

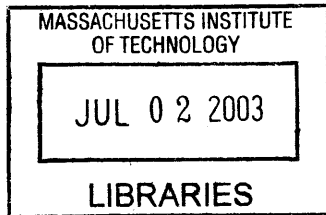
# Wireless Bridges: The Laptop Experience in the Learning Environment

by Sophia J. Lee

Bachelor of Architecture  
University of Southern California, 2001

Submitted to the Department of Architecture in  
Partial Fulfillment of the Requirements for the  
Degree of Master of Science in Architecture Studies  
at the Massachusetts Institute of Technology  
June 2003

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May 22,  
2003



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## **Wireless Bridges: The Laptop Experience in the Learning Environment**

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# **Wireless Bridges: The Laptop Experience in the Learning Environment**

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abstract

The Laptop experience has changed the way people work and interact with learning space. The integration of technology in learning environments affects the usage of space and produces new learning patterns. However, new learning patterns do not come automatically with new technology. Technology, space and social behavior affect each other, and cannot have their full effect without adjusting to one another. Therefore, in order to optimize the use of wireless technology, both spaces and social behaviors have to change. To understand and design space which accommodates the new technology, we need to observe and see how people interact with space and what kind of learning and interacting patterns emerge with mobile technology. This thesis begins this process of observation and analysis through an examination of how several students at MIT utilize wireless laptops during the semester.

[Thesis Co-Supervisors]

William L. Porter  
Title: Norman B. and Muriel  
Leventhal Professor of  
Architecture and Planning

Francis Duffy  
Title: Visiting Professor of  
Architecture

Professor William Porter, for your guidance and wisdom during the last two years in forming and developing this thesis. I can't thank you enough for the learning experience you provided for our SMArchS class.

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Kat, for your being my 911 and 411. I found a kindred spirit in Boston.

Minjung and the rest of SMArchS studio, for good spirit and late nighters.

Helen, Kathy, Elizabeth and JeeSu for moral support and long-distant phone calls. You have been the life force.

The Changs for always being there with unconditional love and support. I'm coming home.

Mom, for everything you done for me, can't express with words.

Numerous interviews were conducted in preparation for this thesis. I would like to acknowledge the following students and faculties at MIT, whose participation provided important information on specific aspects of learning environment: Lucy Wong, Nathalie Westernvelt, Aaron Malnarick, Chris Johns, Christian MacCarroll, Mike Lehner, Susan Yee, J. Meejin Yoon and Ann Pendleton-Jullian.

## Acknowledgement

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## **01 introduction**

## Domains



### Domains:

1. Technology - Wireless technology  
Wireless technology is represented by laptops.
2. Space - Higher education facilities  
Space represented by MIT School of Architecture  
- Existing MIT School of Architecture  
- New learning space for the Architecture School
3. Social behavior  
The new learning and interacting behaviors found during the observation

## Laptop Program



### Laptop Program in MIT

MIT Academic Computing made an institute-wide proposal to support Campus Laptop Program. This program was to support the wireless campus project so MIT can test students using laptop and wireless connections throughout the campus. Different departments applied to Academic Computing to be part of the Laptop Program and from School of Architecture, Susan Yee submitted a proposal for the department. In Fall 2001, the laptop program began and 50 laptops were given to the Architecture School.

In Fall 2001, 50 laptops were given to the students in a specific class called Geometric Modeling, which is a required course for level I Master of Architecture students (MArch). Geometric Modeling is computer intense course using AutoCADD, 3DMAX, and other computer programs. In Spring 2003, the laptops were given to students in the next sequence of class called Architecture in Motion Graphics. This class is an advance version of the Geometric Model, using computer rendering programs. Both classes used computers as the main tool to accomplish assignments.

In Fall 2002, instead of targeting a specific class, the laptops were distributed to the studio levels, MArch levels I and II. Though Geometric Modeling is a required course for MArch I, rest of the classes are not required to use laptop or specific computer programs. By distributing laptops to all levels I and II, and not a computer class, students were encouraged to take the initiatives to use wireless technology on their own and invent new ways of using laptops.



## Observation Summary

### Observation Summary

The observation period was from February 25, 2003 through April 18, 2003. Observation was also targeted to the three areas of domain, which were technology, space and social behavior. During this time, I observed students with a laptop and without a laptop. The environments which I made these observations included design studio activities and learning spaces.

The initial approach to the observation was to choose students with a laptop and without a laptop, and study their behaviors hourly. However, this method was not effective since the amount of time that a student was engaged in one activity was not the important part, but rather, it was more important to know when a student transitioned from one activity to another. Therefore, a month into the observation, I tried to understand the modes of learning and observed students gone from one mode to another. In addition, during the interview, students were helpful to inform me of their main activities. An initial interview and exit interview were conducted with some of the subjects.

The hourly observation strategy worked better with spaces. At every hourly interval, the method was to check how many students are using a desktop in studios 5 and 7. I also observed the Dome Cafe to see how many people were using their laptops during this time. Minor observations were made with AVT and the computer lab in building 7.

## Terms and Definition

### Observation Terms and Definitions

- Studio Activities: all learning and interaction happen during the architecture design studio

- In-Studio Setting:

*Laptop activities* - able to move laptop within limited studio space, which gives maximum use of space

*Other studio activities* - studio activities happening within the studio space

*Informal learning modes* - laptop and other studio activities happening within the studio space

- Out-of-Studio Setting:

*Laptop activities* - able to move laptops within architecture school, to different studio, technology support areas, cafe, library, and on field trips

*Other studio activities* - studio activities happening outside the studio space

*Formal learning modes* - laptop and other studio activities happening outside the studio space

## Technology



Laptop in Locker



Laptop in Studio Space



Desktop in Studio Space

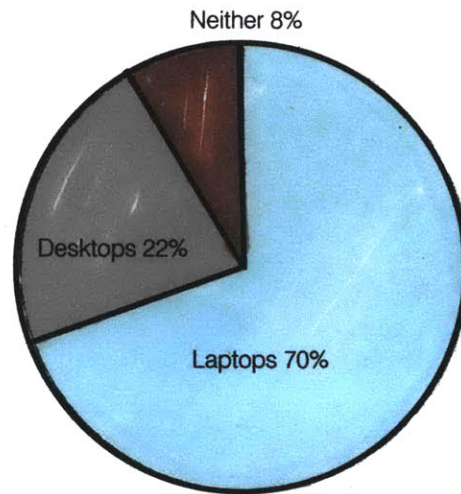


Diagram A:  
All MArch Students' Computer Ownership

## Laptops vs. Desktops

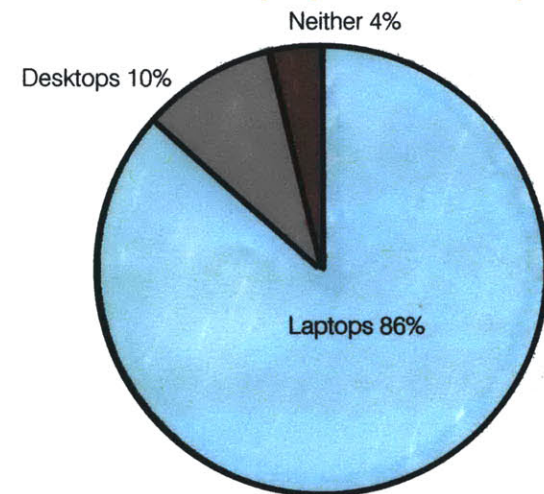


Diagram B:  
Level III Students' Computer Ownership

In architecture school, all students are given private studio space. In MIT School of Architecture, a student is given about 42 sqft of space with two tables, a locker that fits under the table and a chair. This space is just enough for drafting board and modeling space. If a student chooses to bring in his desktop, it takes about 4 sqft, close to 10 % of table space, one has to give up either drafting or modeling space. Also, once a desktop is brought into the studio space, it is fixed throughout the semester. While a laptop takes about 0 - 1.5 sqft since it can be put away in the locker or easily moved for user's convenience.

The number of desktop owners and laptop owners reflect the students' preference as well. 44 levels I and II students have laptop with the MIT laptop program. 21 level III students have laptops out of 32 students. Only 8 students have their desktop in studio and all 4 thesis students have laptops. Looking at the tight space in thesis studio, desktop takes too much space for students to have both modeling and drafting space.

**02 space**



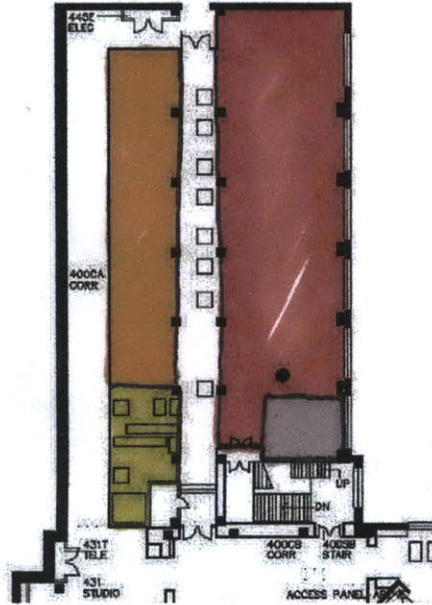
## Existing Spaces



Undergraduate Studio (orange)



Printing Area (green)



Plan of Studio 7



MArch II Studio Area (red)



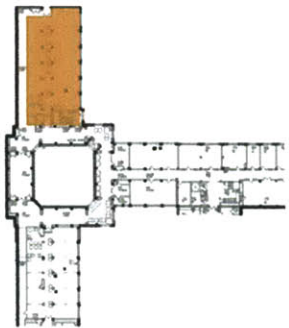
Sliding Glass Doors



Thesis Studio Area (purple)



Desktops in Studio 7



## Studio 7

Studio 7 is divided into 5 basic areas: undergraduate studio, MArch Level II, thesis studio, printing area, and circulation with 8 desktops. The studio is composed of 18 undergraduate students occupying 1,170 sqft, 30 Level II student in space of 2,184 sqft and 4 thesis students in a tight corner. The sliding glass doors were designed to extend the studio space out into the corridors. However, the sliding doors do not go up often because by opening the doors, the studio would be extending into the corridor blocking the fire exit route. The students each have their own private studio space, but there is a lack of common space for group work, large scale models or storage spaces.

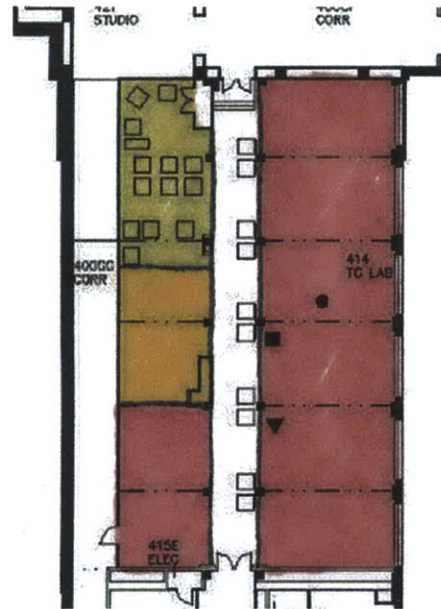
## Existing Spaces



Desktops in Studio 5



Common Area (Orange)



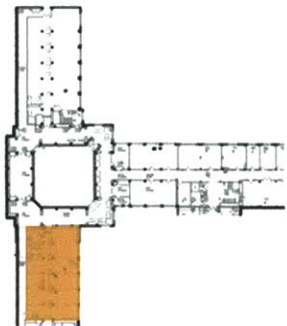
Plan of Studio 5



Desktops Area



MArch III Studio (red)



## Studio 5

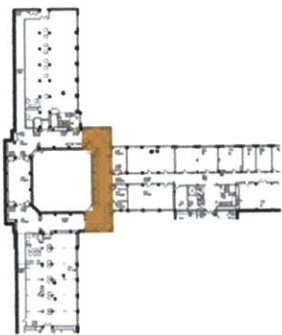
Studio 5 is mainly for MArch Level III students' studio space. There are 32 level III students and they share 2,514 sqft of space. There is desktop area and common area with large tables. Studio 5 has more common area for group meetings, which is used for a class required for MArch Level III students (Thesis Preparation course). Within each studio section, there is more common space for students in studio 5 than studio 7.

## Learning Space

## Flexible Spaces



*Dome Cafe Activities*



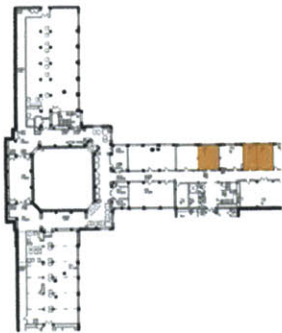
The Dome Cafe is a gathering place for architecture school students, faculty members, and outsiders that come to eat and meet to do other activities. You will find students working in this space at any time of the day or a group of people in discussion as well as individuals working side by side. The Dome Cafe is well lit with natural light throughout the day and has high ceilings. There are 18 small tables and 8 big tables. These tables are affixed to the floor so people do not have flexibility to move them around.



## Fixed Program Spaces



*Computer Lab*



## Computer Lab



*Class, students with their laptop*

The computer lab consists of 12 desktops and large scale scanner. The location is not convenient for architecture students to use because it is far away from the design studios. This type of facility is used to accommodate a class with labs which requires computer programs. Since two levels of architecture students have laptops, classes can easily be held in any available spaces. In addition, most students do not like to work in a room that consist of computers and nothing else.

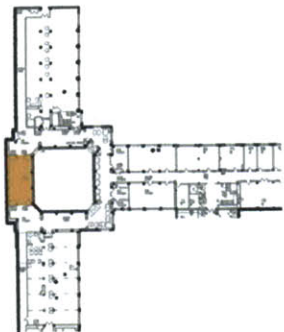
## Fixed Program Spaces



Presentation Preparation



Presentation



## Advanced Visual Theater

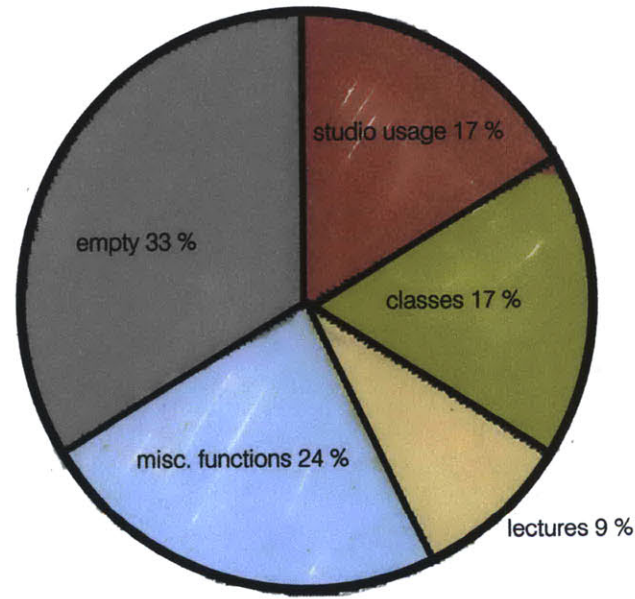


Diagram C: AVT schedule Fall 2002 from the HQ



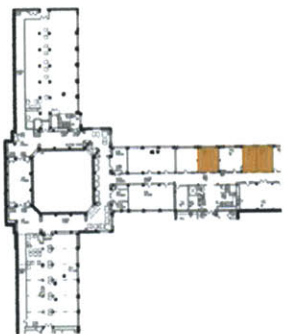
Lecture

AVT is used for many different functions; regular class meetings to department gatherings. During the final presentation period, it is one of the most highly sought after places for students to give these presentations. However, this is not because AVT is a desirable space, but because it has most of the Audio/Visual equipment. It is locked during the time it is not being used and in order for anyone to use this room, they have to go through the head quarter office and reserve the room in advance. Though AVT appears to be in high demand and always in use, after looking at the AVT's schedule, it tells us that it is empty third of the time. The diagram shows that out of 792 hours during last fall's AVT schedule, the total usage was 521 hours.

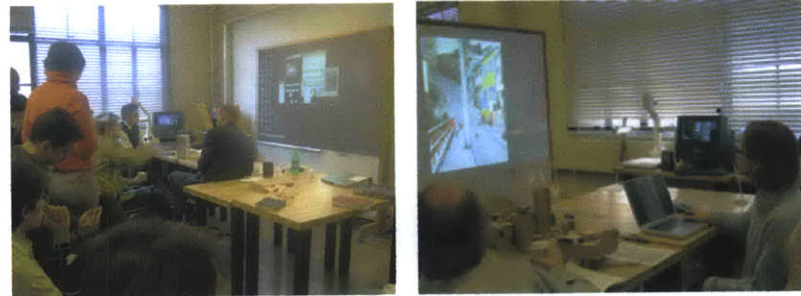
## Fixed Program Space



*Classroom*



## Classrooms and Distance Collaboration Classroom



*Distance Collaboration Classroom*

These classrooms are often used for lectures or presentations. These rooms need to be reserved ahead of time like AVT. Professors and students cannot have spontaneous meetings, lectures, or presentations. Since the classroom is accessible only by reservation it requires the studio activities to be planned ahead of time. Space is always in demand whether it be design studio space or lecture/presentation space. These classrooms are not in use for most of the day, but the fact they are locked keeps them from being used more readily. The classrooms do not house any expensive equipment installed, there is no real reason for them to be locked at all times. If security is an issue, the classrooms should be only accessible to an instructor with card key access.

Distance Collaboration room is a facility that has been set up for on-going digital fabrication workshop. MIT collaborates with another school or group from a different country and participate in joint projects with other students. All communication is supported by the facilities in this room. Sometimes studio reviews take place in this room to invite guests from another location. In spring 2002, this room was set up in the Studio 5, but was relocated in Fall 2003. When this facility was located in the studio 5, there was clear no division between the rest of the studio space and made holding classes in the studio difficult. By moving the facility to the current location, it provides privacy for the class and a defined space. However, by moving away from the studio, it took away the non-class students interaction with the distance communication. This is the third semester of the workshop, and as more students take the course, they can integrate the tools and communication in their design studio even if they are not in the workshop. If the equipment is located near studio space, it is more likely to be used by other students who are not in the class.

**03 tools**

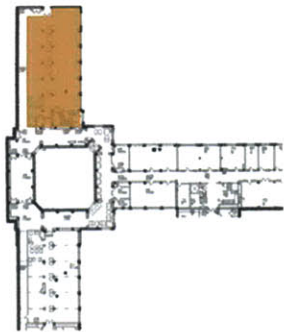
## Fixed Tools



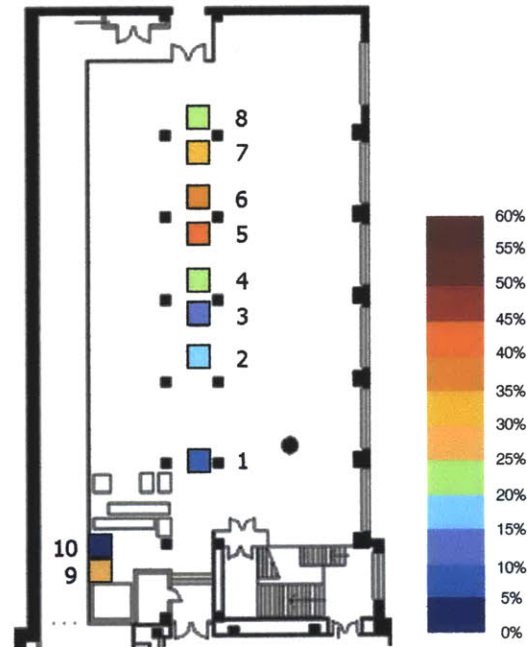
Desktops in Studio 7



Desktops Printing Area



## Desktops in Studio 7



Total Hours of Observation = 42 hours  
 Number of Desktops in Studio 7 = 10  
 Desktop 4 is attached to a slide scanner  
 Desktop 6 is attached to a scanner  
 Desktop 9 is for laser cutter  
 Desktop 10 is for 3D laser cutter  
 Desktop usage: Lowest 0% to Highest 43%  
 Highest number of desktops usage during observation = 6  
 Average number of desktops usage during observation = 2 (20%)

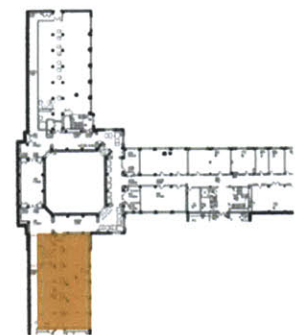
## Fixed Tools



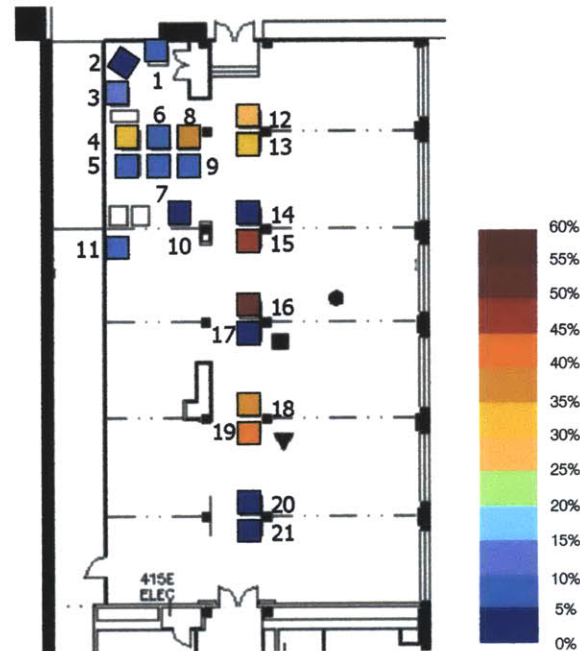
Desktops in Studio 5



Desktops in Studio 5



## Desktops in Studio 5



Total Hours of Observation = 42 hours  
 Number of Desktops in Studio 5 = 21  
 Two desktops for VHS digitalization  
 Desktop 3 is attached to a scanner  
 Desktop usage: Lowest 0% to Highest 43%  
 Highest number of desktop usage during observation = 9  
 Average number of desktop usage during observation = 3 - 4 (18%)

## Flexible Tool - Laptops

## Group Modes



*Group Mode 1: Critique*



*Group Mode 2*



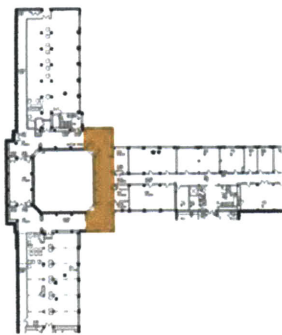
*Group Mode 3: Structure TA Hour*



*Group Mode 4*



*Group Mode 5*



During the observation period, there were many interesting moments with students working in groups with one or more laptops. Since Dome Cafe is a public place, people feel comfortable talking to each other without disturbing others unlike in offices or labs. Also, there are many informal meetings occurring in this space with laptops as supporting work stations. These group modes are not exclusive to students, but also with TAs during TA hours and meetings with advisors.

## Flexible Tool - Laptops



Single Mode 1



Single Mode 2



Single Mode 3



Single Mode 4



Mobile Mode



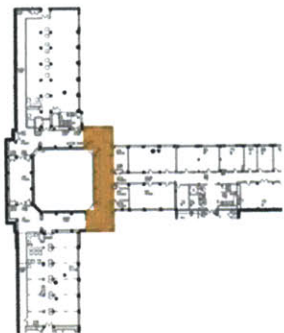
Single Mode 5



Single Mode 6



Single Mode 7



## Single Modes

Whether an individual lacks an office space or is looking for a desirable space, many people choose to work in Dome Cafe. It is so busy that sometimes, the people who can not find a table, sit on the near by benches to work while waiting for an available table. Along with the Laptop Program, the School of Architecture is supported with wireless connections, which extends to the cafe. Even more people will be encouraged to use this kind of public space if there is a greater security for laptops and personal things.



## **04 bridging studio activities in one space**

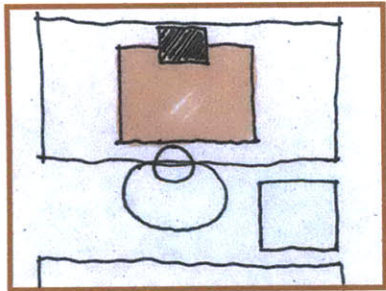
## Laptop Bridging Different Studio Activities



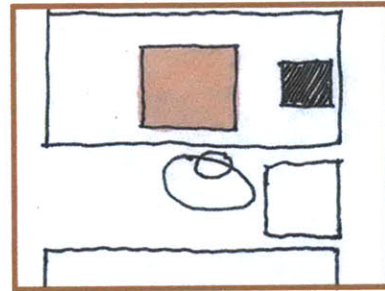
Working Mode 1:  
Site Photo Analysis



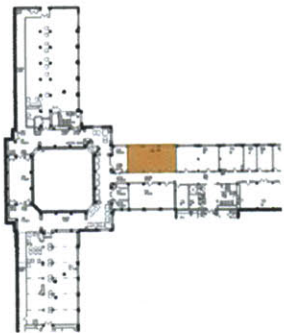
Working Mode 2:  
Drafting



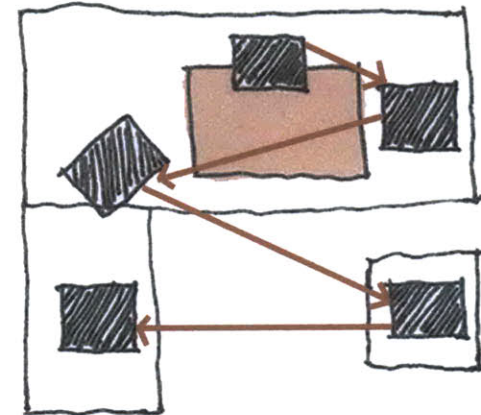
Movement Diagram 1:  
Laptop Active



Movement Diagram 2  
Laptop Passive



## Movement Analysis: In-Studio Setting



Movement Diagram AA:  
Laptop movement during studio

Mobile technology allows students to use any given space more intensively. There are different learning modes in the studio environment. Computers became one of the tools to help the design process, like a drafting table or a pencil. Some tools are more permanently placed than others; the drafting table is a fixed part of studio space, whereas a pencil is mobile. Computers, until the introduction of the laptop, were a fixed part of studio space. It required a percentage of space at all times (See pg11 for more detail). Even if a student uses their computer in majority of his design, the location of the desktop might not be most convenient for all the working modes. With a laptop, the computing tool is like a pencil. It can be used when needed and put away when it is not in use. The following chapter measures how mobile technology helps students to use their studio space more intensively through images and movement diagrams.

## Laptop Activities

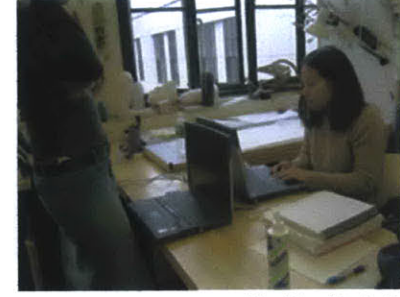
## Movement Analysis: In-Studio Setting



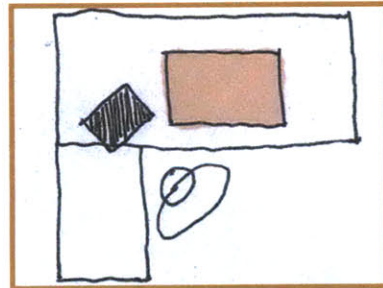
*Working Mode 3:  
Modeling*



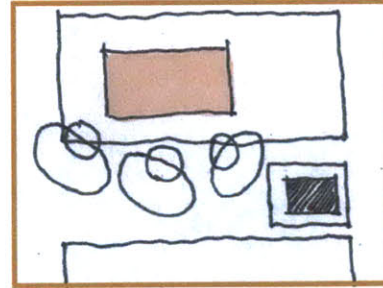
*Working Mode 4:  
Desk Critique*



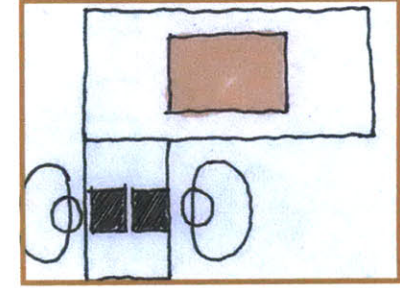
*Working Mode 5:  
Using computer software*



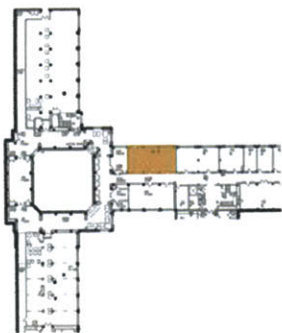
*Movement Diagram 3:  
Laptop Active*



*Movement Diagram 4:  
Laptop Passive*



*Movement Diagram 5:  
Laptop Active*



While a student is making site drawings, she is using her laptop screen to show the images from the site visitation. After gathering all the information from the images, she moves her laptop to the side to maximize her drafting space. Likewise, when she is modeling, she places her laptop to either an available or desirable space to make her models. When student is either talking to her studio instructor or a classmate, she can place the laptop in a place where she can make it ready for use at any time during the critique.

Depending on how much privacy a student requires in order to work, students may put their laptop against each other, while facing each other to work, this kind of position encourages interaction between students.

## Non-Laptop Activities



*Working Mode 6:  
Drawing*



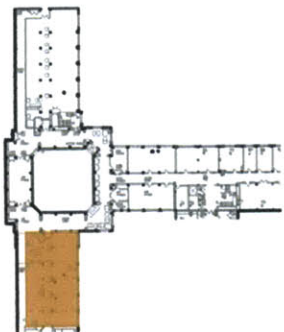
*Working Mode 7:  
Small scale Modeling*



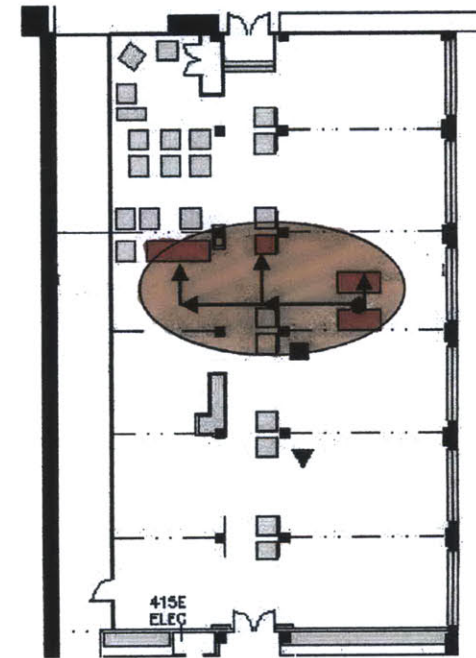
*Working Mode 8:  
Using computer software*



*Working Mode 9:  
Big scale Modeling*



## Intensity of Spatial Usage Without Mobile Technology



*Movement Diagram BB:  
Spatial usage without Laptop*

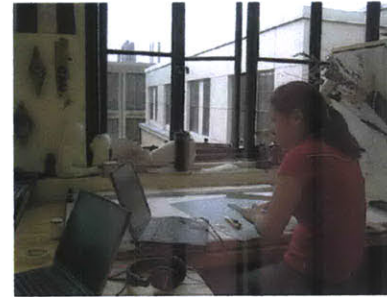
In design studio and during design process, students often go back and forth between drawing and modeling. This process helps the student to test and better examine their ideas. When going from one mode to another, student use the results from the previous working mode. Therefore, when you go from one mode to another, you need more space to work. For example, in order for the student to use his work from working mode 6, he has to move to another table to have enough space to make models and still be able to see his drawings. Using a desktop; in this case the student does not have computer in his studio, he has to find an available desktop shared by studio to use computer software.

## Space Intensity Comparison - Fixed tool vs. Mobile tool

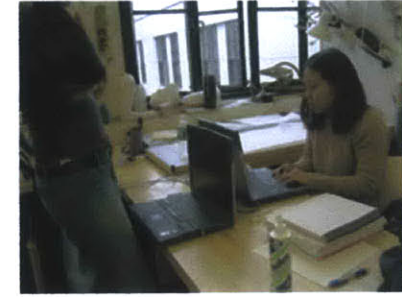
Mobile Tool



Working Mode 1



Working Mode 3



Working Mode 5

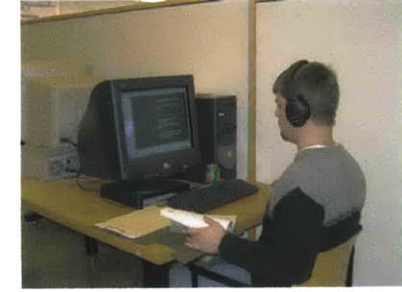
Fixed Tool



Working Mode 6



Working Mode 9



Working Mode 8

With mobile technology, each time the student changes her working mode, the laptop screen becomes a space to store the information of the previous mode. Laptops allow the student to maximize space to work while going from different working modes. In the images of mobile tool setting, the laptop is the common denominator that connects each working mode. In the fixed tool, the drawings become the link between different working modes. If the scale of the drawing is not too big, this might not be an inconvenience; however, architecture students often work with bigger scale site models and detailed drawings. These drawings and models not only take larger spaces, but if a student has to move his work station, he has to move everything with him.

**05 bridging spaces for studio activities**

## Bridging Spaces



*Working Mode 10:  
Moving Work Station*



*Working Mode 11:  
Work outside of Studio*



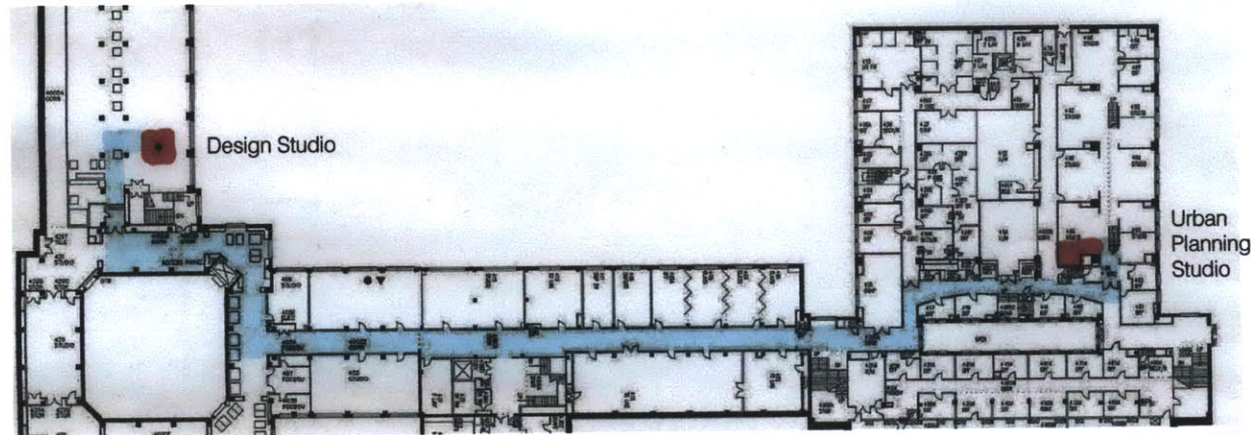
*Working Mode 12:  
Interaction*



*Working Mode 13:  
Class*



*Mobile Mode 14:  
Moving back to Design Studio*



*Movement Diagram CC*

Mobile technology allows students to use various spaces for different purposes. What happens in a specific space is not dictated by what kind of tools are available in the space, but rather what space is desirable or available. Though design studio space is the main work station for most of the architecture students, there are times when a student takes a course in the Urban Planning Department. While desktops keep students from having more than one work station, the laptop allows a student to move his work station as needed and he is able to go from design studio to urban studio a few times a week and utilize both studio spaces.

## Laptop Activity

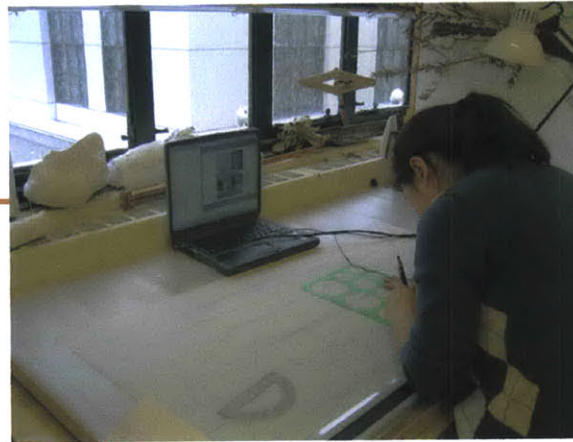
## Bridging Spaces



*Working Mode 15: Group Project  
Location: Common space in Studio*



*Working Mode 17: TA Hours  
Location: Dome Cafe*



*Working Mode 1: Working in studio  
Location: Studio*

## Movement Analysis: Out-of-Studio Setting



*Working Mode 16: Mid-Review  
Location: Corridor*



*Working Mode 18: Presentation  
Location: classroom*

Working Mode 15: Group Project - Often students work together on site analyses or other research projects during the semester. Students use the common area in the studio to do group projects.

Working Mode 16: Mid-Review - Students do not have to find a room with LCD projector and computer to show quick animation or analysis.

Working Mode 17: TA Hours - Seeing instructors or TAs may need to take place away from the studio for privacy or other reasons. However, students still require to show their work during these session. Students use their laptop along with other tools to show their work.

Working Mode 18: Presentation - Presentation is yet another part of studio learning, and students use many different tools to present their ideas. With laptop, students are not limited by availability of equipped spaces.

## Other Studio Activities



## Bridging Spaces

### Mobile Tool Setting



*Working Mode 18:  
Laptop Setting - Individual Critique*



*Working Mode 19:  
Laptop Setting - Studio Interaction*



*Working Mode 20:  
Laptop Setting - Group meeting*

### Fixed Tool Setting



*Working Mode 18:  
Desktop Setting - Individual Critique*



*Working Mode 19:  
Desktop Setting - Studio Interaction*



*Working Mode 20:  
Desktop Setting - Group meeting*

## Space Diversity Comparison - Fixed tool vs. Mobile tool

Laptop allows any learning modes to happen in desirable or available space. Students and instructors spend less time looking for a place with equipment such as computer. While all the activities happened around the tools, which are desktops in the fixed setting, the mobile tool setting allows the activity to happen anywhere.

## **06 bridging learning modes and technology**

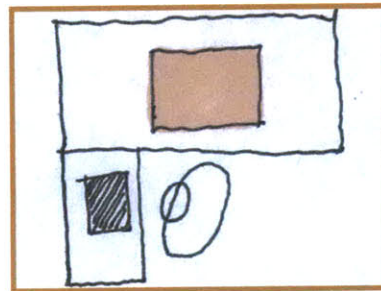
## Laptop Bridging Design Process in Studio Learning



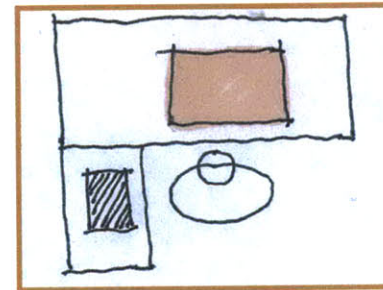
Working Mode 21:



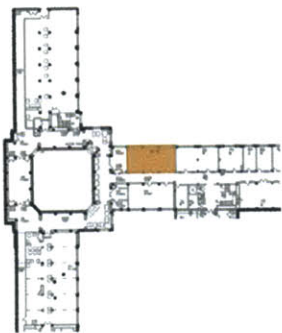
Working Mode 22:



Movement Diagram 21:  
Laptop Active



Movement Diagram 22:  
Laptop Active

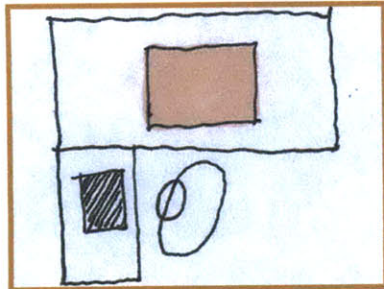


Design process is one part of the whole studio learning process. It is also made up of different components. It may differ from studio to studio or by the individual student, but in general, sketching, modeling, 3D presentation, presentation preparation and research, are components of the design process. Mobile technology links all steps in the design process and creates a smoother transition between studio design process.

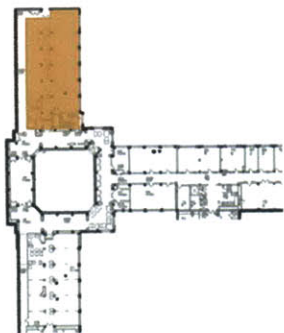
## Bridging Studio Learning



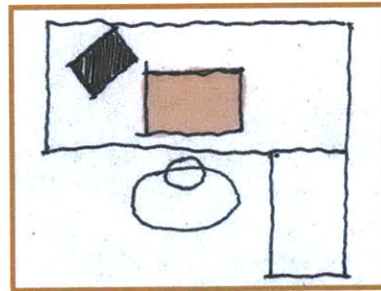
Working Mode 23:  
Using Computer Software



Movement Diagram 23:  
Laptop Active



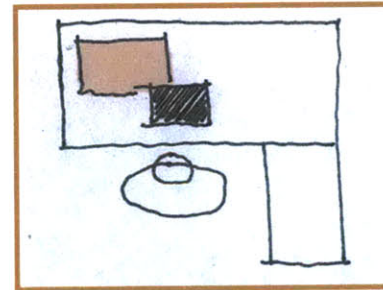
Working Mode 24:  
Sketching



Movement Diagram 24:  
Laptop Passive



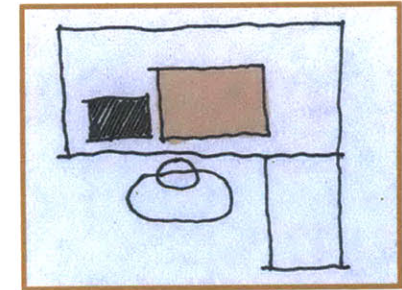
Working Mode 25:  
Research



Movement Diagram 25:  
Laptop Active



Working Mode 26:  
Modeling



Movement Diagram 26:  
Laptop Passive

## Laptop bridging Studio Design Process

Laptops do not replace a drafting table or any modeling tools, but the available programs complement the design process. Laptops may be the main tool for some parts of the design process like using AutoCADD (*working mode 23*) or preparing for a presentation (*working mode 25*). For the many other processes of design studio, the laptop's purpose is to link each stage of the design process.

## Bridging Studio Learning



*Working Mode 1:  
Site Analysis*



*Working Mode 28:  
Printing*



*Working Mode 27:  
Research*



*Working Mode 29:  
Scanning*



*Working Mode 26:  
Modeling*



*Working Mode 30:  
Plotting*



*Working Mode 24:  
Sketching*



*Working Mode 31:  
Laser cutter*

## Laptop Bridging Studio Learning Modes

Design process is only one part of the whole studio learning. Most of design process happen within the private space of a student's studio, but there are other parts of learning which happen outside one's studio space. Some other studio activities are sharing information with classmates, group projects, meetings, presentations, lectures, using other technologies and supporting equipment like printers. Mobile technology allows students to go from one learning mode to another with less difficulty and time. Laptops carry enough information to become a student's work station, so when the students have to go to another location to work, they can access their work on their laptop, thus, the laptop becomes the students' virtual work station.

## Bridging Studio Learning



Working Mode 4:



Working Mode 19



Working Mode 32:  
Guest Lecture



Working Mode 33:  
Lecture



Working Mode 34:  
Interaction and sharing



Working Mode 20



Working Mode 15

## Laptop Bridging Studio Learning Modes

Laptops introduce an interesting dynamic to interaction among students. When a student needs to share with another student, the sharing happens more immediately. Interactions happen at the moment of initiator's desire (*working mode 27*), the initiator does not need to wait for the recipient's convenient time. The initiator takes her laptop and shows or shares her idea directly from her laptop monitor. A similar dynamic happens in studio lectures or quick reviews. Lectures or quick reviews can happen more spontaneously and as needed during studio time without planning ahead, or reserving equipment and special rooms with AV system.

## Bridging Studio Learning



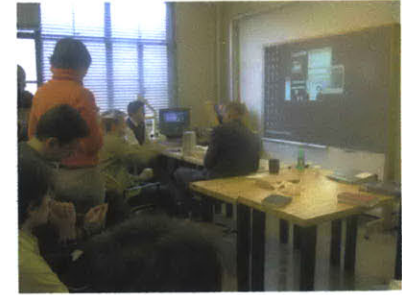
*Working Mode 35:  
Presentation*



*Working Mode 36:  
Presentation*



*Working Mode 16*



*Working Mode 37:  
Distance Presentation*



*Working Mode 38:  
Distance Presentation*



*Working Mode 38:  
Distance Presentation*



*Working Mode 39:  
Laptop Presentation*



*Working Mode 39:  
Laptop Presentation*

## Laptop Bridging Studio Learning Modes

Whether it is because of a smaller audience, or the choose not to over emphasize with large projector screen, students may not want to use the LCD projector to present their ideas during smaller reviews and presentations. Students may choose to use laptop monitors as an additional form of presentations. By using their personal laptop, the user is familiar with their machine, which gives them an added comfort during a nervous time of presentations and lectures. There are times when the laptop is the primary tool for the presentation, but most architectural reviews have parts of presentation which do not requires computer. Students may be discouraged to reserve a room with the required equipment for 3 minute animation, at the same time, the 3 minute animation can better communicate the student's ideas and proposals.

## Bridging Studio Learning

## Laptop Bridging Different technologies more closely



Working Mode 40:  
3D Modeling Machine



Working Mode 41:  
Plotting



Working Mode 42:  
Mobile Scanner



Working Mode 43:  
Printing



Working Mode 44:  
Laser Cutter



Working Mode 29:  
Scanner

Using various machines such as printers, plotters, 3D printers and laser cutters have become more than producing the end product. Many students use these machines in between their design processes to test ideas and proposals. Laptops save time and decreases distance between studio space and the location of the technology; therefore, students are more apt to use new technologies than those with a desktop or without a laptop. The above images show that students bring their laptops to the equipment they desire to use, as they use the machines, they can change and work on the results. There is no need to go back to the studio space to re-send the file if there are errors or to fix any mistakes as soon as the student can see the results from the printer or plotter.



## **07 learning modes in one space**

## Movement Analysis



Plotter and Printer



3D Modeling

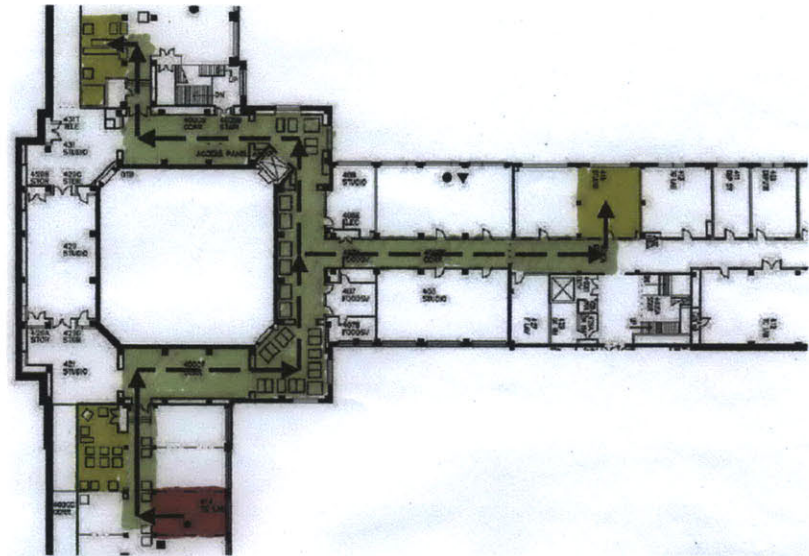


Laser Cutter



Studio

## Existing Movement from studio to equipment areas



Movement Diagram DD:  
From Studio to Equipment Areas

Learning is most efficient and effective when there is the option of having all learning modes occurring in one space rather than having to move from one location to another. Although MIT Architecture started this introducing process by placing the printers and plotters in studio 7, not all the studio students have direct access to the equipment. Some may argue that the distance between the studios are not great; nonetheless, the problem is not the distance, but lack of convenience. When the machines are conveniently located, students are more likely to use them. Laptops improve the learning process by using wireless connection so students can transport their laptop next to the machine they use. If studios are inter-connected or each studio has the same equipment, students could integrate different methods to express their ideas and proposals.

## Movement Analysis



AVT

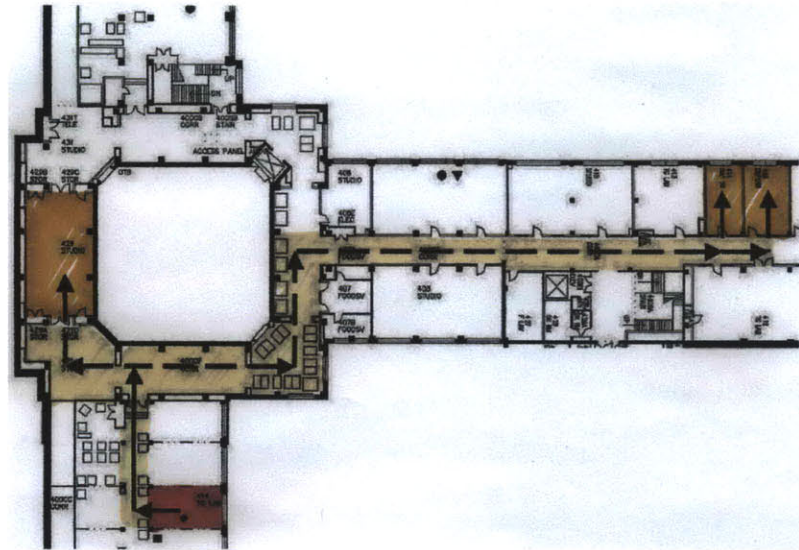


Classroom



Studio

## Existing Movement from studio to lecture space



*Movement Diagram EE:  
From Studio to Lecture Areas*

Many instructors use computer and LCD projectors to give lectures. While some lectures need the place and environment to be formal and unique, other lectures in the studio do not need a unique space. The current spatial layout requires that a lecture to be given in another location, this is due to lack of privacy and common areas in the studio space. Again, the distance between the studio and available lecture spaces are not far, but by moving 10-12 students from one location to another, the instructor may lose the previous dynamic of the studio.

## Movement Analysis



*Distance Collaboration Classroom*



*AVT*



*Classroom*

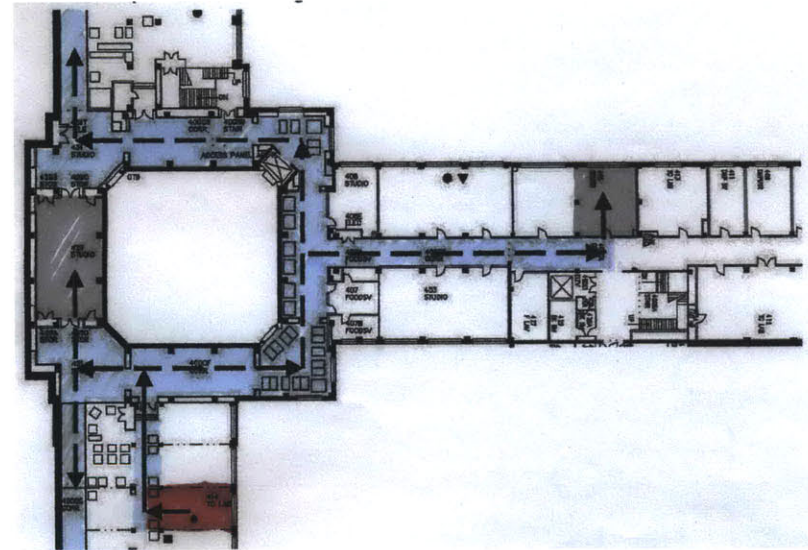


*Working Mode 26*



*North Corridor*

## Existing Movement from studio to presentation space



*Movement Diagram FF:  
From Studio to Presentation Areas*

A large portion of learning in architecture is dedicated to giving presentations. Both formal and informal presentations are part of the studio learning. By moving location, a presentation can become more formal where students become less involved in the discussion of each others' presentation. While some presentations should happen in a place away from the usual working space, most of informal and quick review should happen near student's working station, which is in the studio. What keeps this from happening in the studio is the lack of space, specifically lack of a common, flexible working area.

**08 precedent studies**

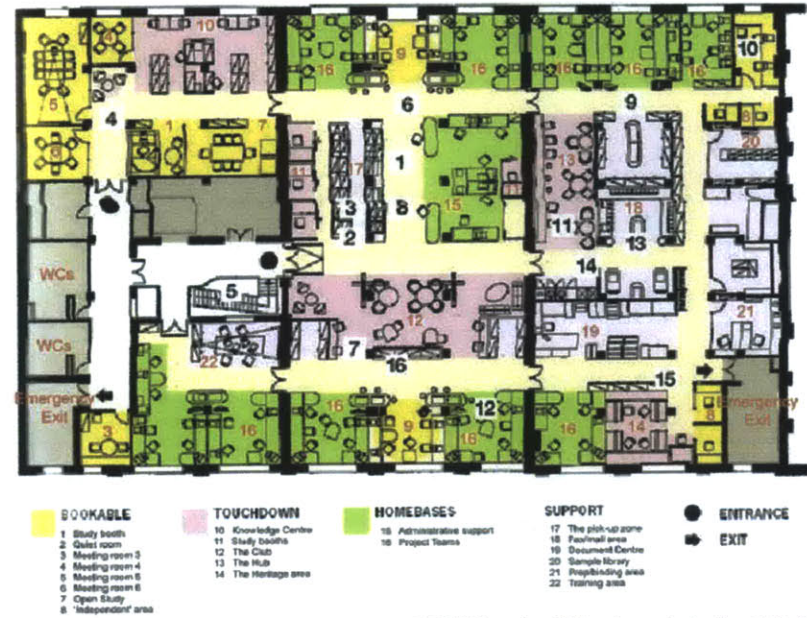
## Precedent Studies



TEAL, MIT Undergraduate Physics Lab



## TEAL and Frank Duffy's DEGW London Office



DEGW London Office Layout - by Frank Duffy

Emergence of new learning behaviors with new spatial organization and technology

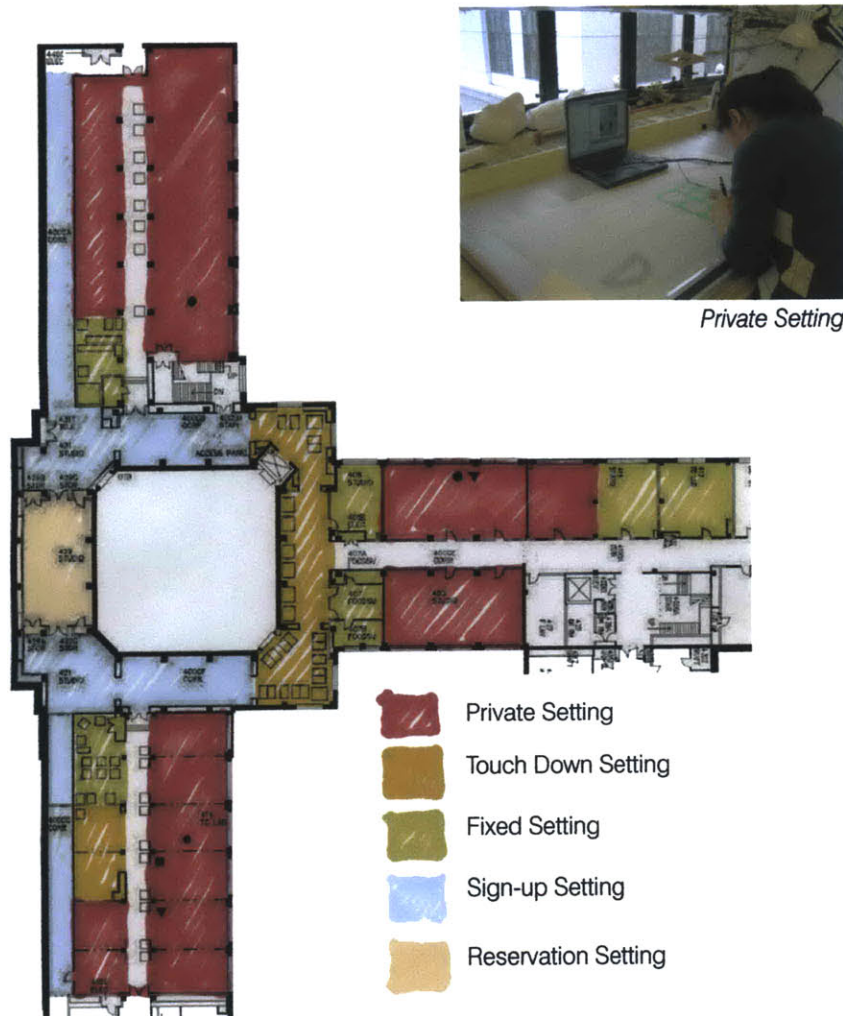
1. Round table to encourage interaction among students
2. Organizing the classroom so that the instructor stands in the middle
3. Able to see the result of a problem set instantly to see if the teaching method is effective

DEGW London office

Degrees of privacy - Homebase - private (private offices), Bookable - semi private (meeting rooms), TouchDown - semi public (Group Work Areas) and Support - public (sharing spaces)

## **09 conclusion and recommendations**

## Recommendation for New Studio Layout



Private Setting



Touch Down Setting



Fixed Setting



Sign-up Setting



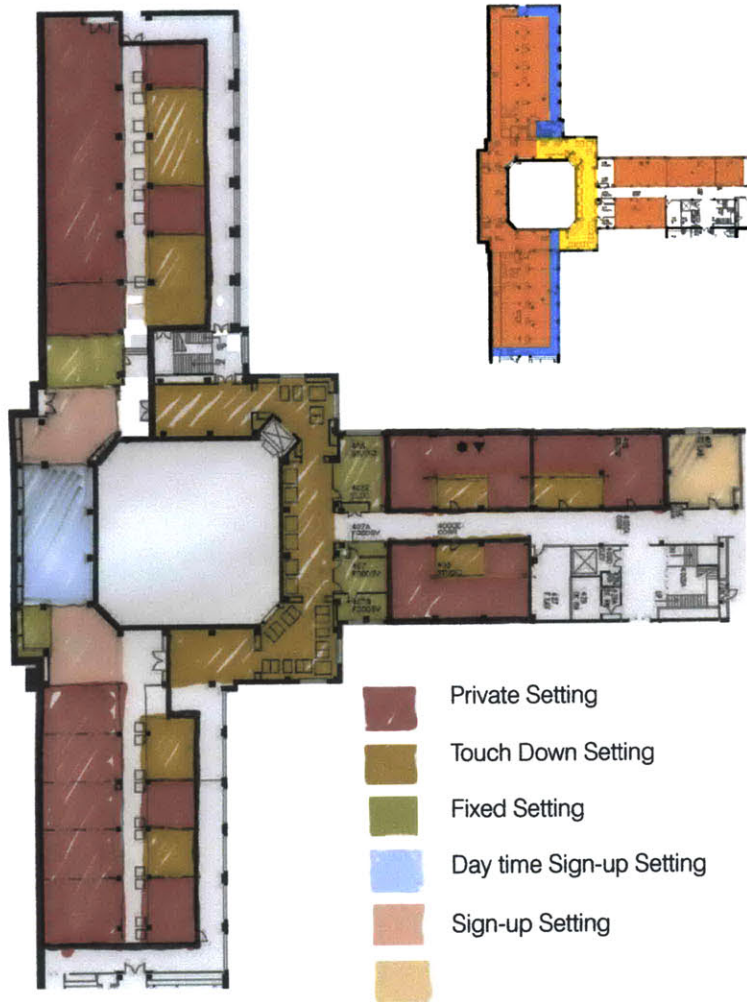
Reservation Setting

## Existing Layout vs. New Layout

- Private Setting - individual studio space
- TouchDown Setting - Term borrowed from DEGW office layout, free and flexible space where people can use without sign up or reservation
- Fixed Setting - Program space with no flexibility, i.e. Computer lab
- Sign-Up Setting - Places for informal review, informal sign up
- Reservation Setting - Need reservation to use, no access without reservation



## Recommendation for New Studio Layout



## Existing Layout vs. New Layout

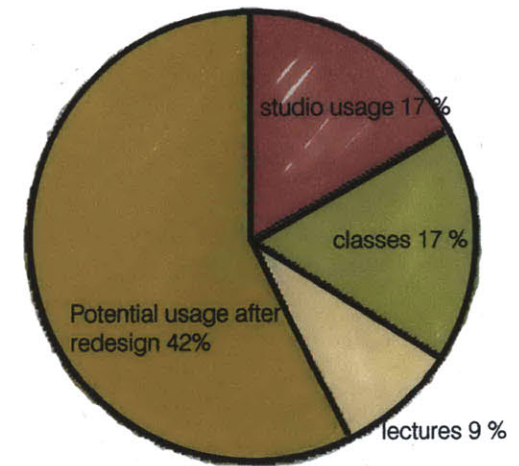
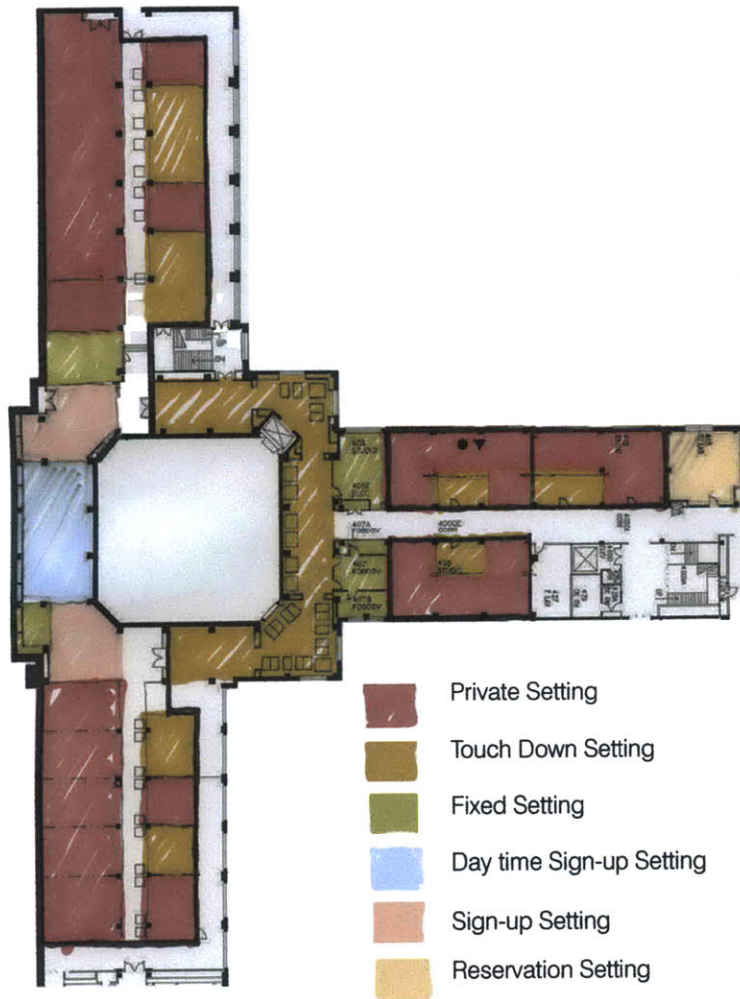


Diagram D: AVT Usage after redesign settings

The new layout opens AVT to create one studio for all three levels of MArch. AVT becomes part of studio and accessible to the students all day long. Also equipment such as plotters and printers will be in direct access to all the levels. The diagram above shows the possible hours that can be used by students if AVT is part of studio and students have access. (See pg 18)

## Recommendation for New Studio Layout



## Private Setting



*Prediction of future studio space*



*Studio*



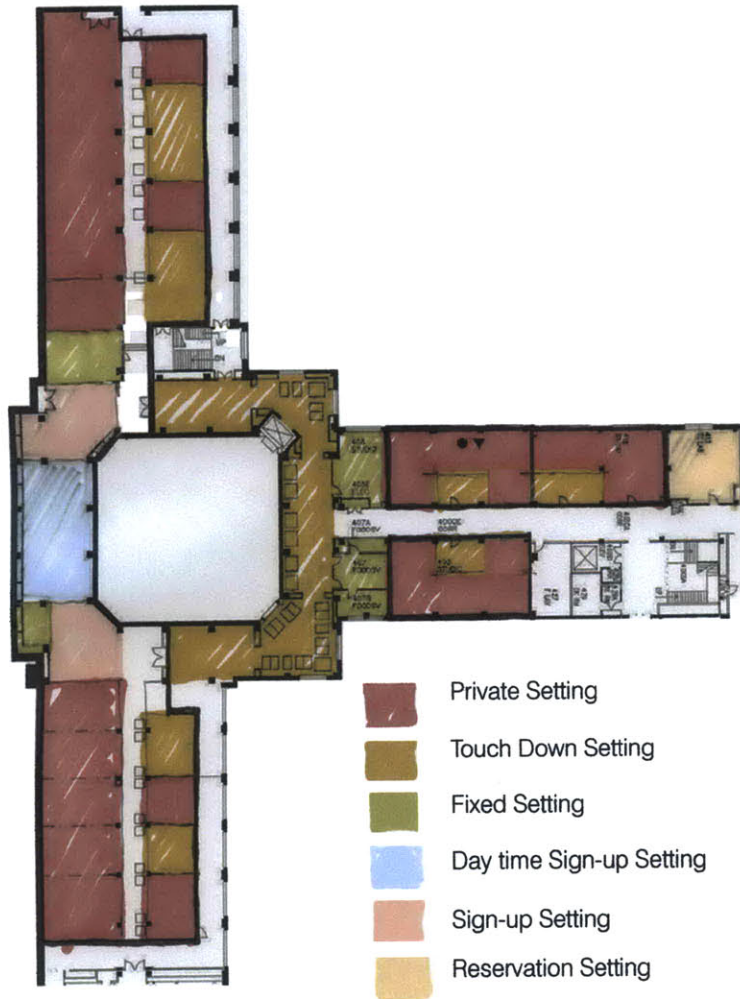
*Desk Critique*



*Prediction of future studio space*

The current layout of the School of Architecture segregates all three levels of students in different studio space. In addition, different modes of learning happens throughout the school due to the lack of space in the studios. With the new layout, the individual student's studio space does not increase; however, the goal is not to increase the private space but to increase less private space for more flexible learning to occur throughout the studio learning.

## Recommendation for New Studio Layout



## Touch Down Setting: In-Studio



*Quick Review with instructor and TA*



*Desk Critique*



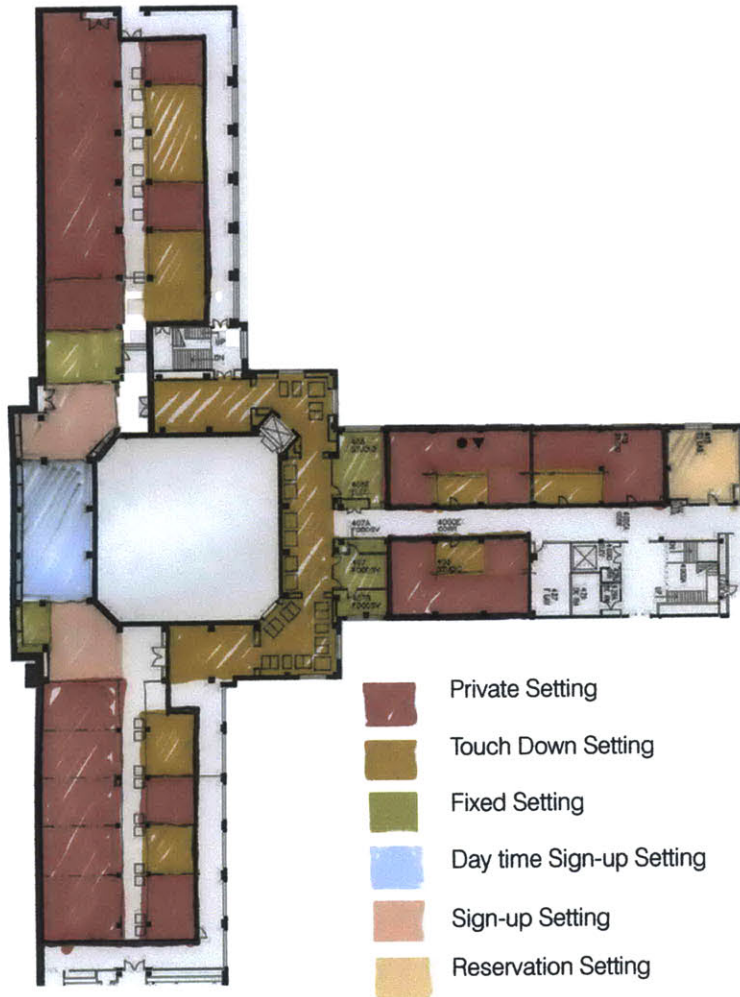
*Group Meeting*



*Group Sharing and Interaction*

Within the design studio space, touch down setting will provide un-planned activities to happen. Whether it is individual reviews or studio lecture, these touch down space will bring different dynamics to studio environment and learning. Many learning modes are not drastically different, but the space that learning modes take place are very separated. These flexible space will bring less gap between the learning mode spaces. In the new layout, the touch down setting increased by 1,273 sqft, more than 200% of current touch down setting.

## Recommendation for New Studio Layout



## Touch Down Setting: Out-of-Studio



*TA Session*



*Group Meeting*

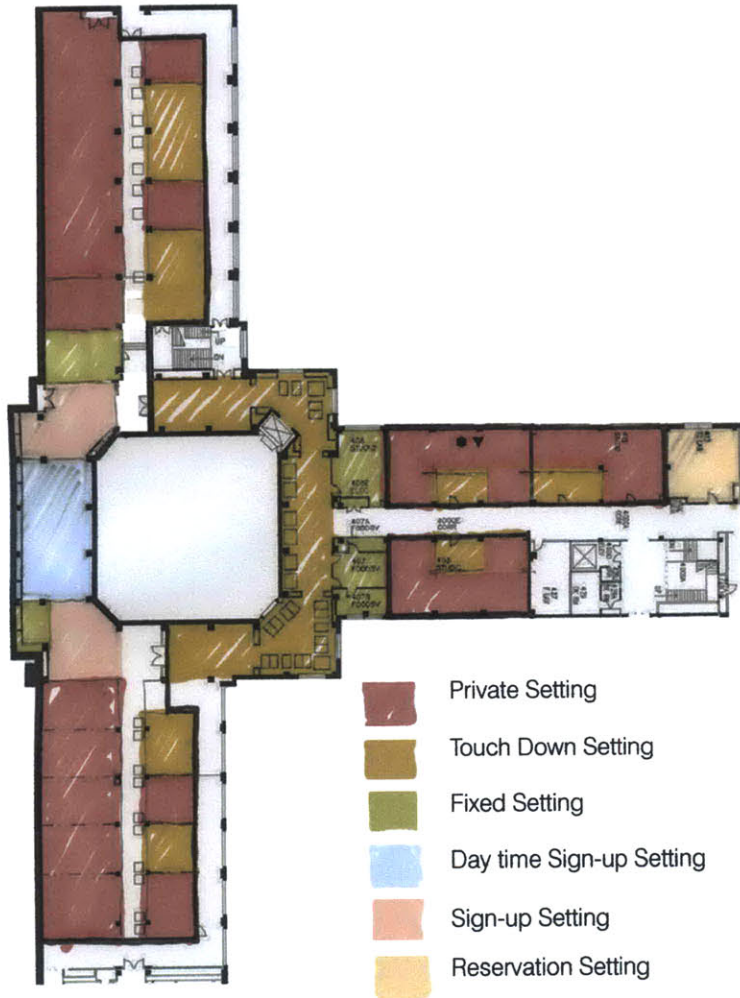


*Prediction of the future public space*

Dome cafe is another good example of Touchdown setting. It is important to provide Touchdown setting in both in-studio and out-of-studio environment. While the in-studio's Touchdown setting merges different learning modes and space, the out-of-studio's Touchdown setting provides privacy and some separation away from the studio. When students simply want to remove themselves from familiar studio surroundings, they can bring their work station to places like Dome Cafe. This is also possible and convenient due to laptop, students can bring their mobile work station and work.

## Recommendation for New Studio Layout

## Fixed Setting



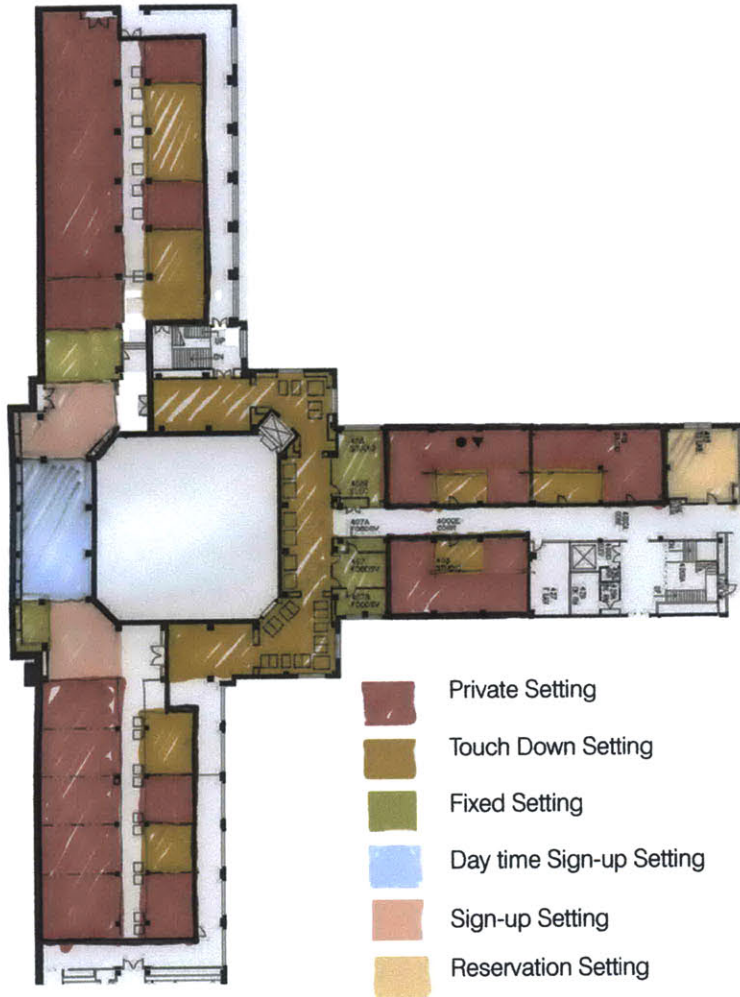
*Laser Cutter*



*Plotter and Printers*

Within the studio space, the fixed settings are the desktops areas, and space for printers and plotters. With the laptop program and increasing individual ownership of laptop, there is no need for any concentrated areas of desktops. On the other hand, it is important to give direct access to the necessary equipment to all students. The current condition only allows studio 7 to have direct access to printing equipment and studio 5 and level 1 students have to go from their studio to studio 7 in order to use these machines. By designing one studio for all three levels will provide everyone to have direct access to any equipment.

## Recommendation for New Studio Layout



- Private Setting
- Touch Down Setting
- Fixed Setting
- Day time Sign-up Setting
- Sign-up Setting
- Reservation Setting

## Day Time Sign-Up Setting



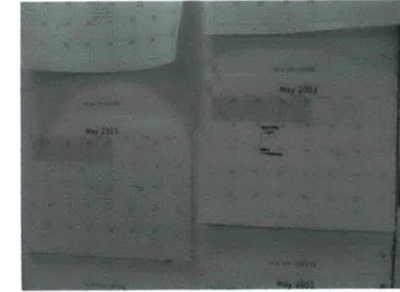
*Mid-Review*



*Mid-Review*



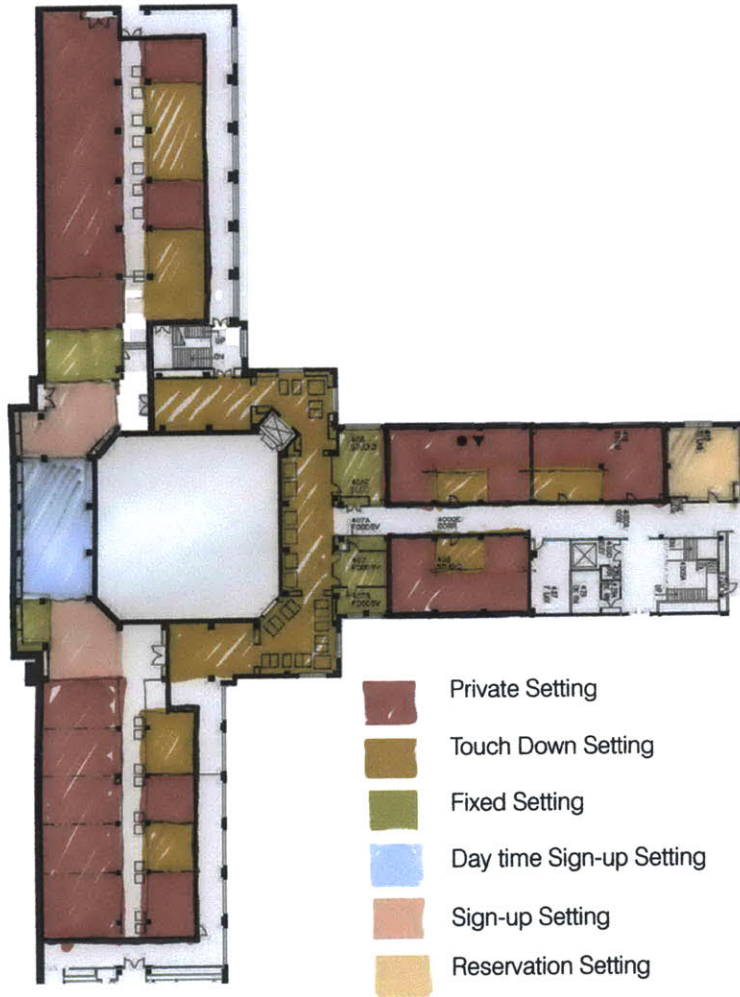
*Mid-Review*



*Sign-up place*

Day time sign-up setting is for any space, which is in high demand during certain time of the day. In Architecture school, this time may be during the hours of studio. After the given time, anyone is allowed to use the space without sign-up or reservation. The Day time sign-up setting has similar characteristics as Touchdown, but Day time sign-up gives little more separation from the individual studio space. This kind of layout will give levels of privacy for different studio activities and it will provide flexibility to use for many learning modes.

## Recommendation for New Studio Layout



## Existing Layout vs. New Layout



Presentation



Presentation



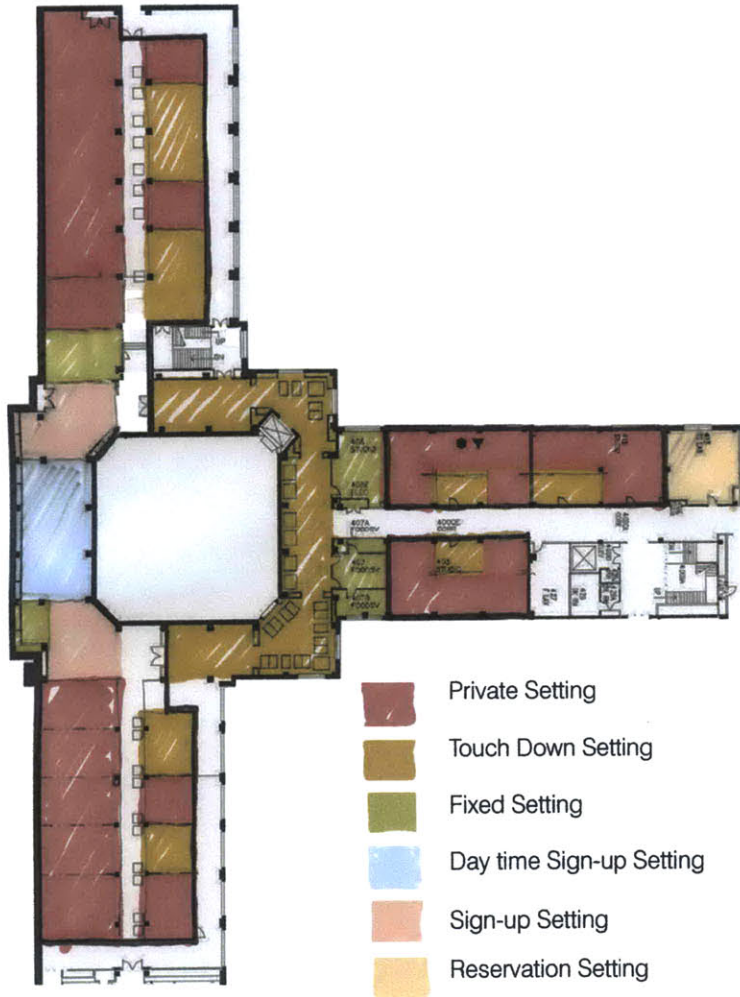
Lecture



Presentation

The studio instructors begin the semester with class schedule. Although they may not follow the schedule with every event, some of the events are more fixed than the other. For example, presentations and guest lectures can be scheduled ahead of time. Since these activities occur in every studio and level, pre-sign-up may be required in order to use the space. However, it is not a formal reservation, so when it is not being used, it is free for unsigned people to use the space.

## Recommendation for New Studio Layout



## Reservation Setting



*Class*



*Guest Lecture*



*Class*

In order to use the reservation setting, student or instructor needs to make a formal reservation in the Head Quarter. The reservation setting areas will be locked during the hours not being used and not accessible to people. The reservation setting will only be necessary for security purposes or if the space is in high demand that there is need for some regulation to reserve the space.



## 6 things to consider when you design Wireless Learning Spaces

1. Learning modes are less divided, therefore more space can be merged.

Different learning modes like lectures and labs are more integrated. Thus, learning space should provide more than one learning modes.

2. Rethinking corridors, grand stairways and previously ignored spaces to provide new working and functional spaces.

3. Public space should provide more security for those who like to work outside of their private work station.

More people would take advantage of wireless technology in public spaces like cafe; however, the lack of security keeps people from working in the public spaces. Designers should consider temporary lockers or attached locks in furniture in designing public space.

4. Give degrees of privacy in working space.

By giving degree of privacy and flexibility to space, the users are better able to use the space.

5. Re-evaluate programs in learning spaces.

Some conventional spaces may not be needed any longer and new functional space may be required to accommodate new learning cultures.

6. Re-organize programs in learning spaces.

Since laptop is able to connect certain functional spaces, some of those spaces do not need to be adjacent to each other or even in the same building.

*“Teaching and learning don’t go on only in specialized spaces, but all the time and everywhere here. The whole campus system needs to work together to support teaching and learning.”*

*William J. Mitchell,  
Dean of Architecture and Planning,  
MIT*

## Recommendation

Technology, space and social behavior. The beginning interest in this research came from wanting to clarify the relationships among the above three areas. Technology is changing so fast while the space and social behavior remains slow to change. In traffic, the problem does not lie in the what is fast or what is slow, but rather, the difference in speed brings accidents. Likewise, the difference in changing speed makes technology, space and social behavior awkward and not as effective. Technology is changing rapidly, in fact, the laptop is only a representation of wireless technology because new technology will soon replace the laptop. However, buildings do not change like technology, and old habit does not disappear without a good reason. If technology and space is not in harmony, there will not be changes in culture whether it is in working or learning.

Laptop has changed our working environment, less people are restricted by working around fixed machines or their work station. But we have yet to understand fully how people interact differently with space and mobile technology. With laptop, we focus on the greater physical distance, but neglect to study what happens locally. [While it is obvious that laptops affect communication at greater distances, it is important to study what happens locally.]

The result of this observation and research may not be a revolution, in fact, the change is slow. Nevertheless, our surrounding is slowly changing to take more advantage of the wireless technology. Famous architecture is not only loved by people due to their beauty but also for their timeless functionality. In order to design space which accommodates the rapid development of technology it is necessary to know how people behave with their working tools and interact with space. As Dean William Mitchell said during his lecture on "Places for Learning", architecture should not dictate what happens in the space, but it should provide space for activities.

*"If you build not the architecture the rigid presumption of how things should be done, it won't always work out,"*

*William J. Mitchell,  
Dean of Architecture and Planning,  
MIT*

## Conclusion

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