WORKSPACE IN TRANSITION

: RETHIKING WORKSPACE THROUGH THE DESIGN OF RECONFIGURABLE WORKSURFACES

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Submitted to the Department of Architecture in partial fulfillment to the requirements for the degree of
Master of Science in Architecture Studies
at the Massachusetts Institute of Technology
June 2003

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ABSTRACT

Communication is an integral part of today’s workplace, linking people, objects, and information. Now that knowledge exchange is considered a significant work activity, new technologies have been developed to support communication with people who are on the move. As a result, people can work not only anywhere within the office, but anywhere outside the office as long as access to information is provided. In this new flexible work condition, it is important to create work environments that can accommodate a dynamic relationship between people, physical workspace artifacts, and information. In particular, the study of mobility in modern work is useful when creating a framework for the design of physical workplace artifacts. Furthermore, the design of these artifacts can be beneficial in terms of balancing the complex relationship between people and information through the integration of related communication activities. Based on this idea of merging physical workplace artifacts and information, this thesis creates a conceptual framework for the design of a responsive workplace artifact that links information and related communication activities. It accomplishes this through the use of a deployable and adaptive electronic material for workplace product design. The ultimate goal is the creation of a worksurface that is physically transformable and visually reconfigurable.

It is anticipated that this adaptable digital worksurface will have new applications while enriching existing ones, thereby elevating a user’s daily work experience as well increasing the amount of activities that can occur in a given space. To achieve this goal, a series of studies were conducted prior to actual design in order to map trends in workplace design with respect to various information display methods. Diverse spatial dimensions in the workplace were identified and subdivided into several categories. Tectonic and digital properties of surface materials were explored to in order to develop worksurfaces that responded to each specific workspace dimension. Finally, functional and spatial applications of the proposed set of design products were illustrated through the creation of diverse spatial scenarios. These simulations were intended to demonstrate possible relationships between the proposed artifacts and visual information, anticipating an effect on communication activity as well as space usage. These scenarios highlight the nomadic characteristics of modern work activity and information transfer through the use of the proposed worksurface products.

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Title: Associate Professor of Architecture
ACKNOWLEDGEMENT

I am deeply thankful for
all my thesis committee members for your visionary inspiration and questions

and

my beloved parents, brother, and Hyunjung for your endless encouragement and support.
The growth of knowledge-based work forces and the parallel developments in information technology have created a new work pattern: a mobile work situation. Workers have greater mobility than ever before. Workers do not necessarily have to go to the offices, or to stay at their desks for the entire work day. WORK TAKES PLACE WHERE WORK IS DONE.
Personal mobile information technology is one of the driving forces that influence the ways people work. It has enabled people to work from location-dependent fixed workspaces to independent dynamic conditions such as mobile, temporarily shared, or alternatively situated flexible work environments.

Restructuring, employee relocation, or reformation of project teams can result in shifting people or equipment in workspace. Whereas this rearrangement may have a positive impact on a company's goal in the end, the immediate effect can be disruptive and costly. According to the authors in the book, titled "Tomorrow's Office: Creating Effective and Human Interiors," replacing office furniture with cost-effective modular system furniture and introducing movable work surfaces can reduce extra-expense caused by this frequent moving and restructuring. Use of mobile furniture, workstations, and cubicle systems have increased mobility and flexibility, reducing disruption and expense when changing workplace layout.

Therefore, the ability to quickly respond to these on-going changes is one of the major challenges in workplace design. Adaptability is the key to create responsive and flexible work environments where a variety of work activities can be facilitated without causing too much disruption and inconvenience.

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Workspace design products are becoming more and more adaptable in terms of accommodating possible future changes such as space layout, office infrastructures, user group reformation, etc. Responding to this trend, it has been emphasized that workplace product needs to have flexibility, mobility, and integration with electronic infrastructures.

**Desks and Tables**
- Fig. 8-2: Meeting arrangement
- Fig. 8-3: Transformable personal desk
- Fig. 8-4: Mobile storage cart

**Storages**

**Seatings**
- Fig. 8-5: Stackable task chair

**Accessories**
- Fig. 8-6: Wall accessories

**Territorial Screens**
- Fig. 8-7: Mobile individual screen panel
ELECTRONIC INFORMATION DISPLAY DEVICES

Mobility, portability, compactness in terms of packaging and storing, multi-functionality, cost efficiency are the key design issues of today's consumer electronic display devices.

Multi-functionality

Portability

Fig. 9-1, 2, 3: Multi functional display systems-desktop, laptop, palm pilot design

Fig. 9-4, 5: Concept prototype, cylinder PC

Surveillance

Fig. 9-6, 7, 8: Cellular phone, e-book, screen phone design

Fig. 9-10: Room wizard

User-Friendly Interface

Compact Package

Fig. 9-10, 11: Environmental installation, touch panel design

Fig. 9-12: Integrated package
INFORMATION DISPLAY SURFACES IN THE WORKPLACE

All kinds of display surfaces play integral parts in today's work activities.

Traditional display surfaces: papers, white boards, projection screen, etc..

Contemporary electronic display surfaces: LCD screens, Electronic desk surface, Mobile office carrel with CRT display station.

Integrated display surface with interiors: wall surface becomes an interface for communication. All kinds of possible worksurfaces can turn into display area.
INTEGRATION: WORKSURFACES AND INFORMATION DISPLAY TECHNOLOGY

"When information came in weighty books and files, it needs horizontal surfaces to support it. With weightless electronic, data it is more natural to have it in the line of sight and vertical. We are moving from having things to put down, to having things to look at. And voice-activated computers won't even need a shelf for the keyboard has the desk had its day?"


Precedent study of workplace design products, information display devices, and their combined use in work environments draws the following questions.

What is THE threshold of adaptability, flexibility, and mobility among a diverse range of worksurfaces in terms of

- Physical transformation of worksurface configuration
- Rearrangement of visual information contexts displayed on the used worksurfaces

What kind of visual information is used in workplace? What are the characteristics of these information in relationship to worksurfaces? Considering competitions among various information display methods from papers to sensor-based interactive worksurfaces, what types of worksurfaces can serve the following aspects of display criteria most appropriately and effectively?

- Space dimension
- Quality of projected images
- Duration of display time
- Privacy vs sharability
- Hierarchy of significance

THESIS STATEMENT

This thesis deals with the issue of adaptability in today's constantly changing work environments: Flexibility of workspace that promotes the potential to accommodate diverse work activities with transformable worksurfaces. In addition, the thesis explores visually mutated work environments by creatively adapting electronic display technology.

THESIS OBJECTIVES

First, To identify different types of worksurfaces translating diverse work activities in nomadic work environments.
Second, To propose a variety of new and enriched ways to transform physical arrangement of worksurfaces.
Third, To integrate the proposed worksurfaces with appropriate visual information reflecting the associated work activities.
Fourth, To highlight certain qualities of workspaces through a seamless marriage between worksurfaces and displayed information, not found in other customary products.
APPLICATIONS OF ELECTRONICALLY MEDIATED WORKSURFACES IN TEMPORARILY SHARED TRANSIENT WORK ENVIRONMENTS

Will create the following two possibilities in workplace:

- Physical rearrangement of worksurface configuration
- Visual reconfiguration of information mapped onto the related physical worksurface
Proposed design process is conducted by the following sequence. Each phase of the design exercise is structured to create final visionary scenarios that will demonstrate a visual spectrum of all the proposed design products and their influences in space uses throughout the daily work situations.

01 ANALYSIS

02 CONCEPT FORMULATION

03 MATERIAL SELECTION AND INVESTIGATION

04 PRODUCT DEVELOPMENT

05 SIMULATION OF USAGE SCENARIOS

06 EVALUATION AND FURTHER SUGGESTIONS
FOCUSED AREA:

MAIN WORKSPACE

01 OPEN WORKSTATION

higher usage  lower usage

02 OPEN GROUP CLUSTER

03 ENCLOSED INDIVIDUAL OFFICE ROOM

04 ENCLOSED GROUP SPACE

05 LOCAL CIRCULATION

06 LOCAL BUILDING STRUCTURE

RELATED WORKSURFACES

FIXED INTERIOR STRUCTURE SURFACES
- walls/columns
- floors
- ceilings
- doors and windows
- built-in storages
- service components

MOBILE INTERIOR FURNITURE/ ARTIFACT SURFACES
- seatings
- desks and tables
- panels and boards
- freestanding partitions
- personal/group storage units
- accessories - lighting fixtures
- office supplies files artworks
- textiles - shades blinds curtains
- floor carpeting mats etc.

ELECTRONIC EQUIPMENTS:
INFORMATION DISPLAY SURFACES
- PCs and peripherals laptops
- PDAs monitors electric boards
- signboards telecommunication
devices sensor/control display
accessories etc.

* The colored codes illustrate usage ratio among three types of worksurfaces in each space.
### FOCUSED AREA:

#### MAIN WORKSPACE

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#### CHARACTERISTICS OF DISPLAYED INFORMATION

- **SPACE PROXIMITY**: Distance/Immediacy
- **QUALITY**: Resolution/Legibility
- **DURATION**: Time/Update frequency
- **SCALE**: Size
- **ACCESSIBILITY**: Privacy/Sharability
- **HIERARCHY**: Significance

*Number of key symbols indicates a degree of intensity in each displayed characteristic category:
  e.g. : smaller scale  : larger scale
- Space proximity: immediate personal workspace such as a workstation and cubicle setting.
- Surface reconfigurability: higher demands on mobility, transportability, and frequent rearrangement.
- Surface characteristics: flat, or slightly curved surfaces depending on ergonomics and a relative distance/location from information surface, adjusting viewing angles, etc.
- Information types: higher resolution, short-term based, frequent contents-update, various levels of privacy from personal to sharable within a group, and open to public.
WORKSURFACE TYPOLOGY TWO

- Space proximity: intermediary personal work surroundings primarily defined by enclosed interior elements such as walls, partition walls, etc.
- Surface reconfigurability: mid to low range of mobility, relocation, and rearrangement frequency.
- Surface characteristics: heavy and durable worksurfaces that can serve as additional surface layers to protect, conceal, or soften existing interior surfaces particularly such as walls, columns, and floors. Applied to an enclosed individual work area.
- Information types: moderate resolution quality, longer display time, occasional contents-update, low degree of information privacy level. More public oriented information can be accommodated.

03 ENCLOSED INDIVIDUAL OFFICE ROOM

04 ENCLOSED GROUP SPACE

Fig. 19-1, 2: Enclosed personal/group space
WORKSURFACE TYPOLOGY THREE

-Space proximity: distanced work surroundings, in-between area interconnecting or disjoining adjacent spaces
-Surface reconfigurability: high to mid range of mobility, relocation, and rearrangement frequency
-Surface characteristics: the most flexible and light-weight worksurfaces that can be blended into a larger workspace area. It serves mainly as an environmental backdrop. This category of worksurface can be used to reinforce fluidity of interior spaces, or delicate separation between neighboring spaces.
-Information types: defined territory is somewhat ambiguous, because it is temporarily created ephemeral structure. Hence, displayed information can be a low quality, image-oriented ambient patterns that can influence mood and atmosphere in the interior. Depending on display purposes, content-update frequency could vary from slow to fast transition.

05 LOCAL CIRCULATION

06 LOCAL BUILDING STRUCTURE

Fig. 20-1: public space in workspace
Exemplary spaces
SELECTED MATERIAL
E-INK AND ELECTRONICS
Electronic ink is a proprietary material that is processed into a film for integration into electronic displays.

REASONS FOR SELECTION
1. Duality of display characteristics that bridges between paper and other electronice CRT and LCDs
2. Mobility
3. Flexibility
4. Light-weight
5. Readability that superseed paper quality
6. Low power consumption
7. Permanance
8. MANUFACTURING PROCESS
The ink is printed onto a sheet of plastic film that is laminated to a layer of circuitry. The circuitry forms a pattern of pixels that can then be controlled by a display driver. These microcapules are suspended in a liquid "carrier medium" allowing them to be printed using existing screen printing processes onto virtually any surface, including glass, plastic, fabric and even paper. Ultimately electronic ink will permit most any surface to become a display.

ADVANTAGE OF E-INK MATERIAL:
E-Ink can be laminated, or applied to virtually any substrate, which offers a new level of design versatility for applications requiring rugged, conformable or bendable displays.

MATERIAL EXPERIMENT : POLYMER- BASED THIN FILM PROPERTIES

Material experiment was performed before the actual product design phase to understand material properties and behaviors. This exploration will serve as a critical framework to formulate a conceptual background for the next product design development phase.
In this design development phase, a set of multiple design solutions are proposed for each focused spatial dimension. An individual design product is developed guided by the following underlying principles.

01 BASIC E-INK COMPONENTS

02 SURFACE REINFORCEMENT COMPONENTS

03 SPATIAL STRUCTURE COMPONENTS

04 PROPOSED WORKSURFACE MODELS

05 STORING LOGIC AND PACKAGING
- Basic e-ink components: using e-ink's flexibility, diverse curvature profiles such as flat, concave, and convex curves can be created to accommodate users' different viewing angles, relative locations from the screen surface, etc.
- Surface reinforcement: surface is reinforced by mechanical substructure components. A set of interlocking two arms are placed onto the backside of the basic e-ink surface to control the surface. Flexible metal strips are attached to these supporting arms. Together, the arms and strips create various ranges of surface curvature profiles.
- The purpose of this mechanical intervention is to create substructure elements that can increase adaptability and transformability of the basic surface configuration, responding to a demand for easy adjustment of the surface configuration in their most immediate work environment.
STUDY MODEL CONSTRUCTION: Exploration of surface reinforcement logic by mechanical hardware components and surface profile deformation
Surface Substructure Layer: Interlocking arms and thin metal strips control the basic e-ink surface profiles, deforming into diverse surface profiles.
The intent of spatial structure components in this first design experiment is to place the curvature adjustable e-ink surface -developed from the previous design phase- in users' immediate work territories within close reach.

- Spatial structure elements such as a metal frame stand with adjustable arms, rotational hanging structure with cables, and transparent hardtop surface with fastening clips are designed and integrated with the reinforced e-ink surface to locate the panels in space.
- Proposed functional uses of these e-ink surface panels can be a mobile screen panel structure, overhanging display panel, and e-ink inserted hardtop desk.
- Connection logic: a possible strategy for connecting multiple panels is by placing metal clips along the edges of two adjacent panels and sandwiching the surface between top and bottom metal clip pieces.
PROPOSED WORKSURFACE MODELS

PRODUCT ONE: FREE-STANDING MOBILE SCREEN UNIT

This worksurface product can accommodate diverse ranges of display surface configurations in the most immediate personal/group work environments through a rotational flexible arm and a mobile metal frame stand. The basic arm and stand components can be multiplied and transformed into a more complex structure by connecting this basic unit with each other. Wires and cables can run through the inside of the metal stand.

Multiple screen panels can be integrated with the frame stand. Attached to the rotating arm structure, panel angle, location, and height can be adjusted easily.
COMBINED ASSEMBLY IN SPACE: Freestanding mobile e-ink screen panels can create various display conditions in situations when display quality, rearrangement frequency, and mobility are the most critical concerns.
PRODUCT TWO: SUSPENDED INFORMATION PANEL

Overhanging e-ink work panels can elevate the dynamic of workspace interiors, maximizing possible display surface areas in the immediate work territories. Height and angle of this suspended panel can be adjustable depending on a user’s display preference and viewing purpose.
COMBINED ASSEMBLY IN SPACE: Suspended e-ink screen panels can amplify functional uses of interior work surfaces and vitalize the work atmosphere, by turning a ceiling space into an active display surface.
PRODUCT THREE: HARDTOP DESK

This e-ink panel can be easily clipped onto the under-side of a transparent hardtop desk. Slided underneath, or laid on top of an existing transparent hard top desk, this worksurface product can be supplementary to other worksurfaces, or conventional display methods such as papers, PDAs, Lap tops, etc.

COMBINED ASSEMBLY IN SPACE: this category of e-ink display panel can be an extremely versatile worksurface element in individual workstations, or meeting desk areas. It is anticipated that this worksurface panel can be substituted, or added to other existing visual devices in the immediate worksurface area.
STACKING

Each e-ink screen panel and frame component can be easily dis-assembled and stacked together when not in use for space-saving purpose. Collapsibility of the proposed product is the result of a unit based design strategy.
- Basic e-ink component: This design experiment uses the transformability of an e-ink surface that can be rolled into a cylinder shape.
- Surface reinforcement logic: The basic e-ink unit is reinforced by heavy fabric substructure materials, particularly by plastic-based industrial textiles such as vinyl and felt. These heavy industrial fabrics are layered on the backside of the e-ink surface to provide durability and weight to the original e-ink material. Vinyl is used for back-support material, and felt for non-slippery padding.
- The purpose of these substructure components is primarily to strengthen the original material by adding protection and stability. It is particularly useful when the display surface should be placed on the existing interior floors, or mounted onto the walls, partition walls, columns, etc.

**01 BASIC E-INK COMPONENTS**

**02 SURFACE REINFORCEMENT COMPONENTS**

E-ink is rolled inside of a cylinder component, or reinforced by back-padding materials.
CONCEPT STUDY MODEL: Heavy-duty fabrics such as industrial vinyl and felt materials are combined with a basic e-ink component for reinforcement. The combination of materials can give stability to the original structure and yet, creates a soft finish in the interior of intermediate work environments.

Structural layering logics: additional layers on the back side of e-ink
The spatial structuring logic is designed to cover, or lay this textile-reinforced e-ink fabric on the existing interior surfaces. The intent of the spatial structure components is:

- first, plastic cylinder with mounting units such as fasteners, clips, and strings attaches the e-ink fabric onto the vertical interior surfaces.
- second, felt backing and velcros create a durable supporting system allowing this e-ink fabric on the floor surface.

Detail study model demonstrates rolling and backing strategy.
PROPOSED WORKSURFACE MODELS

PRODUCT ONE: INFORMATION RUG

Felt backing materials and velcros can create a great opportunity, transforming a floor area into a dynamic display surface in the intermediary work environments. Potential for electronic signage, multiple display projections, atmosphere controls in an enclosed room situation are the possible examples for applications.

COMBINED ASSEMBLY IN SPACE: Covering a larger surface area, this surface product serves as an information carpet, or wall paper, creating a dynamic backdrop in the enclosed, or semi-enclosed interior spaces.

Detail shows back padding and connection between fabrics by velcros.
PRODUCT TWO: INFORMATION TAPESTRY

Plastic cylinder structure and mounting components enable this e-ink fabric to be mounted on the existing interior wall surfaces, or partitions. This product covers a larger surface area in the enclosed room situations, creating an information backdrop. This can be used with the other display surfaces placed in a more immediate work territory.
ROLLING

Cylinder and velcro structures serve for storing this durable e-ink fabric in a compactly packaged format as well as providing a spatial structure for mounting, or overlaying on the floor.
LAMINATED DRAPERY

- Basic e-ink component: this design exercise adapts foldability, a deformation logic learned from the previous, material exploration phase.
- Surface reinforcement logic: The basic e-ink surface is reinforced by laminating two, or multiple sheets of e-ink films. Stability can be gained through this layering method, and yet, flexibility is still maintained by limiting into a smaller number of layers.
- Each layer is printed with a selected single tone of black, or white color which is coarsely coated onto the substrate film surface. This will create transparent spots on the e-ink surface. Layered e-ink surfaces are adhered to the front and backside of a thin film material. As a result, combined film layers produce translucent effects.

01 BASIC E-INK COMPONENTS

02 SURFACE REINFORCEMENT COMPONENTS

CONCEPT STUDY MODELS: Laminating multiple film layers using an adhesive and transparent tape
CONCEPT STUDY MODEL CONSTRUCTION: Process of folding and laminating. Alternating printing mechanisms based on selected ink colors can create translucent effects on the e-ink surface.

Layering logic and folding deformation
- Connecting mechanism used for paper/fabric pieces can be applied to create spatial structure logic for this design product. Hardware such as buttons, snaps, hooks, and tapes are used to place this worksurface in a distanced, a larger scale workspace dimension.
- The purpose of this structural component is to create a delicate joint, or separation between neighboring spaces with a temporary time basis.
- These spatial structure components can serve as a connecting strategy for separate drapery sheets to enlarge possible display surface areas.

Details of hooks, buttons, snaps, tapes, etc. illustrate a placement logic and connection method between e-ink sheets.
PRODUCT ONE: AMBIENT DRAPERY

Hanging, or stretching over a certain open workspace area, this flexible and translucent e-ink drapery can interconnect, or separate neighboring spaces, or redefine a space with a temporary boundary. This type of worksurface serves for creating ambient mood, or atmospheric effects.
COMBINED ASSEMBLY IN SPACE: Ambient drapery creates a subtle accent in spaces. This worksurface product increases fluidity of a space, blending the defined area with the rest of surrounding environments.
FOLDING

A folding configuration strategy can create a compact package of e-ink drapery and hardware component together. This space-saving packaging logic converts a larger drapery surface into a small, transportable e-ink bag.

Details illustrate an integrated packaging solution that contains the driver unit inside of the folded e-ink bag.
SIMULATION OF USAGE SCENARIOS

Simulated usage scenarios are illustrated in the following three workspace zones.

**FOCUSED AREA:**

- **MAIN WORKSPACE**

  - **ZONE ONE**
  - WORKSPACE TYPOLOGY ONE
    - 01 OPEN WORKSTATION
    - 02 OPEN GROUP CLUSTER

  - **ZONE TWO**
  - WORKSPACE TYPOLOGY TWO
    - 03 ENCLOSED INDIVIDUAL OFFICE ROOM
    - 04 ENCLOSED GROUP SPACE

  - **ZONE THREE**
  - WORKSPACE TYPOLOGY THREE
    - 05 LOCAL CIRCULATION
    - 06 LOCAL BUILDING STRUCTURE
WORKPLACE TIMELINE

ZONE ONE  Personal Workstation and Cubicle

Before intervention

After intervention
Laura logs into the firm's network using her laptop. She transfers her files from her PDA and laptop into a hard top e-ink desk and mobile screen panels. She checks on her schedule and prepares for a client meeting agenda scheduled this afternoon. Looking through a monthly calendar and a schedule note in the mobile screen panel, she checks back and forth with data projected on the e-ink hardtop desk.
John is connected to his team members, Paul and Linsey in the NY office to discuss a possible change for an upcoming construction document set deadline and bidding schedule for the Convention Center Competition in Seoul, South Korea. This virtual team meeting is a live-broadcasting that is facilitated by suspended e-ink panel. Data files from the meeting are transmitted into his PDA connected to the e-ink panels. The floor e-ink rug is also used to provide images and texts necessary for his remote team members during the virtual meeting. Outside of John’s cubicle: Today’s business news and Wall street stock market information are displayed on the e-ink mobile screen panels that create a sense of a territorial boundary between John’s workstation area and the adjacent corridor.
Laura and John are having a meeting with a client in a room that is temporarily set up for this special occasion. Partition walls are set up to create an enclosed space. E-ink tapestries are mounted on the partition walls to create display surfaces that mainly serve for oversize, visual images and drawing materials. Focused areas are zoomed in and out. Transition from one image to another is made through a fading effect. When contents are highlighted, contrast increases. Around the desk space, curvature adjustable panels are facilitated along with a laptop. E-ink panels display large size drawing documents. In addition, e-ink floor rugs show site context images and maps. Overhanging e-ink ceiling panels are used to broadcast the NY office team members during the meeting.
The same area used for the client meeting is quickly modified into a conference room for lunch time presentation. Foil TEC Inc. in London office will be presenting uses of film-based building facade materials and related curtain-wall engineering technique.

Overhanging e-ink ceiling panels display information for the audience, accommodating multiple viewing angles through a large display surface. Height is adjusted appropriately for people seating on the desks. The floor e-ink rug and tapestry surface simulate information with different highlights and contrasts.
ZONE THREE
Open Public Space and Local Circulation

Before intervention

After intervention
Common areas such as a lobby, a break-out space, and a local circulation corridor are turned into work exhibition spaces. Mobile e-ink screens are used for exhibition work boards and installation panels, displaying static and animated information relating to the firm's projects. The floor e-ink rug surfaces illustrate dynamic texts explaining the exhibited materials. The floor surfaces also project animated signage indicating room location, current users and events in the rooms, direction, staff names, scheduling, etc. for visitors and guests. Local circulation corridors become info-ban mediating space, time, information, and people.
The same zone becomes a space for today's main event, the firm's weekly happy hour time!

This public common area facilitates multiple activities. A dance floor, game zone, drinking lounge, sports bar, etc. are the exemplary space use models. Temporary draperies are placed to subdivide the larger open space into several separate zones serving for the activities described above. Interplay of translucency and presented images create diverse ambience in the interior space. NY office employees are also invited through a network live connection for this exciting event!
The intent of the design exercise was the creation of a framework for workspace artifact design: a design process was established in the beginning to provide guidelines for material exploration, worksurface product development, spatial placement logic, and storage/packaging ideas. Each design product was developed according to the proposed sequential process. A series of development experiments thoroughly investigated diverse types of workspaces, communication activities, and related visual information in relation to deployable worksurface products. One component of this research that requires further articulation is the integration of physical devices with electronic hardware and software products (such as e-ink) that will inevitably influence the aesthetics and operation of the physical shell (and vice versa.) An iterative design process that switches back and forth between design and prototyping can be used to produce a realizable product concept. Another important issue not covered in this thesis is interface design. The flow of visual information from one worksurface to another is critical, since it deals with the interactivity and adaptability of the worksurfaces in relationship to spatial contexts. Increased mobility and manageability of visual information (accomplished through intelligent interface design) has the potential to create a truly responsive workplace, in which visual information can smoothly transition from one worksurface to another. An integrated worksurface can ultimately create an environment in which communication activities are translated into visual information that is blended with the surrounding interior surfaces.
The basic principle that underlies this thesis investigation is a significant paradigm shift in workplace design thinking. Work activities are no longer confined to pre-defined, rigid and monotonous conditions. Rather, the advent of advanced communication technology allows work to be performed virtually at any place and at any time. Recent developments in wireless technology have made location-independent workspaces even more promising. In addition, work patterns within office environments are also being influenced by technological development. As a result, it has become necessary to re-establish spatial conditions in the workplace to accommodate the flexibility and mobility of modern work activities. In these situations, it is valuable to critically evaluate the current workplace in terms of space configurations, physical artifacts, and information technology.

Another motivation behind this thesis investigation was a personal interest in devising new architectural applications for e-ink display technology in the workplace. Since this e-ink technology exists somewhere between paper and LCD projection, it is anticipated that this technology has the potential to enrich the experience of interior space. Up until now, however, architectural applications of this technology have been limited to surface applications on building exteriors. As a result, researching the potential of deployable e-ink technology to influence space usage and communication activity in the workplace is particularly worthwhile. To accomplish this, a series of scenarios were created that envisioned future workplace environments modified through transformable and reconfigurable workspace design products, as a way of elevating the dynamic characteristics of contemporary work. In order to achieve the goals described above, the material properties of polymer-based thin film surfaces were carefully investigated, with a particular focus on the characteristics that thin films exhibited when used in combination with other materials. The end result was an optimized surface structure that can be adapted to different spatial contexts and displays. Material studies became an integral part of the product design process; the academic research and associated material experiments led to a design scheme for each product developed. One highlight of this exercise was the portrayal of the worksurface’s potential impact within the spectrum of a daily timeline at work. Worksurfaces, visual information, people and activities were juxtaposed in each work scene to give more realistic visions of the potential use of assembled e-ink workplace products.
To summarize the thesis, the true value of this design research and product development exercise was the exploration of the potential application of integrated worksurfaces at various workspace scales. The changes to the workplace as a result of these new technologies are dependent on how these new technologies (new worksurfaces and display devices) are utilized. The proposed products can be supplementary, additive, or can become complete replacements for certain types of display surfaces.

First, in the immediate workspace zone, the new worksurface proposal can be mostly supplementary to existing mobile electronic devices and traditional paper. The intervention can be used to bridge gaps between existing products.

Second, in the intermediary workspace zone, the proposed solution can add a new dimension to interior surfaces and improve space use by creating dynamically configured responsive worksurfaces.

Third, in the ambient workspace, the proposal can provide a wholly new vision. As a temporarily constructed ephemeral membrane, this worksurface will be truly mobile in concept and use, celebrating the constant transformation of modern work situations.

Wendy Guan-Wen Ju, "The Design of Active Workspaces," Master of Media Arts and Sciences, MIT, Cambridge, MA(1991)
All images are prepared by the author unless noted below.

**Figures**

Fig. 07-1: http://www.imagebank.com
Fig. 08-1, 2, 3, 4, 6: http://www.hermanmiller.com
Fig. 08-5, 7: http://www.steelcase.com/servlet/ProductServlet
Fig. 09-1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 12: http://www.ideo.com
Fig. 09-10: http://www.steelcase.com/servlet/ProductServlet
Fig. 10-1, 2, 5, 9: http://www.hermanmiller.com
Fig. 10-3, 4, 6: http://www.steelcase.com/servlet/ProductServlet
Fig. 10-7,10: http://architecture.mit.edu/hcuse_n/web/projects/
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Fig. 20-1: http://www.steelcase.com
Fig. 21-1, 2: http://www.eink.com/products/index.html