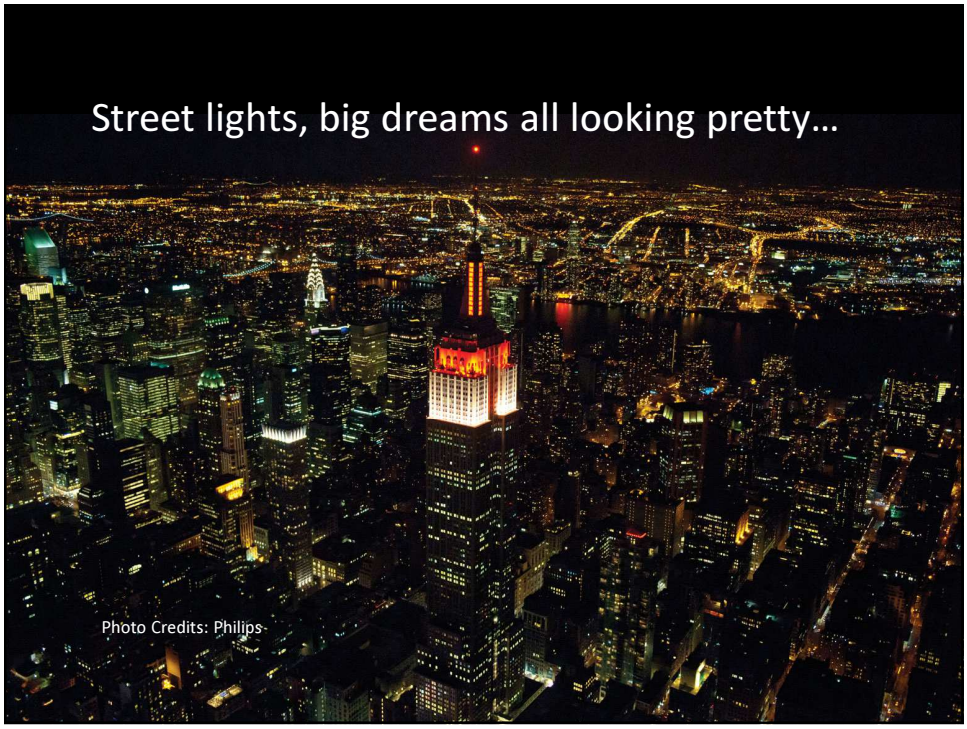

Notes from the Field
Susanne Seitinger, PhD
Public Segment | Philips Professional Lighting
Innsbruck, Austria on December 17, 2015

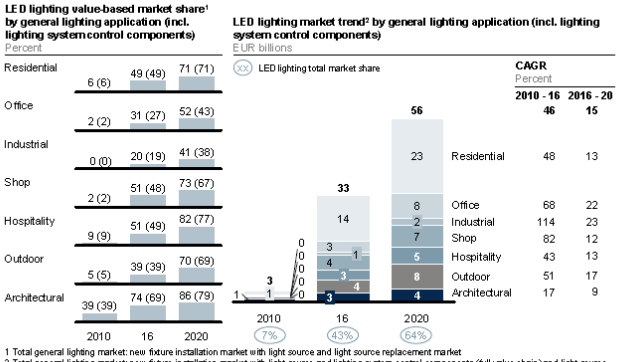
Disruption



Architectural Lighting = Early LED Adopter

McKinsey & Co. (July 2011) *Lighting the Way*.

Architectural is the early LED adopter, with residential moving slowly, but significantly



1 Total general lighting market: new fixture installation market with light source and light source replacement market
2 Total general lighting market: new fixture installation market with light source and lighting system control components (full value chain) and light source replacement market
NOTE: Numbers may not sum due to rounding

SOURCE: McKinsey Global Lighting Market Model; McKinsey Global Lighting Professionals & Consumer Survey

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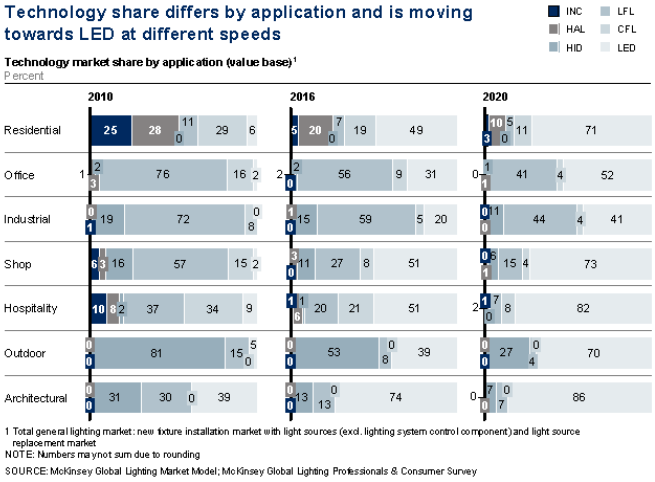
Speed of Adoption by Application

McKinsey & Co. (July 2011) *Lighting the Way*.



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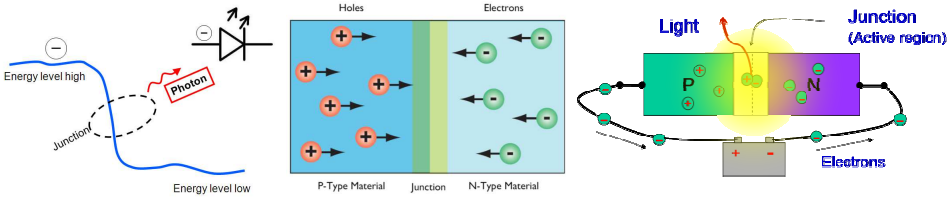
What is an LED?



- LEDs are semiconductor diodes
- Semiconductors are materials with ability to conduct electrical current
- The diodes are formed by combining two different semiconductor materials to form a PN junction (P=charged positive(holes) and N charged negative(electrons)
- By applying current, electrons(N) are forced to move to one direction and P to the opposite direction
- Photons (light) are generated when the positive and negative charges recombine.

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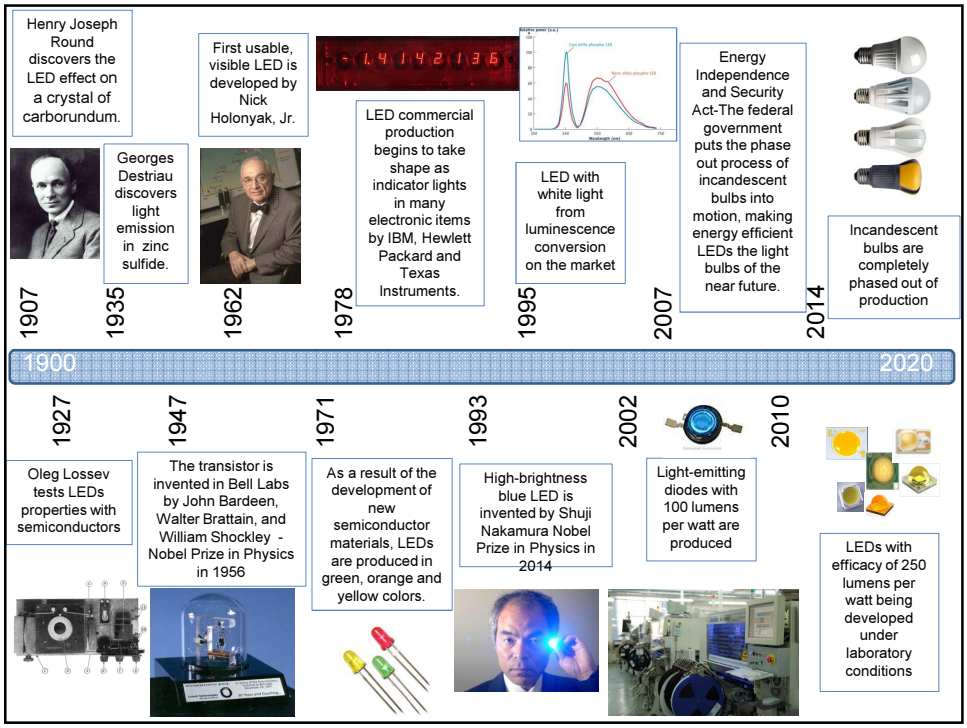
Henry Joseph Round discovers the LED effect on a crystal of carborundum.
1907
Georges Destriau discovers light emission in zinc sulfide.
1935
First usable, visible LED is developed by Nick Holonyak, Jr.
1962
LED commercial production begins to take shape as indicator lights in many electronic items by IBM, Hewlett Packard and Texas Instruments.
1978
LED with white light from luminescence conversion on the market
1995
Energy Independence and Security Act-The federal government puts the phase out process of incandescent bulbs into motion, making energy efficient LEDs the light bulbs of the near future.
2007
Incandescent bulbs are completely phased out of production
2014
1900
2020
1927
Oleg Lossev tests LEDs properties with semiconductors
1947
The transistor is invented in Bell Labs by John Bardeen, Walter Brattain, and William Shockley - Nobel Prize in Physics in 1956
1971
As a result of the development of new semiconductor materials, LEDs are produced in green, orange and yellow colors.
1993
High-brightness blue LED is invented by Shuji Nakamura Nobel Prize in Physics in 2014
2002
Light-emitting diodes with 100 lumens per watt are produced
2010
LEDs with efficacy of 250 lumens per watt being developed under laboratory conditions

Yellow phosphor coating
P-type
N-type
Base
Substrate (Sapphire or SiC)
Different Types of LED Sources
Renewal Every 18 Months!
Light emitted forward
LED Chip
Reflector
PC
Cathode lead
Anode lead
Silicone Lens
Phosphor Layer
Metal Interconnect Layer
Cathode
LED Chip
Ceramic Substrate
Thermal Pad
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8

LED Package + Luminaire Efficacy

DOE MYPP (April 2013, *p.30, 43)*

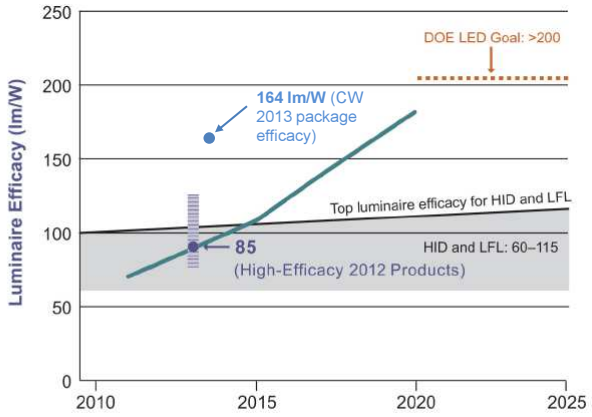


FIGURE 3.7 COMPARISON OF SSL AND INCUMBENT LIGHT SOURCE EFFICACIES
Source: LED Lighting Facts product database

LED System Benefits

Incandescent

Halogen

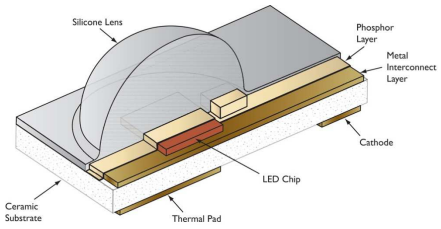
Fluorescent

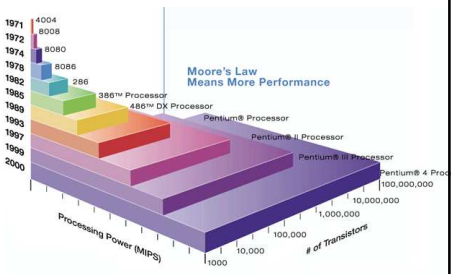
Gas-discharge (example: neon)

- Ultra long source life (40-80K hrs)
- Highly efficient, 40+ lumens/watt
- Low power consumption
- Low maintenance
- No moving parts
- No UV emissions
- No radiated heat (IR) from light
- Digitally controllable
- Unaffected by cold temperatures
- Unaffected by high vibration
- Fast response

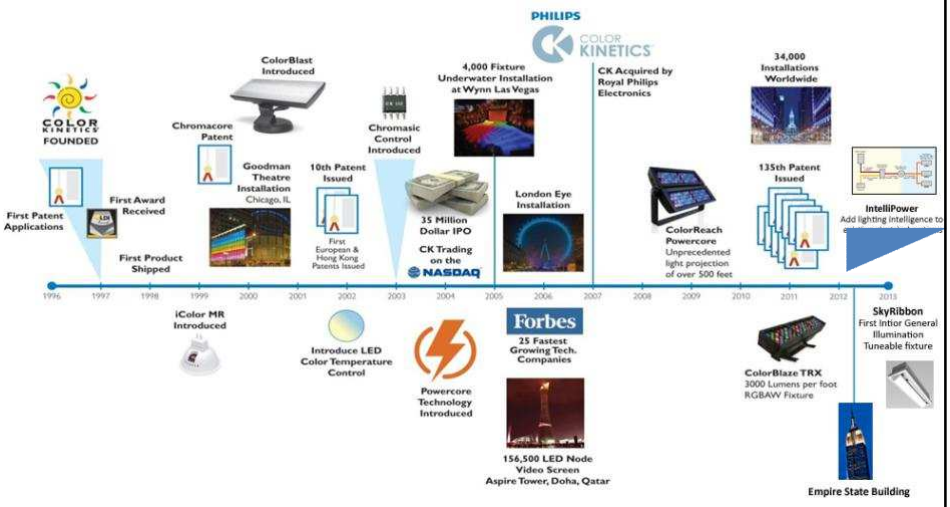
Conventional → Solid-State

Unlocking the Power of Digital Lighting





www.geek.com/wp-content/uploads/2010/04/moores_law_graph.png



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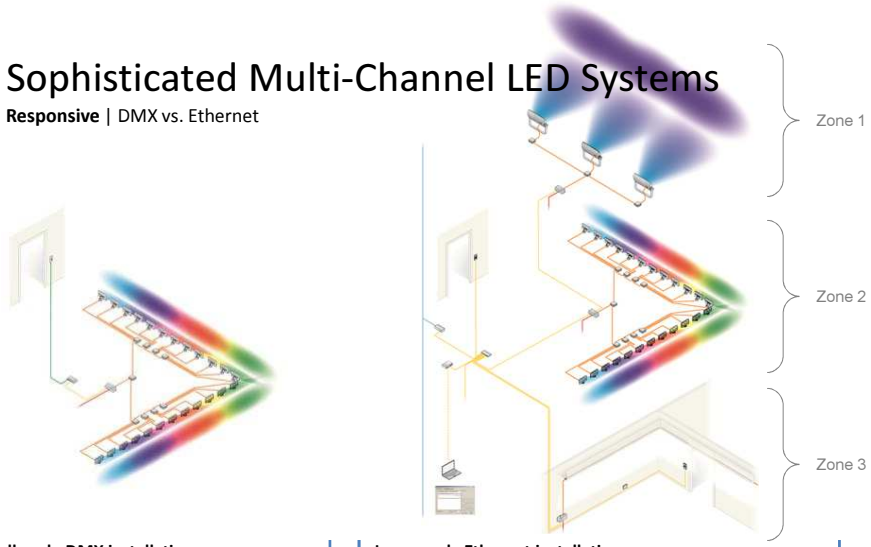
Sophisticated Multi-Channel LED Systems

Responsive | DMX vs. Ethernet

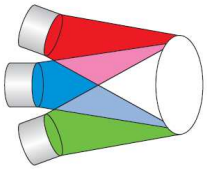


Small-scale DMX installation
Small-scale installations may feature one or more runs controlled by DMX. Data Enabler Pro devices can be connected in series

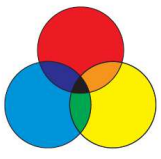
Large-scale Ethernet installation
Large-scale installations may include multiple zones of fixtures controlled by Ethernet. Each Data Enabler Pro supports a single run of fixtures, and connects to an available port on the Ethernet switch.

Color Mixing

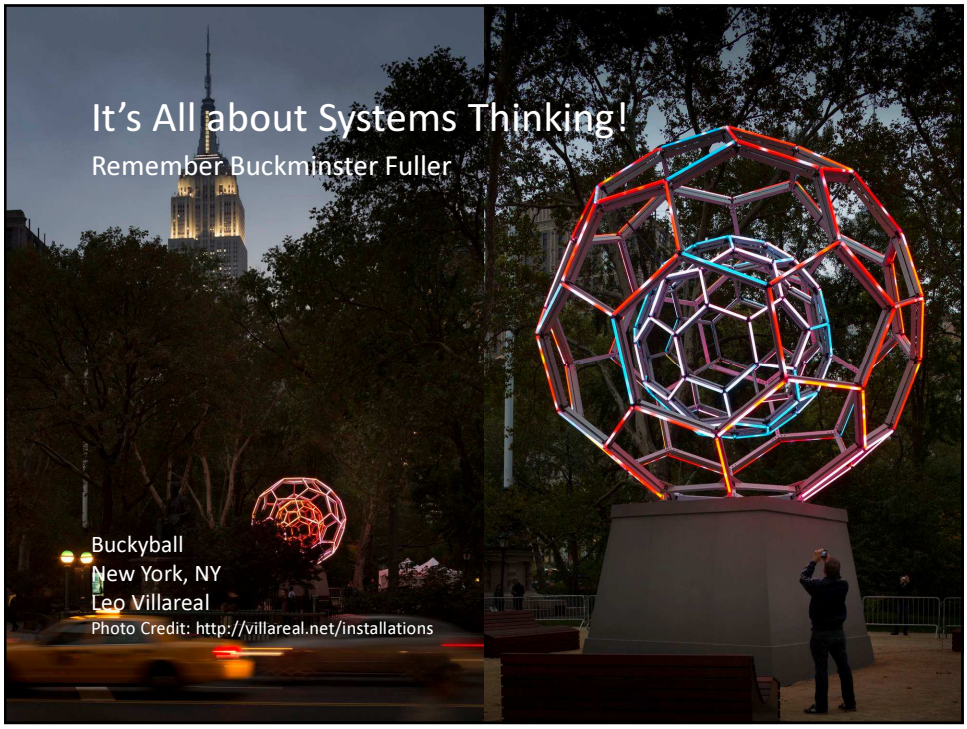
Victoria Coeln | Chromotopia Planai
Schladming, AT 2013 | © Victoria Coeln, Helmut Prochart | #PLA-20130206-2718 atelier@coeln.at
One image is free of charge when strictly used for non-commercial purposes while giving the credits.



ddtive color model applies to light
ed directly from an illuminant.
ining red, green, and blue in equal
nts produces white.



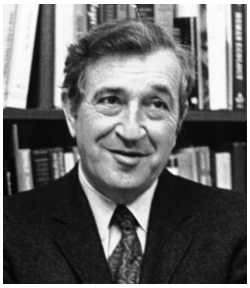
ıbtractive color model applies to
tive surfaces such as paints, dyes, and
Combining red, yellow, and blue in equal
nts produces black



Seamful Design

MIT Media Laboratory

Tale of Two Buildings



"The study of man-made and living systems will prosper in an environment where they can nurture each other."
Jerome Wiesner, *Media Lab co-founder, MIT President (1971-1980)*

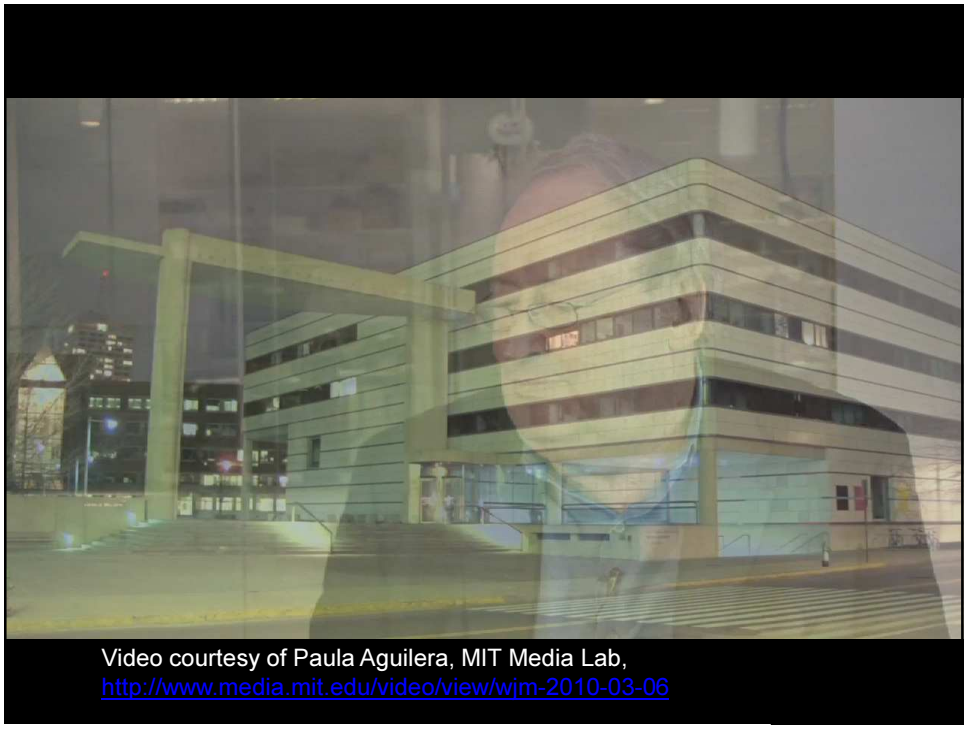
Rethinking the Automobile (2010)
Imagining MIT : Designing a campus for the twenty-first century (2007)
Trilogy of digital cities: *Me++* (2003); *E-topia* (1999); *City of Bits* (1995)

MIT Media Laboratory

Tale of Two Buildings

Wiesner Building designed by I.M. Pei. Photo Credits: MIT hyperstudio : h + digital. Completed 1985.

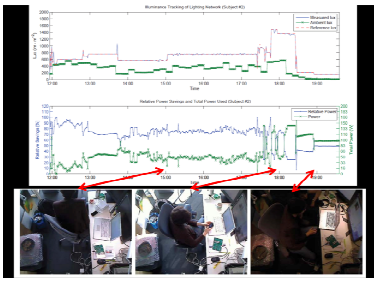
The Media Lab Complex designed by Fumihiko Maki. Photo Credits: Andy Ryan. Completed 2009.



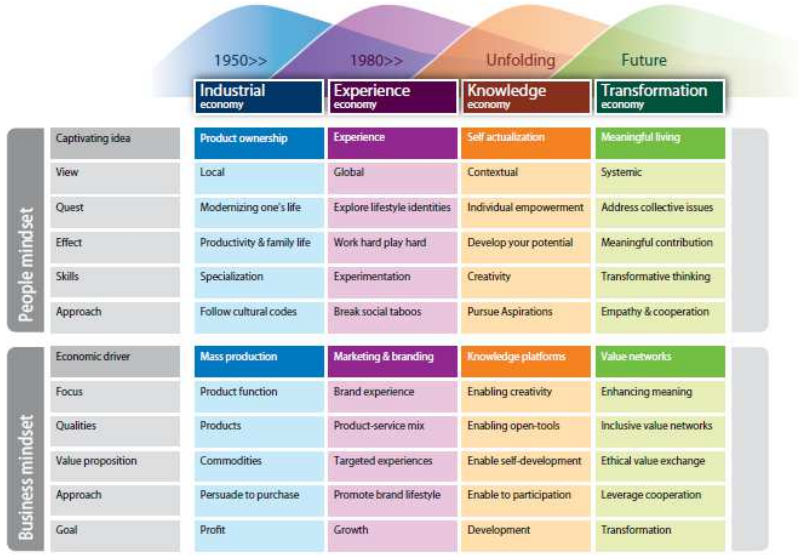
Video courtesy of Paula Aguilera, MIT Media Lab,
http://www.media.mit.edu/video/view/wjm-2010-03-06

Ubicomp Vision

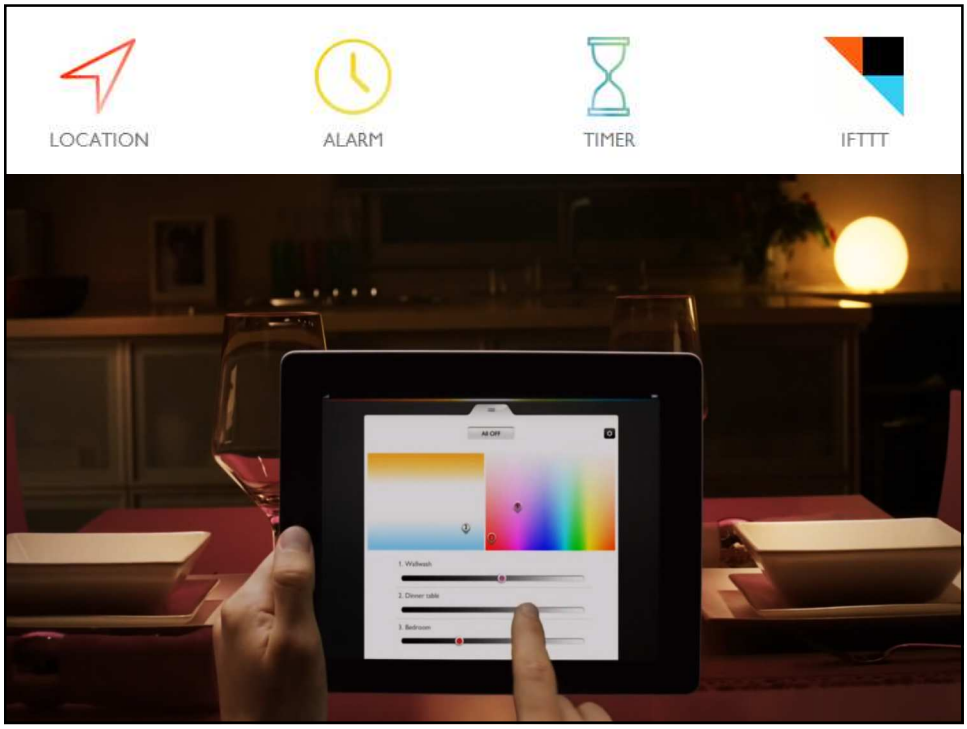
From Seamless to Seamful?



Images from Adaptive Lighting research in Responsive Environments Group (Aldrich et al., MIT Media Lab, 2012)



Reon Brand, Simona Rocchi, (2011). *Rethinking value in a changing landscape*, Philips Design.



The Natural Power of Light

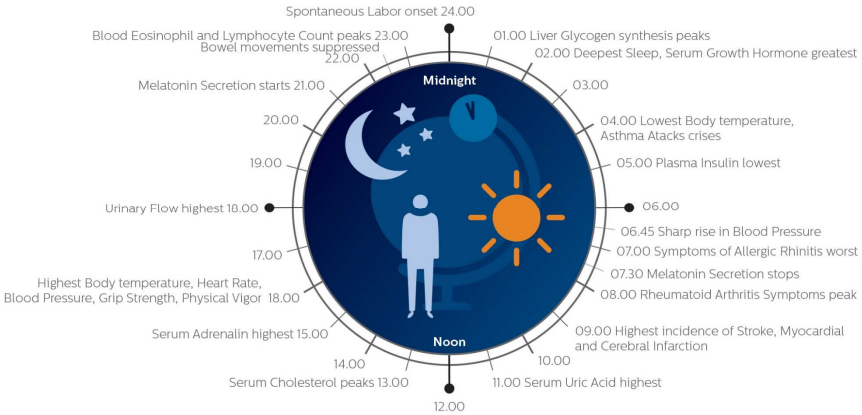
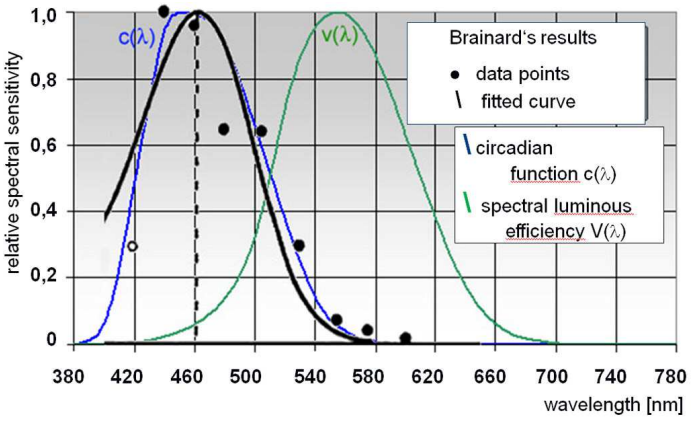


Image credit: Schlangen, L. (2014) "The e! ect of light on our sleep/wake cycle," White Paper Circle of Light.
www.lighting.philips.com/main/connect/Lighting_University/Assets/Daily-sleep-wake-cycles-whitepaper-FINAL.pdf

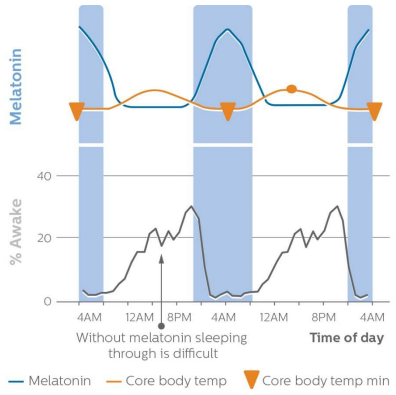
Light Regulates Our Circadian Rhythm

Brainard's action spectrum



rted-

Light Regulates Our Melatonin Secretion



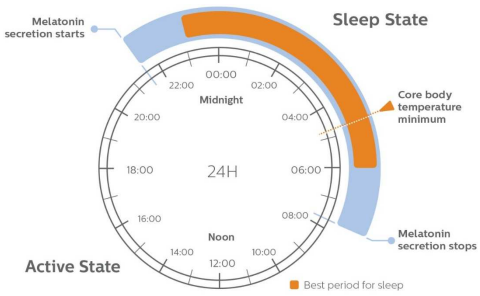


Image credit: Schlangen, L. (2014) "The e! ect of light on our sleep/wake cycle," White Paper Circle of Light. www.lighting.philips.com/main/connect/Lighting_University/Assets/Daily-sleep-wake-cycles-whitepaper-FINAL.pdf

Enabler for Location, Commissioning, and…

A.M. Vegni and T.D.C. Little, "Handover in VLC Systems with Cooperating Mobile Devices," to appear in *Proceedings of Mobility and Communication for Cooperation and Coordination (MC3) Workshop,* part of the IEEE International Conference on Computing, Networking and Communications (ICNC 2012), January 30 – February 2, 2012, Maui, Hawaii, USA. [pdf].

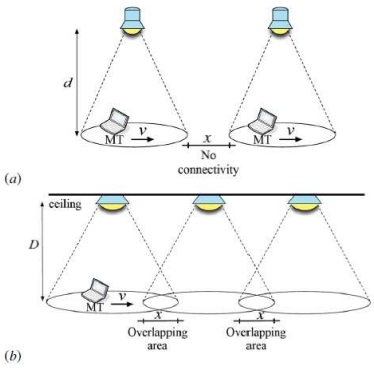
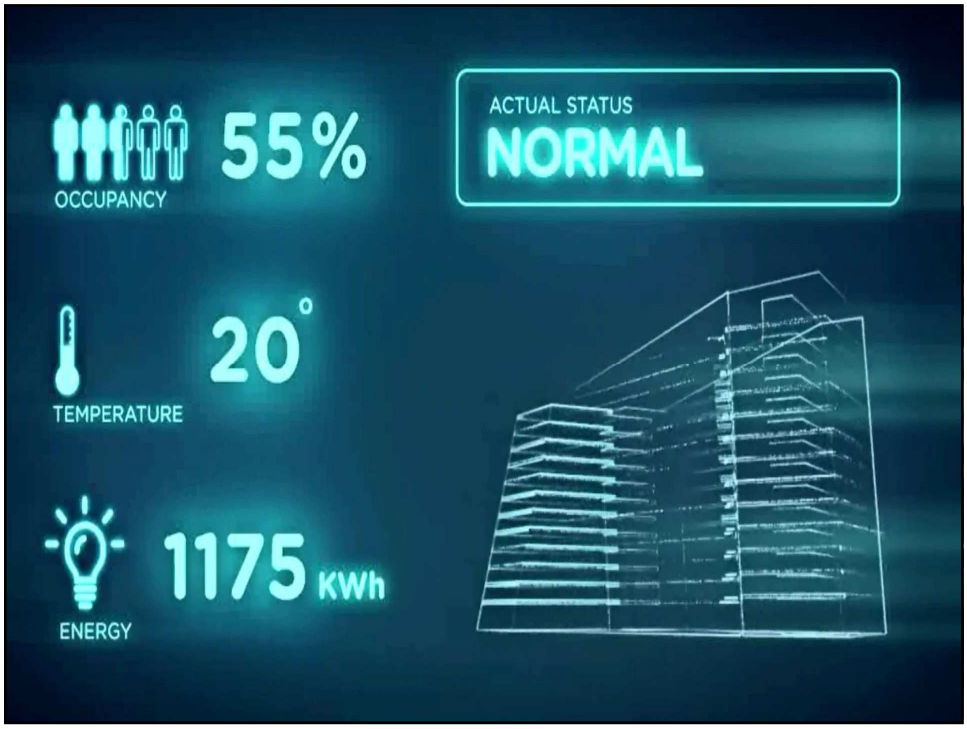


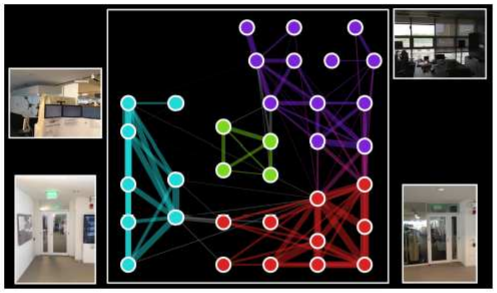
Figure 2: (*a*) Non-overlapping spotlighting, and (*b*) overlapping uniform lighting cells scenario, respectively.


55%
OCCUPANCY
ACTUAL STATUS
NORMAL
20°
TEMPERATURE
1175 KWh
ENERGY


Light Settings
Save
Break
Focus
Meeting
Brightness

Nan Zhao at al.

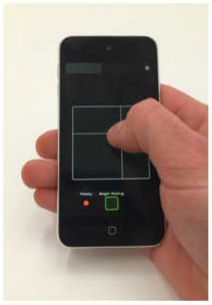
Random Walk and Lighting Control

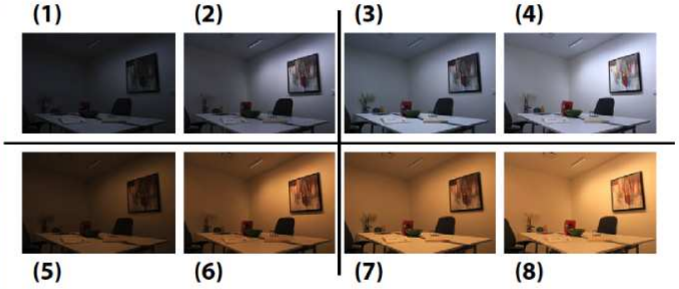


Matt Aldrich at al.

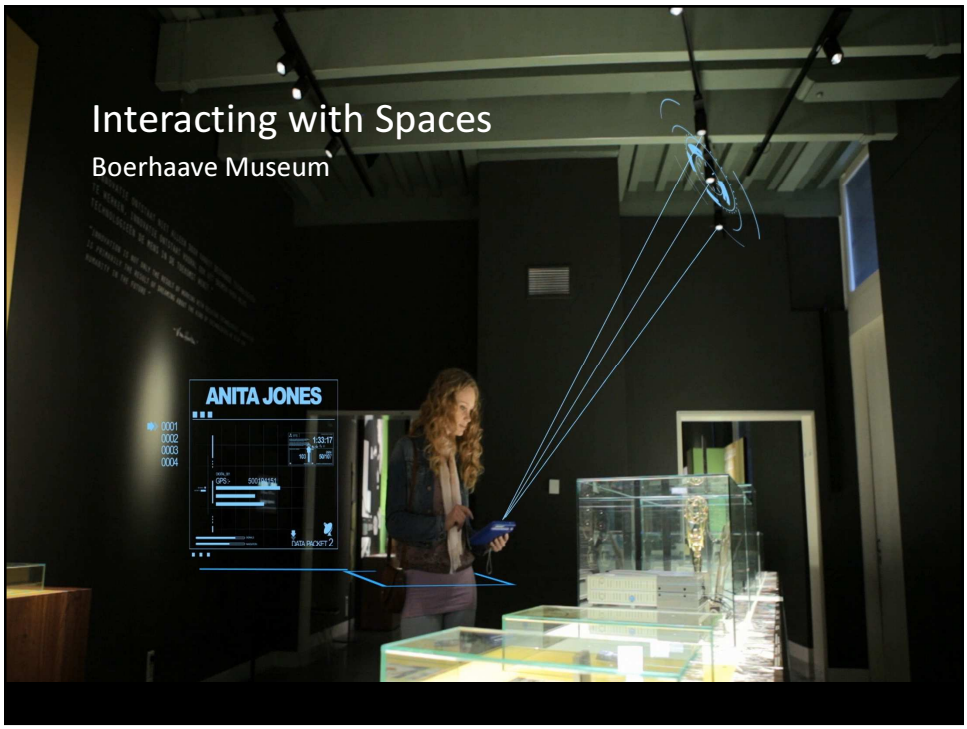
Publication:
Aldrich, M., Badshah, A., Mayton, B., Zhao, N., and Paradiso, J.A., "Random Walk and Lighting Control," IEEE Sensors 2013

Lighting control axes





Matt Aldrich at al.



Adapting to Human Activity

Washington D.C. Metro

Bill Lam

Bill Lam Tribute, IES Banquet (May 24, 2012) by Paul Zaferiou: "Bill applied principles of visual perception to inform decisions about what should be illuminated and why. The principles that he developed and stood for, we take for granted today. Bill may not have invented indirect lighting, but he took it to a whole new level in his quest for glare free environments. Lighting surfaces, like ceilings and walls, expand space and create the perception of brightness, resulting in visual comfort and interest."

http://www.visitingdc.com/images/washington-dc-metro-subway.jpg
http://blog.lampartners.com/lighting-design/bill-lam-tribute-ies-banquet-may-24-2012.html

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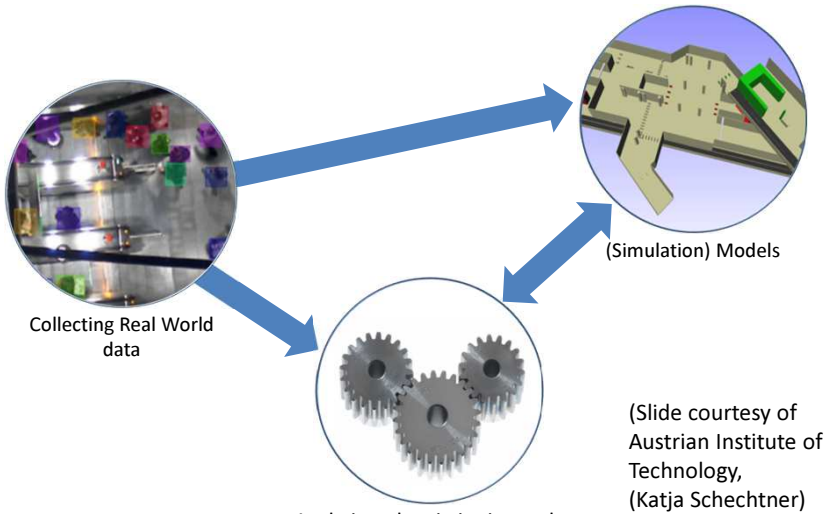
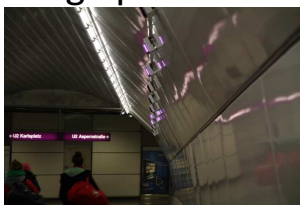
Understanding Crowd Dynamics

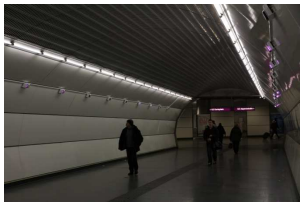


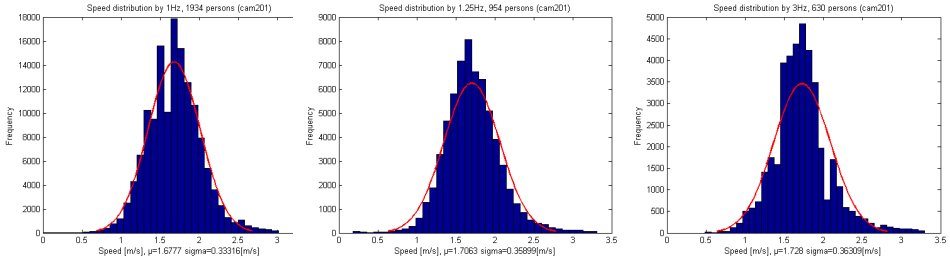
(Slide courtesy of Austrian Institute of Technology, (Katja Schechtner)

Impact on Walking Speed

13th International Symposium on the Science and Technology of Lighting (LS13) RPI







(for all passengers) 1.6777m/s @ 1Hz → 1.728m/s @ 3Hz

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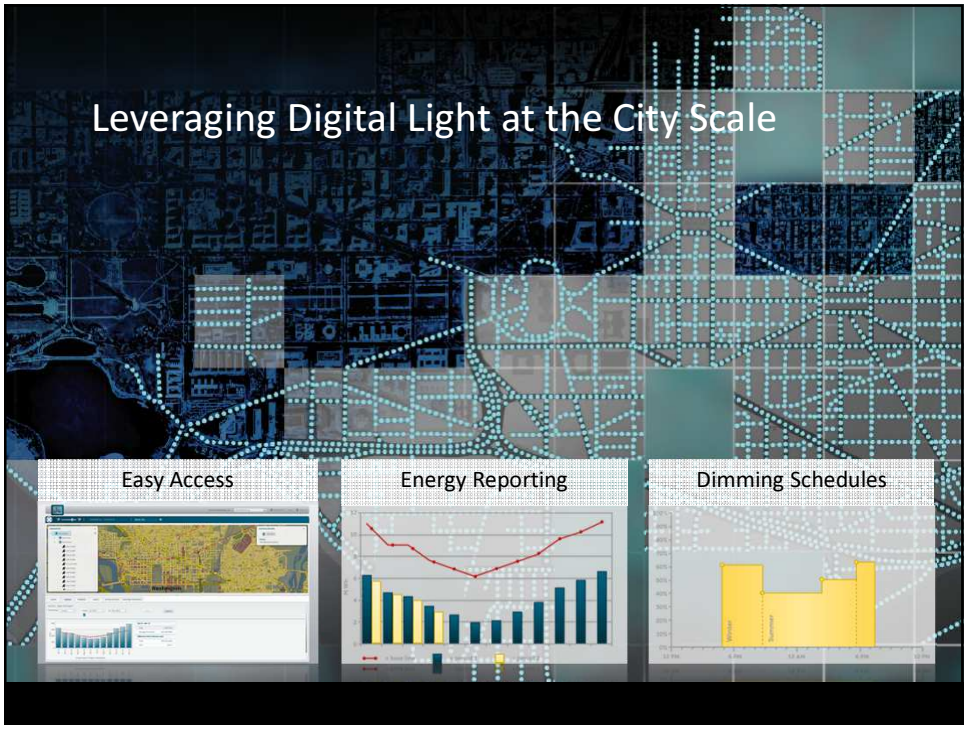
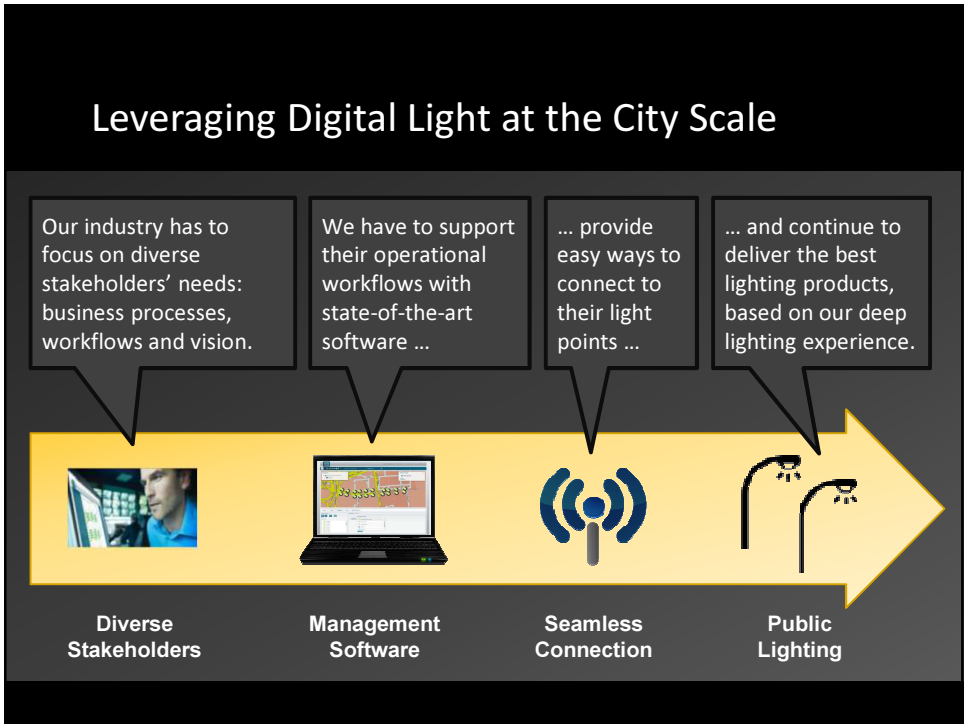

Leveraging Digital Light at the City Scale
Easy Access
Energy Reporting
Dimming Schedules


Leveraging Digital Light at the City Scale
Our industry has to focus on diverse stakeholders' needs: business processes, workflows and vision.
We have to support their operational workflows with state-of-the-art software …
… provide easy ways to connect to their light points …
… and continue to deliver the best lighting products, based on our deep lighting experience.
Diverse Stakeholders
Management Software
Seamless Connection
Public Lighting

Erwin Blumenfeld 1946, reprinted 2008, *City Lights,* C-type print, 40x30 cm

Light as Media and Medium

How much meaning per pixel?

Adapted from I/O Bulb, Underkoffler & Ishii 1999

light bulb I/O bulb encoded information?

Techniques for Encoding Information

Resolution	Encoding	Meaning
Very low	Information as color	Implicit
Low	Information as movement	Implicit
Medium / low	Information as text	Explicit
High	Information as image	Explicit
Low relative to scale	Information as architecture	Implicit

Gulf Tower

As color…

Photo Credit: William E. Gossett

Gulf Tower

Legend for the color code of the weather beacon on the Gulf Tower in Pittsburgh, PA as published in a local newspaper

(Credit: KDKA-TV)

Jim Campbell

As movement…

Running and Falling Series

http://www.jimcampbell.tv/portfolio/low_resolution_works/running_falling/ambiguous_icon_five_running_falling/

Media Lab Prado

As movement…

Langarita Navarro Architects, Madrid, Spain

WGBH HQ

As image…

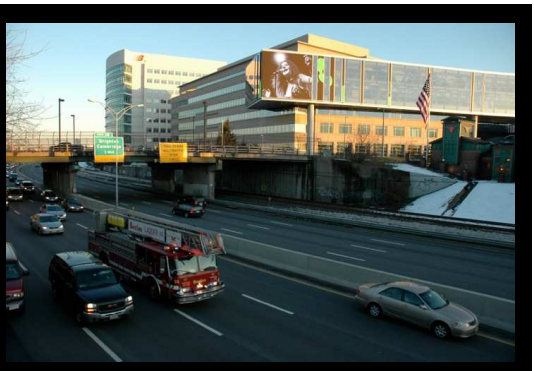
Digital Mural in Boston, MA

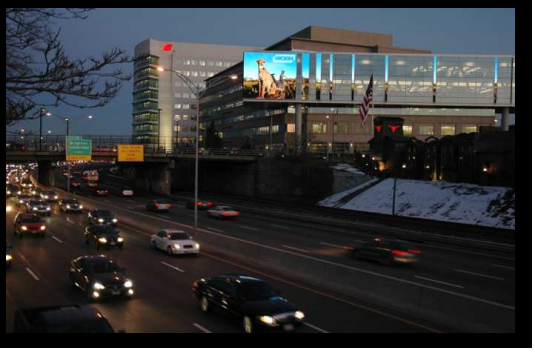
WGBH HQ

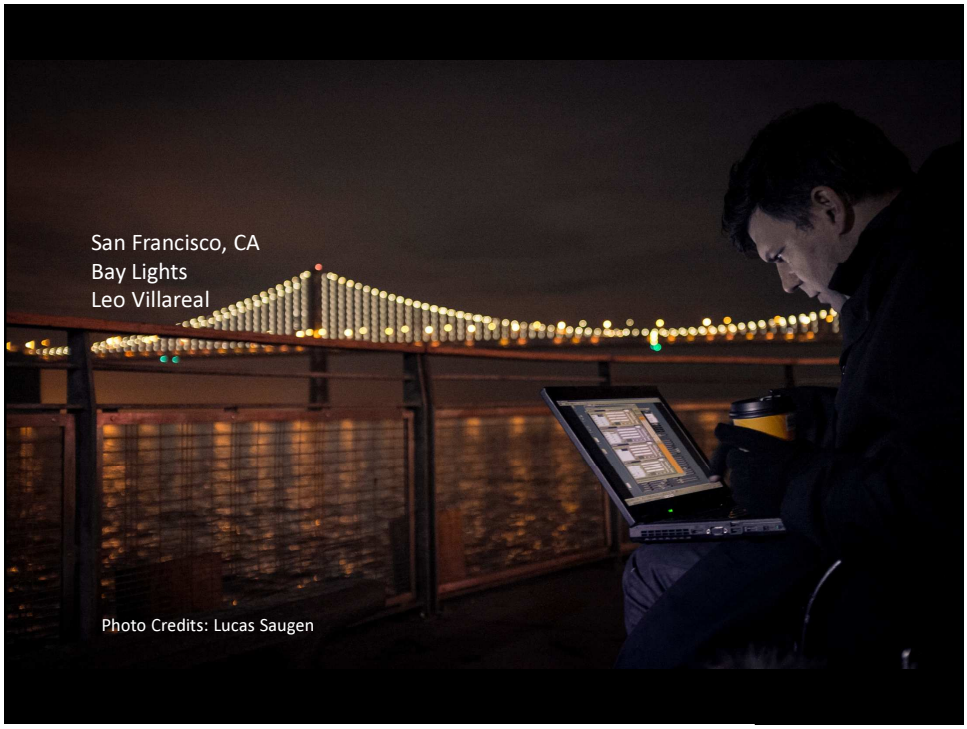
As architecture…

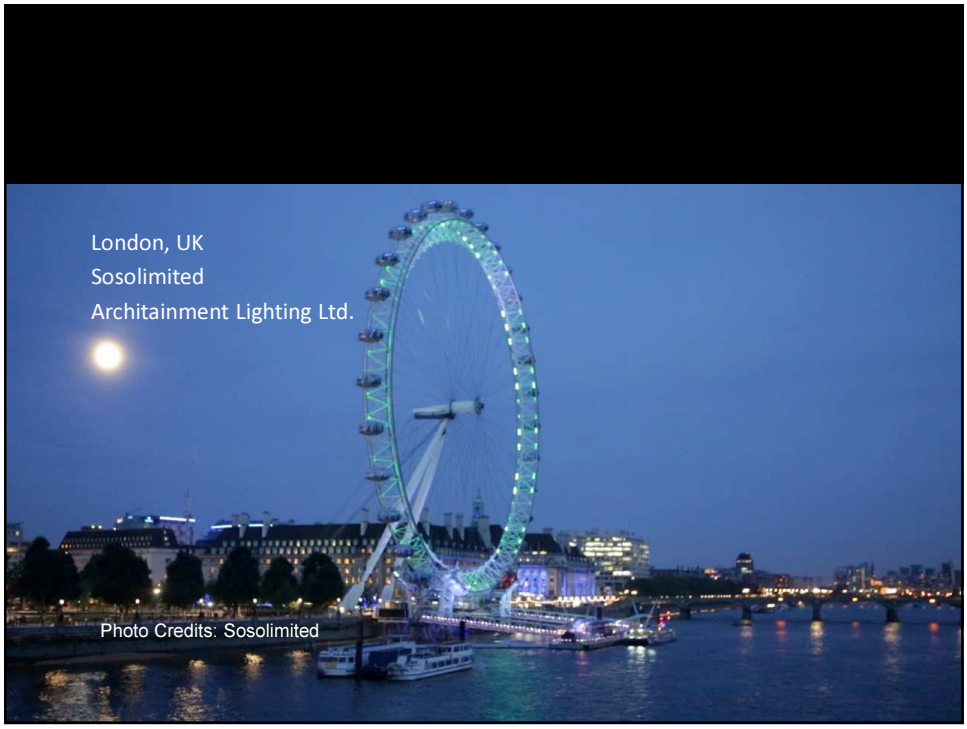
Venturi reviews many examples of what he calls “explicit mannerism” including two buildings in Times Square: the Morgan Stanley building on Broadway between 49th and 50th and the Morgan Stanley Dean Witter building on Seventh Ave. and 50th Street both designed by KPF: “Viva the facade as computer screen! Viva facades not reflecting light but emanating light - the building as a digital sparkling source of information, not as an abstract glowing source of light!”

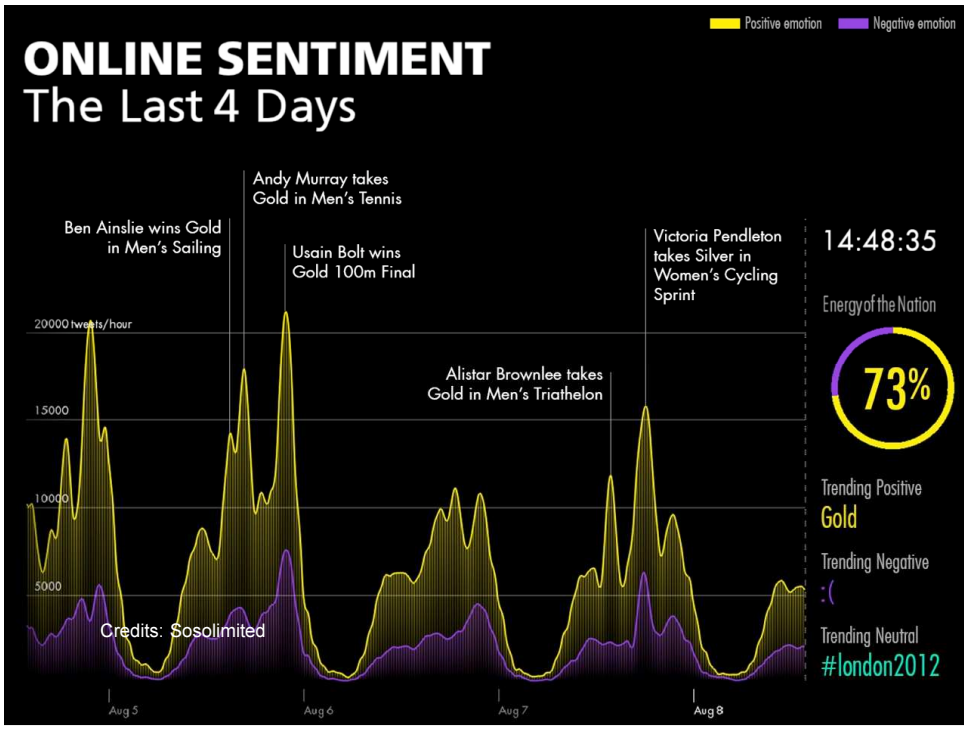
(Venturi 2004)





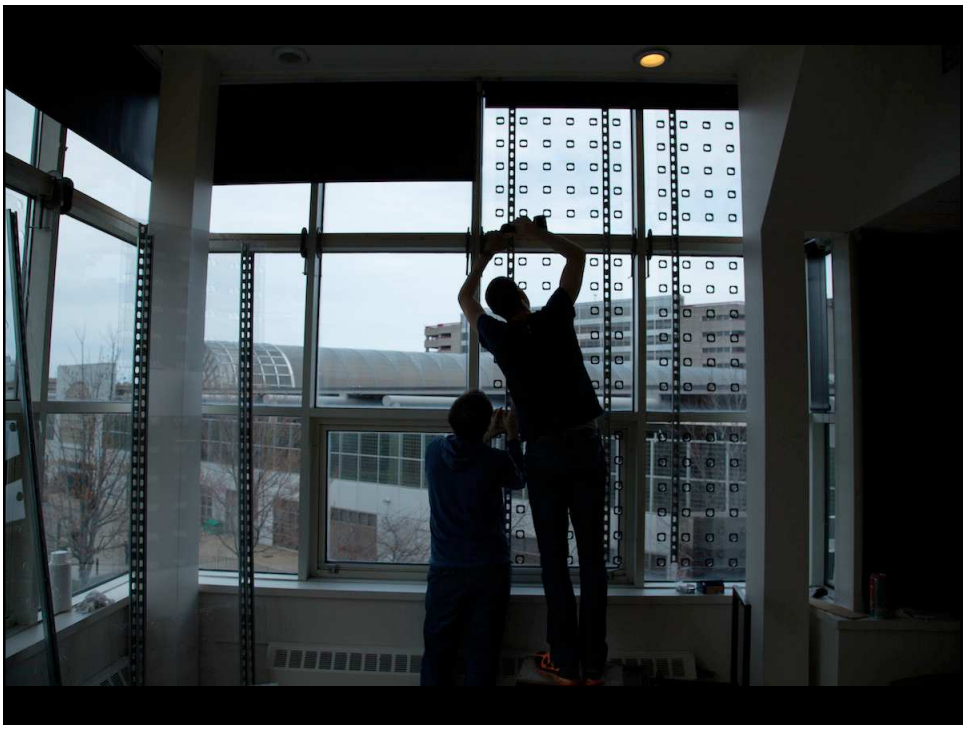

San Francisco, CA
Bay Lights
Leo Villareal
Photo Credits: Lucas Saugen


London, UK
Sosolimited
Architainment Lighting Ltd.
Photo Credits: Sosolimited


Positive emotion
Negative emotion
ONLINE SENTIMENT
The Last 4 Days
Andy Murray takes Gold in Men's Tennis
Ben Ainslie wins Gold in Men's Sailing
Usain Bolt wins Gold 100m Final
Victoria Pendleton takes Silver in Women's Cycling Sprint
Alistar Brownlee takes Gold in Men's Triathelon
20000 tweets/hour
15000
10000
5000
Credits: Sosolimited
Aug 5
Aug 6
Aug 7
Aug 8
14:48:35
Energy of the Nation
73%
Trending Positive
Gold
Trending Negative
:(
Trending Neutral
#london2012

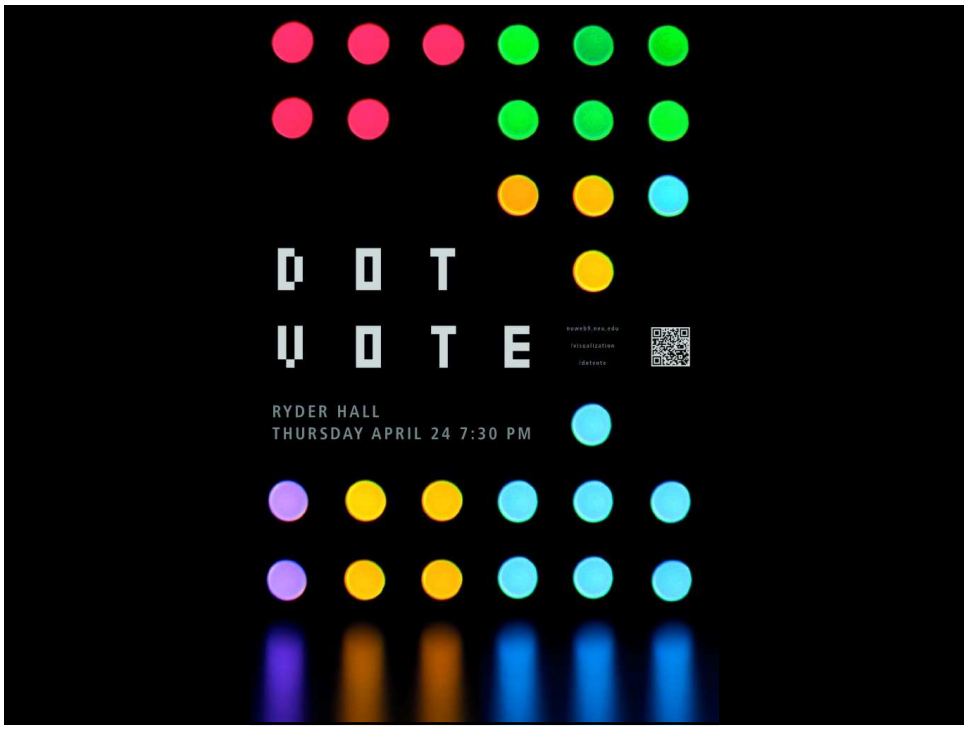
dotvot.es

Photo and Video Credits: Maria Amasanti, Dietmar Offenhuber, Peter Schmitt, Vivian Lee.




KUNSTISMS


RYDER HA


DOT
VOTE
RYDER HALL
THURSDAY APRIL 24 7:30 PM


.vote
Northeastern University
Boston, Massachusetts, USA
Photo Credit: E. Karaman, D. Offenhuber, and Maria Amasanti

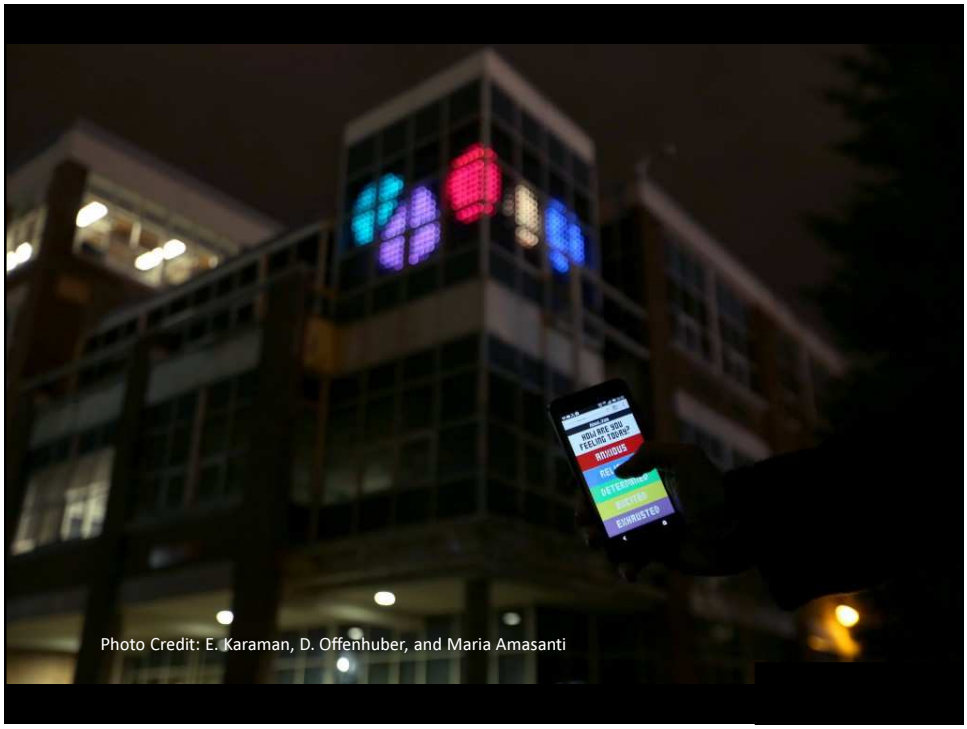


Photo Credit: E. Karaman, D. Offenhuber, and Maria Amasanti

Street Seats Beacons

Collaboration with Design Museum Boston

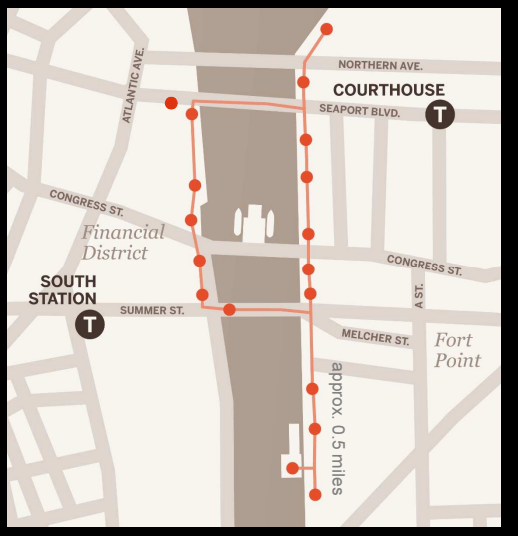
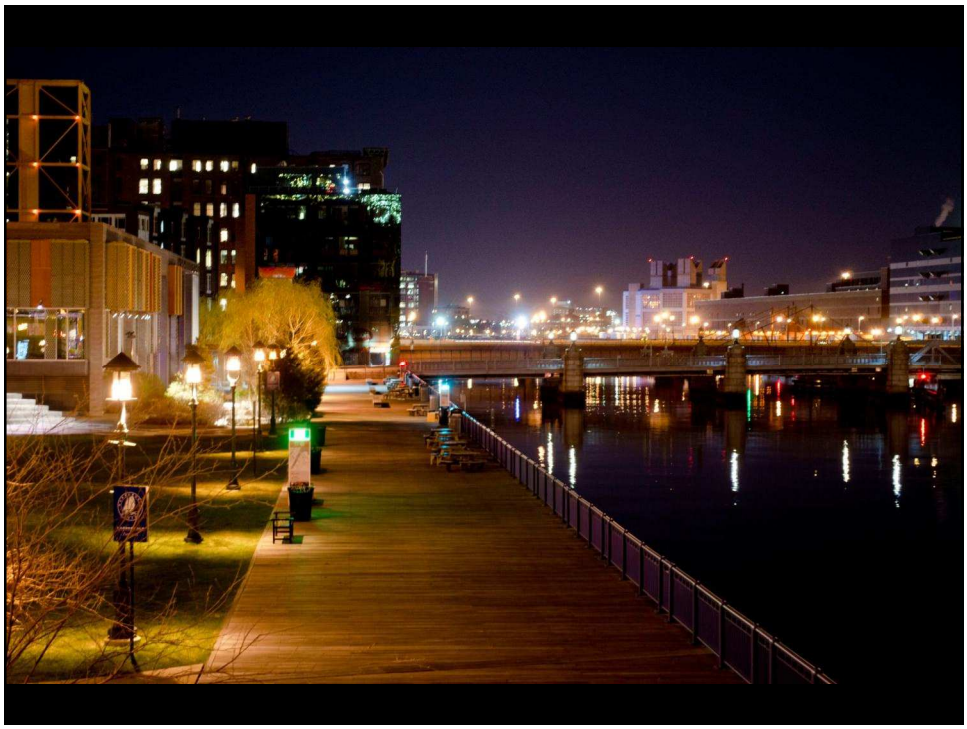
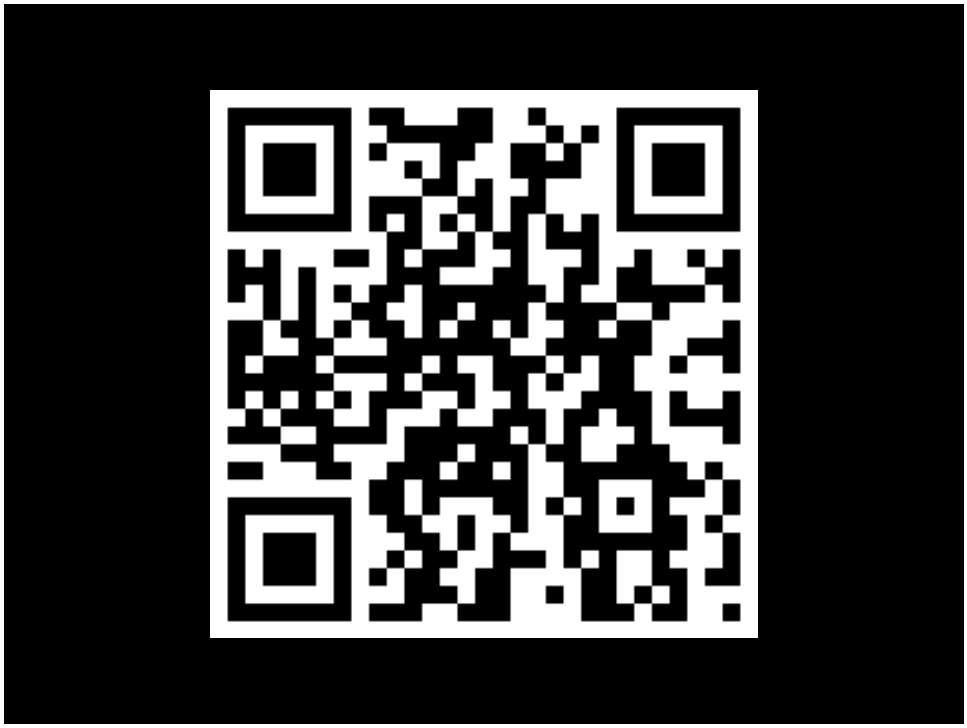
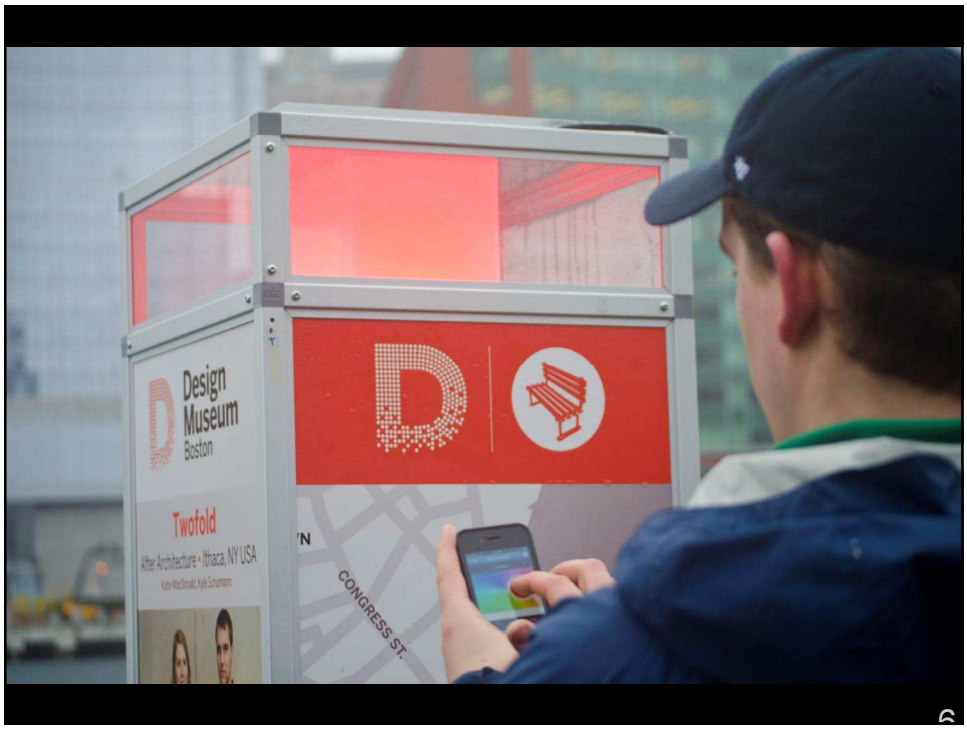
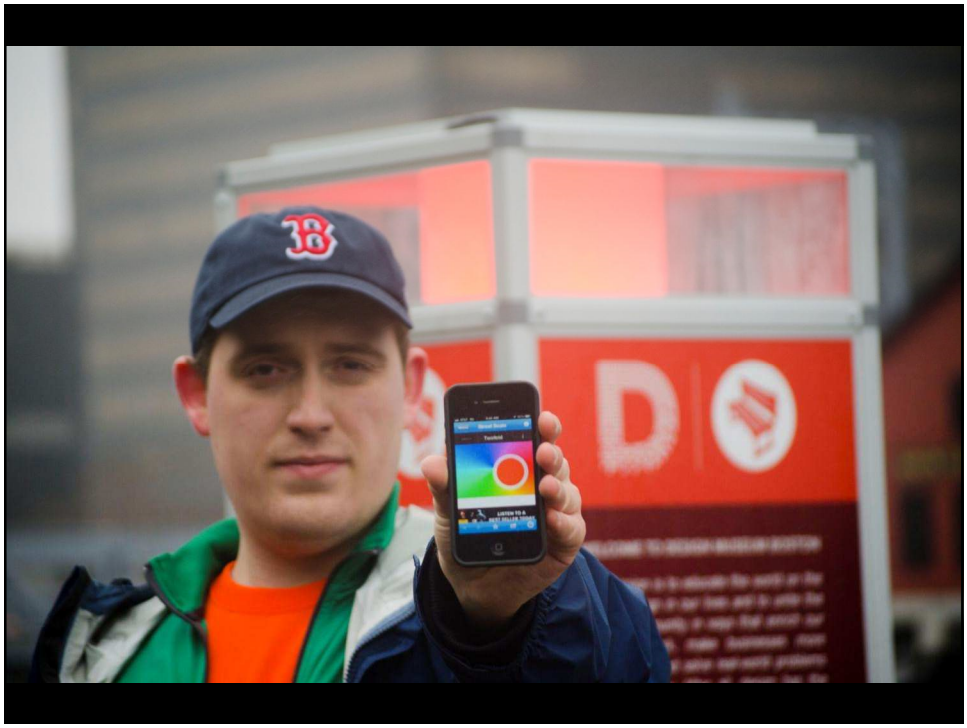


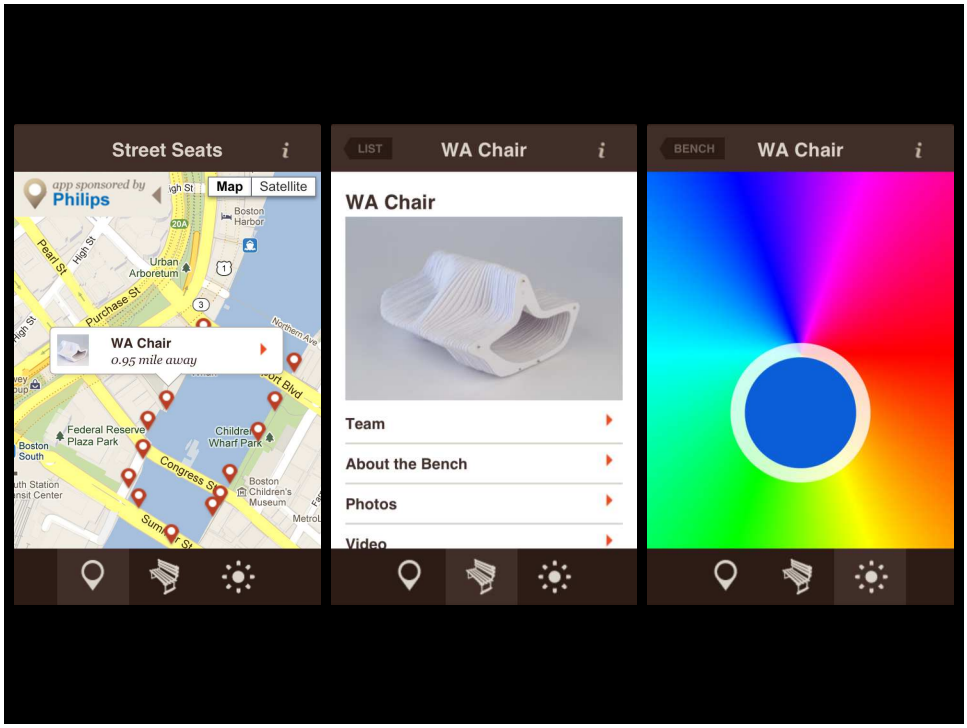
Photo and Video Credits: Garrick Dixon

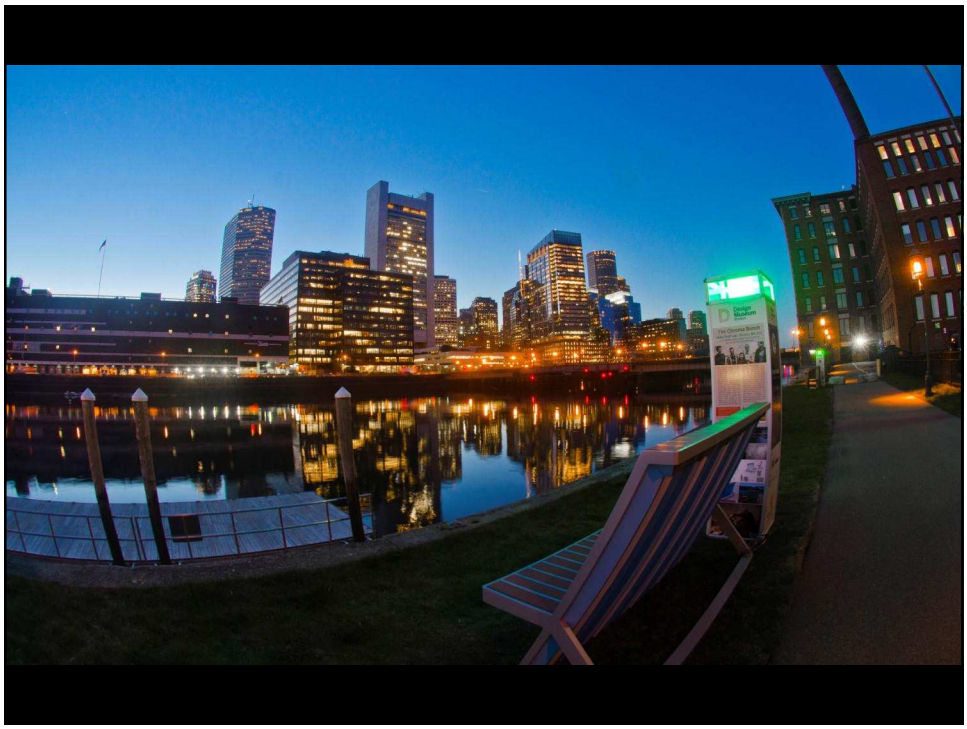




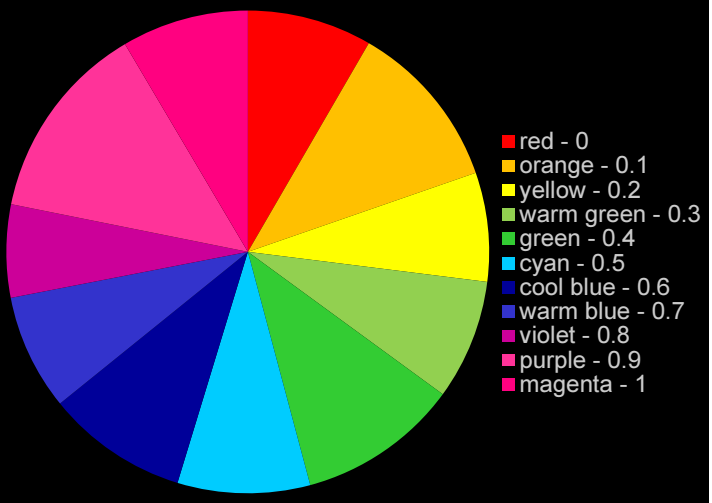

Design
Museum
Boston
Twofold
After Architecture • Ithaca, NY USA
CONGRESS ST.




Street Seats
app sponsored by
Philips
Map
Satellite
WA Chair
0.95 mile away
LIST
WA Chair
WA Chair
Team
About the Bench
Photos
Video
BENCH
WA Chair

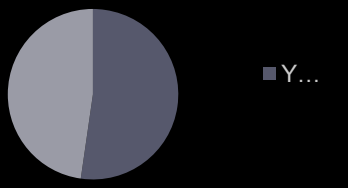


What's your favorite color?

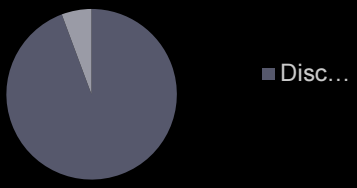


Fort Point Channel Area

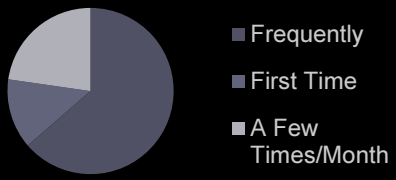
Have you noticed the Street Seats exhibition?



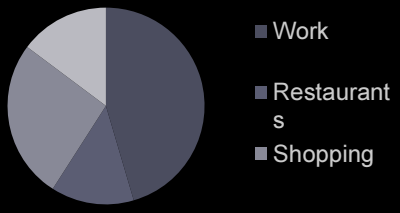
Was Street Seats a discovery or a destination?



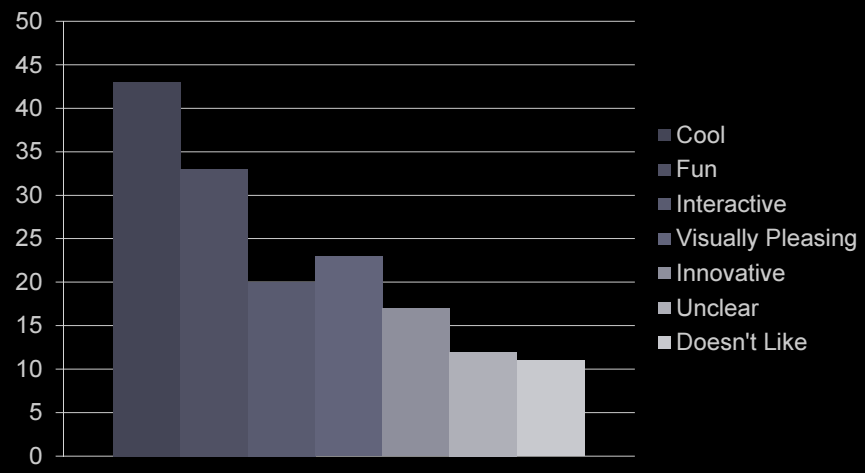
How often are you in the Fort Point Channel area?



What brings you to the area?



What did you think of the lights?



Survey Quotes (On-foot and In-app)

- People seemed **delighted** with the interaction, *"A true discovery. But not truly inviting immediately after a heavy rain! But I will come back with my smartphone in drier weather!"*
- Most people commented on **ease of use**, "Appreciated not having to download an app", "could change color the beacon so easily" but still some "found it hard to find despite the QR code" (also had to do with physical placement of code, etc.)
- Definitely addressing **tech-savvy crowd**
- Questions on how system supports **multiple users**
- **When it didn't work** on someone's phone for whatever reason it was a l**et-do**wn. Challenge working with multiple OS's, available cell network, etc.
- **Children** loved lighting. Could it be daylight visible? Could there be special controls just for kids? *"Our kids love changing the colors!"*
- Integration with the benches was challenging, *"Had to catch a train. Awesome Idea. Reminds me of the "cows" project back in 2004ish."*

Spatial Legibility

Spectrum of Engagement

ambient dynamic responsive interactive

Considering and fulfilling pedestrian needs

ambient

Ambient lighting

- Considers pedestrian orientation needs
- Establishes a hierarchy of contrasts
- Lights up interesting elements like vertical surfaces, trees, water…
- Reveals the complexity of a space
- Minimizes glare

Considering and fulfilling pedestrian needs

dynamic

Dynamic lighting

- Alternates spaces at night and creates drama
- Emphasises event times and supports the identity of venues
- Surprises pedestrians and connects to their curiosity
- Initiates dialogues about urban environments among citizens

Considering and fulfilling pedestrian needs

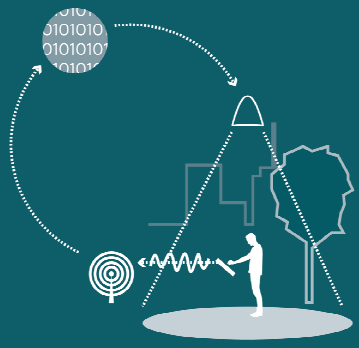
responsive

Responsive lighting

- Creates meaningful light changes according to pedestrian flow, weather, etc.
- Makes citizens aware of available data in the city
- Creates stunning effects when dynamic light is linked with real time events characteristics, e.g. noise
- Cost saving input to dynamic light shows

Considering and fulfilling pedestrian needs

interactive

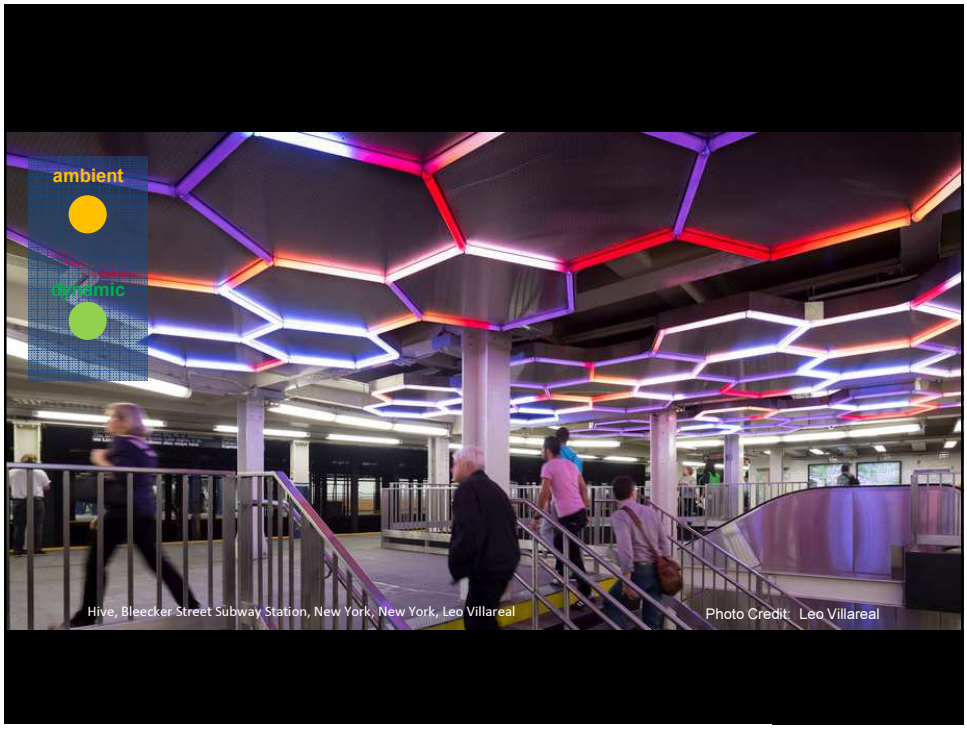


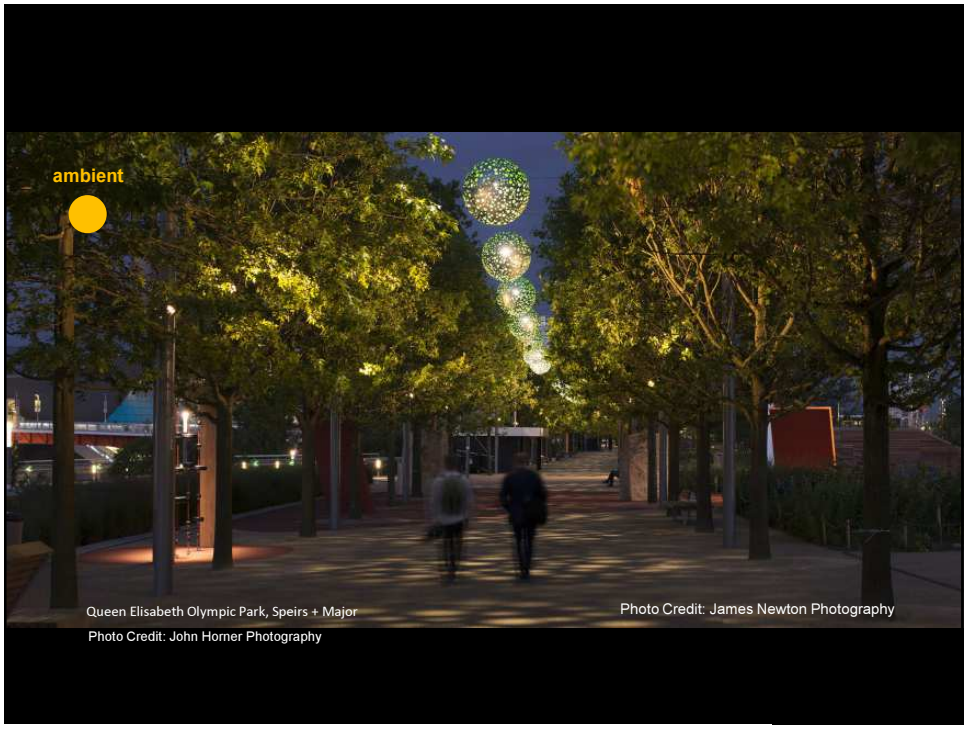
Interactive light:

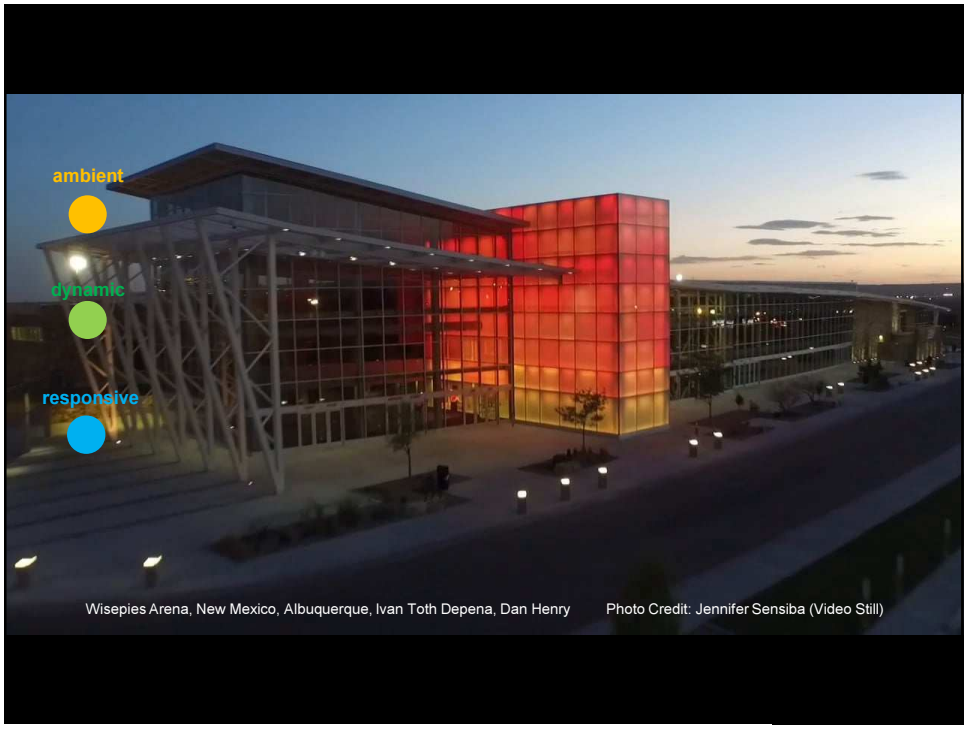
- Gives pedestrian opportunities to influence their environment
- Alternative content creation for dynamic light shows
- Changes pedestrian flow and behavior
- Brings innovation to people and fosters creativity

Reviewed 90+ projects in pedestrian, urban settings

SALC October 4-7, 2015 Savannah, GA


ambient
dynamic
Hive, Bleecker Street Subway Station, New York, New York, Leo Villareal
Photo Credit: Leo Villareal


ambient
Queen Elisabeth Olympic Park, Speirs + Major
Photo Credit: John Horner Photography
Photo Credit: James Newton Photography



Wisepies Arena, New Mexico, Albuquerque, Ivan Toth Depena, Dan Henry Photo Credit: Jennifer Sensiba (Video Still)

Photo Credit: Claudia Paz & Cheung

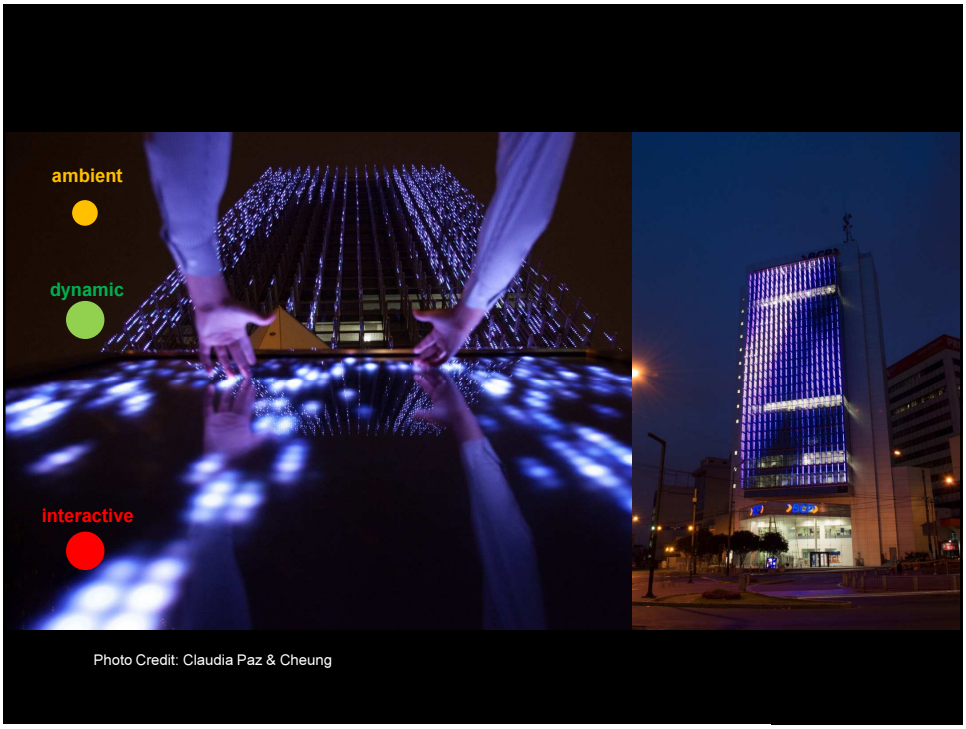
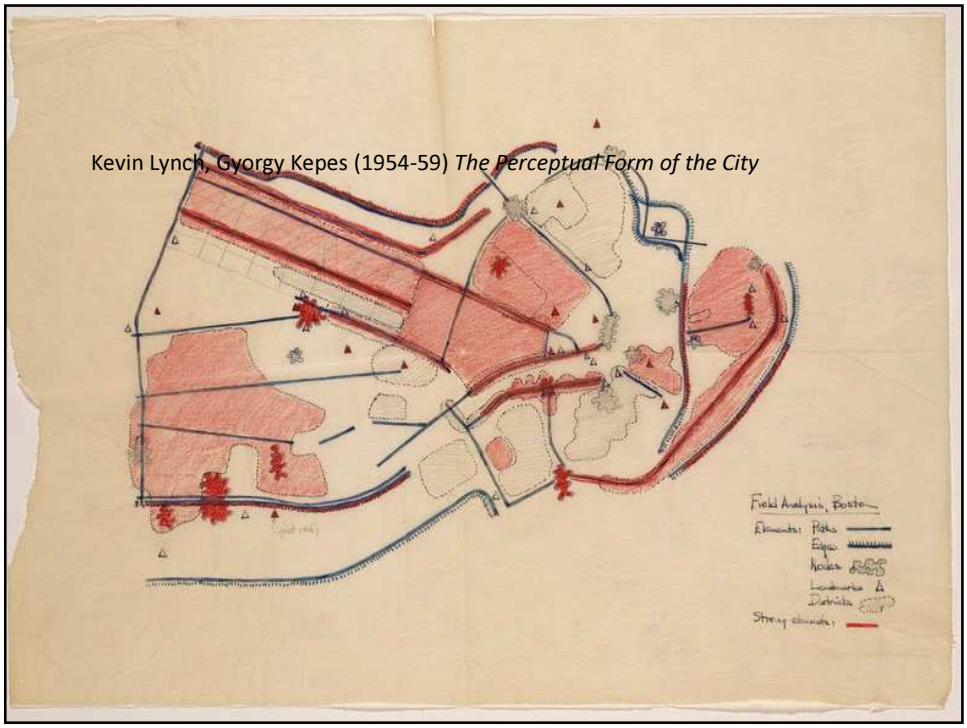


Photo Credit: Claudia Paz & Cheung

Digital ground and getting into place…

Digital ground is shorthand for a complex proposition: Interaction design must serve the basic human need for getting into place. Like architecture, and increasingly as a part of architecture, interaction design affects how each of us inhabits the physical world.

(McCullough, 2004, p. 172)


Kevin Lynch, Gyorgy Kepes (1954-59) *The Perceptual Form of the City*
Field Analysis, Boston
Elements: Paths
Edges
Nodes
Landmarks
Districts
Strong elements:


How will technology influence citizens' experience?
We can take it as read that our networked technologies will continue to play some fairly considerable role in shaping the circumstances and possibilities experienced by billions of city-dwellers worldwide .
-- Adam Greenfield
Field Analysis, Boston
Elements: Paths
Edges
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Landmarks
Districts
Strong elements: