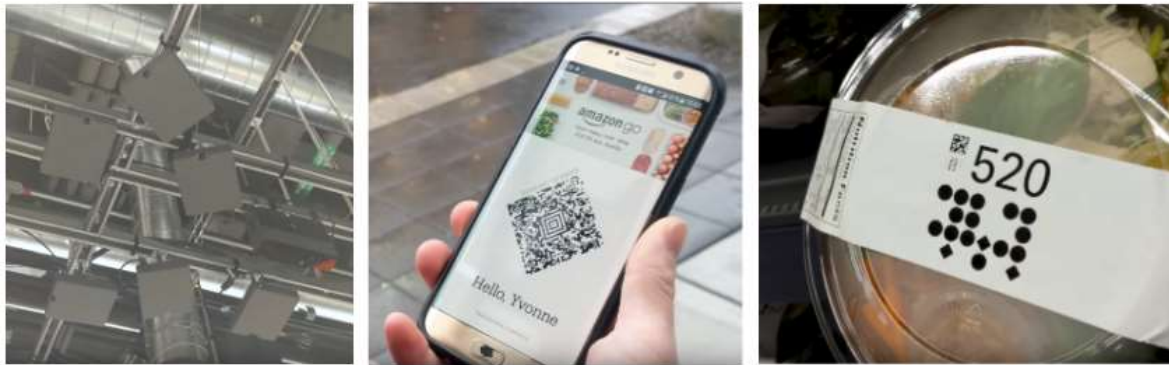
Figure 4.1: Cameras and QR codes make up Amazon Go's Platform[69]

2. 5G-IoT Driven cellular networks for Mobile Applications: 60% of the global population use the internet, and 67% possess smartphones, making smartphone applications a handy technological tool for the Covid-19 pandemic, as they can provide accessible services to large populations from the comfort of their home/office. Many developments in wireless sensor networks (fig. 4.2) led to Fifth generation (5G) cellular networks that provide better coverage. By 2025, the number of devices connected to the internet will rise[67].

Wireless Technology	Data-Rate	Services	Bandwidth	Reference
1G	2.4Kbps	Voice	30KHz	[63]
2G	10Kbps	Voice, Data	200KHz	[63]-[64]
2.5G	50Kbps/200Kbps	Voice, Data	200KHz	[63]-[64]
3G	384Kbps	Voice, Data, Video Calling	5 MHz	[63]-[64]
3.5G	5-30Mbps	Voice, Data, Video Calling	5MHz	[63]-[64]
3.75G	100-200Mbps	HD video, peer to peer file sharing, composite Web services, online gaming	1.4MHz-20MHz	[63]-[65]
4G	DL 3Gbps UL 1.5Gbps	HD video, multimedia, data services at much higher data-rate	1.4MHz-20MHz	[65]-[66]

Figure 4.2: Previous Wireless technology from 1G To 4G [67]

3. Augmented reality and Virtual Reality (AR and VR): There have been a lot of technological advancements over the years, such as augmented reality, virtual reality, and other devices that try to eliminate the need for a PC. Augmented reality (AR) began with Pokemon Go and other gaming applications. Its use slowly grew in various fields like design, engineering, building

construction, and even interior design visualization. A majority of augmented reality platforms are available on smartphones. The applications use a smartphone's camera to capture the real space and put virtual furniture within that space. The IKEA Smart store is one of the most commonly used applications, with its catalog of tools for users to pick and choose from to place in their homes. Home stagers may be requested to come and stage the home with the chosen products, and they use AR applications to scan one's home and place the chosen furniture within that space. The IKEA store, which has standardized its furniture for dimensions, shades, and other product features, allows less to no customization of the actual product. The drawback about this is sometimes elements of the catalog are missing, and there can be glitches too.

Recently, Facebook launched a product, 'Oculus,' which lets users plan their spaces and workouts. Users can now visualize the color of their walls, the flooring materials, or select furniture they like for their living room. Of course, in these scenarios, the user does not know how the result would turn out and would have to rely on the closest possible swatch or match to achieve their perfect design. AR has been more widely used for designing homes as they look into aesthetics and allow a lot more personalization. These tools were developed to eliminate incorrect assessments of how pieces of furniture would look together and to test out color palettes. As AR became accessible by smartphones, many interior design applications emerged, where users could overlay existing furniture onto spaces using their smartphone camera. AR creates illusions of real spaces where digital objects or furniture placed in the space appear real and close to the user's line of vision[70]. For more personalized homes, multiple iterations and changes are accepted, and the time frame for home interiors or renovation projects is longer; hence, having these tools allows users to play around more slowly, addressing the more aesthetic elements of a home. However, in a professional setup, the concept of permanence may not be beneficial as there is a need for flexible re-use/ sustainable re-use[70].

TOOLKITS FOR SPATIAL VISUALIZATION

DIGITAL TOOLS

In architectural practice and product design, helping clients or customers envision or create a product they like has slowly begun to advance through the use of tools.

AutoCAD software by Autodesk is used for drafting, drawing, and designing floor plans or projections. It is an architectural tool used by design professionals like architects, interior designers, product designers, and engineers[70]. The software allows for spatial planning and visualization both in 2D and 3D.

SketchUp, Rhino, Lumion, and Canvas have blank 3D workspaces[70] where users can scan any space, rotate it at any angle of their choice, position a camera, and place blocks and elements within the space. Online building tools like sketch-up and Adobe or draw my room have a lot of online tools to select furniture, paint and even change flooring textures.

A pertinent problem that users face while using these software are the restrictions on file size and collaboration. Due to multiple versions of a single software, file sharing is hindered and time-consuming. E.g., A person with version 1 of the software cannot access a file created on version 3. Users can only update their software at a cost. These tools might become outdated due to their limited accessibility as more and more users are shifting towards collaborative digital workspaces.

Drawing from personal experiences of using SketchUp and Canvas for over five years, the negative aspects outweigh the positive. The software's pros like precision accuracy are overlooked as spatial planning and architectural building bring more complex challenges. It is low-fidelity and can hinder visualization and imagination of the final physical product may get difficult. The tool is more flexible than others but requires additional software for realistic rendering. A few years later, the power of augmented reality was discovered. The use of tactile and immersive experiences started changing the ways we feel spaces.

PHYSICAL TOOLS

Professionals are used to analyzing architectural plans, building models, scales, etc. However, it can be intimidating for people outside the design and architecture to use software and build on architectural graphics. Hence, physical tools are a great starting point to encourage users to build without worrying about precision and accuracy, but instead bringing their focus onto imagination and creativity that they foresee for their working needs.

1. *DIY Toolkits*: A few physical tools have been developed to adress this gap, like Do-it-Yourself toolkits (DIY) with step-by-step instructions for easy construction, dismantling, and assembly[71]. The best example of these DIY kits is IKEA's furniture toolkits (fig 4.3). These products reach the end customer as a dismantled set of furniture pieces and building tools that encourage users to build themselves and familiarize themselves with ways to visualize how modular pieces can be fixed together. The pieces are arranged within a toolkit, accompanied by an instruction manual with step-by-step instructions and sketches.

Figure 4.3: Catalogs with Hand Drawn Sketches for Spatial Visualization [71]

2. *Brainstorming Kits and Workshops*: IBM recently launched a physical toolkit for employees in a brainstorming and design workshop. The single kit included sticky notes to capture ideas, thick markers for everyone's work to be easily read, dots, tape, and other stationery supplies for voting on the best idea. Rooms with wall spaces and chairs and storage shelves on the corners were also provided to keep the central floor space accessible.

Keeping spaces clear and minimal aids process reflection[72]. Resource sharing (brainstorming rooms vs. individual desks) encourages deep insight and helps users collaborate and work while also being aware of proxemics[72]. Proxemics is a study that analyses how users communicate through their use of space[73]. It is also a perception of one's social and personal space, specific to seating and living arrangements. There have also been a lot of workshops for designing interiors for real-time physical spaces, where designers sit within the space and sketch their ideas, later building a physical model within the same space. These techniques help with creativity and provide references to scale and proxemics[73].

Moreover, users can adapt to new ways of designing and bring their ideas to life. 3D printing workshops are another great way to visualize built environments. Softwares like Rhino and AutoCAD help users develop 3D printed blocks of their design. However, compared to other workshops, these are less free-flowing as they rely on the precision and accuracy of digital models or drawings. They require knowledge of digital tools for building and layering, and rendering software.

Libraries have evolved from passive reading rooms to communities of collaborative learning promoting active engagement. The development of smart spaces within libraries has helped users across age groups study, solve problems, and participate in co-led projects and activities. The Concordia Webster library has 22 study space configurations for participatory design and hands-on activities, solving problems together, and strengthening social interactions.

3. *Building Blocks*: The idea of 'play' is integral in helping users make sense of their surroundings and the 'world around them'[72]. It is integral to building activities, education, and promoting learning (fig.4.4). Lego blocks were initially intended for children to create and build their characters and play spaces, but their use has grown tremendously. Today, it is a solution-driven tool that professionals across industries use for spatial perception and even for facilitating creativity and imagination for innovation, business strategy development, designing, animation, and stop motion. It is a multi-functional tool and very versatile [72].

A study explores the use-cases of Lego blocks and compares their use with digital tools. A case is made where Lego blocks have a unique ability to rekindle hand-eye coordination and close relationships between the hand and mind. Lego blocks also prevent the physical manipulation of objects that some digital tools do by default[72].'The aim of the current work detailed here is to reclaim Lego Building practices for use in academic and pedagogical practice[72].'
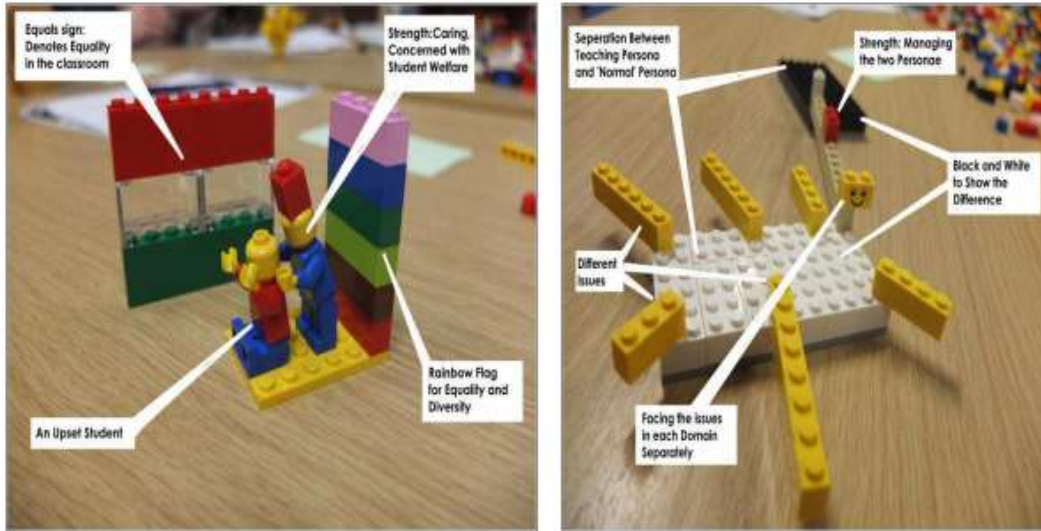
Figure 4.4: Developing Teacher Personas Using Lego Blocks
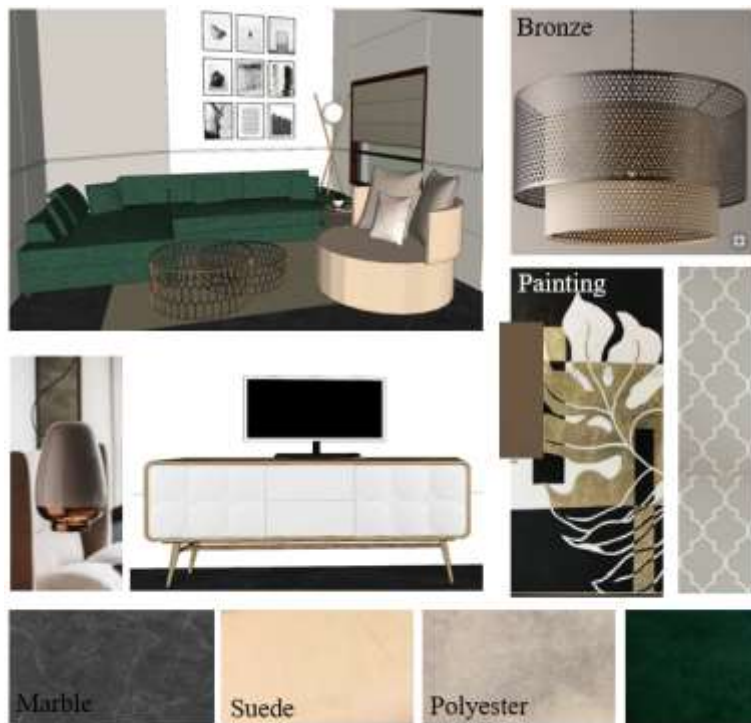
Figure 4.5: A Moodboard for a Residence

4. *Catalogs and Mood boards*: Catalogs and mood boards are collections of designs and configurations of furniture arrangements, color palettes, and upholstery (fig. 4.5). Catalogs help users identify color palettes and place complimentary furniture pieces within a certain space. It has been used as an integral step of the design process for aesthetics and planning and requested by clients and residents as a way to visualize their own homes. They inspire users to broaden

their vision and have been used for many years as a reference in interior design firms and architecture offices. Extensive catalogs may include wood samples, wall textures, upholstery, and complementary furniture. These physical tools educate readers and help them with design decisions and color preferences. They are also helpful for client discussions when architects want to discuss designs with their clients. They help clients make valuable choices and understand color palettes.

HYBRID TOOLS

Hybrid tools broaden the horizon of collaboration and participation as they allow for remote designing in the comfort of one's home/studio/office, where users can collaborate in a flexible hybrid working environment[74]. A study explores a hybrid application designed for touch interfaces like iPads[75]. The tool is a blank digital workspace that uses clusters of building blocks, where each block represents a past design idea. Every project member is assigned a color identity, and their contributions to the digital room are monitored. The tool is designed for architecture students and novice practitioners in a studio environment to facilitate brainstorming and creativity (fig 4.6). Users can access spatial plans of buildings by merging their use of a digital screen and hand drawings[75].

Figure 4.6: Hybrid tools and Participation[74]

More recently, after the covid-19, Miro and Figma—two collaborative design tools—have helped colleagues plan activities and designs while working remotely. The tools are widely used for collaborative learning, participatory design activities, and brainstorming business plans. Hybrid tools have the potential to make users participate without drastically changing their environments. Just like Miro and Figma, which help users plan together in a collaborative digital workspace, many tools perform as great communication channels for designing. Another study

develops a pedagogical tool for architecture[70] that promotes reflective design learning among architecture students. The tool can trace concepts and design ideas from brainstorming sessions and provoke design thinking and making[70]. Moreover, the participants can build off others' ideas and explore alternatives.

Table 4.1 discusses the pros and cons of all three tools to further analyze the ideal tool to build. Although all the tools have limitations, the hybrid tool incorporates digital and physical tools best. Employees require flexible working means today, and hybrid tools can provide them with the flexibility they are looking for. These tools can also retain their relevance in a post-pandemic context.

Table 4.1: A Comparison of the Pros and Cons of the Tools

Types of Tools	Examples	Pros	Cons
Digital	3D Visualization Software	Accuracy Flexibility	Requires Additional Inbuilt Tools Less customizability Time-consuming
Physical	DIY Toolkits and Manuals Catalogs and Moodboards Workshops 3D printing workshops	Learning Collaboration	May be inaccurate Dependent on external factors
Hybrid	Pedagogical tools Collaborative tools	Avoids Design Duplication Collaboration Emergence of a new Design practice	Requires Collaboration Dependent on the availability of Both physical and Digital Tools

Smartphone apps are very helpful in this process. The tool I am developing would also contribute to the existing hybrid tools, where merging the physical and digital paves the way for future design practice. The tool combines color, furniture, and brainstorming to develop a toolkit to help users build and visualize spaces for their working needs. Exploring these interaction design tools and the case study (Project 1) have laid the foundation for my other mini-research projects—Project II and III, discussed in the following chapter.

CHAPTER 5:CREATIVE PRACTICE FOR RESEARCH FINDINGS

MINI-RESEARCH PROJECTS

PROJECT II: DINING FOR SOCIAL CONNECTEDNESS

DIRECTION AND LITERATURE

This project attempts to change our ways of dining during the pandemic while reframing our meaning of social connectedness. The pandemic has brought new realities to Dining spaces, where restaurants, cafes, and food halls are not to be taken for granted as before the pandemic[76]. They contribute to the global economy of the 21st Century, with more than a million people working within these spaces daily [76]. The project explores movement strategies and communal dining design for connectivity, safety, and socialization in a post-pandemic scenario by merging the positive experiences of online food ordering and in-house dining. In this project, a restaurant dining arrangement is designed to encourage safety and socialization during a pandemic by exploring biological ontologies, affordances of objects, and actor-network theories. The overarching question I am trying to answer is how social distancing and social connectedness may co-exist in communal dining spaces and how biomimicry can shape an antivirus dining environment for users.

Considering that my project required restrictive yet relaxed user access simultaneously, a new zoning system is suggested, with color-coded floor graphics on the mock-up. Based on the user groups (couples, families, and individuals), the types of interactions (casual conversations, business meetings, and private dining), suitable conveyor belt arrangements are explored, and the proposed space is segregated into zones. Viewing the artifact in a fragmented form (photos and videos) might allow users to reflect in action on the temporalities of time and space. I also believe users might have a deeper understanding of ecological literacy by rethinking the symphony of mechanized systems with natural, organic forms.

A spatial strategy in a restaurant is proposed to encourage safety and socialization during a pandemic by exploring biological ontologies, affordances of objects, and actor-network theories. The project deliverables are:

1. An operating system

2. A spatial arrangement created from a probe

3. A stop-motion video showing potential users and wayfinding within the space

The next section discusses the project deliverables in detail and the process of arriving at the final prototype.

PROJECT DELIVERABLES AND DESIGN PROCESS

The first step in the design of the prototype was to create an operating system. Considering that this project was well situated in a pandemic context, zoning considerations were taken into account throughout the planning of the space. The prototype explores an operating system (fig 5.1) of three demarcated zones/nodes (A purple zone for individuals, a blue zone for groups of 2, and a yellow zone for families and larger groups) for easy identification and crowd management. The operating system identifies user-to-user, human-to-space, and user-to-stager interactions and allows interlaced conversations between working and space. Thinking through the operating system and spaces' zoning helped identify some potential configurations of communal dining spaces.
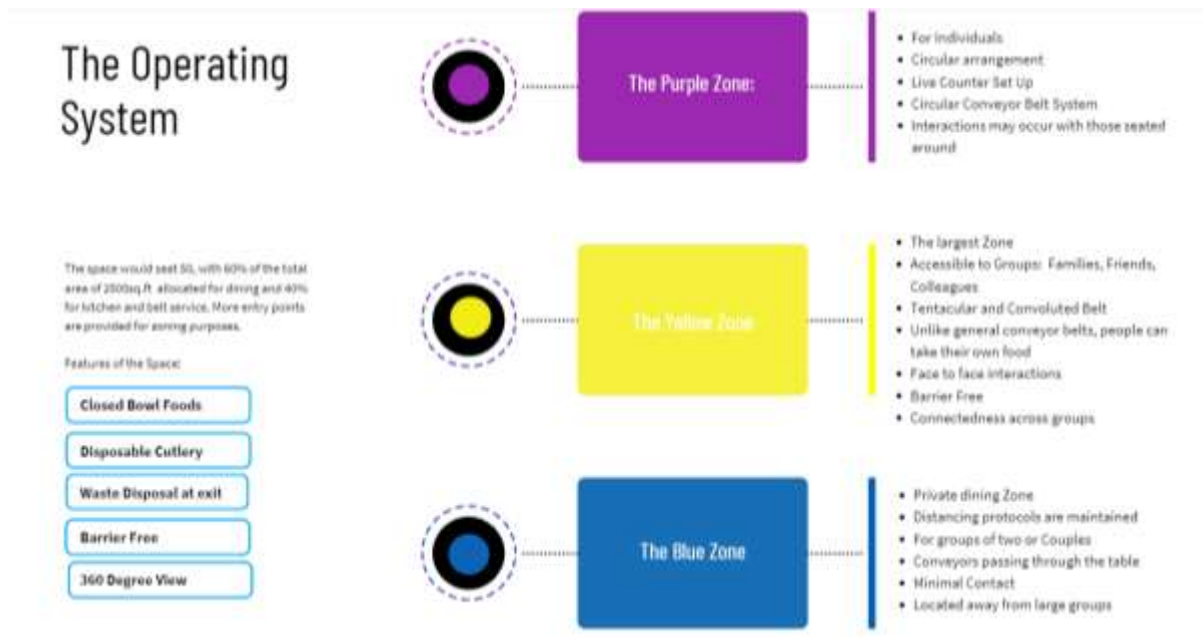
Figure 5.1: The operating system uses zoning and crowd classification for monitored entry and exit

Understanding the logistics of conveyor belts in contactless dining scenarios also resulted in including a conveyor belt within my design. To consider principles of Materiality and Scale, I Initially planned to create a smaller scaled model for my final prototype.

My thought process began by using a simple cultural probe to explore spatial arrangements and seating for the restaurant. The initial probe was an assortment of a magnetic board, pins, and millboard cutouts (fig 5.2). The 3D representation of my thoughts and the process of moving elements around the board helped me analyze how to zoning the space's elements. I was able to generate layouts and physical forms (fig. 5.3). It suggested an ideal scale for my final probe. Also, it helped me realize that building a miniature probe, as I had initially planned, would lack the elevational aspects, material aspects, depth, and fluidity that I wished to convey in my prototype. I analyzed materiality and scale in my design process, placing vs. gluing components onto the board and testing alternative table and belt arrangements. In other words, testing alternative spatial configurations with the probe was explored. I tested different layouts for the tables and belts,

retaining three entry kiosks. It helped analyze if individual dining zones could be brought together to create a holistic group dining system.

Figure 5.2: Exploring cultural probes for spatial visualization

Figure 5.3: Developing the final probe

Figure 5.4: Elements of the final probe

While Testing Alternative table and belt arrangements, I established the final elements of my Probe (fig. 5.4). They needed to be lightweight to stay on the board and enable quick repositioning for the stop motion video.

1. **Tables**: The tables are created with Origami Paper (fig 5.3). The folds in the paper help with the stability of the piece on the whiteboard. They are lightweight and well streamlined to hold the conveyor belts in place.

2. **Conveyor Belts**: The conveyor belts form an integral part of the probe. I used foam paper and fish wire to convey the material aspects of the belt that are stapled across the tables and placed on the board.

3. **Entry Kiosks:** The entry kiosks are placed at the board's edges using laser-cut thermacol.

4. **Chef Station:** The chef station is made using millboard and is color-coded to show how the belts run across the various spatial zones.

Exploring spatial arrangements with these elements resulted in the final probe, a 1:15 scaled model with a 2500sq.ft board was designed to provide dining services for 50 occupants at a given time. The chef station, created with white millboard, performs as a central nucleus and converging point for all the conveyor belts and tables.
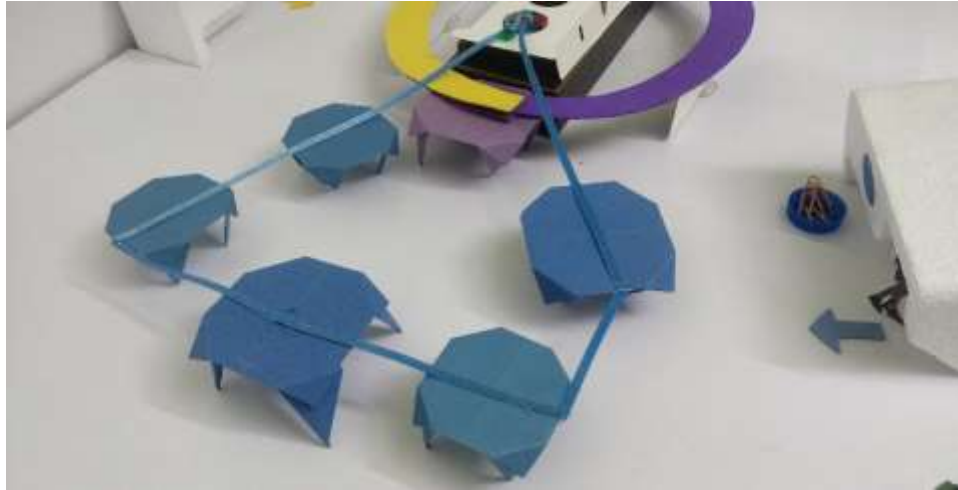
Figure 5.5: Running Conveyor Belt Technology within the Space

Creating a stop motion video prototype added fluidity and new levels of spatial perception that I was looking to achieve. The movement strategies were visualized using renders, and human figures were added into space to show the movement strategies in action (fig 5.6). In the physical artifact, the three conveyor belts have an increased affordance. The belt runs across a large space to minimize users' movement, thereby preventing viral spread. Secondly, the belts allow users to touch and receive their food without relying on a third party, making the system safe and contactless. Hence, the user's interaction with the belt decreases while their interaction with other users increases. The entry and exit points in the model carry a low affordance, as groups of 2 will have to enter and exit through the blue zone and so on.

Figure 5.6: A Snap of the Stop Motion Video

FINDINGS

Documenting the process helped me realize how different my initial process was compared to the final prototype. The process of abductive reasoning generated new ideas and observations for an open-ended discussion with colleagues and faculty members. When viewed from a wider lens or as a part of a larger entity, the space brings a reason of 'being'[25] for essential functions like circulation, spatial flow, and traffic control. The project is a reflection of the uncovered potential of public spaces.

Working with cultural probes in this mini-research project helped me understand the transformation of co-working spaces into multi-purpose spaces. Moreover, this project helped me understand the logistics of a co-dining space. I was interested in understanding how similar spatial retracing can be done for a working space or office context. The project also helped me reflect on the relevance of multi-purpose spaces and shifting spaces. Every use case is different, and a single arrangement may not work for others.

Developing the model and the probe elements helped me understand how cultural probes can help with spatial visualization. My research would address this gap in knowledge of using cultural probes for spatial perception and visualization not just for space but also for systems.

This mini-project is a creation of speculative design when compared to my final research creation. The project uses a single staged space put forward by a designer to see if it could satisfy the needs of multiple users. However, one layout or design may not work for all user groups. Hence in my research creation, I would like to take spatial design practice to a new level where users are encouraged to stage their own space and become designers themselves, with the help of cultural probes and a mobile application. Identifying the juxtaposing concepts of already staged spaces by designers vs. to be staged spaces by users has helped me explore new potentials for my research creation. However, a need exists for flexibility, modularity, and fluidity within space.

The next section discusses a mini-research project that incorporates the 'retrofitting' abilities of space, where interaction design meets space through technological tools.

PROJECT III: RETROFITTING INFORMATION AND COMMUNICATION TECHNOLOGY (ICT) INTO SPACE

Last summer, I explored human mindfulness and interactions with people vs. technological tools. I tried to develop tools for achieving communal sync in informal dining spaces and event spaces. By accommodating ICT (Information and Communication Technology) [77] and various cultural contexts, a new and meaningful techno-social experience is proposed for post-pandemic interactions. The project used technology as a high affordance tool for social interactions and is focused on virtual and exploratory experiences (helping one find themselves and their mindfulness) through altered interior environments. The project also studies human behaviors that take place in a virtual environment using a combination of commands, categories, touch pads, tiles for augmented reality visuals, and buttons to change the indoor temperatures of the space constantly.

My role in this project was to ideate and navigate use cases, explore cultural contexts, create tasks for each use case, and foresee its working by identifying technological tools for each task. In developing these concepts with the help of storytelling, our team could analyze and foresee the various use cases from a multi-disciplinary lens and reach a consensus on what would work best in the selected installation space at the Next Generation Cities Institute (NGCI).
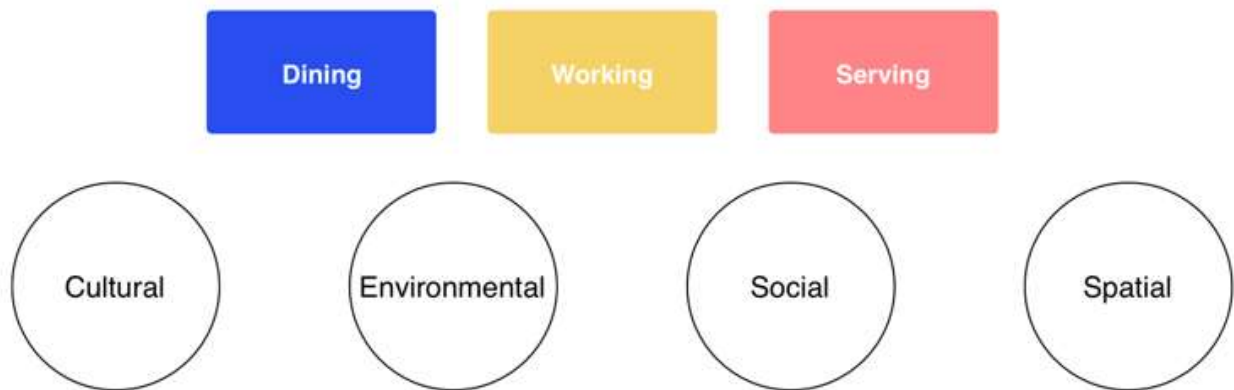
Figure 5.7: The Role of a Table

THE BRAINSTORMING AND IDEATING PROCESS

To begin with, I started exploring various use cases and different cultural contexts for the ICT project. Various ideas were discussed, and a few were shortlisted to expand upon.

A. Surface Level exploration

The brainstorming process began by simply identifying the role of a dining table (fig. 5.7) and how it could be used in various setups to suit various audiences.

1. **Level 1**: Restaurants, homes, and offices for dining purposes

2. **Level 2**: Family gatherings / Friends reunions / Students gathering / Couples/celebrations like birthdays and anniversaries for serving and hosting purposes

3. **Level 3**: Colleagues / Business talks / Kids for studying and working

I began exploring the various problems in a dining setup and how certain surrounding environments could change the behavior of people seated in a physical dining setup. A few cultural dimensions of the model were explored, like Power Distance relationships while dining, Uncertainty Avoidance, Individualism vs. Collectivism, and Masculinity vs. Feminity. Common situations like heated arguments at a dinner table, Dining alone, and accommodating guests were analyzed (fig 5.8). These ideas were broken down and fragmented further to find connecting points between general scenarios and use cases.

Existing problems and solutions		Ideas to Explore
Dining Alone	Problems: • Spaces that don't have a fantastic view • Apartments and studios with less floor space Solutions: • VR • Moving Wallpapers	Temperature, changing backgrounds (3D & 360) • Recreating your old home in your living room • Dining amidst a forest with animals moving around to heighten your senses (• Candlelight dinners in the Sahara Desert • Feasting with Mughals in a palace (past) • Checks the time of the day, type of meal and simulates a virtual environment suitable Eg. Eating a hotdog at a carnival, eating sandwiches by a beach, and having a feast at a palace
	Calling people up (audio calls, video calls, zoom etc) limitations: Time differences, internet issues, clashing schedules, other engagements, lack of feeling and expressing oneself, loneliness arising from the loss of a loved one, gaps in communication	A human simulation to eat with you: • A Guardian/parent/Friend from the past present or future who eats with you • A personal assistant simulation to de-stress you by neatly organising your tasks for the day and narrating it • Mutual understanding and relationship building
	Books, Kindles and personal diaries to read by yourself	• Simulation narrates stories to relax you • A simulation of yourself enacting a page of your personal diary (a memorable event, trip etc) • Fictional characters from books speak to you
	Netflix, Television, YouTube	• Ambient sounds such as the sound of crowds, a Marketplace in your hometown with a visual to make it realistic • Learning things while eating, health and wellness education and cooking tips from Chefs
	Spotify, Music Streaming platforms	• 8D audios and good surround sounds: Resembling a simulation of musicians performing for you at your living room • Artists painting a large canvas in front of you

Figure 5.8: Fragmenting the Use cases

SCENARIOS

After exploring various use cases and evaluating the installation space at the Next Gen Cities Institute (NGCI Kitchen), two were shortlisted that would work well with the space regarding lighting, projection capacity, material, and type of users. The user behavior, technical specifications, tools, and user journeys were mapped for each scenario. A storytelling approach was adopted for the same.

A. Augmented Experience Design and Visuals:

The first scenario focused on the expansion and dimensionality of space using projections, light, and sound. It uses a tile that presents Light vs. Dark themes, lighting and sound presets for the user to choose from. It is intended for private dining and meeting spaces. Incorporating technological tools like sensors and projectors into the space seemed well aligned with post-pandemic interactions involving contactless protocols for dining (fig 5.9). The projector aimed to stimulate mindfulness amongst the Covid-19 chaos and allow users to feel the space with the touch of a button. The themes generated within the space would also help users reminisce experiences lost during the pandemic. Lastly, these tangible technological tools are designed with a purpose to merely aid individual dining experiences through user interactions and not distract users from conversations with fellow individuals or the food they are eating.
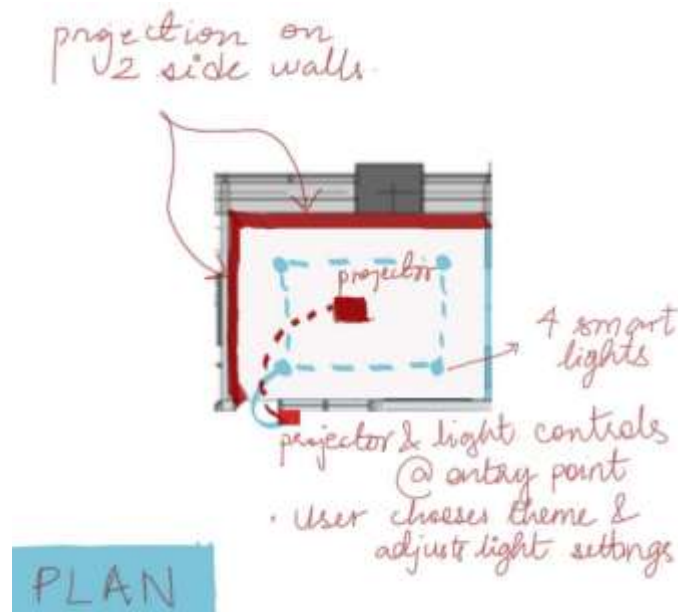
Figure 5.9: Analyzing the dining setup

B. Capturing Group Experiences:

The second scenario uses a mirror TV and a QR code to capture group experiences during a party/dining event. The concept was initially drawn to visualize how the space could function and how the tools could be positioned within the space (fig 5.10).

The scenario is explained using the example of Emily, an event attendee who scans a QR code at the space entrance (fig 5.11). The QR code would register Emily onto a cloud, ask her permission to be photographed. As Emily enters the space and meets a few colleagues, she sees a mirror TV on the wall. A screen mirror on the wall would give them a countdown and allow them to adjust their hair and strike a pose before it clicks the perfect picture. These photos can be downloaded onto their device or shared on social media after the event by scanning a QR code at the space entrance (fig 5.11).

Figure 5.10: The Set-up

SCAN FOR SNAPSHOTS OF YOUR EXPERIENCE

Emily is attending an event. She sees a QR Code scanner at the Entry Point of the event.

She scans the code on her phone.

'Registration Successful, Your photos will be ready after the event ends'
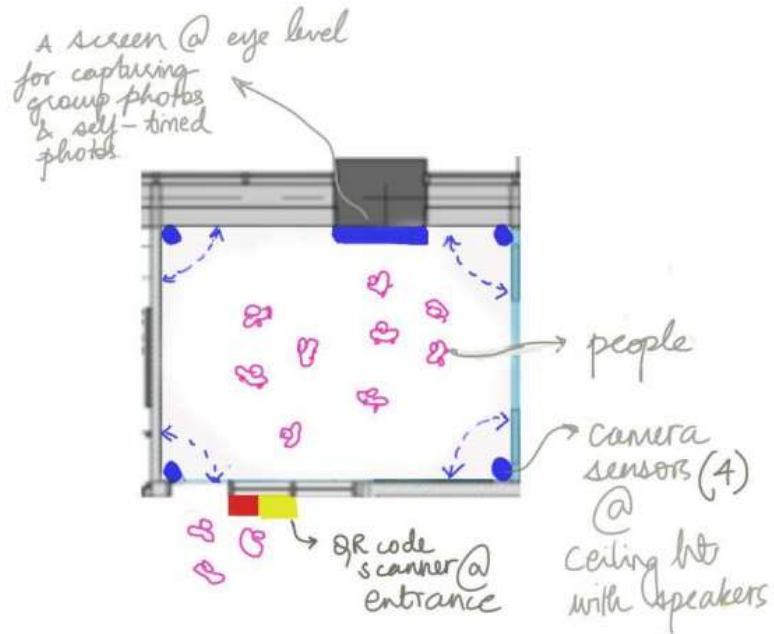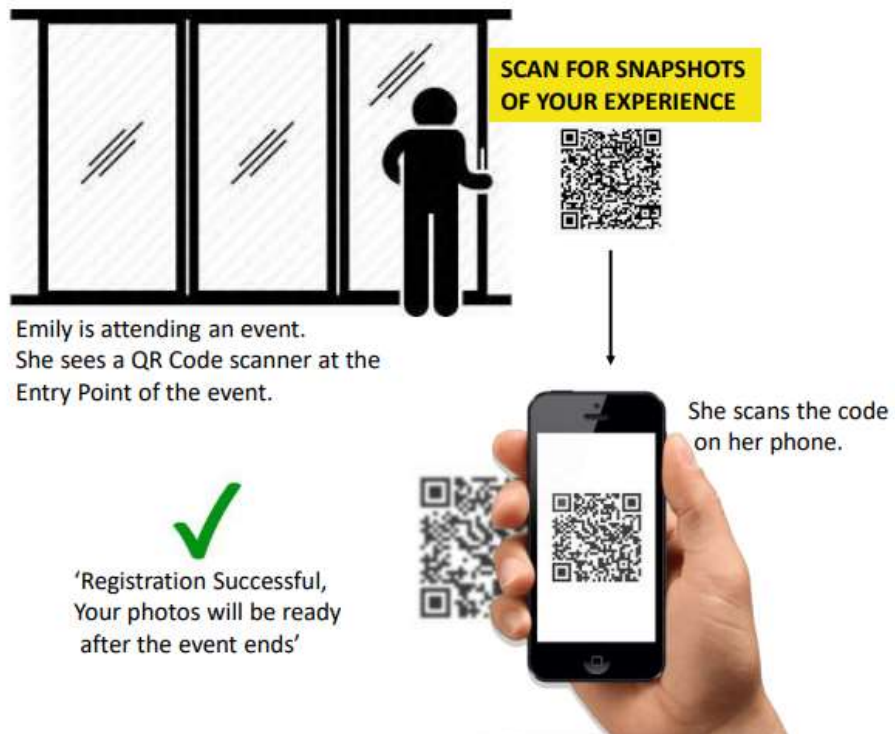
Figure 5.11: QR code at the entrance

Placing the TV at eye level in a party hall seemed a good idea (fig. 5.12) to capture group photos of individuals when it detects people standing around it and then upload them onto a common drive for attendees to view. The TV's photo-taking ability encourages meaningful one-on-one conversations and group discussions with less phubbing. The TV is designed using a selected set of metrics for its intelligence-distinguishing between people standing still vs. talking or moving, proximity to the camera, orientation, and frame-person ratio. When the TV senses a group of people standing in front of it in a stationary position for more than 3 seconds, the camera shutter will click after a countdown of 3 seconds. A self- timer would be activated, followed by a camera shutter click.
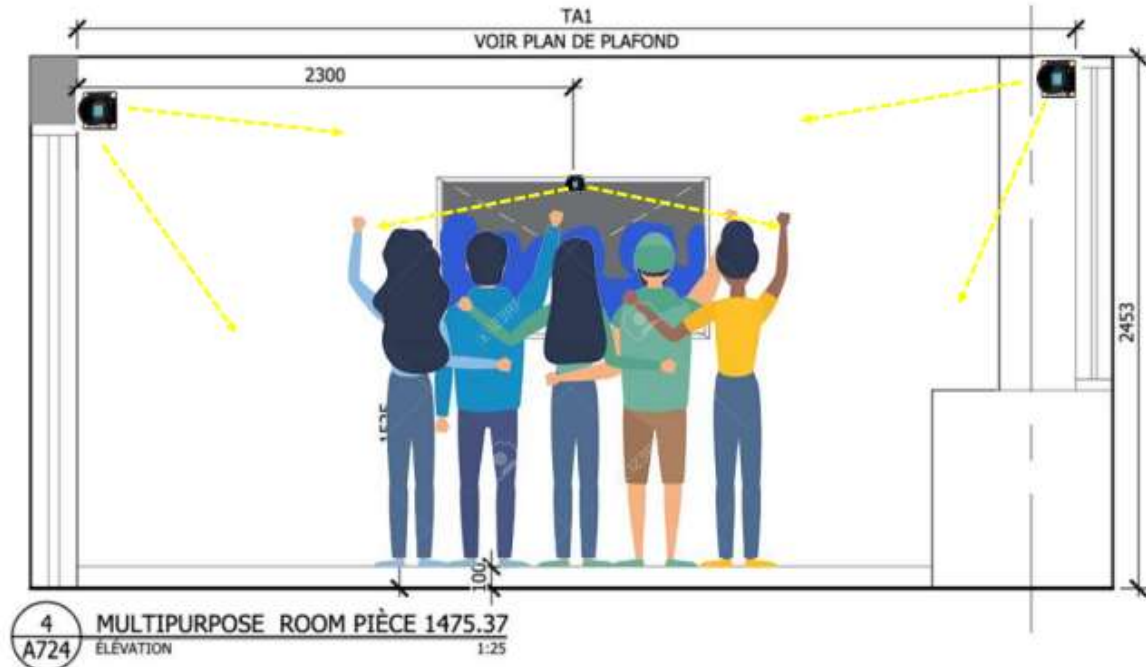
Figure 5.12: Mirror TV within the Space

1. A projector + dimmer + QR code outside the room for seated and standing dining events (the settings are fixed for a span of one to two hours)

2. A projector + dimmer that changes its visuals every time a new person enters.

3. An IoT Toolkit: Table Tiles with distinct functions linked to a mobile Application

   ■ Red Tile: for human actions

   ■ Blue tile: For services (Projecting Functions, camera functions and Light settings)

   ■ Yellow Tile: Feedback (for the simulation, inputs of audio and images)

   ■ Green tile: Clock and Progress Bar

   ■ Purple tile: Safety alerts for excess energy consumption and fire hazards

Figure 5.13: Exploring Combinations and Possibilities

The tools and ICT used for each scenario were later jumbled and mismatched to view permutations and combinations that could potentially work in the space and update the user experience each time (fig. 5.13). Colour coding and assigning separate tiles a function were also discussed.

FINDINGS

The process of rethinking existing dining set-ups and suggesting innovative ways to bring in technology was collaborative and interesting. After presenting the ideas to the rest of the team, we reached a consensus on which idea would work best at the NGCI space, given the resources and time available for the installation. I simultaneously mapped out the pros and cons of each idea from a user and installation perspective (table 5.1).

Table 5.1: Pros and Cons of the analyzed tools

Tools	Features	Pros	Cons
Augmented Experience Design and Visuals	Dimming and brightening the interior space Creating microclimates Projected visuals on walls Background sounds and music	Immersive Experiences A High Mindfulness level Personal Experiences are captured	Requires a Lot of data extraction Quality of the visuals and difficulty in achieving lifelike visuals It can be overly distractive and draw attention away from the eating aspect
Capturing Group Experiences	Documenting the food, music, and people (snapshots, candids, photo bursts, videos)	People can focus on the food in front of them and interact with people around them More social interactions and mindfulness achieved Interpersonal relationship building using memory-making mechanisms	Specific moments may not be captured Bad Camera Angles You can only view the documented photos after the event

In interaction design and architecture, the project's design process helps us navigate a user's experience and their recurrent needs from time to time. This project makes me think that technology could be used as a unique intervention to create experiences never imagined before. The subtlety of the tiles can make it appear almost invisible in a room which I believe can improve human connections and social inclusion around various cultural practices around dining. Moreover, users are learning and unlearning simultaneously, given that they respond around the ICT and do not blindly follow its orders. The participatory aspects of ICT, such as voice, touch, and speech inputs, are very useful as conversation starters, interpersonal skill developers, and a platform for people to express their likes and dislikes freely.

The project also made me wonder what the general public—, specifically students from various cultural contexts who have been regular outdoor diners before, during, and after the pandemic— have to say about their experiences. I prepared a questionnaire and interviewed a few of them during the summer. They also have a fair idea of the current dining restrictions and the changing dining ways across India and Canada.

Although the project captures sensory elements through its tactile and interactive media in the given space, I would like to explore how the space can be made more safe and comfortable before, during, and after entering. A tracker that monitors the number of people in the given space and sets limits for each given hour would be interesting to explore. Auto-generated menus based on food preference are also something that I would like to explore.

In my research, Instead of exploring the existing restaurant and cafés, I wanted to create new experiences for people in a post-pandemic scenario to reimagine the future of work. My project initially revolved around dining experiences for people during the pandemic. Still, recently, its role has shifted towards post-pandemic interactions in an office and how ICT can help redesign working experiences for people who always want to try something new.

CHAPTER 6: DISCUSSION OF RESEARCH CREATION AND RESULTS

PROJECT IV: CREATIVE PRACTICE

THE PHYSICAL TOOLKIT

There is a need for a physical tool to build with that can be participatory and playful for users (fig. 6.1). Moreover, making or building by hand in the design process can be less intimidating and more effective as a learning strategy[72]. The probe is designed keeping the following design objectives in mind— A hands-on, non-verbal narration of spatial needs, blurring the boundaries between work and play, and accommodating customization, hybrid environments, and personalization to suit every user. Based on their configurations, the tool would also test the user's knowledge of scale, proxemics, and spatial allocations.

Figure 6.1: The Final Toolkit on Display

DESIGN PROCESS

The next section entails the ideas, thought processes, and design principles through the creation stages of the physical toolkit, the Mobile application, and the exhibition display. Before developing the final prototype, I began visualizing the possibilities of physical space design tools.

1. **Ideating**: The complete brainstorming process

2. **Prototyping**: Mock-ups for the final design of the toolkit

3. **Feedback**: User Feedback from the 4th Space (Exhibit space)

IDEATING

The first step in developing the probe was to see its potential from a user perspective/standpoint. The brainstorming process began by mapping the user experience from beginning to end using storyboarding (Fig 6.2). As the spatial context for the research creation is offices, we take an example of a potential employee who would use the tool. Kathy, an employee at company X, has a vision for her workspace. She knows that this space need not necessarily be her permanent workstation. However, with a few tasks in mind, Kathy desperately needs a space to work in as the current design of her space is not helping her productivity. With the potential Tool, Kathy can now plan her space and complete her tasks on time.

Figure 6.2: Sketching the Concept

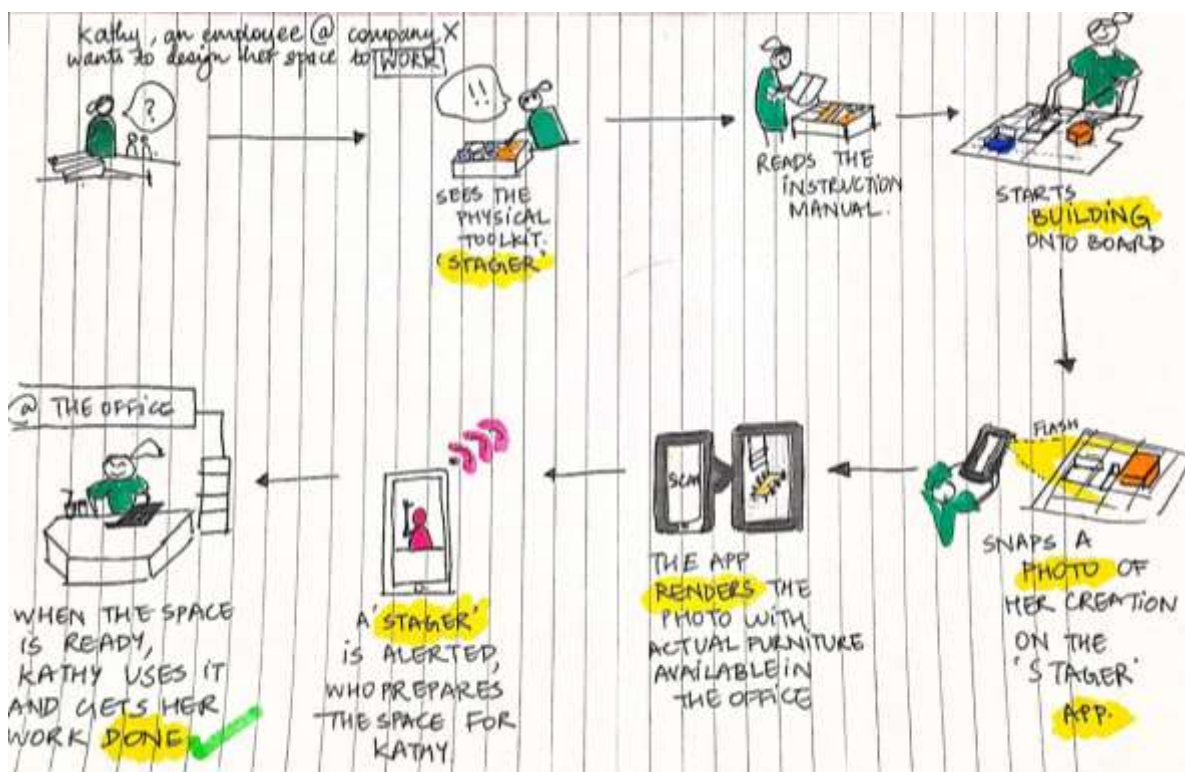In Kathy's example, she opts for a 'studying and quick task' activity, where she wants a stationary piece of furniture; a desk for completing some immediate tasks, and a temporary storage unit for keeping her belongings.

The next step of the design process was to identify more user scenarios and activities to analyze further the type of furniture and equipment needed for each scenario. (table 6.1).

Table 6.1: Activity and Furniture identification for Use-cases

Scenario	Activity	Furniture and equipment
An Employee needs to complete pending work tasks on their to-do list to end the week	Studying & Quick Tasks	Stationery desk, Chair, Charging Points, Storage shelves,
An Intern requires online courses for training purposes in the organisation		Study Table, chairs, Monitors and Charging points
A manager needs to check with their team on updates, targets and progress	Meeting	Meeting tables, Screens, Podium, Sofa, kitchenette
	Planning and Delegation	Long meeting tables, Screens Podium, movable chairs, kitchenette
Teammates need to discuss a new product Launch	Brainstorming	Informal seating, movable chairs and tables, stools,

The table discusses four user scenarios and broadly categorizes them into Activities. Enlisting the use-cases helped identify the type of furniture required for each task. Some activities are more suited to temporary working setups, while others require fixed configurations with little to no furniture in the room. Another conclusion from this categorization was that certain activities such as meetings and conferences might sometimes require additional accessories in the space like podiums and kitchenettes for attendees.

The Story-boarding sketch brought in design insights for furniture and material selections for the probe as well as considerations on fixed vs. movable furniture based on the types of activities (table 6.1). After identifying the user tasks, I could slowly visualize what elements I wanted to include in my probe. This led to developing the probe's components (fig. 6.3). Drawing from existing literature, I began to list the toolkit's components in a textual and visual format to design my cultural probe.
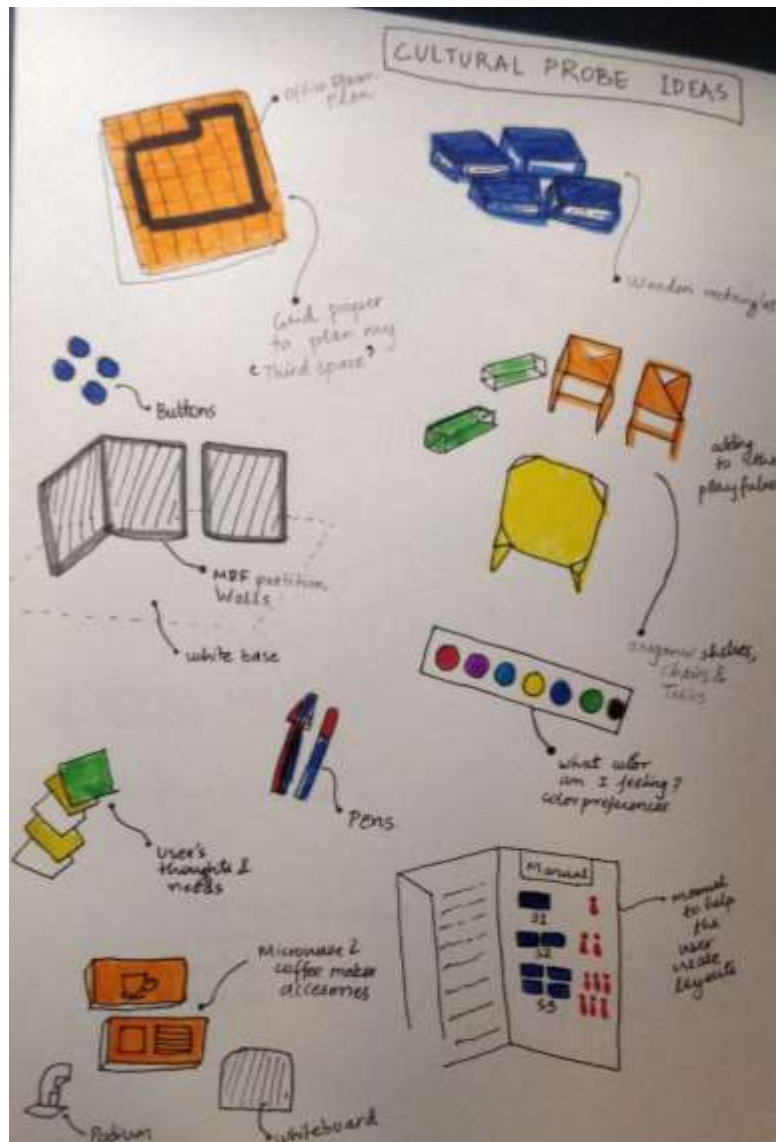

Figure 6.3: Sketching the Elements

I also wanted to provide a board for users to build on, with grid paper that would indicate a boundary within which they can build. Partition walls were also included in the kit to be used as space segregators for more privacy and soundproofing.

PROTOTYPING MOCK-UPS

The first step in the prototyping process was creating simple mock-ups for flexible and fixed furniture. Understanding the elements of the probe and the supplementary tools led to assembling simple mock-ups of the probe to see how the elements can come together for easy assembly, making, and dismantling.

Having worked with the origami paper for Project II, I decided to employ a similar paper folding technique for my research, keeping in mind the flexibilities associated with origami paper. Understanding Origami art was integral in creating more table and chair configurations for my cultural probe. Moreover, origami furniture is indicative of lightweight furniture and movable pieces of furniture that can be constantly shifted within a space for multiple activities.

For the fixed furniture pieces of my probe, the use of wooden blocks was befitting to indicate heavy furniture pieces like tables, screens, or benches within a space that would be fixed (fig 6.4). The wood blocks were machine cut at the Concordia Wood Shop on a scale of 1:10. The standard table measurements of 2ft by 3ft were considered for the blocks. To prototype, I created a total of 25 origami tables, wooden tables, and 20 chairs.

Figure 6.4: Machine cut Wood blocks for the probe

The low fidelity probe included simple everyday materials, some made by hand and some material sourced from CUCCR, a recycling unit at Concordia. I also designed a few low-fidelity

mock-up configurations (fig. 6.5) to see how the pieces were standing and how they could be modified if needed.

Figure 6.5: A low-fidelity mock-up of the prototype
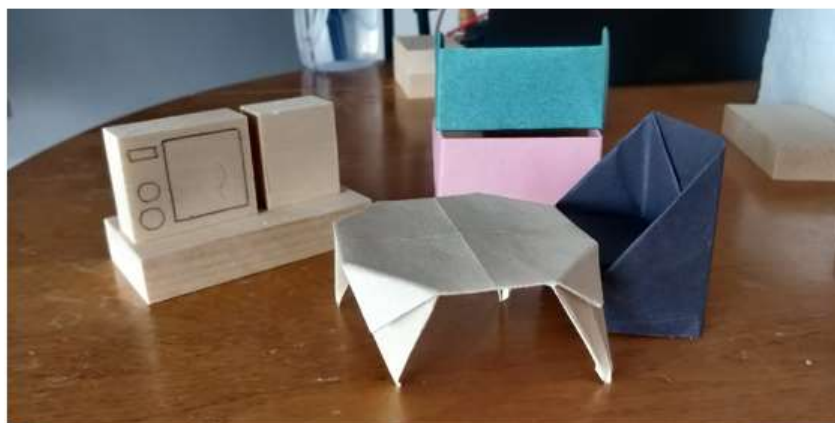
Figure 6.6: ABW Configurations from the low-fidelity mock-ups

I played with the tool and tried to create multiple configurations of study and informal meeting spaces (fig. 6.6). I kept a count of the number of users for each configuration and how they could accommodate themselves in different activities.

. After identifying the furniture pieces and accessories, the next step was identifying supplementary tools for users to draw, plan or write their specifications or recommendations for their space. It led to the development of the user manual and mobile application. For planning their space, a user manual was designed with hand-drawn sketches and sample configurations for new users to be familiar with creating and building their space (fig 6.7).
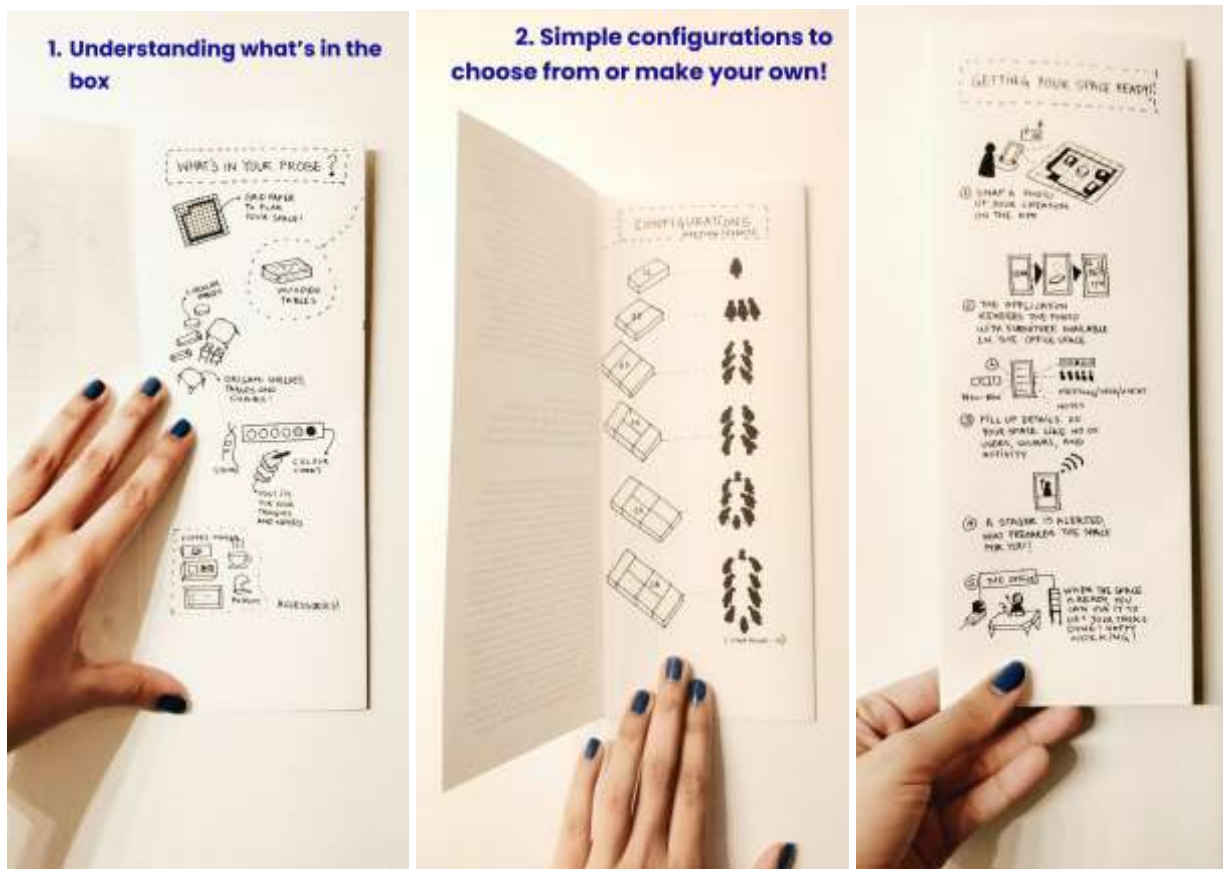
Figure 6.7: User Manual for the probe

The user manual has a general 'what's in the probe' page where users can see the various elements and categories for the building process. The second page shows some sample configurations and the maximum number of users for each of these configurations. The manual helps employees understand how to build, keeping in mind the number of users for their space and the maximum capacities, proxemics[73], etc. It was designed primarily for the physical exhibit and its expected outcomes. However, a digital component was missing; hence, the need for a mobile application was identified to improve the tool's efficiency and allow collaboration. Users could pick an activity for their space and share their designs with teammates and stagers.

PROTOTYPING THE FINAL PROBE AND ITS CONFIGURATIONS

Creating the low-fidelity probe led to conceptualizing the final probe (fig. 6.8) as well as interior arrangements for specific activities (fig 6.9, fig. 6.10).

The main components of my probe are as follows:

The color pad: The color stickers can be placed onto furniture or sticky notes to specify any color schemes or palettes the users want in their space. This process helps users visualize color schemes and aesthetics for their space.

Sticky Notes: Any specifics or additional requirements for the space can be written on the sticky notes provided. E.g., the need for a screen, an extra charging port, or equipment needed for the space. Users can also specify alternatives for certain equipment like tables, chairs, etc.

Accessories: The toolkit includes kitchenette accessories such as a coffee machine and microwave. Additional accessories like podiums, screens, and hooks are available upon request. (if the office premises has them available at the time).

Furniture Components: The furniture elements are created from origami paper and wooden blocks. The origami folds help users flip, create and convert these components into a sofa, table, or chair per the user's needs. They are flexible. The wood blocks indicate more permanent fixtures and can be used as tables, walls, screens, and more!

Figure 6.8: The final Probe and its components

Figure 6.9: Configuration for collaboration and discussion spaces

Figure 6.10: Configuration for studying and quick tasks

FEEDBACK

In the context of the MDes program, all the students' final projects are displayed at a suggested public exhibit space that is also accessible to other students and professors. This year, my project was displayed at the 4th space. The 4th space is an interactive space and exhibit space at Concordia University. I chose to display my probe on a light table provided by the space to have audiences interact with my work. Users can move elements around, interact with the tool, and provide valuable feedback and insight on the future scope of the creation. For sketching, visualization, and specific instructions, a whiteboard, a set of sticky notes, and a pen was added to the list of elements to include in the interactive table. I analyzed some user explorations with my prototype and collected user feedback from the participatory building board (fig 6.11).

For example, considering that most activity-based working configurations accommodate hybrid lifestyles, the presence of ports for charging and internet can be requested for the user's design. Lastly, for choosing interior design themes like complementary colors/furniture colors or color palettes for the space, a set of colored stickers are provided that users can stick onto their furniture blocks to specify their preference. Drawing from other cultural probe designs, the use of color palette stickers, pens, and sticky notes bring personalization and participation with the probe. It encourages employees and users to participate, play with the probe, and experiment with it comfortably. Some of the observations from the interactions is that audiences not only built with the furniture pieces but also wrote onto the light table, which helped their creative thinking process (fig. 6.12). The wooden blocks were moved and used as a stand, a bench, and a divider between blocks.

Figure 6.11: Participatory work table before use
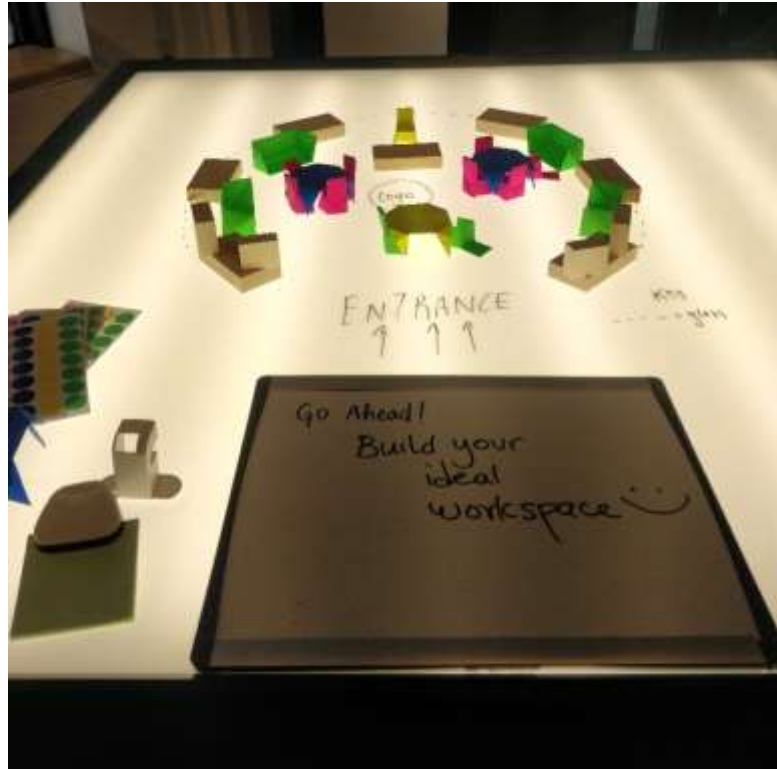
Figure 6.12: Participatory work table after use

I could see some of the configurations audiences could create from the toolkit and how they imagined their workspaces. The configurations created helped me understand the value of the tools and the multi-purpose nature of the tools in the kit. In conclusion, having the toolkit and participatory table on display was insightful as I was able to help users choose themes and configurations for their space to complement their activities and discussions. They could build quick and simple mock-ups that a potential stager could create in a day or two, understand the concepts of scale, occupancy, design, and flexibility through trial and error, and lastly, sketch their work and document them for future reference.

THE MOBILE APPLICATION

To assist the physical prototype, 'Stager,' a mobile application, was designed. The application intends to let users experience the combined potential of a physical toolkit and an app. It allows flexibility of both physical and virtual means of assistance while creating their ideal space. The application forms the basis for the probe to function. The probe on its own would not be enough for the execution of the design to take place. A user would probably need both tools to design. The physical toolkit meant understanding the scale and bringing a hands-on design approach. The mobile application merges the design's functional aspects and allows for activity coordination.

USER CONTEXT

Building and creating the application began with the user context assessment. Considering that this design framework operated within an office context, the users began to be easily identifiable as employees, managers, interns, students, and anyone with access to office premises. Identifying these audiences and their tasks (table 6.2) helped me formulate the affordances for these users.

Table 6.2: Activities and their tasks

Scenario	Activity	Types of Tasks
An Employee needs to complete pending work tasks on their to-do list to end the week	Studying & Quick Tasks	To-do lists, short time-bound tasks, Deadlines, studying and reading, online test preparation, writing tasks
An Intern requires online courses for training purposes in the organization		
A manager needs to check with their team on updates, targets, and progress	Meeting	Target assessment, performance Reviews, informal discussions, employee analysis, and review
	Planning and Delegation	Briefings, New targets, Co-ordination between teams
Teammates need to discuss a new product Launch	Brainstorming	Thinking through ideas, process mapping

The table, like before, discusses four user scenarios and broadly categorizes their task into an activity. The types of tasks are listed for each of the activities. The broad categorizations encourage users to be creative and work around them. Instead of reframing ideas, we are looking at giving users a general idea of what their space can be and then allowing them to build as they go. Moreover, users can have a general idea of their tasks and accordingly pick an activity laying within that task.

The first use case is an employee X, who has pending work tasks and needs to finish these tasks before the end of the week. This scenario would fall under the 'Studying/Quick Task' activity (fig. 6.13), and the employee can tap the 'Studying & Quick Tasks' Button on the mobile Application.
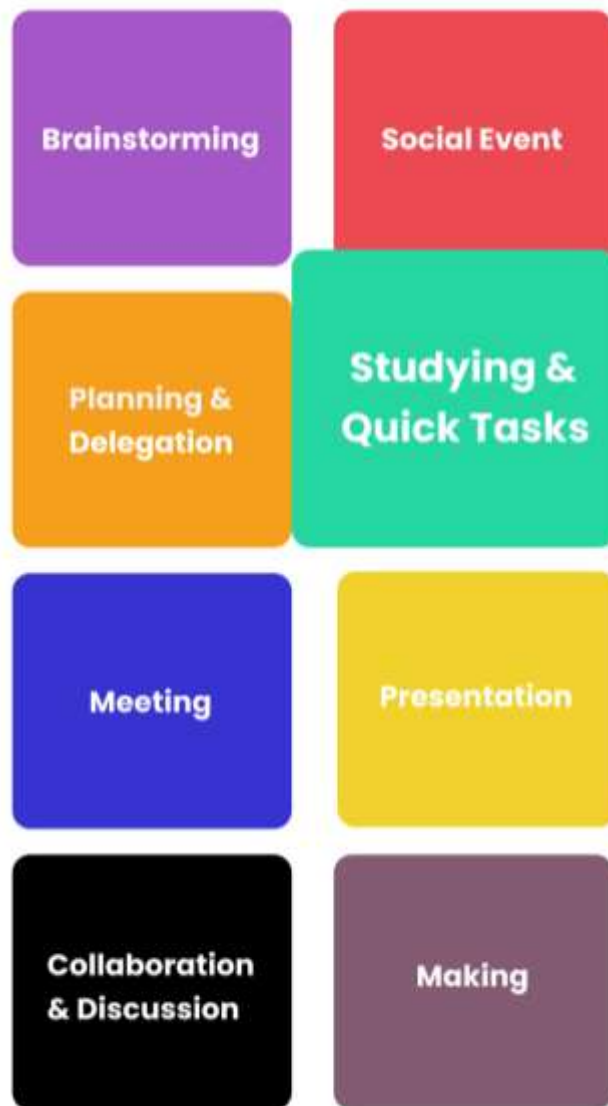

Figure 6.13: Artboard: Activities to choose from before building your space

Drawing from the use-cases of cultural probes for spatial visualization in my methodology and the relevance of some activities in a 21st century office ABW setup [41], I came to understand what activities users would pick. If unsure of the types of tasks, the application would prompt users on the type of task to select. The first activity, Brainstorming, is a creative thinking product of collaboration and evaluation of many ideas[78]. The product of brainstorming is a creative technique or idea that stands out from the rest. Brainstorming is a great way to work together as a team and devise solutions to a problem. Sometimes, managers find it difficult to brainstorm ideas with colleagues due to barriers to creative thinking[78]. These barriers are often physical and can diminish the creative mindset and focus that individuals need to brainstorm. There are many connections between brainstorming and space. [78] Brainstorming sessions are meant to be fun, joyful, instigating laughter and requires a space that has the potential to complement these feelings. The curated spaces can be a combination of formal and informal, but users are encouraged to bring their feelings and thoughts about brainstorming within the space they create for themselves. Moreover, well-designed spaces can loosen up tensions between subordinates and managers.

Similarly, as per the existing use cases in Chapter 3, which discusses a probe's physical use cases, I have tried to recreate these activities onto the mobile application, where users can choose from these activities to design their space accordingly. Moreover, the framework ensures that all employees would be given a compact physical toolkit to build from home and can snap their space while they plan their activities and tasks. The application ensures that users can build and learn from others too.

Analyzing the user context, theories and observations helped me understand the application's motivations concerning design principles and the interface design itself. The next section discusses these concepts that were important guides in the creation process.

DESIGN PRINCIPLES

1. *Ease of use*: The application would be installed on smartphones, and users can immediately start planning their spatial needs. I wanted the interface to be simple, with clear communication channels and instructions on getting started on a project. I wanted the planning process to be easy to follow for all users.

2. *Flexibility of Space and Time*: The application would need to be flexible and accommodate the hybrid working styles of many employees. A thousand employees from various organizations would be able to build simultaneously at various locations. Hence, users would need to be given the option of building at their convenience, from their home/office.

3. *Participatory Design*: The application is participatory, wherein users can create and share their designs with colleagues. They can also share feedback on their previous design processes and collaborate with a stager. The application has a high affordance for duplicating and repurposing designs of others. It encourages users to be creative and makes the design process more fulfilling, fun, and participatory.

APPLICATION SCREENS

The interface design was intended to be simple and easily navigable for users, using a tutorial method to inform users about the contents and possibilities of the physical probe. A white interface with blue prompts has been used in the application, and the same design language continues throughout the app. The first screen allows users to enter their details; their name, employee email ID (for verification purposes), password, current role in the organization, and their office location. This protocol helps us understand where the user is located and analyze their needs based on their allocated role in the organization. These are the preliminary requirements of the application to maintain a tab of the employee identities.

The home screen is the focal point of the application flow. It has sample options for users to scroll through before they create their design. The home screen (fig. 6.14) resembles a newsfeed, where users can scroll through the most recent designs of their colleagues, such as meeting room designs, brainstorming rooms, study rooms, and more. The '+' icon indicates that users can begin a new project. When clicked, the icon navigates users towards a new page where they can begin a new project for designing their ideal space.
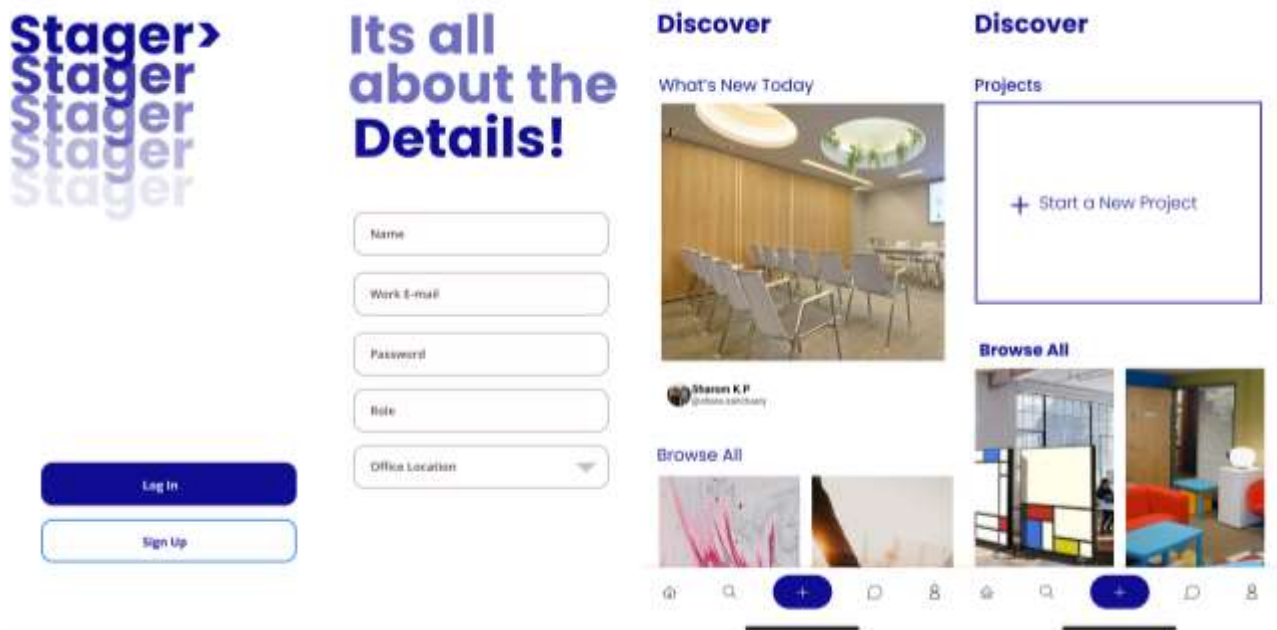
Figure 6.14: Login/ Sign Up Screen and Home Screen

Users can either choose to replicate a colleague's configuration or start their project from scratch. The app only allows users to design one configuration at a time. If a user likes a design by a colleague, they can duplicate the design for their own space (fig 6.15). The duplication process is intentional as it helps similar learners and designers create spaces that work for them.

Everyone has different learning styles, and the method of duplication can help certain users quickly gain inspiration and experiment as they work.

Based on the type or category of space that users are looking for, they can duplicate designs. The figure below shows how users can duplicate a design in the 'studying and quick tasks' category. Viewing a colleague's experience post designing and their additional recommendations helps other users make informed decisions on replication of designs. The application provides a user affordance for these actions as it accommodates scenarios where users don't have time to preplan their space or need a quick setup.
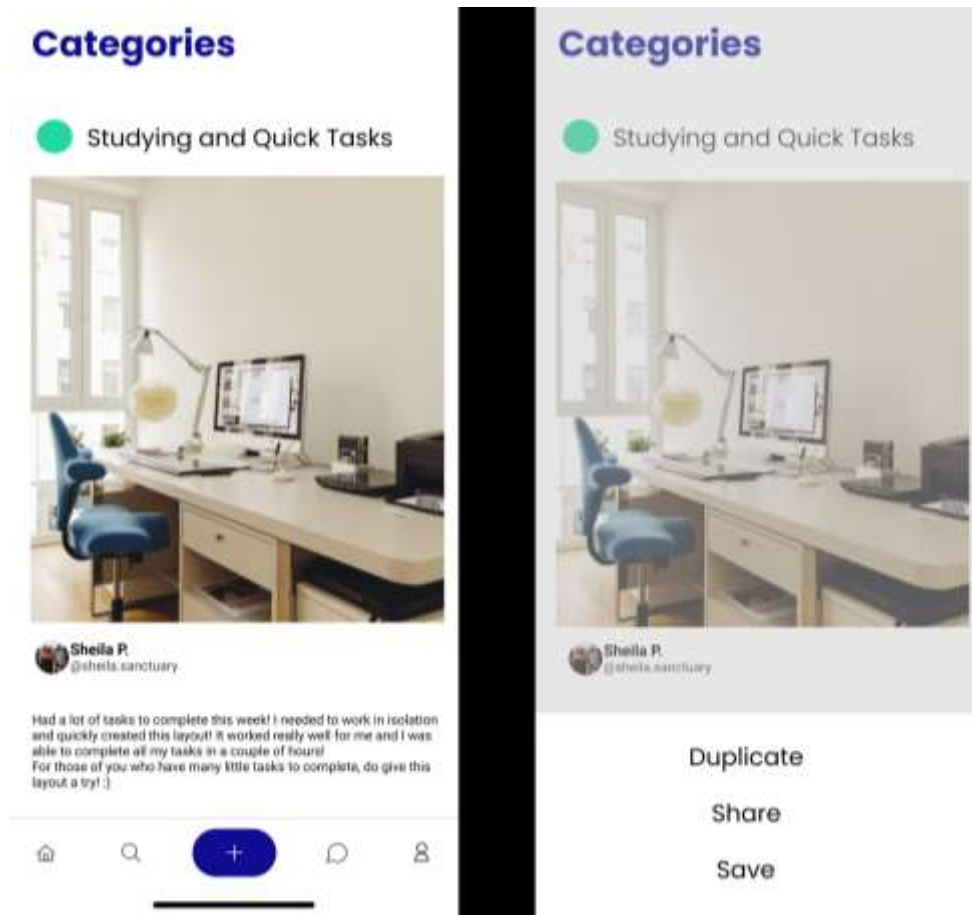
Figure 6.15: Categorization and Duplication

The first step of the designing process is choosing an activity or a task that the user wishes to complete (fig 6.16). The interface allows users to hover and choose the activity of their choice—Brainstorming, Social Events, Planning and Delegation, Studying and Quick tasks, Meetings, Presentations, Collaboration and Discussion, and Making activities.

The second step of the tutorial introduces the components of the physical toolkit (fig. 6.17). Each employee is given this physical probe and asked to build with it with the help of the mobile application. The toolkit's components are illustrated, and each element's possibilities are explained as the user hovers over the elements. These are the same elements as that of the physical probe.

In step 3, users can snap a photo of their creation in portrait mode (fig. 6.18) using their phone camera. With the Physical Probe provided, users can now begin to play and build their space. The mock up space seen below (fig 6.18) is a 'Collaboration and Discussion' space with a formal and informal working space.

Figure 6.16. Pick an Activity App Screen

Figure 6.17: Build your space

Figure 6.18: Step 3 Snaps A Photo of your design

The application scans the image into a 3D rendering of what the space would look like at the actual office. The digital prototype tries to accommodate some of the more recent digital tools for visualization like AR and VR. The rendering feature on the application helps users scan the space in a 360 camera view, view the furniture, and shift the position of certain elements within the space. Users can enter a 360 camera viewpoint to see their rendered space and add or eliminate elements that they don't want (fig. 6.19). Once they are happy with the design, they can click 'done' and enter Step 4 of the design process where they enter specifications for their space (fig. 6.20).

The specifications are an important input from the users as they determine the extent of customization and personalization they want for their space. It is the last but most crucial part of the design process. The application requests users to primarily enter the number of people their design can sustain. In today's post-pandemic context, this is an important step in identifying the maximum capacity for the space when designing group and event spaces. As the platform enables users to build ahead of time, they are asked to schedule a date to use the space. It can be a day, two days, or more from the date of their creation.

Figure 6.19: 3D rendering of your design

Figure 6.20: Specifications of a User's Design

Moreover, the duration specifics are also requested as the space is multi-purpose and would be dismantled after use for others to create within the same space. In some circumstances, users can request a possibility of extension of their designed space for an extra day or two. Some exceptions include the possibility of events, workshops, or group meetings, where tasks may not be completed in a single sitting. These specifications are an important step in the design process for the system to understand user needs and for a Stager appointed by a company to fulfill these needs. A stager comes into the design system to execute the employee's ideas.

Fig. 6.21 explains the role of the stager. A stager is a person who is well accustomed to designing or curating spaces for temporary use. The application will allow stagers to see and assess the designs of the employees and then go ahead with designing their space. Users can be allowed to participate in their spatial design. Moving furniture can be difficult for employees, so stagers are appointed to help stage the furniture and components of the space. The specifications are instructions, important for the stager as they can coordinate activities with the user on the app's chat feature (fig 6.21). Once employees build their design and post it, it is the stager's responsibility to see how the design can work for the user, make adjustments, and suggest alternatives when there are limitations to the availability of furniture, color swatches, etc. Also, since the employee has to prepare their agendas and work tasks, the stager is appointed to follow through with the user's design. In the physical space, the stager would manually move around furniture and ready the space for the employee.
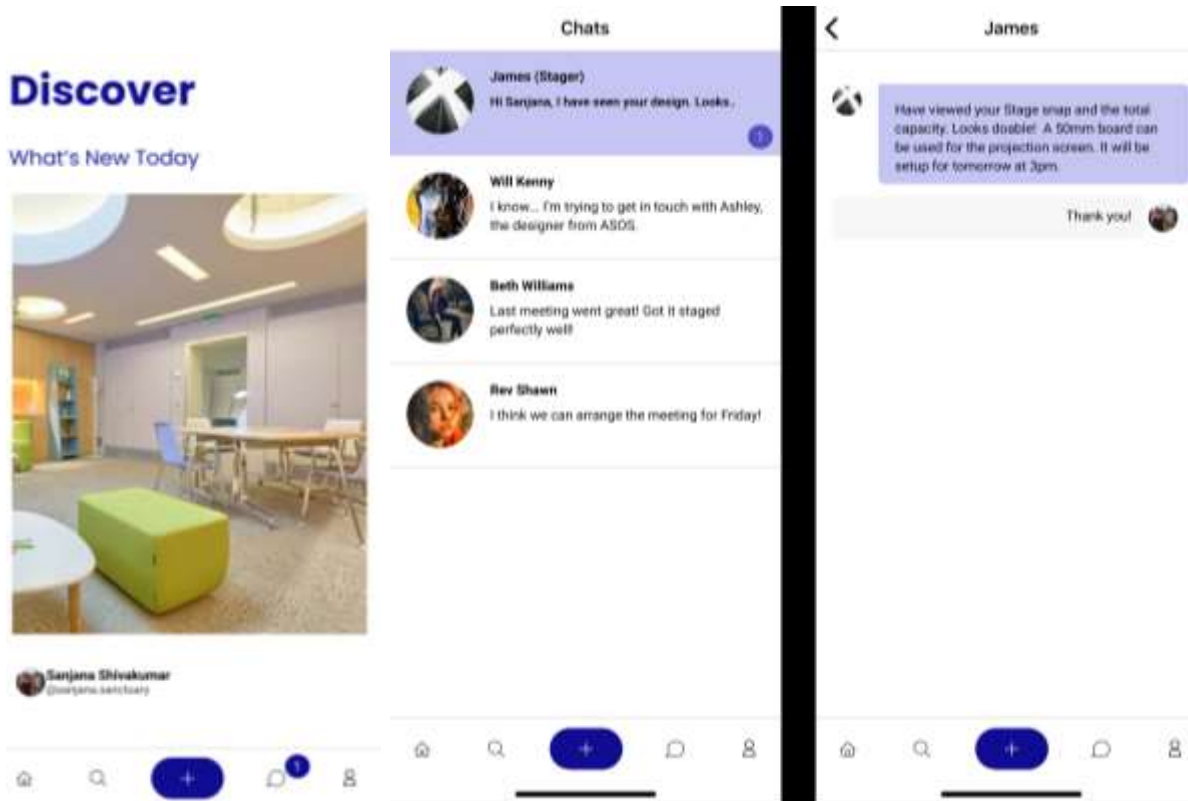
Figure 6.21: Chat Option for coordination with Stager

The repetitive cycle encourages users to become more productive and have fun as they keep working. The application allows users to constantly design and develop their ideas with the stager's help and put together ideas they couldn't imagine earlier. This exercise can help users expand their understanding of space, proxemics, color theories, aesthetics, and most importantly, see what works for them through trial and testing. The probe gives users options to either build in person at the office or design from home and then meet in person.

As every project has a timeline, users are asked to dismantle their work once they finish creating their space on the application. The application archives their work if they want to revisit or view it at a later time. Once dismantled, users can start a new project, and the cycle continues.

The mobile application acts as a guide for users to build, snap a photo of their creation and keep trying and testing out new configurations. It is a way for users to see the spaces that can accommodate their tasks and improve by building new spaces over time. Users can also recreate a space by looking at other colleagues' designs. With employees simultaneously designing spaces, the relevance of such a tool is brought to light. A new community of design practice is formed, and our ways of living and working are changed forever.

DISCUSSION OF RESULTS

Analyzing the projects helped me rethink the theoretical frameworks discussed in my literature review. The three mini-research projects and my research creation incorporate my theoretical frameworks, as seen in the table below. Each project considers some of the theories discussed in chapter 2.

Table 6.3: Theoretical Frameworks adopted in Projects

Theoretical Frameworks	Project I Case Study	Project II Mini Research	Project III Mini Research	Project IV Research Creation
Situatedness and Space	✓		✓	✓
Biological Ontologies		✓		✓
Network Theories		✓		✓
Aesthetic Experiences	✓		✓	✓
Mechanisms of Affordance	✓	✓		✓
Emergences		✓	✓	✓

PROJECT I

In Project I, a mall case study was conducted using users' real-time observations to propose a new public intervention for social distancing. The design aimed to bridge the gap between a user's and designer's thinking. The observational study incorporates theories of situatedness and space, where real-time interactions within the mall are monitored. The elimination of physical barriers in a space is also a principle discussed within the theory of situatedness and space. The case study adopts a similar barrier-free design approach for suggesting simple and engaging public interventions.

The proposed design suggests ways of using retrofit signboards and automation to communicate the idea of 'play' with light and sound, allowing audiences to have varying aesthetic experiences each time they pass through the mall.

Lastly, the design draws from mechanisms of affordance, giving users varied affordances through visual communication ques in the mall. Both the existing signboards as well as the proposed signboards have varied affordances.

PROJECT II

Project II was mini research that proposed a new system and spatial arrangement for dining spaces. It draws on existing theories to know the possibilities of bridging the gap between safety and social connect in communal dining areas. The project addressed a few main questions with close reference to these theories:

How can biomimicry shape an antivirus dining environment? How can biological ontologies bridge the gap between safety and social connect in communal dining areas?

The theory of 'making-with' by Donna J. Haraway, explores connections between human and non-human elements and how their co-existence within a space can lead to a balanced tentacular system of systems. In my design, I have tried to explore the physicality of the theory and the tentacular framework as a functional operating system. Creating connected nodes, inspired by an organism's structural skeleton and nucleus seemed relevant for this project, considering a controlled environment with regulated entry and exit points[29]. By designing organically, we can identify constraints in the built environment and derive meanings from 'form follows function' perspectives through the resilience of natural systems[29]. Thinking through different configurations of communal spaces and the logistics of conveyor belts resulted in a 1:15 scaled model of 2500sq.ft that could cater to 50 occupants at a given time. The chef station performs as a central nucleus and converging point for all the conveyor belts. The prototype explores an operating system of three demarcated zones/nodes (A purple zone for individuals, a blue zone for groups of 2 and a yellow zone for families and larger groups) for easy identification and crowd management.

Can the movement of people be minimized by increasing the affordance of the conveyor belt? 4. Who Touches what?

Tom H. Fishers text 'What We Touch, Touches Us'[35]suggests that we do not perceive the function of things in the abstract by itemizing their particular qualities, but we perceive their "affordance"—what they particularly allow us to do[35]." The built environment- a large system─ consists of smaller spaces or systems containing objects of varied affordances. Moreover, the awareness of an object/entity's affordance leads to a consensus between the user and object followed by a decision on whether they wish to continue to use the product. An object's affordance can increase or decrease their interactivity with it. In the physical artefact, the 3 conveyor belts have an increased affordance. The belt runs across a large space to minimize the movement of users, thereby preventing viral spread. Secondly, the belts allow users to touch and receive their own food without having to rely on a third party, making the system safe and contactless. Hence, the user's interaction with the belt decreases, while their interaction with other users increase. The entry and exit points in the model carry a low affordance, as groups of 2 will have to enter and exit through the blue zone and so on.

Elimination of physical barriers already puts pressure on maintaining an antivirus environment. This means that the sensors' entry and exit points would need a low affordance. The conveyor belts would need to have a low affordance to ensure safe contactless arrival of food at respective tables. The smart phone application however, would carry a higher affordance encouraging users to choose their meal, eat at their preferred table, and leave with minimal movement.

How can the outcomes of interacting with the space be measured? How can user groups maintain distancing while being connected?

Bruno Latour's actor-network theory emphasizes the main resources for overcoming obstacles in vast systems and networks. Primarily, linking systems to nature leads to ecological literacy and eco-evolution with a space. The second principle is to promote sociality and cooperation through community building and weaving together of various social fabrics. A thorough analysis of social contexts and socio-cultural assumptions may result in a well executed systems framework. The third one is to allow actors and participants to exercise their choices and use reflection-

action as an explorative way to convey meaning from their selected actions [7]. Considering that my project requires restrictive yet relaxed elements simultaneously, zoning and color-coded floor graphics on the mock-up created a controlled environment. The belt arrangements were decided based on the cultural contexts, behavior patterns, and habits of users entering the space.

An Emergence is an idea or a process of co-creation that brings with it new complexities and introspection of existing theoretical frameworks[38]. The project incorporates the theory of 'making-with' by Donna J. Haraway[29][28], exploring biological ontologies connections between human and non-human elements and how their co-existence within a space can lead to a balanced tentacular emergence of systems. The operating system identifies human-to-human, human-to-belt and human-to-chef interactions and allows interlaced conversations between a family dining around one convoluted belt and a family dining at another. The proposed dining arrangement is also a result of abductive reasoning from gathered observations of various layouts, shapes, forms and materials. I have also tried to adopt a multidisciplinary approach that combines colour theories and gamification aspects of interaction design as well as architectural design strategies of zoning, scale and form.

PROJECT III

Project III was a mini research project that discusses the use of participatory tools for amplifying spatial experiences. . It attempts to reduce screen engagement within a space and allow for more personal interactions to follow. The project is focused on virtual and exploratory aesthetic experiences (helping one find themselves and their mindfulness) through altered interior environments and the presence of physical entities and simulations. The use of ICT helped achieve mindfulness, a state where users are attentive to interactions around them and their surrounding environments.

PROJECT IV

Project IV is the final research creation that draws from all the 3 mini-research projects and creates a hybrid tool for planning and building one's ideal workspace.

In this study, I would like to use principles of materiality, minimalism, and empathic design using an participatory toolkit to make spatial experiences more engaging and reflective for users. The toolkit comprises a blank grid on which users can demarcate their boundaries. The other elements like furniture blocks and tables can be placed onto the grid based on the activity/task the user has to complete. The more configurations the user can build for themselves, the more familiar they become with the tool, bringing a feeling of situatedness by knowing what works for them. In my research, users are asked to visualize a workspace from scratch. I link 'nothingness' here as a blank canvas for users to freely design with and construct the spaces that best suit their immediate work needs. This model contrasts already built environments that users are made to work with. The model disregards the traditional, predictive ways of designing for users and instead asks users to see what works for them by building their space. And this space can be created repeatedly to show its physicality for flexibility.

I also explored the scalability of the kit for multiple employees in an office space to see the '*tentacular*' nature of their designs to form a community of practice. Our learnings from the pandemic also helped me understand the importance of hybrid working and inclusivity in organizations; hence, I wanted to include these as design principles in my project. Creating a mobile application helps users communicate their ideas when they may not be physically present in a workspace.

In my research, biological ontologies hold relevance as they help users see a space in so many ways that their ways of thinking become organic. By thinking through various configurations, a new concept of Fluidity exists (Fluidity of form in particular). The furniture elements of the kit can be repurposed and placed differently. For example, many rectangles can be fixed together to form a square, or the same rectangular components can be arranged in non-linear configurations to allow movement through the space rather than around the space. There is a potential for creating multiple configurations using the same kit over and over again that creates a new community/ecosystem of spatial design. Moreover, users can broaden their imagination by blurring the boundaries between work, play, and activity. The possibilities are endless.

In my research creation project, the actor-network theory holds significance with the toolkit that allows actors; users to play, create and work with their hands. The tools and the space are the medium for designing, while the employees and stager are the actors in the system, responsible for using the medium and bringing their thoughts into action.

Every tool needs to have an affordance; hence, this cultural probe has a certain affordance. Users are given ready-made origami pieces instead of a sheet of origami paper. This project considers that not every user is aware of origami techniques, and teaching folding techniques is not the project's aim. It is more of a time-saving way of building space with the office's furniture. Hence it becomes important for the very design to have boundaries for its users. These are some of the limitations of the kit so that the rest of the system, like the stagers and the application, can recognize the user's creation. It can't be very random as the application has to recognize the furniture and see if the same furniture would be available at the workplace.

The exhibition design was a pre-final component to my Masters Thesis, where I attempted to rearticulate theories of space, aesthetic experiences and phenomenology in my exhibition display. My exhibition strategy was to draw audiences towards the possibility of a new design process and practice in modern workplaces. I tried to make my exhibit elements as tangible and interactive as possible to gather maximum feedback. I was able to understand the way users interacted with all my prototypes.

This display strategy aimed to encourage audiences to visualize space and aesthetics and see the playfulness of the toolkit through colorful visual cues. A physical manual and looped stop motion video accompany the prototype to encourage users further to see the possibilities of what they can create for their ideal space. After gathering user feedback on my display, the correlation between aesthetics and interior design was well established. The display was easy to navigate and communicated the playfulness that was intended.

The emergences discovered in this thesis are the multipurpose capability of space, elevated hybrid working experiences, and the potential of collective re-use of spatial visualization tools for designing. The research aims to combine the playfulness of a physical probe and the

convenience of a mobile application with helping users make informed decisions and learn through their reflections of space. I want to think of my research creation as an emergence that combines the power of physical and virtual tools for designing and building. It brings possibilities and fresh configurations for living and working as well as complexities in the world of design and community practice. All the above-discussed projects encourage a new way of living and a new design practice for hybrid living and working.

CHAPTER 7: CONCLUSION AND REFLECTIONS

To summarize, analysing the mini-research projects helped me articulate my thesis and frame my research question. All the projects discussed in this thesis explore the impact of participatory design and tools to enhance the user experience. In all projects, the users' involvement and input takes precedence in the design process and spatial designs are proposed and analysed. Most importantly, the projects identify input tools like probes to improve and influence the ways users think through space, while encouraging users to be designers in a hybrid world.

Both my walking experience as an end-user as well as other users' experiences within the mall laid the foundation for Project I. The study gathered public expectations from live participants and explored some of the gaps in existing social distancing signs and designs laid out along the mall. The project adopted a participatory approach as users were asked to walk around the space and interact with the signs laid out in front of them. Their interactions were observed and analysed. The study encouraged users to share their needs in public spaces, suggestions and expectations (ways to improve the public experience in the mall, preferences, and redesigning spaces). Navigation strategies, new interventions and protocols were also discussed. Staying within the mall throughout the study was necessary for better visualisation, documentation and photo capturing of the space to correct or suggest design improvements. Project II explores how flexible probes inspired by biomimicry can shape a new dining environment. To follow the concept of 'making with [28]' and to see how free flowing forms inspired by biomimicry could influence the designs users come up with, a participatory approach was adopted here as well. Participants were given a set of everyday objects, stationery and sheets of paper and asked to create furniture pieces and spatial arrangements for their ideal dining space. Giving them a set of pre-made pieces and plain paper to create their own pieces resulted in a lot of new insights from the participants such as repurposing tables for different activities, origami folding techniques and how combining pre-made components with origami pieces could bring in a new dynamic to public dining spaces. The project was intended as an experiment to see how users can play with probes and the possibilities that it brings with the understanding of space and furniture. It also brought about reflections on what furniture pieces users like as well as what tools they would need to create with. This project helped me understand the logistics of a co-dining space to retrace the steps for a working space or office context. Project III explores how the integration of digital tools into group spaces can enhance the user experience and collaborative capacity of space. The project was a simple exploration of participatory tools like Webcams, QR codes and Photo-capture TV's to enable participation and create a more fun atmosphere for users. This project was very helpful in identifying potential elements for Project IV, my final research creation and how a mobile application could emerge as an agent[37] for user behavior.

The research creation stemming from these projects enables the chosen theories. The first theory of situatedness and embodiment that discusses the conceived, lived and perceived space is reflected in the project as the designed tool produces and reproduces new spaces. It is not just an activity of drawing from one's situatedness, but it also helps users visualize spaces in new ways that their ways of thinking start becoming organic. The study uses principles of materiality, minimalism, and empathic design through a participatory tool that makes spatial experiences more engaging and reflective for users. The mobile application further helps users reflect on their situatedness, and build their vision as they create their own space of comfort and familiarity. The

more configurations the user can build for themselves, the more familiar they become with the tool, bringing a feeling of situatedness by knowing what works for them. The space can be created repeatedly to show its scope for flexibility. The project also draws from biological ontologies. There is a potential for creating multiple configurations that creates a new community/ecosystem of spatial design. Moreover, users can broaden their imagination by blurring the boundaries between work, play, and activity. The project explores ABW, with many possible configurations for brainstorming, meeting, and collaboration. The 'staged' space would be created by an employee and assembled by a stager, with access to members of an organization. The actor-network theory holds significance with the toolkit that allows the space, application, stager and employees to co-exist and build together. Every design must set boundaries for its users. The research creation also sets limitations for each user such as only designing one space at a time so stagers on the app can recognize and balance user needs. The application has to recognize selected furniture and see if the same furniture would be available at the workplace. The research discusses the use of agencies to alter user behaviors and also alter the dynamics of the entire system. The mobile application serves as an agent in my design. The individual toolkit elements afford all types of users and employees at office spaces. For example, the wooden components of my toolkit are fixed pieces whose position can't change once assembled as they hold sockets and electric fixtures. The origami elements and the paper elements are movable and can be changed and configured differently for each activity. Hence each component's affordance is measured by the extent of user play and design. The mobile application too has varied affordances for each of its features. Users may not be able to build multiple projects simultaneously. If they wish to start a new project, they would need to dismantle their current project with the dismantle option on the home screen. They have a high affordance to duplicate other designs when their tasks are time bound. They can also move and replace furniture pieces on the mobile application. The research creation has also lead to other emergences like multipurpose capability of space, elevated hybrid working experiences, and the potential of collective re-use of spatial visualization tools for designing.

Moving forward, I would like to see my research creation as an emergence that combines the power of physical and virtual tools for designing and building. I would like to test my tool with users. I am specifically looking at companies as well as some professors at Concordia who require different spatial configurations for their lectures. Design classes and studio classes are also participatory and hence users might adopt the use of this tool for a similar participatory approach to build with. It brings in possibilities of fresh configurations for living and working. I would also like to investigate how furniture companies can perform as stagers in the system to provide new furniture components in the kit for larger spatial designs and more color swatches to choose from, both on the application and the probe. Moving physical furniture in a single space is easy, but when more users join the platform, there would need to be more available office spaces and more furniture to store. Hence the tool could first be tested within offices and universities that already adopt the use of modular furniture and have adequate storage space.

The toolkit is not just a pragmatic approach to design but also intended as a reflective practice that can help users see their creations and adapt to their changing daily environments over time. I understand that this tool may not satisfy every user's needs or preference, but it is a vision that I would like to put forward and test in different offices in the future. As a designer, conducting these mini experiments can reflect understanding the deeper meanings of space, time, context, location, and use. Spaces have much to offer if supported and construed using the right tools. I

am happy that this Masters gave me the opportunity to immerse myself in my research and collaborate with my colleagues and professors. It has been very fulfilling to see my supervisor support me and see all the elements of my project come together.

REFERENCES

WORKS CITED

[1]   M. Jayaweera, H. Perera, B. Gunawardana, and J. Manatunge, "Transmission of COVID-19 virus by droplets and aerosols: A critical review on the unresolved dichotomy," *Environ. Res.*, vol. 188, no. May, p. 109819, 2020.

[2]   N. A. Megahed and E. M. Ghoneim, "Antivirus-built environment: Lessons learned from Covid-19 pandemic," *Sustain. Cities Soc.*, vol. 61, no. May, p. 102350, 2020.

[3]   World Health Organization, "Q&A on coronaviruses (COVID-19)," *World Health Organization*, 2020. [Online]. Available: https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/q-a-coronaviruses. [Accessed: 12-Jun-2020].

[4]   E.-A. Kim, "Social Distancing and Public Health Guidelines at Workplaces in Korea: Responses to Coronavirus Disease-19," *Saf. Health Work*, vol. 11, no. 3, pp. 275–283, 2020.

[5]   B. Boland, A. De Smet, R. Palter, and A. Sanghvi, "Reimagining the office and work life after COVID-19," *McKinsey & Company*, 2020. [Online]. Available: https://www.mckinsey.com/business-functions/organization/our-insights/reimagining-the-office-and-work-life-after-covid-19#. [Accessed: 05-Aug-2020].

[6]   K. Devlin and D. Rosenberg, "Information in the Study of Human Interaction," *Philos. Inf.*, pp. 685–709, 2008.

[7]   Lu-Hai Liang, "If even a single surface is compromised, a virus can infect the majority of a workplace in a matter of hours.," *BBC Worklife*, 2020. [Online]. Available: https://www.bbc.com/worklife/article/20200324-covid-19-the-ways-viruses-can-spread-in-offices. [Accessed: 05-Aug-2020].

[8]   J. Mudditt, "Pandemic-proofing offices could involve short-term fixes, new working patterns and long-term design upgrades that put hygiene at the heart of workplace planning.," *BBC*, 2020. [Online]. Available: https://www.bbc.com/worklife/article/20200514-how-the-post-pandemic-office-will-change. [Accessed: 05-Aug-2020].

[9]   L. Arundell *et al.*, "The Impact of Activity Based Working (ABW) on Workplace Activity, Eating Behaviours, Productivity, and Satisfaction," *Int. J. Environ. Res. Public Health*, vol. 15, no. 5, 2018.

[10]   C. Johnson, B. Surlemont, P. Nicod, and F. Revaz, "Behind the StarsA Concise Typology of Michelin Restaurants in Europe," *Cornell Hotel Restaur. Adm. Q. - CORNELL Hotel RESTAUR ADMIN Q*, vol. 46, pp. 170–187, May 2005.

[11]   A. Madeira, T. Palrão, and A. S. Mendes, "The impact of pandemic crisis on the restaurant business," *Sustain.*, vol. 13, no. 1, pp. 1–13, 2021.

[12]   E. Booke, "A pandemic timeline: How COVID-19 turned Dallas restaurants upside down," *The Dallas Morning News*, 2020. [Online]. Available: https://www.dallasnews.com/food/restaurant-news/2021/03/17/a-pandemic-timeline-how-covid-19-turned-dallas-restaurants-upside-down/. [Accessed: 31-Mar-2021].

[13]   D. Pavesic, "Setting the Table: The Transforming Power of the Hospitality Business, by Danny Meyer," *J. Culin. Sci. Technol.*, vol. 10, no. 3, pp. 271–275, Jul. 2012.

[14]   N. Ntounis, C. Mumford, M. Loroño-Leturiondo, C. Parker, and K. Still, "How safe is it to shop? Estimating the amount of space needed to safely social distance in various retail environments," *Saf. Sci.*, vol. 132, p. 104985, 2020.

[15]   B. Uherek-Bradecka, "Architectural and aesthetic aspects of workspace at home {\textendash} a new design challenge in the age of pandemic," *{IOP} Conf. Ser. Mater. Sci. Eng.*, vol. 1203, no. 2, p. 22005, Nov. 2021.

[16]   M. J. Jafari *et al.*, "Association of sick building syndrome with indoor air parameters," *Tanaffos*, vol. 14, no. 1, pp. 55–62, 2015.

[17]   "3. Generic preventive measures The generic preventive measures include simple public health measures that are to be followed to reduce the risk of infection with COVID-19. These measures need to be observed by all (employees and visitors) at all times. Th," pp. 1–4, 2021.

[18]   "Dated the 10," vol. 19, no. February, p. 2016, 2010.

[19]   J. Qian, B. Xing, B. Zhang, and H. Yang, "Optimizing QR code readability for curved agro-food packages using response surface methodology to improve mobile phone-based traceability," *Food Packag. Shelf Life*, vol. 28, p. 100638, 2021.

[20]   A. Pal and M. Sankarasubbu, "Pay Attention to the cough: Early Diagnosis of COVID-19 using Interpretable Symptoms Embeddings with Cough Sound Signal Processing," pp. 1–15, 2020.

[21]   J. Kim and J. C. Lee, "Effects of COVID-19 on preferences for private dining facilities in restaurants," *J. Hosp. Tour. Manag.*, vol. 45, pp. 67–70, Dec. 2020.

[22]   Laura Itzkowitz, "How Restaurant Design Is Changing As a Result of COVID-19," *Architectural Digest*, 2020. [Online]. Available: https://www.architecturaldigest.com/story/restaurant-design-covid-19. [Accessed: 10-Mar-2021].

[23]   N. A. Megahed and E. M. Ghoneim, "Antivirus-built environment: Lessons learned from Covid-19 pandemic," *Sustain. cities Soc.*, vol. 61, p. 102350, Oct. 2020.

[24]   P. Phapant, A. Dutta, and O. Chavalparit, "COVID-19 experience transforming the protective environment of office buildings and spaces," *Sustain.*, vol. 13, no. 24, pp. 1–21, 2021.

[25]   A. Sodaro, "Memory, History, and Nostalgia in Berlin's Jewish Museum," *Int. J. Polit. Cult. Soc.*, vol. 26, no. 1, pp. 77–91, 2013.

[26]   A. R. Caponigri, *Dialectical Materialism*, vol. 9, no. 0. 1959.

[27]   Corinne Murray, "The essential guide to activity-based working," *We Work*, 2021. [Online]. Available: https://www.wework.com/ideas/research-insights/expert-insights/essential-guide-activity-based-working. [Accessed: 13-Feb-2022].

[28]   D. J. Haraway, "Tentacular Thinking," *Stay. with Troubl.*, pp. 30–57, 2016.

[29]   D. Haraway, "Tentacular Thinking: Anthropocene, Capitalocene, Chthulucene - Journal #75 September 2016 - e-flux," *e-flux J.*, no. 75, 2016.

[30]   B. Latour, "On actor-network theory. A few clarifications, plus more than a few complications," *Logos (Russian Fed.*, vol. 27, no. 1, pp. 173–200, 2017.

[31]   A. T. Wessells, "Reassembling the Social: An Introduction to Actor-Network-Theory by Bruno Latour," *Int. Public Manag. J.*, vol. 10, no. 3, pp. 351–356, Aug. 2007.

[32]   C. Cucuzzella, "Creativity, sustainable design and risk management," *J. Clean. Prod.*, vol. 135, pp. 1548–1558, 2016.

[33]   C. F. Strauss and A. Fuad-luke, "The Slow Design Principles," *Chang. Chang. Des. visions, Propos. tools*, pp. 1–14, 2008.

[34]   G. Bruno, "Light Spaces, Screen Surfaces," 2020.

[35]   T. H. Fisher, "What We Touch, Touches Us: Materials, Affects, and Affordances," *Des. Issues*, vol. 20, no. 4, pp. 20–31, 2004.

[36]   J. L. Davis, Ed., "Mechanisms of Affordance," *How Artifacts Afford: The Power and Politics of Everyday Things*. The MIT Press, p. 0, 11-Aug-2020.

[37]   J. Tholander, M. Normark, and C. Rossitto, "Understanding agency in interaction design materials," *Conf. Hum. Factors Comput. Syst. - Proc.*, 2012.

[38]   S. Kagan, "Aesthetics of Sustainability: A Transdisciplinary Sensibility for Transformative Practices," *Transdiscipl. J. Eng. Sci.*, vol. 2, pp. 65–73, 2011.

[39]   P. Stephan, "Designing 'matters of concern' (Latour): A future design task ?," 2015, pp. 202–226.

[40]   A. Yaneva, *Mapping controversies in architecture*. 2013.

[41]   P. Myerson, Jeremy; Ross, *The 21st Century Office*. Laurence King Pub, 2005.

[42]   S. Yin, "Theory Studies: Archetypical Workplace Practice In Contemporary Interior Design," *Phys. Rev. E*, no. January, 2011.

[43]   Sustema, "The Return of the Cubicle: Designing Control Rooms Post Covid-19," *Sustema*, 2020. [Online]. Available: https://www.sustema.com/post/the-return-of-the-cubicle-designing-control-rooms-post-covid-19. [Accessed: 06-Jul-2021].

[44]   L. Rolfö, "Activity-based Flexible Office work environments : Design and implementation processes and outcomes," *Div. Ergon.*, no. December, pp. 1–98, 2018.

[45]   G. Beaudry, "The Transformation of the Webster Library : 22 Study Environments , and Innovative Technology Program and a Strong Consultation Process 38 th International Association of University," 2017.

[46]   Y. S. L. edited by Norman K. Denzin, *The SAGE handbook of qualitative research*. Fourth edition. Thousand Oaks : SAGE, [2011] ©2011.

[47]   A. Aliseda, *Abductive Reasoning: Logical Investigations into Discovery and Explanation*. Springer Netherlands, 2006.

[48]   MSR Blog, "About Abductive Reasoning," 2020. [Online]. Available: http://www.msrblog.com/science/mathematic/about-abductive-reasoning.html. [Accessed: 01-Jun-2022].

[49]   S. Granados, "New normal: How far is safe enough?," *Reuters Graphics*, 2020. [Online]. Available: https://graphics.reuters.com/HEALTH-CORONAVIRUS/SOCIALDISTANCING/qzjvqenmyvx/. [Accessed: 03-Sep-2020].

[50]   M. of H. and F. Welfare, "SOP on preventive measures in shopping malls to contain spread of COVID-19," pp. 3–5, 2020.

[51]   J. Meis and Y. Kashima, "Signage as a tool for behavioral change: Direct and indirect routes to understanding the meaning of a sign," *PLoS One*, vol. 12, no. 8, pp. e0182975–e0182975, Aug. 2017.

[52]   D. Topolšek, I. Areh, and T. Cvahte, "Examination of driver detection of roadside traffic signs and advertisements using eye tracking," *Transp. Res. Part F Traffic Psychol. Behav.*, vol. 43, pp. 212–224, 2016.

[53]   H. Xie, E. Galea, and P. Lawrence, "Experimental study of the effectiveness of dynamic signage system," *Conference Proceedings: Interflam 2013: 13th International Fire Science and Engineering Conference*, vol. 2. Interscience Communications, Greenwich, London, UK, pp. 967–978, 2013.

[54]   T. DeForest, "DC Comics," *Brittanica*. Brittanica, 2020.

[55]   American Academy of Child and Adolescent Psychiatry, "Role Models and Children," *American Academy of Child and Adolescent Psychiatry*. [Online]. Available: https://www.aacap.org/aacap/families_and_youth/Facts_for_Families/FFF-Guide/Children-and-Role-Models-099.aspx. [Accessed: 07-Dec-2020].

[56]   Mary Badon, "Red Light, Green Light: The Invention of the Traffic Signal," *Design Observer*, 2018. [Online]. Available: https://designobserver.com/feature/red-light-green-light--the-invention-of--the-traffic-signal/8627/. [Accessed: 07-Dec-2020].

[57]   Catherine Legros, "Designing Cultural Probes," *Medium*, 2018. [Online]. Available: https://medium.com/@catherinelegros/designing-cultural-probes-31f2c62b9dcf. [Accessed: 09-Sep-2022].

[58]   E. P. Bill Gaver, Tony Dunne, *Interactions*. 1999.

[59]   O. M. Celikoglu, S. T. Ogut, and K. Krippendorff, "How Do User Stories Inspire Design?

A Study of Cultural Probes," *Des. Issues*, vol. 33, no. 2, pp. 84–98, 2017.

[60]   D. A. Schon, *The Reflective Practitioner: How Professionals Think In Action*. Basic Books, 2008.

[61]   O. S. Iversen and C. Nielsen, "Using digital cultural probes in design with children," *Proc. 2003 Conf. Interact. Des. Child. IDC 2003*, no. December, p. 154, 2003.

[62]   I. Markovic, "What Is a War Room and How to Use it in Project Management," 2019. [Online]. Available: https://tms-outsource.com/blog/posts/what-is-a-war-room/. [Accessed: 15-Jan-2022].

[63]   A. Nediari, C. Roesli, and P. M. Simanjuntak, "Preparing post Covid-19 pandemic office design as the new concept of sustainability design," *{IOP} Conf. Ser. Earth Environ. Sci.*, vol. 729, no. 1, p. 12095, Apr. 2021.

[64]   Y. Saharkhiz, M. Valizadeh, and H. Salamat, "The Evolution of Academic Libraries in the Age of Technology," *J. Hist. Cult. Art Res.*, vol. 5, p. 402, Jan. 2017.

[65]   and L. M. Kate Jerde, Melissa Minton, "65 Home Office Ideas That Will Inspire Productivity," *Architectural Digest*, 2020. [Online]. Available: https://www.architecturaldigest.com/gallery/home-offices-slideshow. [Accessed: 18-Jan-2022].

[66]   R. Knight, "How to Do Performance Reviews — Remotely," *Harvard Business review*, 2020. [Online]. Available: https://hbr.org/2020/06/how-to-do-performance-reviews-remotely. [Accessed: 15-Jan-2022].

[67]   K. Shafique, B. A. Khawaja, F. Sabir, S. Qazi, and M. Mustaqim, "Internet of Things (IoT) for Next-Generation Smart Systems: A Review of Current Challenges, Future Trends and Prospects for Emerging 5G-IoT Scenarios," *IEEE Access*, vol. 8, pp. 23022–23040, 2020.

[68]   M. Pérez-Sanagustín, D. Parra, R. Verdugo, G. García-Galleguillos, and M. Nussbaum, "Using QR codes to increase user engagement in museum-like spaces," *Comput. Human Behav.*, vol. 60, pp. 73–85, 2016.

[69]   Sjors Timmer, "Space as a Medium for Interaction Design," *Medium*, 2018. [Online]. Available: https://medium.com/@sjors/space-as-a-medium-for-interaction-design-e546b3421a58. [Accessed: 19-Jul-2022].

[70]   Firdous Nizar, "Retracing Spatial Design Processes: Developing a Pedagogical Tool for Architecture," 2020.

[71]   I. Fubbla, F. Led, and W. Lamp, "IKEA 204.367.13 BAGGEBO Bookcase Instruction Manual," *IKEA*, 2022. [Online]. Available: https://manuals.plus/ikea/204-367-13-baggebo-bookcase-manual.pdf. [Accessed: 29-Jul-2022].

[72]   S. Mccusker, "Lego®, Seriously : Thinking through building," *Int. J. Knowledge, Innov. Entrep.*, vol. 2, no. 1, pp. 27–37, 2014.

[73]   O. M. Agnus, "Proxemics: The study of space," *Irwle*, vol. 8, no. 1, pp. 1–7, 2012.

[74] WebJunction, "Toolkit for Creating Smart Spaces," *Teen Smart Space at Cornwall Public Library, NY*, 2021. [Online]. Available: https://www.webjunction.org/news/webjunction/toolkit-creating-smart-spaces.html. [Accessed: 29-Jun-2022].

[75] C. C. De Oliveira, "Experience Programming : an exploration of hybrid tangible-virtual block based programming interaction," *Master's Program.*, pp. 1–95, 2018.

[76] C. Muller, "Restaurant Organizations and the Power of the New Economy : A Pandemic , Labor Value and Lessons From the Past," *Bost. Univ. Sch. Hosp. Adm.*, 2020.

[77] M. Jia, A. Komeily, Y. Wang, and R. S. Srinivasan, "Adopting Internet of Things for the development of smart buildings: A review of enabling technologies and applications," *Autom. Constr.*, vol. 101, no. January, pp. 111–126, 2019.

[78] J. G. Rawlinson, *Creative Thinking and Brainstorming*, 1st Editio. London, 1981.