Versatile Home Workspace Environment

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Versatile Home Workspace Environment Project

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EDMM 4920 - Multidisciplinary Sr Project
Senior Design Final Report
Spring 2021
Abstract

Since the initial spread of COVID-19, many individuals around the world have experienced a rapid shift from an external workplace, to needing a dedicated workspace within the home. While some individuals have been faced with new distractions like family members and pets, others have been faced with the struggle of having a workspace in common areas, where relaxation and socialization normally occur. Due to the needs for many people to work from home and be isolated from coworkers, it is essential for living spaces to be adaptable to meet these needs. Producing an effective separation can help lead to overall better mental well-being and productivity in individuals. The importance of designing an effective space has become evident through researching the effects that sensory cues like light, sound, and smells can have on productivity, as well as in learning how detrimental having little separation between work and home is for employees, shortening recovery periods. The team also conducted a survey pertaining to what individuals' value in workspace and a second survey has data being collected on the specific components that individuals require in a workspace. To create a separation between personal life and professional life, it is essential to have that physical dichotomy reflected in between one’s living space and workspace. Over the course of the past two semesters, the team designed and created CAD models, as well as physical models, that promote a shift in atmosphere from productivity to relaxation, transforming the perception of the space and the capabilities of it.
Table of Contents

Introduction: The Need for an Effective Workspace .............................................................................. 3
  Background Information ......................................................................................................................... 4
  Nomadic Furniture ................................................................................................................................. 5
  Current Office Market Designs ............................................................................................................... 7
  Differences in Materials and Product Quality ......................................................................................... 7

Creating an Effective Workspace .......................................................................................................... 8
  Lighting Dynamics Analysis ................................................................................................................... 8
  Aromatherapy Applications .................................................................................................................... 9
  Acoustic Analysis .................................................................................................................................. 10

Methodology .......................................................................................................................................... 11

Results .................................................................................................................................................... 13
  Data Collection ..................................................................................................................................... 13
  Designs Considered & Designs Chosen .................................................................................................... 14
  Portrayal of Designs ................................................................................................................................. 16
  Materials - Color and Texture Options .................................................................................................... 17

Conclusion – Key Design Intentions ....................................................................................................... 18

Acknowledgements ................................................................................................................................. 20

Works Cited ........................................................................................................................................... 21

Appendices ............................................................................................................................................ 24
  Appendix A – Existing Market Information ............................................................................................ 24
  Appendix B – Sketches and Initial Physical Models ................................................................................. 25
  Appendix C – CAD Models for The Canopy ............................................................................................. 31
  Appendix D – CAD Models for the Curvy Cocoon .................................................................................... 33
  Appendix E – Final Renders in Rhino for The Canopy and Curvy Cocoon .............................................. 35
  Appendix F – Images of the Physical Models Created of The Canopy and Curvy Cocoon ..................... 40
  Appendix G – Progression of Designs ....................................................................................................... 45
  Appendix H – Dimensions of functionality for a comfortable workspace ............................................... 46
  Appendix I – Bill of Materials .................................................................................................................. 47
  Appendix J – Recommended Additional Components ............................................................................... 51
  Appendix K – Pugh Matrix ....................................................................................................................... 52
Introduction: The Need for an Effective Workspace

With the current global situation related to Covid-19, remote work from home has become the new normal for a significant percentage of the population. As of June 29th, 2020, about 42% of individuals based in the U.S. were working from home, with some companies like Facebook, Twitter, and Nationwide Insurance planning on maintaining this plan (Berliner, 2020; Wong, 2020). Additionally, many colleges and universities also shifted education for the 2020 and 2021 school years to either a hybrid or completely online formats. With this transition, comes the need for a workspace that can engage the user, limit potential distractions, and help individuals feel a separation between spaces for productivity and relaxation.

While research has been ongoing for many years about what makes a productive work environment in large-scale office settings, much of the research can also be translated to the home office. Companies like Herman Miller, Steelcase, and Haworth have been focusing on the commercial office flavor of workspaces for many years, now being forced to adjust strategies to shift with the office-furniture market. Due to the pandemic putting a strain on the job-market as well, many individuals were likely to turn to a more cost-effective option, like IKEA, to fill the need for an at-home workspace. While these designs fulfill the basic need for a desk and chair, this does not necessarily ensure that a functional and productive work environment like that created in commercial office spaces has been created. In James Hennessey and Victor Papnek’s “Nomadic Furniture” books, designs and construction instructions are displayed, many composed of a basic frame that can be customized and utilized according to need. While all these designs include elements that could create a satisfactory work environment in the context of a perfect living space, it is apparent that this is not the reality for most people.

It has been proven that there are many benefits to using variations of lighting, scents, and sounds to help boost productivity, concentration, and calmness, all of which have the potential to be beneficial in a workspace. In addition, there has also been concern around the effects that having a workspace in the bedroom can have on sleep cycles, due to the constant viewing of blue light and the difficulty separating sleep from focused work (Harvard, 2020). Through altering elements of an existing workspace, a space can be created that emulates the dichotomy that once existed between the external workspace and home.
Background Information

While work-life balance is deemed important by many, working from home makes this an even more difficult goal to reach. This is especially relevant for parents that have small children who are balancing working from home with childcare responsibilities. In research done on the balance of parenting and performing childcare, it was found that women who work from home experienced a higher number of interruptions during the workday, especially tied to the increase of responsibility and expectations for her to tend to the family’s needs (Troup & Rose, 2012). This can contribute to longer working days and could mean that mothers are not getting enough time to recover day to day. The physical work-home boundary that used to exist allowed for more recovery time after work, especially with commuting, assuming that traffic is not a stressor. It is important to remember that time outside of the workplace must not be equated with leisure time (Iso-Ahola, 1997). Domestic demands and child-care activities are examples of activities that do require effort and do not help to restore an individual’s resources, further drawing from them (Sonnetag 2001).

According to an article called “Does Work-Homes Interference Mediate the Relationship Between Workload and Well-Being?”, work-home interference has been linked to dissatisfaction, anxiety, depressive complaints, exhaustion, psychosomatic symptoms, poor physical health, and sleeping disorders (Geurts, Kompier, Roxburgh, & Houtman, 2003). With the physical separation dissolving between work and home, it is likely that many individuals may not be experiencing the proper recovery time due to workspaces being in the place where they relax, contributing to some of these outcomes. Some individuals may also have workspaces in bedrooms, which can make a recovery even more difficult. Many products that currently exist on the market do solve some of the needs that arise with a home workspace, but the issue of the physical location of the workspace in the home requires a more in-depth analysis. This especially pertains to the components that can make a significant impact on comfortability of a workspace, as well as space efficiency.

While efficient utilization of space is a significant concern for many individuals, including apartment and dorm dwellers, other individuals have a separate office where versatility is not as significant of a concern. Nomadic furniture is a better option for spaces that require multi-functional furniture, whereas workspace elements can be purchased from Steelcase, Herman
Miller, or Haworth. While Steelcase and Herman Miller have higher-end options, Haworth has variety in the cost of products, while still maintaining quality. Even lower cost workspace solutions can be found at IKEA, as the company is known for inexpensive easily manufactured home furniture products. When evaluating these designs, the team learned about what exists in the current market and which features are important to consider in a design.

*Nomadic Furniture*

In the books “Nomadic Furniture” and “Nomadic Furniture 2” by James Hennessey and Victor Papanek, furniture designs that are ideal for a nomadic lifestyle are described, as well as the ways to fabricate them. The designs in these books include topics such as seating, tables, desks, sleeping areas, and lighting solutions. These designs are described as “lightweight furniture that folds, inflates, knocks down, stacks, is disposable and can be recycled”, which aligns very well with many of the needs that many individuals are experiencing in space-contentious living environments. These designs are shown below and have been evaluated for applicability to a variety of users in different home contexts.

*Figure 1: Relaxation Cube*

The design featured in figure 1 is called the “Relaxation Cube”, featuring a frame design made of wood provides a light-weight solution that allows for a separate workspace “room” to be created (Hennessey & Papanek, 1973). There is much versatility with this design, allowing different decorations, plants, cloth dividers, and monitors to be hung. As well, different types of storage could be easily added to suit the user’s profession.

When considering how well this design would integrate into a living space, this design could be too large and some individuals may prefer a simpler solution.
When considering the needs of a workspace for a college student or an individual in an apartment, versatility of space is key. This design in Figure 2 and Figure 3 could be especially useful if additional worksurface is required for collaboration. With alterations, a design shown above could also feature different storage options and potentially cable management and power distribution.

While this design may not be the most functional when the storage is tucked away with no space, due to no leg room for a seated user, it could be useful if the items being stored were used as consistently as the worksurface. This option provides a very clean look and helps to hide the items from view. When considering how a desktop computer or monitors would integrate into this space, there is not a very feasible option other than leaving them on the surface or picking them up and storing them below. This is not ideal, especially considering that cables may need to be disconnected for this.

While the table shown in Figure 4 was originally designed as an eating and buffet solution, this design could also potentially be integrated into a concept for a work environment (Hennessey & Papanek, 1973). While there is some storage shown, it is the rotating capability that is especially intriguing. One downside to this design is that it does require a bit of space to transform between the elongated position and the “together” position. Despite this, the narrow surfaces could function as independent work areas when separated and could be merged to create a collaboration space. The context of this space could include storage for additional items and décor elements, as shown in the image. In addition to better utilizing space and having flexible options, versatile seating is also an important consideration for work and relaxation spaces. Seating can be integrated into the workspace system, allowing it to be hidden and stored when not in use.

Figure 2: Open Rotating Storage Design

Figure 3: Closed Rotating Storage Design

Figure 4: Rotating Shelving
While these designs are aimed more at those individuals interested in building the designs themselves, 75% of employees who transitioned to working from home spent $572 of their own money, indicating that many people would prefer purchasing components of a workspace from more affordable companies such as IKEA, middle cost like Haworth, or high-end like Herman Miller or Steelcase (Mendoza, 2021). Height-adjustability is a key factor for many individual’s worksurfaces, which all the companies listed have included into products. Of course, cost differs greatly depending on how this height-adjustability is achieved, whether it be through pneumatics, a hand-crank, or via an electric motor.

Current Office Market Designs
There are multiple companies that manufacture at home office furniture in the current market including Haworth, Herman Miller, and Steelcase, with other furniture stores like IKEA also having some workspace options. In the current market, there is a wide price range for office furniture which factors on the quality of the materials, brand name, warranties, features, and color/style options, as shown in Figure A.1 (see appendix A). On the upper end of the price range there are companies like Herman Miller, Steelcase, and Haworth, who are well known for office furniture. Height adjustable desks are priced within the range of $550-$4000 for these companies. The reasoning behind the large price range is due to the number of options these companies give the consumer. While companies like IKEA have less available customizability and have a price range of $75-$600. For companies like Steelcase, Herman Miller, and Haworth, there is much more customizability available for desk style, shape, color, finish, and size. IKEA and home department stores are at the lower end of the price spectrum with prices ranging from $75-$600. These companies manufacture these parts with the mindset of quantity over quality. Where is affordable for most consumers, the desks and chairs lack in quality and aren’t built to last.

Differences in Materials and Product Quality
The main difference between high-end furniture manufacturers like Haworth, Steelcase, or Herman Miller and mass-produced products from companies like IKEA, is the average length of life, durability, and failure rate of components. Manufacturers need to balance reliability with profits, which is why cheaper furniture usually comes with a shorter life span (Jo, 2016). Due to this, it is not out of the ordinary for these mass-produced products to wear out and require
replacements after just a few years. This creates a need for quality furniture that lasts, with many people turning to the higher cost, quality options of products from Steelcase, Haworth, and Herman Miller. For many, the higher price point is justified by a product that is built to last. With technology like CAD and CNC programs, wooden parts can be produced quickly and with high precision and quality. With these designs, the lifecycle of the product is crucial, especially when considering how these products are contributing to sustainability of the natural resources used to make the product.

Creating an Effective Workspace

When considering the key factors that make an enjoyable workspace, there are three central levels of comfort that need to be considered: psychological comfort, functional comfort, and physical comfort (Vischer, 2008). The diagram shown in Figure E.1 in Appendix E outlines the different facets of comfort for the workspace. Some of the subcategories listed in this figure include “sociability”, “adaptability”, “practicality”, and “happiness”. For many, a workspace in a living area intended for socialization may not encourage a separation between relaxation, especially when accompanied by the typical stressors of the workday (Vischer, 2008). However, it may be more comforting to have family members or roommates nearby to chat with throughout the day. With the shift away from a separate physical space requiring travel to a different location, the lack thereof could be connected to a lack of perceived separation. The usual division that is created by the commute to work helps individuals have time to rejuvenate themselves after work before returning home, where unwinding is intended to occur (Troup & Rose, 2012). The elimination of this physical separation can contribute to reduced family-time or working longer hours than if the individual was still working in a typical office environment. To fulfil the physiological needs of the individual, temperature, humidity, lighting, and noise need to be regulated. Below, the effects of lighting, sound, and smells on productivity and wellness are discussed.

Lighting Dynamics Analysis

There are plenty of options on the market today that offer the ability to change the ambiance of light in your environment. Understanding how certain ambiances effect mood and concentration throughout the day is crucial to developing a productive or relaxing atmosphere, with the
possibility of having a system that can be adjusted within the space. A warmer ambiance of soft dim light around 2500k has been shown to have a positive effect on an anxious or sad mood and is effective in calming by reducing one’s arousal levels (Kuijsters, 2015). On the other end of the spectrum, a more intense active light around 5000k promotes a feeling of contentment which can make it easier to focus and stay on task (Kuijsters, 2015). In the “Light to Make You Feel Better” study, participants were exposed to a short movie that evoked a sad or anxious mood and then were moved to a room with either high intensity active light, warm cozy light, or a neutral light (Kuijsters, 2015). In each room, it was examined if and how the moods would change. All the rooms were effective in reducing the negative mood and the active and warm light rooms showed additional positive effects on the participants’ moods as well (Kuijsters, 2015). The most significant difference was a higher arousal state with the active lighting (blue light) (Kuijsters, 2015).

The science of blue light and brain stimulation has gained traction recently, pertaining to use of television, phones, and computer screens stimulating the brain and causing restlessness; however, not all colors of light have the same effect. Blue light wavelengths are beneficial during the day because they boost attention, reaction times, and stimulate the release of serotonin. Researchers from Harvard conducted an experiment to study the effects from 6.5 hours of blue light exposure compared to 6.5 hours of green light exposure and learned about how blue light is a natural melatonin suppressor (Harvard, 2020). The results showed that blue light suppressed natural melatonin secretion twice the duration of green light and 2.5 to 3 times as long as red light of comparable brightness (Harvard, 2020).

**Aromatherapy Applications**

Aromatherapy products have become increasingly popular, including devices that attach to an outlet, essential oil diffusers, and classic candles. Many people use these forms of aromatherapy at home to help relax or make think of something enjoyable. In addition, aromatherapy can also help with keeping one focused and even encourage memory retention. Implementing different aromas into work and living space is an effective tool to achieving different atmospheres into the same space. Knowing which aromas to implement for production and relaxation can be an effective way of transforming an environment to suit specific needs.
Aromatherapy with scents such as peppermint, which is a natural stimulant and has been scientifically proven to improve cognitive function, can be an ideal scent for getting started in the morning (Scott, 2020). Other scents, such as lavender, promote a feeling of contentment which is great for keeping one focused during the day when productivity is needed (Scott, 2020). Some scents can be ideal for unwinding at the end of a long day, such as aromatherapy with Ylang-Ylang Oil which has been shown to decrease alertness and increase information processing time which effectively forces your body to relax (Scott, 2020).

**Acoustic Analysis**

In a study analyzing acoustic environments, a company switched from a private office floorplan to an open office floor plan. Considering that people have varying sound level disturbance thresholds for different types of tasks, it also important to acknowledge that certain sounds are generally enjoyable for individuals and help increase concentration (Kaarlela-Tuomaala, Helenius, Keskinen, & Hongisto, 2009). As shown in Figure 5, different types of tasks have different levels of disturbances reported from various sources of sounds in the office environment. It is shown that the mathematical tasks being done had a higher amount of disturbance reported from sound distractions whereas the tasks that required lower levels of concentration had more tolerance of sound (Kaarlela-Tuomaala, Helenius, Keskinen, & Hongisto, 2009).

Another concept that was tested for covering sounds and increasing concentration was included in a study by Haworth. This technology is called biophilic sound-scaping which uses higher frequency sound that occurs in nature, such as waterfalls, wind, or ocean waves as a preferred method of covering distracting speech (Johnson, Thompson, Waddell, & Gussenbauer, 2020). In the study, it was found that biophilic sound-scaping led to more positive feedback regarding
satisfaction with masking content, volume, and effect on work when compared to the control, baseline, and traditional methods (Johnson, Thompson, Waddell, & Gussenbauer, 2020).

While the studies mentioned have been performed in the context of an office setting, whether in the form of open or private offices, this information is very relevant to the application of sound solutions for at home workspaces. At home there are many sounds that are distracting throughout the workday, especially if a workspace is not in a separate space from the common areas. Living with other individuals, especially children, can prove to be a significant source of these distractions. The strategies suggested for absorption, attenuation, diffusion, and cover will be important to consider in the design of an ideal workspace that can provide a sound-controlled space, capable to reduce distractions in a variety of sound-level contexts (Haworth, 2020; “Understanding the Basics of Noise Reduction”). The evidence found can help provide a benchmark for the sounds that are acceptable in an environment and best contribute to productivity.

**Methodology**

In the initial phases of the project, the members of the team discussed the needs that exist for individuals that live in a small living space based on initial surveying of individuals. Among these needs was multi-functional, space-efficient furniture that is affordable and utilizes the living space in a way that positively contributes to daily life. Upon beginning the project, the team was going to pursue creating a modular furniture solution that can transform between a couch, shelving, or a table. Some of the initial concepts included a couch made from smaller triangular sections that could be separated and reconfigured to create a worksurface or a desk. Due to the timing of the project taking place during the Covid-19 pandemic, the team determined that home workspaces could be a relevant area to focus on. It was also discussed that different components for lighting, sound, storage, and cable management could be included as customizable features that users could choose based on specific needs and preference.
To investigate this further, the team created a series of questions that served as an initial screening for family and friends about the needs that exist for workspace and the preferences in atmosphere. From the results of this survey, versatile workspaces were determined to be the best route to pursue. After this, the team created a more in-depth set of 30 questions that inquired more specifically about working from home and workspace component preferences. In reviewing the feedback, the team gained better insight in the key design intentions. Before becoming too involved in any of the initial designs the team had created, it was decided that it would be important to more closely observe some of the existing designs that existed in the office space market as well as other furniture designs that cater to the space efficiency.

Within the office space market, most products observed were intended for large commercial spaces where collaboration and socialization could occur between employees, which is significantly less relevant for home workspaces. Upon considering nomadic designs, the team learned about components that can be integrated to create more flexibility in the furniture. To determine the needs of individuals who work or complete schooling from a living space, the team decided to create an initial screening survey that inquiring about the effectiveness of home workspaces and the aspects that need improvement. In keeping cost in consideration, the team had the goal to design components to improve an existing workspace that is below three hundred dollars. This goal was based on the responses to the survey question asking the amount of money that individuals would be willing to spend on a workspace, with the results reflecting that fifty-eight percent of individuals would spend over $100 on a workspace and twenty-eight percent willing to spend over $200. In addition to this, the team wanted to design a workspace including a worksurface that was under five hundred dollars, which the team did accomplish.

After this, the team created sketches of four different designs including the Canopy, Curvy Cocoon, Shell, and Stacked (Appendix B). The team created scale models of three of the initial designs, Stacked, Curvy Cocoon and Canopy. Photographs were taken of the scale models and were sent out to the participants in a second survey along with the initial sketches. With the data from the second survey, a Pugh matrix (Appendix K) was created and the Curvy Cocoon and Canopy designs were selected to move forward with.

After selecting these designs, the team began working on the CAD models as well as the two 1/6th scale physical models. Three-dimensional CAD models were created of the Curvy Cocoon
and Canopy, along with two different design variants for each. The progression of all the designs into the two final concepts is shown in Figure G.1 in Appendix G. The 3D models were created in PTC Creo which has a rendering studio built into the program. The Creo rendering application is not the best in the field, which led the team to transfer the Creo files into Rhino 3D to get the highest quality renders (Appendix E).

**Results**

The team began data collection by simply having conversations with friends, family, and co-workers, asking them what they would and would not want in an ideal homework space. The team took that information and used it to develop our initial sketches as well as our in-depth survey. The team was able to develop a greater understanding of the types of atmospheres that individuals desire in a workspace and incorporated it into our final designs. As well, the surveying continued through the following survey that asked specifically about the desired components, typical working patterns and working positions. These questions were influential in considering the integrability of the environments created with additional components. This data led to team to determine that the Curvy Cocoon and Canopy designs should be pursued. From here, these designs were portrayed in the form of CAD models via PTC Creo, renders via Rhino 3D, and 1/6th scale physical models.

**Data Collection**

In aims to better understand what individuals' value in a workspace, the team sent out a survey, asking questions about workspace preferences about lighting, whether current workspaces are separate from living spaces, and what types of elements are most important in workspaces as well as social spaces. Individuals were asked to “list five words to describe your ideal workspace” of which the most popular replies were spacious, organized, comfortable, quiet, clean, and having natural light. In addition, another prompt asked “list five words to describe your ideal area for relaxation, which included answer such as cozy, comfy, quiet, warm, isolated, and dark as some of the most common answers. Between these lists, one apparent difference is the types of lighting and amount of space that individuals prefer. For the workspaces, individuals tended to want “spacious” and “naturally lit” spaces, while for relaxation, “dark” or “dimly lit” were preferred as well as “isolated”.
In the second survey, one of our key prompts was “is your current workspace in the same room that you sleep in?”. According to the data, 58.1% of individuals reported that their workspace is in the same room they sleep in. Not having a distinction between the place where one sleeps and the area where work is done may also lead to longer working days and can mean that each activity is not as beneficial and efficient of an experience. In addition, the survey asked questions about how effective the individuals believed their workspace is and why it may not be an effective space. The presence of distractions was a common answer, while others said that their space was simply too small. Images of workspaces were also collected, as well as individual’s descriptions of their workspaces. Another crucial piece of information to be collected was the position that individuals tend to work in, of which the choices provided were sitting in a chair, sitting on the floor, and standing. In determining which specific components were most preferred in a workspace, there were questions that asked about shelving, cable management, speakers, candles, and space for personal items, inquiring how important that each of these are to the individual.

With the data from the second survey the team developed four designs the Canopy, the Shell, the Curvy Cocoon, and Stacked. The team then developed a third and survey that was sent to participants who were willing to provide feedback on the designs. The survey asked how likely participants were to use each design and which one they preferred the most. It was also asked if participants had any improvements or suggestions so that the designs could be further developed. It was found that the preferred designs were the Curvy Cocoon and the Canopy, which had average ratings of 8.2 and 6.7, respectively. Additionally, it became evident that although participants did not prefer the Stacked design independently, the shelving system was admired. Due to this, it was incorporated into one of the Canopy design variations.

**Designs Considered & Designs Chosen**

The team brainstormed four initial designs (see Appendix B): The Canopy, Curvy Cocoon, Stacked, and Shell. The Canopy is a minimalistic exterior design that allows for privacy with storage and lighting features built in. The Curvy Cocoon has an aesthetically pleasing curved outer shell that helps create a separation between the living space and the workspace. Another key feature with this design is cable management inside of the outer shell that can be accessed from a door along the bottom edge. Towards the back of the design, a half-circle tower holds a
monitor and can be lowered when not in use to create a larger, clean workspace. The Stacked design has interchangeable frames which encourage the user to customize the space to fit the needs for their schoolwork or career. The frames can house sound-diffusing materials, additional lighting, storage, monitors, plants, or other decorations, as well as being removable and functional as a stool if a cushion was added. The Shell design allows the user to be closed into a half-circle personal office that would encourage a clear physical boundary from the external space. Two retractable partitions allow for the environment to transform from being completely closed to being entirely open if desired. The Canopy and Stacked were designed to be adapted for use with a pre-existing desk or with a work surface built in, while the Curvy Cocoon and Shell designs were standalone models that have the work-surface built into the design. Sketches and small-scale physical models of these designs can be found in Appendix B.

The team decided to move forward with the Canopy and Curvy Cocoon designs, based on the survey results obtained from potential users. Through this process, there was an integration of the Stacked and Shell into versions of the Curvy Cocoon and The Canopy. One of these additions was an option to have a bookcase in the Canopy design with the removeable frames from the Stacked design. For the Curvy Cocoon, a flexible partition was added as a design option, like the partition from The Shell design, allowing for more sound diffusion, more of a physical separation behind the user, and a background the enclosed environment was integrated into the Curvy Cocoon. The team chose these designs as they were the best fit for the project and best designs based on survey results.

For the Canopy, there are a few different options that were focused on. The first of these is the Canopy integrated with the Stacked shelving next to the desk. This version features a false back to the shelving that allows for cable management, as well as troughs under the worksurface and upper shelf that allow for cables to be stored. Inside of the triangular shelving there are USB ports as well as lights. The curtain behind the user allows for a separation to be accomplished, there to be a background for video calls, and for sound diffusion. Storage is accounted for in stacked shelving where additional components can be selected that fit the specific individual. For the basic version, there are the options for an existing desk to be added to the environment or for a new worksurface to be added. As well, there is a wall-mounted version for individuals who
want a more permanent environment, in addition to a self-standing option for individuals who cannot attach fasteners to the wall. The final renders of these designs are shown in Appendix E.

For the Curvy Cocoon, there is a hollow outer shell that can be composed of High-Pressure Laminate (HPL) of a fabric-covered polymer. Along the back of the design there is the monitor platform that is made from the same material and is raised and lowered by a mechanical system. Due to the outer shell being hollow, cables can enter the outer wall by a narrow opening and can be stored within the walls. A small door along the bottom of the system allows for cables to be accessed. Along the top edge of the Curvy Cocoon is a curved tube lighting system that features RGB LED lights that can be adjusted according to the specific type of lighting necessary within each moment. Other versions of the curvy cocoon are the partition and screen designs, with the partition design featuring a foldable paper partition that can be compressed and stored in the hollow outer wall when not in use. This partition allows for sound absorption a diffusion to occur, encourages a boundary being established, eliminates external distractions, and can serve as a background for video calls. The design of this partition was inspired by Molo Design, a company that manufactures large, movable wall structures as shown in Figure E.8. Another potential iteration of the Curvy Cocoon design features an overhead screen that reaches above and behind the used, further separating the environment and providing light diffusion. The final renders of these designs are shown in Appendix E.

**Portrayal of Designs**

The team decided that the final deliverables for the presentation would be high-quality, small-scale physical models and Computer-Aided Design (CAD) models created in Creo for the Canopy and Curvy Cocoon found in Appendices A and B. The 1/6th scale physical model of the Canopy was constructed out of bass wood, with thin pieces glued together to construct the supports. These pieces of bass wood were stained with linseed oil. After completing the models, photographs were taken in different lighting scenarios with props and scale figurines. The curvy cocoon design, the curved outer-shell was 3D-printed and touched up with Bondo spot putty and spray-painted white. The main worksurface and tower worksurfaces were cut to size out of bass wood and were stained with linseed oil. The lighting tube was replicated using an adjustable RBG LED light strip with ½” clear plastic tubing. After the components were all completed, the Curvy Cocoon was assembled (Appendix D).
In addition, a bill of materials and cost analysis for the different potential materials were completed. A list of products to be used in conjunction with the design has also been created, helping the user to have a more immersive workspace environment. Among these products were additional lighting solutions, essential oil diffusers, sound managing technologies, fans, heaters, and cost-effective office chairs. These additional products help the home workspace environment reach its greatest potential and will help to increase the separation even further between workspace and living space. This list of products is visible in Appendix J.

*Materials - Color and Texture Options*

When creating an environment, one of the essential aspects of visual stimuli to be considered are the textures and colors of the different fabrics, plastics, and laminates being used. According to an article called “Color Play”, “Most subconscious opinions about a product are formed within the first 90 seconds of seeing it”, with between sixty-two and ninety percent of those opinions formed being based on only color (Bravo). Due to this, it is important for the small-scale physical models and CAD models to be portrayed in a way that helps the potential-users look past the colors to the design features that could serve to be beneficial. Another aspect of user experience to consider is “Haptics”, being the science of determining why individuals feel what they feel when touching something and the influence that may have on overall perceptions (*The 'Sensational' Role of Texture in Surface Design*, 2016).

In the Curvy Cocoon design, the outer shell was initially designed to be a very neutral off-white color. This helps to create the feeling of spaciousness and cleanliness that potential users indicated is important to them. With the outer shell being manufactured out of a high-pressure laminate material, the texture of the material also needs to be considered. Due to the outer shell almost completely filling the user’s line of sight, it is important that the outer shell is not too brightly colored or too reflective of a surface. To create a more welcoming feeling upon entering the environment, the outer shell will be slightly warm in coloration and will have a matte finish. While colors besides an off-white could easily be implemented and be options for the user to select, it is important that the design decision will contribute to a better workspace environment. When considering a solution that could be a divider from the surrounding space, the team came across the design solution that was created by the company Molo Design. One design that the
company has created is known as the “paper softwall room divider” at is easily moveable and was created to have a “flexible honeycomb geometry” that allows the structure to be folded up (Paper softwall / folding partition). Due to the layers of fire-resistant folded paper, this structure is helpful for blocking and diffusing sounds (Paper softwall / folding partition). If this design was slightly shorter with an overall smaller width, it could be integrated into the curvy cocoon system so that it could be stored within the outer structure when not in use. The folded paper structure created by Molo Design is visible in Figure E.8.

For the Canopy Design, the worksurface or existing desk could either have a solid color or natural wood grain HPL top, a veneer top, or could be composed of real wood. Depending on the selection for the worksurface or desk, a variety of colors could be chosen along with a type of glossy or matte finish for the wooden supports that make up the rest of the system. Due to this design not being as surrounding compared to the Curvy Cocoon, it is not as essential for neutral colors to be considered, as the amount of space will likely feel very similar regardless of the color intensity of the frame. The more significant contribution to the feeling of spaciousness in this design is the curtain that allows for a separation from the surrounding environment. The fabric of this curtain will also be matte and will be a color that is more neutral to provide a flattering background for video calls. As well, sound diffusion will also be considered when selecting the fabric.

**Conclusion – Key Design Intentions**

With Covid-19 changing the workspaces of the world, there is evidently a need to counteract the effects that shifting workspaces into living spaces has brought forth. The current market offers satisfactory at-home workspaces, but these lack the functionality to switch between work and relaxation. For individuals who have limited space, desks are often placed wherever they can fit, which often means they could be in spaces that are intended for relaxation. Furthermore, many companies have product lines that reflect the acceptable cost-range for corporation’s office spaces but exceed the range that many individuals are able and willing to spend on office furniture.

Workspaces are filled with variables including sensor stimulants, coworkers, and daily routines that affect individuals in both positive and negative ways, with even more variables arising with the shift towards working from home. Research from Brigham’s Division of Sleep and Circadian
Disorders has shown that having a work area in a bedroom can result in sleep loss, which leads to less productivity overall. Regarding the senses, certain scents can affect the wiring of the brain to believe that a scent has an action behind it (Scott, 2020). While peppermint can increase cognitive function, Lavender has a calming effect (Scott, 2020). Lighting can also play a key role in productivity and relaxation, with brighter lights promoting productivity and dimmer lights encouraging relaxation. Sound can be a distraction in the workplace, as well as within home workspaces, although they come in a different form and may be connected to other variables in environment.

Although the designs portrayed are intended to force a shift in environment, there are also several recommendations for additional products that can increase the effectiveness of the transition. An essential oil diffuser, candle, or another form of aroma therapy can used as a stimulant to increase productivity and then can be switched to a relaxing scent when work is completed. In addition, white noise machine or small speaker can also be a beneficial addition for someone looking to add or drowned out background noise.

Considering the knowledge about what makes an effective workspace, a better idea of what this consists of begins to come into view. Creating a space that allows individuals to experience an immersive relationship with work, made possible with as few home distractions as possible, can encourage the work-relaxations separation that is desired. In addition, it is also essential to place an emphasis on sharing how research has shown how workspaces can be slightly altered to result in a better overall experience. When an environment is created that encourages positive experiences, it can allow for individuals to focus more on other aspects of well-being throughout the workday. In considering the research and intentions that were taken into consideration when creating the Canopy and Curvy Cocoon designs, it has become evident that a home workspace environment has enormous potential that includes so much more than a desk and a chair.
Acknowledgements

Our team would like to acknowledge first and foremost our advisor Mr. David Middleton, as his guidance has led the project to its destination. Mr. Middleton has gone out of his way to help us during our available time while managing a home life, multiple classes, and three other groups. His positivity and knowledge are greatly appreciated by ever member of the group, with lessons and techniques that will be remembered for a lifetime. He was a wealth of knowledge when it came to forming and creating our initial design ideas. We would also like to thank Professor Dana Hammond for supplying us with the framework to complete every step of the process over our last two semesters. In addition, Beck Johnson, a researcher at Haworth, was also kind enough to aid us in finding research that would contribute positively to our project. Finally, our team is very appreciative of everyone who participated in our surveys.
Works Cited


The 'Sensational' Role of Texture in Surface Design. (2016, June 3). Retrieved from https://iands.design/articles/35021/sensational-role-texture-surface-design


Appendices

Appendix A – Existing Market Information

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<th>IKEA</th>
<th>SteelCase</th>
<th>Herman Miller</th>
<th>Haworth</th>
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<td><strong>Upside Sit-to Stand</strong></td>
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Figure A.1 – Existing market information chart
Appendix B – Sketches and Initial Physical Models

Figure B.1 – The Canopy Initial Sketch

Figure B.2 – The Canopy Physical Model
Figure B.3 Stacked Design – Initial Sketches

If a frame system was used, cushions could be removed and replaced with shelves, filing drawers, etc.

The locking mechanism itself would be on the frame.

Thors could also be covers that could attach to the frame if an area needed to be covered (cable management).

Thors could also be drawers.
Figure B.4- Stacked Design Physical Model
Figure B.5-Curvy Cocoon (initial sketches)

Figure B.6 – Curvy Cocoon (with partition)
Figure B.7– Curvy Cocoon (with overhead screen)

Figure B.8- Curvy Cocoon Physical Model
Figure B.9 – The Shell (Open Configuration)

Figure B.10 – The Shell (Closed Configuration)

Versatile Home Workspace Environment Project - p.30
Appendix C – CAD Models for The Canopy

Figure C.1

Figure C.2

Figure C.3-The Canopy (Pre-Existing Desk)
Figure C.4 and C.5-The Canopy
(Added Worksurface and self-standing)
Versatile Home Workspace Environment Project

Appendix D – CAD Models for the Curvy Cocoon

Figure D.1 and D.2 – Curvy Cocoon

Figure C.6 and C.7-The Canopy (Added Stacked Storage)
Figure D.3 and D.4 – Curvy Cocoon (With added partition)

Figure D.5 and D.6 – Curvy Cocoon (With added overhead screen)
Appendix E – Final Renders in Rhino for The Canopy and Curvy Cocoon

Figure E.1 – The Canopy with stacked shelving (curtain open)

Figure E.2 – The Canopy with stacked shelving (curtain closed)
Figure E.3 – The Canopy (curtain open)

Figure E.4 – The Canopy (curtain closed)
Figure E.5 – The Curvy Cocoon Basic Version (raised monitor platform position)

Figure E.6 – The Curvy Cocoon Basic Version (lowered monitor platform position)
Figure E.7 – The Curvy Cocoon with the Storable Screen

Figure E.8 – The honeycomb structure of the Paper Softwall by Molo Design
Figure E.9, E.10, E.11 – The Curvy Cocoon with three different lighting scenarios of green, blue, and orange.
Appendix F – Images of the Physical Models Created of The Canopy and Curvy Cocoon

Figure F.1 – Physical model of the Canopy with props and a figurine (open curtain)

Figure F.2 – Physical model of the Canopy with props and a figurine (curtain closed)

Figure F.3 – Physical model of the Canopy with props and a figurine (curtain partially closed)
Figure F.4 – Physical model of the curvy cocoon with props and a figurine (outer partition configuration with warm lighting)

Figure F.5 – Physical model of the curvy cocoon with props and a figurine (outer partition configuration with cool, white light)
Figure F.6 – Physical model of the curvy cocoon with the monitor platform in the raised position

Figure F.7 – Physical model of the curvy cocoon with the monitor platform in the lowered position
Figure F.8 – Physical model of the curvy cocoon in a slightly darker lighting environment with the lighting bar set to purple.

Figure F.9 – Physical model of the curvy cocoon in a slightly darker lighting environment with the lighting bar set to blue.

Figure F.10 – Physical model of the curvy cocoon in a slightly darker lighting environment with the lighting bar set to yellow.
Figure F.11 – Physical model of the curvy cocoon in a dark lighting environment with the lighting bar set to orange.

Figure F.12 – Physical model of the curvy cocoon in a dark lighting environment with the lighting bar set to green.

Figure F.13 – Physical model of the curvy cocoon in a dark lighting environment with the lighting bar set to purple.
Appendix G - Progression of Designs

Figure G.1 – The progression of the four designs
Appendix H – Dimensions of functionality for a comfortable workspace

Figure 2. Dimensions of functionally comfortable workspace design. Adapted from “Towards an Environmental Psychology of Workspace: How People are Affected by Environments for Work,” by Vischer, Jacqueline C., 2008, Architectural Science Review, 51:2, 104. 2011 by “Taylor and Francis".
### Appendix I- Bill of Materials

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<thead>
<tr>
<th>Design</th>
<th>Part</th>
<th>Quantity</th>
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<td>Stacked Canopy</td>
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<td>Work Surface</td>
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<td></td>
<td>Support Stand</td>
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<tr>
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<td>Light Mount</td>
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<tr>
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<tr>
<td></td>
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<tr>
<td></td>
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<td>Wall Mounted w/ Work Surface</td>
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<td>Light Seating</td>
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<tr>
<td></td>
<td>Curtain Bar</td>
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</tr>
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<td></td>
<td>Overhead Shelf</td>
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<tr>
<td></td>
<td>Screws</td>
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</tr>
<tr>
<td></td>
<td>Washers</td>
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<td>Wall Mounted w/ Pre Existing Work Surface</td>
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Figure I.1 – Bill of Materials for the Canopy Design versions
Cost for Hollow Rectangular Extruded Aluminum

- $380.00 for designs with two support stands (Free Standing and Wall Mounted)
- $325.00 for designs with one support stand (Stacked Canopy)

Cost for Wood (Board Foot)

- $365.00 in Oak for Stacked Canopy
- $165.00 in Laminate for Stacked Canopy
- $125.00 Maximum, $35 Minimum for any wood used for Free Standing and Wall Mounted Canopy
  a. Mahogany
  b. Oak
  c. Maple
  d. Walnut
  e. Pine

Figure I.2 – Additional cost information for the Canopy Design versions
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<td>Inner Shell</td>
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<td>Top Piece</td>
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<td></td>
<td>Tower Worksurface</td>
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<tr>
<td></td>
<td>Tower Outer Shell</td>
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<tr>
<td></td>
<td>Shelving Divider</td>
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<tr>
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<td>Lighting Cover</td>
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Figure I.3 – Bill of Materials for the Curvy Cocoon Design versions
Cost for outer shell
- $95 for polycarbonate shell
- $165 for laminate

Cost of standard model - $300-520
Cost with additional separation $510-730

Cost for partition - $210

Light bar – $60-70

Cost for wood for desktop and shelving
- $28 for laminate
- $98 for hard wood

Figure I.4 – Additional cost information for the Canopy Design versions
### Appendix J– Recommended Additional Components

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<th>Type of Component</th>
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<td>Bose QuietComfort® Earbuds</td>
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<td>Essential Oil Diffuser</td>
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<td>Vitruvi Stone Diffuser</td>
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<td>Office Chairs</td>
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<td>Office Star Deluxe Breathable ProGrid Back</td>
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<td>Additional Lighting</td>
<td>LED Desk Lamp, BZBRLZ Metal Swing Arm Lamp</td>
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<td>Buzzi Plant</td>
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<td>Buzzi Free</td>
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Figure J.1 – List of recommended components to be used with the systems
### Appendix K – Pugh Matrix

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Figure K.1 – Pugh Matrix