

NETWORKS OF MAKING

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A thesis submitted in partial fulfillment of the requirements for the degree of
Masters of Architecture

University of Washington
2015

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Program Authorized to Offer Degree:
Architecture

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Abstract

Networks of Making

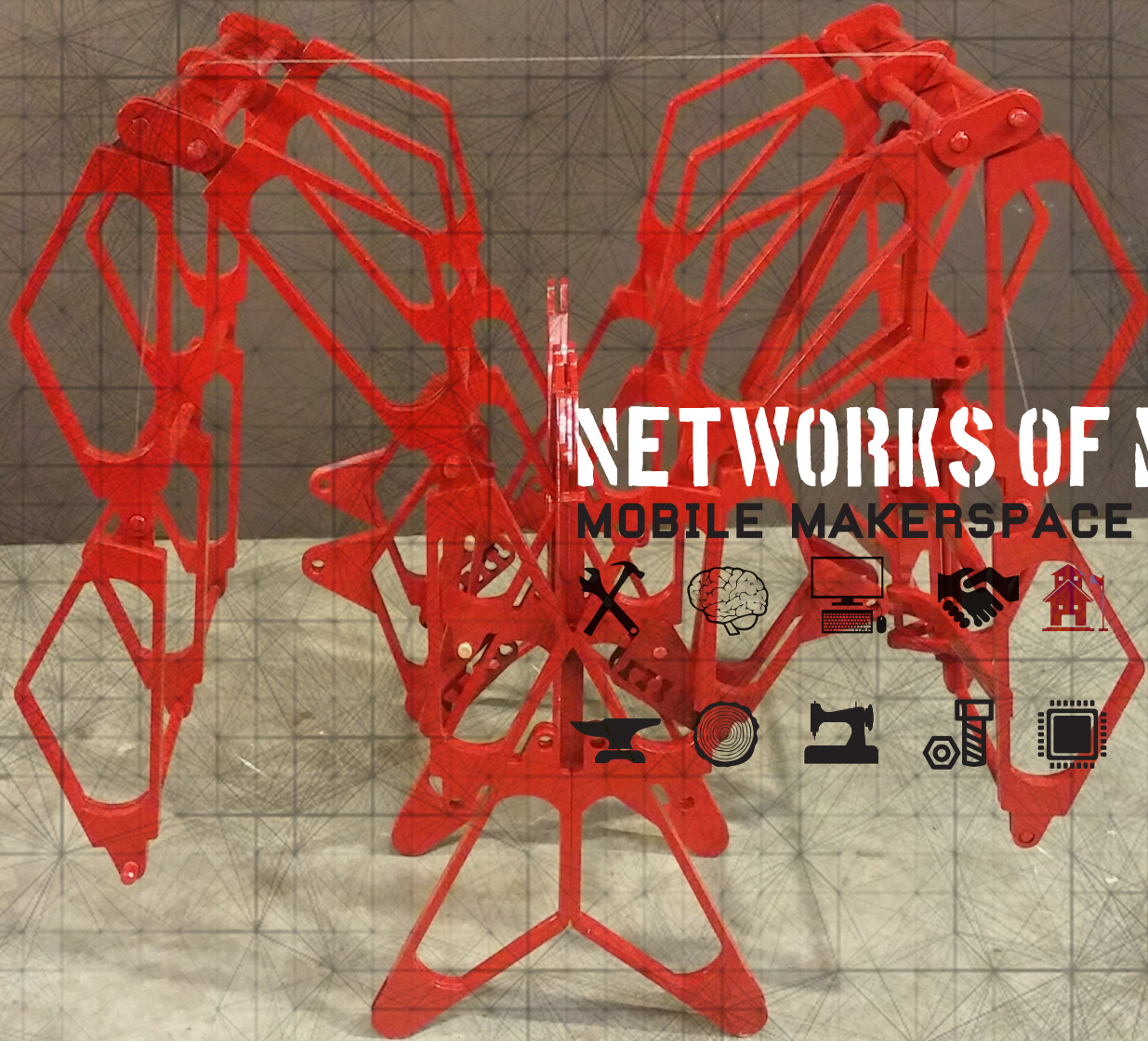
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Associate Professor Brian McLaren

Architecture

Networks of Making is a commentary on the global dominance of network culture, the social and physical impact it is having on the world of making. Networks of Making looks at the primary cultural relevance of network culture and how it is informing the world of making. An architectural resolution is proposed, a mobile maker space is to be utilized as a system or armature of engagement to be deployed at certain nodes within the Seattle Network. The system is to be conceived of as a flexible and adaptable solution based on the process of making and the pursuit of tinkering.



NETWORKS OF MAKING

MOBILE MAKERSPACE



DEDICATION

This thesis is dedicated to the “Makers” in my life, who have inspired me to pursue a degree in Architecture and follow my dreams. A big thanks goes out to all of the Faculty members at the University of Washington as well as the University of Texas San Antonio that have contributed to the development of this thesis. I would also like to Thank my Mom and Dad the original makers in my life for giving me the pursuit of design, buying me LEGOS, and most of all sticking by my side through all these years of Architecture School.

Finally I would like to give a major thanks to some of the beloved Mentors in my life. Thank you for feeding the fire, giving me a voice, and most importantly challenging me every step of the way. Thank you Curtis Fish, Mark Blizard, Mr. McCormick, and Mr. Bingham.

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CH.1 NETWORKS OF MAKING

Networks of Making / Return To Making: An Intro

Today there is a return to making that is being catalyzed by online instruction, as well as our human desire to get back to making things. We live in a globalized world defined by consumerism and a shift from local manufacturing to overseas manufacturing. Furthermore we live in a time when the internet has become the dominant culture logic capable of creating influential movements that can manifest themselves in the physical world having an impact on our relationship with making. Network culture begins to define a shift from the physical artifact to the digital artifact or virtual experience. Lastly the most recent shift can be defined by the maker movement. This movement is characterized by our human need to get back to making things, it is about tools, community, exploration, and education. It is a response to the changing landscape of manufacturing and consumption and the global dominance of network culture. Lastly the maker movement is reversing societies dying belief in making as a form of education and once again learning through the act of making is becoming a viable form of education and inquiry. These two shifts have brought about cultural and social changes in the way we make, inform, and seek knowledge. Making today is not a solo effort, instead making exists as a network of makers linked through the internet, connecting individuals to communities and communities to other communities and so on.

This thesis argues that architecture can play a role in the network of makers by providing a new model, one that is flexible, adaptable, and most importantly engages makers on a local and global scale. It acknowledges the social and educational nature of network culture along with the institutionalization of makerspaces in the urban fabric and the hopes to joining the two. As a result an architectural resolution is proposed, one that recognizes “Network Culture” as a primary catalyst of the 21st century Maker Movement. Thus the architectural solution will align itself with the Maker Movement’s Manifesto outlined by Mark Hatch. Secondly it will use progressive educational theories as framework for informal learning practices. And finally the solution will engage the network through the documentation of the physical artifact to be used toward a larger discussion of making across the network.

MAKING IS FUNDAMENTAL TO WHAT IT MEANS TO BE HUMAN. WE MUST MAKE CREATE AND EXPRESS OURSELVES TO FEEL WHOLE. THERE IS SOMETHING UNIQUE ABOUT MAKING PHYSICAL THINGS. THESE THINGS ARE LIKE LITTLE PIECES OF US AND SEEM TO EMBODY PORTIONS OF OUR SOULS. HATCH M. N.D. PG. 1

CH.1 NETWORKS OF MAKING

Physical

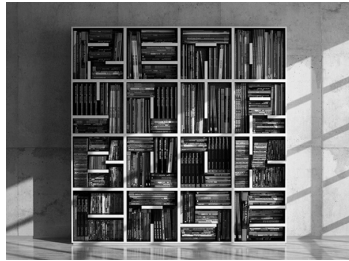
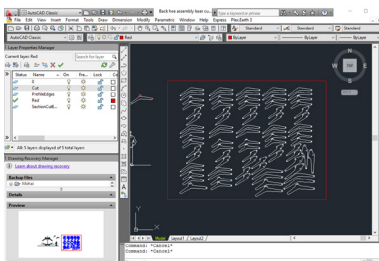
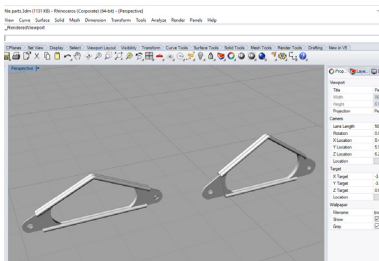


Fig. 4 Physical Vs Digital



Fig. 3 Physical Vs Digital

Digital



Computers and technology today have created a unique cultural and social situation for the 21st century. Humans make and create artifacts that manifest themselves in the physical world through our memories and desires. Historically, physical Artifacts left behind in the landscape become vessels containing knowledge of a past culture or civilization, they mark human existence leaving behind a piece of the creator to be analyzed for insight into how, what, where, when, and why. Artifacts are inherently educational tools that we study. Traditionally you might consider the “artifact” as a piece of pottery or perhaps an ancient tool uncovered at an archeological dig. Once uncovered the artifact would be placed in a museum for all to study and perhaps even make sense of the world. In order to better understand the world of making it is important to understand that we live in a world made up of artifacts, however as we shift towards a dominant network culture the **physical artifacts** once made by man are slowly becoming replaced with **digital artifacts** stored on a network. The “network” is a collective database of artifacts that serves as an open source, collaborative, and ever changing library of information. This collective database is used by the 21st century maker today as a tool and a resource. Lastly it is providing a forum for the general discussion of making today. (Artifact image 1) “Network Culture” has created a vast ambient landscape for the storage and playback of human culture, history, and most importantly the artifacts that we make. Today with the advent of computers the internet is becoming the primary source of information within the household today. The internet is making it easier to **share** everyday life but also **record and playback** the physical artifacts created by mankind. This historical phenomenon is described by Kazy Varnelis in his essay “*The Meaning of Network Culture*,” where he states the “network has become the dominant culture logic.” (pg. 1, 2010) He argues that the digital revolution has come to replace physical aspects of our everyday lives, newspapers have been replaced by amateur blogs or other content. Libraries and physical books have moved to a **mobile platform**, allowing the user to read a digital copy of a physical book. This influences the way we think about physical artifacts and raises the question about the authenticity of the digital artifact.

CH.1 NETWORKS OF MAKING

Networks of Making / Return To Making: An Intro / Physical to Digital: Rise of Network Culture

This idea of network culture is a means to explain the vast digital landscape that is used by “individuals seeking freedom and communication with others who share their interests, desires and hopes.” Network culture is not bound by time, instead “network culture delivers remix, shuffling together the diverse elements of present-day culture.” (pg. 3) As a result we are presented with a network of digital artifacts in the form of blog posts, pictures, movies, music. These Fig. 3.1 things are to be considered manifestations or artifacts of the Human mind, only they exist in the form of data, or ones and zeros to be precise. Network culture defines the world as an integrated, and well connected network made up of nodes and pathways linking everything together. Lastly it defines a world that is comprised of Fig. 1.1 interconnected systems all in communication and collaboration. Information and knowledge in the 21st century is passed from one node to another through a more invisible and ambient network. (Network Culture image 2)



Fig. 6 Hybrid Tools

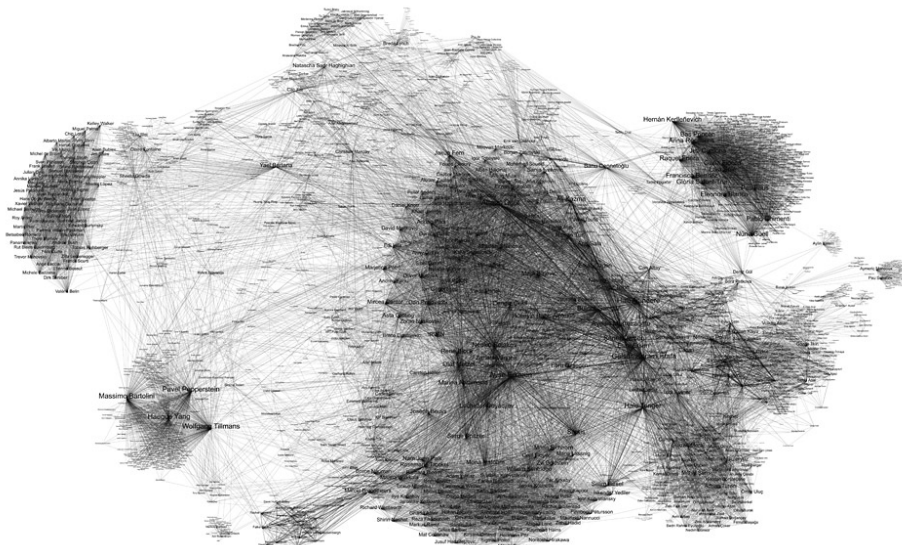


Fig. 5 Networks Image

CH.1 NETWORKS OF MAKING

Networks of Making / Return To Making: An Intro / Physical to Digital: Rise of Network Culture / **Maker Movement**

ACCORDING TO MITCHEL RESNICK AND ERIC ROSENBAUM THE EMERGING MAKER MOVEMENT IS CATALYZED BY BOTH TECHNOLOGICAL AND CULTURAL TRENDS. NEW TECHNOLOGIES ARE MAKING IT EASIER AND CHEAPER TO CREATE AND SHARE THINGS IN BOTH THE PHYSICAL WORLD AND THE DIGITAL WORLD. AT THE SAME TIME THE MAKER MOVEMENT BUILDS UPON A BROADER CULTURAL SHIFT TOWARDS A DO-IT-YOURSELF APPROACH TO LIFE WHERE PEOPLE TAKE PRIDE AND PLEASURE IN CREATING THINGS PERSONALLY RATHER THAN ONLY CONSUMING MASS PRODUCED GOODS. MITCHEL RESNICK AND ERIC ROSENBAUM PG. 1

Dale Dougherty is often seen as the grandfather of the maker movement, in 2005 he created *Make Magazine* and in 2006 he created the first Maker Faire in San Mateo California. Maker Faire was important in catalyzing the movement because it provided a place for makers, tinkerers, enthusiasts, engineers, and kids to gather and share their inventions. Today the movement is comprised of a diverse group of participants including designers, writers, architects, other white collar types who all actively participate in the community of making. According to Dale Dougherty “we are all Makers. We are born Makers” and it is in our everyday activities that define the scope of making. Furthermore he is classifying the movement as a “digital Revolution that has now reached the workshop” one that is about transforming these digital manifestations into physical artifacts.

The movement is important because it defines the next revolutionary step in manufacturing, making, and education. Chris Anderson chief editor of *Wired* and author of *The new Industrial Revolution* defines the movement and its capacity to scale down the tools of production in what he calls from “inventor” to “entrepreneur”. In short the movement is making it easier to make and take a product to market through the use of free and or cheap tools. Lastly the movement is characterizing a time when the internet and social media are becoming the primary platforms for sharing and consuming the knowledge of making. The spirit of the maker movement can be outlined by author Mark Hatch in his book titled *The Maker Movement Manifesto*, in it he uses a set of action words to frame the movement’s revolutionary can do attitude and all of the facets of the movement. Mark Hatch is CEO of TechShop, “the largest and most influential makerspace in the world.” (Hatch pg.4) At this time there are six TechShop locations across the United States with spaces ranging from 16,000 to 20,000 square feet. These shops contain all of the necessary tools to design and build almost anything. Mark Hatch presents a manifesto to be modified, manipulated and made your own. This manifesto is important in defining the ideology of the maker movement and community involved. It characterizes the social nature of making today which is collaborative, educational, and open source thanks to the internet.



Fig. 7 Make Sign in Fluke Hall

CH.1 NETWORKS OF MAKING

Physical to Digital: Rise of Network Culture / Maker Movement / **Death of Vocational Education**

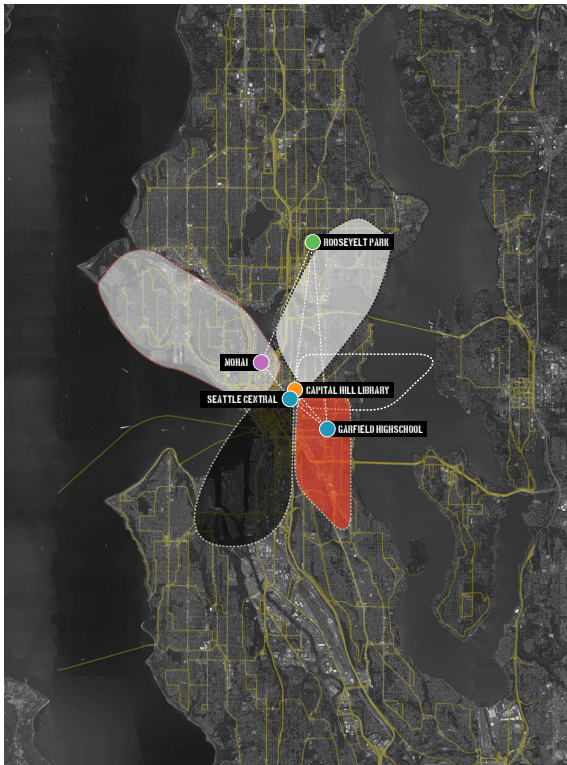
Starting as early as 1980s the United States saw a decline in Vocational Education programs in order to make way for the knowledge economy. In the article The Re-Visioning of Vocational Education in American High Schools (1989) Leonard Cantor points out that declining resources, a continuing stigma, and a rise of academic standards can all be attributed to the decline in vocational education programs. The death of the workshop from educational spaces was actually seen as a technology revolution in which schools focused their attention on computers and the mind rather than a physical inquiry through experience. Computers are expensive and as a result inadequately funded schools disbanded shop classes as well as electives to pay for computers, and other high tech equipment. Computers harbored a new generation of makers who put down their fathers tools, only instead of making furniture they were tinkering with circuits.

CH.2 MAKING TODAY

Making Spaces: An Intro

Today there are thousands of makerspaces in various forms across the world. Some focus on taking a product to market, some present themselves as educational space for kids, while others “collectively use [their] creativity to attack the worlds’ greatest problems and meet people’s needs.” (Hatch pg. 10) Regardless of the focus they all have a common theme of **exploration, collaboration, and learning** through active **engagement with your hands.** (makerspace image 5)

Makerspaces within the city have provided individual makers and entrepreneurs alike with the necessary support needed to make or design a product and take it to market. Many of them function like TechShop in which users pay a small fee to use the space and tools. Some people join to gain access to high tech digital tools and the ability to experiment with them, while others join to realize a startup. In any case people are participating in maker spaces to gain a collective knowledge and exercise the use of their hands. Today “many artists, engineers, and inventors work alone in their labs and studios, but just as many or more collaborate.” (Hatch pg. 26) Makerspaces such as “TechShop” or “FabLab” have helped create a global identity for the maker movement, as well as a sense of place and community that local makers can tap into for support. In Seattle there have been a number of spaces to open that have followed the ideology of the maker movement including **Sodo Makerspace** and **Metrix Create Space** in Capital Hill. Sodo Makerspace empowers its citizens to become makers by helping people turn their ideas into a reality. Both spaces educate the public by offering classes on digital software, coding, 3d printing, CNC machines, vinyl cutters, and even metal and wood working. These spaces are not limited to high tech tinkering such as 3d modeling and circuit printing, but are also capable of low tech tinkering such as working with paper or other hand tools. Stand-alone spaces are the most common form of makerspace, however they can be limited in their reach. As a result **libraries, museums, and schools** have also started hosting makerspaces geared more toward tinkering and education. These spaces are usually impromptu and are not dedicated spaces capable of running twenty four seven, however these spaces do function as makerspaces once they are staged and the tools are brought in. In the end makerspaces today have the potential to become institutions within the city that communities of makers, tinkerers, and entrepreneurs alike can participate in to realize their ideas but also feel a stronger connection to the world of artifacts both digital and physical. Makerspaces today are about community participation rather than a solo romanticized effort.



- Sodo Makerspaces
- Metrix Create Space
- Fluke Hall(UW)
- Jigsaw Renaissance
- Seattle Attic
- Makerhouse(closed)
- ATLSpace

Fig. 8 Site Selection

CH.2 MAKING TODAY

Making Spaces: An Intro



Fig. 9 Fluke Hall Makerspace "Seattle Next"



Fig. 10 SODO Makerspace

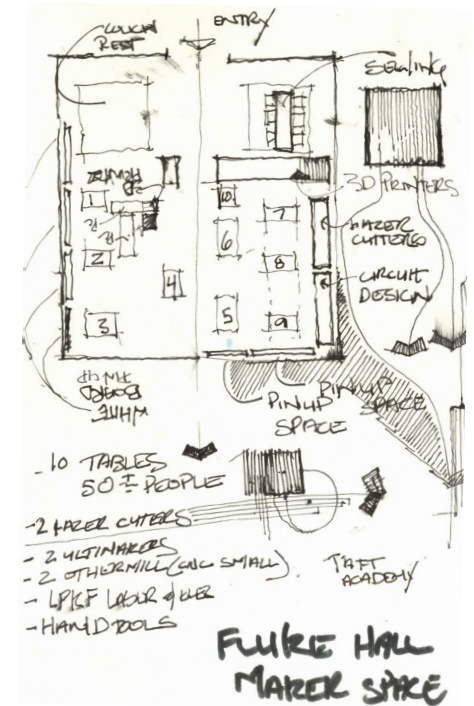


Fig. 11 Fluke Hall sketch

MAKING IS NOT PLACE BOUND. MAKING CAN HAPPEN AT YOUR HOME WORK A WORKSHOP AND SCHOOL PRETTY MUCH ANYWHERE RESOURCES ARE AVAILABLE. FROM THE PHYSICAL TO THE DIGITAL AND FROM ATOMS TO BITS. THE ARTIFACTS CREATED TODAY ARE HAPPENING ON THE SCREENS. LEARNING AND MAKING DOES NOT RELY ON A SINGULAR PLACE LIKE THE LIBRARY. PLACE MATTERS LESS AND LESS IN MANUFACTURING THESE DAYS IDEAS TRUMP GEOGRAPHY. CHRIS ANDERSON PG. 14



Fig. 13 CNC cut plywood



Fig. 14 glue up

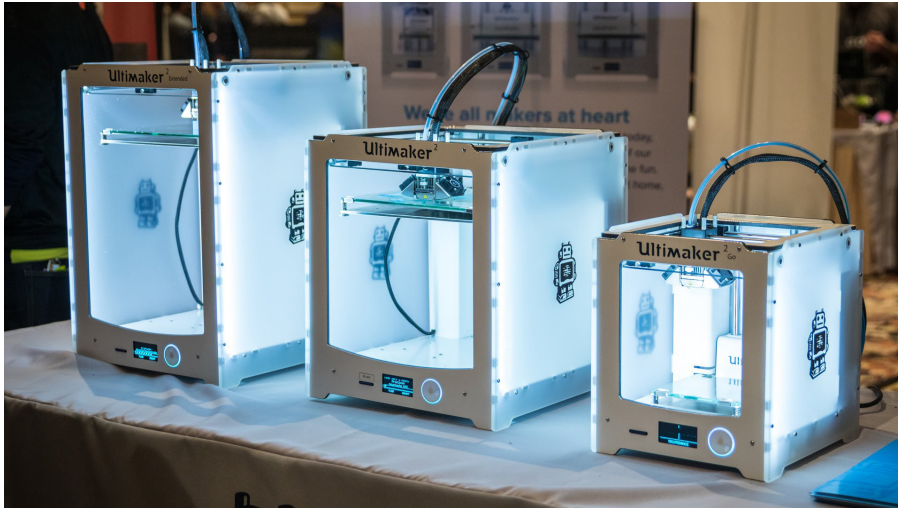


Fig. 12 Ultimaker 3d printer

According to Mark Hatch “it is a fact that tools of the industrial revolution have been exceedingly expensive, hard to use, and of limited power—until now. They are now cheap, easy to use, and powerful.” (Hatch pg. 30) Chris Anderson believes there is no denying the propensity of the maker movement’s capability to bring about an industrial revolution. The maker movement is changing the way we can manufacture and produce things by scaling down operations cost. As a result individuals with nothing more than a computer, some software, and a laser cutter are able to produce a product and take it to market on websites like Etsy with little to no initial investment. Startups are able to create cheap prototypes of their ideas in house without relying on large manufacturing costs or long wait times. In the past, the cost associated with innovation was largely expensive, time consuming, and difficult to obtain. Today thanks to the movement and the community of makers; information, tools, resources, money, and people are easier to obtain than ever. Due to the open source nature of the internet and network culture; information is distributed in an open source fashion waiting to be built upon or remixed. Furthermore sites like IndieGoGo, and Kickstarter have created platforms for funding innovation in which the community participates by donating a sum of money to the cause. For a small donation participants receive perks; the more money they donate the better the perks will be. Chris Anderson says that “the process of making physical stuff has started to look more like the process of making digital stuff.” (pg. 25) Personal computers, 3D printers, laser cutters, and CNC are beginning to liberate the means of production putting them directly into the hands of the maker. This democratizing effect; means that startups can be both small and global, high tech and low cost. In short the DIY movement has met the digital computer revolution. Today the cost of innovation means having access to digital fabrication tools which have been cheaper, and far more powerful than ever before. Thus making is not limited to the factory, in fact the tools of industry can now exist in any space.

IF YOU DO SOMETHING VIDEO IT. IF YOU VIDEO SOMETHING POST IT. IF YOU POST SOMETHING PROMOTE IT TO YOUR FRIENDS. INDIVIDUAL MAKERS GLOBALLY CONNECTED THIS WAY BECOME A MOVEMENT. CHRIS ANDERSON PG. 13

Starting in the 1980s and 1990s the romance of making things with your hands began to fade, people stopped tinkering with their car engines, and taking things apart. Instead people began tinkering with computers and making in bits. Finally computers replaced shop classes, and the tools were put into storage. The maker movement is reversing this and once again learning through the act of making is becoming a popular trend. This style of learning defined by Seymour Papert as Constructionist learning theory “undergirds the maker movements focus on problem solving and digital and physical fabrication.” (Halverson & Sheridan pg. 497) Furthermore **tinkering** frames learning as a product of play, experimentation, and authentic inquiry” (pg. 497). Therefore Mitchel Resnick and Eric Rosenbaum in their paper *Designing for Tinkerability*, they state that “just making is not enough,” and therefore propose Tinkering as the act of making with a playful approach, experimentation, and iterative style of engaging with a problem or project. (pg. 164) This type of play is the way the maker engages the world in a dialogical practice. The learner must have a conversation with the problem, material, and the people around him. Tinkering is not limited to the physical world and can be used in the context of making digital or physical artifacts. Mitchel Resnick and Eric Rosenbaum make the case that if the informal nature of making and tinkering are to become a model for education then there must be some blurring of the lines between formal education and informal progressive learning theories.

#NATIONOFMAKERS

THIS IS A COUNTRY THAT IMAGINED A RAILROAD CONNECTING A CONTINENT IMAGINED ELECTRICITY POWERING OUR CITIES AND TOWNS IMAGINED SKYSCRAPERS REACHING INTO THE HEAVENS AND AN INTERNET THAT BRINGS US CLOSER TOGETHER. SO WE IMAGINED THESE THINGS THEN WE DID THEM. AND THAT'S IN OUR DNA. THAT'S WHO WE ARE. WE'RE NOT DONE YET. AND I HOPE EVERY COMPANY EVERY COLLEGE EVERY COMMUNITY EVERY CITIZEN JOINS US AS WE LIFT UP MAKERS AND BUILDERS AND DOERS ACROSS THE COUNTRY. -PRESIDENT OBAMA REMARKS AT THE WHITE HOUSE MAKER FAIRE NATIONAL DAY OF MAKING ON JUNE 18 2014



Fig. 15 Tinkering Lego Mindstorm

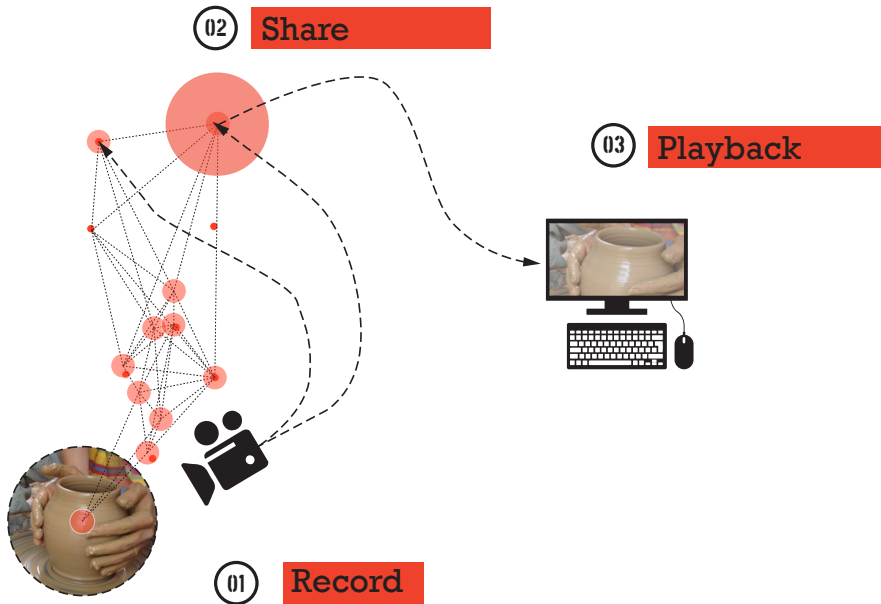


Fig. 16 Record>Share>Playback

Part of what is driving the maker movement is the acquisition of knowledge and information, something that is being accelerated by the network culture and online instruction. This network is “exploding with instruction,” all one has to do is open up [Youtube.com](https://www.youtube.com), [Lynda.com](https://www.lynda.com), or [instructables.com](https://www.instructables.com) and learn anything from calculus to playing electric guitar. Furthermore websites like “thingiverse” provide users with 3d models that can be downloaded; then manipulated and modified before finally printing it on a 3d printer. This cultural network is important in understanding the human experience today and how the world of tomorrow will learn and access information. Thus today we see the trend of instructional videos and other forms of online learning as information and knowledge becomes further democratized. These informal videos have created an instructional overload with literally millions of educational videos to browse from. Network culture has brought learning to the masses through “how to” cooking videos, carpentry, mechanics, sewing, software, and many more. This phenomenon is popularizing the education of making and once again people are learning to make through informal instruction. “Today we situate ourselves less as individuals and more as the product of multiple networks composed of both humans and things.” (Varnelis, pg. 7) Makers are sharing their knowledge and experience with making to a much wider audience rather than keeping it a secret for themselves. Today’s return to making is characterized by the open source nature of the network in which the necessary knowledge, skills, and resources around any particular type of making can be found online. In short, Network culture is informing the act of making by providing easy access to information, tools and resources.

CH.3 CONNECTING MAKER NETWORKS

Goals and Objectives

The model for a new makerspace should fall in line with the ideology of the maker movement, creating spaces that support the act of making as an investigatory approach. Furthermore the strength of the makerspace will depend on its ability to reach an audience both local and far. In order to achieve this, the makerspace will not exist in isolation, instead it will plug itself into existing networks both physical and digital. Thus a makerspace will depend on "Network Culture" as infrastructure in order to support the necessary collaboration between communities of makers. At an urban level the network of maker spaces will serve communities much like a network of libraries, acting as hubs providing open access information to be accessed by anyone. It will focus on the act of making (tinkering) as a new form of education and inquiry, thus blurring the lines between formal and informal education. Furthermore the process of making is to be seen as a dialog between digital and physical craft and a resolution between the two. Lastly the documentation of the physical artifact is a necessary process, thus the space will capture the act of making to be shared with the community of makers across the network. This documentation will serve as a digital artifact or rather an instructional video to be shared, remixed and built upon. The mobile makerspace does not isolate itself within the fabric of the city but presents itself as a system of makers, making the case that making is stronger in numbers.

GOALS AND OBJECTIVES

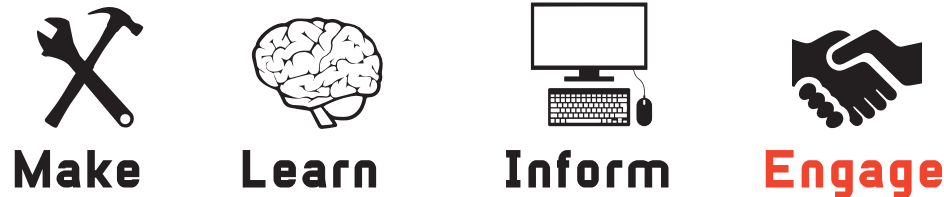


Fig. 17 Engage Diagram

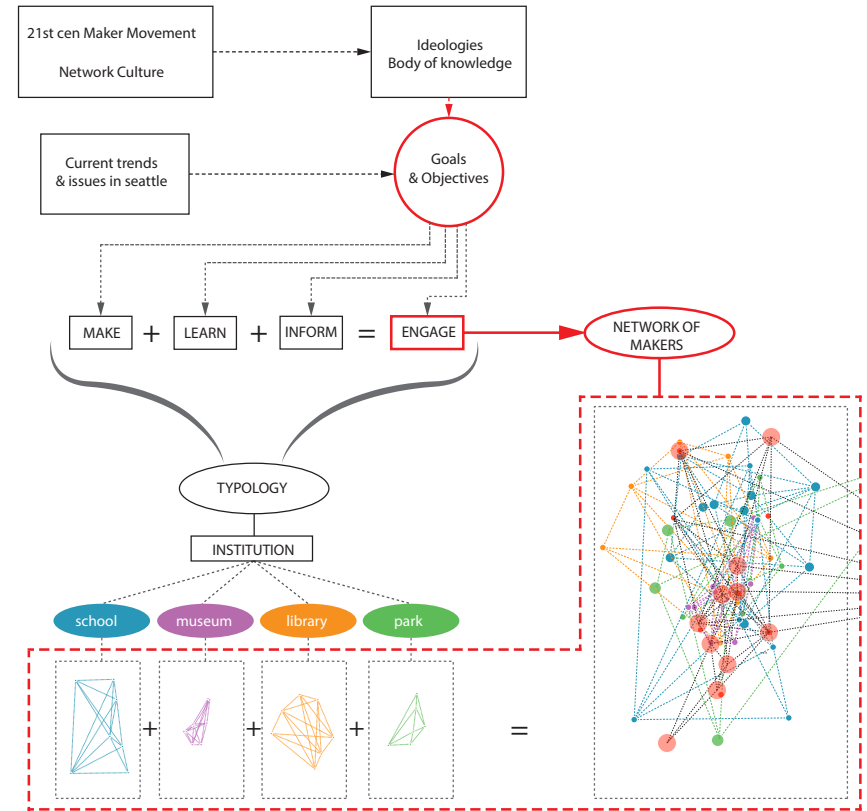


Fig. 18 Goals into Networks diagrams



CH.3 CONNECTING MAKER NETWORKS

Goals and Objectives / Site Selection

PLACE MATTERS LESS AND LESS IN MANUFACTURING THESE DAYS IDEAS TRUMP GEOGRAPHY. CHRIS ANDERSON

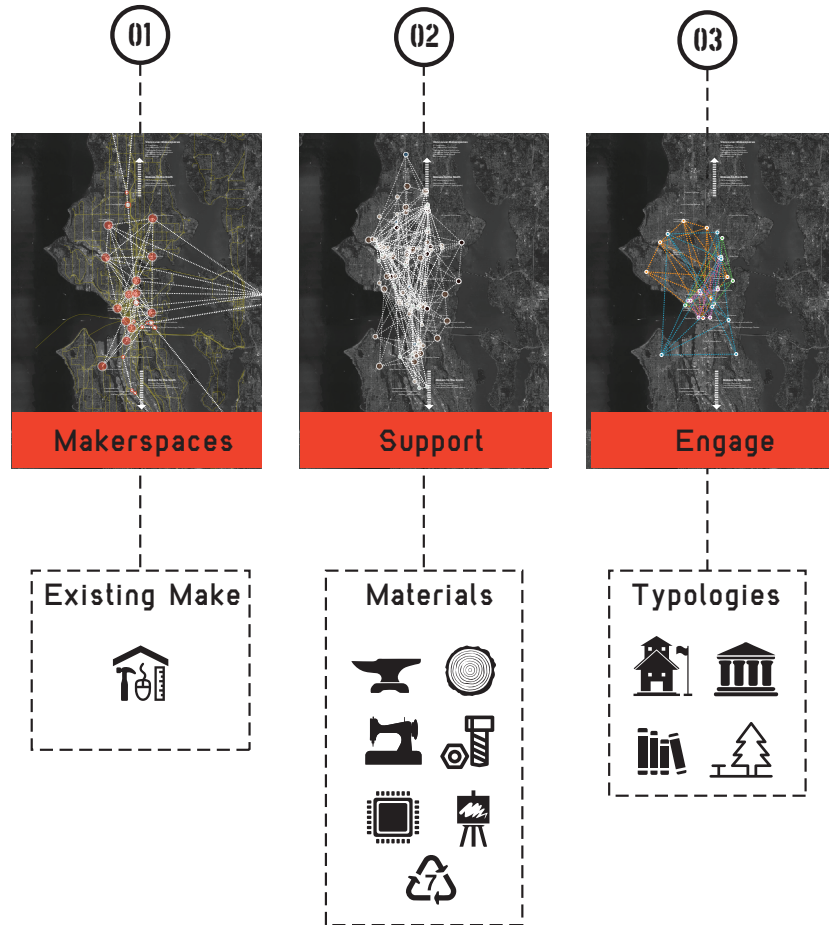


Fig. 19 Concept Model mobile makerspace

Making is not place bound. Making can happen at your home, work, a workshop, school, and pretty much anywhere resources are available. From the physical to the digital and from *Atoms to Bits*. The artifacts created today are happening on screens. Learning and making does not rely on a singular place like the library. The Pacific Northwest today can be characterized by its “cutting-edge technological development,” but it is also here that a “new maker culture is emerging.” (Jennifer Navva Milliken, pg. 19) The location of a new maker space is to be located in the city of Seattle at the intersection of multiple networks both physical and digital. However the intersection is in constant flux and therefore a mobile makerspace is proposed. With a mobile platform the makerspace can move from site to site, plugging into existing local infrastructure as well as local institutions. The mobile platform will be able to travel to a particular place unfold and transform into a space for making. The makerspace is to be thought of as a modular system of spaces that can be unpacked and set up much like a traveling carnival. Therefore spaces will be defined by activity and the process of making but also by the constraints of a mobile platform. This challenges the idea of making in the 21st century and makes a statement about places of education and knowledge. Education is not limited to any one particular place, furthermore mobile platforms have been used in the past for a variety of uses including blood banks and even mobile healthcare facilities. A mobile platform is free to challenge the idea of making and education in the 21st century without particular site constraints, or damaging its message by only addressing a single community of makers. The makerspace should support the education of making within the local community of Seattle as well as the larger context, one related to network culture and the maker movement. A mobile platform is therefore free to move within the local context of Seattle as well as the larger and broader definition of network culture. The mobile makerspace will move through the existing network (making, learning, information) documenting the process of making along the way and uploading the process of making for a larger context to learn from. Therefore site is to be conceptualized as a network of makerspaces that a mobile platform could plug into further connecting communities of makers together.

CH.3 CONNECTING MAKER NETWORKS

Network of Makers



Makerspaces - Existing makerspaces within Seattle that begin to support a 21st century maker movement narrative. These physical spaces while they support the maker movement do not engage the public on an urban level. This thesis acknowledges the potential of a static intervention and realizes that the economy of a physical maker space does not always add up. Of the maker spaces to pop up in Seattle a couple of them have closed due to the financial feasibility in keeping a makerspace running.

Support Network - A support network is defined as the potential to make. It represents the physical and ambient flow of materials. Seattle has a long history with industry and much of the physical support network that created said industry is still alive. A support network is defined as a material (wood) and is to include everything related to the modification of that material.

Engage Network - Defines a potential intervention within the urban fabric. The engage network looks at the existing typology of institutions within Seattle and recognizes their potential to become energized urban cores with high levels of foot traffic. The engage Network is used to foster a relationship between local neighborhood institutions and the network of makers both physical and digital; local and global.

Fig. 20 Three Networks

CH.3 CONNECTING MAKER NETWORKS

Goals and Objectives / Site Selection / Network of Makers in Seattle

MAKERSPACES

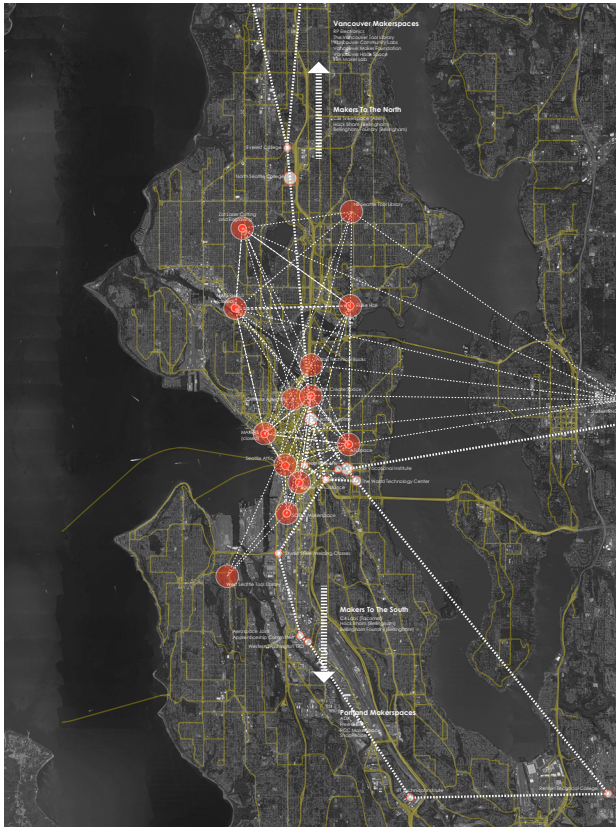


Fig. 21 Existing Make Network



ENGAGE

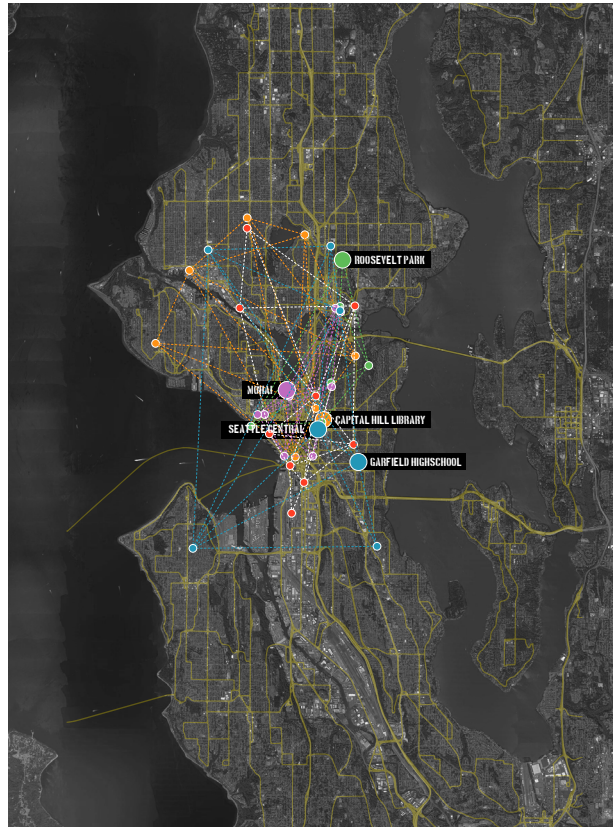


Fig. 22 Engage Network



SUPPORT

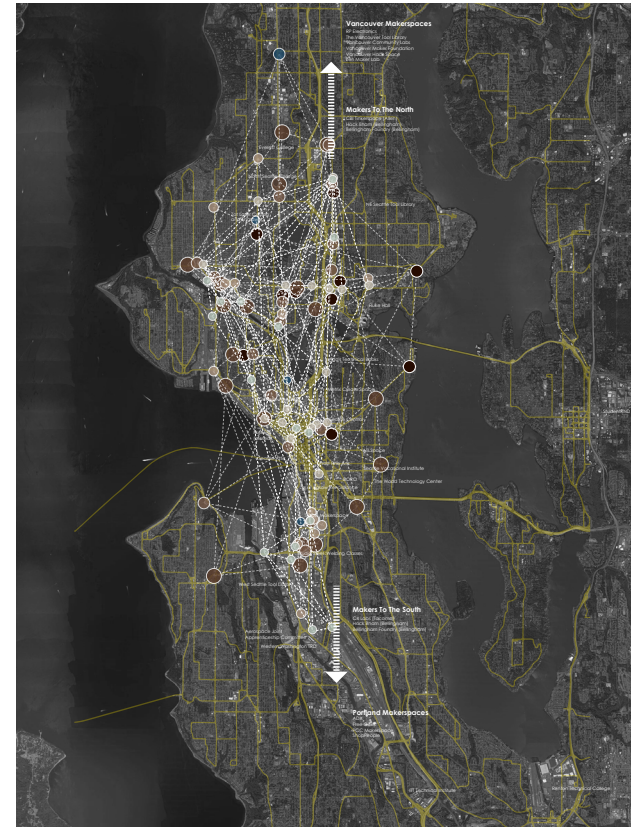


Fig. 23 Support Network



CH.3 CONNECTING MAKER NETWORKS

Goals and Objectives / Site Selection / Engage The Network

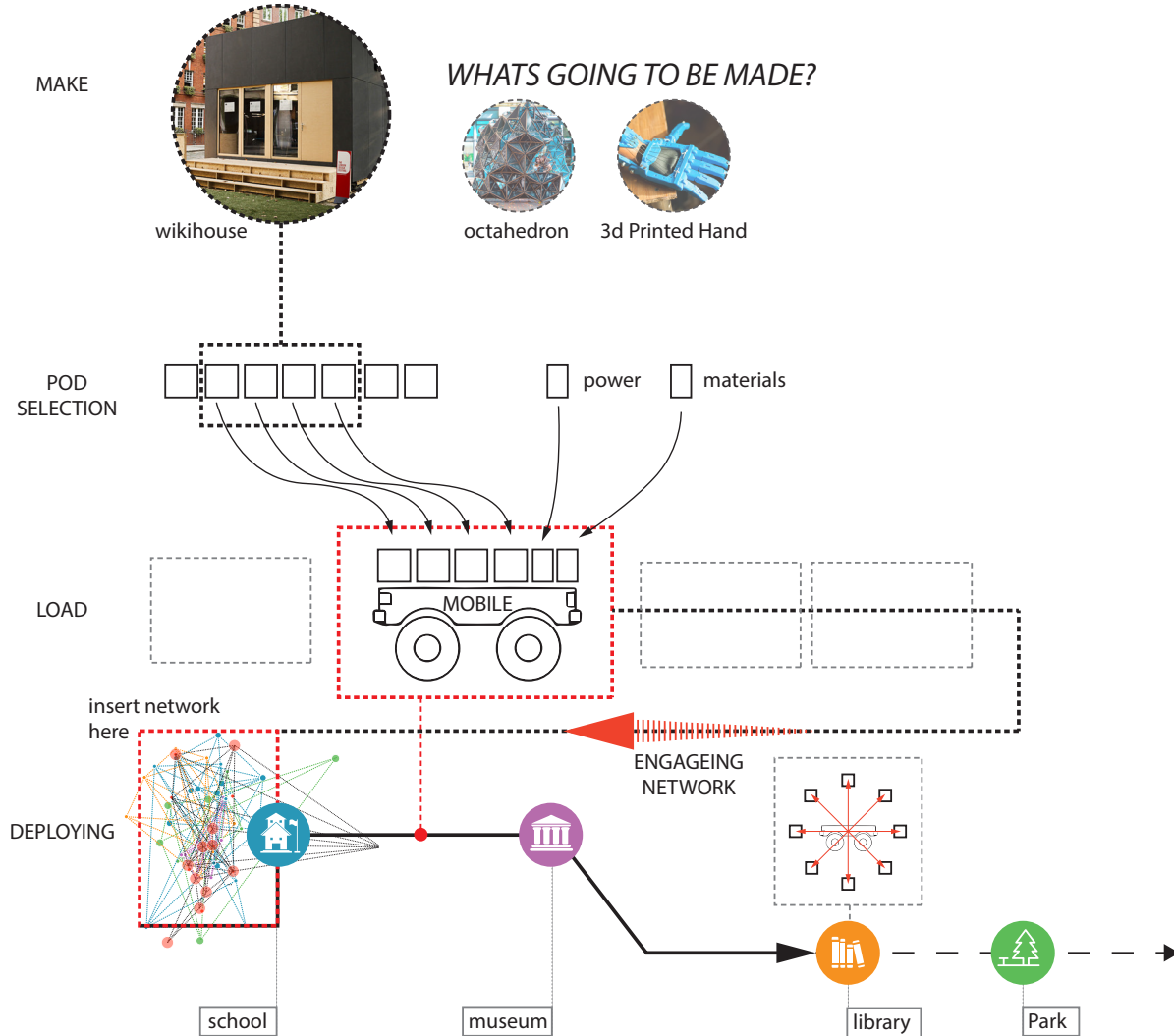


Fig. 24 Mobile Makerspace Diagram

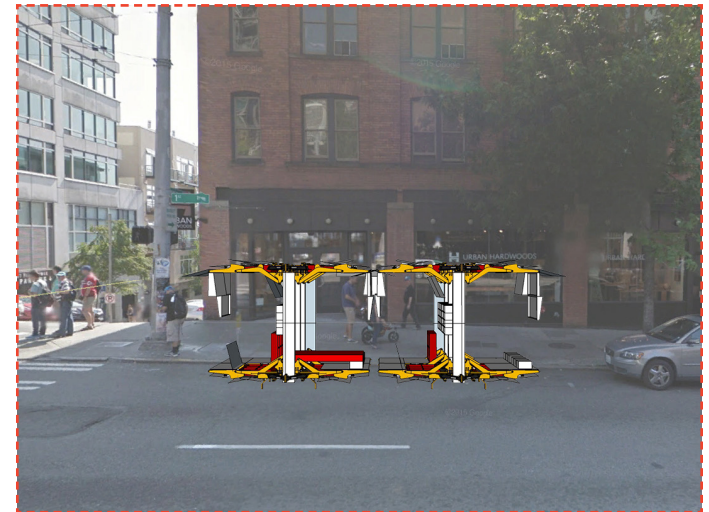


Fig. 25 Site Deployment

CH.3 CONNECTING MAKER NETWORKS

Goals and Objectives / Site Selection / Engage The Network / Program

The program for a new makerspace is to be broken down into its main ingredients and is to be defined by the act of making, education, and documentation. As a result space will be defined by the process of making and learning; reflecting the open, flexible, and collaborative nature of making and education today. Education will happen through an informal exploration of making, thus providing adaptable and flexible work space will be necessary to ensure a variety of possible outcomes. The making of “maker space” will be based on community engagement, adapting to the particulars of the maker and or site. Documentation will happen alongside the act of making and exist as a system within the mobile platform however a cellphone will do just fine. The documentation of making will be done through video and photo, and then uploaded to the #networksofmaking. Lastly, community engagement should be supported with program elements that engage the network of makers on a local and global scale.

MAKER PODS

programatic elements

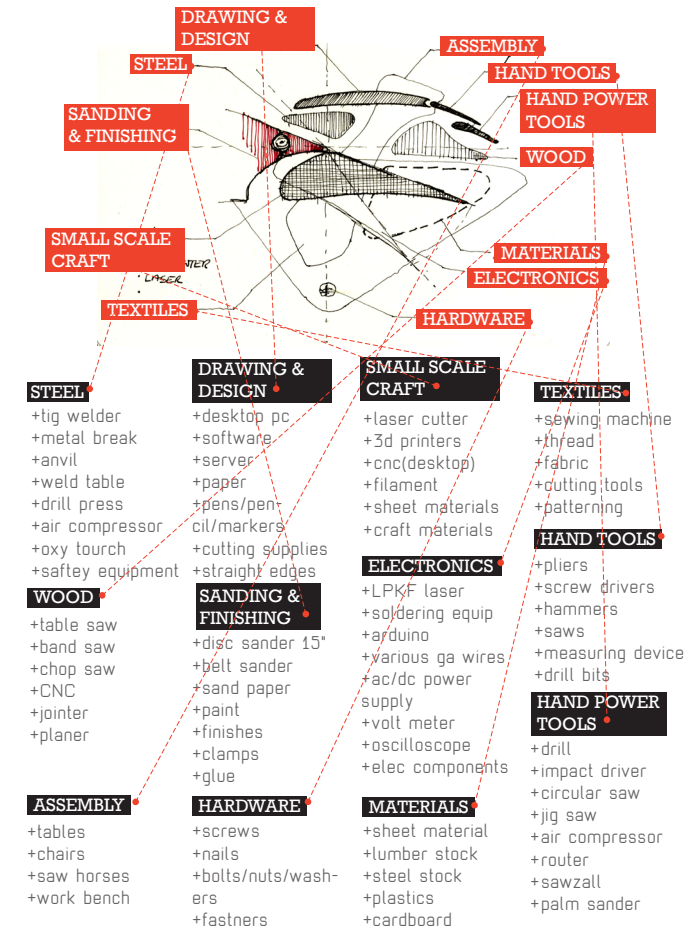


Fig. 26 Programatic Elements

CH.3 CONNECTING MAKER NETWORKS

In determining the role of architecture the design will be approached as an exploration in systems design. Therefore the design process will be based on a series of prototypes for the mobile maker space and how the process of making can inform the role of space. Scott Doorley, author of *Make Space: How to Set the Stage for Creative Collaboration* outlines a list of interventions that can be done to create a more collaborative making environment. By using a variety of adaptable work surfaces, storage solutions, and pin up walls the traditional workspace can be transformed into a space prepared for adaptability. The process for the MMS was unusual in that the development of a flexible system was done initially by utilizing what was already here as a way of representing the various systems that would make up the final MMS. This was done to bake complexity and variability into the design from the beginning. Doing so allowed for quick testing of the initial concept something that would develop from prototype to prototype. The design process can be characterized as a constant back and forth dialogue between site and armature. Throughout the process prototypes at any given stage were constantly being plugged into the site for testing. A dialogue between site and armature was to be desired and even discovered. Furthermore a connection between the process of making and the layout of the armatures on site were also to be discovered.

Furthermore this thesis begins to explore the meaning of the Physical and Digital Artifact by working through a hybrid process of digital and physical prototyping. The process is described as hybrid in which sketches and physical models become translated and even remixed through a digital process. Likewise the digital artifact then becomes translated back into another sketch. In other words the digital or the physical artifact exists in flux waiting to be remixed back into either a digital or a physical artifact. Through this process the sketch or physical artifact becomes the purveyor of ideas and a representation of said idea, awaiting to be carried out or realized through a digital manipulation. Therefore process is played out as the development of a dialogue between the tangible, physical artifact and the intelligible idea.

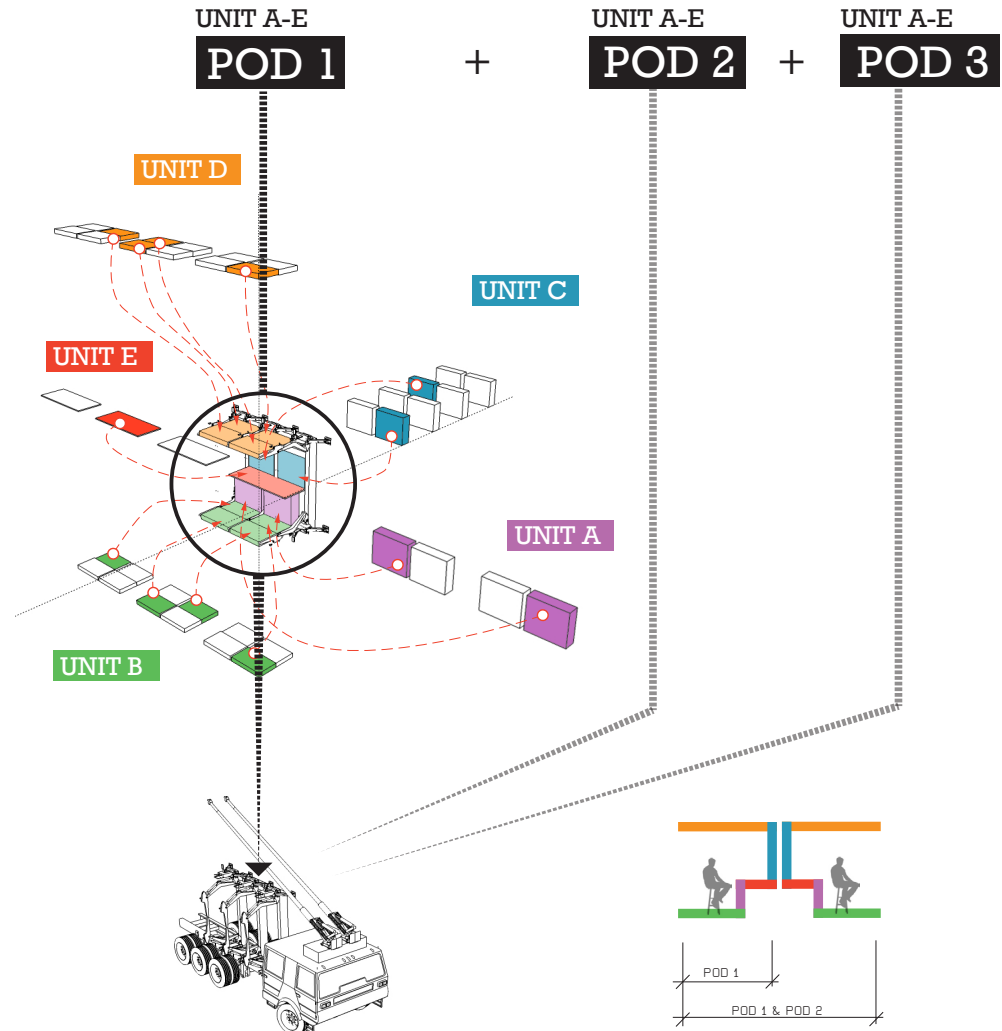


Fig. 27 Components and Kit of Parts Diagrams

CH.4 DESIGN

Process Diagram

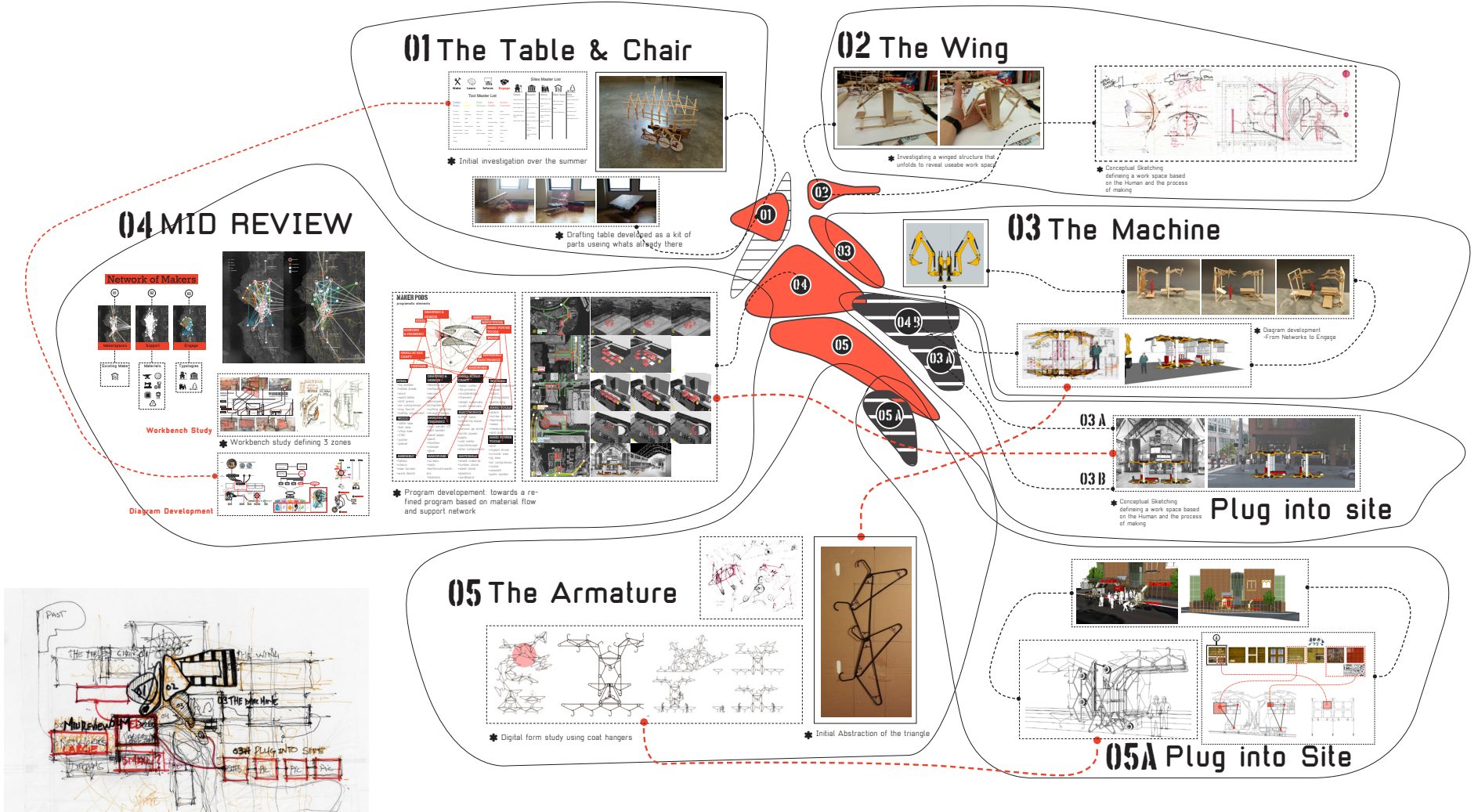


Fig. 28 Physical Artifact of Process Diagram

Fig. 29 Process Diagram Abstract

CH.4 DESIGN

The Table and Chair / The Wing / The Machine / The Armature

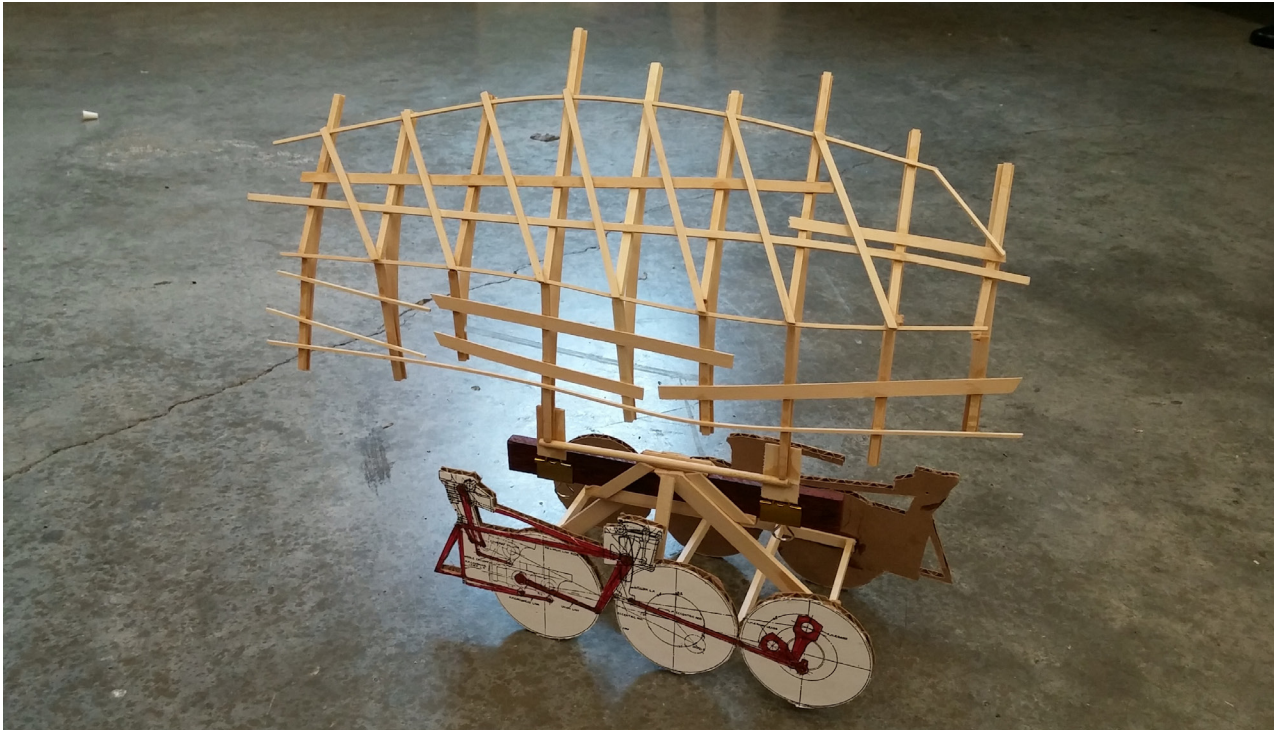


Fig. 31 Concept Model Mobile Makerspace



Fig. 30 Concept Model Table and chair

The mobile maker space is conceived of as a mobile, adaptable, and flexible system that can accommodate a wide range of making processes and site conditions. A mobile makerspace needs to be flexible and adaptable enough to allow for small scale craft one day; and large scale construction the next. Therefore the design is to be conceived of as a system that can be broken down into a series of components or a kit of parts.

The final drafting table was conceived once the sum of the parts were realized. This concept model looks at an assemblage of parts found within my apartment, an old beat up lawn chair, some random boards from a table, my toolbox as a counterweight and some duct tape to hold it all together. Each piece or component holds its own function as separate artifacts, however once combined their identities begin to read as one. Just like that a chair flipped over becomes a frame or structural system that can support the weight of the drafting table.

It was from this initial model that the spirit of making was uncovered and a method for process began to develop.

CH.4 DESIGN

The Table and Chair / **The Wing** / The Machine / The Armature

First concept model embodies the idea of a movable and deployable wing. It is in these first concept models that the idea for a self-contained deployable system was born. The initial idea is that space is framed by the armature and the act of making can spill out onto the streets. It was also realized in this early prototype that the pod itself could possibly contain space once it is closed and frame space once it is deployed. The space for making did not want to be contained behind walls, instead making would happen in the streetscape framed by the armatures themselves. The vision for what would become the final design was born.

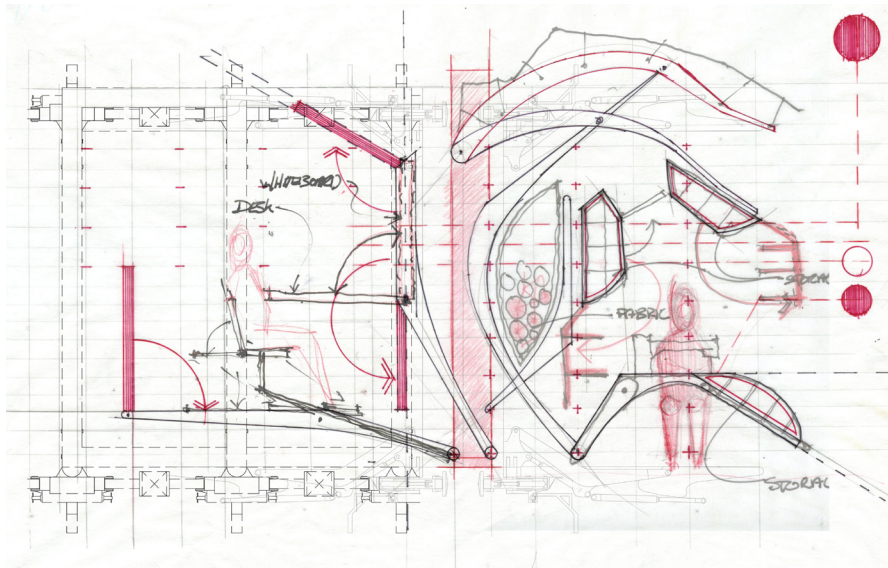


Fig. 32 Concept Mechanism

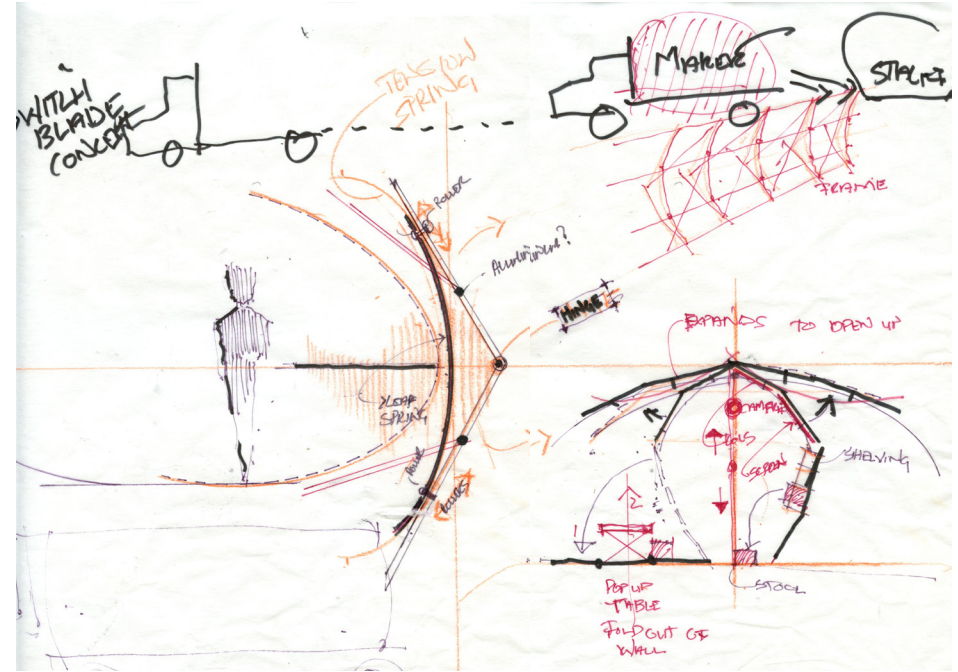


Fig. 33 Searching for The Wing

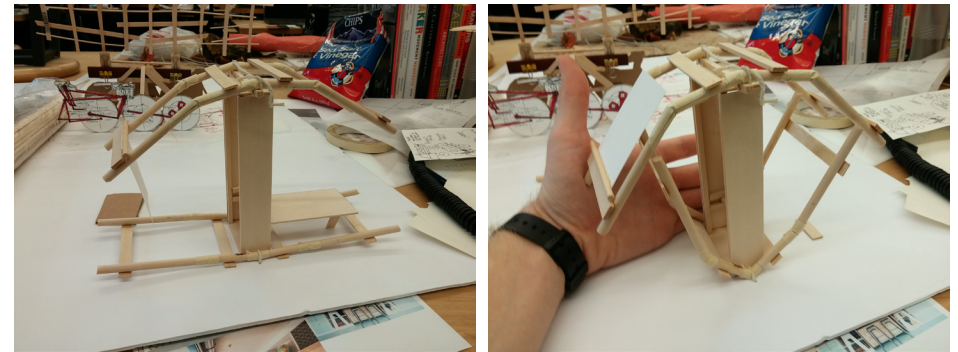


Fig. 34 The Wing Concept Model

CH.4 DESIGN

The Table and Chair / The Wing / **The Machine** / The Armature

Further investigation into the mobile maker space as a machine. The inspiration for hydraulic arms comes from the backhoe assembly of a tractor. This phase of the design was carried out using what is available and remixing them in a way for a customized making experience. The initial concept models were to be thought of as an assemblage of parts and therefore digital models were initially done using downloaded parts off of the sketch up warehouse and bashing them together. Model bashing is a technique originally used by Hollywood in which scaled replica model kits are bashed together to make complex models for movies like Star Wars. Hydraulic arms, Ikea shelving, and tools were remixed together to create a fully moveable flexible prototype. Further development of the physical model was accomplished by laser cutting the arms out and attaching them to a frame. From this study model, the begging's of how the work surfaces could interact with the ground began to uncover itself. It was discovered that a double hinge could allow for another level of fine adjustment so that work surface height becomes an important yet controlled variable by the user. This understanding would be broadened and developed in the next iteration of the mobile makerspace.

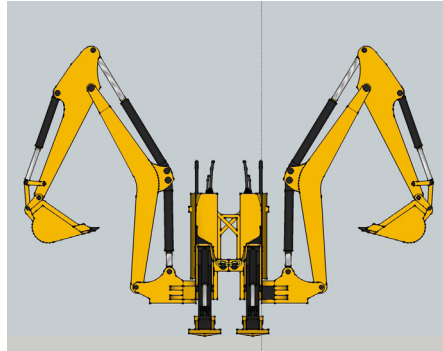


Fig. 36 Back Hoe Arm Assembly

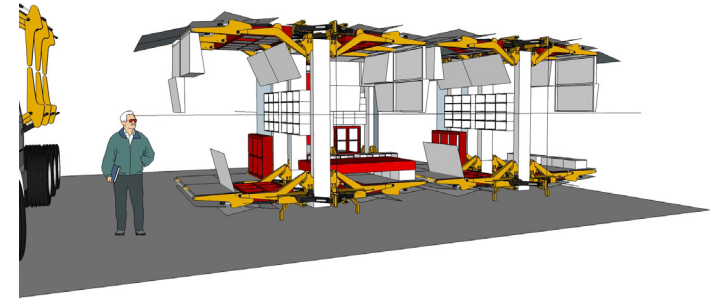


Fig. 37 Model Bashing

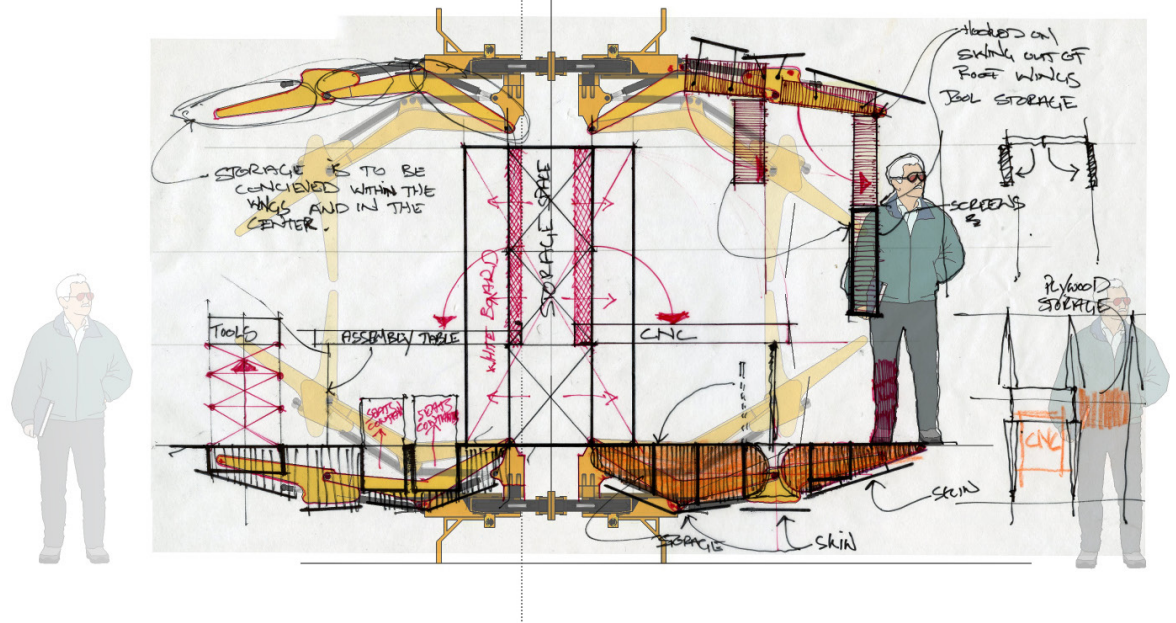


Fig. 35 Remixing the back hoe arm assembly

CH.4 DESIGN

The Table and Chair / The Wing / The Machine / **Work Zone Study** / Armature

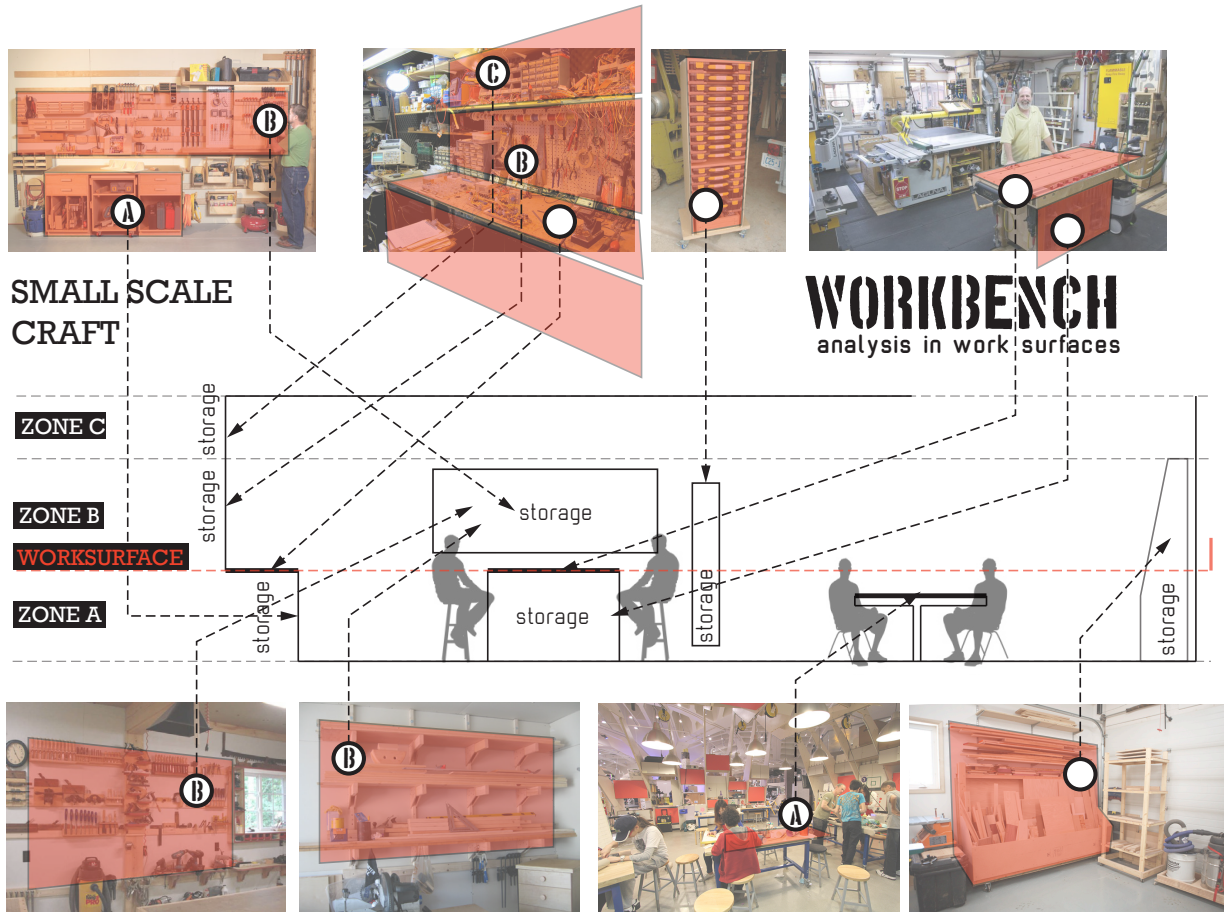


Fig. 38 Work Zone Analysis

WORK ZONE STUDY

It is also during this phase of design that a quick study was done outlining the types of spaces commonly found within a workshop. It was through this exercise that the components or kit of parts began to reveal themselves and an understanding of how storage space functions with respect to work surface and how they can be laid out to aid the process of making.

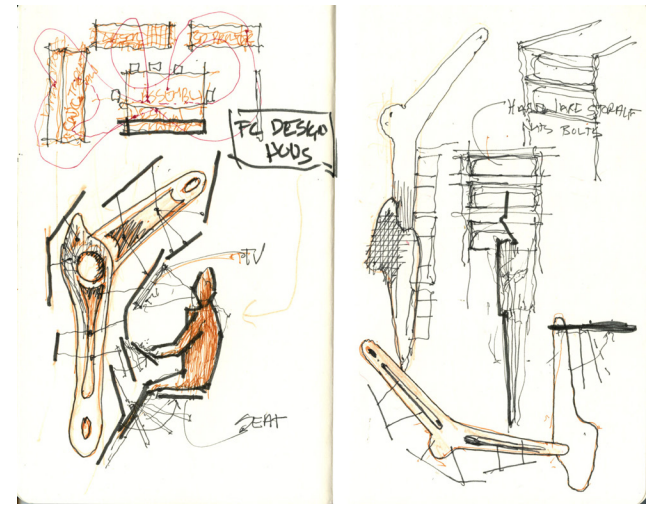


Fig. 39 Investigative sketching

CH.4 DESIGN

The Table and Chair / The Wing / **The Machine** / Work Zone Study / The Machine into Site / Armature

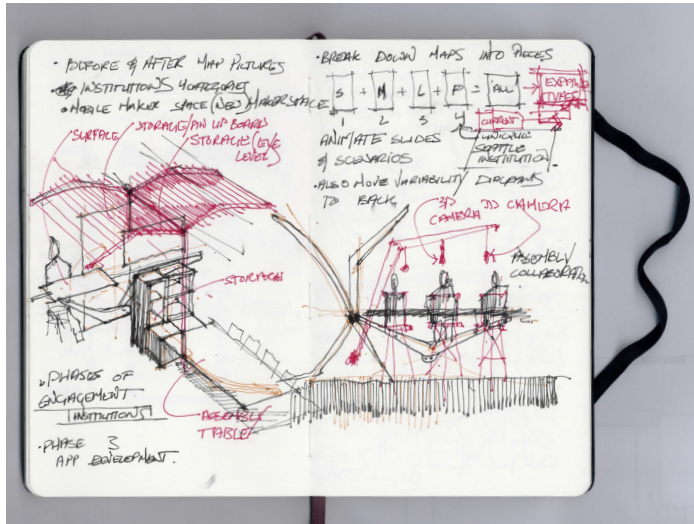
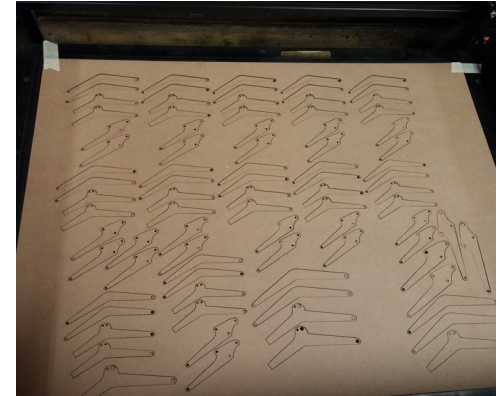


Fig. 40 Tinkering With the Concept Models

Fig. 41 Physical Artifact Remixed

Fig. 42 Laser Cut Parts

CH.4 DESIGN

The Table and Chair / The Wing / The Machine / Work Zone Study / **The Machine into Site** / Armature

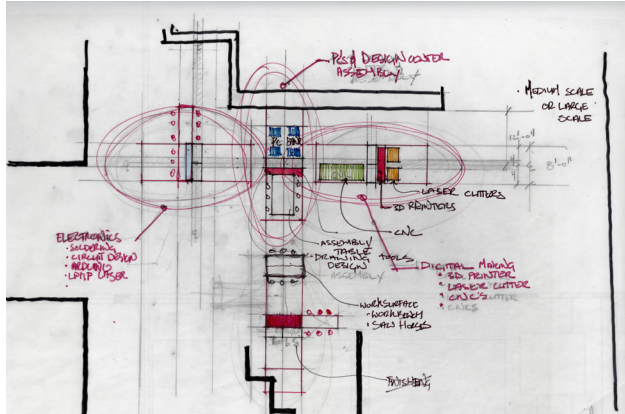


Fig. 43 Plugging the Machine onto site

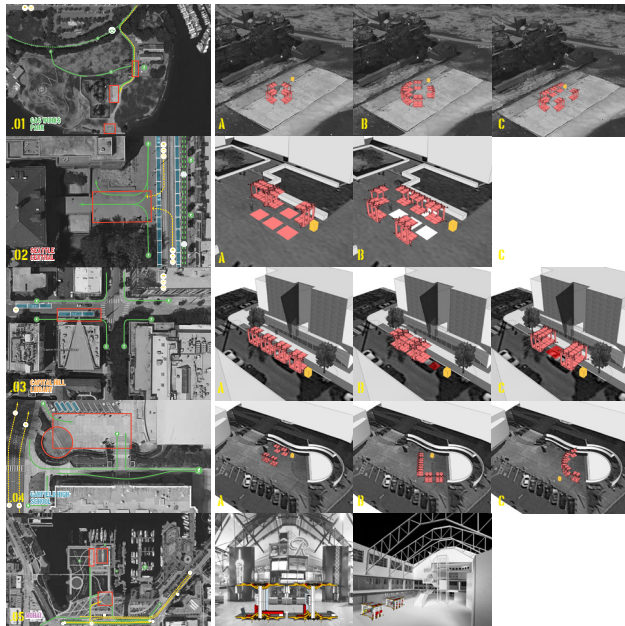


Fig. 44 Site Variability Diagrams

The machine prototype was then plugged into a selection of sites in order to investigate its usability on a wide range of site conditions. Aside from the process of making; a mobile system would need to be able to respond these conditions; including topography, rain, and power. Therefore an understanding of site conditions including topography was developed from these initial site studies. Ultimately a system for how the mms could address these site conditions would need to be developed.

At this stage Making is conceived of as a process that requires space. It is seen as the transformation of raw materials into something else. Often times the process is an additive process or a deductive process in which materials are slowly removed or added. In any case the process of making is often done in stages or different phases. Whether you're designing and cutting pieces out on a laser cutter; then assembling the pieces or your cutting pieces of wood out on a table saw there is an order of operations that ensues. The program of the mobile maker space is developed with this understanding of operations, and realizing that tool placement and process can be a flexible system defined by the maker and a particular process. A generalized system could be developed with enough control variables to allow for a complete customized making experience, one that can be laid out by the maker. Therefore space is defined by the modification of materials, the tools required to do the job as well as overlapping assembly spaces. Some spaces become generalized multipurpose making spaces, while others can become very specific making spaces. These spaces are defined by the act of assembling something or tinkering with materials or even used as multipurpose space to design, draw, think and even collaborate. How these spaces ultimately function once placed on site within the mobile makerspace are to be determined by the maker allowing for a customized yet interactive making experience.

CH.4 DESIGN

The Table and Chair / The Wing / The Machine / Work Zone Study / **The Machine into Site** / Armature

.01 GAS WORKS PARK



Fig. 45 Gas Works Park site plan

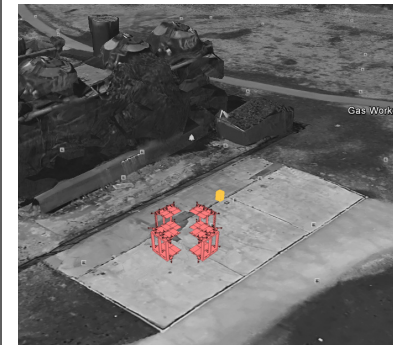
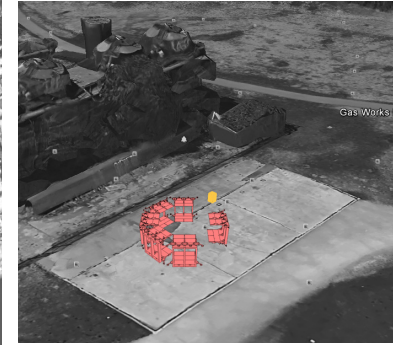


Fig. 46 Gas works Variability

CH.4 DESIGN

The Table and Chair / The Wing / The Machine / Work Zone Study / **The Machine into Site** / Armature

.02 GARFIELD HIGH SCHOOL

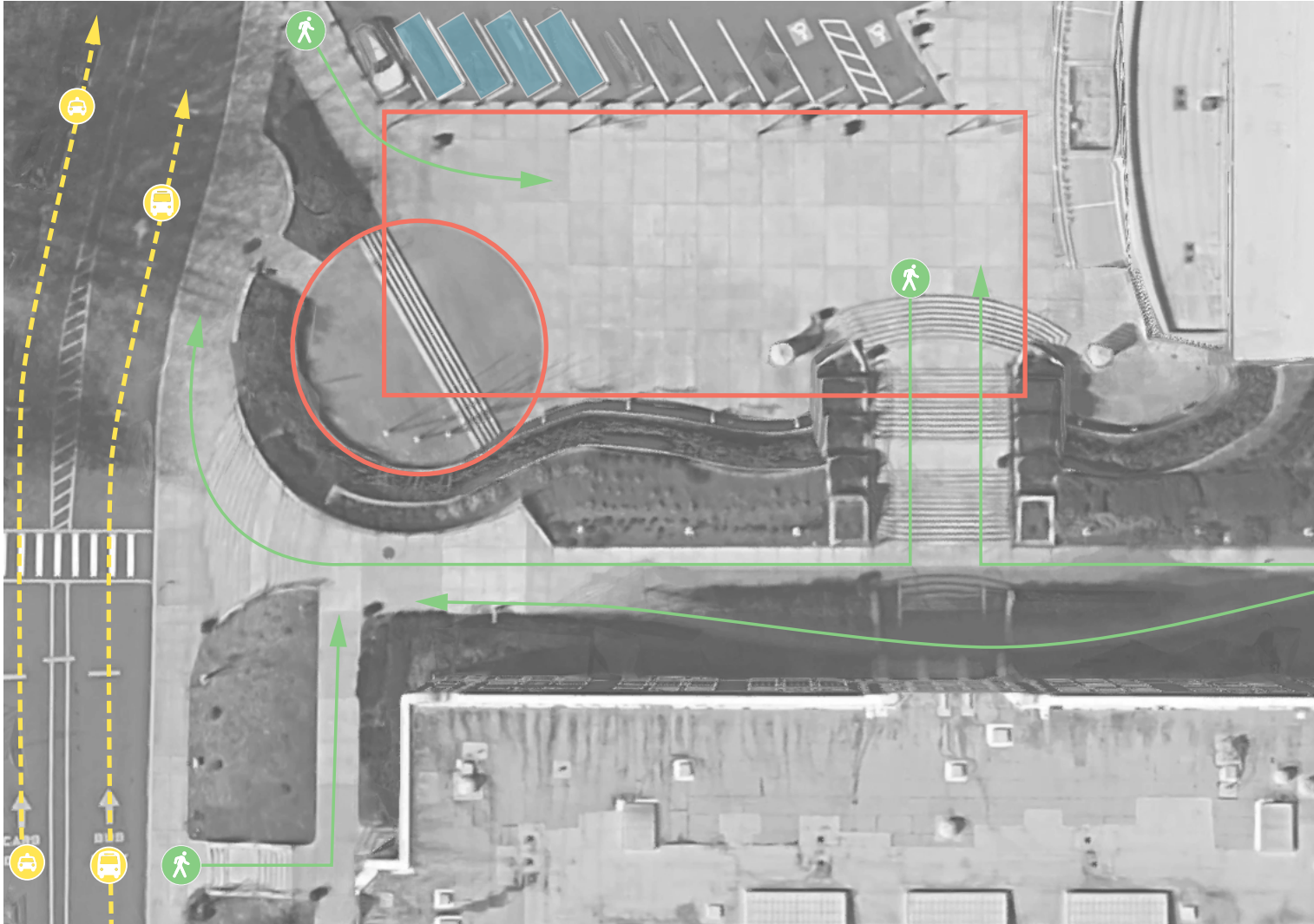


Fig. 47 Garfield High School

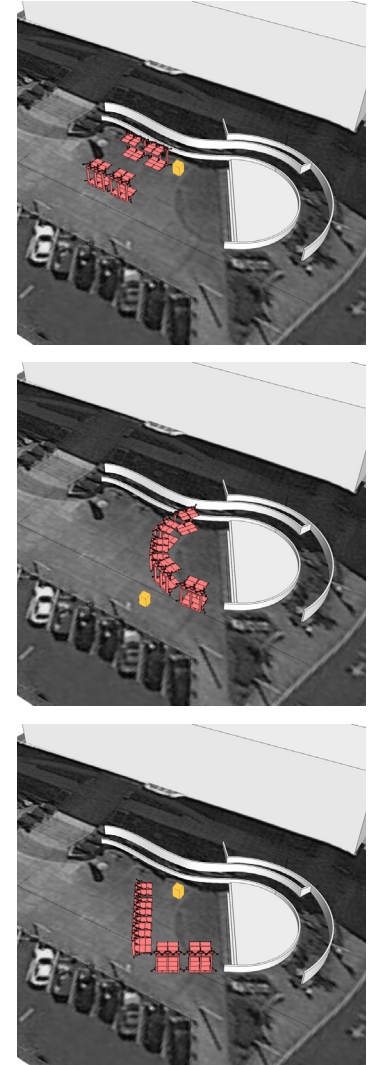


Fig. 48 Garfield Variability

CH.4 DESIGN

The Table and Chair / The Wing / The Machine / Work Zone Study / **The Machine into Site** / Armature

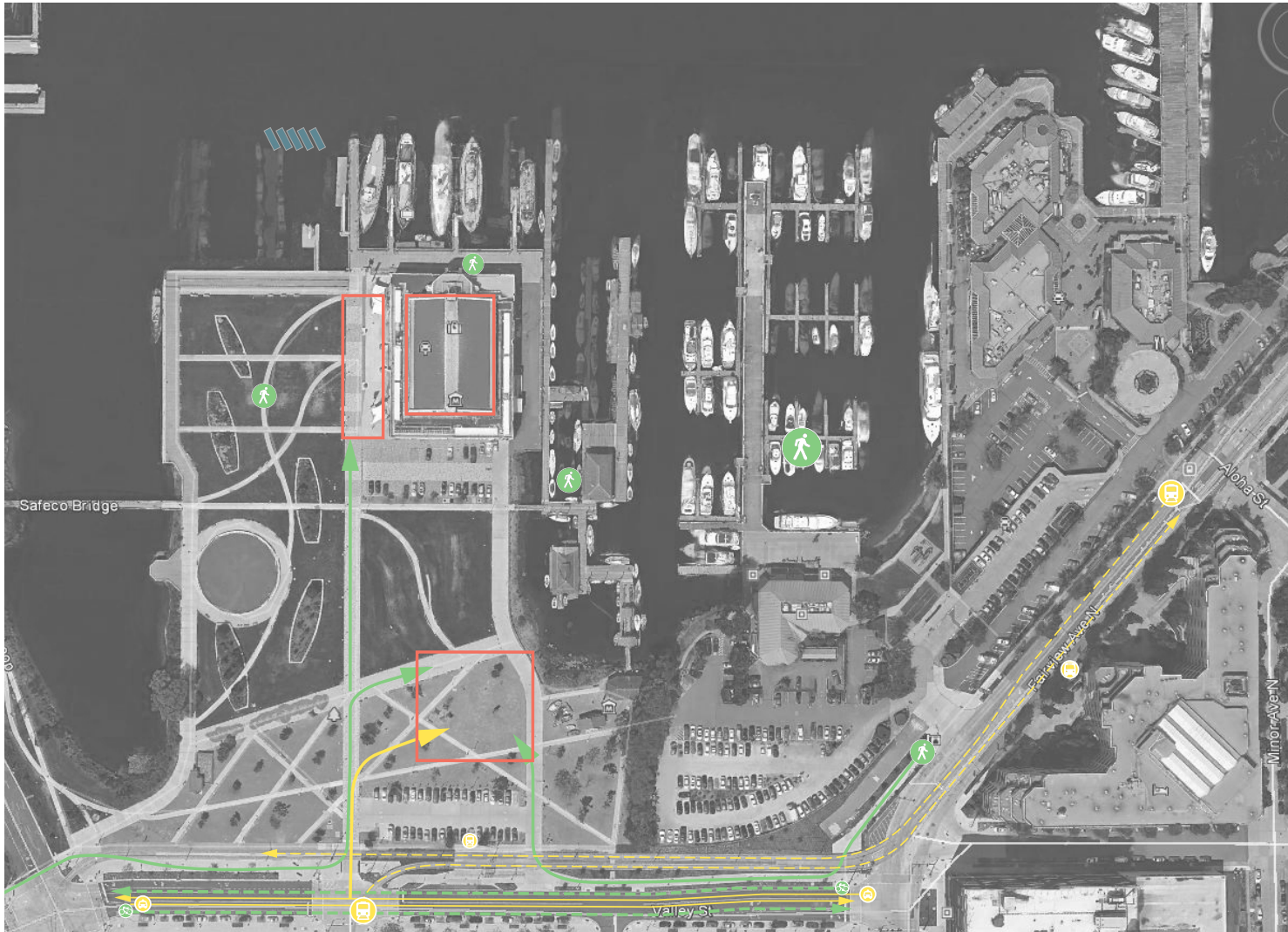


Fig. 49 MOHAI Site Plan



Fig. 50 Plugged into MOHAI

CH.4 DESIGN

After my initial development with the Machine an understanding of site conditions and functionality was fully realized. The concept of the mobile makerspace was realized but without the sensitivity of the human touch or scale. The idea of the machine was originally about creating a very complex machine that could open and close. The development of the Armature is seen as a simplification of the Machine. Meaning was extrapolated from the machine and then simplified for the Armature. In other words the idea or essence of the Machine was to be embodied or carried over into the Armature. It is to be characterized as the frame with which tools and working surfaces can plug into. A frame to house and literally define space and the act of making, nothing more nothing less. With the development of the Armature transparency and permeability are a must, therefore the frame was designed to be both physically and visually lightweight. The idea of making things is to be defined as the relationship between human, tools, materials, and the making space. Therefore the frame or armature supports this idea by creating a dialogue with site by framing out the spaces for making within the urban fabric. The character of the mobile makerspace was conceived of as tools exploding out of their tool box and into the urban fabric. I wanted visibility through the individual pods so that space would feel more open but also so that the act of making becomes staged and framed for the process of documentation through video or photo. In this way the urban fabric or the actual streetscape is conceived of as making space. This is done with the hopes of engaging the public in their own neighborhood. This prototype begins to resolve the kit of parts by begging to define the system that will ultimately make up the final design for a MMS.

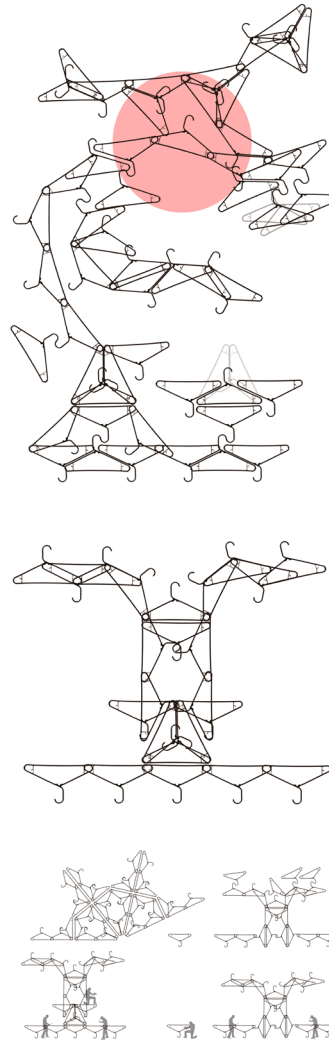


Fig. 51 Discovering the Armature Fig. 52 Tinkering with Hangers

CH.4 DESIGN

The Table and Chair / The Wing / The Machine / Work Zone Study / The Machine into Site / **Armature**

The development of the armature came from extrapolating existing geometry from the machine. An understanding of the geometry present in the hydraulic arms was carried over. I knew that triangular geometry was present in the operation of the arms. I also knew that this idea of an armature or frame was starting to reveal itself through the process. So another concept model came from playing with traditional plastic coat hangers. The hangers metaphorically represent this idea of an armature or a system that is used to temporarily hold or even display something. Throughout the process the hangers are used to represent a structural shape with a pivot point or the potential for a hinged joint that could move. The making of the prototype was thought of as tinkering with the suggestive shape of the triangle by using what already exists. A series of analogue and digital studies uncovered the possibility of a lightweight truss like structure. From these investigations the kit of parts started to become clearer as it became obvious the armature or frame needed to respond to particular site conditions, while allowing other components to respond to the act of making. This exercise investigated how one could take a shape or component and just through the process of arraying it make a unique yet customizable system. It is also in this iteration of the mobile makerspace that great amounts of thought were given to how it touches the ground and sky. Initially the ground for making was conceived as a part or even a component of the mms. In this iteration the ground for making becomes realized and it is decided that making should occur on the physical ground rather than an artificial system or fold out component. In order to accomplish this a self-leveling, adjustment system would need to be developed in order to accommodate the varying amounts of grade change on each site. This detail would also transpire into the same system that could be used to adjust the height of each working surface.

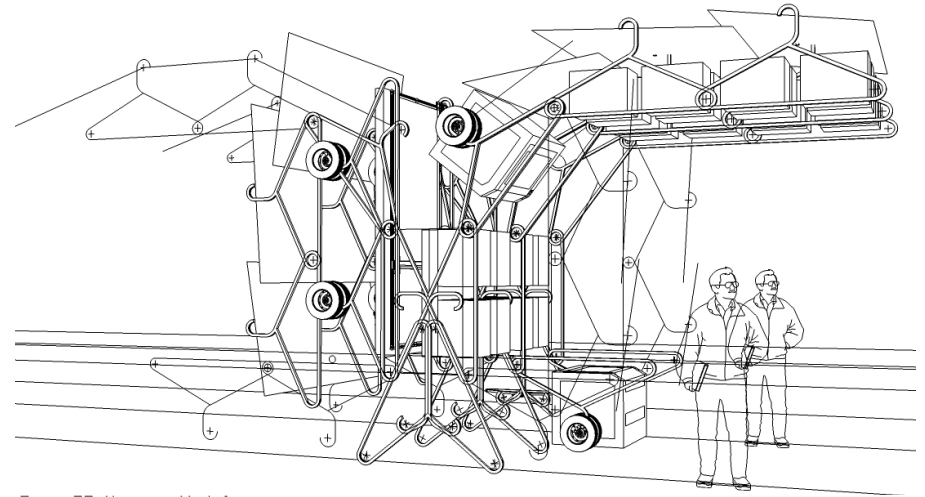


Fig. 55 Hanger Model

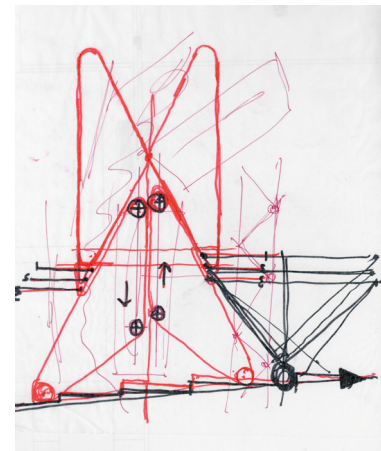


Fig. 53 Armature Geometry

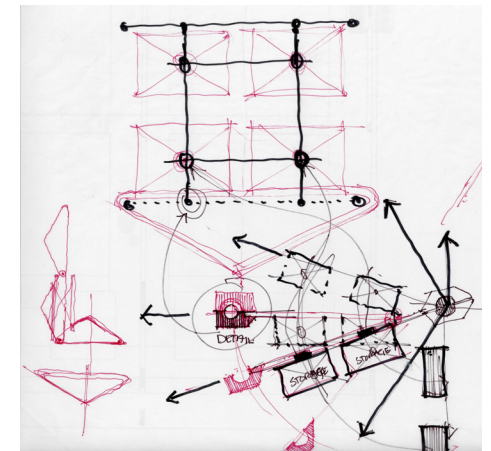


Fig. 54 Systems sketching

CH.4 DESIGN

The Table and Chair / The Wing / The Machine / Work Zone Study / The Machine into Site / Armature / Kit of Parts

The final design of the MMS is to be defined as a kit of parts that are ultimately interchangeable creating a unique and customized making spaces to be defined by the maker or user. Therefore the mobile makerspace is to be broken into its 3 main components the Armature or frame that actually and conceptually plugs into the site. Storage space for the various tools that could be loaded up onto a mobile platform. And finally the last component is thought of as the work surface.

Kit of parts towards a final assembly

- A. Armature
- B. Storage boxes
- C. Working surfaces

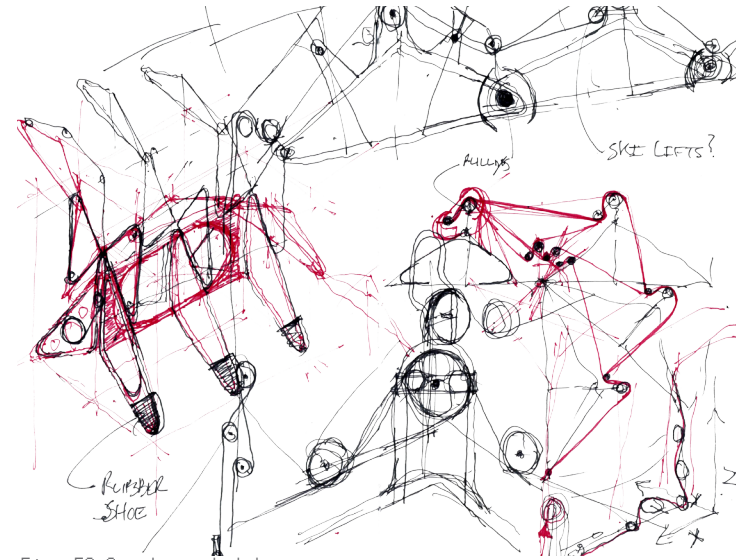


Fig. 58 Armature sketch

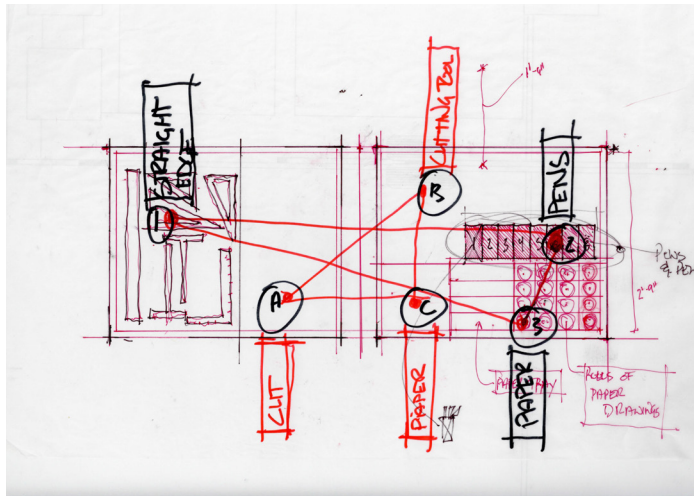


Fig. 56 Storage boxes sketch

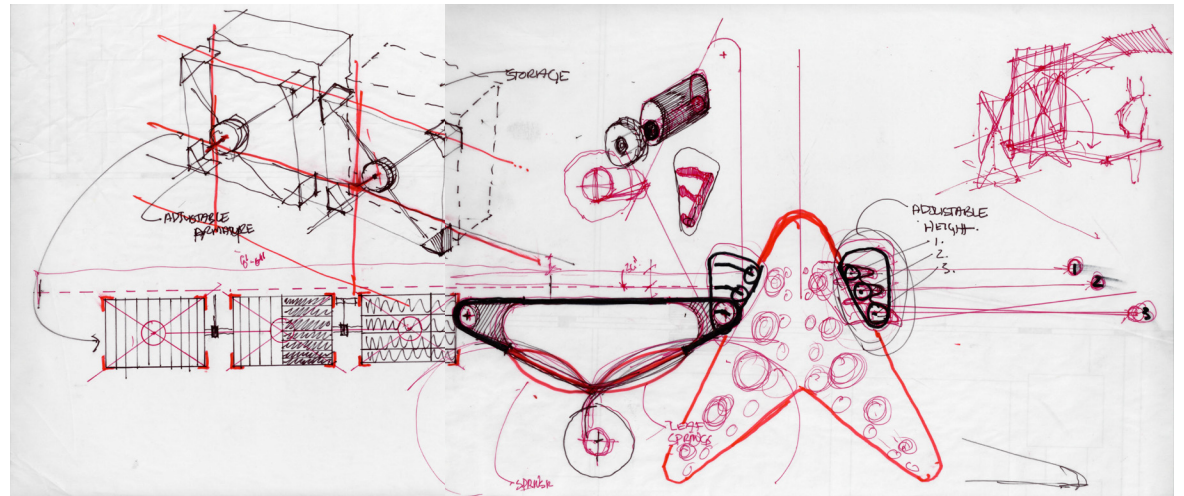


Fig. 57 Working Surfaces Sketches

CH.4 DESIGN

Kit of Parts / (A) Armature

(A) The frame or armature is considered the bare bones with which an array of storage boxes could be selected then clipped into the frame. The idea is that the frame much like a car can be universally flexible enough to respond to site conditions, allowing the rest of the components to respond to the act of making. Therefore the armature was evaluated by its ability to respond to site conditions. The armature developed from tube steel would be painted yellow so as to bring a fun vibrant color to the site and to create contrast with the grey Seattle sky. Yellow is an optimistic and energetic color that will engage the maker and the space it sits in.



Fig. 60 Assmebling the model

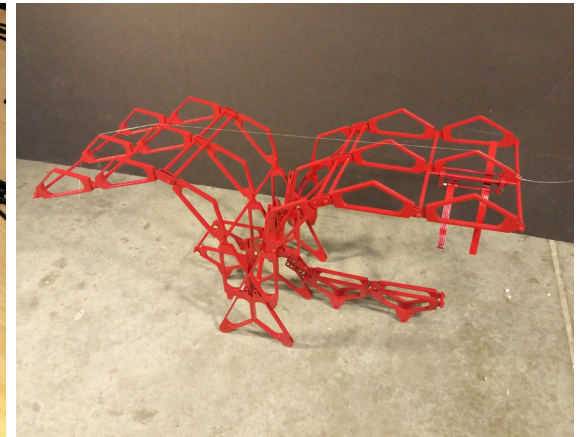


Fig. 62 Assembled Model

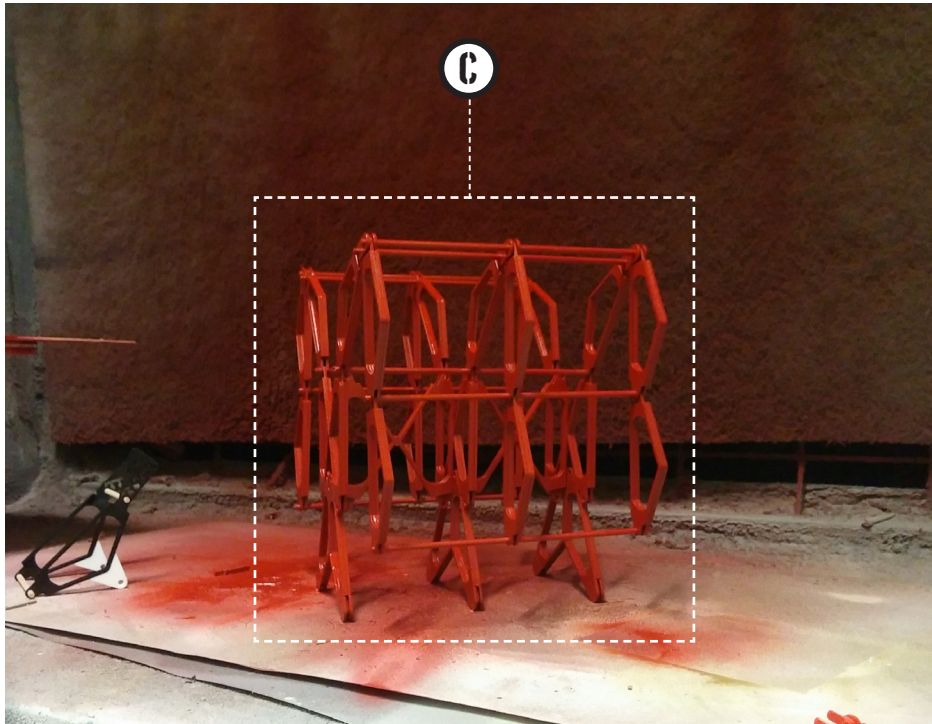


Fig. 59 Armature painting booth



Fig. 61 Knolled out model parts

CH.4 DESIGN

Kit of Parts / (A) Armature / (B) Storage Boxes

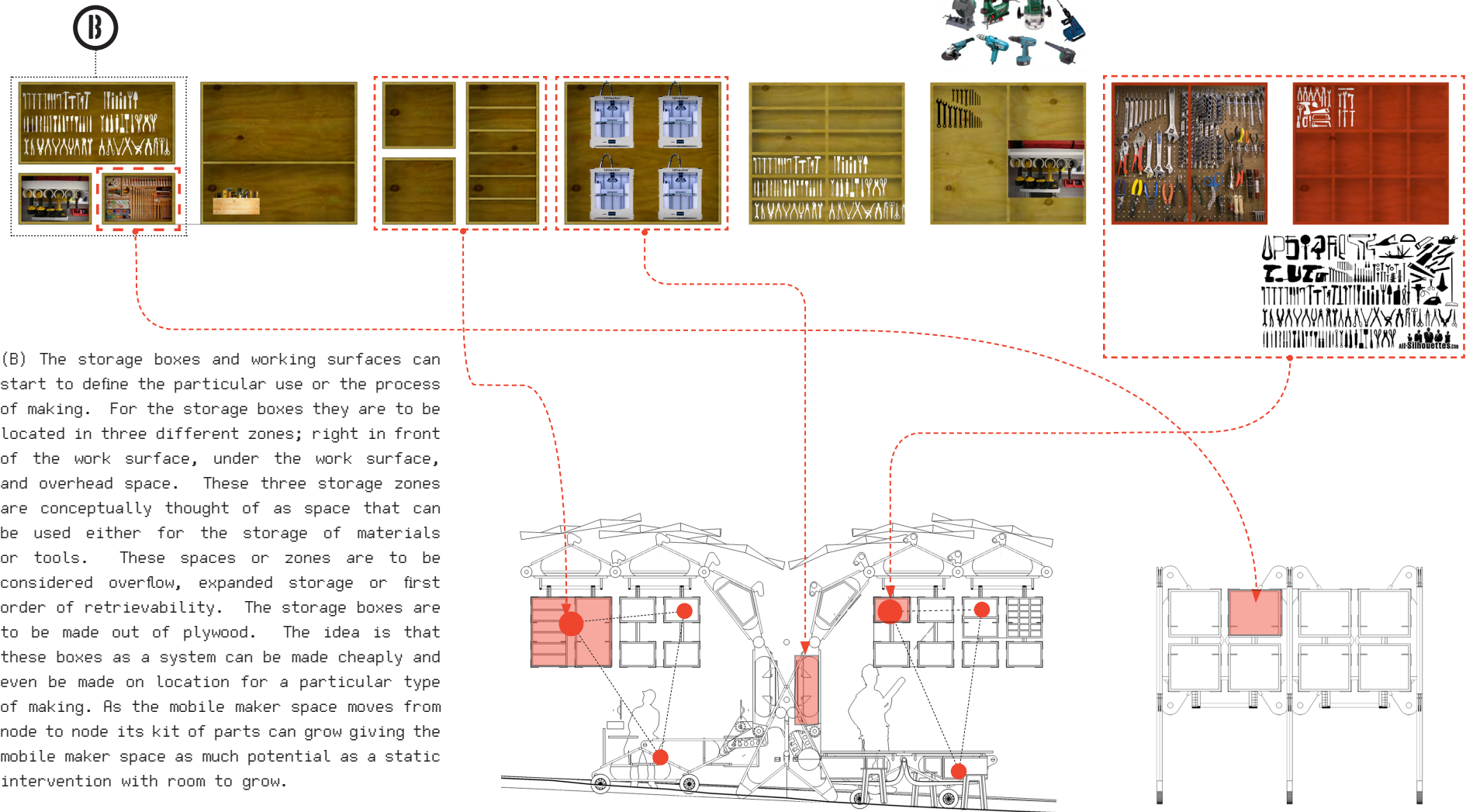


Fig. 63 Storage Boxes Diagram Components

CH.4 DESIGN

Kit of Parts / (A) Armature / (B) Storage Boxes / (C) Worksurfaces / Drawings

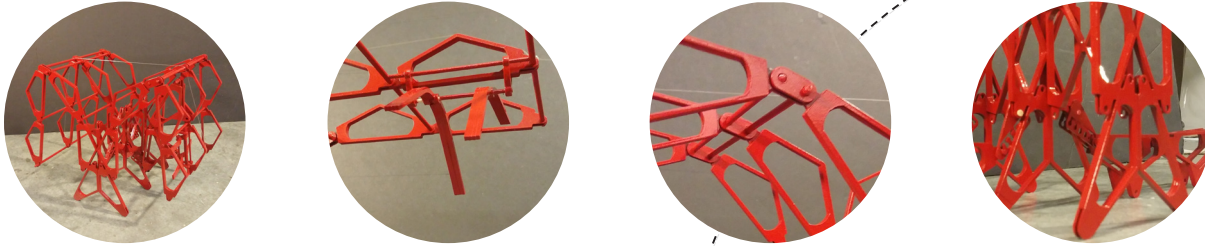


Fig. 66 Armature Details

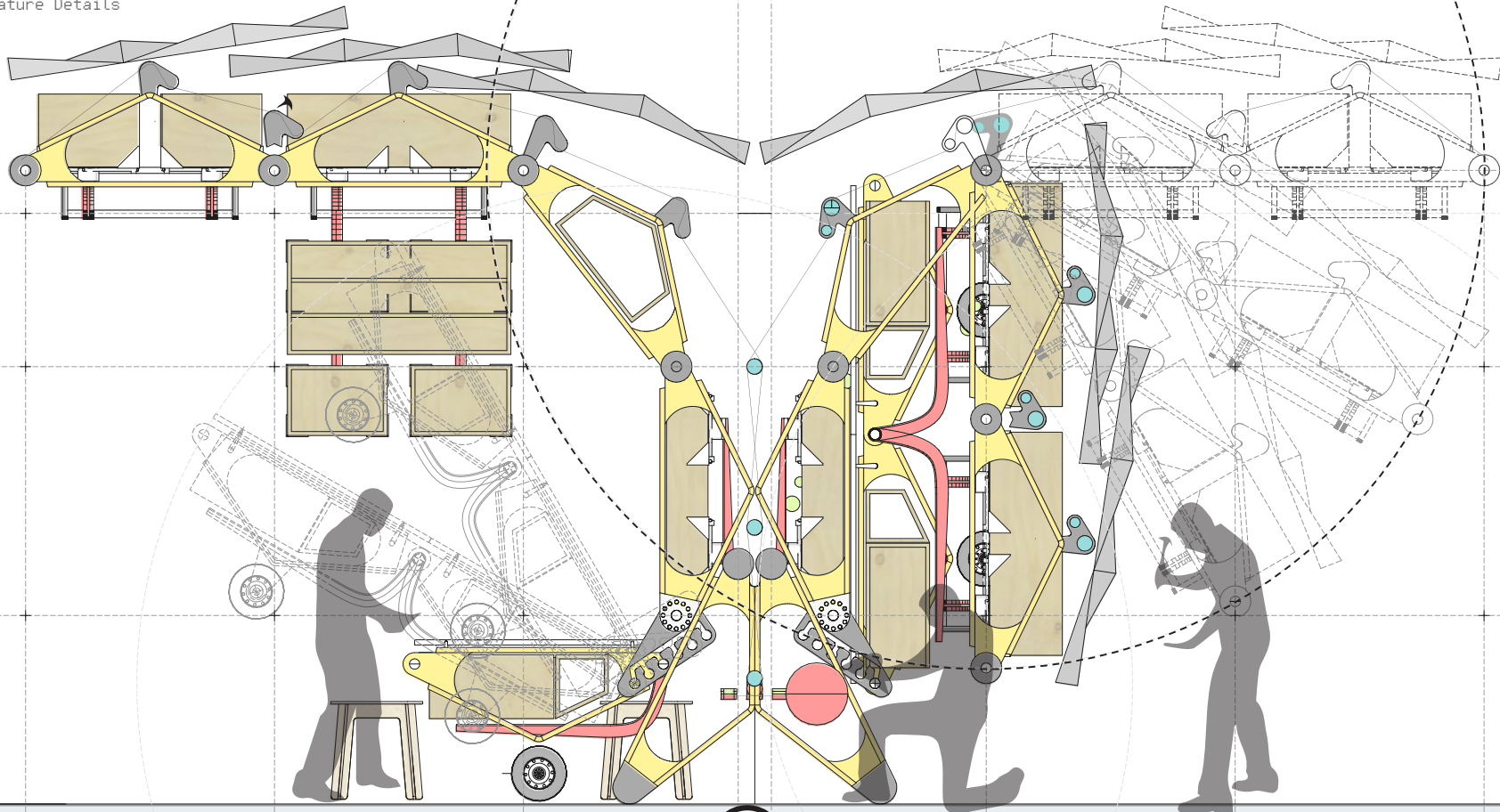


Fig. 65 Open and Close Elevation

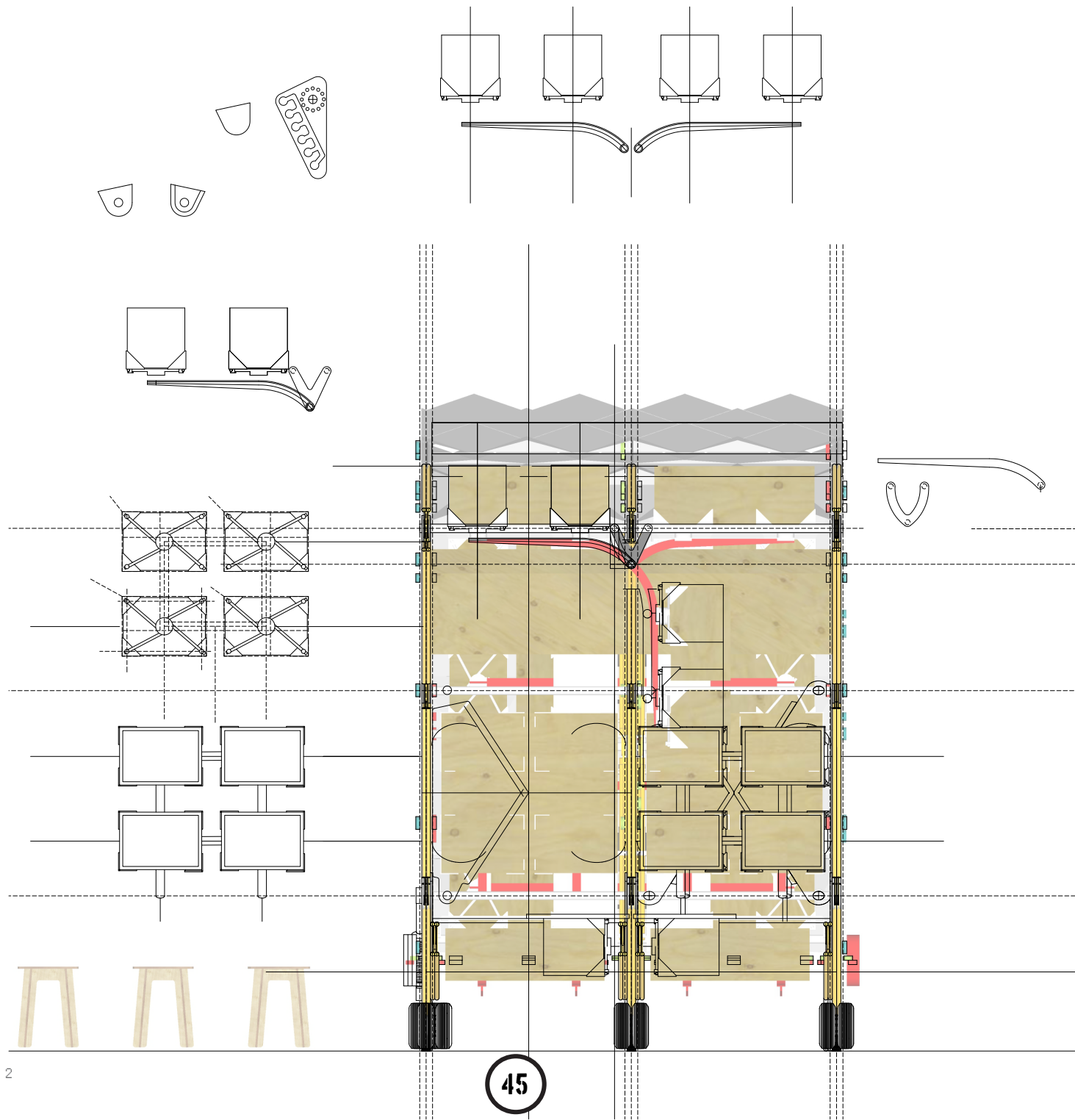


Fig. 67 Elevation 2

45



The sketch features several interconnected diagrams and annotations. At the top left, there are three clusters of nodes connected by red lines, with the text 'SLIDABLE DRIVERS' written in red above them. Below this, a larger network of nodes is labeled 'WHEEL OF TOURS'. To the right, a perspective sketch of a building with a curved roof and a curved entrance is shown, with the word 'MAKER' written in black inside a hexagonal frame to its right. At the bottom left, a dense grid structure is labeled 'EXPANDABLE GRID STRUCTURE'. A circular node at the bottom center contains the number '46'. Red arrows and lines connect various parts of the sketch, indicating relationships and flow.

CAPITAL HILL LIBRARY

46

Fig. 68 Sketch Abstract

CH.4 DESIGN

The Armature Into Site / Capital Hill Library

.04 CAPITAL HILL LIBRARY

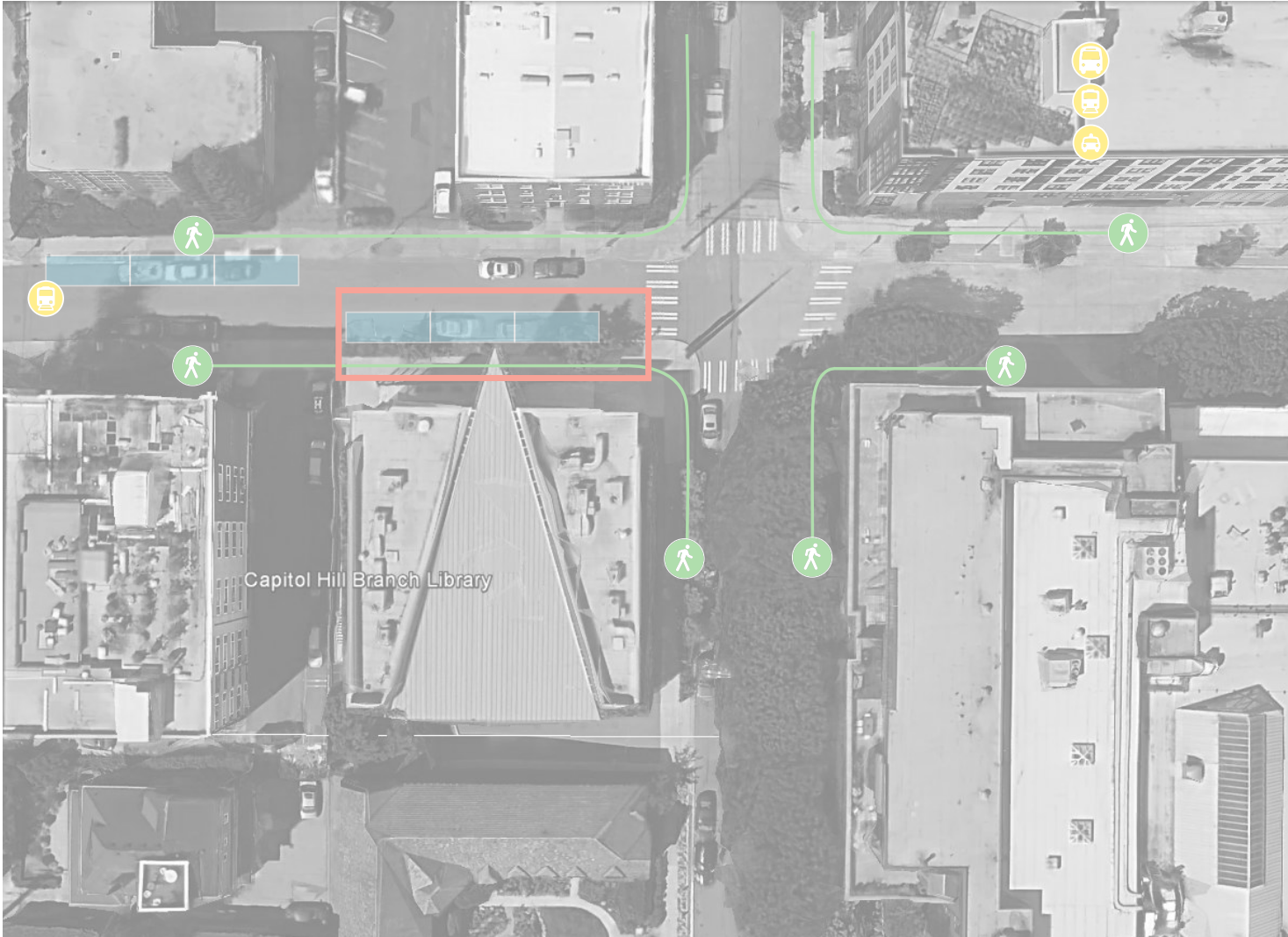


Fig. 69 Capital Hill Site Plan

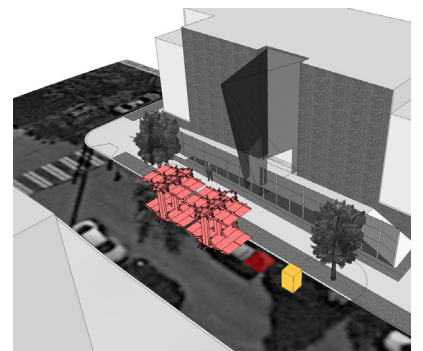
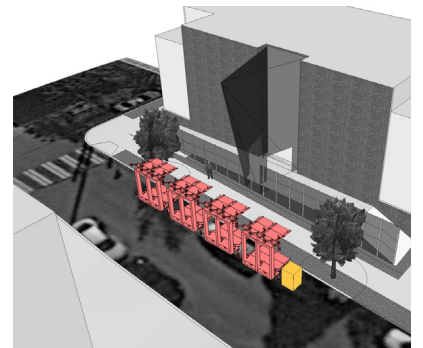
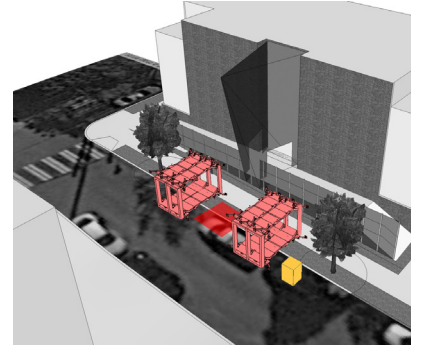


Fig. 70 Capital Hill Variability

- +desktop pc
- +software
- +server
- +paper
- +pens/pencil/markers
- +cutting supplies
- +straight edges

- +LPKF laser
- +soldering equip
- +arduino
- +various ga wires
- +ac/dc power supply
- +volt meter
- +oscilloscope
- +elec components

- +laser cutter
- +3d printers
- +cnc(desktop)
- +filament
- +sheet materials
- +craft materials

COMPUTERS

ASSEMBLY

**ELECTRONICS
DESIGN**

DIGI FAB

Fig. 72 Plan Diagram CHL

Fig. 71 Elevation of CHL

48

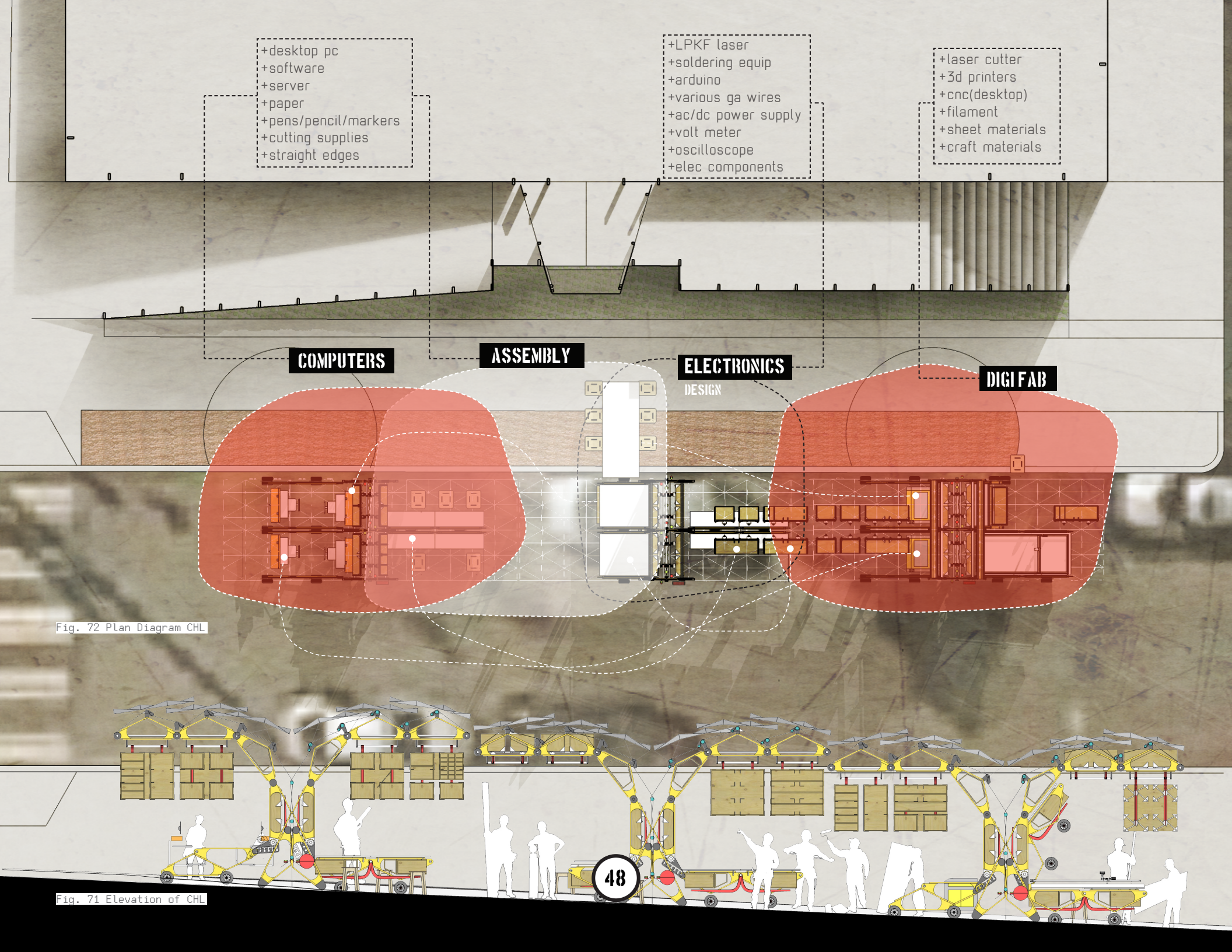


Fig. 73 Capital Hill Library Perspective



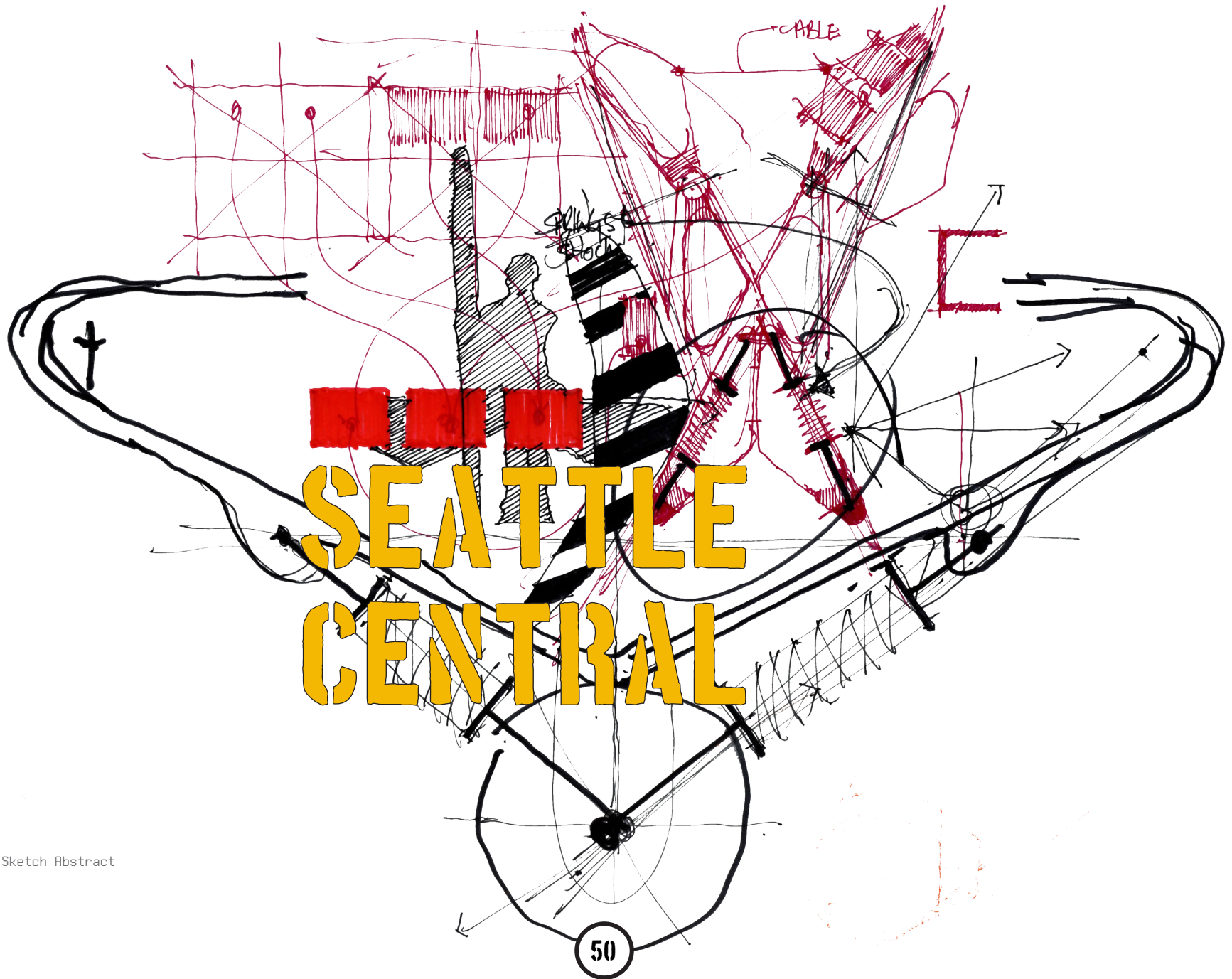


Fig. 74 Sketch Abstract

CH.4 DESIGN

The Armature Into Site / Capital Hill Library / Seattle Central

.05 SEATTLE CENTRAL

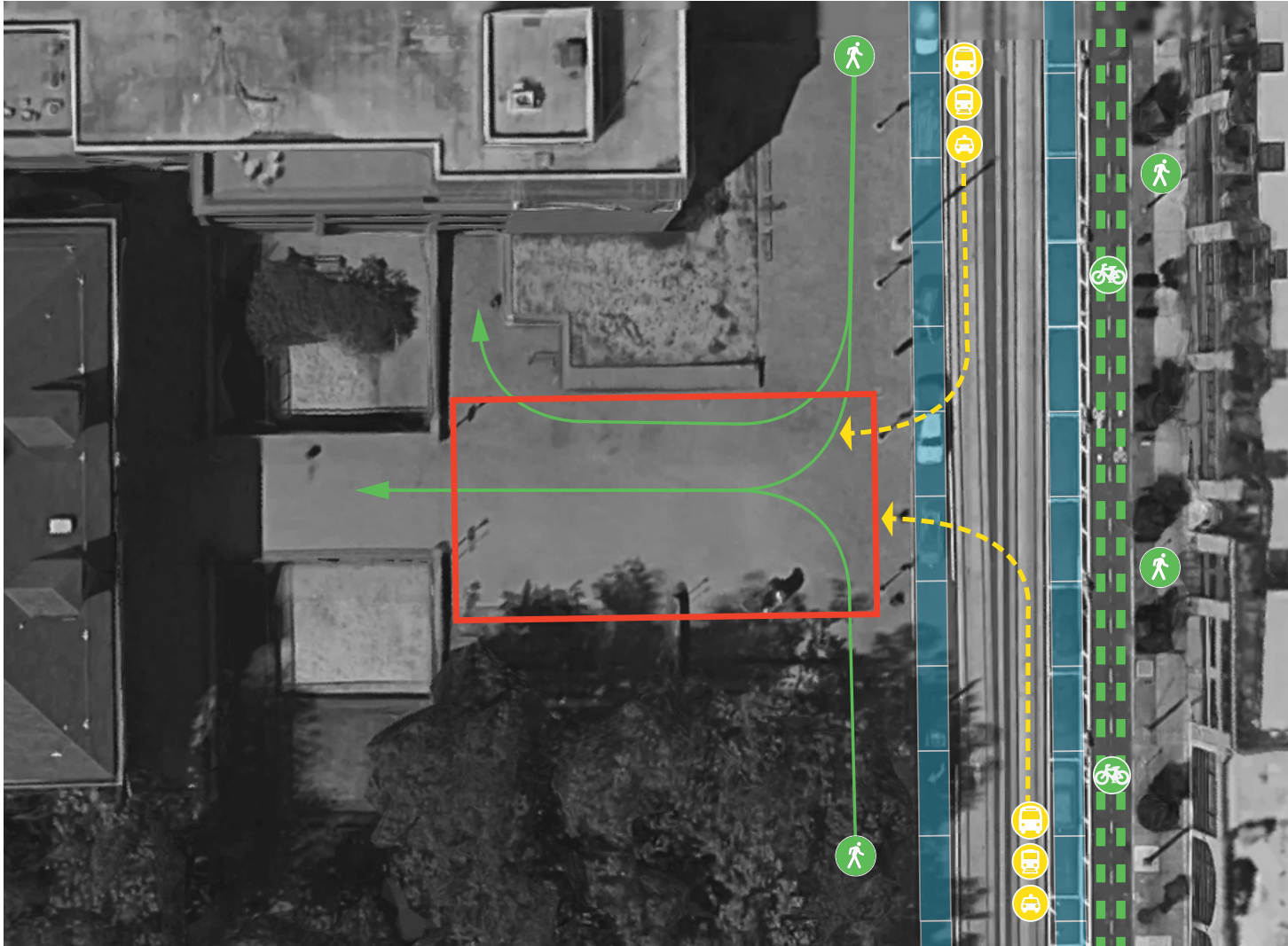


Fig. 75 Seattle Central Site Plan

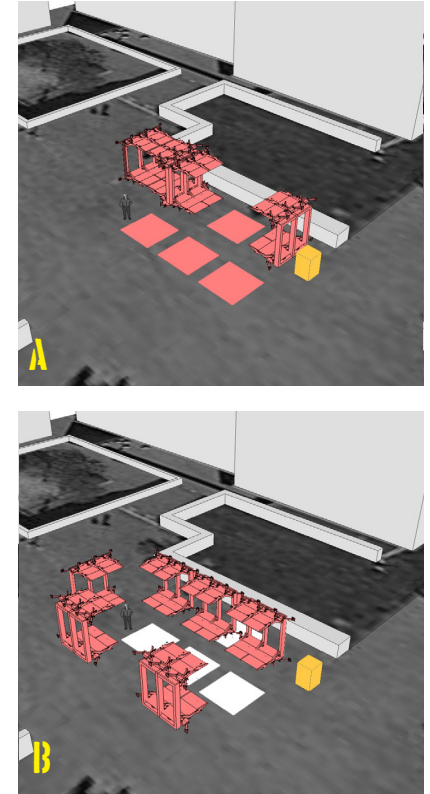


Fig. 76 Variability Diagrams

CH.4 DESIGN

The Armature Into Site / Capital Hill Library / Site Variability

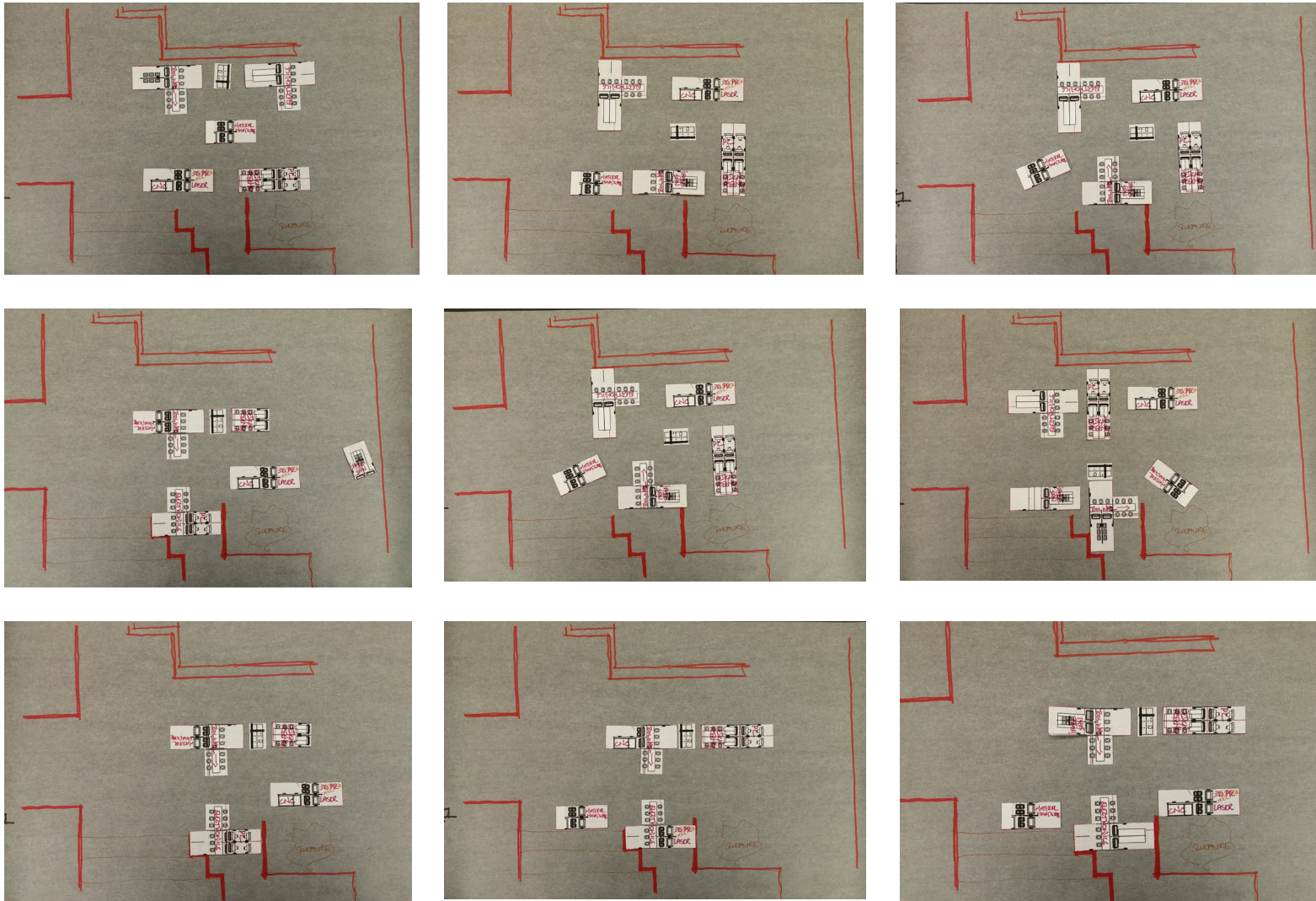


Fig. 77 Tinkering With Site Variability

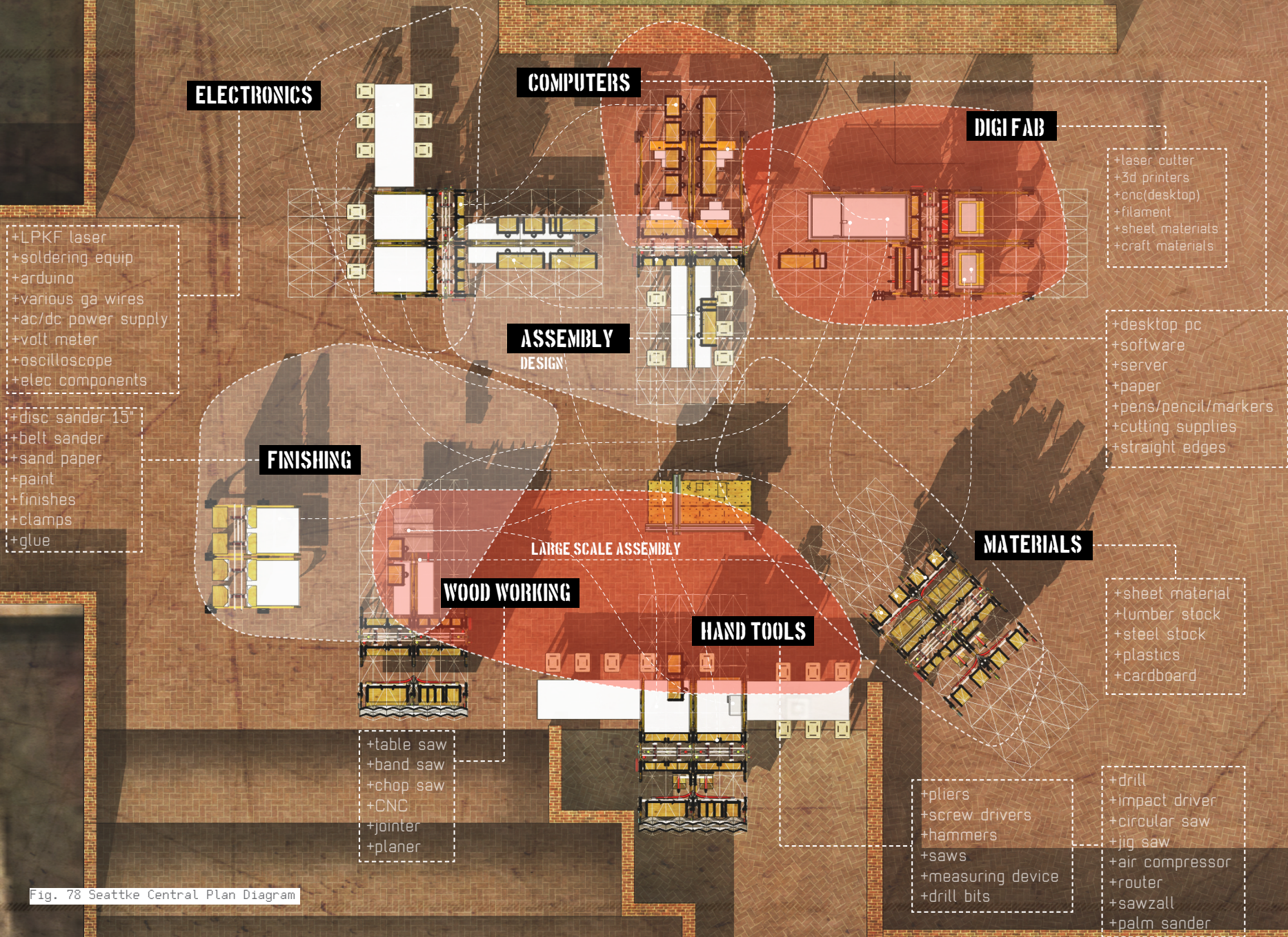


Fig. 78 Seattke Central Plan Diagram

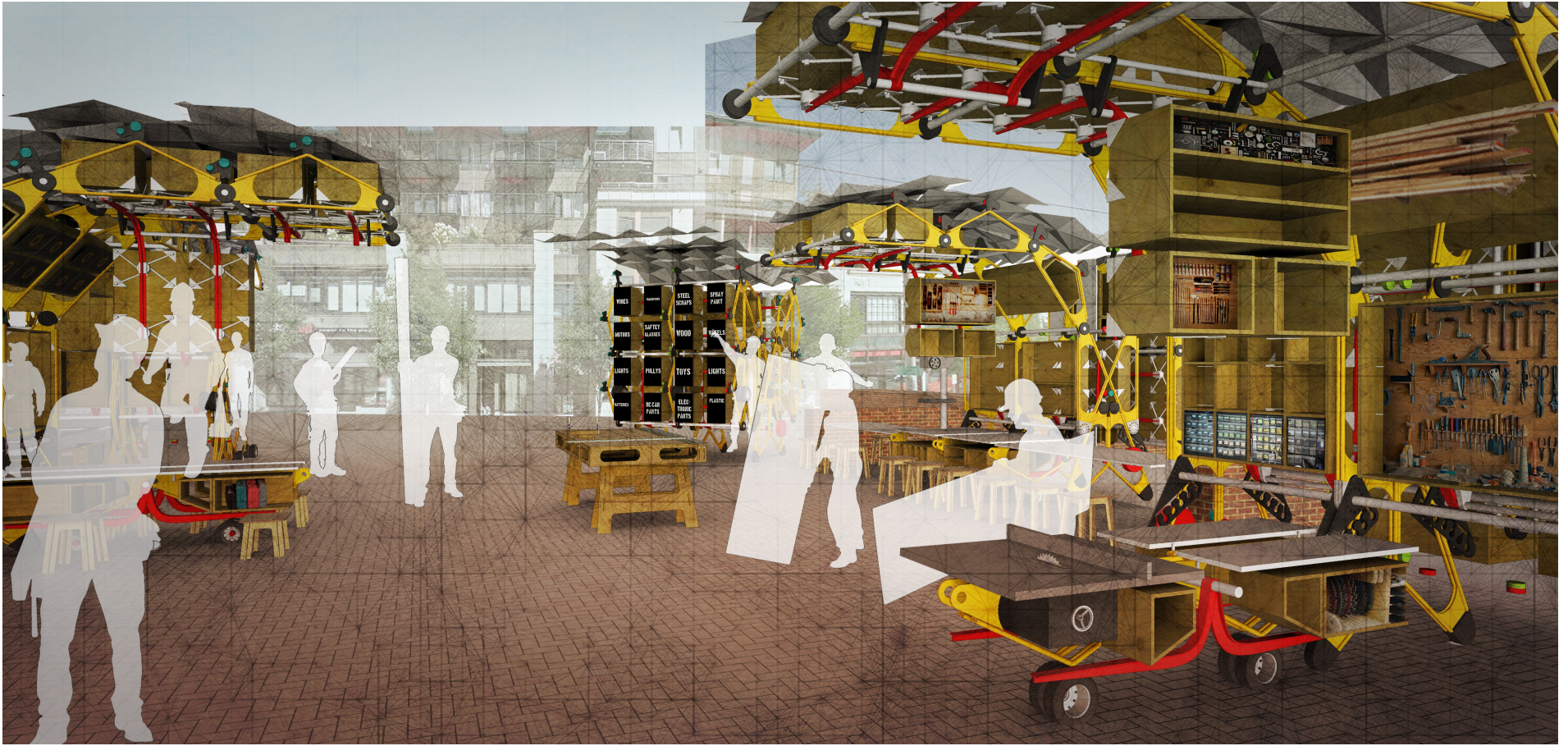


Fig. 79 Seattle Central Perspective



Fig. 80 Seattle Central concept Render

CH.5 CONCLUSION

Conclusions

According to “Chris Anderson,” Making can happen anywhere. This thesis begins to present itself as commentary on the state of making today, and the dominant cultural logic that is fundamentally changing how we make. We define the world around us as a series of systems or networks both physical and ambient. These networks are to be thought of as infrastructure which allows the transmission of goods but also ideas. Therefore the internet is conceived of as the primary catalyst of network culture in which ideas, information, and even capital can be found. It is because of network culture that the 21st century maker movement exists as a social movement in which the awareness around everything made is being brought to the mainstream through an online interface. Making today is thought of as a return to making in which active makers or new found tinkers are learning to create utilizing digital technologies. It is a making revolution defined by economy and people’s desire to not only consume but also create.

The investigation into the 21st century maker movement and network culture brought a global context to my thesis in which making on a larger scale was to be investigated rather than anyone particular type of making or industry that could be picked out on a map. So the idea of a mobile makerspace was developed as a way to respond locally to a series of specific site conditions, while at the same time present itself as a flexible yet universal system that can respond to the act or process of making as it is done today. So the concept for a mobile makerspace is developed because a mobile system has the potential to respond to the small scale of Seattle as well as the larger globalized idea of making centered around network culture. A mobile platform acknowledges the reality of the 21st century working space, one that is increasingly becoming mobile with collaboration taking place over the internet. Physical space is needed only for physical collaboration only and used as temporal space. This thesis makes the argument that a more temporal solution is needed in Seattle and other cities who have a growing and healthy startup culture and burgeoning tech industry both of which could utilize a mobile makerspace for their own educational or even entrepreneurial endeavors. As the death of the physical artifact fades away into the ether

so does the school, library, museum, and park that it was once housed made or conceived in.

The common ground for making is happening online, but this thesis makes the argument that an existing network of sites has the potential to broaden and even expand their identities within the urban fabric. An existing engagement network is defined because of the institutions ability to exist within the Seattle urban fabric; forming energetic public spaces with high levels of foot traffic. Furthermore an engagement network is defined by public space or adjacent public space. The engagement network is also defined as such, because schools, museums, parks, and libraries all over the country are beginning to participate in the maker movement hosting their own mini maker events. By using the public urban space outside of a school or museum the mobile maker space is attempting to create a new common ground one that engages the urban streetscape and the people in it. It is a commentary on learning today making the statement that learning primarily takes place through a wire and a digital interface. The process of making has always been considered a tangible experience one that requires a hands on approach to fully understand. However today the act of making is played out and shared to the network for all to see, it inspires somebody else half way around the country to make and even develop the idea further. With this fundamental shift, making becomes a remix of an idea; transformed or customized to fit the individual maker’s unique needs. The maker movement alongside network culture is creating the beginning of mass customized consumption in which the goods and services we humans consume will become increasingly more customized for the user. This is due to the democratization of powerful digital tools that have been placed directly into the hands of the consumer.

DRAWINGS

Physical Artifact: The Sketch



Fig. 81 Developmental Sketches

MAKING SPACE PROCESS

Used Worksurfaces

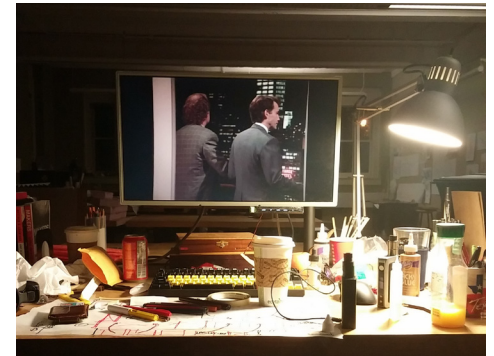
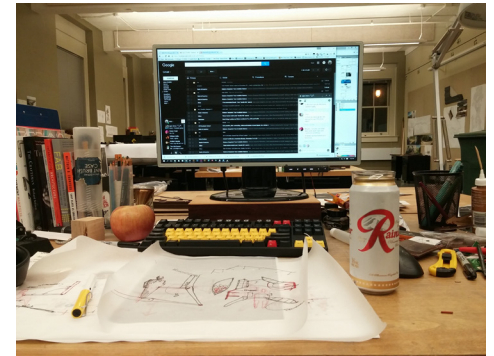
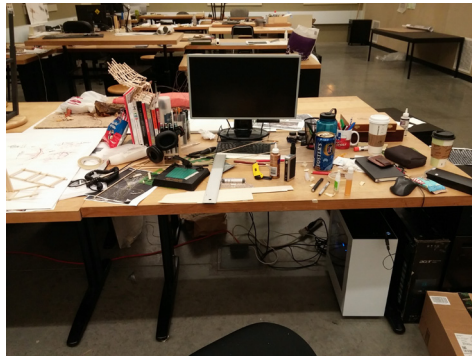


Fig. 82 Work Space Process Documentation

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