Engaging Public Voice in Big Data Society

An on-line participatory design experiment.

by **Yi Hou**

B.L.A at Iowa State University, 2012

Submitted to the Department of Architecture
in Partial Fulfillment of the Requirements for the Degree of
Master of Architecture at the
Massachusetts Institute of Technology
February 2016

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Abstract

Should the design of architecture be solely in control by architects? Should we trust the public to let them design with us? These are the core discussion revolves around participatory design, a design approach involves public effort. In theory, this democratic process should results a more responsive and suitable project for users. Although the concept of participatory design works well in theory, but there are constrains that stopped itself from wider application. How can we collect large amount of ideas that can directly lead to a design solution? Will the result have any advantage compare to traditional design process?

Building upon historic precedents, my thesis proposes an on-line participatory platform, a new computational tool that allows large number of participants participate into the design process. Each user's desire can be translated into a set of data that represents their preferences on architecture. Then, to extract common patterns from data pool to compute result. The final goal is to calculate an optimized design that will suit most users' desire. Will the public like what they designed collectively? The result will spark an interesting discussion.

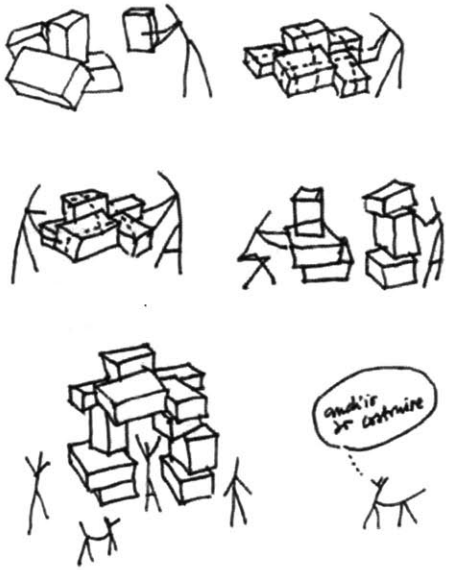
Thesis Advisor : Takehiko Nagakura
Title : Associate Professor of Design and Computation

Bibliography

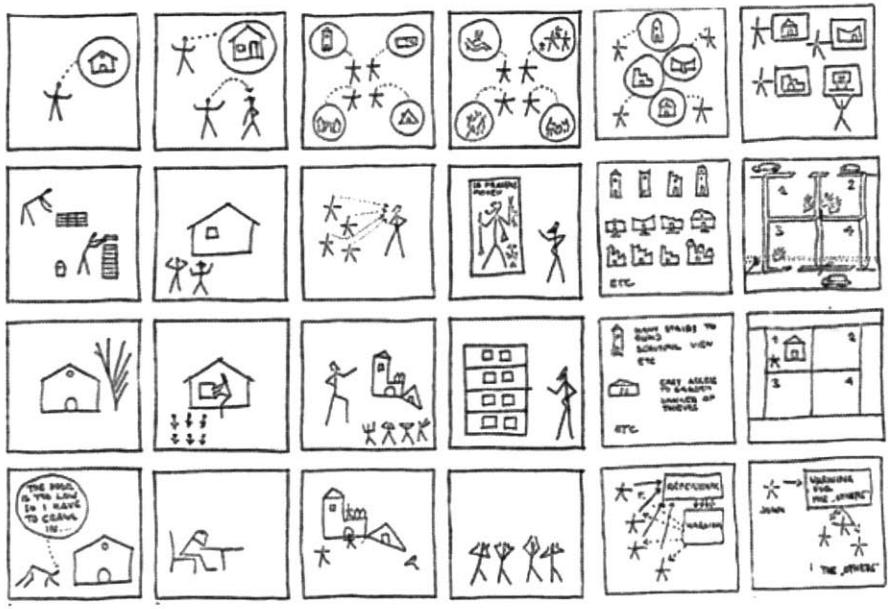
Negroponte, Nicholas. The Architecture Machine. Cambridge, MA: M.I.T., 1968. Print.

Negroponte, Nicholas. Soft Architecture Machines. Cambridge, MA: MIT, 1975. Print.

The stressful process of creating a user satisfied design, because architect just don't get the idea.....



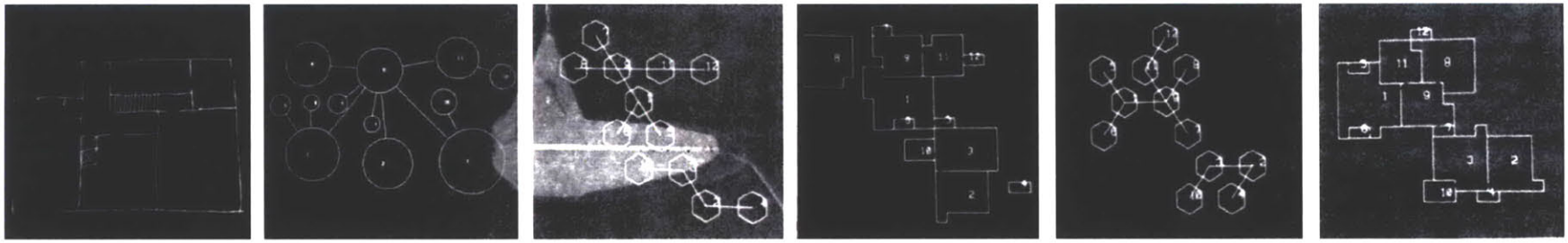
Sketch by Yona Fridman



Yona Friedman's pictograms from Negroponte's "Computer Aided Participatory Design" in "Soft Architecture Machines"

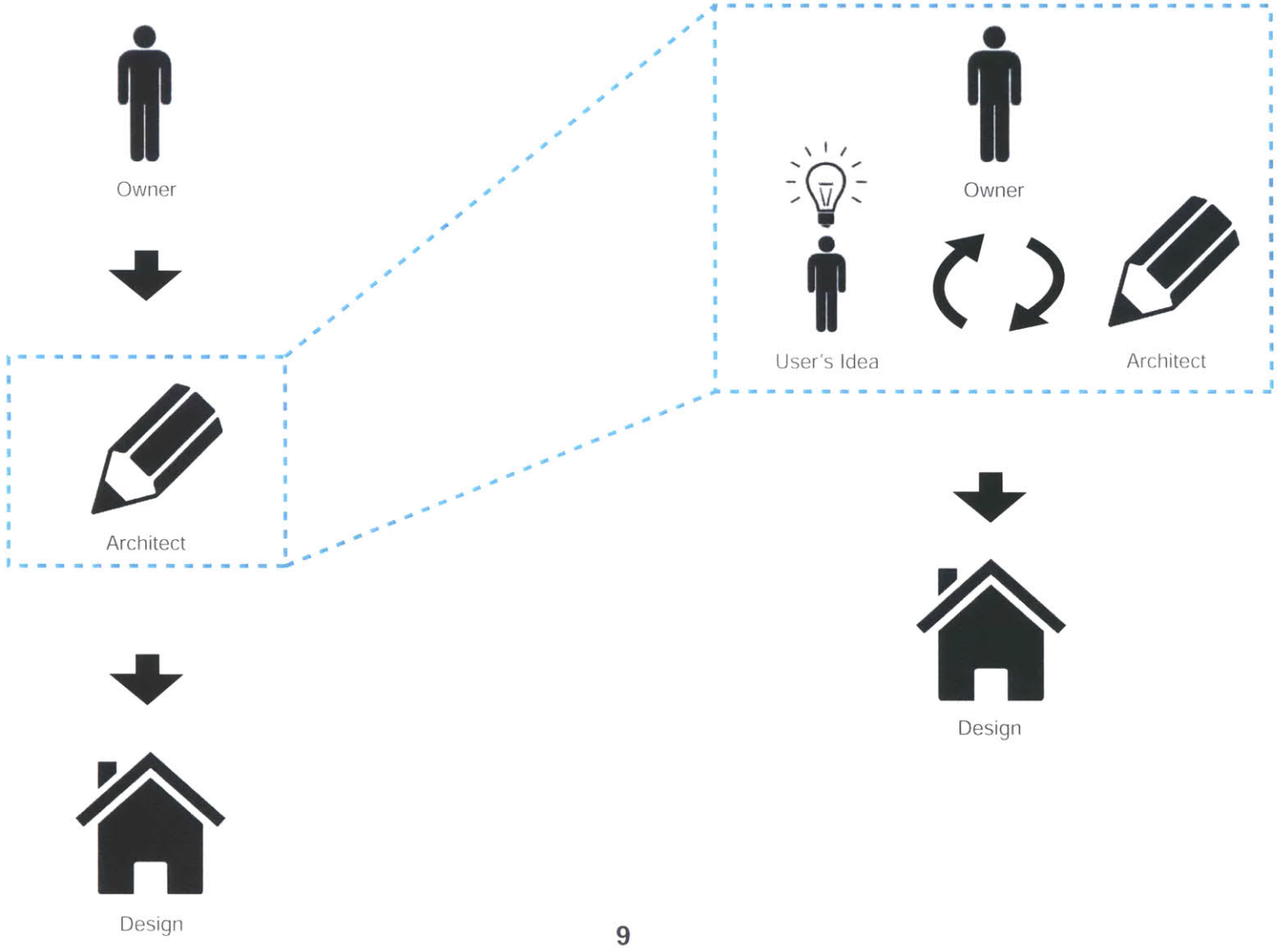
Early studies from Nicholas Negroponte

First image: Participant sketch out his version of the ideal house.
Second image: Participant created an abstracted diagram that represents the spatial relationship between programs.
Third image: Computer redrew the same diagram.
Fourth image: Computer generated plan from diagram.
Fifth image: Computer reinterpreted previous diagram and generated new diagram based on the same concept.
Sixth image: Computer regenerated new plans that share the same concept with other plans but with different configuration.



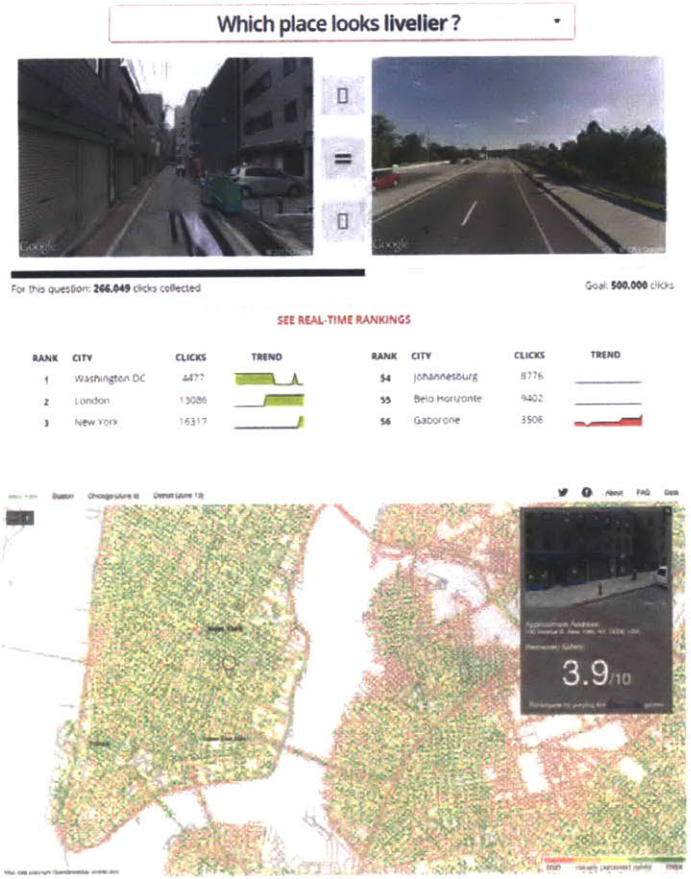
Traditional design approach

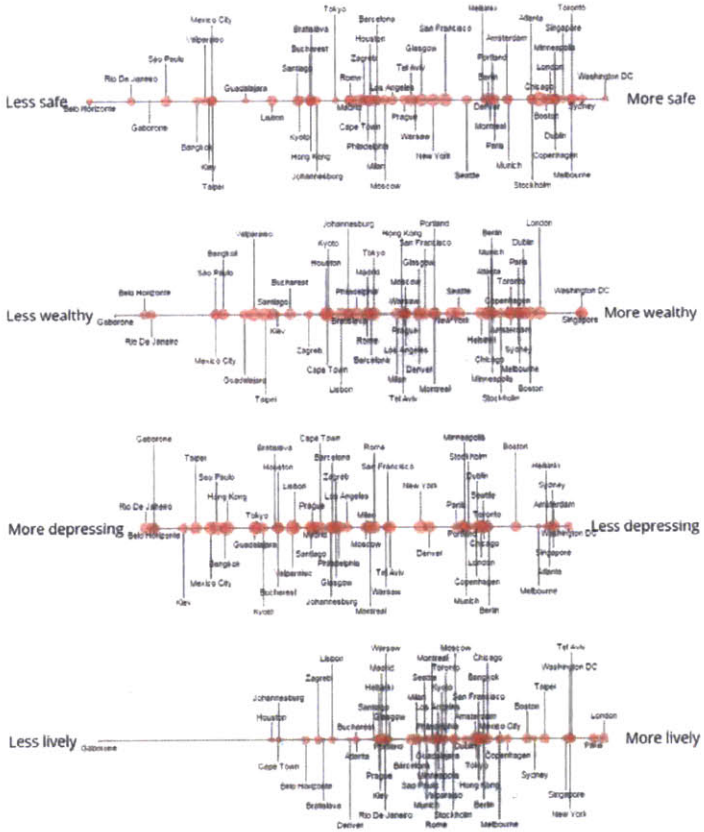
Participatory approach



Crowd-sourcing Programs

Place Pulse quantitatively measures urban perception by crowdsourcing visual surveys to users around the globe. This program asks users to compare images collected by Google from different part of the world. By letting large amount of users to evaluate which place do they like better, a collective big data pool is created to rank places based on users inputs.





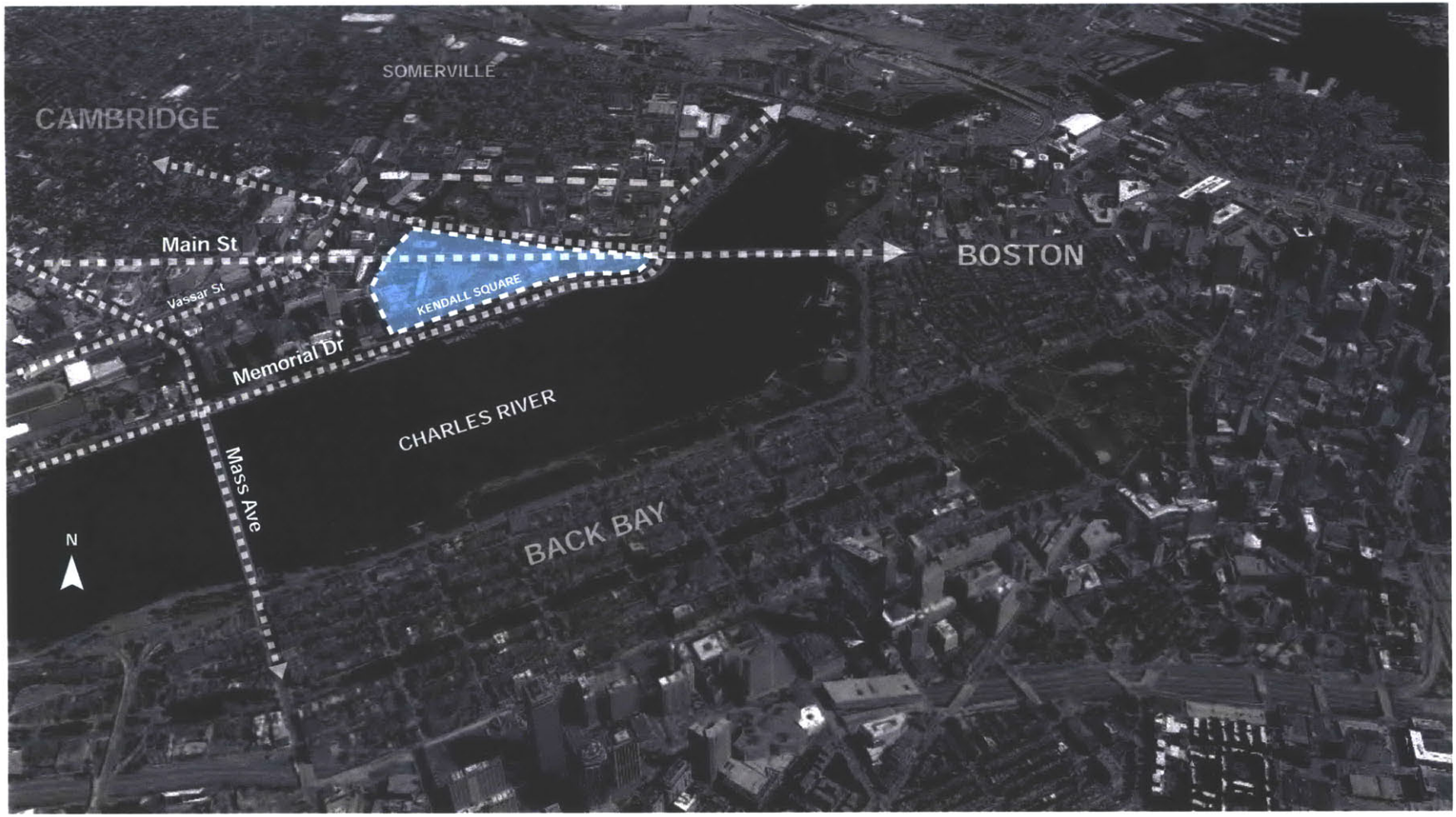
INTRODUCTION

PARTICIPATORY PLATFORM

DESIGN

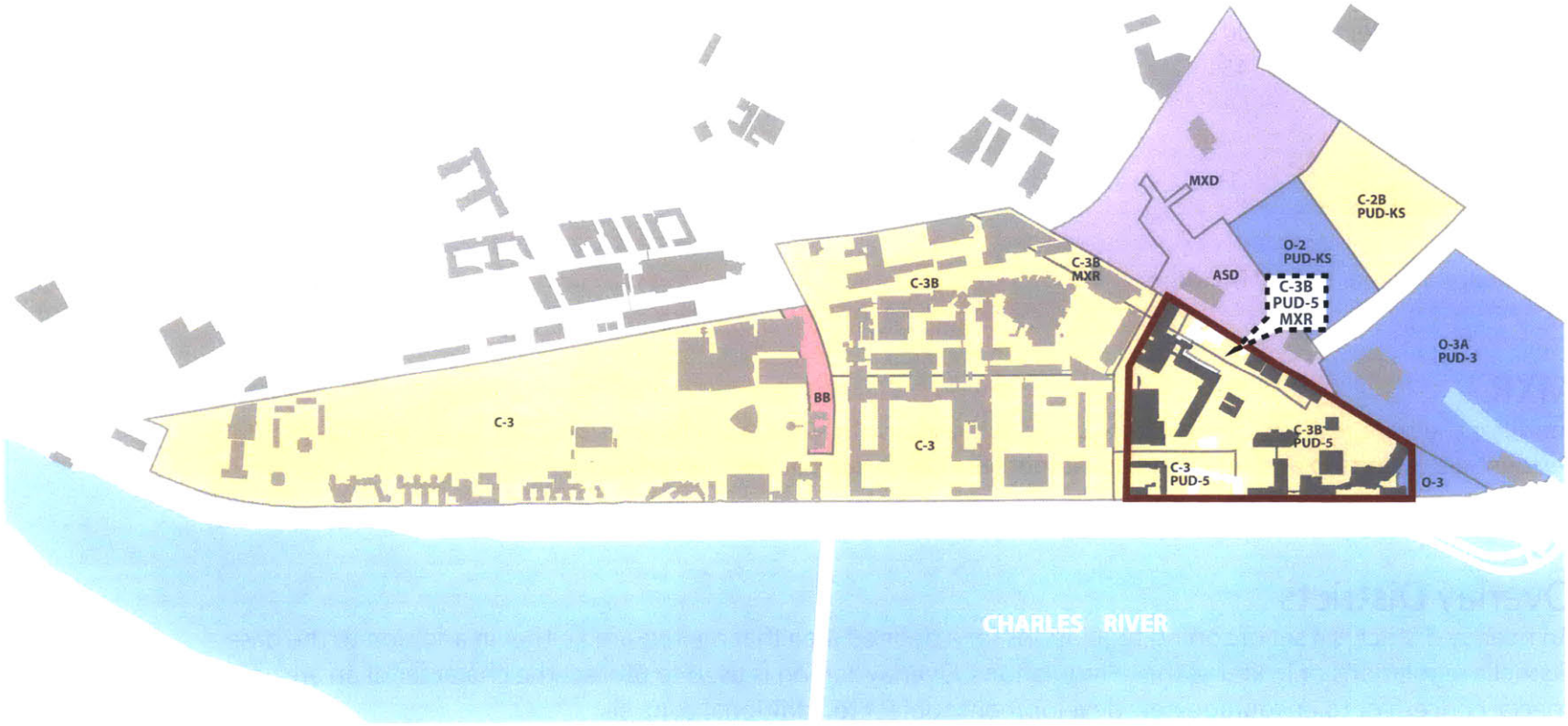
Site Location: Kendal Square

Kendal square has a unique advantage on location and demographic. Its close relation with MIT has offered the potential to become the most innovative square mile on this planet. At the same time, its location has also brought a great complexity of demand into its territory. A mixed group of student, tech-company employees, workers, and tourists presence at different time. Therefore, I choose to apply my participatory strategy to engage this highly diverse and dynamic neighborhood, in order to collect the most accurate data and significant result.



Zoning Districts

During the early stage of the project, I started to introduce various constrains to setup the computational logic. One of them is zoning regulations. The site situated on C-1 and PUD-5 zone, which development is limited by both zoning requirments.



C-3B PUD-5 MXR

C3B Residence

Multifamily
Limited Office
FAR: 3.0/4.0
Height: 120'
Minimum Area Per Units: 300 sq. ft.
Maximum units per Acre: 145

PUD-5

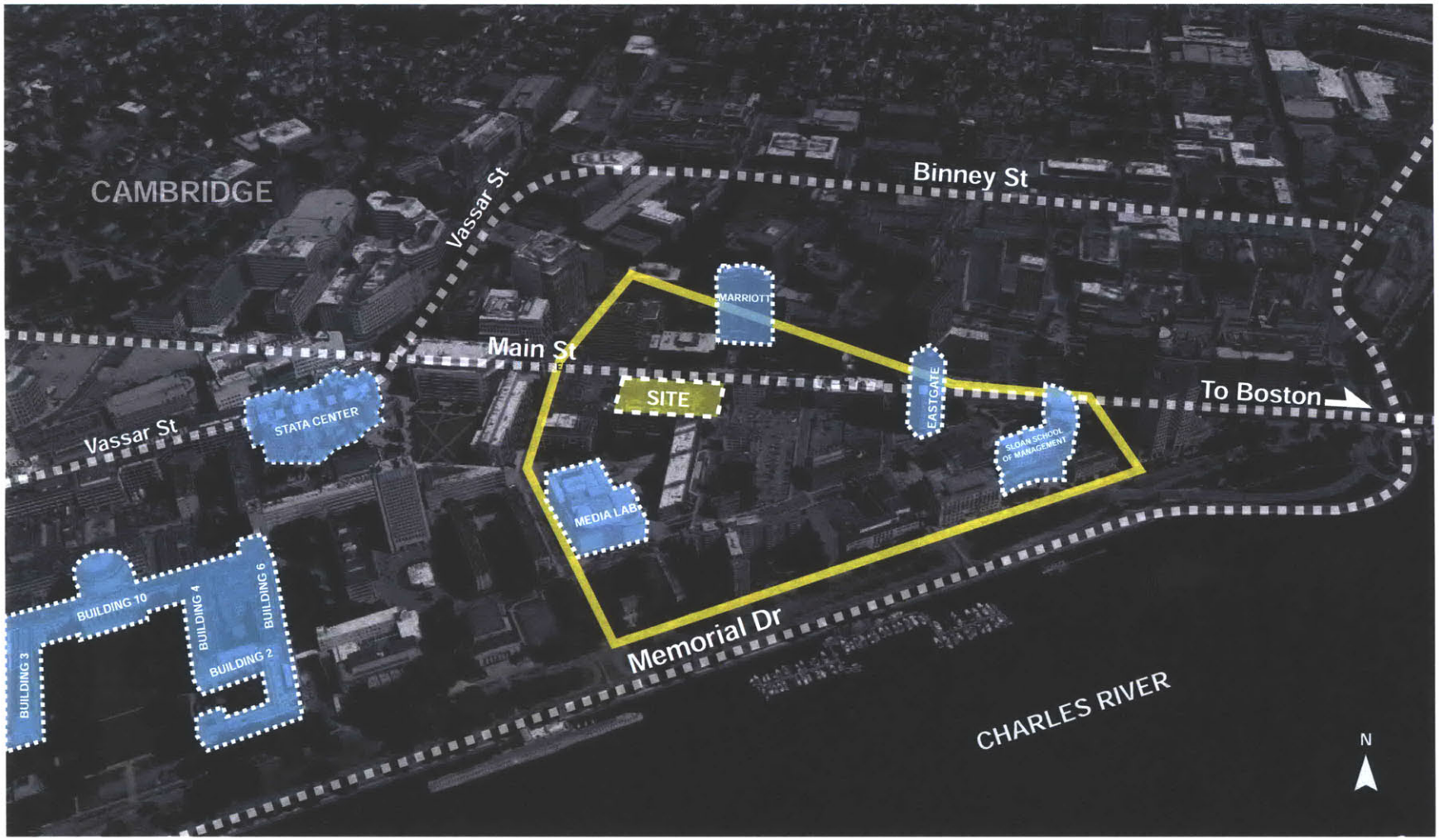
Office, Retail, Hotel
FAR: 2.0
80% builtable area, 3 story building

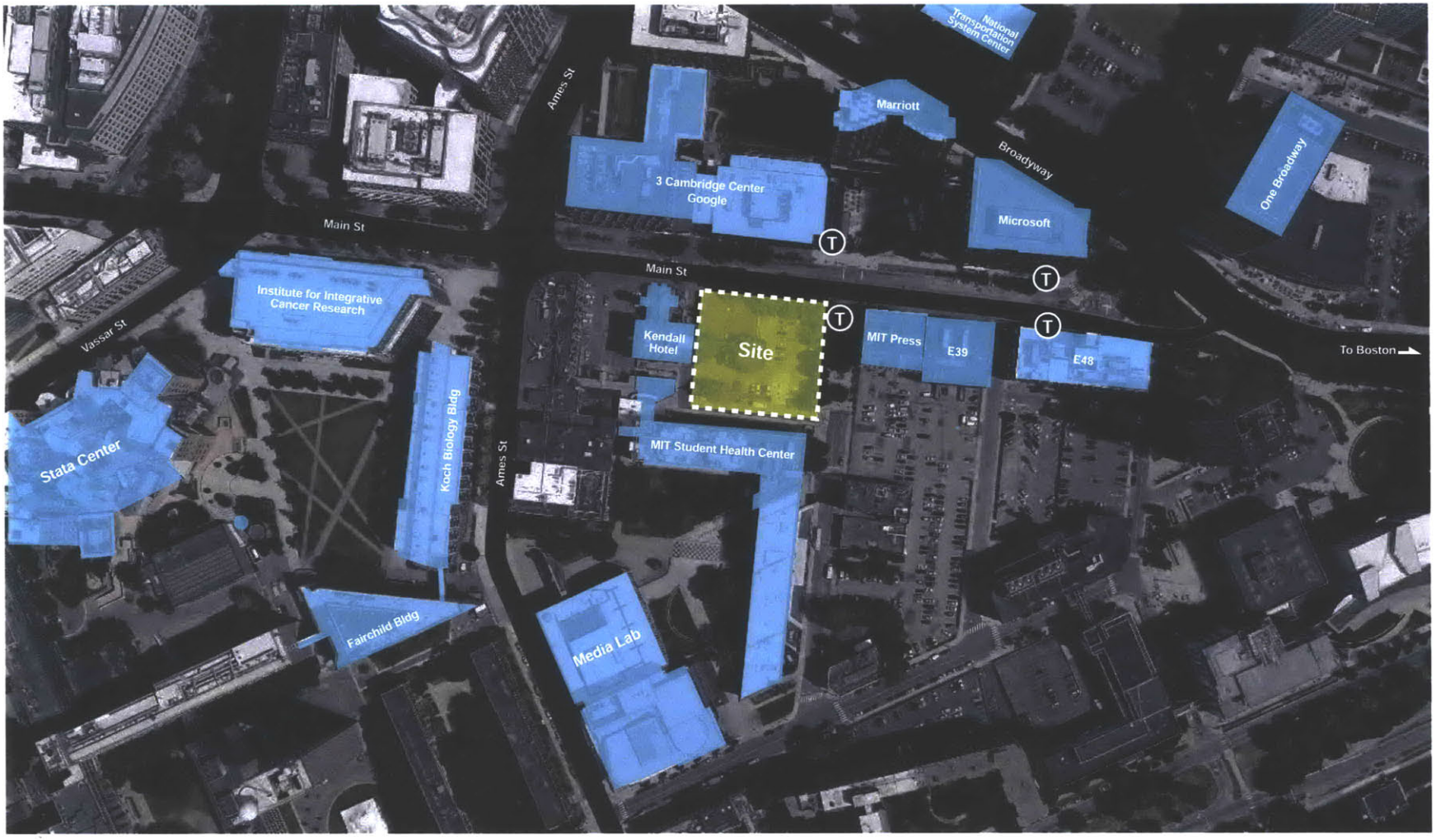
MXR

modifies the base residential district regulations in areas with substantial non-residential uses to encourage residential conversion and retail and consumer services to support residential uses.

Overlay Districts

An overlay district is a set of zoning regulations for a defined area that are required either in addition to the base district's regulations or in lieu of those regulations. Overlay zoning is used to protect the character of an area of special concern or to encourage new development subject to additional controls.


CAMBRIDGE
Vassar St
Binney St
Main St
MARRIOT
SITE
EASTGATE
To Boston
Vassar St
STATA CENTER
SLOAN SCHOOL OF MANAGEMENT
MEDIA LAB
BUILDING 10
BUILDING 4
BUILDING 6
BUILDING 3
BUILDING 2
Memorial Dr
CHARLES RIVER
N


National Transportation System Center
Ames St
Marriott
Broadyway
One Broadway
3 Cambridge Center
Google
Microsoft
Main St
Main St
Institute for Integrative Cancer Research
Vassar St
Kendall Hotel
Site
MIT Press
E39
E48
To Boston
Stata Center
Koch Biology Bldg
Ames St
MIT Student Health Center
Fairchild Bldg
Media Lab

Public Participation

This is how today's public participatory design is generated. Public expresses their opinions on sticker notes.
It brings out public interests on certain issues, but does not lead to any design or formal suggestion.

Crowd-Sourcing Process

The crowd sourcing tool consist of two parts. The first part is a spatial game that collect public's interests on building form, massing and program.

The second part is a image comparison platform that collect public aesthetic. User can choose between different style of the same building elements to vote on their favorite aesthetic styles. Then, architects can use these crowd-sourced results as a reference to make a design that in theory could satisfy the most users.

Spatial game

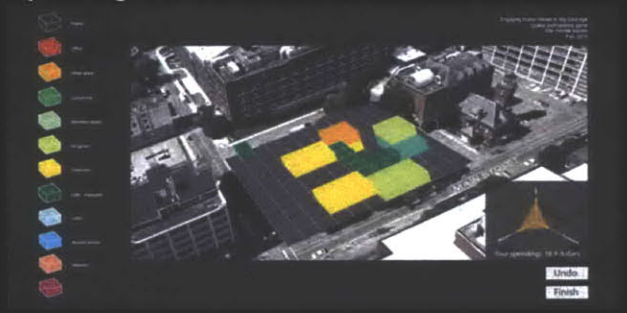


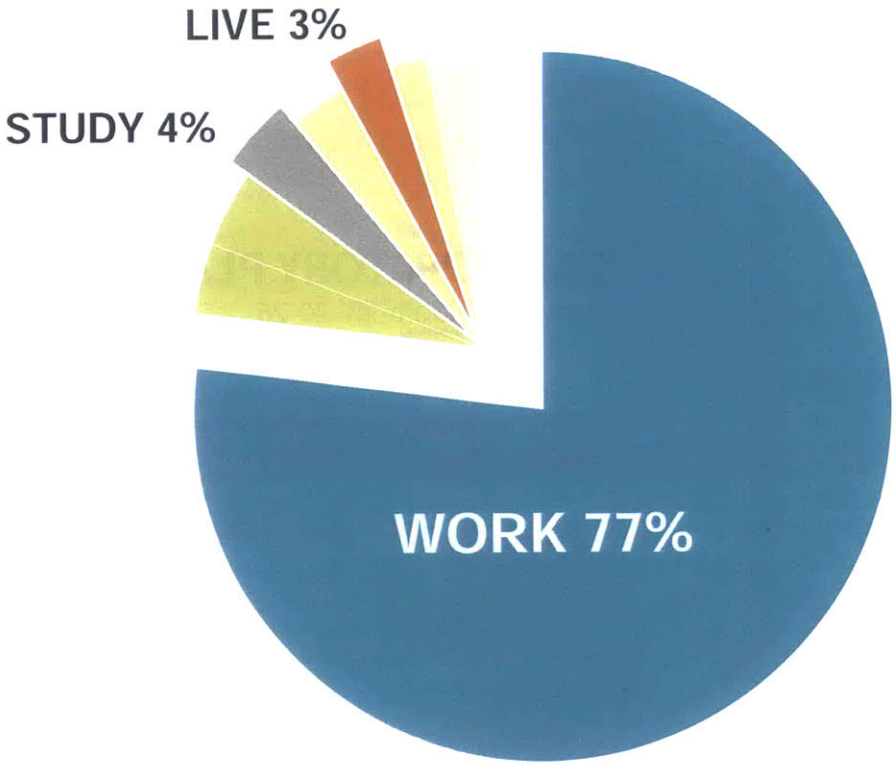
Image comparison platform

Massing preference

Aesthetic preference

Architect

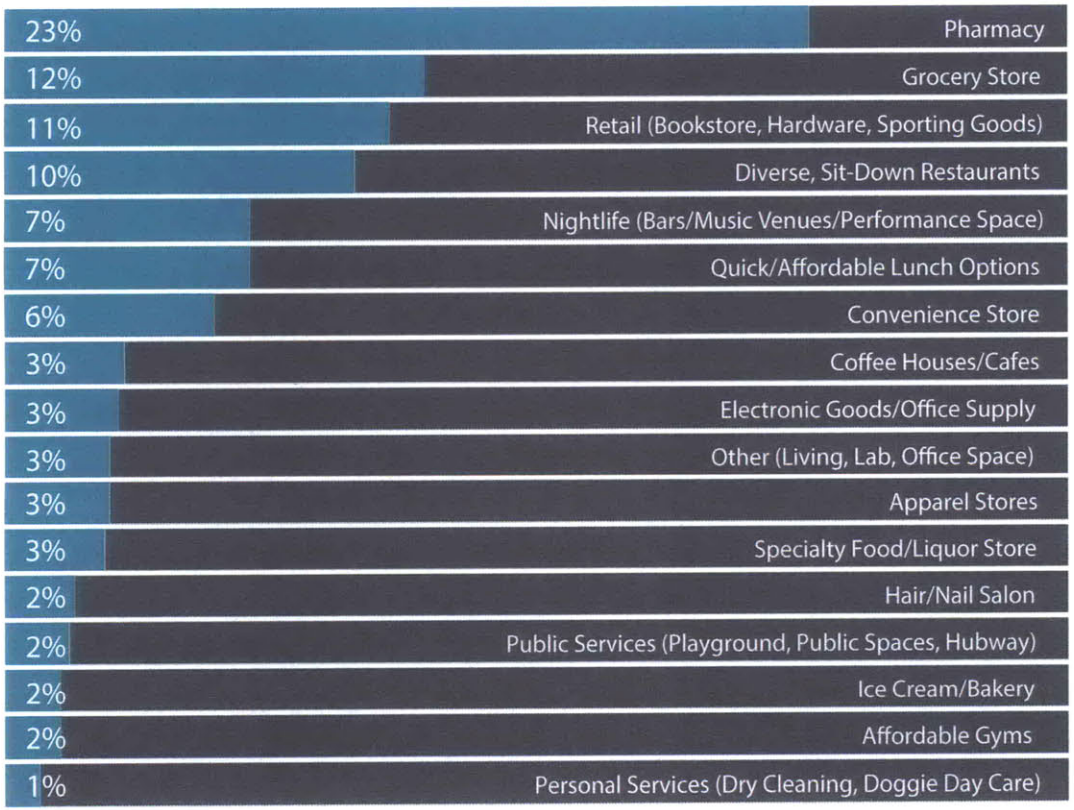
Final Design



Retail Demand Projection

At present, there is about 100,000 square feet of retail in Kendall Square. Among the existing retail establishments in the Square, bookstores, coffee shops, farmers markets, and food trucks were rated as highly desirable by the community, according to the Customer Intercept Survey done by the Community Development Department in 2011. "work" was the primary purpose for respondents being in Kendall Square. This indicates that the area has a larger daytime population and a relatively smaller nighttime population.

List of Desired Businesses in Kendall Square



A survey has been conducted by the Kendall Square Initiative. This survey summarized a ranking for desired programs in Kendal Square area.

A drugstore was the most desired retail according to the Customer Intercept Survey. The large daytime population of the area would supply the number of customers needed to support such a business.

The second most-desired retail was a grocery store, which is a key amenity to create a more complete neighborhood. There is insufficient demand for a traditional supermarket due to the presence of competitors nearby.

Program Development

During the gaming process, users will be asked to input their desired program, together with the pre-determined traditional museum programs, The final program list is confirmed.

Traditional museum

Exhibition space

Art gallery

Lecture room

Classroom

Cafe / restaurant

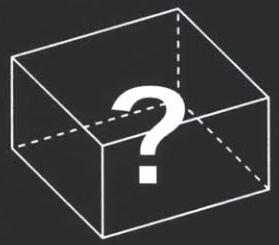
Lobby

Restroom

Landscape

+

User's choice



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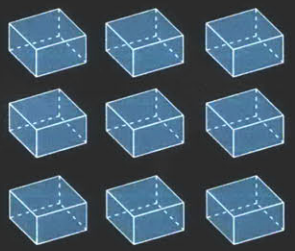
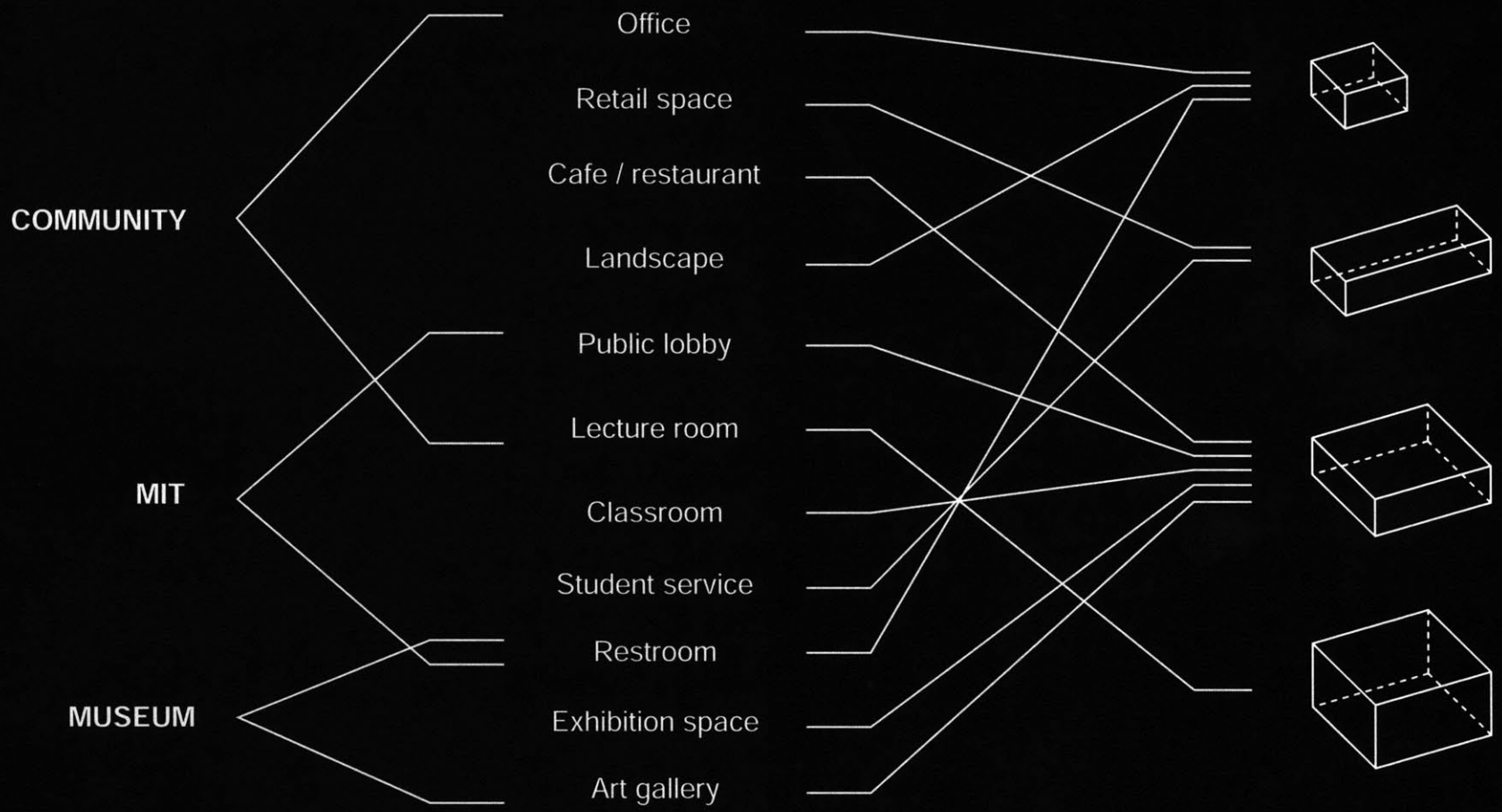
Final program list



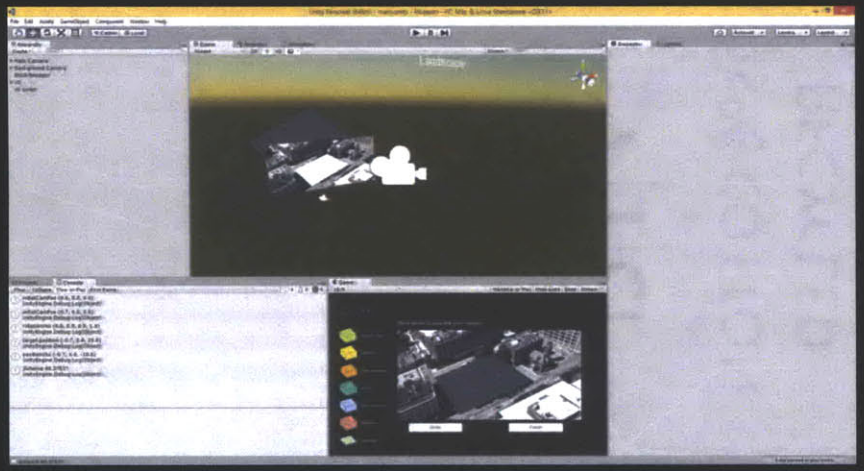
Program Development

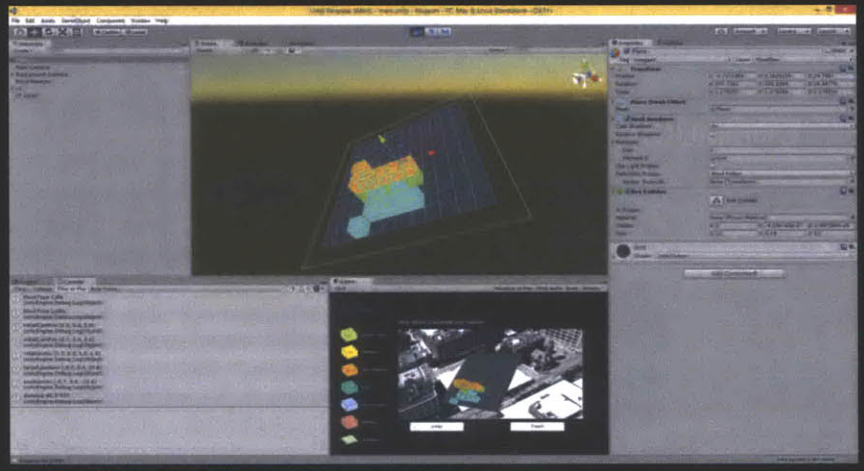
To further define the constrains of the game,
each program block is categorized into different groups based on their size and functions.



Game Development

The game was developed on Unity Game Engine.





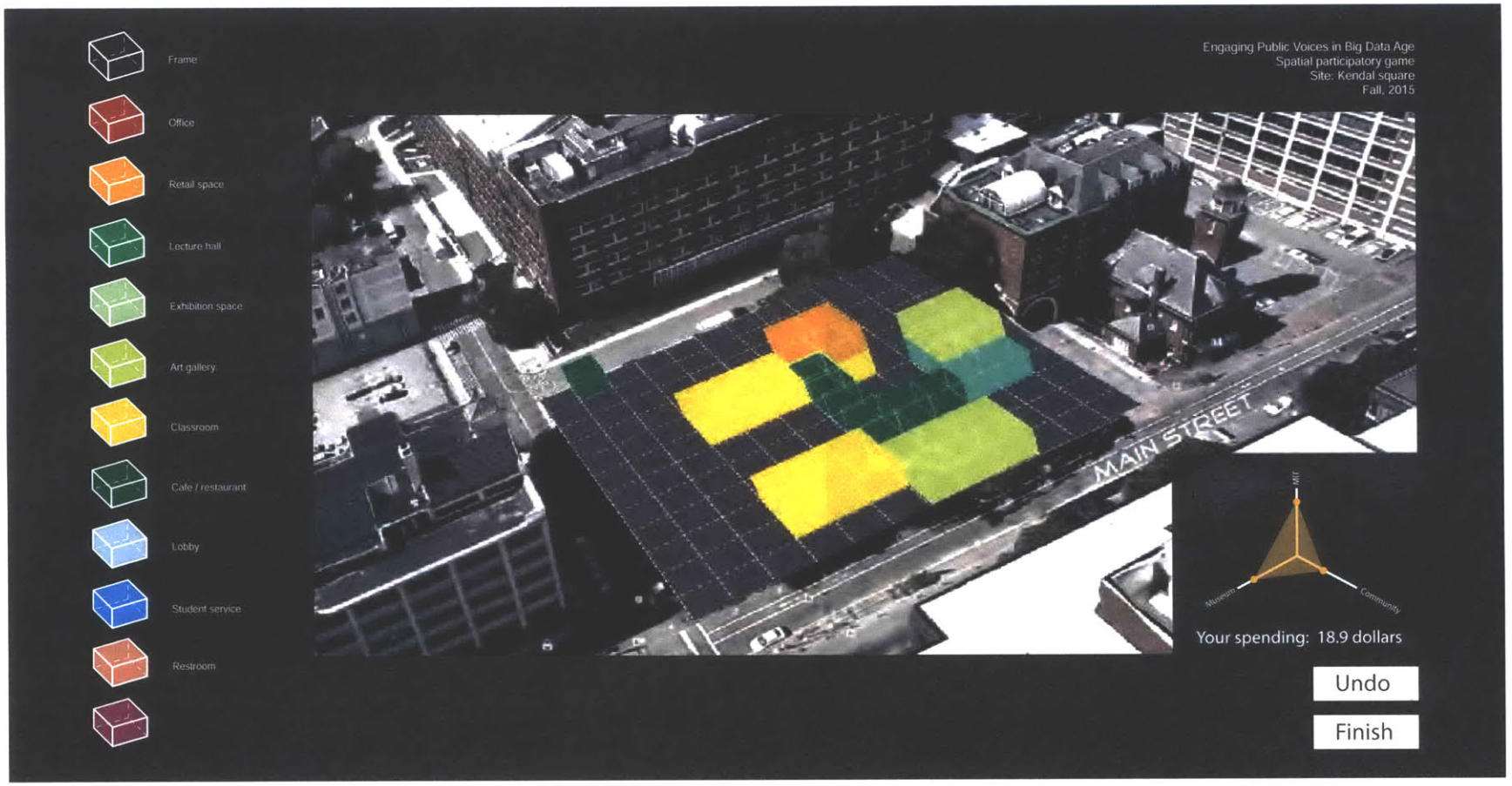
Gaming Interface

User can drag blocks into the center of place them based on their preference. Each program is color coded and comes in different modular sizes.

This responsive program also communicates with user by displaying a interactive diagram at the lower right corner. This diagram informs each user the trade offs and impacts to the surrounding environment and budget of their proposal.

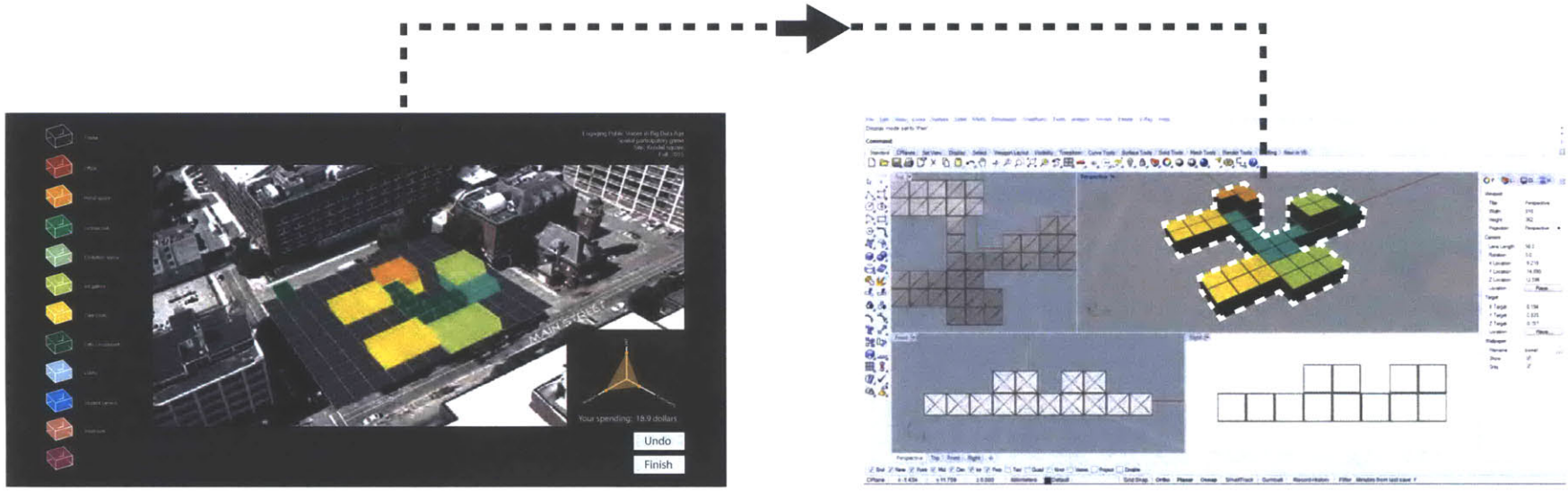
The game also follows zoning regulations by taking total Gross Floor Area and height into consideration.

The game can generates infinite amount of massing solutions.

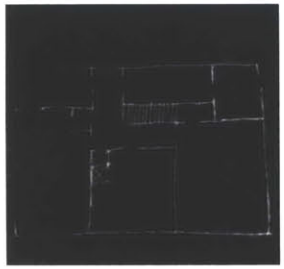


Model Export

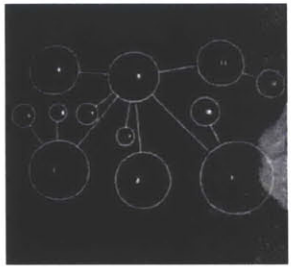
User result will be automaticlly recorded and exported as OBJ massing files.
So they can be used for later analysis.



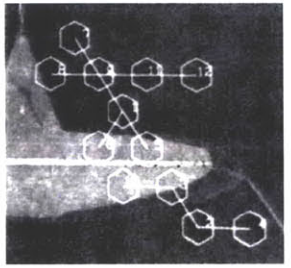
User's input



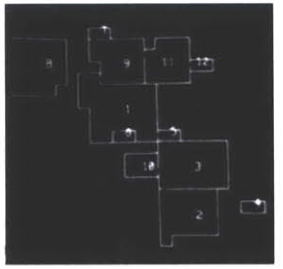
Diagrammatic analysis



1st
Reorganization

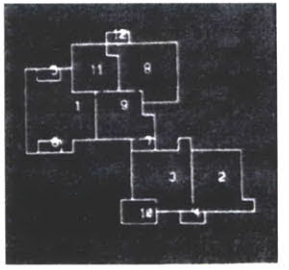


1st
Regeneration



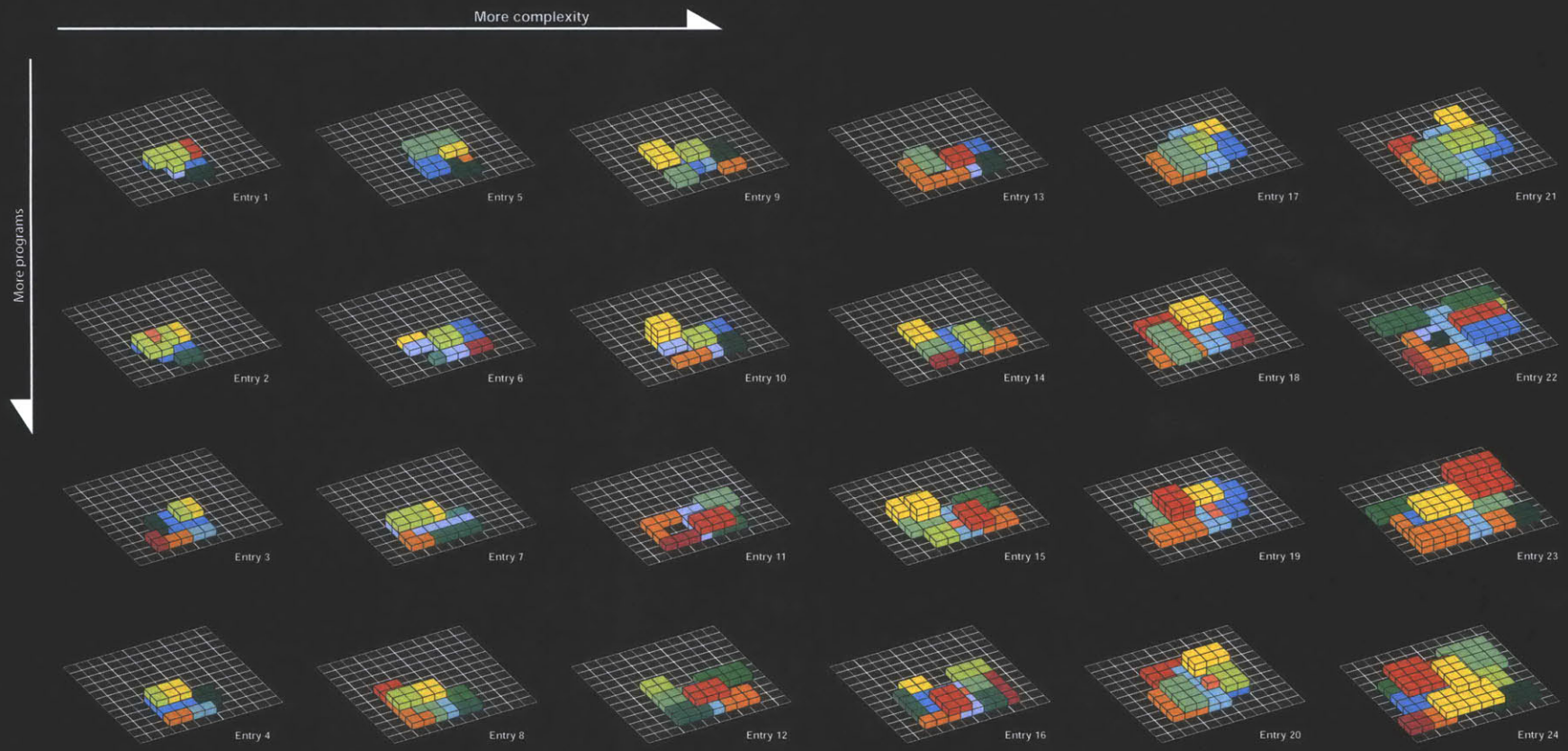
2nd
Reorganization

2nd
Regeneration



Prototyping Results

After recoeding result for all 24 participants, their massing models are ranked based on size and complecity.

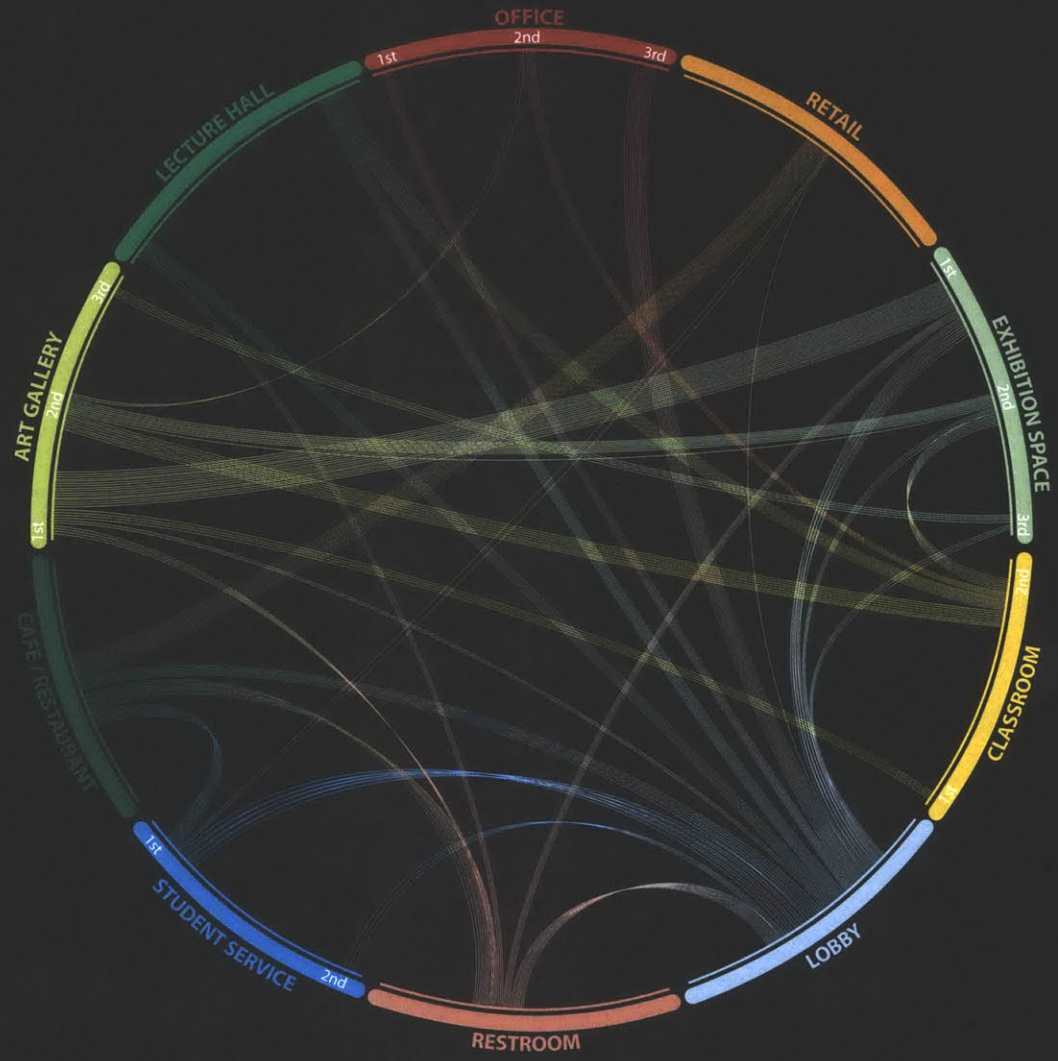


Program Distribution

A more thorough analysis is then conducted by disassembling each block and place them back to the coordinance.
This way, we can clearly observe the size and spatial location each participants has determined for each program.

Programmatic Adjacency Diagram

The spatial adjacency is the most important factor that will affect the final massing solution.
By connecting progams that participants has choosen to place next to each other. It provides a clear visual reference of public preference on where and how they want each program is used.



Optimized Massing Solution

This optimized massing model is calculated from the submitted results of all 24 participants.
The model is created based on:

1. Where did they place in term of its spatial location, including floor numbers?
2. What program did they place next to?
3. How many blocks did they place?

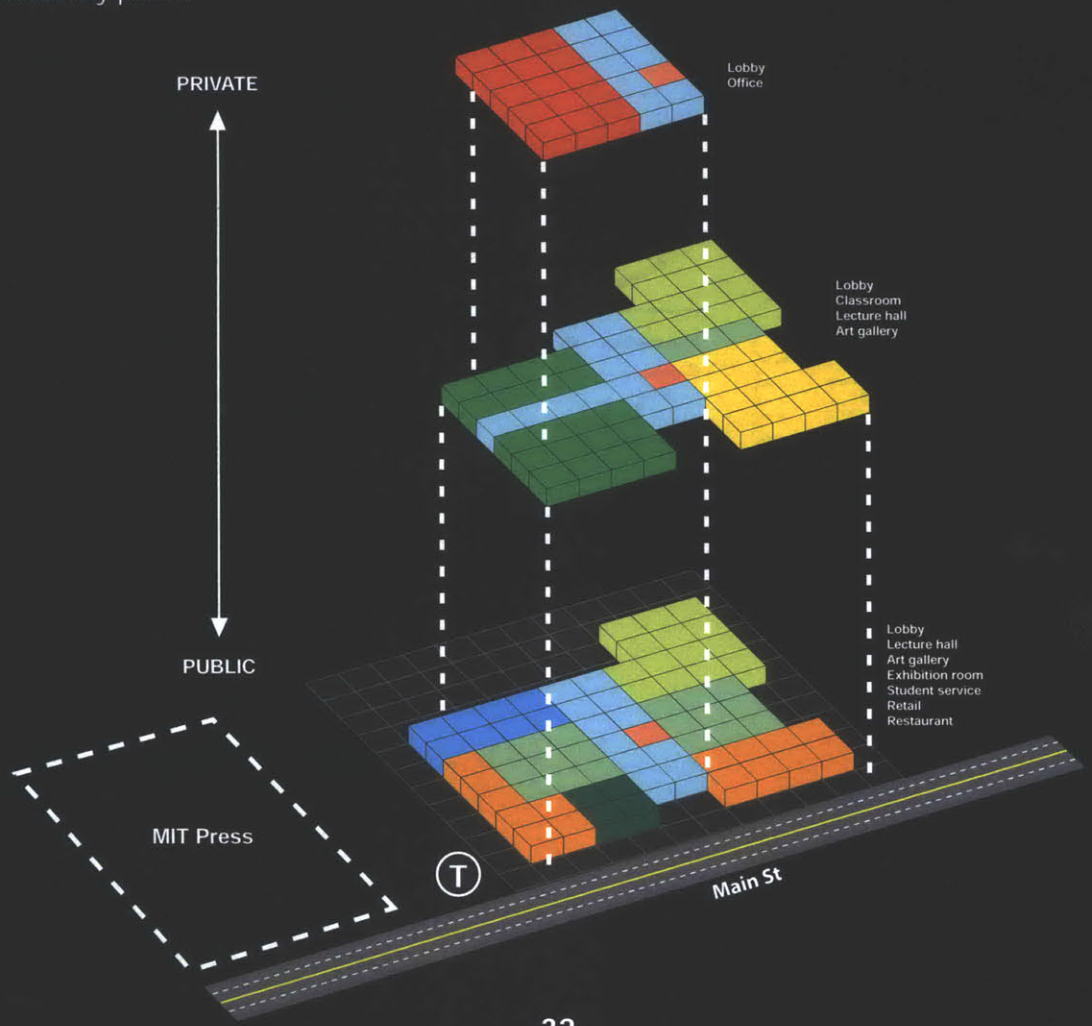
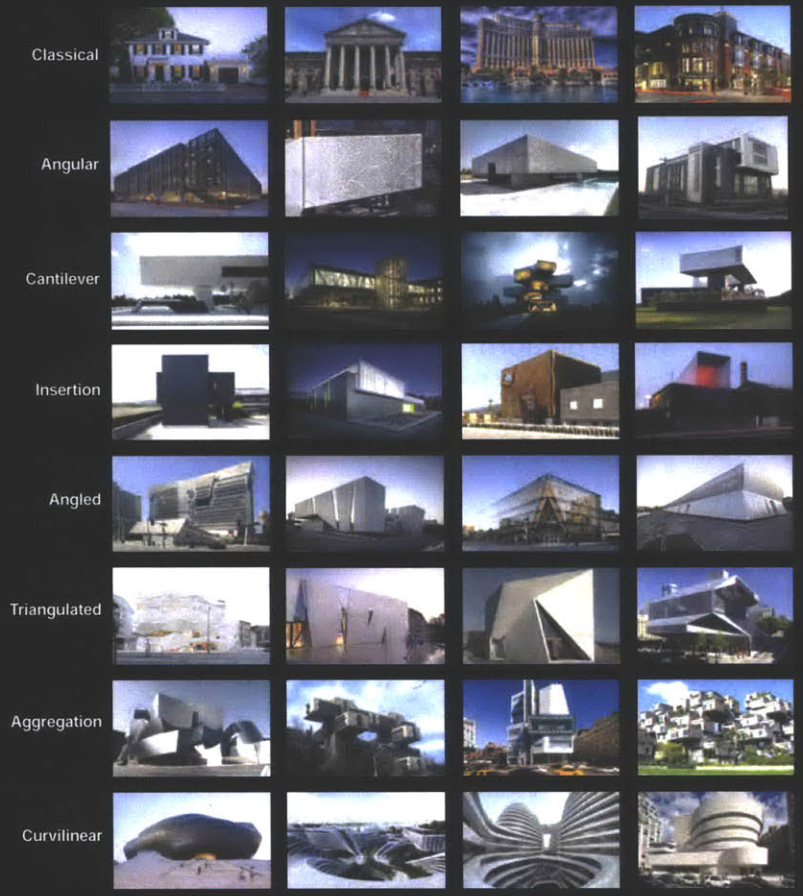


Image Comparison Platform

The image pool has been separated into two categories:
1. Images that emphasize on architectural form
2. Images that emphasize on architectural facade material

Each category is then separated into 8 sub-groups based on the style of Form and style of Material.

Architecture form:



Facade material:

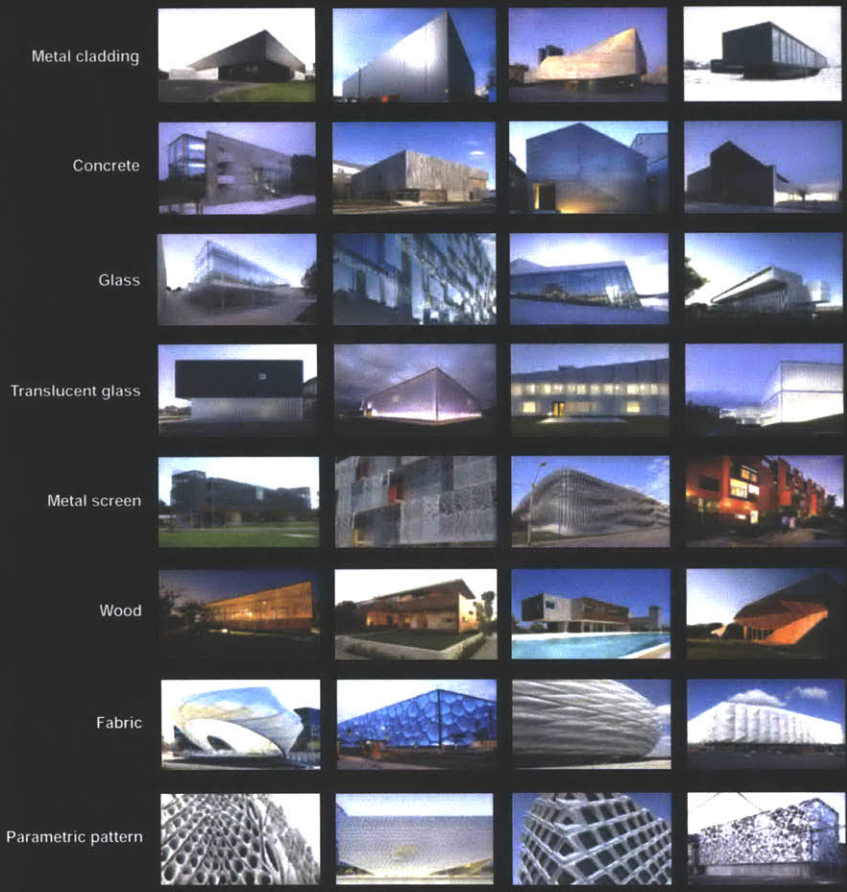


Image Comparison Platform

The first set of questions ask user to vote on their favorite building materials.
Each image is chosen from a different sub-group, so users than evaluate and pick a winner.

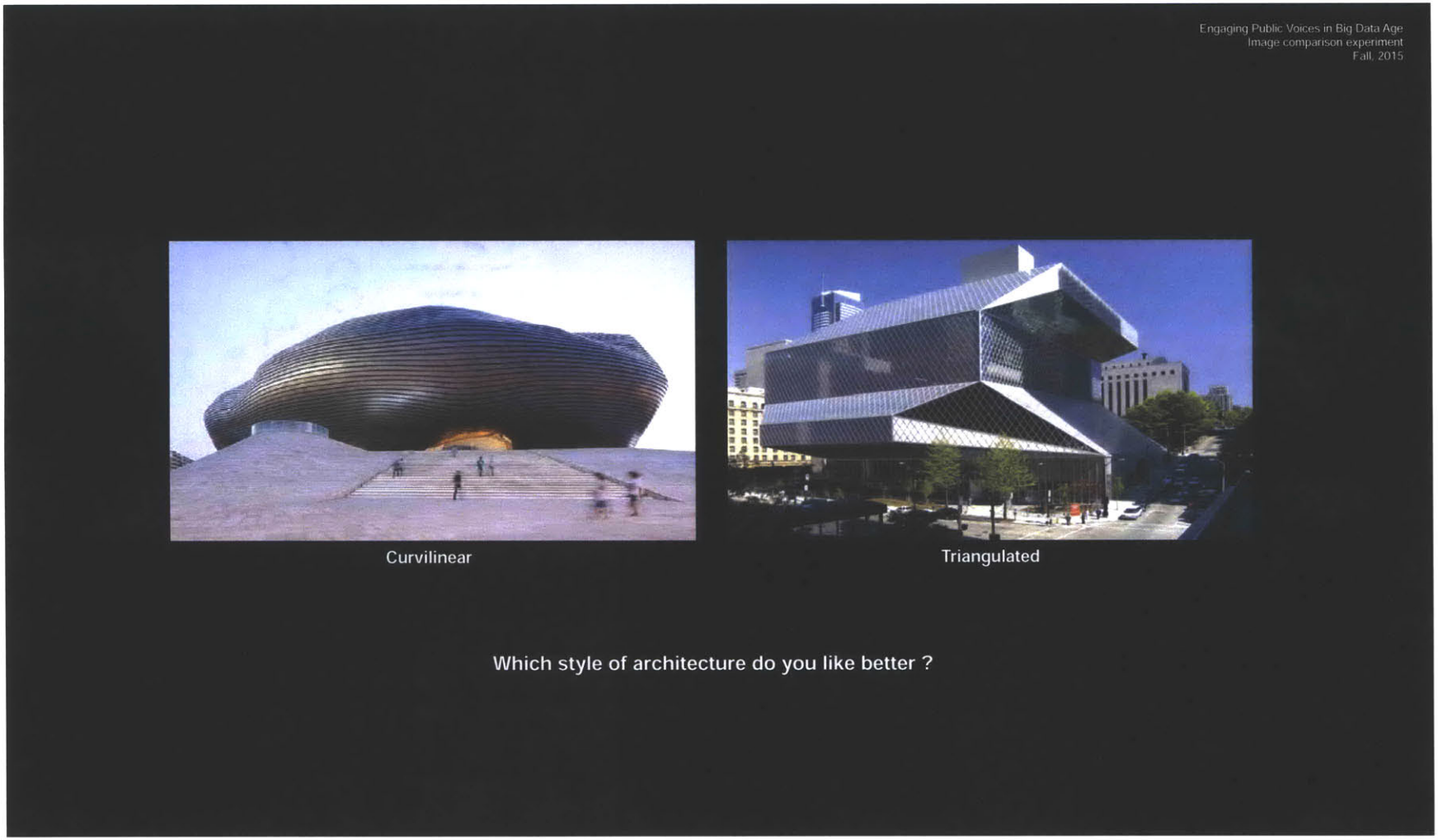


Image Comparison Platform

The Second set of questions ask user to vote on their favorite architectural massing form / style.
Each image is chosen from a different sub-group, so users than evaluate and pick a winner.

Image Comparison Result

The number of votes received by participants are listed below.

Architecture form:

Classical	11	14	13	11
Cube	29	28	36	32
Cantilever	29	32	31	28
Insertion	27	26	23	25
Angular	29	32	22	25
Triangulated	27	15	30	31
Aggregation	24	19	33	30
Curvilinear	27	17	24	20

Facade material:

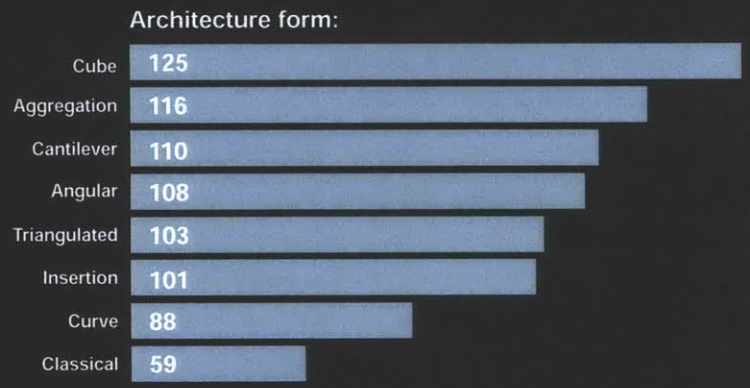
Metal cladding	23	28	37	10
Concrete	33	23	31	34
Glass	34	14	18	07
Translucent glass	35	29	30	42
Metal screen	25	34	29	23
Wood	22	14	26	20
Fabric	28	25	22	20
Parametric pattern	23	25	18	15

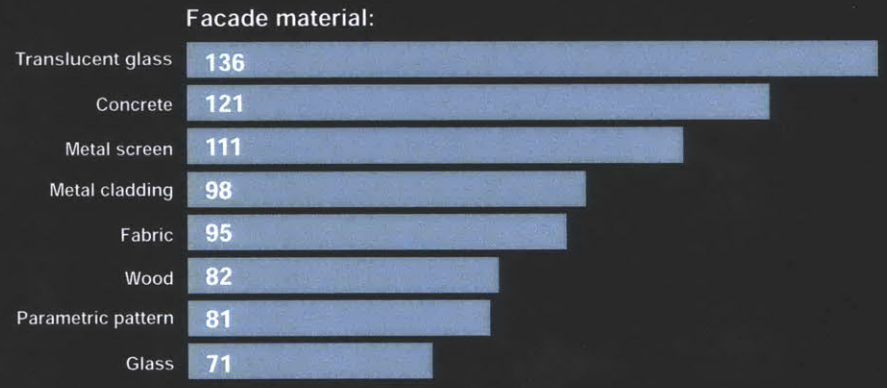
Image Comparison Result

Data are reorganized in bar diagram.

The top two ranked building forms are:
1. Cube
2. Aggregation

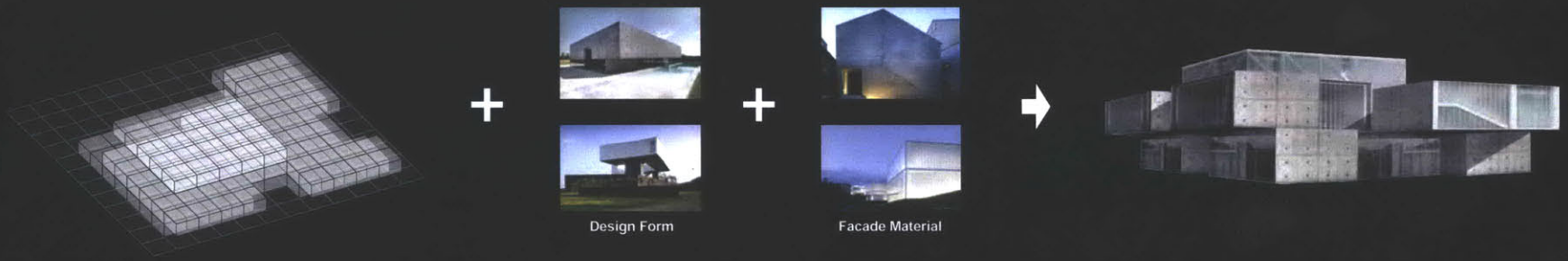
The top two favorite facade materials are:
1. Translucent glass
2. Concrete



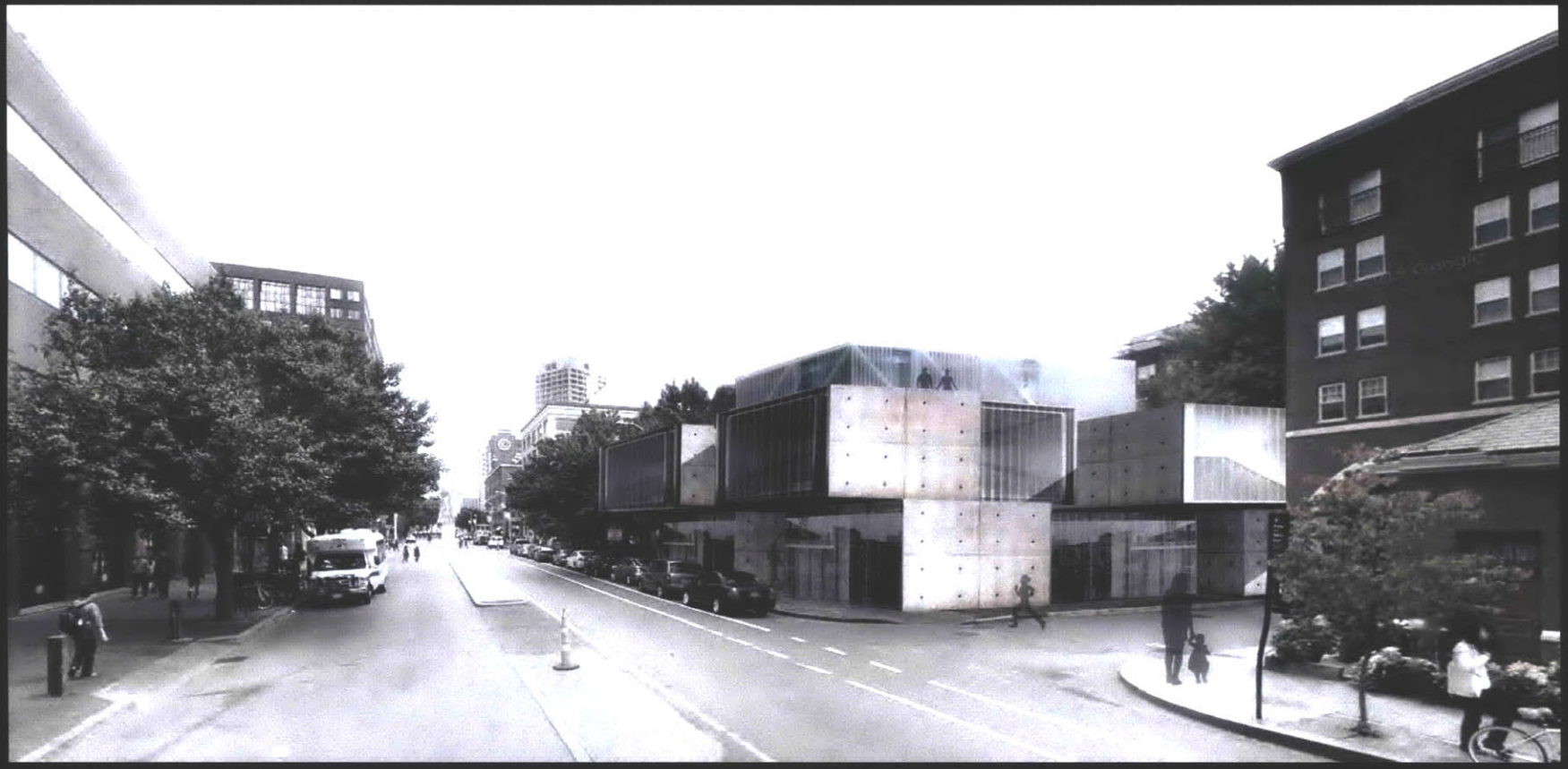


Design Realization Process

With the massing and material preferences crowd-sourced from participants, architect can then take these data as a reference to generate design that can in theory be the most attractive design for this group of participants.

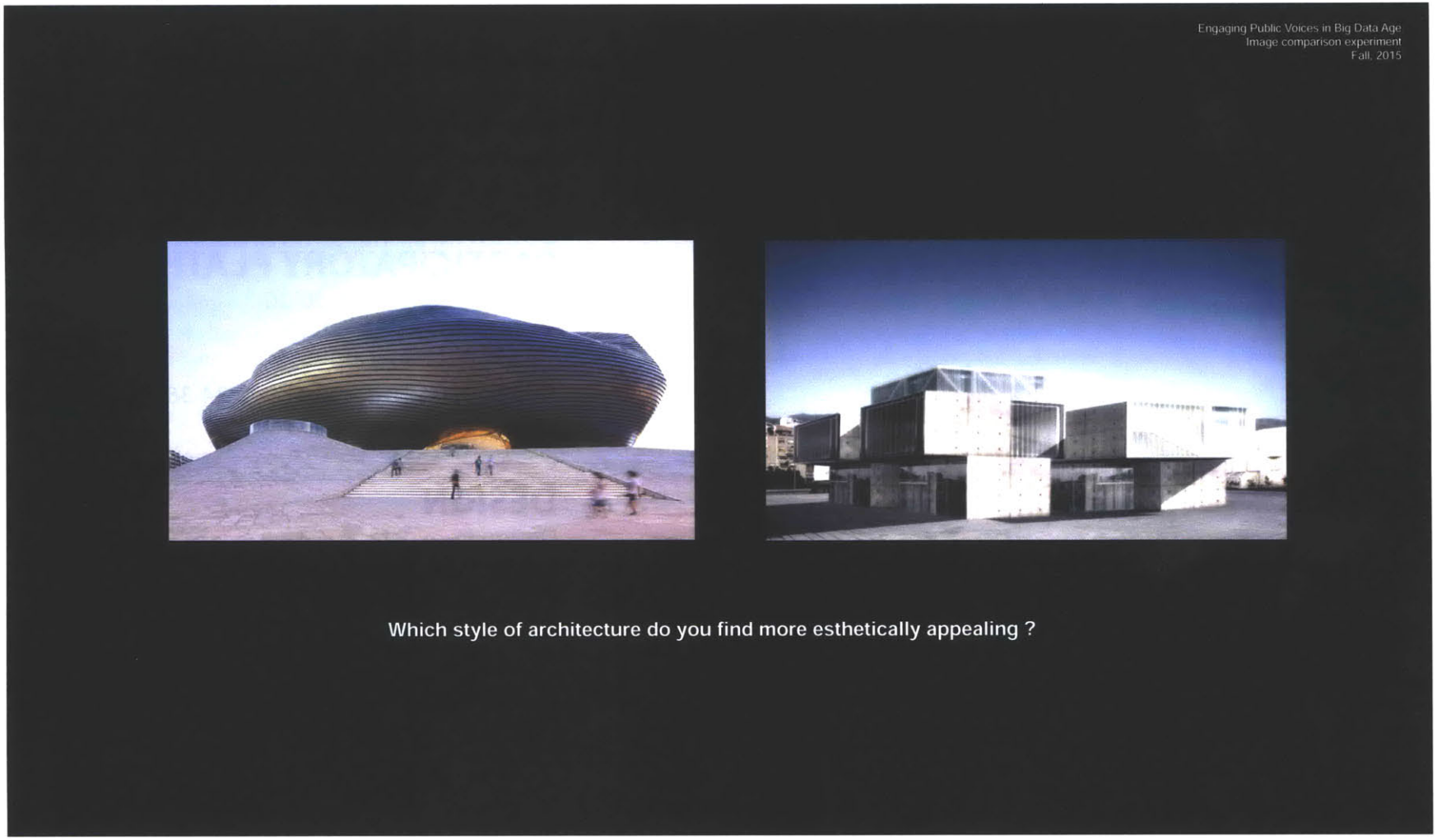


Final Rendering



Data Validation

In order to approve and self evaluate the effectiveness of the platform. A data validation procedure was required to find out whether the final design respond to user's desire.
The final design was taken back to the platform for user reevaluation against other images that users has encountered in previous experiment.



Data Validation

Users are asked to compare 8 groups of images, each with a different style of building form and facade material.

Group 1

Group 2

Group 3

Group 4

Group 5

Group 6

Group 7

Group 8

Data Validation

The voting result validates the final design.
The crowd-soured design won 6 of 8 comparison groups.

Group 1

Group 2

Group 3

Group 4

Group 5

Group 6

Group 7

Group 8

Data Validation

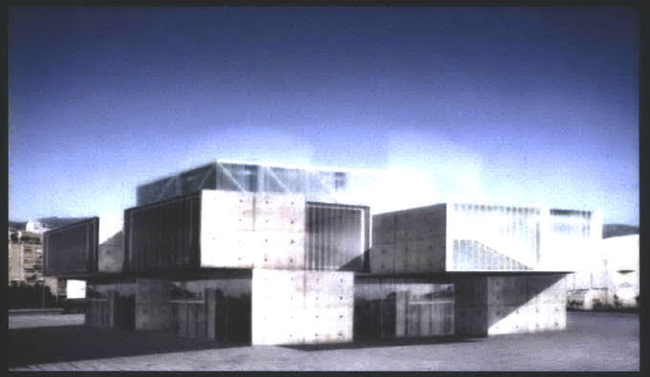
A second reevaluation was designed to validate data result in a more critical approach:
To use the lower ranked facade materials to replace the top ranked materials to generate a second design for comparison. In theory, the first design should still get more vote.

Comparison Rendering

The second rendering applied lower ranked facade materials:
Metal cladding / Metal screen
in stead of Concrete / Translucent glass

Comparison Test

Engaging Public Voices in Big Data Age
Image comparison experiment
Fall, 2015



Which facade material do you like better ?

Data Validation

But the second validation test brought us a suprising result.
The top ranked material loss the comparison test. In stead, the new design with lower ranked material won the most vote.

Testing Failure

Do public have self-consciousness when it comes to aesthetic
Do public know what they really like?

The experiment was setup to compare images with isolated aesthetic properties. User were asked to compare only one element of building at a time. But during that process, some might be distracted by other details in the image, like the building context, color of the sky or even the resolution of image. These factors caused inconsistency in data result. Not even mentioning participant's personal instability factors, like weather, emotion or health condition might have affected their ability to make a consistent judgment. In order to eliminate these distractions, we need more thorough studies of how to extract public aesthetic. Most users can not name their favorite architecture before they begin the experiment. But during the image comparison test, everyone was able to give an answer within a relative short time. The experiment setup helped user to organize their internal aesthetic logic, so they were able to make a final judgment. The revaluation of the platform proved the system functions as it was intended for the most part. But the inconsistent final result also exposed the weakness of the system.

Perhaps the solutions lies in a more sophisticated technology that can interact with users to extract more accurate data. Imagine in the near future, the experiment will take place in ideal virtual environment where distraction is limited to minimum. Users can wear VR goggle to explore their preference in a fully immersed virtual architectural environment. Then, they would be able to make a much more accurate decision. Such technological intervention should be able to help architects finding out the true desire of public, to extract preferences that public don't even realize they have.

Today, we are one step closer to this goal. This project revolutionized participatory approach by crowdsourcing mass data and transform them into a tangible design, at the same time, raised new challenges to enhance data accuracy through educating public. Testing failure has a irreplaceable role in this process of discovering new frontier, and it is our new role as an architect, to be responsible and in charge of generating a more democratic and educating design process.