
SMARTER BUILDINGS

HOW DO EMERGING TECHNOLOGIES MAKE OUR BUILDING MORE INTELLIGENT?

THE BIG IDEA

The way we understand and define our buildings is being revolutionized, along with the tools we use to design them. The impact of the tools has been a proliferation of technology embedded within the built environment, or Smart Buildings.

The goal of this research is to explore emerging technologies and how they interface with our built environment. The increasing deployment of sensors and hand-held electronics in recent years is allowing for a new approach to the study of the built environment. This research will examine buildings that were designed with intelligence in mind and explore how that intelligence can impact the future of design. This project will study an intellect that encompasses and revolutionizes efficiency, sustainability, constructability and user interface.

As the built environment becomes increasingly inundated with digital technologies, data will help us understand how that physical environment can become better suited and more adaptable while interfacing with its users.

"Smart Buildings" are not a new concept, but in today's world the term has more possibilities.

Technology permeates deeply into the core, systems, and services of next generation buildings and today's tenants are expecting it. "Smart Buildings" of the future are sensed, networked, and managed in the Cloud. They produce millions of data points every minute that can be analyzed for the purpose of exceptional performance. How that data is mined and put to work becomes an important factor in the intellect of a building. Can a building learn? Can those lessons be taught to other buildings?

Networked Smart Buildings can store, secure and interact with their environment and users. They can be personalized to the needs of each user and are green, efficient, and economical.

The interaction of users with building systems and sensors provides a new paradigm through which we see our built environment. The greatest challenge we face is that the future is already here. Consequently, planning, design, construction, and building operations have to adapt to accommodate rapidly changing possibilities and expectations.

INFORMATION WILL MANIFEST
ITSELF INTO THE FUTURE OF
OUR BUILT ENVIRONMENT.
PHYSICAL INFRASTRUCTURES
AND DATA WILL MERGE.
HOW CAN WE ANTICIPATE THE
NEEDS OF THAT FUTURE AND
DESIGN WITH IT IN MIND?

RELEVANCE & IMPACT

Seattle has a long history of innovations and environmental consciousness, while consistently ranking among the greenest cities in the U.S. The presence and growth of tech companies creates the current surge in construction Seattle, making it the perfect place to innovate the marriage of data and the built environment. And in many ways we already have.

As technology firms, entrepreneurs, governments, planners, designers and an emerging groups of civic hackers are trying to shape this new frontier, our Smart Buildings must consider motivations, aspirations, and shortcomings of these attempts while offering a new civics to guide our efforts as we build the future together. In response, buildings worldwide are deploying technology to address both the timeless challenges of government and the mounting problems posed by climate change at a previously unimaginable size and complexity.

In Chicago, GPS sensors on snow plows feed a real-time "plow tracker" map that everyone can access. In Zaragoza, Spain, a "citizen card" can get you on the free city-wide Wi-Fi network, unlock a bike share, check a book out of the library, and

pay for your bus ride home. In New York, a guerilla group of citizen-scientists installed sensors in local sewers to set of an alert when storm-water runoff overwhelms the system, dumping waste into local waterways. The City of Seattle and the University of Washington have joined a new national network of city and research university partnerships that will work together on "smart city" solutions in collaboration with the new White House Smart Cities Initiative.

The City of Seattle is poised to capitalize on our current tech base construction boom beyond our High-Performance Buildings Pilot Project, a Smart Buildings partnership between the city of Seattle, Microsoft and the Seattle 2030 District, a project aimed at reducing power consumption through real-time data analysis of

Seattle buildings. This pilot program uses information technology to analyze the performance of buildings in real-time, allowing building owners to drive energy efficiency into existing buildings, without costly retrofits and without disrupting tenants. All of these recent developments offer examples of ways in we have already begun to utilize the newest technologies available to make our buildings and environments smarter while also meeting current civic and environmental needs. This project will explore relevant case studies, lessons learned and buildings designed, with the goal of informing our ability to capitalize on future design opportunities in Seattle.

APPLICATIONS



Seattle City Light is working to upgrade of the city's electric meters so that users get more accurate readings of their electricity consumption and have the ability manage their own energy conservation.



The City of Seattle and the University of Washington have joined a new national network of city and research university partnerships that will work together on "smart city" solutions.



2013 Seattle partnered with Microsoft to launch High-Performance Building program. The program allows for real-time tracking of Energy efficiency to help reduce energy costs and carbon emissions.

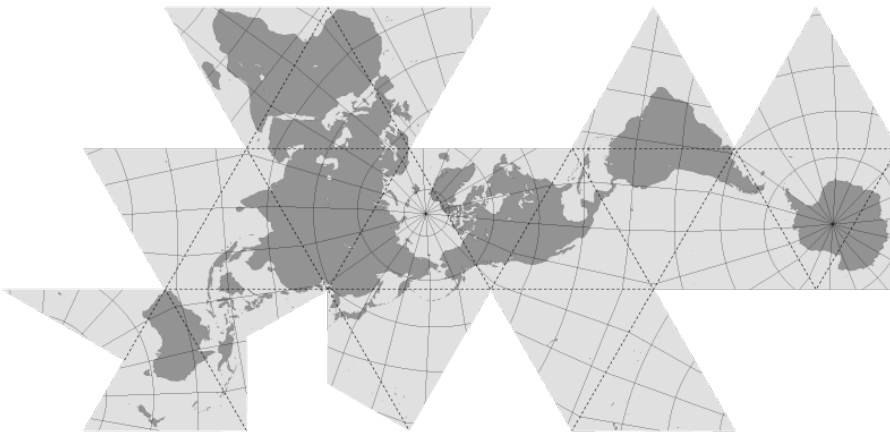


Seattle offers tax breaks to businesses and residents that buy and put into place environmentally friendly tech, and the city also helps residents who qualify configure their homes to become more energy efficient



Seattle needs to integrate its individual islands of innovation into a complete picture. "Nor is the city fully committed yet to sharing infrastructure and costs between departments. Cities that take a holistic approach typically find they can cut 20% to 30% from their budgets by eliminating duplication and redundancy." Jesse Berst - Seattle Council Chairman

RESEARCH METHODS



WHAT ARE THE WORLD'S SMARTEST BUILDINGS?

Intelligent buildings use a new generation of tools that leverage today's data-rich building environments to help create a more capable, sustainable and conversable structures.

The case studies selected for research cover a broad range of smart technologies. From environmental controls and waste water systems to unique user interfaces and advanced construction methods. All of these building represent the arguably the world's smartest buildings, not only in the degree to which technology is embedded with the built environment, but also in the ingenuity in which that technology is harnessed.

There is no set measure as to what constitutes a Smart Building but the intent of this project is to explore what the best is the world has offer and how that may be applicable to Seattle. At The Edge, in Amsterdam, the users are totally connected to the building from lighting adjustments to the building's knowledge of individual users coffee orders. As Seattle's technology industry grows the next technological interface with the built environment may come from here at home.

As our city continues to grow it is important to understand how to grow smart. Planning for

sensors, data storage and yet to be discovered technologies is happening earlier and earlier in the design process as can be seen by London's Leadenhall Building. Those vary sensors and technologies not only enhance the final building but can also help inform architects of the buildings performance during construction cutting down on waist, energy, time and even possible structural failures.

The Al Bahar Towers, at first glance truly a world away from Seattle, are a great example of responsive technology and also an honesty of place and time. Perhaps Seattle will develop an building as expressive that is activated by our rainy days and more frequent than advertised sunny days.

The Port of Portland is a regional building that is not only one of the world's Smartest Buildings but also a very relatable example. The project drivers echo many of our cities own ethos of sustainability.



CASE STUDIES

Site visits, interviews, photos and film



BIG DATA

Reports, research papers and articles



FORUMS

Expos, conferences and gatherings

PARALLEL EXPLORATIONS

We also see important parallels of Smart Buildings in adjacent fields. In cities, Big Data is making a tremendous impact across a broad spectrum: it is helping to run mobility infrastructure more efficiently, reducing pollution and showing the vast patterns of humanity... Big Data echoes from energy to waste management, from street maintenance to air quality. It is a silent infrastructure that can promote new forms of civic engagement.



JENNIFER DUNGS & PAOLO SANTI

Project Leads

Ambient Mobility operates in tomorrow's new urban paradigm. The near-future of mobility will be radically transformed by pervasive deployment of sensors, networked technology, and the big data that they generate. These advances, hand-in-hand with self-driving technology, intelligent transportation systems, new forms of design and applications as well as electric vehicles, are poised to revolutionize urban flows. The distinction between individual and mass transportation systems will erode, as public and private mobility is blurred. Ambient Mobility works towards a future in which extensive ride and vehicle sharing – enabled by dimensions of autonomous driving such as the optimized vehicle re-location – will provide personalized, on-demand mobility with modular car concepts addressing the specific requirements of cities. The parallel trend towards electric vehicles will re-shape urban energy needs and require innovative means of integrating of vehicle fleets with the power grid and reveal potential opportunities. The broad spectrum of smart mobility applications will result in a drastic reduction of circulating vehicles, travel times, emissions, and parking infrastructure, presenting enormous benefits for urban communities. The Ambient Mobility Lab seeks to understand and impact these trends through the design of future urban mobility systems.



CARLO RATTI

Principal Investigator

Underworld imagines a future in which sewage is mined for real-time information that can inform policy makers, health practitioners, designers, and researchers alike. Such is the idea behind Underworlds: a cross-disciplinary, open-data platform for monitoring urban health patterns, shaping more inclusive public health strategies, and pushing the boundaries of urban epidemiology. Pioneered by the Senseable City Lab and the Alm Lab, and sponsored by the MIT-Kuwait Center for Natural Resources and the Environment, a prototype smart sewage platform is being developed at MIT consisting of physical infrastructure, biochemical measurement technologies, and the down-stream computational tools and analytics necessary to interpret and act on our findings.

LEADENHALL BUILDING

CONSTRUCTIBILITY + SUSTAINABILITY

The construction of the Leadenhall Building began in autumn 2011 and used cutting edge construction techniques incorporating some of the most advanced technologies available.

THE BRIEF

More than 80% of the components were prefabricated off-site and then delivered and assembled on-site by the construction team led by Laing O'Rourke.

The project is piloting the application of radio frequency identification (RFID) software – which uses data tags attached to building components to allow them to be tracked through manufacture, supply, and installation. This will enable preventative action in the event of any delays downstream. When integrated with BIM, RFID can also be used to render a data-rich replica of the project in real time.

LOCATION: London, United Kingdom
CLIENT: The British Land Company PLC
ARCHITECT: RSH+P
GFA: 84,424 sqm.
CONTACTS: RSH+P
Laing O'Rourke
Ziona Strelitz



<http://www.theleadenhallbuilding.com>



At least 83 per cent of construction works took place off site, reducing the delivery schedule by approximately six months.

www.laingorourke.com

AL BAHARTOWERS

ENGINEERING + SUSTAINABILITY

Al Bahar Towers houses the Abu Dhabi Investment Council Headquarters in Abu Dhabi and utilizes what is perhaps the largest and most advanced interactive sun-shading skin system in the world.

THE BRIEF

In a reinterpretation of the traditional wood-lattice screens called 'mashrabiya', an outer skin system of triangular screens arranged in a series of scalable hexagons fold up to create a solid solar barrier around the towers. Each of the 1000 panels is connected to a linear actuator which enables it to function in response to the position of the sun, effectively reducing heat gain and glare by 50% while giving Islamic vernacular a contemporary representation. The intelligent facade, together with solar thermal panels for hot-water heating and photovoltaic panels on the roof, minimize the need for internal lighting and cooling, reducing total carbon dioxide emissions by over 1,750 tons per year.

LOCATION: Abu Dhabi, UAE

CLIENT: Abu Dhabi Investment Council

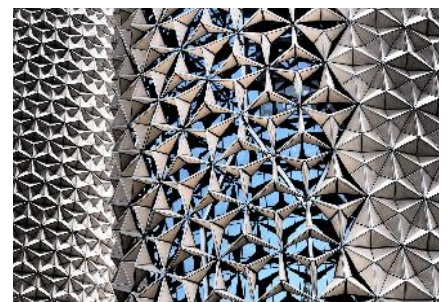
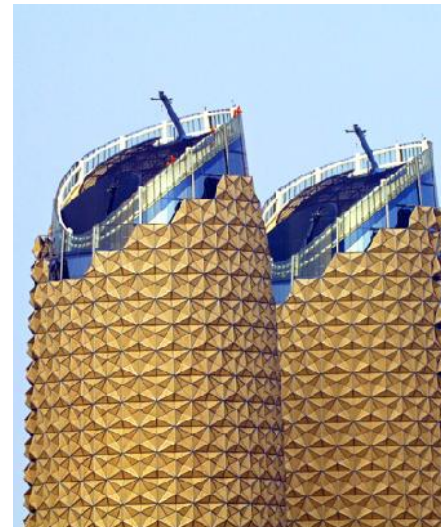
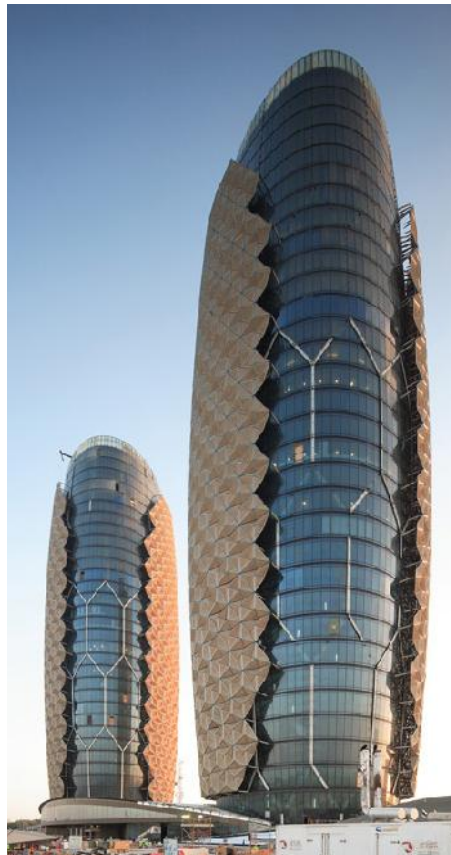
ARCHITECT: Aedas Architects

GFA: 70,000 sqm.

CONTACTS: Aedas Architects - Abu Dhabi



<http://www.aedas.com>



"The facade on Al Bahar, computer-controlled to respond to optimal solar and light conditions, has never been achieved on this scale before. In addition, the expression of this outer skin seems to firmly root the building in its cultural context,"

Chris Wilkinson - Wilkinson Eyre Architects

THE PORT OF PORTLAND CONTEXT + SUSTAINABILITY

Constructing a new building provided the Port of Portland with an opportunity to further its commitment to sustainable and environmentally responsible building practices and operations. Designed to be LEED Platinum certified, the building incorporates many smart building strategies.

THE BRIEF

A unique Loop System—the first in the U.S.—provides ground source heating and cooling with 200 underground pipes, working in tandem with the passive radiant ceiling panel heating and cooling system inside the Port. Warm water from the building in the loop goes out into the ground, gets cooled, and comes back into the building. There is a Living Machine, an organic wastewater treatment system, in the lobby, in which water from the building is treated and reused for irrigation.”

Thanks to these innovations and its eco-friendly programs, the Port of Portland uses 75 percent less water and 35 percent less energy than a standard building of the same size.

LOCATION: Portland, Oregon

CLIENT: Port of Portland

ARCHITECT: ZGF Architects

GFA: 205,000 sq. ft.

CONTACTS: ZGF Architects

Warrell Water.

Mayer/ Reed



<http://www.zgf.com>



A dramatically arcing, canting curtain wall that recalls the prow of a ship. The proportions of which carefully modeled to balance energy performance, natural-light infiltration, and noise reduction, while maximizing the stunning views stretching to the Columbia River and Mount Hood.

Metropolis - Randy Gragg

BITS&BRICKS FORUM ON THE FUTURE CITY

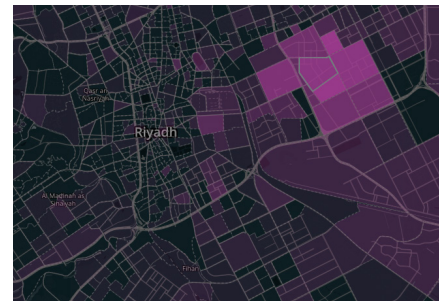
Cities are undergoing a profound transformation: the convergence of digital information (bits) and physical environment (bricks).

THE BRIEF

As virtual systems become spatialized – entering our world through the Internet of Things – no industry remains unaffected. From utilities to transportation, construction to environmental resilience, the 21st century condition presents new challenges... As well as new opportunities.

The MIT Senseable City Lab presents the 2015 Forum on the Future City: Bits and Bricks to gather major stakeholders in the development of cities: leaders of industry, research, metropolitan governance and citizens at large.

LOCATION: Boston, Massachusetts
HOST: Massachusetts Institute of Technology
CONTACTS: MIT SENSEable City Lab
Nashid Nabian - G.S.D.
MIT Media Lab



<http://senseable.mit.edu/bitsbricks/>



Smart cities are envisioned as wired cities, saturated with embedded sensors, actuators, digital screens, hand-held devices and smart phones and all sorts of embedded and situated computing devices, with connectivity as the source of their growth and the driver of their effective performance, where all social classes benefit from the technological integrations of their urban fabric. Nashid Nabian

PRODUCT DELIVERABLES

AS PART OF A PUBLIC EXHIBITION OF THIS PROJECT, THE FOLLOWING METHODS TO BE USED DISSEMINATE INFORMATION TO A BROADER AUDIENCE.



TRAVEL BLOG

A travel blog will follow the initial planning and research, as well as my travel across borders and through the world's Smartest Buildings.



PUBLICATION

Hard copy collection of the research and its findings. Writings, maps and photos will be submitted to various outlets across disciplines to gain more exposure.



FILM

Video will help to capture the true experiences of these buildings. The film will be hosted on the blog and will also be available during the exhibition.



PHOTOS

An accessible on-line album will host an archive of free license photos from each location.



EXHIBITION

One location to house all of the above and allow the public a chance to discuss and question any of the findings of the research.

ITINERARY & BUDGET

Each case study exemplifies a different aspect of what it means to be a Smart Building: sustainability, user interface, constructability, engineering and context.



www.skyscanner.net
www.kayak.com
www.lonelyplanet.com
www.airbnb.com
www.xe.com

It would be advantageous to visit the MIT Bits& Bricks forum on Friday, April 22, 2016, prior to traveling, providing an opportunity to visit with researchers, architects, and other stake holders to discuss what Smart Buildings mean and how to focus my research before visiting each site.

CITIES ABROAD

THE EDGE

AMSTERDAM, NETHERLANDS

4 DAYS...	Flight: Seattle - Amsterdam	\$1,000
	Local Travel: Taxi - Bus - Bike Rental	\$60
	Lodging: Hostel	\$160
	Per Diem: Meals and Misc. Travel Expenses.	\$160
		\$1,380.00

LEADENHALL BUILDING

LONDON, ENGLAND

3 DAYS...	Flight: Amsterdam - London	\$100
	Local Travel: Taxi - Bus - Bike Rental	\$60
	Lodging: Hostel	\$160
	Per Diem: Meals and Misc. Travel Expenses.	\$120
		\$440.00

AL BAHARTOWERS

ABU DHABI, UAE

3 DAYS...	Flight: London - Abu Dhabi	\$500
	Local Travel: Taxi - Bus - Bike Rental	\$60
	Lodging: Hostel	\$300
	Per Diem: Meals and Misc. Travel Expenses.	\$120
		\$980.00

FORUM

MIT - BITS&BRICKS FORUM

BOSTON, MA

2 DAYS...	Flight: Seattle - Boston	\$425
	Local Travel: Taxi - Bus - Bike Rental	\$60
	Lodging: Hostel	\$300
	Per Diem: Meals Misc. Travel Expenses.	\$80
	Forum: Registration	\$80
		\$945.00

REGIONAL EXAMPLE

PORT OF PORTLAND

PORTLAND, OR

1 DAY...	Travel: Seattle - Portland	\$100
	Local Travel: Taxi - Bus - Bike Rental	\$0
	Lodging: Hostel	\$0
	Per Diem: Meals and Misc. Travel Expenses.	\$40
		\$140.00

CASE STUDY

PROJECT NAME

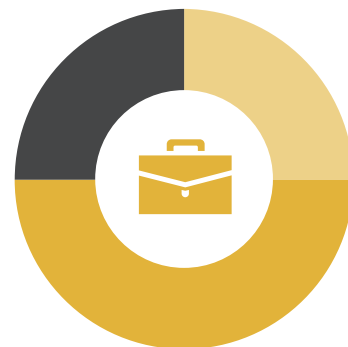


Budget



- Amsterdam - London - Abu Dhabi
- MIT - Forum
- Port of Portland
- Travel Flex - Guides, Tours, Emergency
- Exhibition

Efforts



- Pre Trip Research
- On Site Analysis and Discovery
- Post Site Visit Analysis and Publications