



Changing Places & House_n

Research Topics

Change is accelerating, but the places we create are largely static and unresponsive. Changing Places is a joint MIT Department of Architecture and MIT Media Laboratory Consortium that explores how new technologies, materials, and strategies for design can make possible dynamic, evolving places that respond to the complexities of life.

Changing Places combines the activities of the House_n consortium with additional Media Laboratory research topics, intellectual property rights, and the participation of Media Laboratory researchers.

Research is conducted in the context of three related environments— the home, the workplace, and the city. Although the problems, opportunities, and challenges in each place have different flavors, similar technologies and design strategies can be applied. In addition, similar tools can be used to study the impact of new technologies in each context.

The Home

The home will soon become a center for health care, energy production, and work — but our homes are poorly prepared for this future. A continuation of the House_n project, researchers are investigating how new computational design, fabrication, and sensing tools can be used to create responsive, adaptable environments that will better accommodate complex new activities and ever-changing technologies. We are exploring how new design tools linked to integrated architectural components with standardized connections can allow individuals to become designers/innovators. Two application areas are given particular attention: health (proactive environments for healthy living) and energy (scalable strategies for “net zero” houses).

The Workplace

Businesses operate in an environment of change. Constant change requires continuous learning and collaboration with others. To better understand the changing nature of work, researchers will adapt the tools and techniques developed for the home to the workplace environment. Based on new technology-enabled observational techniques, concepts will be developed for component-based, dynamic learning environments that better support creative problem solving, the capturing of ideas, intensive teamwork, remote collaboration, and other desirable workplace practices.

The City

Cities are also evolving in response to new technologies and new patterns of living. Researchers will study how responsive technologies and narrative can be used to enrich public spaces. We are investigating how personal information devices and responsive building materials/systems can enhance the character and meaning of the city experience.

Changing Places Research Area 1: The Home

The Problem

The home will become a center for proactive health care, distributed energy production, commerce, and learning. It will contain the most complex activities of any building type. But our places of living are poorly prepared for this future. The housing industry, for the most part, is decentralized, resistant to change, wary of new technology, labor intensive, inefficient, and unresponsive to the needs of individuals. Most people live in places that are low-grade, low-tech, inflexible, disruptive to upgrade, high maintenance, and ill-designed. For the past four years, the House_n Consortium (included with Changing Places membership) has addressed these problems. The following are trends that will change how we create places of living:

- o A looming crisis in healthcare, triggered by aging baby boomers, will require a transition to home-based preventative medicine.
- o Energy shortages, brought on by an inability to expand the grid and build new centralized plants, will motivate home-based renewable energy production and advanced conservation methods.
- o Technology companies developing products and services for home-based health care, work, commerce, play, energy conservation, and communication will require a sophisticated, agile, upgradable infra- structure in the home.
- o A shortage of skilled construction labor, identified by 80% of contractors as their most serious problem, will force a transition to automated fabrication processes. The construction of a new home in the United States typically consists of 80% field labor and 20% material costs. Costs are increasing while quality is decreasing.
- o Affordable sensing and computation will find its way into nearly every thing manmade—including building components.
- o Baby boomers and GenX homebuyers, with unprecedented assets, are demanding environments and products that directly reflect their unique values and needs.
- o A return to urban life and escalating property values place a premium on multi-use, compact, flexible, upgradable, high quality living space.

Opportunities

Home computer sales are around \$30 billion/year while the home construction and renovation market is approaching \$450 billion/year. Technology companies, with their more sophisticated approaches to research, marketing and manufacturing, can enter this huge market if the industry moves from 19th Century processes towards integrated systems and components.

Research Areas

Chassis and Infill. The automobile industry is standardizing the chassis, electronics, and other components, while moving towards the mass customization of form, finishes, and functionality. Borrowing from these innovations, researchers are developing an integrated house “chassis” that can be rapidly and precisely installed with minimal field labor (reversing the 80% labor/ 20% material ratio). In one integrated assembly, composite beams and columns provide structure, insulation, sensor arrays, lighting, signal and power cable raceways, and ductwork. The chassis provides the necessary physical, power, and signal connections for mass customized infill components to be quickly installed, replaced, and upgraded without disruption. Infill components may include integrated wall/floor assemblies, specialty millwork with transformable elements, display systems, networked appliances and devices, etc. Criteria will be established that may inform industry standards for connections of both physical and digital components for new design and construction methodologies. Emphasis is given to the incorporation of new high strength, high performance, durable, lightweight materials.

Digital infrastructure. Building networks today are complex and difficult to install, maintain, and expand. In the future, networks should be self-configuring, self-maintaining, easily adaptable and expandable. They will take advantage of low cost electronics, require no complex programming, and promote error-proof construction. Researchers are developing network prototypes where each building component and system has embedded computational devices that announce their presence on the network, and take on functionality according to their location and physical relationship to other components.

Sensing, Interface, and Just-in-time Information. Designing digital interfaces for physical environments with ubiquitous displays and sensing introduces a new set of human-computer interaction challenges. Physical objects, digital interfaces, and multi-person human activity must be simultaneously considered. We are building and testing physical components for an interactive environment that merge the physical space and the digital interface— with application to the home, the workplace, and the city.

New Design Tools (Democratization of Architecture and Technology). Taking advantage of new design tools and an integrated component-based fabrication/construction methodology, interactive design and decision-making systems are being developed that allow individuals— rather than experts— to create tailored solutions that directly reflect their needs and values.

Health: Proactive Environments for Healthy Living. The rapidly aging population and an increasingly overtaxed medical system will force a change to proactive health care centered in the home. Researchers are developing technologies and design strategies for a parallel, user funded system focused on creating healthy environments and encouraging healthy behaviors— without requiring changes to the existing medical infrastructure or medical payment system.

Energy: Net Zero Homes. Creating a “net zero” house— one that produces as much energy as it consumes— is not an interesting problem if the result is simply a “one-off” structure. The development of sophisticated but affordable net zero systems and construction methodologies that could be widely adopted is an exciting and challenging problem. Researchers are focused on developing a net zero home as an integrated system by taking advantage of new manufacturing processes, information technologies, multi-functional pre-fabricated assemblies, and economies of scale so that advanced systems can be affordably integrated into homes using minimal field labor.

Changing Places Research Area 2: The Workplace

The Problem

Businesses operate in an environment of change. Constant change requires continuous learning and collaboration with others— and agile physical and computational environments. But we do not fully understand the changing nature of work. Organizations do not have adequate tools to evaluate complex workplace issues and the impact of new technologies. This limits the effectiveness of new design and technology solutions— and often leads to unintended consequences.

Opportunities

We have new tools that allow for the modeling and simulation of work in unique settings. We have a whole host of powerful sensing, networking, communication, design, and fabrication tools that can be applied to the workplace.

Tools for Observing and Evaluating Workplace Activities. “Portable Place Lab” tools will be used to collect workplace activity data in a variety of workplace settings, with the goal of informing the development of new technologies and design strategies that improve the workplace. These tools will be made available to sponsors to study their unique workplace environments, and to evaluate the impact of new solutions.

Modeling Workplace Knowledge and Activities. Researchers are investigating how latent expert knowledge can be discovered within organizations through the modeling and simulation of complex workplace activities and systems.

The Agile Workplace. Researchers will apply selected House_n chassis/infill concepts to the workplace to develop an integrated component approach to creating reconfigurable physical and computational environments that can be dynamically tailored in response to changing activities and needs.

Changing Places Research Area 3: The City

The Problem

Cities have powerful and compelling stories to tell, but the urban scene has become increasingly fractured and unreadable. People have wide-ranging interests in the historical and contemporary narrative of the city, but these stories— literally its soul— remain largely out of reach, buried behind building facades and dusty guidebooks. Although the potential of mediated places is quite compelling, we are just beginning to understand how access to digital content can impact the character of public spaces.

Opportunities

Low-cost sensing, PDAs, cell phones, GPS, computational story-editing tools, and intelligent building components begin to provide the infrastructure required to present urban narratives that are tailored to the location, activity, and interests of individuals. There are compelling civic and commercial applications that may lead to integration of information media into the design of urban places, with applications that we can only begin to imagine.

Research Areas

Urban Technologies. Tools are being developed that can be used in public spaces to provide information to people in the context of their activity. These technologies can be used to present stories in new interactive, place-based ways that enliven public space. These same tools can be used to strengthen social ties in the community and to encourage a public dialog about the design of public space.

Urban Narratives: Storytelling on Boston's Historic Freedom Trail. This project explores how mediated content can recast the sense of place— how stories can create places. This demonstration project will engage visitors to Boston's historic downtown district with an electronic network of information and old-fashioned storytelling. Using handheld PDA computers, visitors will be able to view location-based film clips, listen as local authors relay the oral histories of each area, and navigate their own "experience map" of these historic sites. The devices will also lead them through outdoor audio environments that recreate the sound-scapes of early Boston, and trigger audio and video histories projected on buildings and sidewalks. The effect of "making the city speak" in these ways is to make visible the stories which create places. Urban Narratives is an alliance between the Joint Program in City Design & Development and the Changing Places Consortium.

Changing Places / House_n researchers are currently engaged in the following initiatives. Please see the separate documents describing each.

- o **PlaceLab**: a highly instrument residential facility for MIT researchers and sponsors to prototype and study new technologies and design ideas in the context of everyday activities. In addition to participating in MIT PlaceLab research, consortium members may apply to use the facility to conduct company-initiated projects. (see "PlaceLab" document).
- o **Place-Based Portable Research**: a collection of tiny wireless sensors, wearable devices, and associated algorithms and methodologies. Consortium members may take advantage of these tools to conduct company-initiated research in everyday places of living, work environments, and public spaces. (see "Portable Place-Based Research Tools" document).
- o **Open Source Building Alliance (OSBA)**: an industrial alliance to explore new models for design, fabrication, and construction leading to cost effective, high performance, responsive places. OSBA brings together companies and researchers to help create pathways for innovative technologies, products, and services to enter people's lives. (see "Open Source Building Alliance" document).

The following researchers participate in both House_n and Changing Places Activities :

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For members of the Changing Places Consortium, the following Media Lab researchers participate:

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