Fall 2012

**inFormatting Architecture: incorporating urban public space into private infrastructures to create didactic environments in the information age**

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*Syracuse University*

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inFormatting Architecture

incorporating urban public space into private infrastructures
to create didactic environments in the information age

LIONEL CAMACHO
"I think there is a world market for maybe five computers."
- Thomas J Watson, President of IBM, 1943
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THE INFORMATION AGE is characterized by the digitization of today’s industries. This process of digitization is composed of two primary components—Information Technologies (tangible hardware) and Information Systems (the intangible process of digitization). Together, these two systems work together to virtualize society’s information. Through virtualization, an immersive amount of information is collected, processed, analyzed, and redistributed back to End Users. In turn, End Users are able to access digital information through a series of interfaces on a computer—such as the internet and applications. This process of digitization has positioned information systems as the prime facilitators of everyday interactions.
THE INFORMATION AGE

Information systems consist of the intangible systems responsible for processing information while information technology is the tangible hardware that collects and houses data.

**INFORMATION TECHNOLOGY**
- tangible components
  - telecommunications
  - hardware
  - software

**INFORMATION SYSTEMS**
- intangible components
  - processing
  - storage
  - distribution

**RESEARCH DOMAIN**
- physical
- digital
- **user interface**
  - "computers"
- **information systems**
  - "data centers"

**INDUSTRIES**

**END USERS**
THE INFORMATION CYCLE
how IS and IT work together

data centers → information matrix → users

I. collection → II. processing → III. storage → IV. distribution → V. analysis

virtualization

CONTEXT
inFormatted ARCHITECTURE incorporates public spaces into the data center’s existing infrastructure to create didactic environments in the information age
IN ARCHITECTURE, the demand to build structures capable of housing the information technologies that operate today’s information systems, has led to the routine creation of the Data Center. In the built environment, the designs for these structures are purely functional and so performance driven that they negate any fruitful interaction with the surrounding public. As these data warehouses continue to exchange information with various industries, the demand for such structures will rapidly grow. This proliferation of Data Repositories, if not addressed by Architects, will start to dwindled Architecture’s role in the urban environment.
Architecture of function begins to form varying relations with the architecture of exchange by exchanging information, these relationships are abstracted away from the public.
"When computers were women"

Jennifer S. Light, Northwestern University

"Where a calculator on the ENIAC is equipped with 18,000 vacuum tubes and weighs 30 tons, computers in the future may have only 1,000 vacuum tubes and perhaps weigh 1.5 tons."

Popular Mechanics, 1949
“architecture, at least as it was traditionally conceived, might no longer play a vital role in shaping the urban experience”

Mark Shepard - Sentient City

JUNKSPACE & GENERIC CITY: REM KOOLHAAS
URBAN SPACE: CRISIS & RENEWAL

architecture plays a pivotal role in shaping the urban experience

ARCHITECTURE & THE URBAN EXPERIENCE

URBAN VENACULAR  URBAN LIFE

experience of the street

to understand the implications between people and the urban street, requires the thinking of space where formal geometry and material articulation are important.
“declaring a crisis in architecture in the face of contemporary conditions as a means of arguing for its reinvention is a classic and well-worn tactic” - Mark Shepard

LIVING CITY: ARCHIGRAM
an exhibition organized presented at the Institute for Contemporary Art (ICA) in London, made clear that urban life was to become the new materials of architecture
JUNKSPACE & GENERIC CITY: REM KOOLHAAS
“echoes Archigram’s assessment that the ‘old’ tools, techniques and obsessions of architecture are no longer relevant to current conditions”

MODERN OBSESSION
- bigness
- undifferentiated
- unattentive detailing

Junkspace
- bland facades
- no formal articulation
- generic interiors

experience of the street
SENTIENT CITY: MARK SHEPARD

“projects a world where computers would disappear into the background, displaced to the periphery of our awareness”

looks beyond materiality in architecture and shifts the focus of creating urban space from the tangible into the intangible

the implications of higher-order information processing in urban environments, redefines “the nature of cities and who constitutes its citizens”
### MODELS OF THE CITY: TANGIBLE & INTANGIBLE

“these urban conditions alter traditional sites of practice and working methods of architecture and urban planning” -Mark Shepard

<table>
<thead>
<tr>
<th>TRADITIONAL CITY</th>
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<tbody>
<tr>
<td><strong>TANGIBLE PERSPECTIVE</strong></td>
</tr>
<tr>
<td>formal articulation of space and material</td>
</tr>
<tr>
<td>“these projects sought to open up the material of architecture to change the adaptation over time in the context of varied uses”</td>
</tr>
<tr>
<td><strong>INTANGIBLE PERSPECTIVE</strong></td>
</tr>
<tr>
<td>informal articulation of space and material</td>
</tr>
<tr>
<td>“the idea that space itself is a social product- one less designed and constructed than enacted or performed through specific behaviors and practices”</td>
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<table>
<thead>
<tr>
<th>TANGIBLE PERSPECTIVE</th>
<th>HYBRID MODEL</th>
<th>INTANGIBLE PERSPECTIVE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>generic city:</strong> rem koolhaas</td>
<td>HYBRID MODEL</td>
<td><strong>sentient city:</strong> mark shepard</td>
</tr>
<tr>
<td>“space based on the Cartesian grid and Euclidean geometry that underlie the dominant spatial models of mainstream architecture”</td>
<td></td>
<td>“these were the materials of a new architecture, an urban dynamic composed of light, sound, and other forms of urban communications”</td>
</tr>
<tr>
<td>engages built materiality</td>
<td>engages ubiquitous technology</td>
<td>engages ephemeral qualities</td>
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<table>
<thead>
<tr>
<th><strong>spatial absolutes</strong></th>
<th><strong>spatial programs</strong></th>
</tr>
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<tbody>
<tr>
<td>“architecture becomes a stage-set for a set of spatial practices that enact the architecture”</td>
<td>“hybrid programs break the normative roles ascribe to each program separately”</td>
</tr>
</tbody>
</table>

“architecture would need to embrace modern urban life in order to maintain claims of cultural relevance”

-Mark Shepard
population & big data
Every day, we create 2.5 quintillion bytes of data, so much that 90% of the data in the world today has been created in the last 2 years alone.

-IBM Big Data Platform
SPECULATIONS:

Demand for structures capable of housing all information technology will continue to increase as the capacity to store information decreases.

- Internation Data Corporation
MOORE’S LAW & INNOVATION
“the number of transistors that could be etched on an integrated circuit(microchip) would double every one to two years.” - Gabe Piccoli

Microprocessor Transistor Counts

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Integrability
Affordability
Usability

PERVASIVE > FINITE

Technology > Space

How much can we fit into silicon chip?
IMPLICATION: ARCHITECTURE

EMERGING TYPOLOGIES
shifts towards an architecture of function

FUNCTION ←---------------------→ public architecture

ROLE OF THE ARCHITECT in the Information Age would then be to combine a Data Center’s pragmatic duty of storing information with a more civic responsibility that facilitates public exchange. If not, the technological developments of the Information Age will continue to bound these emerging storage centers into a utilitarian role that negates public awareness. Doing so will lead the Architecture of the Information Age towards failure as it creates dead space—formally, programmatically, and socially.

PROPOSED TYPOLOGIES
incorporates key components from both typologies

function --------> DIDACTIC ENVIRONMENT ←---------------------→ public

SUCCESS
DATA MEGASTRUCTURES

architecture is generating a utilitarian typology that negates the public realm

PERVASIVE TECHNOLOGY LEADS TO PERVERSIVE ARCHITECTURE

FORM FAILURE results when data warehouses are constructed as mere storage components. Traditionally, these data repositories have defaulted to such forms as a way to maximize storage capacity and reduce building costs. In turn, the resultant storage warehouse has very little interest of engaging society. On the other hand, forms capable of generating public interest are often capable of containing larger public spaces for its occupants. Such forms have prototypically resulted in buildings with large interior spaces, such as atriums in malls and the portals for working institutions. In areas where form was restricted by a site's size constraint, the inclusion of the landscape helped expand interiors spatially into more appropriate social atmospheres. For Data Centers, allocating a large amount of area towards public use is inefficient and even poses a risk to the data. The role of the Architect would then be to explore new hybrid forms capable of maximizing storage capacity that reduce construction costs, but also introduce a public component to Data centers.

IMPLICATION: TYPOLOGY
PROGRAM TRANSFORMATION

architecture is losing its ability to program environments for social exchange

ARCHITECTURE OF EXCHANGE

program

program

library commons

retail commons

ARCHITECTURE OF FUNCTION

PROGRAM FAILURE arises when the inner workings of data centers are limited to only a few individuals. Designed as high performance machines, data centers are composed of an interior program that ensures efficiency, reliability, and security. The desire to minimize costs has led to innovative ways of generating renewable energy such as chiller less technology. Sadly, such innovations have been kept rather isolated as the program of these spaces is restricted to only a few personnel. The potential to raise public awareness of such technology is lost as data centers continue to be designed to conceal their presence from the public. Through revelatory designs, Architects can expose the inner processes within Data Centers and through Architecture improve the general public’s growing illiteracy with the Information Systems & Information Technologies that govern their everyday life.

IMPLICATION: PROGRAM
SOCIAL FAILURE occurs when data warehouse are incapable of forming integrated relationships with their neighboring environment. Due to their monumental scale, data centers have the sheer amount of square footage necessary to influence the relations and culture of host towns directly and indirectly. The mere location where they decide to be built is enough to question society's views on data storages. For instance, the decision to cast them in rural lands or near the periphery of cities makes the statement that society is not ready to celebrate them in the public arena. Furthermore, the choice to design them with minimalistic qualities, such as lack of ornamentation in the façade and a conservative material palette, decreases their relevance to society. Neighboring towns are in return presented with a detrimental image of the data center as a massive structure that has been further abstracted to become a mysterious black box illusive to the public.

IMPLICATION: ICONOGRAPHY

LARGEST US DATA CENTERS

- **350 east cermak, chicago, 1.1 million sf**
- **nap of the americas, miami, 750,000 sf**
- **qts metro data center, atlanta, 990,000 sf**

The architecture based solely on function falls short of being celebrated as a public monument.
the potential for the site should be able to incorporate the data center’s function alongside the public in a way that enhances the urban experience
SUCCESS comes from Architecture’s ability to incorporate social spaces into the data center’s existing infrastructure. Such public areas will coexist with the information technologies that process today’s information systems and in turn deploy spaces that foster the interactive values (interconnectivity and accessibility) of the digital age. This transformation requires the exploration and implementation of innovative forms that are enriched with didactic programs in order to become notable landmarks of society.
INNOVATIVE FORMS are expressive interpretations in the built environment that foster social atmospheres. Such interpretations envision data centers as elegant structures whose integrated approach towards function and public begin to form spaces capable of generating public interest—while at the same time fulfill their utilitarian role. These forms can start to deploy information systems to design interactive typologies that are responsive to both, public and function. The resultant form then becomes an environment for exchange, expressive and not restricted by the typology of warehouses—a detriment to their public image.
VIRTUALIZATION and server consolidation drove declines in physical data center size and eliminated the need for numerous smaller data centers as applications were moved to larger central data centers.

**TYPOLOGIES OF DATA CENTERS**

- **data closet** (< 50,000 SF)
- **data mart** (< 100,000 SF)
- **modular pod** (< 100,000 SF)
- **CO-LOCATION** (< 100,000 SF)
- **data warehouse** (> 200,000 SF)

Data center numbers decline, but capacity increasing.

**TRENDS: VIRTUALIZATION**

Server consolidation and cloud-based application delivery models are shrinking the number of data centers, while the ones that remain are getting larger, IDC reports.

<table>
<thead>
<tr>
<th>year</th>
<th>number of data centers</th>
<th>aggregate floor space</th>
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<tbody>
<tr>
<td>2012:</td>
<td>2.94 million data centers</td>
<td>611.4 million square ft</td>
</tr>
<tr>
<td>2016:</td>
<td>2.89 million data centers</td>
<td>700.0 million square ft</td>
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**CASE STUDY: GOOGLE’S ‘FOLLOW THE MOON’**

Shifting the workloads between data centers lowers the cost for power and cooling during overnight hours, but adds an additional layer of abstraction to the growth of data centers.
CASE STUDY: QUINCY, WASHINGTON

cheap renewable energy
hydroelectric generators

cheap land

mild dry climate

microsoft

intuit

vantage

800,000 sf

240,000 sf

235,000 sf

yahoo!
sabey
dell

250,000 sf

520,000 sf

325,000 sf

TYPOLOGY CONCERN: ANTI-DATA CENTER SENTIMENT

failure to incorporate data centers with communities creates an anti-data center sentiment
case study: artic circle

lower cost for cooling servers
hydroelectric generators
cheap renewable energy

photovoltaic panels’ performance increases due to the greater sun exposure in thinner atmospheres

site selection

cold climates

small communities

case study: artic circle

the decision to build in remote areas further disconnects the public from the presence of data centers

hamina, finland

lulea, sweden

population 21,000
population 46,600

google
data barns

facebook

300,000 sf
TENNESSEE VALLEY AUTHORITY

Ronal Wank
Tennessee region

the functional simplicity of TVA
style incorporated much of the
urban surroundings

‘TVA’- Drive by Truckers

I grew up two hours north of Birmingham.
Me and my daddy used to fish next to Wilson Dam.
He told some stories?Camaros and J.W. Dant;
When I got a little older I wouldn't and now daddy can't.
So I thank God for the TVA,
Thank god for the TVA,
When me and my daddy used to bow to the river and pray,
Thank god for the TVA.

When I was fifteen, me and my girl sat out on the lock,
Watching the raccoons and terrapins dance on the rocks.
She let me put my hand up under her shirt;
I wanted her to want me so bad it hurt.
So I thank God for the TVA,
Thank god for the TVA,
When me and my baby used to lay 'round and wait on the day,
Thank god for the TVA.

My granddaddy told me when he was just seven or so,
His daddy lost work and they didn’t have a row to hoe,
Not too much to eat for seven boys and three girls;
All lived in a tent?bunch of sharecroppers versus the world.
So his mama sat down, wrote a letter to FDR,
‘En a couple days later, couple of county men came in a car,
Rode out in the field, told his daddy to put down the plow.
He helped build the dam, gave power to most of the South.
So I thank god for the TVA,
Thank god for the TVA,
When Roosevelt let us all work for an honest day’s pay,
Thank god for the TVA.
The TVA revitalized a vast area of rural America by building dams to provide cheap electricity, but also protects and conserves natural resources while providing recreational opportunities across the region.

**HYDROELECTRIC FACILITIES**
- Norris Dam: Reservoir
- Wilson Dam: Generator Room
- Kentucky Dam: Switchyard
- Wheeler Dam: Locks

**TVA SERVICE AREA**
- Kentucky
- Virginia
- North Carolina
- Tennessee
- Alabama
- Mississippi
- Georgia

- National Forest: 232,400 acres
- Wildlife Refuge: 202,000 acres
- Public Access: 1,120 acres
- Public Parks: 40,900 acres
DIDACTIC ENVIRONMENTS within data centers will challenge the notion of mixing two contradictory programs by proposing a more cohesive relationship between function and public. Doing so reimagines the program of data center as a collaborative exhibition, where the information processes behind technology are revealed to the public. With such a program, Data Centers begin to participate within a larger social context by operating innovative high-performance systems as public exhibitions. To leave such inner workings to the imagination simply hinders any fruitful interaction between the machine and its users. For data warehouses, a didactic environment promises a desired effect on its inhabitants that demystifies concepts about information systems and information technologies.
DATA CENTER’S OCCUPANCY

Large data centers with more than 200,000 sf might have from 100 to as many as 300 on-site employees.

DATA CENTER’S MULTIPLIER EFFECT

The digital services provided by data centers leads to additional business that employs more people.
Anjali Athavaley, Wall Street Journal

“plans come amid a recent tech boom in NY, a growing number of startups are cropping up in the city”

CONTINUING RAPID GROWTH

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<tr>
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<th>2012</th>
<th>2015</th>
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<tr>
<td>firms</td>
<td>532</td>
<td>639</td>
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<tr>
<td>square feet of work space</td>
<td>1.7M</td>
<td>3.1M</td>
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<tr>
<td>employees</td>
<td>9,628</td>
<td>17,960</td>
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<tr>
<td>additional jobs supported</td>
<td>23K</td>
<td>43K</td>
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<tr>
<td>total economic impact output</td>
<td>$3.1B</td>
<td>$5.9B</td>
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TECH’S IMPACT

the tech triangle consists of the navy yards, downtown brooklyn, and dumbo

- 523 innovation firms identified in the triangle
- 20% of firms started in the last 16 months expect to at least double in employment in the next three years
- 48% of firms expect to at least double in employment in the next three years
- $3.1B economic impact on the brooklyn economy
big tech companies and tech schools are expanding their footprints in NYC

an area running along broadway with a concentration of Internet and new media companies

tech start ups are looking to dumbo as high tech incubator office space

Anjali Athavaley, Wall Street Journal

“plans come amid a recent tech boom in NY, a growing number of startups are cropping up in the city”
CASE STUDY: BELL LABS HOLMDEL COMPLEX

BELL LABS HOLMDEL COMPLEX
Eero Saarinen and Sasaki, Walker and Associates
Holmdel Township, New Jersey
encapsulates an era of ground
breaking scientific, architectural,
and landscape design

1920’s
Holmdel site was used by Bell Labs for Wireless Communication Research

1931
Harold Friis worked closely with Bell Labs scientist Karl Guthe Jansky at Holmdel

1932
Karl Guthe Jansky developed the rotating antenna and was credited with the discovery of the science of radio astronomy

1938
Harald Friis produced one of the first microwave communications and RADAR systems, utilized by the US in WWII to defend against enemy ammunitions

1957
Bell Telephone Company began a research laboratory, constructed between 1959 and 1962

1958
Arthur Schawlow’s and Charles Townes’ invented the laser

1960’s
Frenkel and Engel led a team of engineers to develop the first cellular wireless voice transmission technology, and eventually created AMPS (advanced mobile phone system, the 1st widely deployed cellphone technology)

472-acre pastoral campus with 1.9 million SF structure

People began to realize it could be an amazing place to live, just as it has always been an amazing place to work,” Michael Calafati, heads on NJ AIA

SITE SELECTION
Holmdel is responsible for fostering a community that invented some of the greatest technological innovations of the 20th century, including the transistor, microwave transmission, cell phone technology, and the global wireless movement; precursor to the internet.

The buildings' mirrored exterior is made of a special material developed to allow 25% of sunlight to pass through while simultaneously repelling 70% of solar heat.

Curtain wall of the six-story building with a soaring two-story atrium at the center, surrounded by closed-in lab and office space, with wide corridors along the glass curtain-walls of the exterior.

Icon in the Park

PROGRAM DISTRIBUTION

<table>
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<tr>
<th>Floor</th>
<th>Description</th>
<th>Total SF</th>
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<tbody>
<tr>
<td>fl 1</td>
<td>basement</td>
<td>443,546 sf</td>
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<tr>
<td>fl 2</td>
<td>atrium</td>
<td>99,546 sf</td>
</tr>
<tr>
<td>fl 2</td>
<td>elevator cores</td>
<td>6,032 sf</td>
</tr>
<tr>
<td>fl 2-6</td>
<td>building</td>
<td>1,343,680 sf</td>
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<tr>
<td>fl 3-6</td>
<td>elevator cores</td>
<td>24,128 sf</td>
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<tr>
<td>fl 3-6</td>
<td>bridges</td>
<td>15,504 sf</td>
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<tr>
<td>total</td>
<td>total</td>
<td>1,934,436 sf</td>
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Parti layout

SECTION

1964: Scientists, Arno Penzias and Robert Wilson, used the Bell Labs' infamous horn antenna to lay the scientific groundwork for the "Big Bang Theory".

1967: The building's distinctive features, including its mirror-like appearance, led to recognition as Laboratory of the Year by R&D.

1978: Nobel Prize in Physics was jointly awarded to Penzias and Wilson.

1988: Linn Mollenauer's groundbreaking work in the development of multimode fiber transmission systems.

1996: Andrew Chraplyvy's, Kenneth Walker's, & Robert Tkach's invention of optical fiber for dense wavelength division multiplexing (DWDM) technologies behind the fiber optic backbone of the internet's infrastructure.

1997: Steven Chu's wins Nobel Prize for work in cooling and trapping atoms with lasers.

1998: Jerry Foschini's BLAST technology, the original precursor to MIMO wireless transmission systems.

Tech impact

A historic preservation committee.

Site selection
NOTABLE LANDMARKS garner a positive image within their communities. They are embraced by their environment and often serve as a representation of the values embedded within their community. For Data Centers, their recent sprawls have not yet establish the structure as an icon in the built environment. On the other hand, the Architecture behind public areas is memorable, iconic, and often distinguishable spatially through size. For Data Center to be considered notable, they must begin forming a similar public presence with individuals. In time, Data Centers will join other monuments in the public arena to establish themselves as icons - celebrated landmarks of society.
one of the earliest sections of Brooklyn to be settled and initially developed with frame houses and modest buildings on streets that were once lined with homes, churches, factories, and shops

**SITE SELECTION**

**NEIGHBORHOOD SETTLES**

**1700’s:**
Land occupied by MetroTech was owned by the Duffield and Johnson families.

**1830’s:**
Property was subdivided into lots and residential development began. Streets on the edge of the growing city were lined with a mix of wood and brick houses, most in the Greek Revival style of architecture.

Johnson Street had modest 2 1/2 story houses, with small porches that attracted the families of middleclass, mostly American born professionals and artisans.

Many of the residents attended small local Protestant churches.

**1890’s:**

Elevated railroad on Myrtle Ave plunged the street to semi-darkness. Factories sprang up including the Wilcox Millinery Company’s large plant designed by Parfitt Brothers, with Myrtle Avenue itself becoming the epicenter for local furniture stores.

**1900’s:**

For almost 150 years, this neighborhood evolved at the fringe of the Fulton Street commercial district. -metrobid.org

**BECOMING DOWNTOWN**

**1980’s:**

Residential streets changed dramatically as nearby Fulton Street became a major shopping district. Homes became boarding houses for Irish and German immigrants, while commerce and industry made inroads.

**1980’s:**

Architect R.I. Daus designed the NY and NJ Telephone Company’s office building at 81 Willoughby Street, with its dramatically curved corner and carvings depicting telephones.

**1990’s:**

Brooklyn Borough President Howard Golden and Polytechnic University President Bugliarello conceived and advanced the idea for the MetroTech project.

**1990’s:**

Brooklyn Borough President, commissioned a Regional Planning Association to study Downtown Brooklyn to see if it could become the City’s third central business district.

**1990’s:**

City’s Public Development Corporation agreed to designate Polytechnic University as the urban renewal sponsor for the MetroTech project.

**DOWNTOWN EVOLVES**

**1900’s:**

Small businesses erected storefronts on the lower floors of old houses due to significant transportation improvements, large-scale industrial and corporate companies established headquarters in the area.

**1910’s:**

Architect R.I. Daus designed the NY and NJ Telephone Company’s office building at 81 Willoughby Street, with its dramatically curved corner and carvings depicting telephones.

**1930’s:**

For almost 150 years, this neighborhood evolved at the fringe of the Fulton Street commercial district. -metrobid.org

**1940’s:**

Polytechnic University and PDC chose Forest City Ratner Companies as the developer, whose strong sense of public purpose was seen as an important piece to the development.

**1980’s:**

MetroTech complex has generated over $1 billion in new investment representing over five million square feet of new space.

**DOWNTOWN TRANSFORMS**

**1970’s:**

Brooklyn Borough President Howard Golden and Polytechnic University President Bugliarello conceived and advanced the idea for the MetroTech project.

**1970’s:**

Initiation of a center for research and development modeled on the lines of “Silicon Valley” to become the cornerstone of a revitalized Downtown core.

**1979’s:**

Brooklyn Borough President, commissioned a Regional Planning Association to study Downtown Brooklyn to see if it could become the City’s third central business district.

**1980’s:**

City’s Public Development Corporation agreed to designate Polytechnic University as the urban renewal sponsor for the MetroTech project.

**1980’s:**

MetroTech complex has generated over $1 billion in new investment representing over five million square feet of new space.

**SITE’S TIMELINE: METROTECH CAMPUS**

**NEIGHBORHOOD SETTLES**

**1700’s:**
Land occupied by MetroTech was owned by the Duffield and Johnson families.

**1830’s:**
Property was subdivided into lots and residential development began. Streets on the edge of the growing city were lined with a mix of wood and brick houses, most in the Greek Revival style of architecture.

Johnson Street had modest 2 1/2 story houses, with small porches that attracted the families of middleclass, mostly American born professionals and artisans.

Many of the residents attended small local Protestant churches.

**1890’s:**

Elevated railroad on Myrtle Ave plunged the street to semi-darkness. Factories sprang up including the Wilcox Millinery Company’s large plant designed by Parfitt Brothers, with Myrtle Avenue itself becoming the epicenter for local furniture stores.

**1900’s:**

For almost 150 years, this neighborhood evolved at the fringe of the Fulton Street commercial district. -metrobid.org

**BECOMING DOWNTOWN**

**1980’s:**

Residential streets changed dramatically as nearby Fulton Street became a major shopping district. Homes became boarding houses for Irish and German immigrants, while commerce and industry made inroads.

**1980’s:**

Architect R.I. Daus designed the NY and NJ Telephone Company’s office building at 81 Willoughby Street, with its dramatically curved corner and carvings depicting telephones.

**DOWNTOWN EVOLVES**

**1900’s:**

Small businesses erected storefronts on the lower floors of old houses due to significant transportation improvements, large-scale industrial and corporate companies established headquarters in the area.

**1910’s:**

Architect R.I. Daus designed the NY and NJ Telephone Company’s office building at 81 Willoughby Street, with its dramatically curved corner and carvings depicting telephones.

**1930’s:**

For almost 150 years, this neighborhood evolved at the fringe of the Fulton Street commercial district. -metrobid.org

**1940’s:**

Polytechnic University and PDC chose Forest City Ratner Companies as the developer, whose strong sense of public purpose was seen as an important piece to the development.

**1980’s:**

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**SITE’S DOWNTOWN BROOKLYN PARTNERSHIP**

not-for-profit local development corporation whose mission is to advance economic development activities by assisting in the implementation of major development projects

**BUSINESS IMPROVEMENT DISTRICTS**

manages three Business Improvement Districts that seek to improve and develop the greater Downtown Brooklyn community

**Fulton Mall Improvement Association**

streetscape improvement project that will dramatically improve the appearance and functionality of Fulton Mall, enhancing the shopping experience for current users and attract new ones

**Court-Livingston-Schermerhorn BID**

involved with the maintenance and events programming of Columbus Park, an open space at Court and Remsen Streets, in the heart of the civic center

**METROPARK TECH BID**

3.5 acre park-like private space with public access surrounded by corporate tenants, hosts events including concerts, health fairs, chess tournaments and holiday celebrations

Metrotech Commons

SITE SELECTION
SITE SELECTION

Willoughby Pedestrian Plaza

created in 2006 after a highly successful pilot project that closed part of Willoughby Street to improve pedestrian movement and safety, a true public amenity for Downtown Brooklyn

Willoughby Square Park

1.25 acre park will sit atop a 700-space underground parking garage, new centerpiece for a thriving mixed-use district of hotels, offices, shops, and residences just south of MetroTech

SITE’S URBAN IMPACT

with private investment & $300 million in public improvements, Brooklyn is becoming a great urban center known for its commercial district, growing residential neighborhood, and world-class arts scene
CASE STUDY: COOPER UNION AS A PUBLIC ICON

COOPER UNION FOR THE ADVANCEMENT OF SCIENCE AND ART
Thom Mayne/ Morphosis Architects

“lively public spaces reaffirm that enlightenment comes from the free exchange of ideas, not just inward contemplation”
Julieta Cervantes-The NY Times

FORM MASSING

stainless steel curtain wall wraps entire building

41 COOPER SQUARE

facade exerts a magnetic pull to embrace the city

FLOOR PLAN

grand staircase welcomes students and visitors
creates a series of interlocking social spaces, many undefined, and to allow for the kind of casual encounter that is a central part of urban life.

THREE SCHOOLS

art, arch., & engineering

ATRIUM

functions as an interior public square where social interaction can occur.

FACADE ICONOGRAPHY

exemplifies how a bold, aggressive profile can become an architectural statement for civic pride.

PROGRAM DISTRIBUTION

classrooms, offices, studios, and laboratories surround the vertical atrium and are connected by three separate staircases.

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top heavy proportion 9 stories plus two below grade height: 135 ft.
NOVEL PRACTICES that question the current role of the Data Centers will begin the transformation of them into captivating spaces that deploy interactive programs with abstract forms—thus reformatting dead spaces into didactic environments.
generate an entirely new sector in New York City’s economy that places NYU at the center of a global stage in this field
NYU Polytech

Education/ Cultural /Govt

US Courthouse
City Tech (CUNY)
NY Supreme Court
St. Francis College
Borough Hall
Brooklyn Law School

Open Space

Corporate Offices

Pedestrian

NYU PUBLIC SERVICE

avertages $125,000 annually to community organizations

15,000 students volunteer averaging 1.4 million hours of community service

expansion of NYU’s health training and service across the city

NYU annually places 900 students as tutors in 100 schools

social work students spend more than a half-million hours each year

$30 million in uncompensated care annually for 300,000 patients visits

In the past year alone, there were 500 ‘in-bus’ health care visits
ACADEMIC PROGRAM: LIVING LABORATORIES

CUSP will use cities as ‘living laboratories’ by providing incubator space for start-ups, and interweaving them with space for other technology and entrepreneurial support firms.

SITE: 11 METROTECH

“when people, especially talented and creative ones, come together, ideas flow more freely, and as a result individual and aggregate talents increase exponentially; the end result amounts to much more than the sum of the parts. This clustering makes each of us more productive, which in turn makes the place we inhabit even more so, and our collective creativity and economic wealth grow accordingly.”

Richard Florida
the project fits with the investments being made to NYU-Poly’s academics and physical infrastructure, and it will serve as the applied science arm of a broader, interdisciplinary academic initiative on cities implementing state-of-the-art technology to improve services for New Yorkers.
“this push towards always-on, always-available environment created a growing market for data center colocation” pg 2

“as technology evolves, these data companies have to make the decision as to which data center provider they wanted to work with” pg 2

“A colocation Data Center is an important extension of any organizations and therefore must be properly managed” pg 18
PHYSICAL LOCATION OF CENTER

Weather Patterns
- total damage due to severe weather in 2011 climbed to $1 billion over the course of 12-14 major events

Seismic Risk
- some data centers place more of an emphasis on equipment seismic bracing and or improving their building’s seismic stability

Power Grid & Redundancy
- location of power stations, substations, and feeds to the facility as well as redundancy throughout the delivery system
- recent area outages help to understand the time-to-repair for the utility provider
- redundancy and availability of power
- weather patterns, areas which require more cooling due to heat constraints may have a stressed power infrastructure

Accessibility- Routes, Roads, Airports
- ensure that there are easy ways in and out of the area
- look for routes in and out of the facility that do not require major roads or highways
- ensure that there are several ways to access the data center and redundancies built in for easy access
- availability of an airport...equipment and personnel will have to be flown in for support
- readily accessible airport facility may be an important requirement (regional airports)
HIGH DENSITY METERED POWER

Incremental Growth
“Metered power allows power requirements to increase and incrementally draw power over time when migrating or growing the colocation footprint in phases”

2N+2 Redundant Design
“traditionally, many data centers focused on the number of backup or spare devices in the power delivery architecture”

two completely independent power paths from the utility to the server rack and 2 additional spares for critical infrastructure such as generators and UPSs

N is the number of active devices needed
- N+1 with one spare,
- N+2 with two spares.
- 2N+2 two devices with two spares (best)

Access to a dedicated substation
capable of scaling beyond 8kW per rack or 200 watts per square foot

“best data centers currently offer fully dedicated power substations”

COOLING

100% Availability
“Many data centers have 99% uptime, but in today’s high demand, always on information economy, that 1% can cost millions of dollars”
“1% downtime means over 7 hours of outages per month & 3.5 days of outages per year”

Low PUE (power usage effectiveness)
“an efficient data center colocation meets the cooling needs of computer equipment and facility and manages a low PUE to drive down cooling costs”

Cooling Redundancy
“like the power requirements, with increased density, data centers are susceptible to overheating due to inadequate cooling systems”

“center offers a N+2 chiller plant and N+2 or greater redundancy on air handling units”

Hybrid Cooling Technologies
“integrate and optimize ‘free cooling’ technologies into a hybrid cooling plant, capable of mixing cooling methods to be most efficient”
“today’s demands have outgrown many existing data centers”
PHYSICAL SECURITY

In-house security staff
“armed guards and a full security staff”

Multi-factor identification and authorization
“ID checks, biometrics, and other forms of identification measures”

Layered Security Zones
“redundancy in the security policy- entry points, floors, and access to customer cages all represent layers of security”
“building a building within a building for maximum security”

Camera and security systems
24x7x360 secure environments that prohibit any public access
“security measures such as systems, bollards, fencing, and security all the way from the roof to the parking lots”

AMENITIES

Working Areas
“IT professionals may spend days at a data center colocation working on racks. Servers. Applications or tuning the infrastructure”
“a data center with a campus mentality will have good areas for engineers to work”

Office Space
Offer onsite office to rent for staff, a key part of business operation

Relaxation Rooms
“data centers are stressful places, incorporate downtown areas for the engineers”

Test/Mock Labs
allows for server testing prior to installations

Workstations and Conference Rooms
increases productivity and employee morale
GREEN TECHNOLOGY

EPA Energy STAR certification
“represent 46% of revenue over the next five years- Pike Research Report”

“actively seeking ways to improve the environment and continue to be efficient”

“work with advance metering technologies to monitor power being utilized by equipment, cooling, and electrical components”

Water Conservation Efforts
“using reclaimed water in data center cooling methods”

“it is usually cheaper per gallon than traditional potable water”

“it reduces the impact that data centers have on the environment”

Cooling and power efficiencies
“replacing constant speed pumps and fans in their cooling plants with variable frequency motors that can more accurately match cooling demand to supply”

“smart, automated ways to configure and operate their cooling plants in response to data floor and outside temperatures and humidity”

Airside Economization
“free air” can be used to maintain optimal data room temperature and humidity

Only energy required is for running the fans to draw air inside the building

Renewable Power Sources
Hydro, wind, solar, help reduce the power utility’s carbon footprint
## CLOUD & BIG DATA

- "information becomes distributed between multiple locations and can then be delivered more creatively"
- IT consumerization and BYOD has driven the need for cloud computing

### Data Center Distribution
- The need for data to reside close to the actual workload
- Close to major telecommunications hubs
- Close to your critical user communities where centralized data is a requirement
- Ensures lower latency and increase application/data performance

### Big Data
- Terabytes to Petabytes, increase in data usage is the result of more information being processed within organizational databases as the need for distributed information rises
- Capable of handling the bandwidth of that data
- Having the right type of network switches in place and good connectivity within the data center itself

## NETWORK BANDWIDTH & LATENCY

- "with the increase of traffic moving through the Internet, there is a greater demand for more bandwidth and less latency"

### Bandwidth Bursts
- "allows the administrator to temporarily increase the amount of bandwidth available to the environment based on immediate demand"

### Seasonal and cyclical industries

### Network Testing
- "internal speeds and how data will act on that network"
- "a poor networking infrastructure won’t be able to handle a large organization’s ‘Big Data’ needs despite potentially having fast internet connection"

### Saturated Data Centers

### Know Your Applications
- "gauge data requirements by understanding the underlying application or workload"
- "how the application functions, the resources it requires, and how well it operates on a given platform"
PROGRAM ANALYSIS

WORKLOAD: INFORMATION DELIVERED

MISSION CRITICAL VS GOOD ENOUGH

“classifying the workloads based on their priority”

“which systems should run in high-availability Tier III data centers”

“which systems must have higher uptime requirements versus those with lower priority”

Mission Critical

“specific infrastructure must remain up 100% which requires highly redundant supporting infrastructures”

“recovery times ranges from just a few minutes to a few hours”

“vital pieces that will keep business running”

Good Enough

“contains infrastructure pieces which may have longer recovery time objectives”

INFRASCTURE MANAGEMENT

“purpose built facilities with lots of complex technology”

Workload Balancing

“design your infrastructure around a well-balanced workload model. This means that no one server is over provisioned and that each physical host is capable of handling the workload of another host should an event occur”

Business Continuity

“keep operations running optimally without disruptions in the general infrastructure”

Disaster Recovery

“capable of handling a major failure, while still recovering systems quickly”

Everything is Connected

“devices such as power and cooling delivery need to be connected to a common network...must work as a system (seamless monitoring)”

Innovation through integration

“in house software development resources that can integrate disparate software management tools into a robust system”

Secured portal and reporting

Online view of critical infrastructure, produce reports and trends

Sense and Respond Software

“provide trend analysis and intelligence that can identify problems”

“the current business landscape has created what is known as a ‘data-on-demand’ generation where information is needed immediately on any device, anywhere and at any time” pg 13
proposal

An advance computer application course that explores the possibilities of using Processing as Art.


Overview of general information concepts, implementation concerns and strategies, and information life cycle management.


An interactive approach to teaching Processing to individuals new to computer coding. Broadens that use of computers as an art medium.


A gateway course offered by the Informational School at Syracuse University introducing key principles of information systems.

Arthur E. Morgan. The Making of the TVA (1974) by its first chairman


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