

Towards Generative and Evaluative Feedback in Urban Planning

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Automating
Development | 3.
Automating
Evaluation | 4.
Automating
Feedback |
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<i>Example: Point
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IDEATION

EXPLORATION





IDEATION

EXPLORATION

- develop
- evaluate
- feedback





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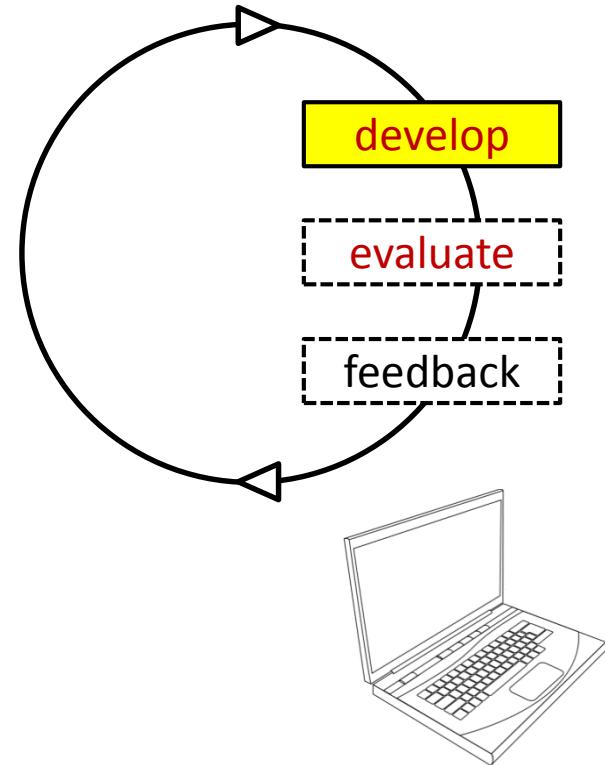
12.

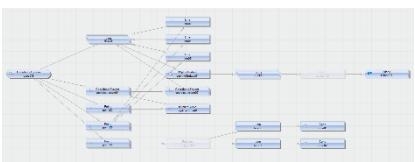
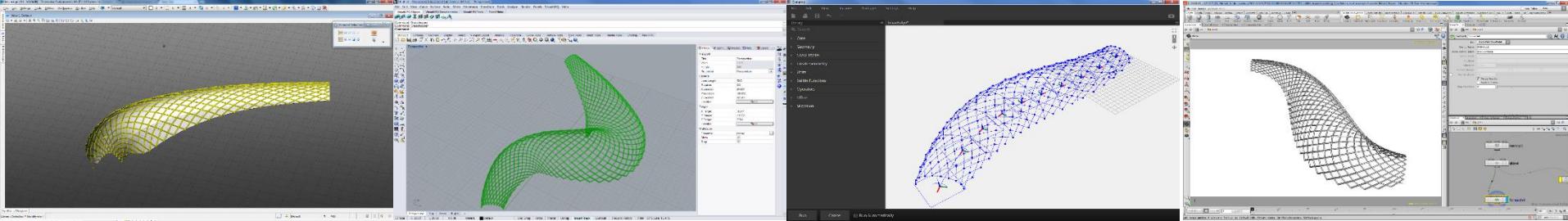
Future
Directions

Exploration

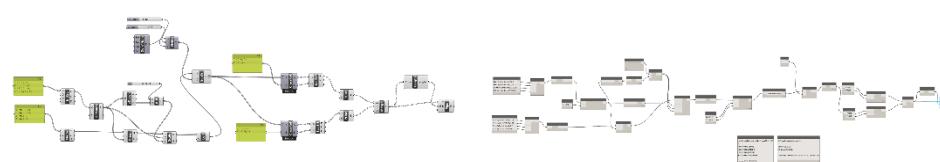
Formal questions:

- Develop complex configurations and structures
- Many parametric modelling tools exist
 - GenerativeComponents
 - Grasshopper
 - Dynamo
 - Houdini

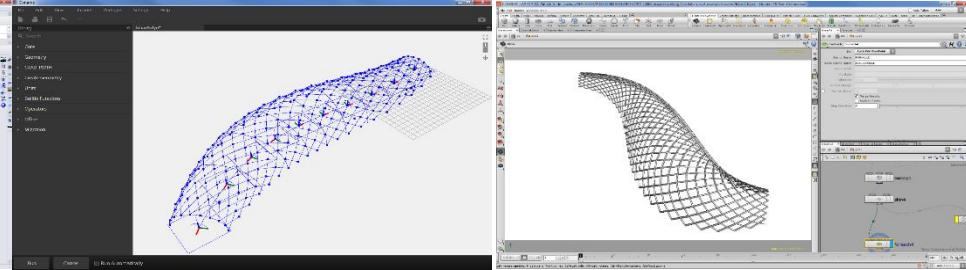




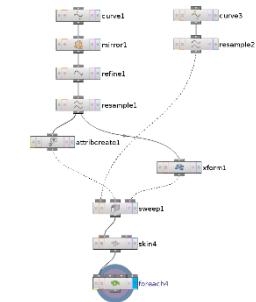
Generative
Components



Grasshopper



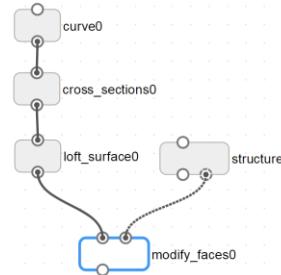
Dynamo



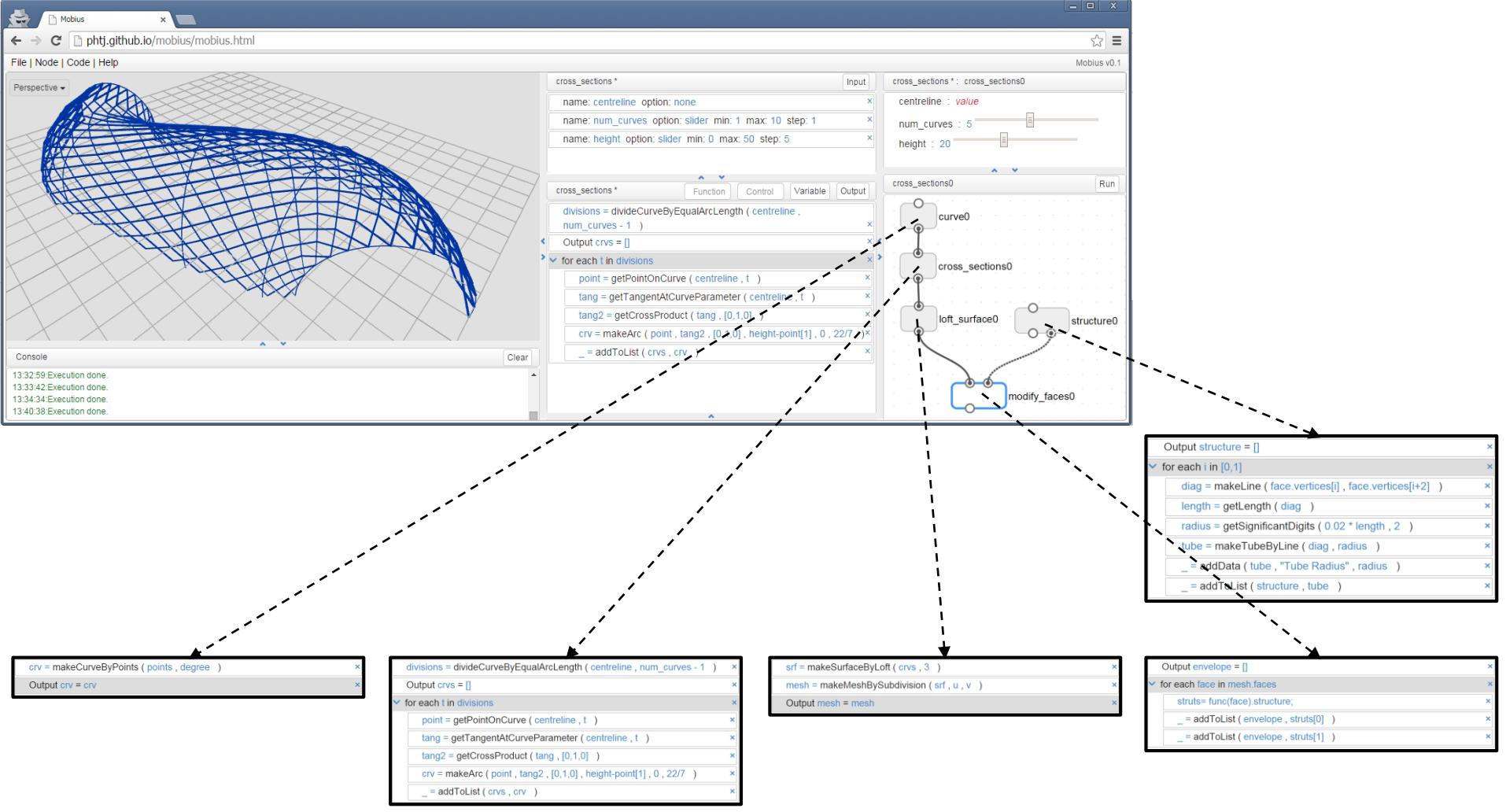
Houdini

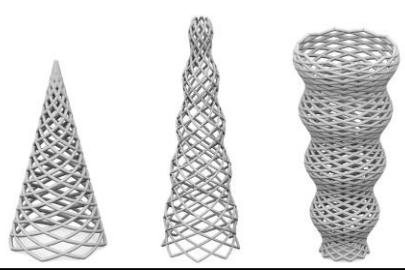
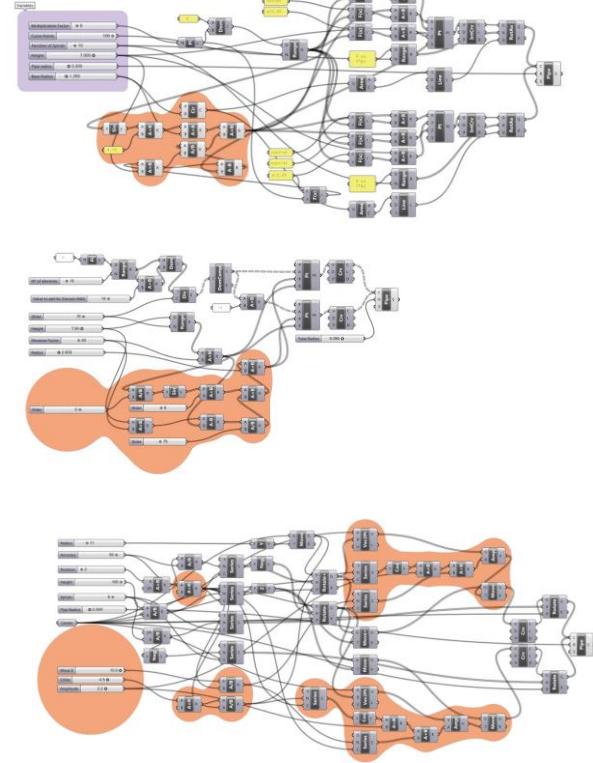
Ongoing Research

- Möbius
- A research project to develop a procedural modelling tool in the browser
- Capable of tackling greater complexity

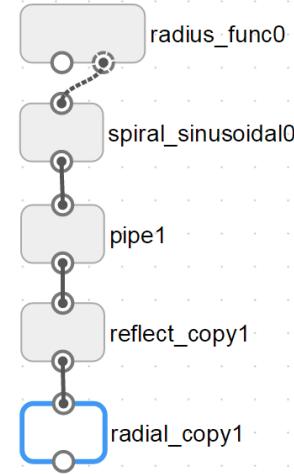


```
cross_sections * Function Control Variable Output
divisions = divideCurveByEqualArcLength ( centreline , num_curves - 1 )
Output crvs = []
for each t in divisions
    point = getPointOnCurve ( centreline , t )
    tang = getTangentAtCurveParameter ( centreline , t )
    tang2 = getCrossProduct ( tang , [0,1,0] )
    crv = makeArc ( point , tang2 , [0,1,0] , height-point[1] , 0 , 22/7 )
    _ = addToList ( crvs , crv )
```





**Programming Languages
For Generative Design:
A Comparative Study**
António Leitão, Luís
Santos, and José Lopes,
IJAC, 2012, 10(1)



Möbius - GIS

- Support iterative design generation and performance analyses at an urban scale
- Workflows capable of integrating:
 - geographic mapping
 - parametric modelling
- Exchange data
 - geometry data (2d vs 3d)
 - attribute data

Attribute table - ne_10m_populated_places_simple :: Features total: 7322, filtered: 7322, selected: 0

	longitude	changed	namediff	diffnote	pop_max	pop_min	pop_other
7312	139.75140742900	0.00000000000	0	NULL	35676000	8336599	1294525
7297	-73.98001692880	0.00000000000	0	NULL	19040000	8008278	929260
7303	-99.13098820170	0.00000000000	0	NULL	19028000	10811002	1001844
7313	72.85698929740	0.00000000000	0	NULL	18978000	12691836	1242608
7318	-46.62501998040	0.00000000000	0	NULL	18845000	10021295	1152294
7221	77.23000402720	4.00000000000	0	Changed feature...	15926000	7633213	674738
7311	121.43650467800	0.00000000000	0	NULL	14987000	14608512	1680357
7316	88.32467565810	4.00000000000	1	Name changed. ...	14787000	4631392	778371
7248	90.40857946650	5.00000000000	0	Changed scale ra...	12797394	7000940	1499553
7290	-58.39753137370	0.00000000000	0	NULL	12795000	10929146	1027145
7295	-118.17998051100	0.00000000000	0	NULL	12500000	3694820	14226
7168	66.99000891000	5.00000000000	0	Changed scale ra...	12330000	11624219	1157027
7310	31.24996821970	0.00000000000	0	NULL	11803000	7724614	1272055

Expression Editor

Expression: "pop_max" > 100000

Functions

Field

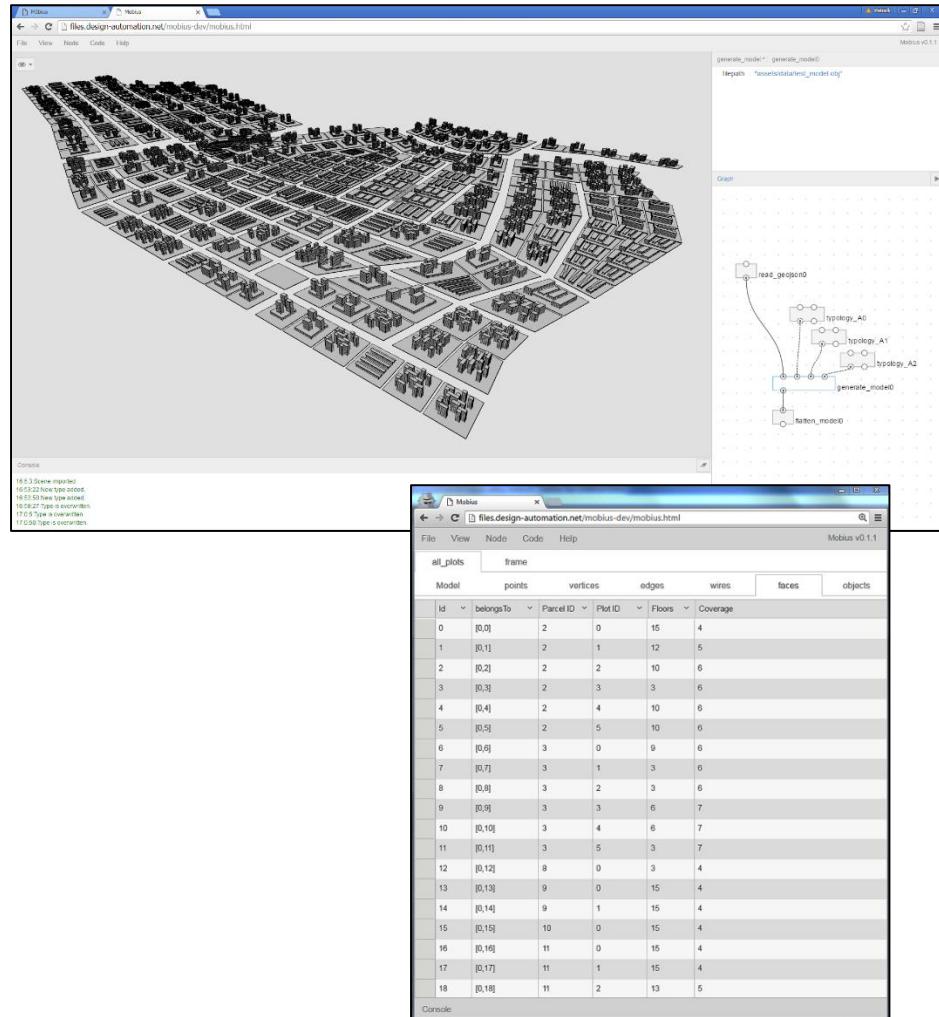
Values

Note:

Load values

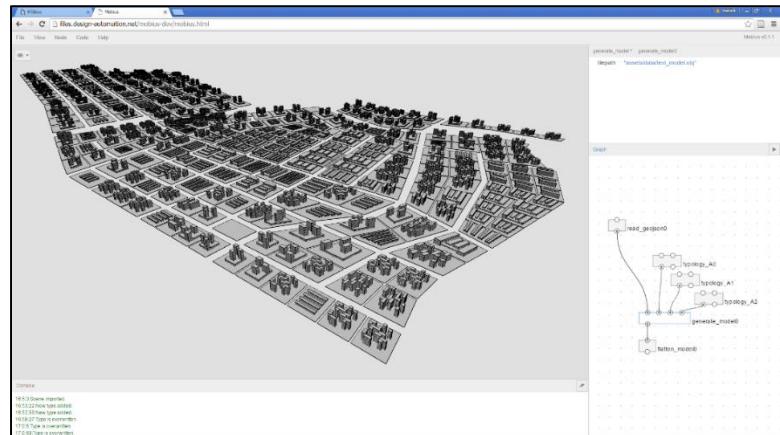
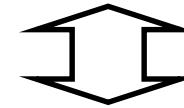
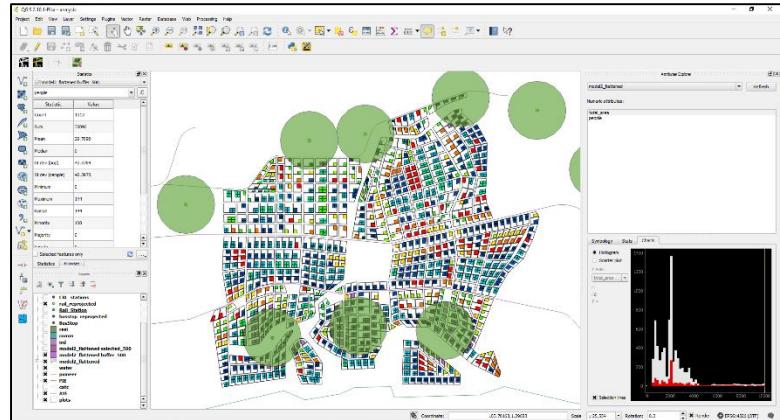
Möbius - GIS

- A parametric modeller in the browser
- Integrates associative and imperative programming styles
- Supports:
 - iterative loops
 - higher-order functions
- <http://files.design-automation.net/mobius-dev/mobius.html>

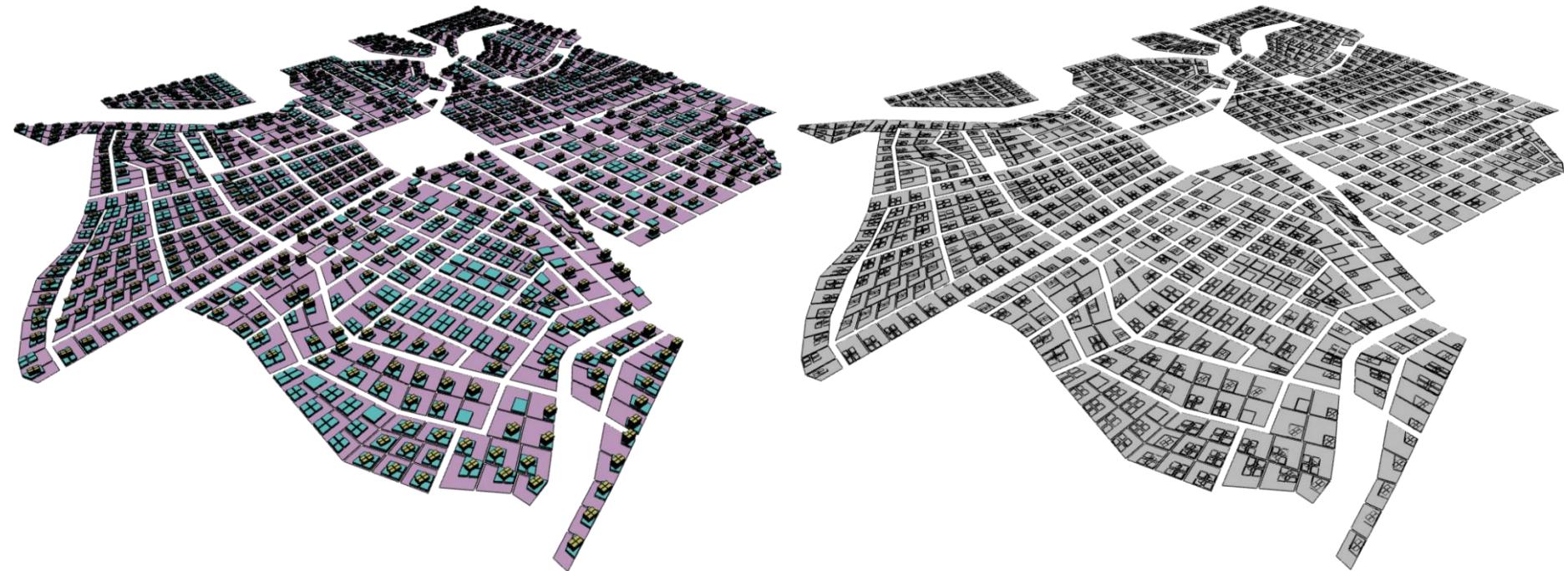


Möbius - GIS

- Support fast iterative generation and evaluation of large-scale urban models
- A workflow that alternates between QGIS and Möbius



Möbius - GIS



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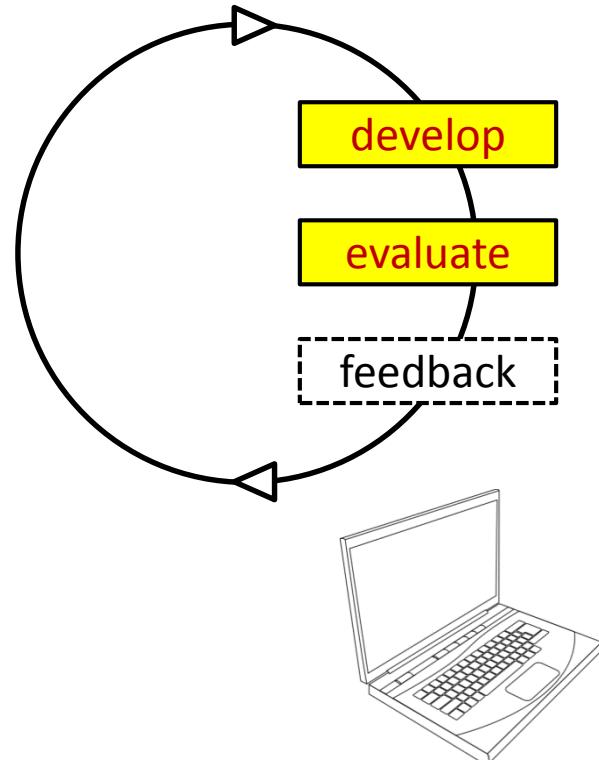
12.

Future
Directions

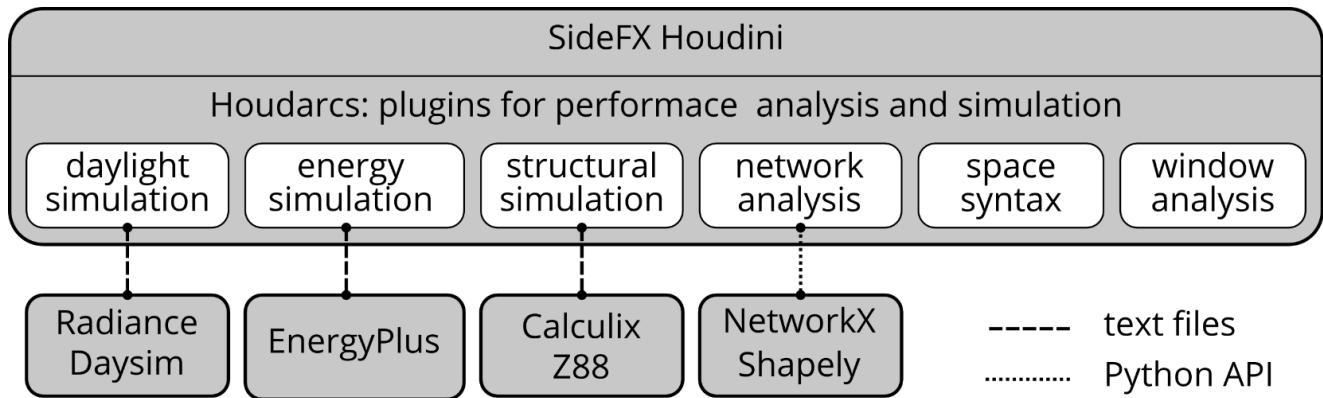
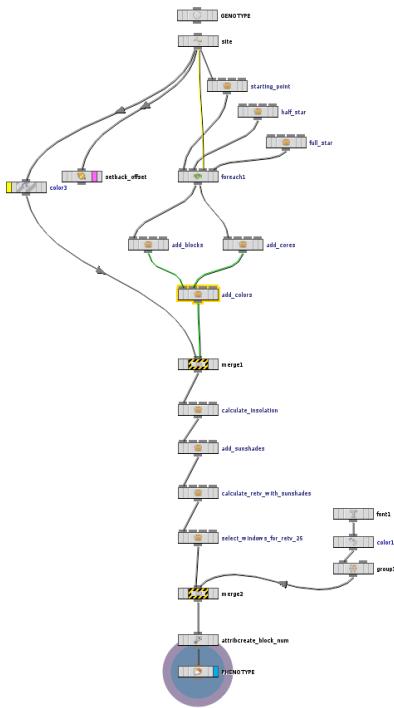
Automating Evaluation

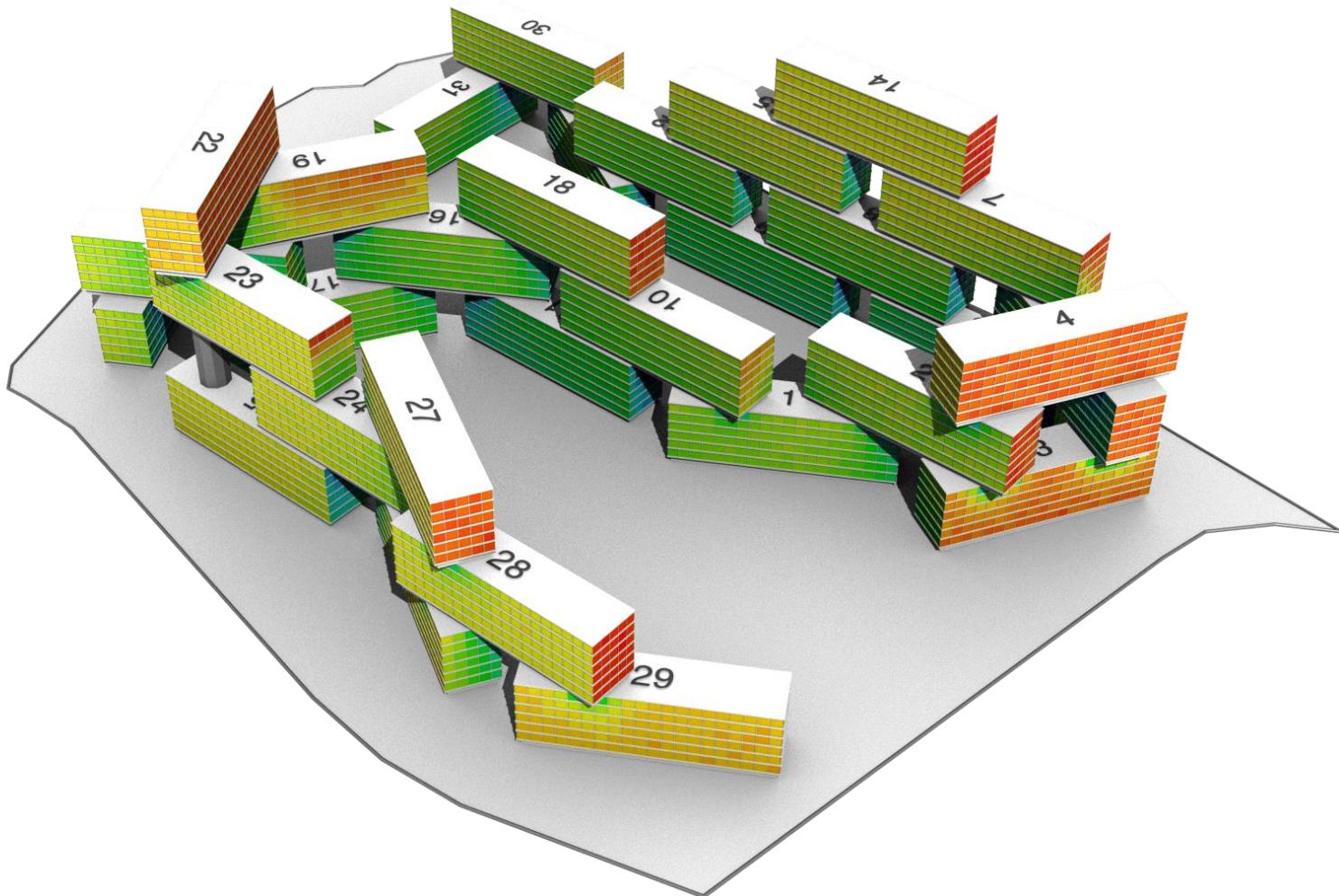
WHAT-IF questions:

- **What** will be the impact on performance **if** we make certain modifications to our design?
- Development and evaluation are automated.



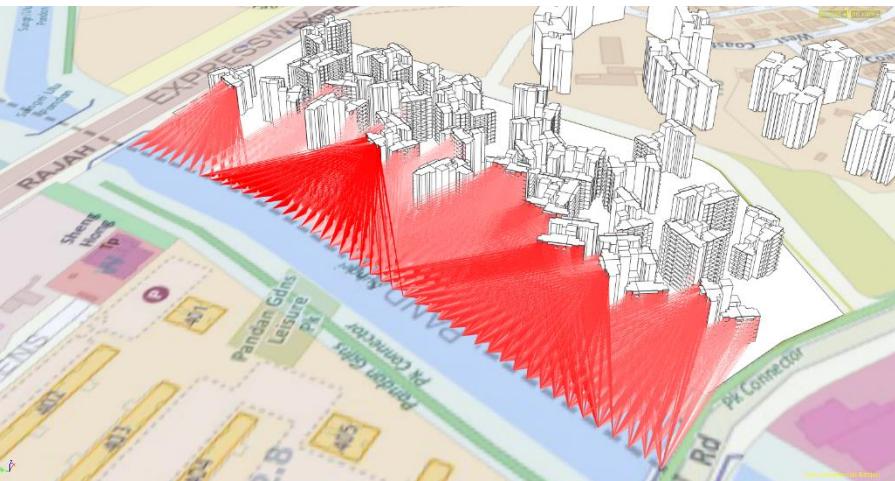
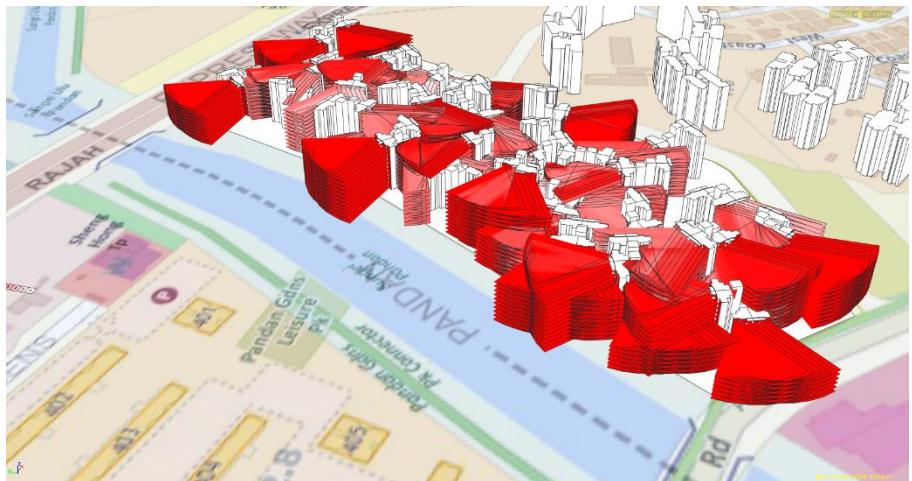
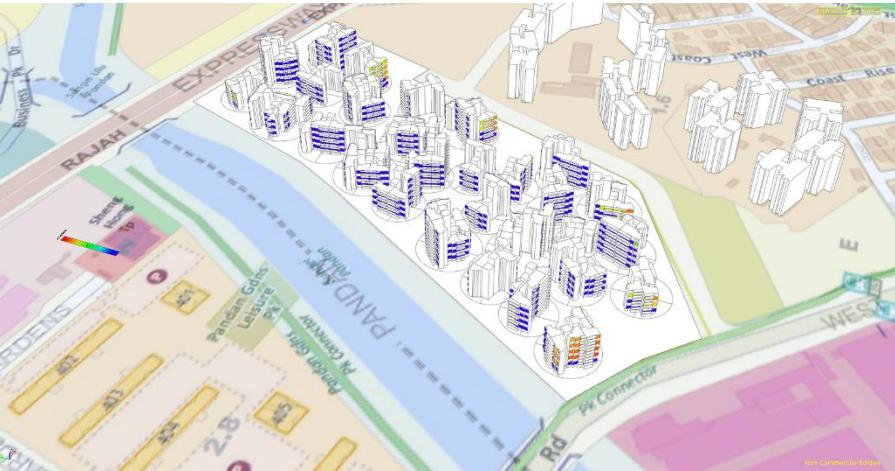
Automating Evaluation





Automating Evaluation

- Solar radiation
- Scenic views
- Unobstructed views



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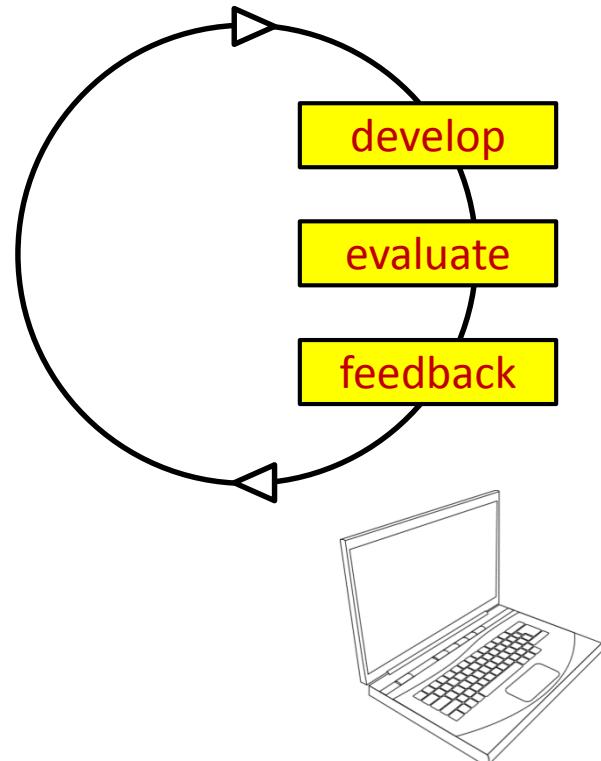
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Automating Feedback

IF-WHAT questions:

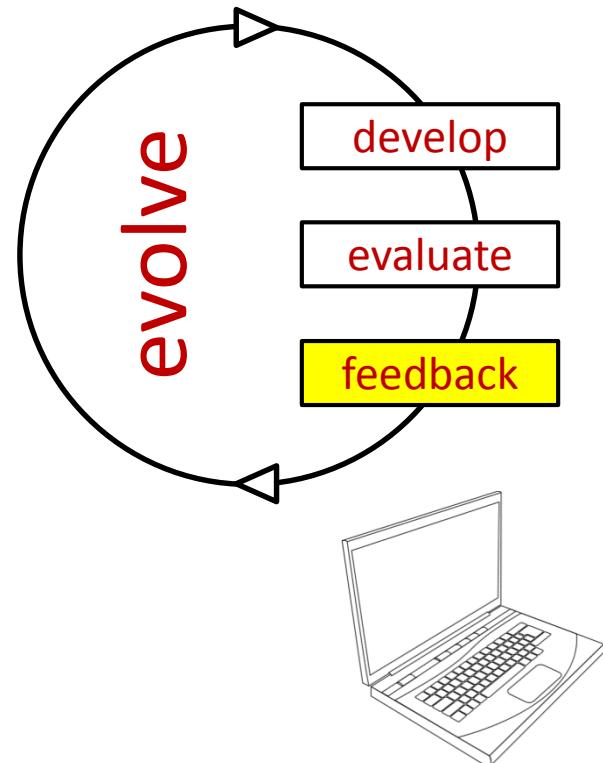
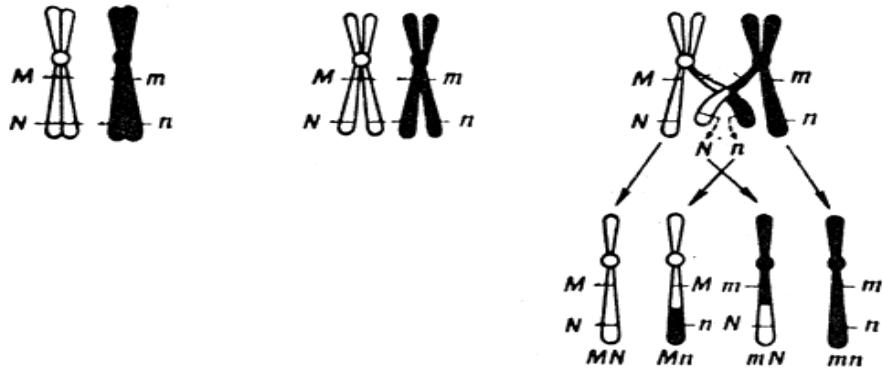
- If we require a certain performance, what modifications should we make to our design?
- Development, evaluation, and feedback are automated

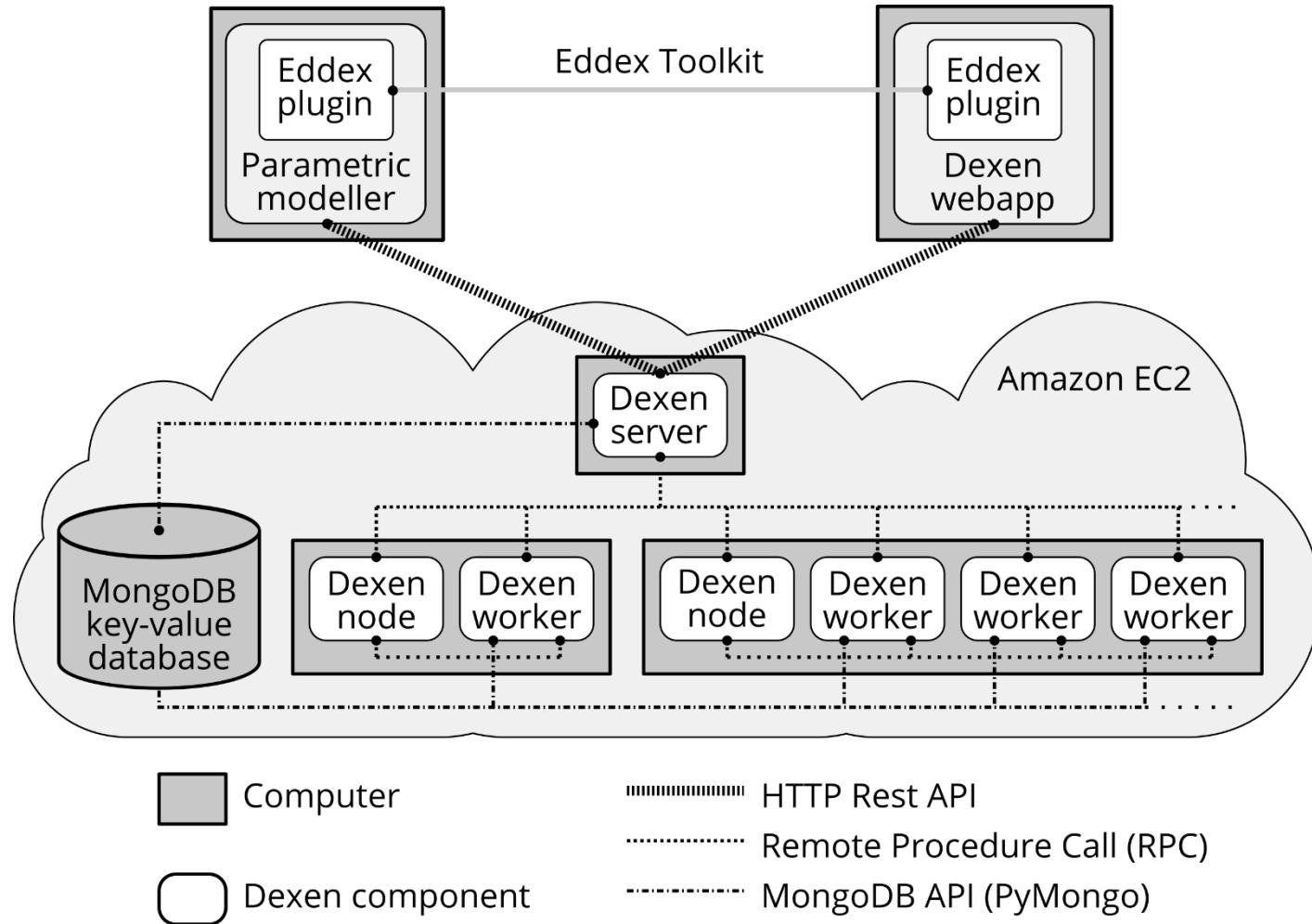


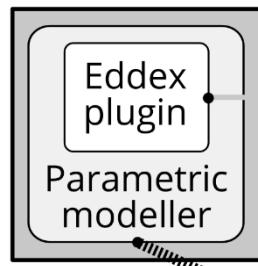
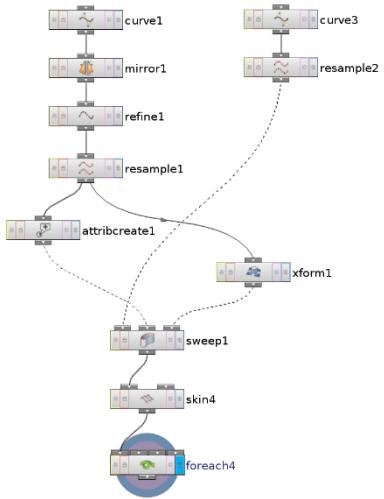
Automating Feedback

Closing the loop:

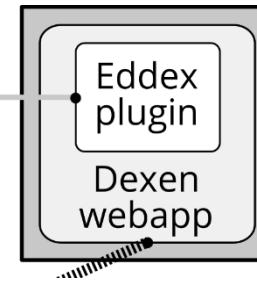
- Survival of the fittest - bad designs are killed, good designs have children. Children inherit the from their parents.







Eddex Toolkit



eddex eddex1

Initialize | Develop | Evaluate | Feedback | Terminate | Data Files | Run

Feedback Task
Task name: feedback
Input size: 40

Selection
Fitness Ranking: Pareto Goldberg Ranking

Survival
Births selection: Roulette Best
Number of births: 4
Deaths selection: Worst
Number of deaths: 4

(a)

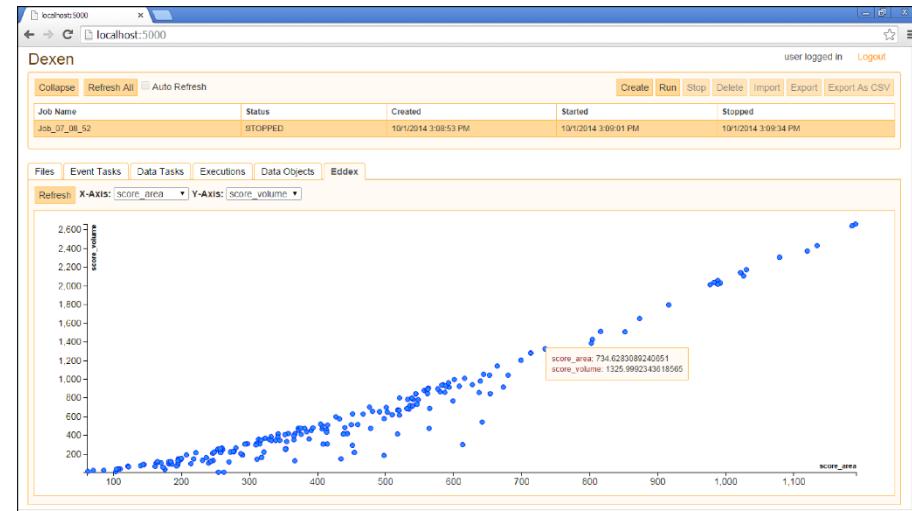
eddex eddex1

Initialize | Develop | Evaluate | Feedback | Terminate | Data Files | Run

Dexen server settings
Username: user
Password: pswd
Dexen URL: localhost
Dexe Port: 5000

Code generation
Code folder: \$HIP/code
 Run job

(b)



Dexen				
Job Name		Status	Created	Started
aaa	STOPPED	6/8/2015, 10:41:35 AM		
job_08_42_11	RUNNING	6/8/2015, 10:42:13 AM	6/8/2015, 10:42:21 AM	
job_21_13_08	STOPPED	6/8/2015, 10:41:35 AM		
job_21_18_51	STOPPED	6/8/2015, 10:41:35 AM		

Files	Event Tasks	Data Tasks	Executions	Data Objects	Eddex
Refresh					

Name	Upload Time	Size
procedures.hipic	6/8/2015, 10:42:15 AM	148294
settings.py	6/8/2015, 10:42:14 AM	3985
taska.py	6/8/2015, 10:42:13 AM	2606

[Upload](#) [Download](#) [Export as CSV](#)

Dexen				
Job Name		Status	Created	Started
aaa	STOPPED	6/8/2015, 10:41:35 AM		
job_08_42_11	RUNNING	6/8/2015, 10:42:12 AM		6/8/2015, 10:42:21 AM
job_21_13_08	STOPPED	6/8/2015, 10:41:35 AM		
job_21_18_51	STOPPED	6/8/2015, 10:41:35 AM		

Files	Event Tasks	Data Tasks	Executions	Data Objects	Eddex
Refresh					
Show 10 ▾ entries					

ID	Task	Worker	Creation Time	Begin Time	End Time	Status	Stderr	Stdout
1	initial	WORKER1	Mon, 08 Jun 2015, 08:42:21 GMT	Mon, 08 Jun 2015, 08:42:21 GMT		Finished		
2	development	WORKER1	Mon, 08 Jun 2015, 08:42:23 GMT	Mon, 08 Jun 2015, 08:42:23 GMT		Finished	Executing initialization	[18, 39, 44, 49, 8, 29, 34, 14, 18]
3	development	WORKER1	Mon, 08 Jun 2015, 08:42:22 GMT	Mon, 08 Jun 2015, 08:42:22 GMT		Finished	Executing development	[24, 45, 5, 50, 9, 30, 45, 10, 25]
4	development	WORKER1	Mon, 08 Jun 2015, 08:42:22 GMT	Mon, 08 Jun 2015, 08:42:29 GMT		Finished	Executing development	[25, 4, 5, 10, 31, 36, 41, 21, 26, 47]
5	development	WORKER8	Mon, 08 Jun 2015, 08:42:22 GMT	Mon, 08 Jun 2015, 08:42:30 GMT		Finished	Executing development	[8, 11, 37, 42, 1, 22, 27, 32, 7]
6	development	WORKER4	Mon, 08 Jun 2015, 08:42:22 GMT	Mon, 08 Jun 2015, 08:42:30 GMT		Finished	Executing development	[12, 17, 38, 2, 48, 21, 28, 33, 13]
7	execute_id	WORKER7	Mon, 08 Jun 2015, 08:42:29 GMT	Mon, 08 Jun 2015, 08:42:34 GMT		Finished	Executing execution	[30, 9, 30, 21, 36, 26, 47, 40, 15, 41]
8	execute_id	WORKERS	Mon, 08 Jun 2015, 08:42:29 GMT	Mon, 08 Jun 2015, 08:42:38 GMT		Finished	Executing execution	[24, 45, 4, 20, 46, 5, 10, 31, 36]
9	execute_id	WORKERS	Mon, 08 Jun 2015, 08:42:29 GMT	Mon, 08 Jun 2015, 08:42:37 GMT		Finished	Executing execution	[30, 9, 30, 21, 36, 26, 47, 40, 15, 41]
10	execute_id	WORKER6	Mon, 08 Jun 2015, 08:42:29 GMT	Mon, 08 Jun 2015, 08:42:36 GMT		Finished	Executing execution	[24, 45, 4, 20, 46, 5, 10, 31, 36]

Showing 1 to 10 of 202 entries

Previous | 1 | 2 | 3 | 4 | 5 | ... | 21 | Next

Dexen				
Job Name		Status	Created	Started
aaa	STOPPED	6/8/2015, 10:41:35 AM		
job_08_42_11	RUNNING	6/8/2015, 10:42:13 AM	6/8/2015, 10:42:21 AM	
job_21_13_08	STOPPED	6/8/2015, 10:41:35 AM		
job_21_18_51	STOPPED	6/8/2015, 10:41:35 AM		

Files	Event Tasks	Data Tasks	Executions	Data Objects	Eddex
Refresh					

Name	Registration Time	Pending Executions	Ongoing Executions	Completed Executions	Avg. Execution Time
intake	6/8/2015, 10:42:16 AM	0	0	1	0.25469967862233987

[Register](#) [De-Register](#) [Delete](#) [Export as CSV](#)

Dexen				
Job Name		Status	Created	Started
aaa	STOPPED	6/8/2015, 10:41:35 AM		
job_08_42_11	RUNNING	6/8/2015, 10:42:12 AM	6/8/2015, 10:42:21 AM	
job_21_13_08	STOPPED	6/8/2015, 10:41:35 AM		
job_21_18_51	STOPPED	6/8/2015, 10:41:35 AM		

Files	Event Tasks	Data Tasks	Executions	Data Objects	Eddex
Refresh					

Name	Registration Time	Valid Data Objects	Assigned Data Objects	Ongoing Executions	Failed Executions	Successful Executions	Avg. Execution Time
developer	6/8/2015, 10:42:17 AM	0	10	1	0	73	4.653437080012612
eval_id	6/8/2015, 10:42:19 AM	0	10	1	0	72	4.8303889072392
eval_id	6/8/2015, 10:42:18 AM	0	10	1	0	72	4.84770314675211
feedback	6/8/2015, 10:42:20 AM	10	20	1	0	345	0.190057978999888

[Register](#) [De-Register](#) [Delete](#) [Export as CSV](#)

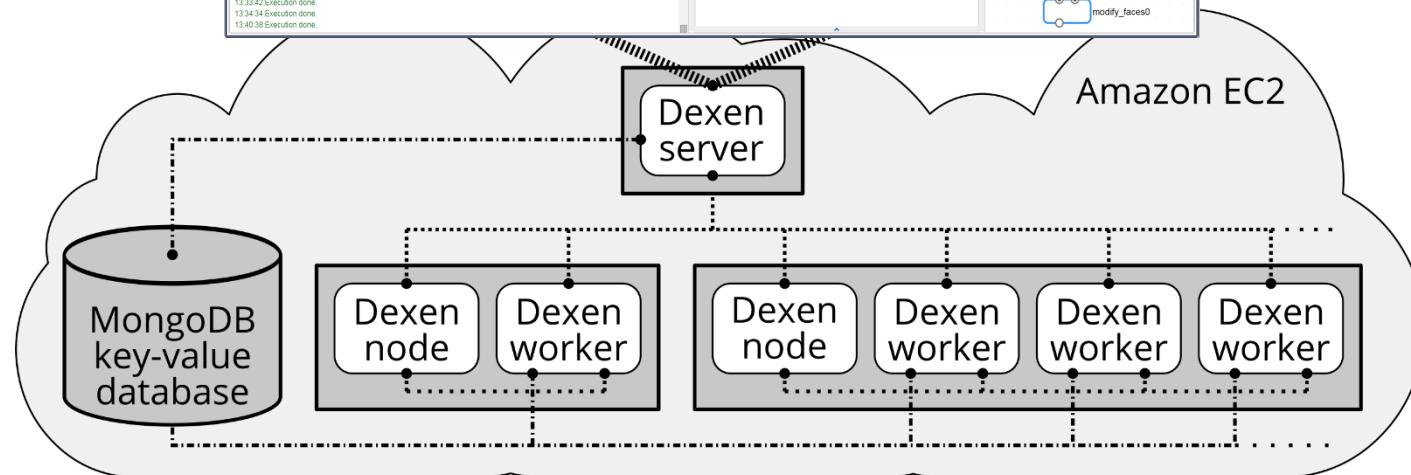
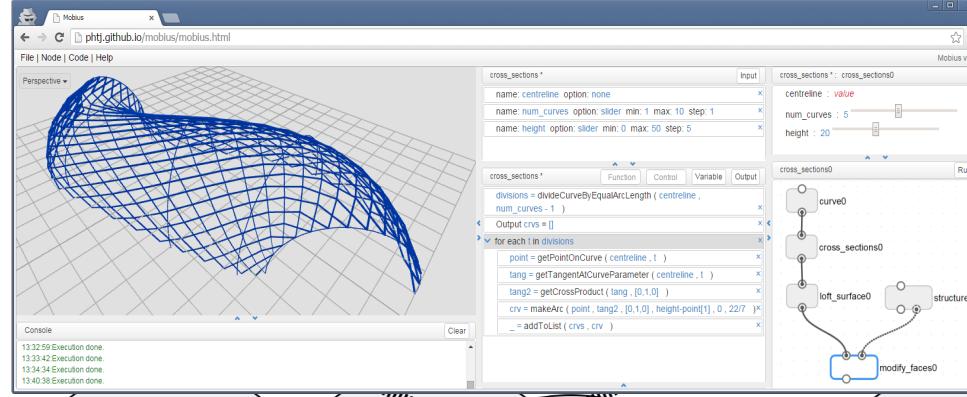
Dexen				
Job Name		Status	Created	Started
aaa	STOPPED	6/8/2015, 10:41:35 AM		
job_08_42_11	RUNNING	6/8/2015, 10:42:12 AM		6/8/2015, 10:42:21 AM
job_21_13_08	STOPPED	6/8/2015, 10:41:35 AM		
job_21_18_51	STOPPED	6/8/2015, 10:41:35 AM		

Files	Event Tasks	Data Tasks	Executions	Data Objects	Eddex
Refresh					
Show 10 ▾ entries					

#d alive genotype	phenotype	total_drect
1 false	0.837704507732596	0.4581742480743867
2 false	0.342161801550216	0.851260391349171
3 false	0.234237784261147	0.2869852261743766
4 false	0.2540233784261147	0.2540233784261147
5 false	0.264853516544152	0.70590899251574
6 false	0.191552227745472	0.1413806237119947
7 false	0.17136284538052	0.33062413472073
8 false	0.1649964401584	0.47094773470947253
9 false	0.1633333333333333	0.3655515474719888
10 false	0.1524686103330188	0.1720096237289695

Showing 1 to 10 of 234 entries

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Computer

Dexen component

----- HTTP Rest API

----- Remote Procedure Call (RPC)

----- MongoDB API (PyMongo)

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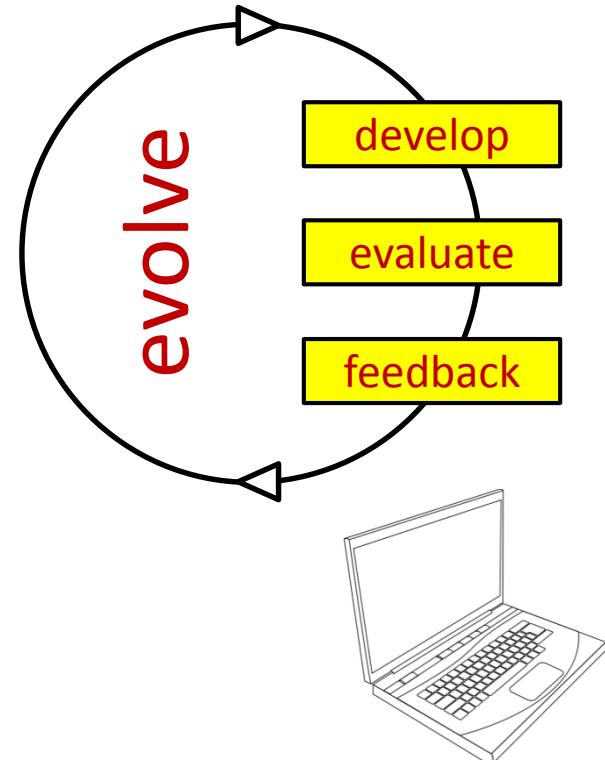
Scenario

Site:

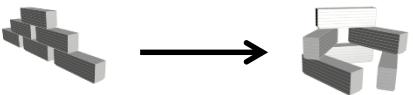
- Area: 9.2 Ha
- FAR: 2.3
- 31 blocks each 6 floors high

Performance:

- Maximise daylight entering windows
- Minimise cost of façade
- Minimise core length



Typology



2013, The Interlace
OMA



2012, Office at Fornebu, Oslo
A-Lab



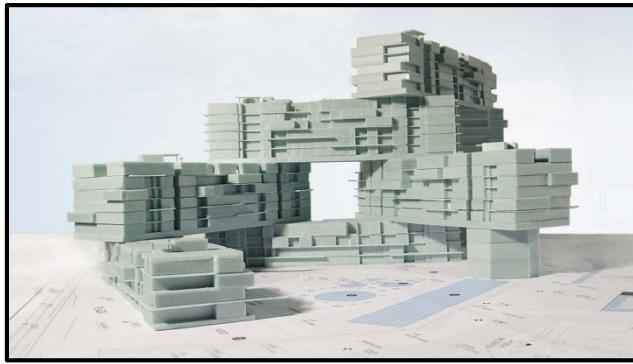
2010, Taipei City wall
BIG



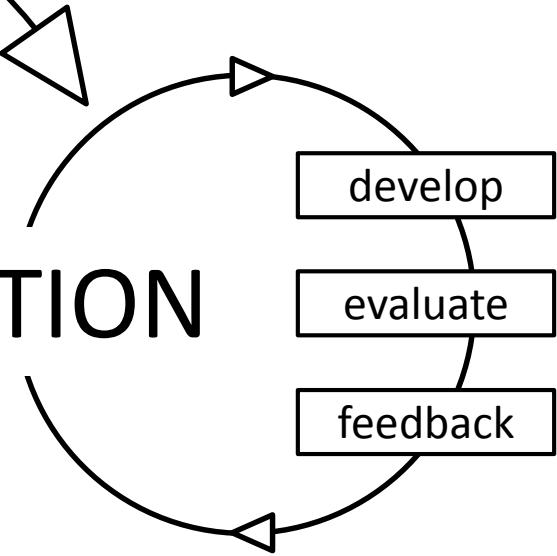
2009, Celosia Building
MVRDV

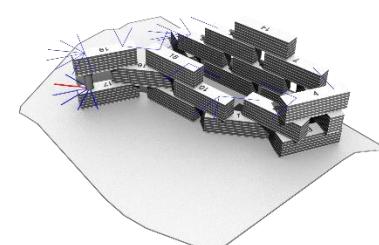
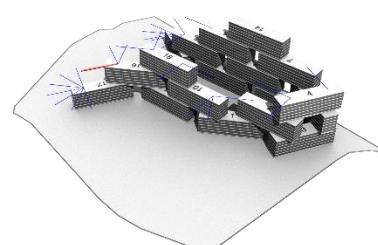
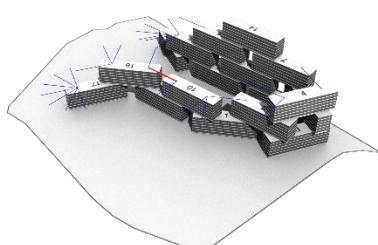
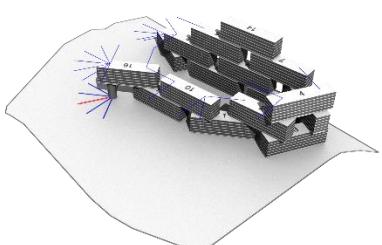
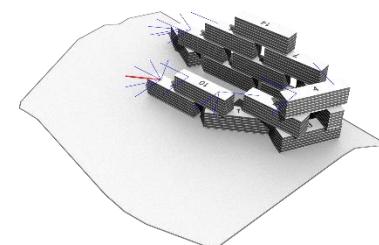
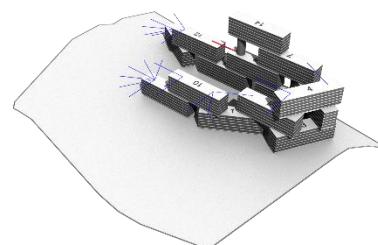
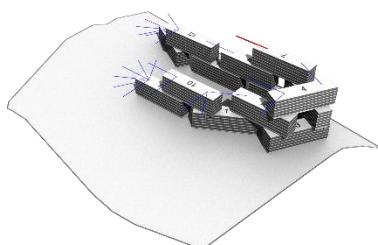
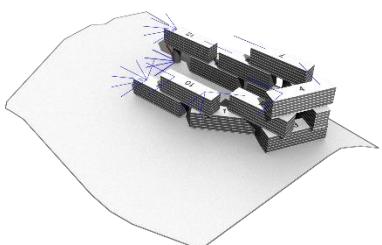
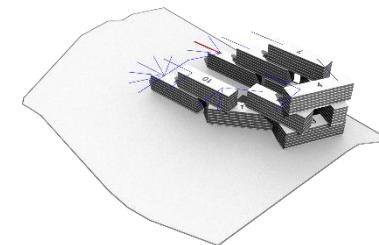
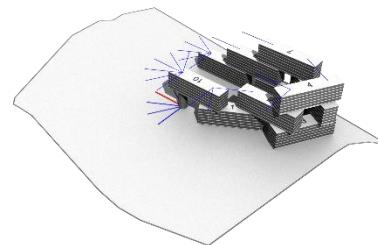
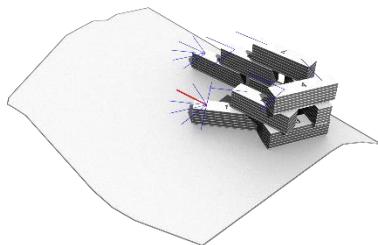
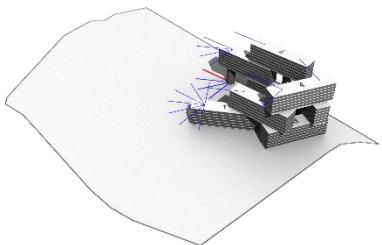
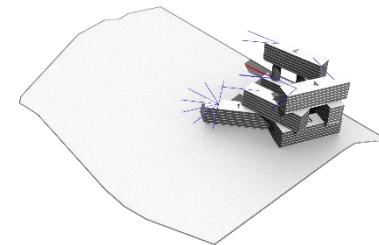
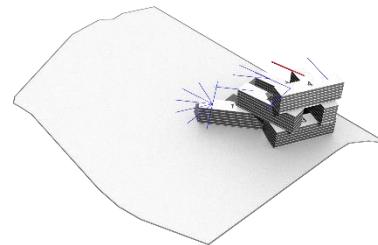
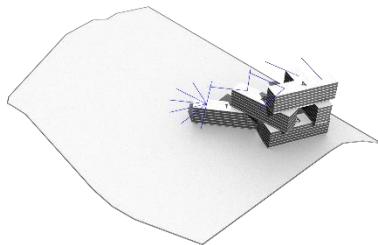
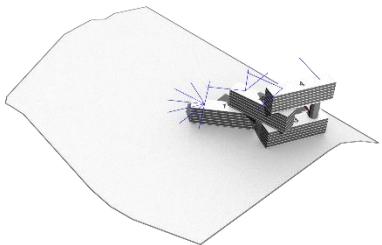


1975, The Bank of Georgia
Chakhava and Jalaghania



EXPLORATION



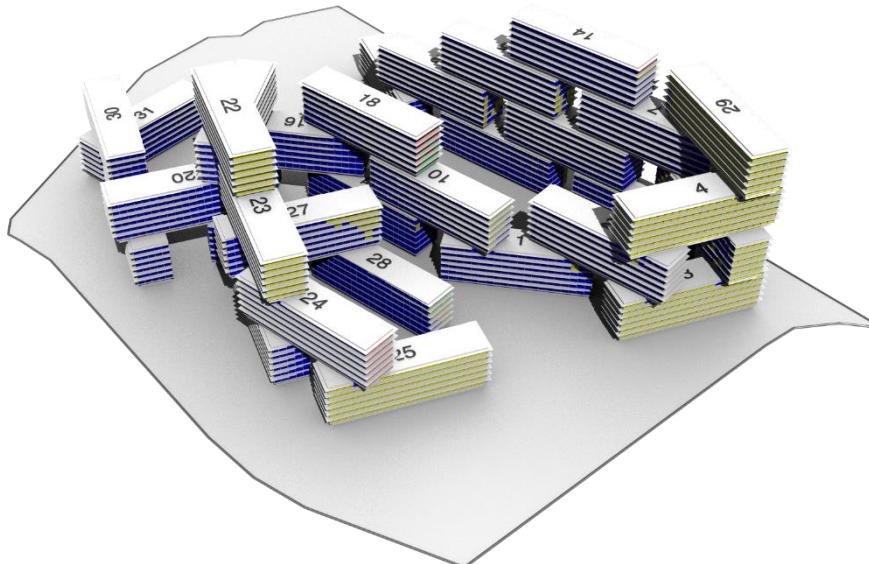


Evaluation procedures

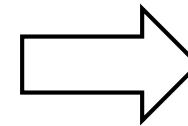
develop

evaluate

feedback



PHENOTYPE



Window daylight: 76.8 %
Façade cost: \$37.99 M
Core length: 0

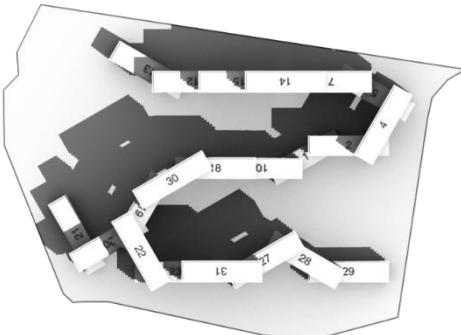
FITNESS

Feedback procedure

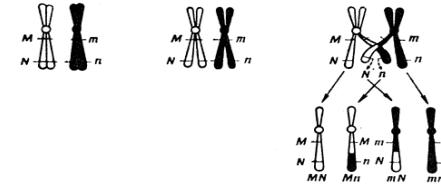
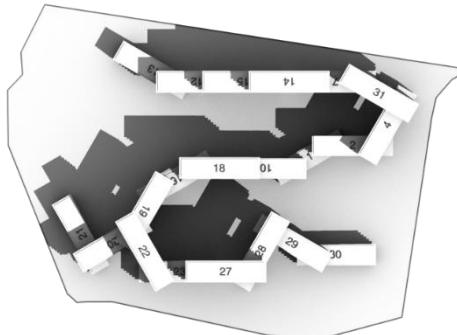
develop

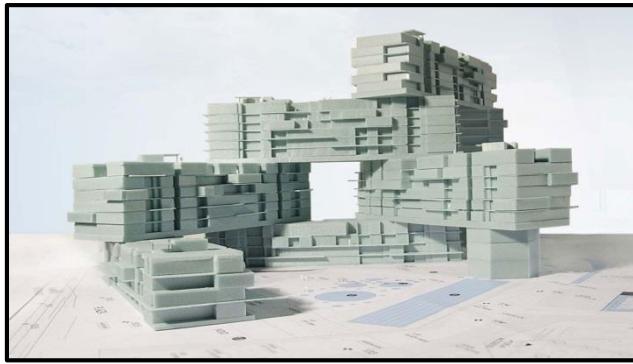
evaluate

feedback

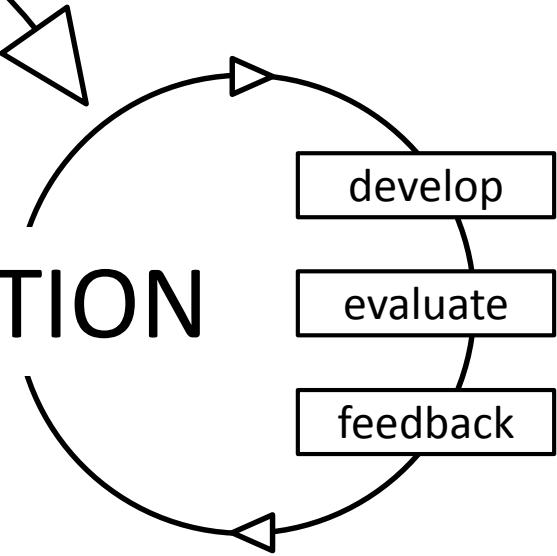


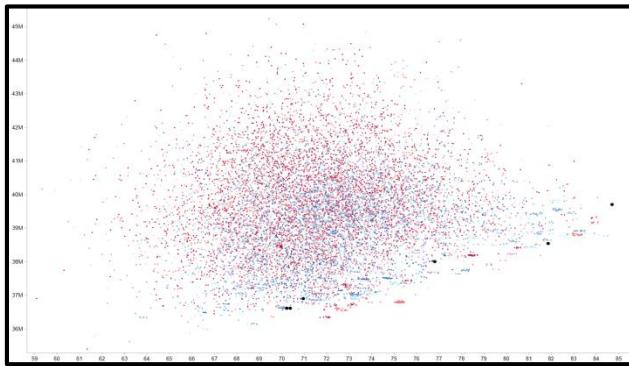
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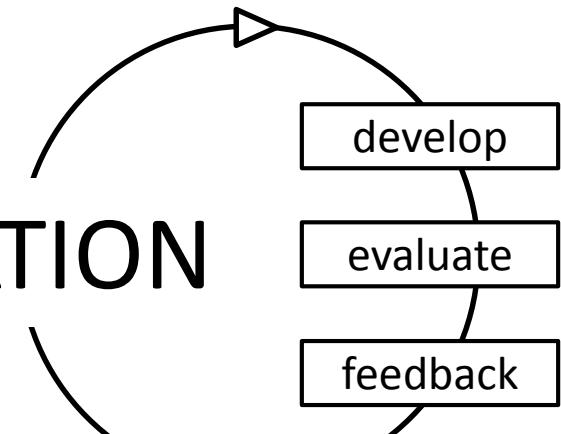


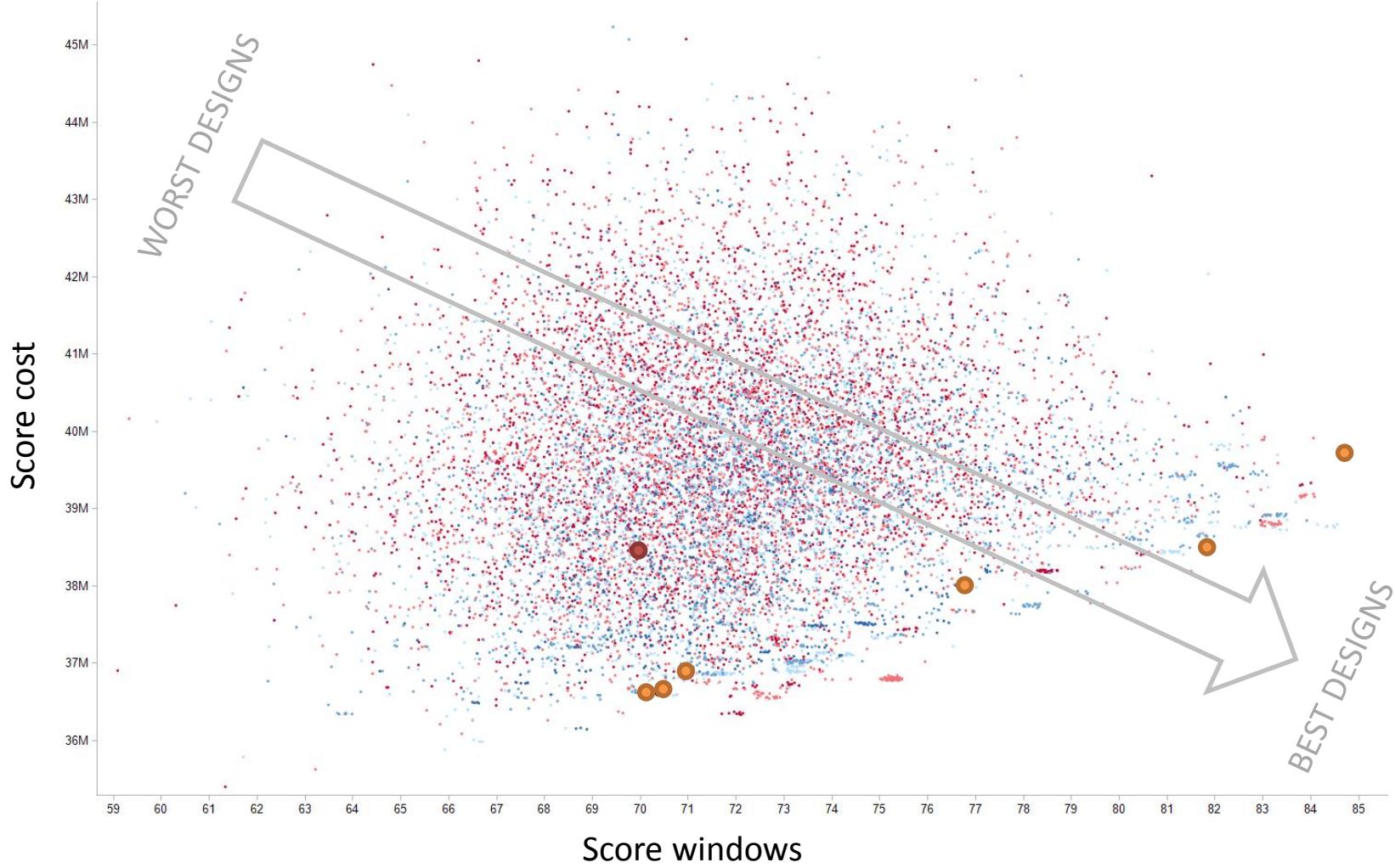
EXPLORATION

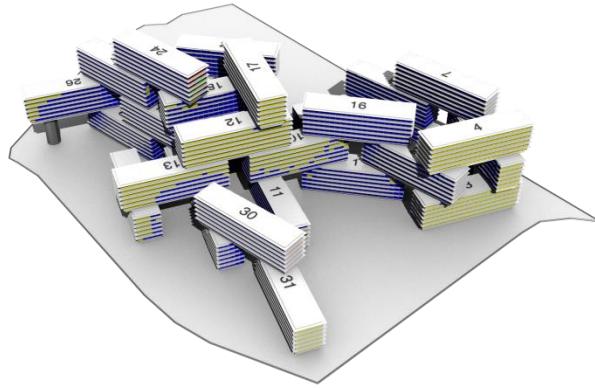
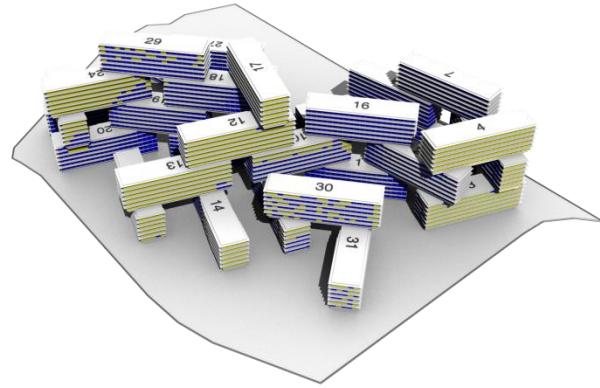
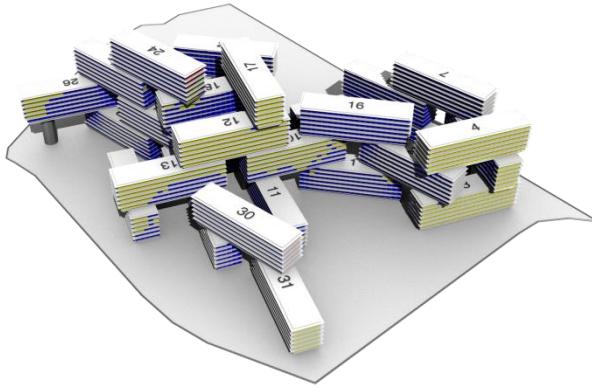




EXPLORATION



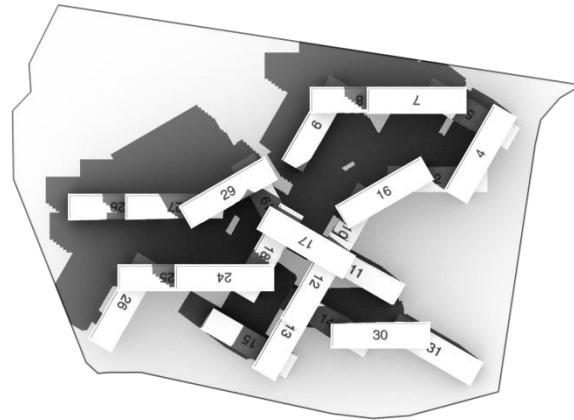
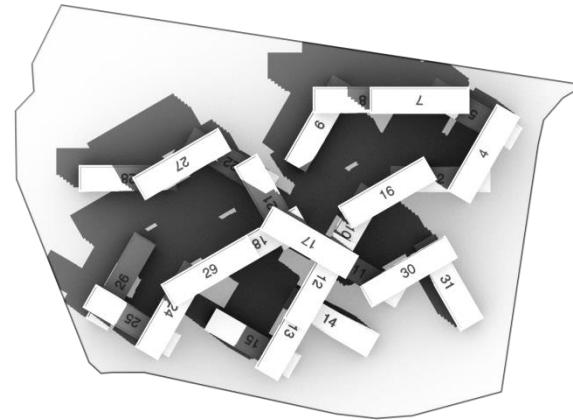
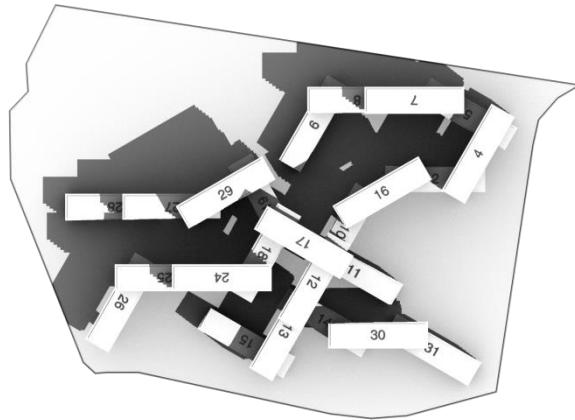


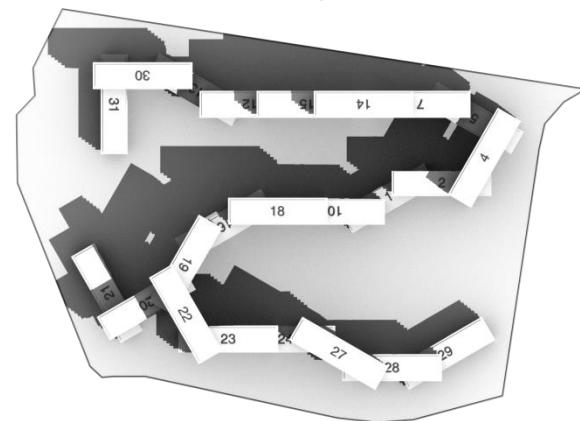
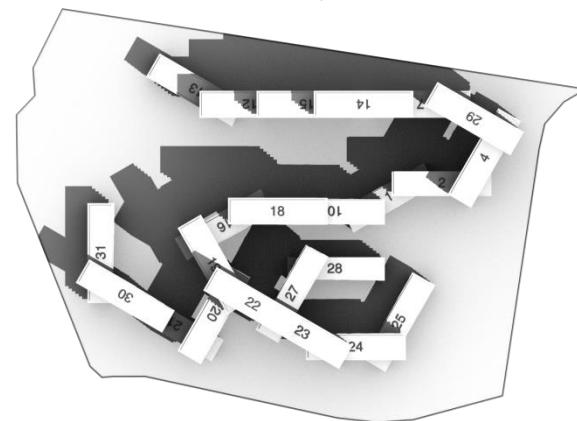
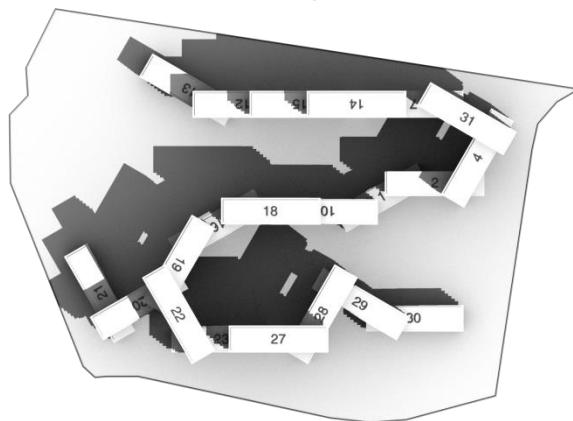
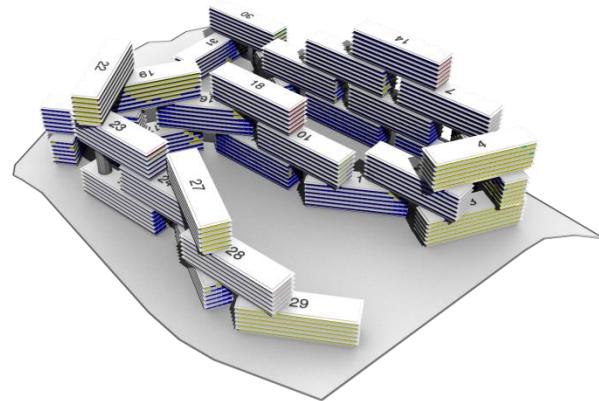
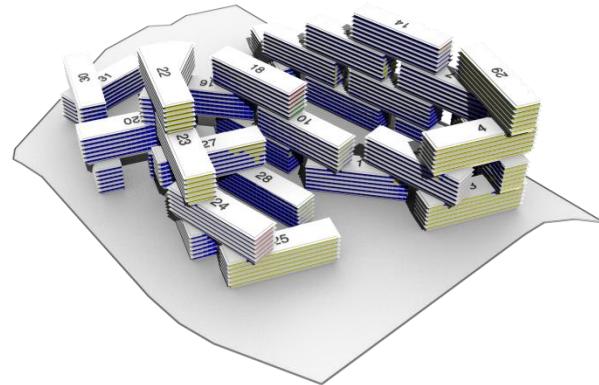
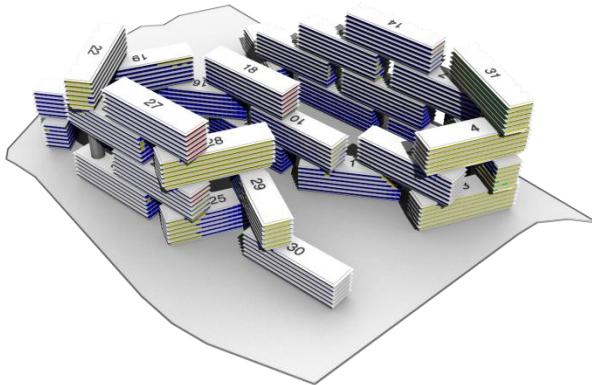


13927

15253

15515





7965

11393

10435

1.

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Example:
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Packing*

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Asia:
Some Context

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Directions

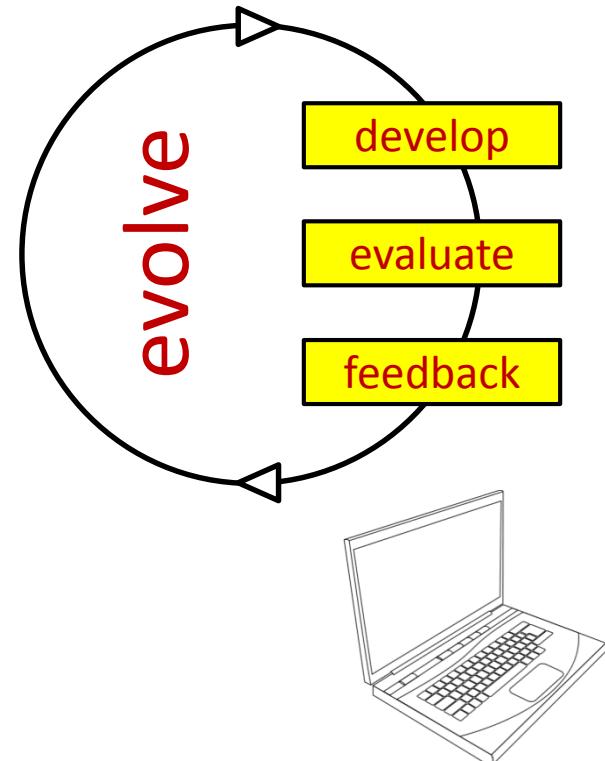
Scenario

Site:

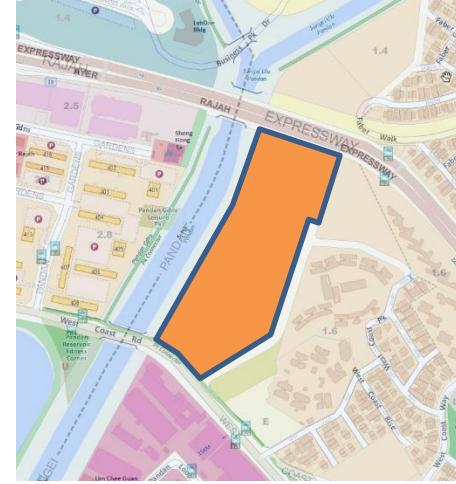
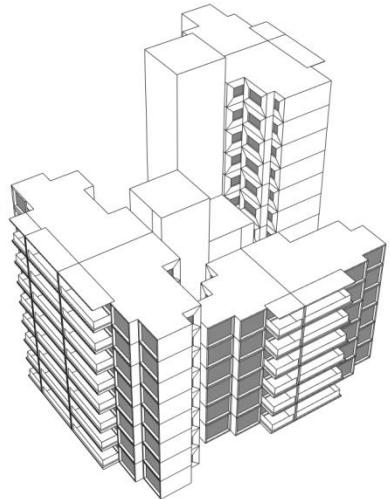
- Area: 8.4 Ha
- FAR: 2.0
- 1400 flats

Performance:

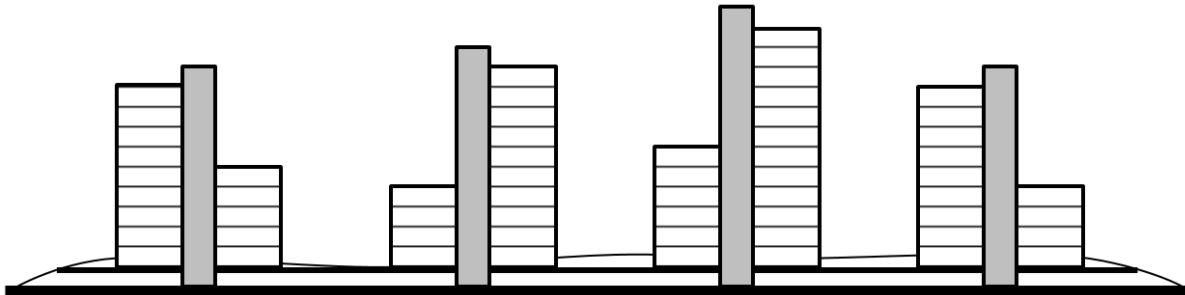
- Maximise Monetary Value
- Maximise Window Performance
 - Minimise noise from roads
 - Maximise views of the canal
 - Maximise unobstructed views



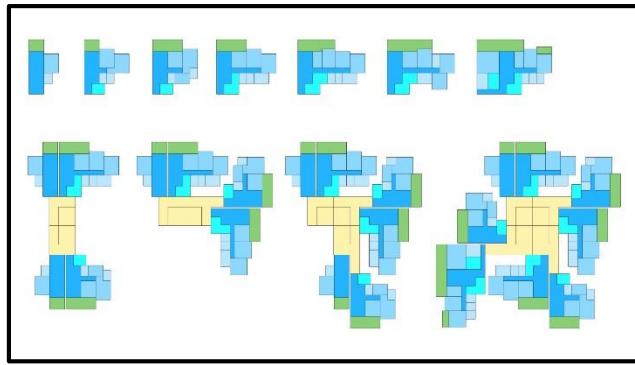
Typology



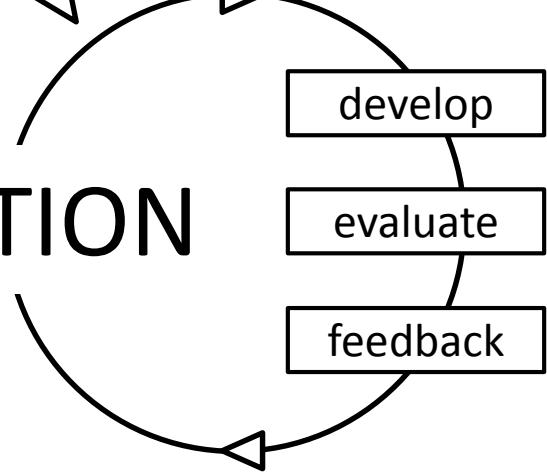
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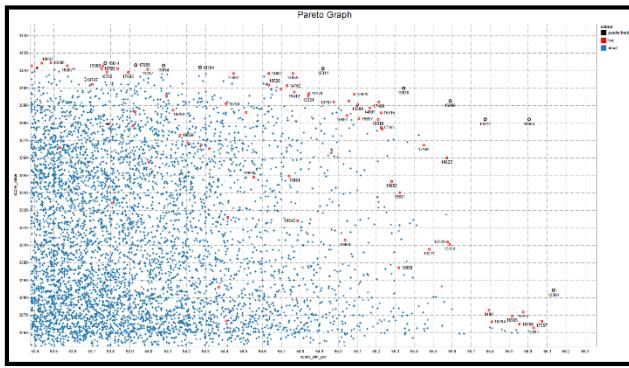


- Level 1+: Residential units
- Level 1: Landscaped deck
- Level 0: Car parking

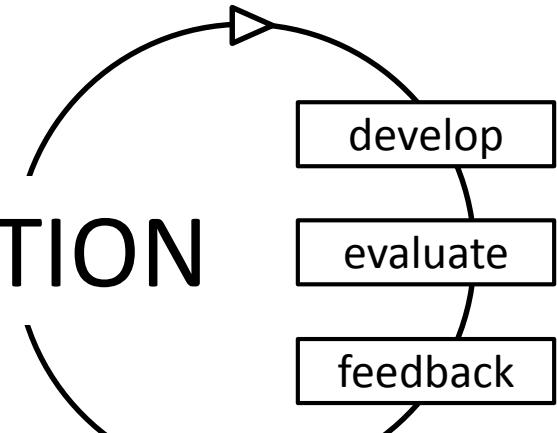


EXPLORATION

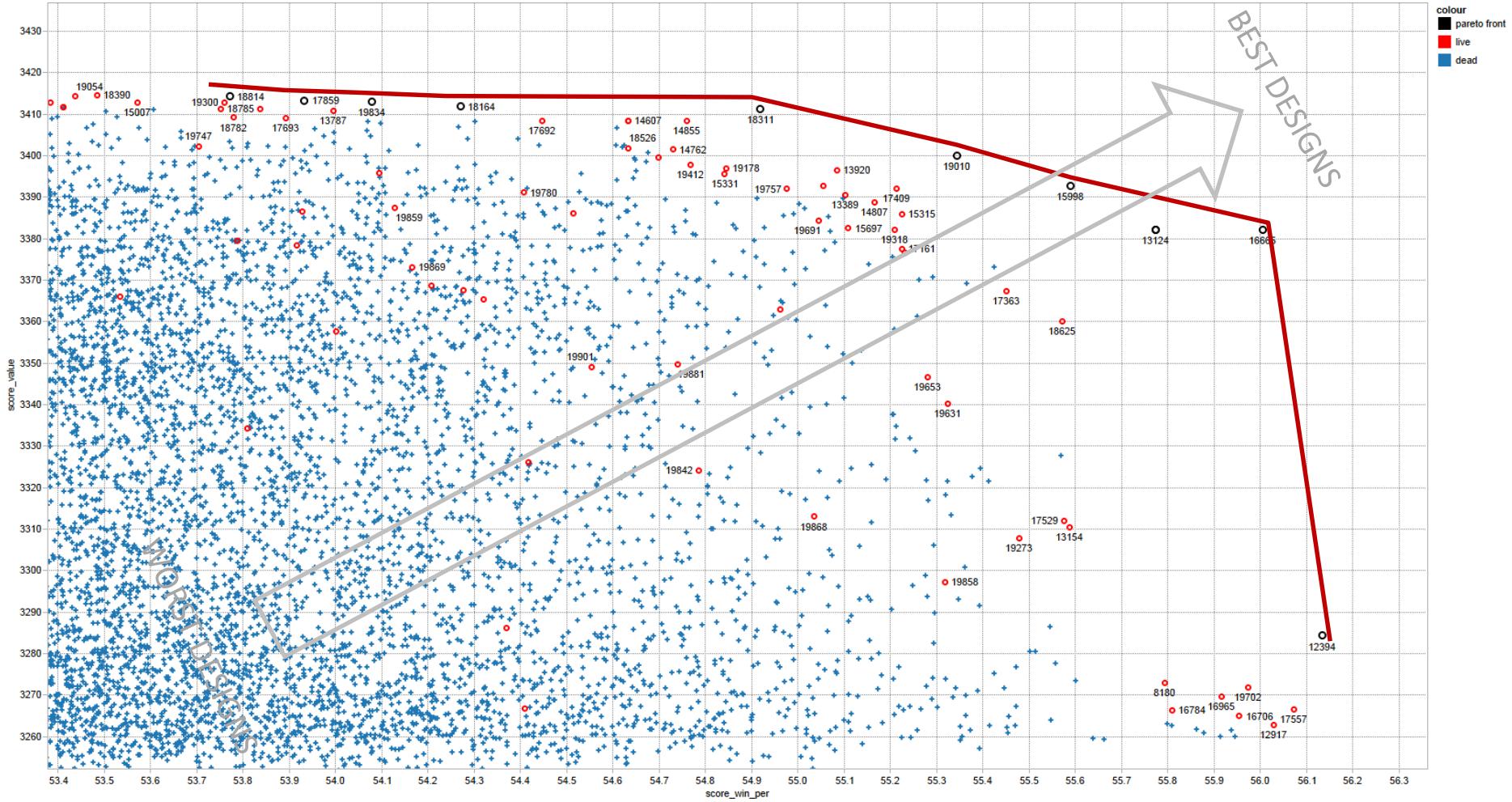


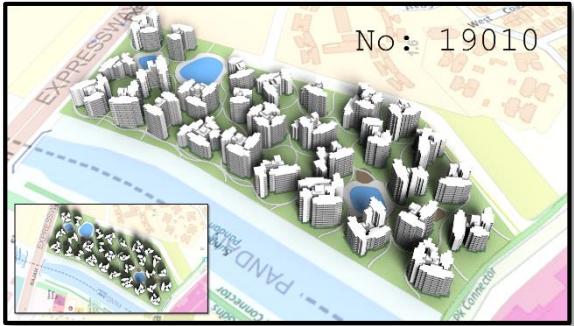
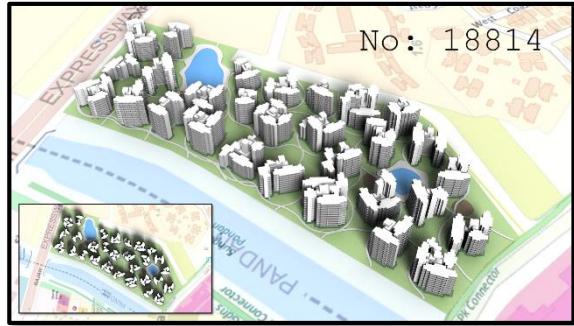
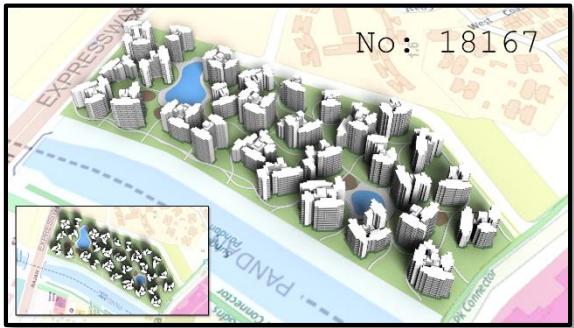


EXPLORATION



Pareto Graph





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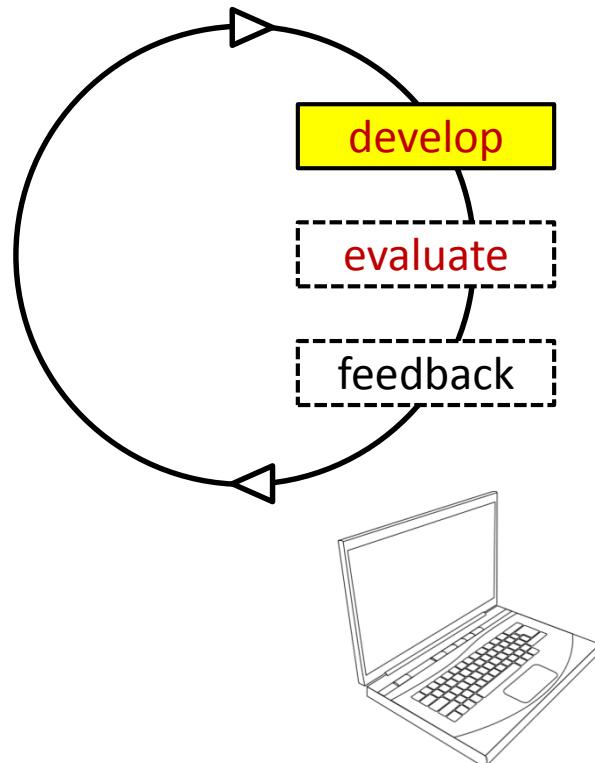
12.

Future
Directions

Scenario

A development procedure for generating street networks:

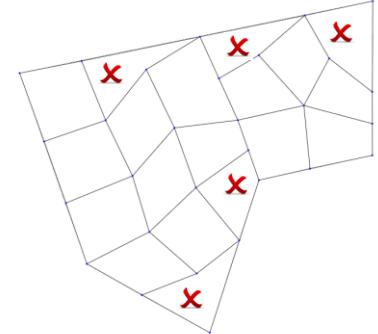
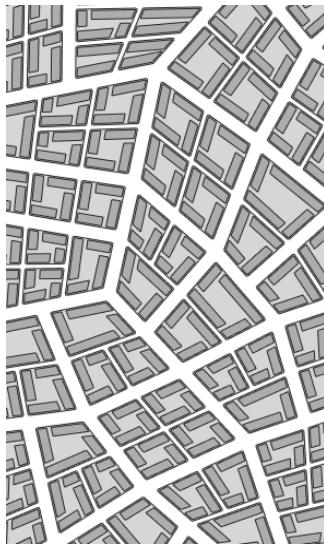
- generate street networks within sites with irregular shapes
- generate street networks that connect to existing surrounding streets
- generate street networks that include different categories of streets



Urban Model Generation

The development procedure should:

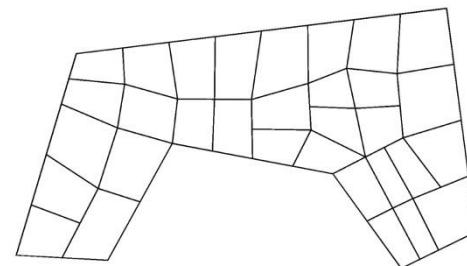
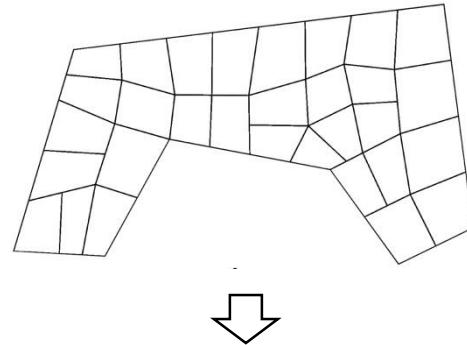
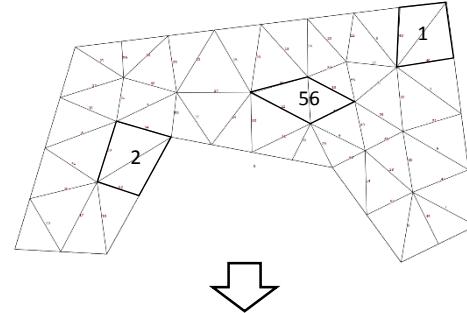
- generate street networks where streets tend to be fairly straight and where intersections tend to have either three or four streets
- generate street networks that result in evenly sized plots that tend to be close to orthogonal in shape



Stage 2: Quad meshes

Initial ordering:

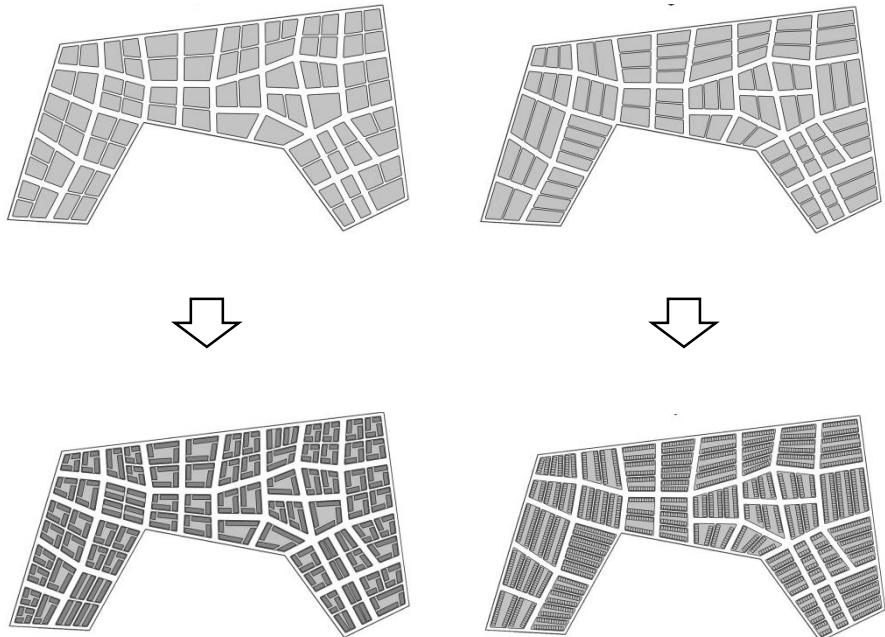
1. Order the edges by sorting them from best to worst
2. Create quad mesh:
 - A) Merge triangle pairs
 - B) Merge isolated triangles
 - C) Fix irregular quads
3. Improve quad mesh by applying solver



Stage 4: Generate building massings

Building massings based on selected typologies are generated within the plots defined by the street networks.

- City blocks are generated for each plot based on a selected typology.



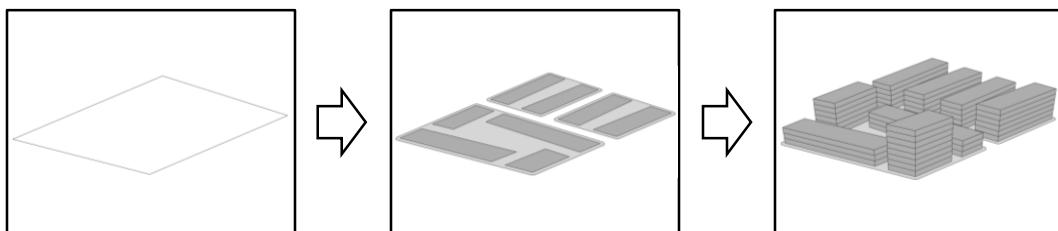
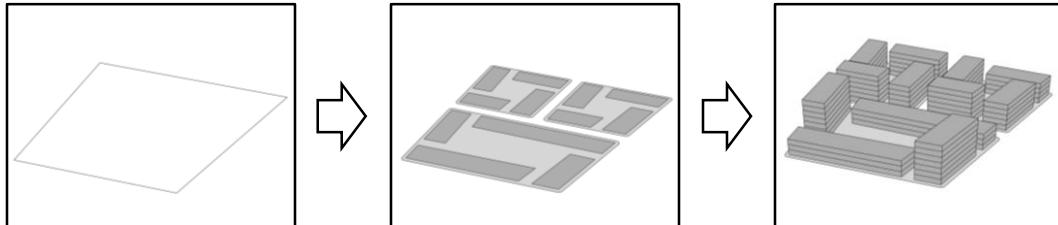
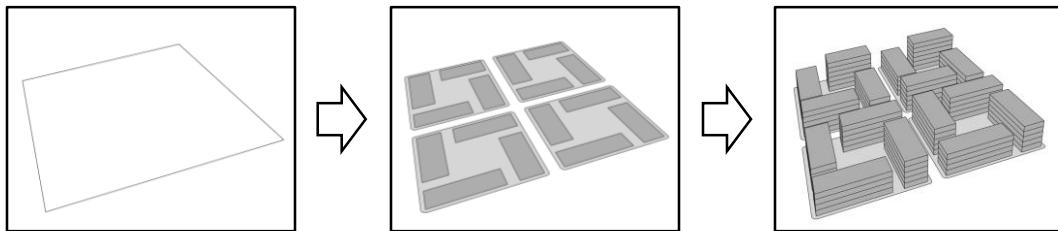
Perimeter block typology

Constraints on the plot:

- Plots are split into strips
- Minimum edge length: 58 m

Constraints on the row houses:

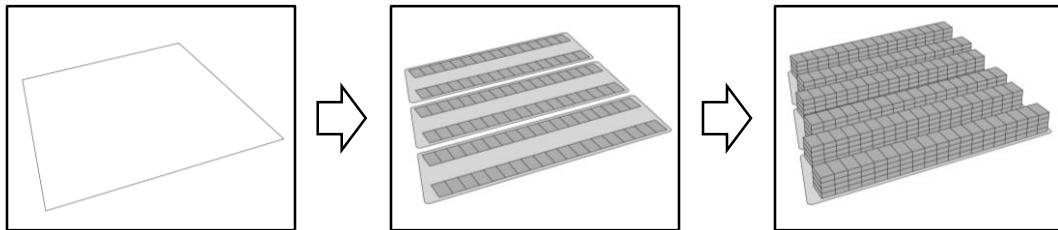
- Height: 2 floors to 10 floors
- Depth: 18 m
- Spacing between blocks: 6 m



Row house typology

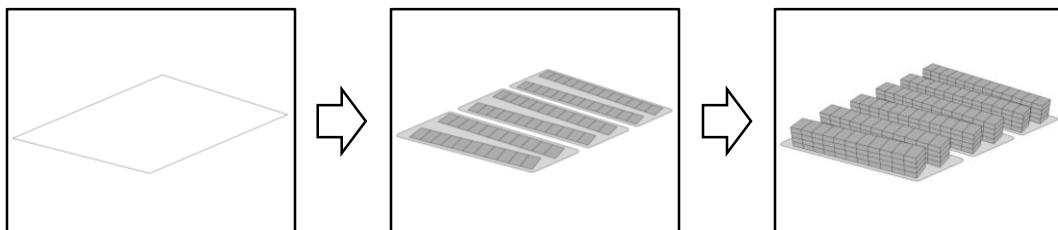
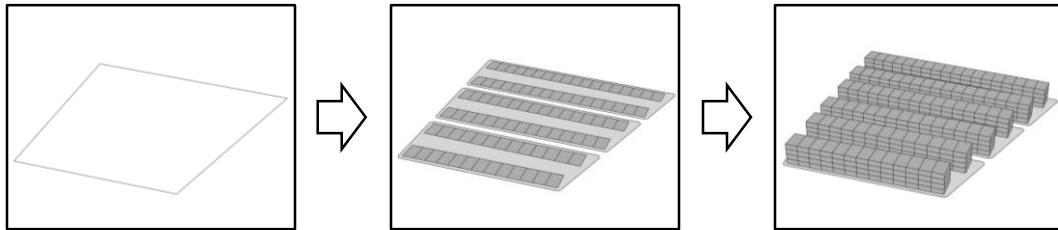
Constraints on the plot:

- Plots are split into grids
- Minimum edge length: 32 m



Constraints on row house typology:

- Height: 4 floors
- Depth: 10 m



Case Study

Building massings based on selected typologies are generated within the plots defined by the street networks.

- Bidadari, Singapore
- 93 Ha, build 11,000 flats



Two options

- Total number of blocks: 598
Min/Max block height: 2-10 Floors
Plot Ratio: 1.56
Building ground coverage: 34.8 %
Road coverage: 42.5%
- Total number of rows: 4480
Plot Ratio: 1.51
Building ground coverage: 37.8%
Road coverage: 59.3 %



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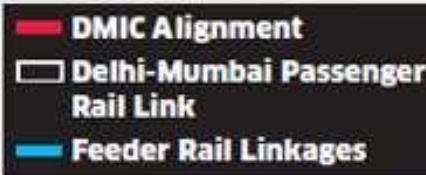
Future
Directions

Indian Mega-cities

- Mega project between the political capital and the business capital of India
- Includes building new 'mega cities' from scratch
- E.g. Gujarat International Finance Tec-City

Taking the Road to Growth

A mix of road, rail, port and airport, the Delhi-Mumbai Industrial Corridor is set to change the business landscape



\$90 billion infrastructure running from Delhi to Mumbai

1483 kms

project is backed by financial & technical aid from Japan

₹18,500 cr

revolving fund will help in planning projects along the corridor

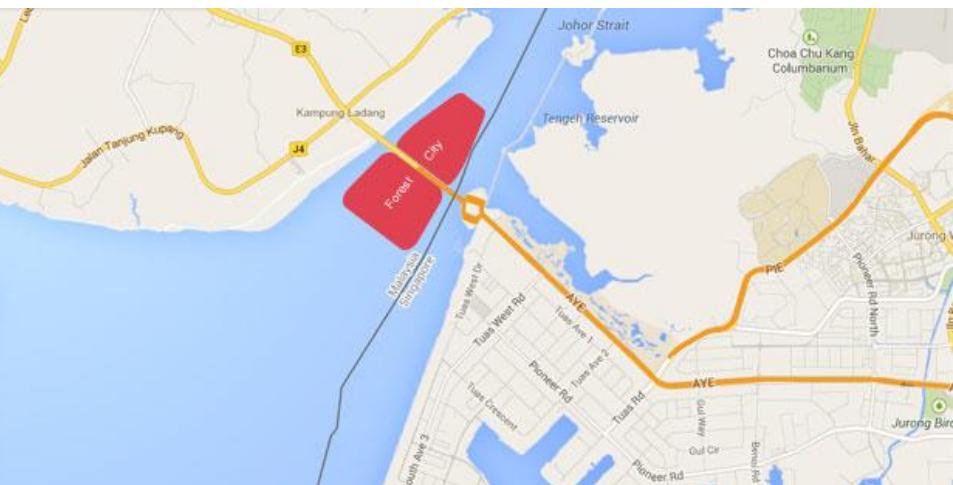


7 new mega cities to be created along the freight corridor

It includes 9 mega industrial zones, high speed freight line, three ports, and six airports

Johor Bahru

- Single project with 500,000 apartments, 700,000 people
- Construction began in February 2016
- A two-bedroom apartment cost one-fifth of the price of a similar-sized apartment in Singapore.



Singapore

- Visions for Jurong Industrial Estate 2050
- Urban design and planning
- Parameters
 - Floor Area Ratio
 - Number of floors
 - Site coverage
 - Function



Team 9

- IFoU studio

Jaume Pla

Goh Jia Li

Geraldine De Neu

Ravish Kumar

Delon Leonard

Made Perwira

Tanzir Taher

Marco Berger

Josef Odvarka

Xiameng Jia

Meng Jing

Peter Lie

Fei Bo

Zhao Danyu

Jasmin Mok



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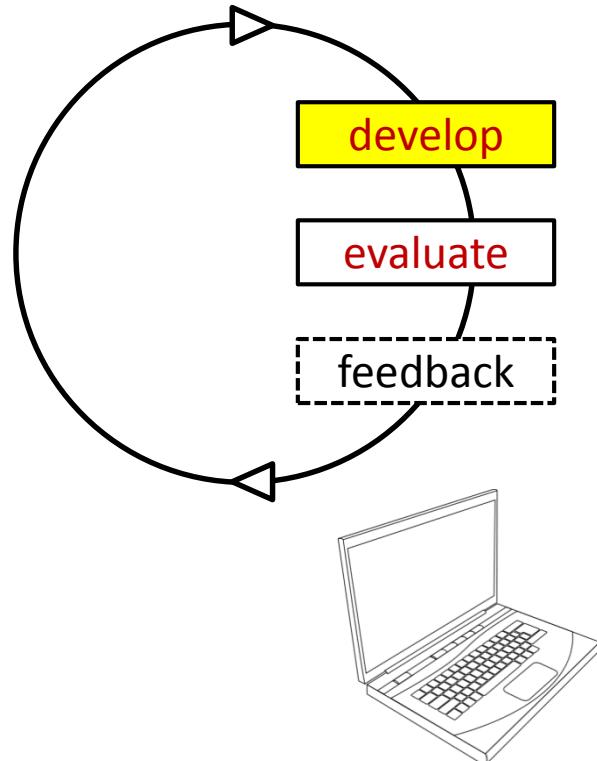
Ongoing
Enhancements

12.

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Directions

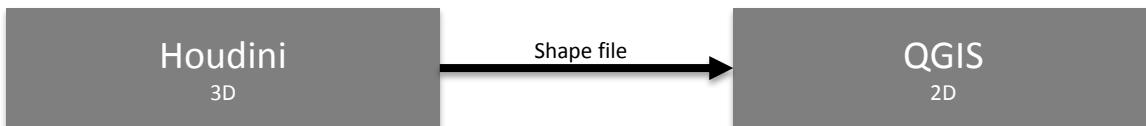
Scenario

- Visions for Jurong Industrial Estate 2050
- Generative Procedures
- Parameters
 - Floor Area Ratio
 - Number of floors
 - Site coverage
 - Function

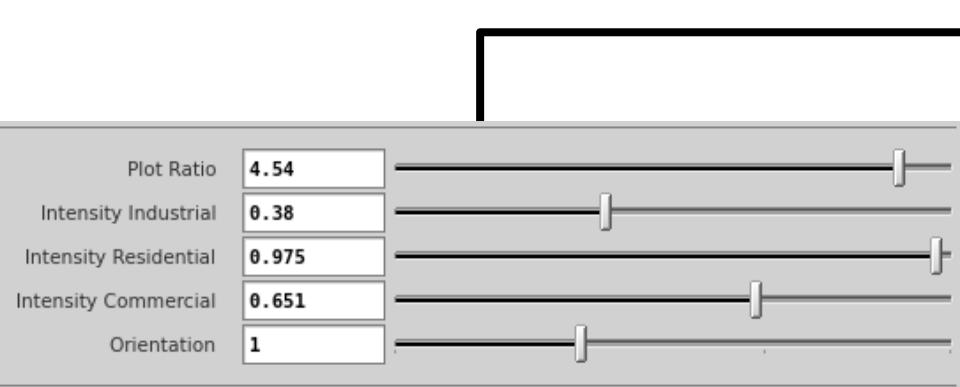


From 3D CAD to 2D GIS

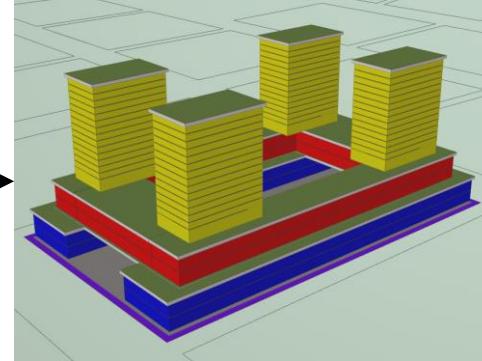
- A GIS shape file is exported
- Data from the 3D model needs to be transferred to the 2D model
- This data can then be analyzed using existing GIS based tools



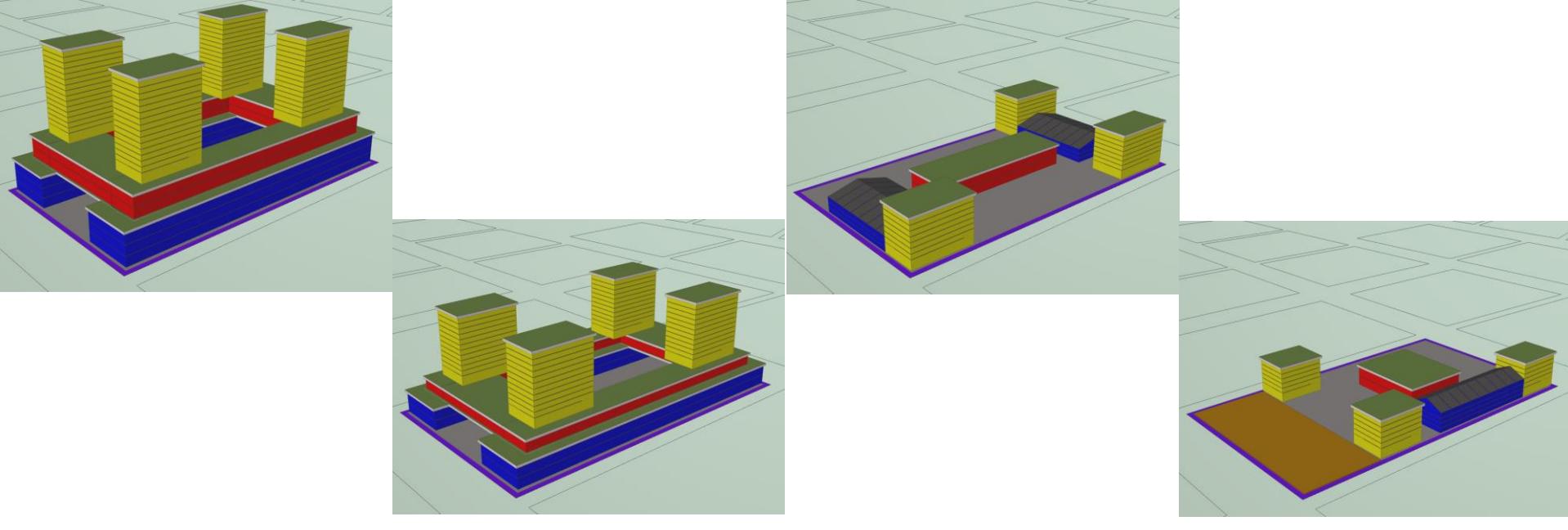
Parametric model



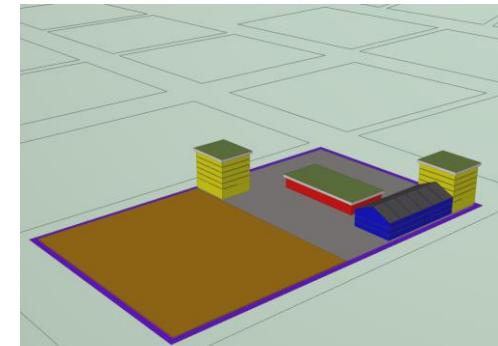
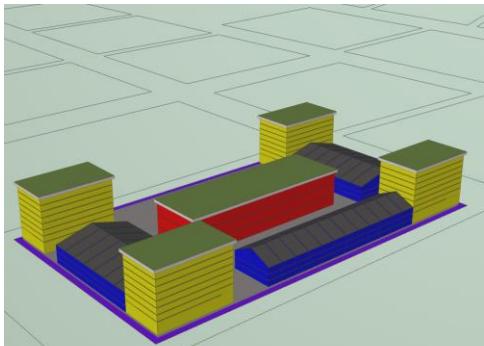
Parameters

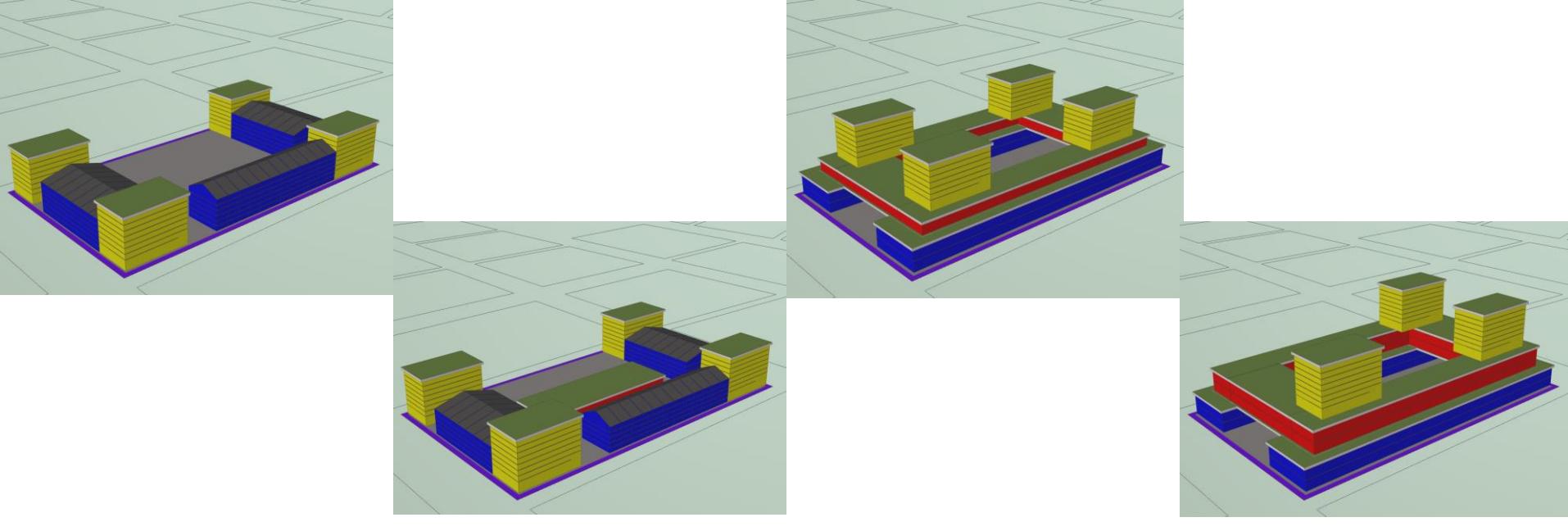


- Parameters are guides
- The model tries to satisfy the parameters
- ‘Intensity’ parameters are relative to one another

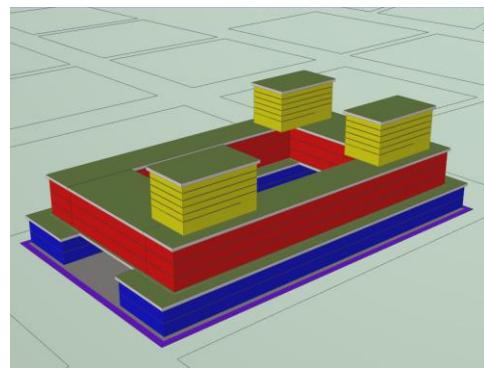
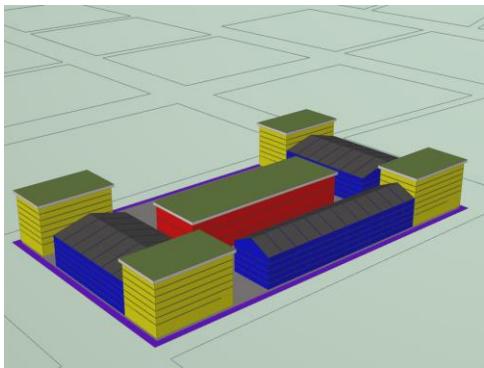


- Reducing plot ratio
- Constant intensities

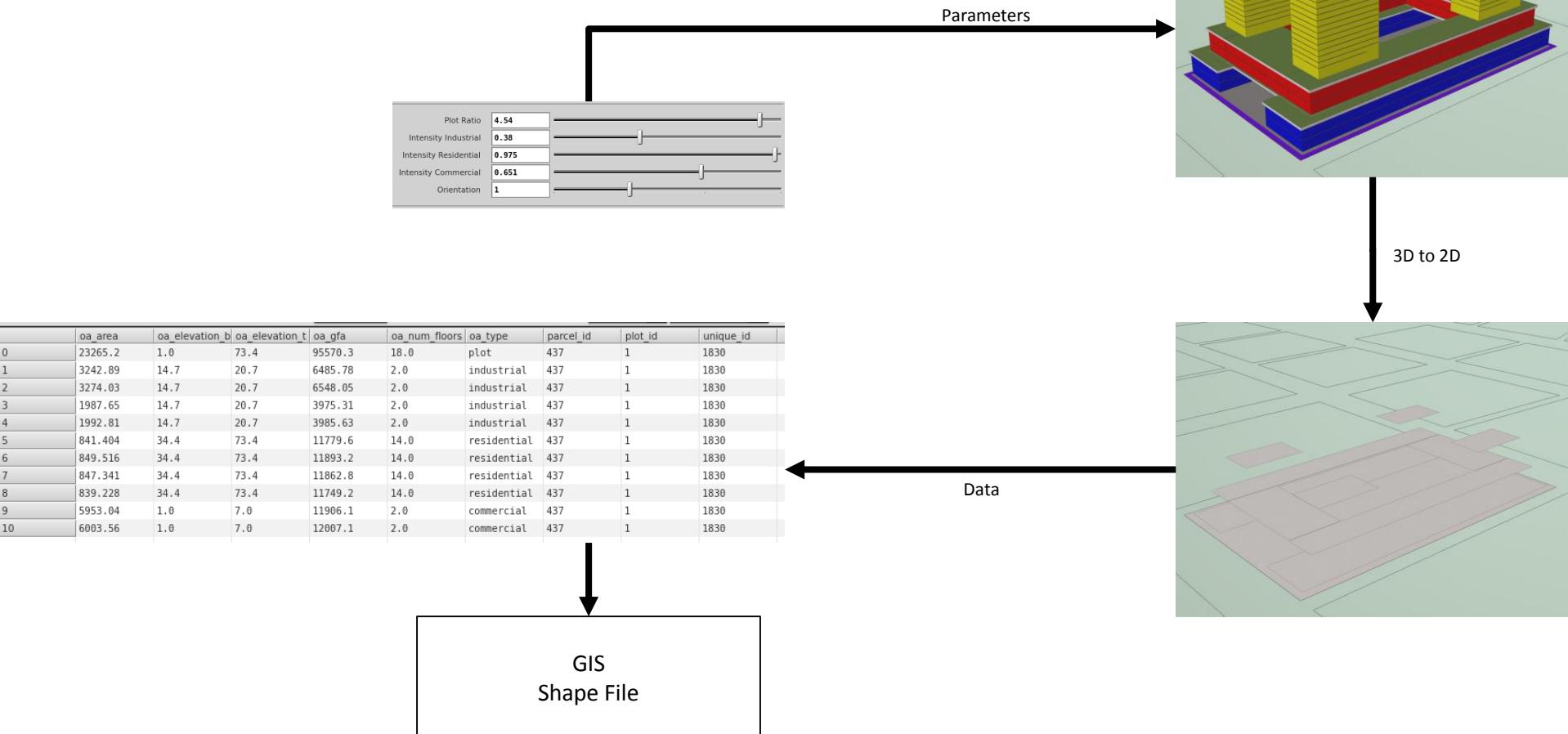


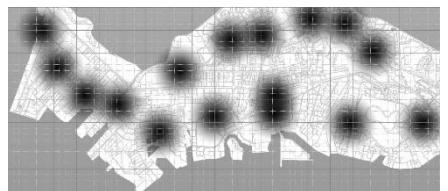
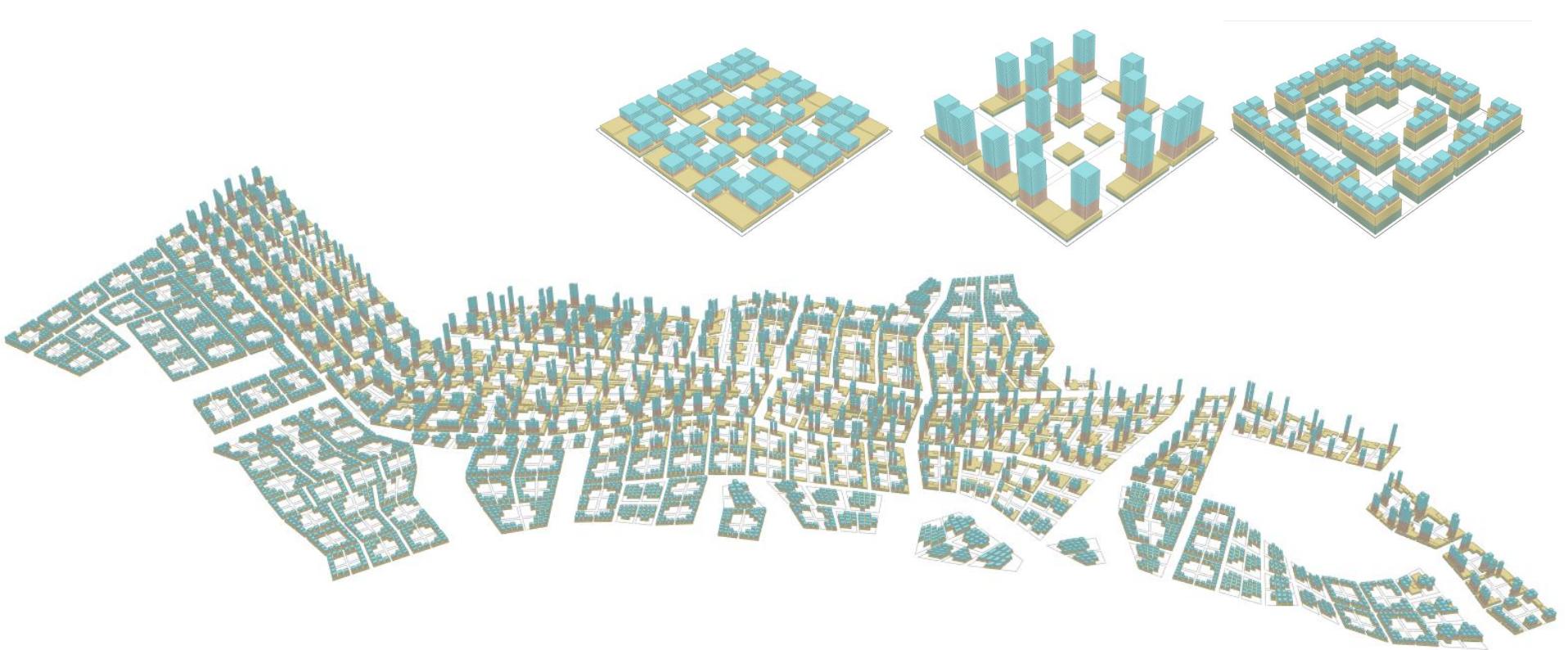


- Constant plot ratio
- Increasing industrial intensity (red)

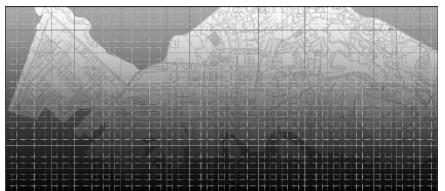


Data extraction from parametric model

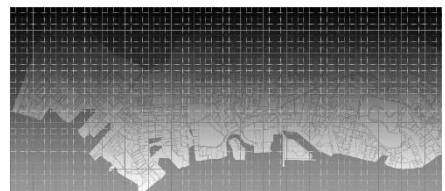




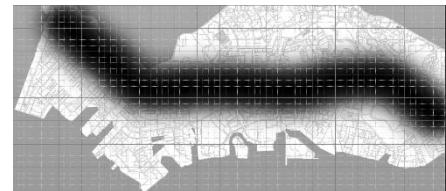
Commercial



Manufacturing



Residential



Number of Floors

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Example:
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Block Typology*

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Feedback

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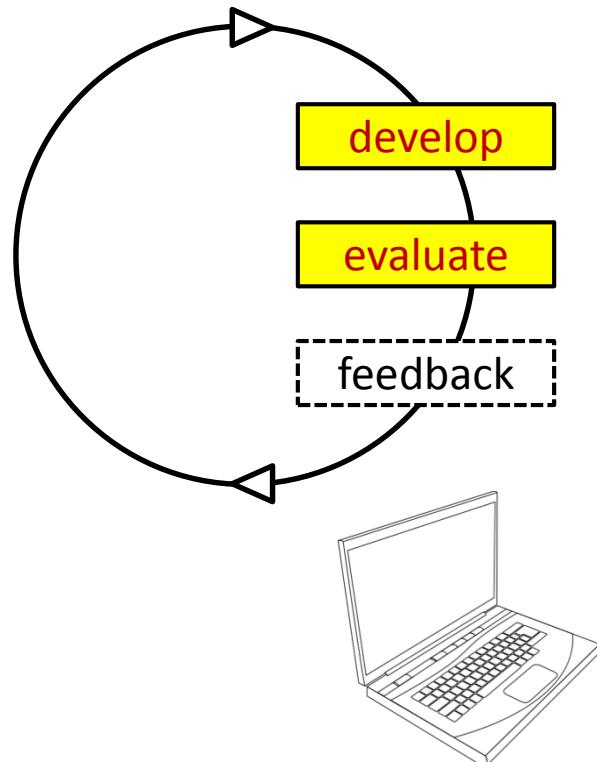
Ongoing
Enhancements

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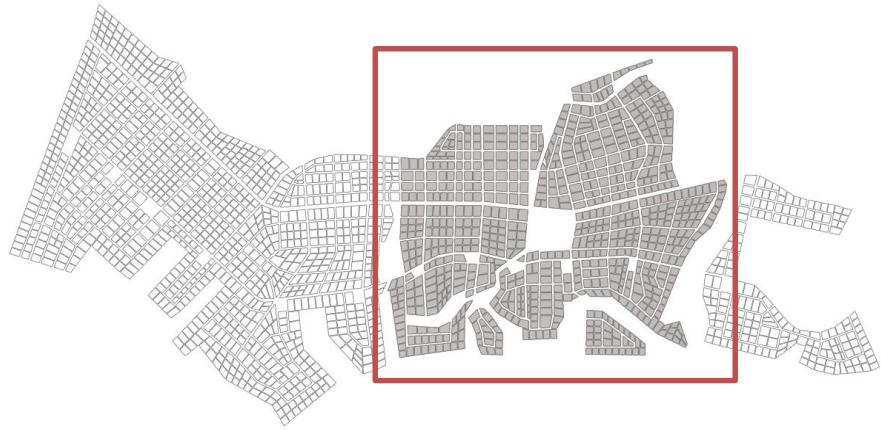
Scenario

- Visions for Jurong Industrial Estate 2050
- Urban planning
- Evaluations
 - Area Quantifications
 - Buffer analysis
 - Network Analysis

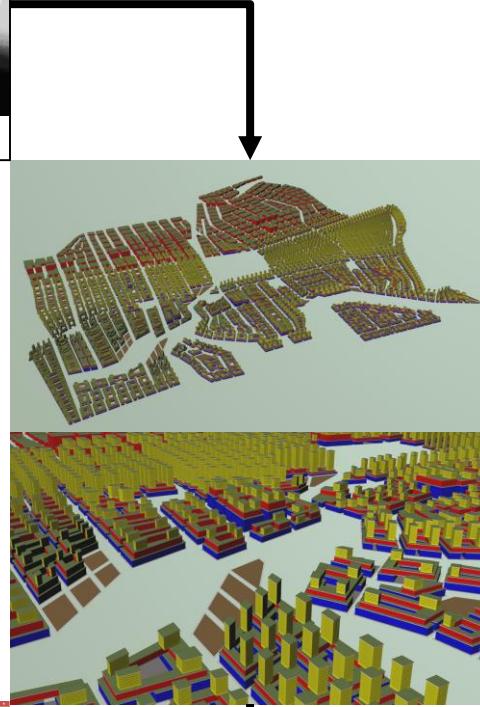
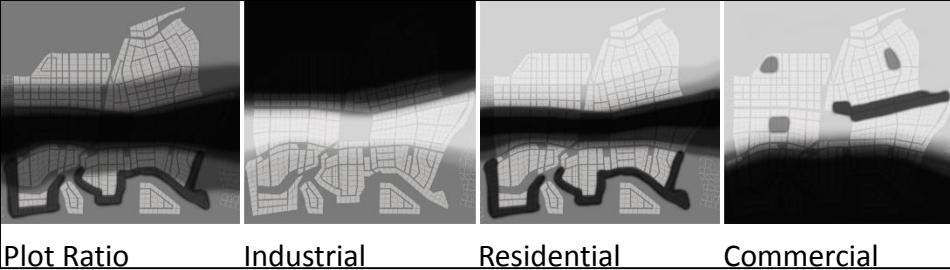


Design decision support

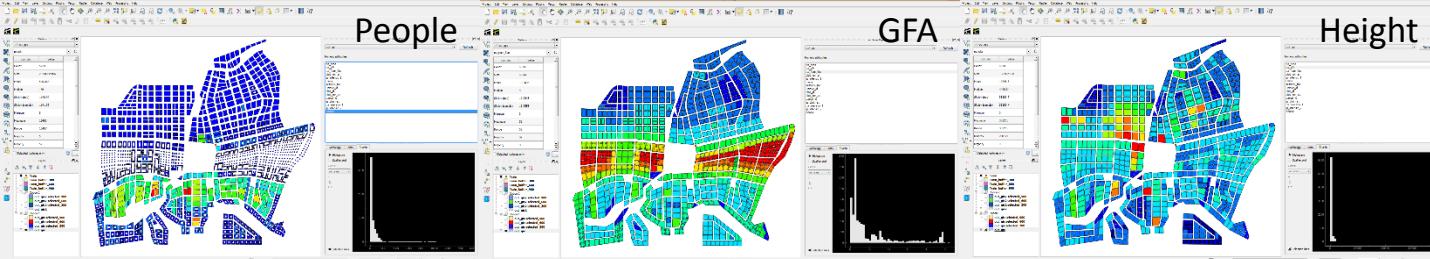
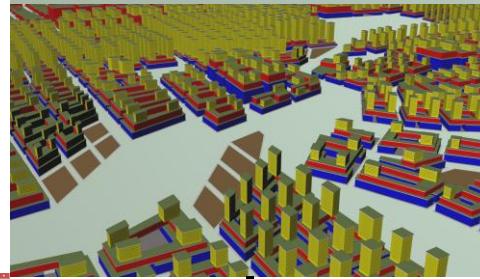
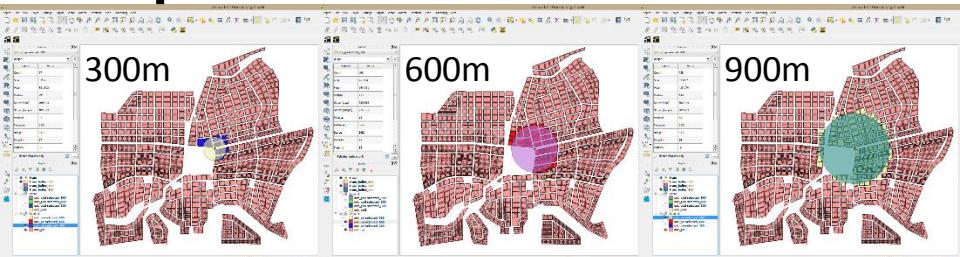
- Experimental Workflow
 1. Create parameter fields
 - 4 image maps for each option
 2. Generate 3D CAD model
 - Full CAD model
 - Simplified GIS model
 3. Analyze results in GIS
 - Quantitative design data
 - Buffer analysis



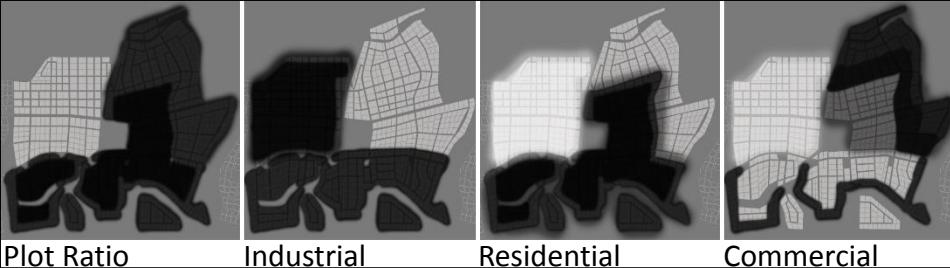
Option 1



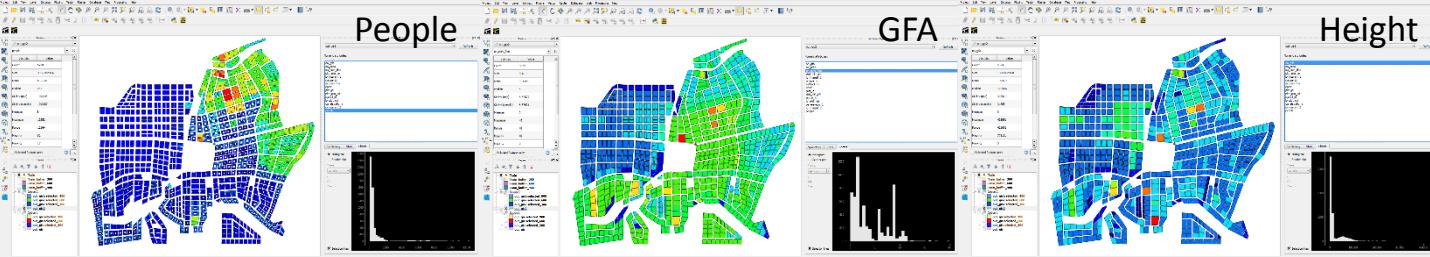
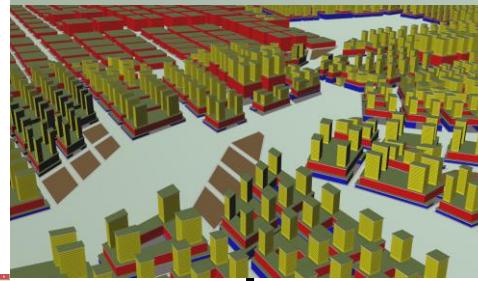
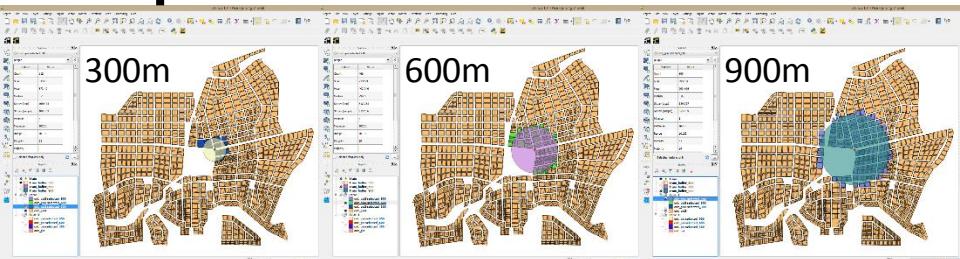
Total (residents):	910,000
300m buffer:	1% of residents
600m buffer:	6% of residents
900m buffer:	14% of residents



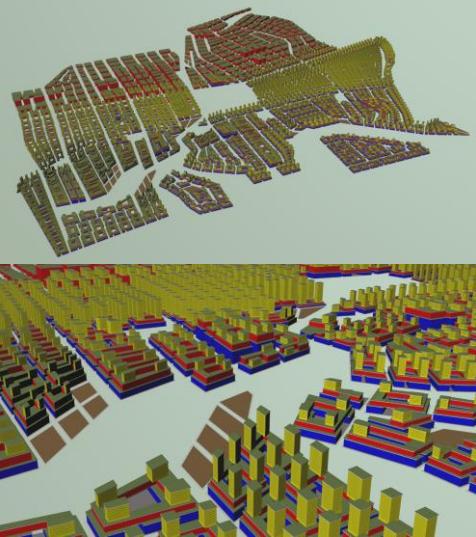
Option 2



Total (residents):	650,000
300m buffer:	2% of residents
600m buffer :	9% of residents
900m buffer :	20% of residents

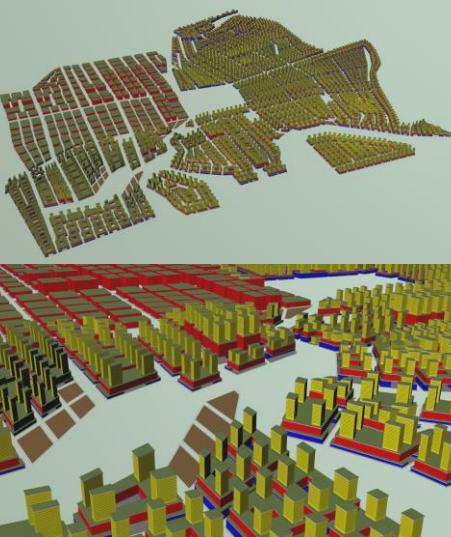
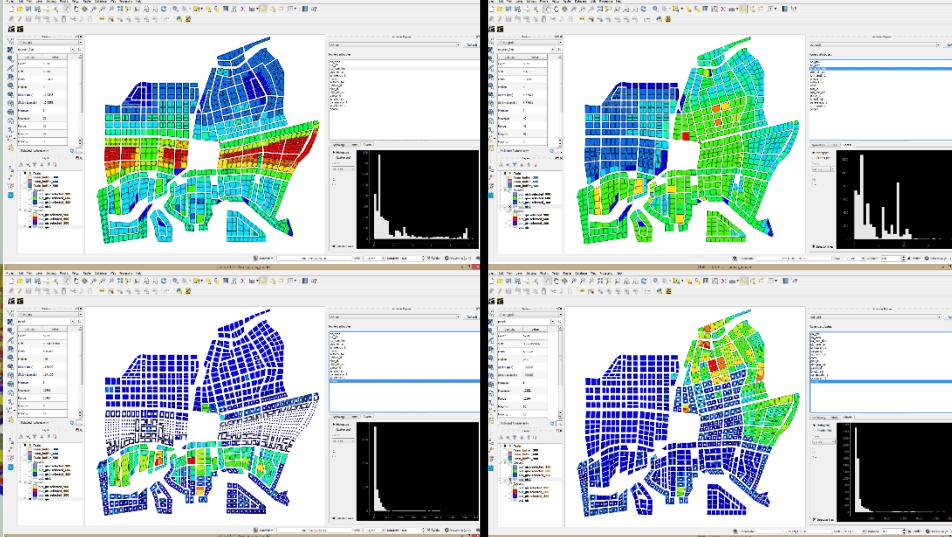


Option 1



Total (residents): 910,000
300m buffer: 1% of residents
600m buffer: 6% of residents
900m buffer: 14% of residents

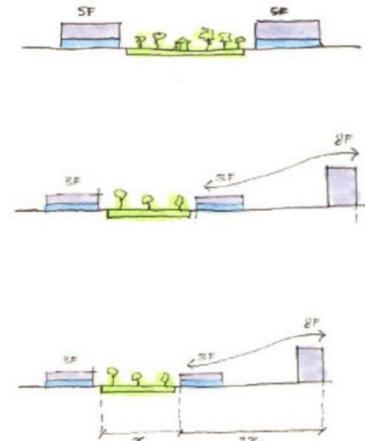
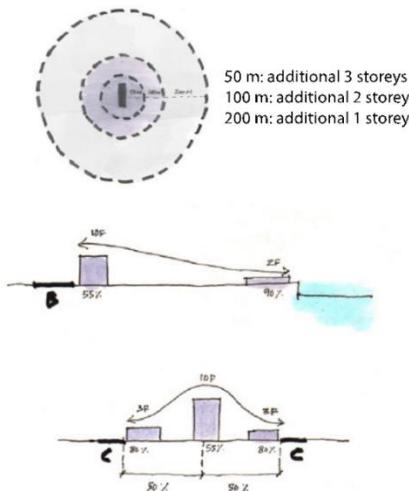
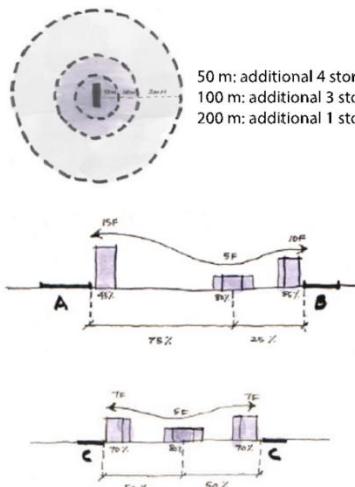
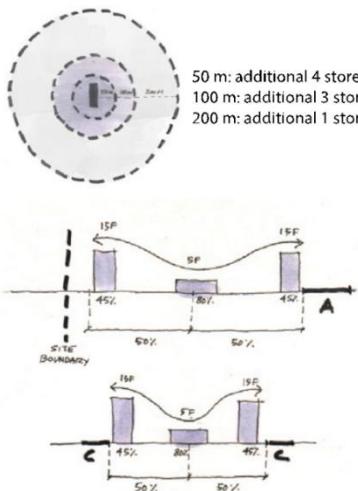
Option 2



Total (residents): 650,000
300m buffer: 2% of residents
600m buffer : 9% of residents
900m buffer : 20% of residents

Case Study

- Students developed a set of rules that defined urban parameters based on the proximity to various elements in the design



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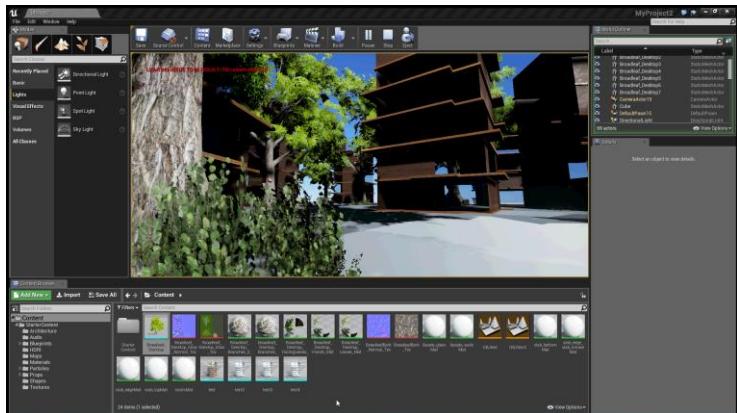
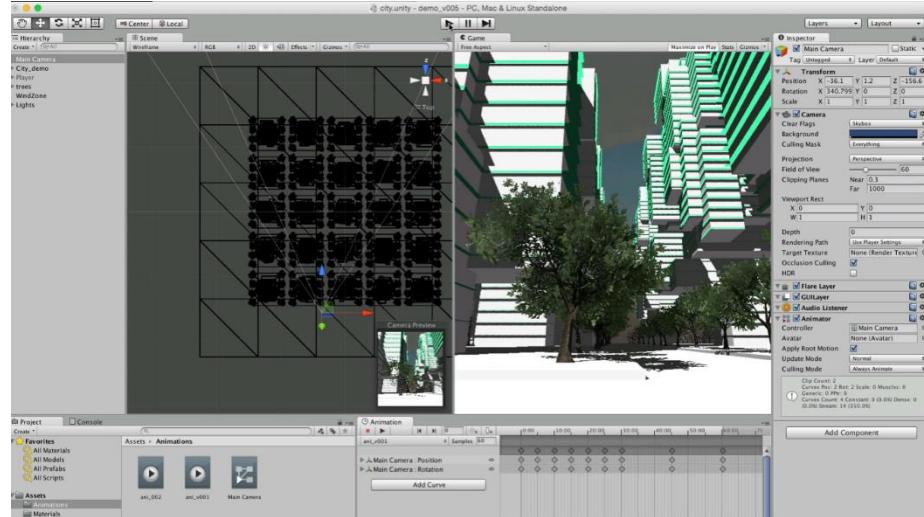
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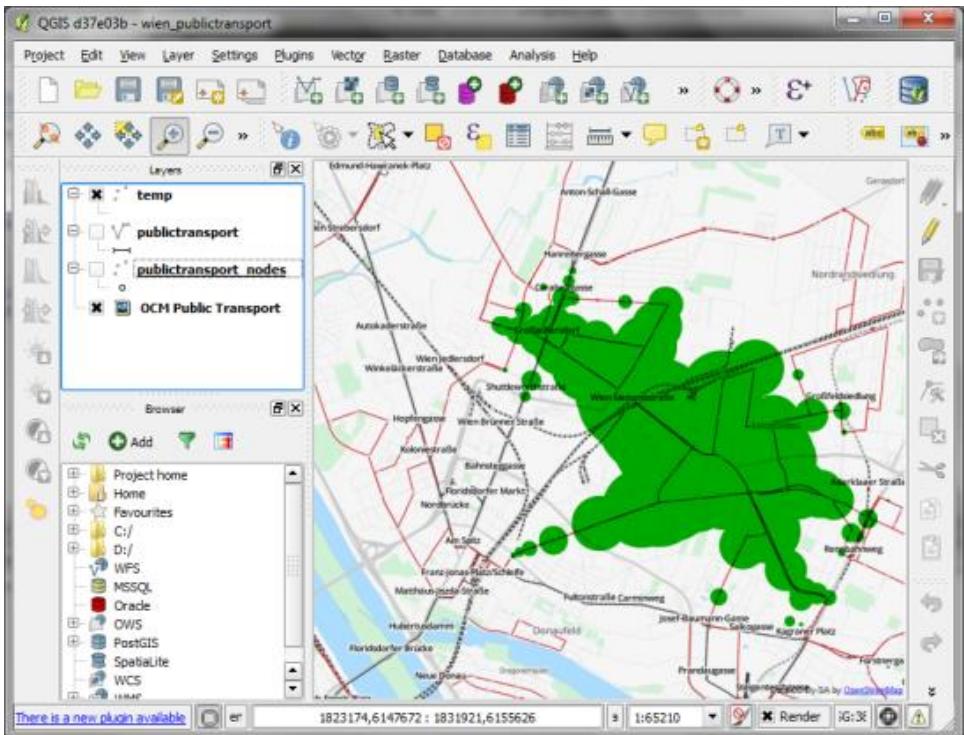
Future
Directions

Visual analysis - Unity3D / Unreal



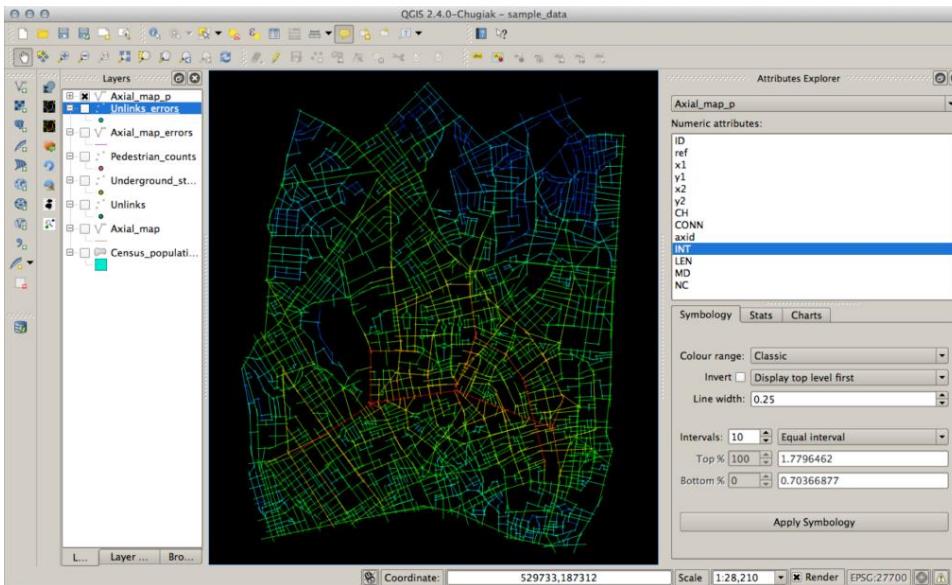
Isochrone analysis

- A map connecting points of equal times
- Requires a connected network with travel speeds define for each link in the network



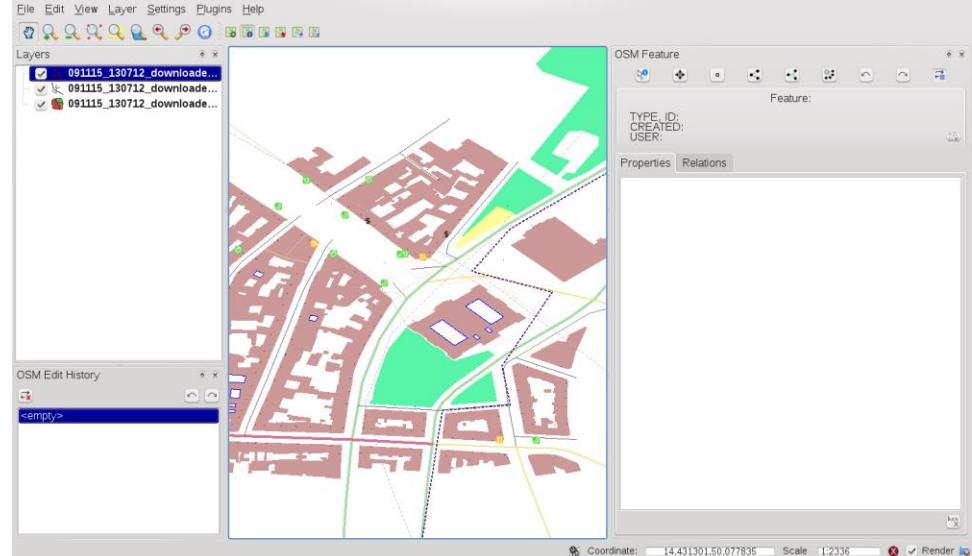
Space Syntax Analysis

- Various types of centrality analysis
- Requires an axial map of the street network
- SpaceSyntax plugin exists for QGIS



Walkability Analysis

- For example, WalkScore
- Requires location of amenities such as shops and schools to be defined
- For existing neighborhoods, the data can be extracted from OpenStreetMap



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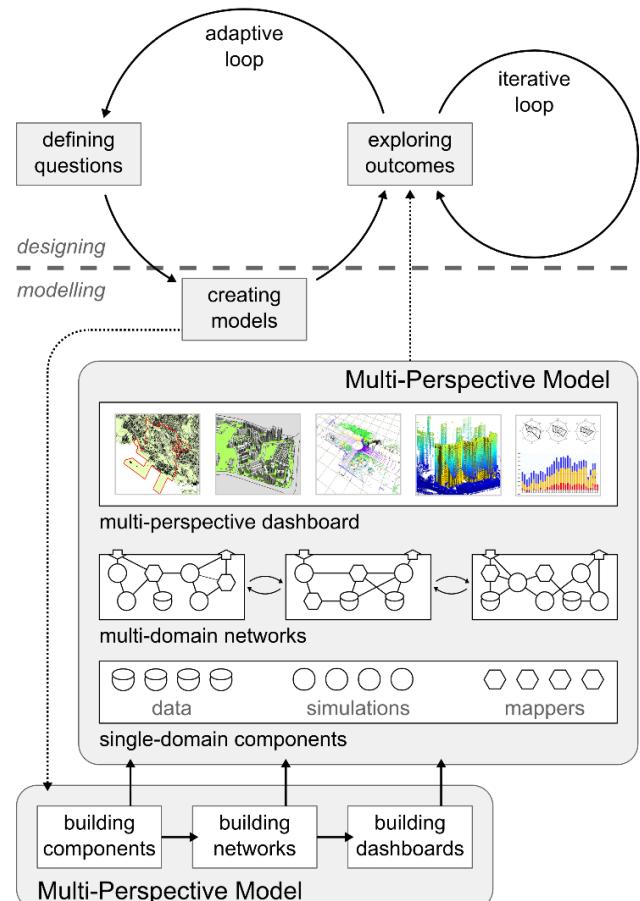
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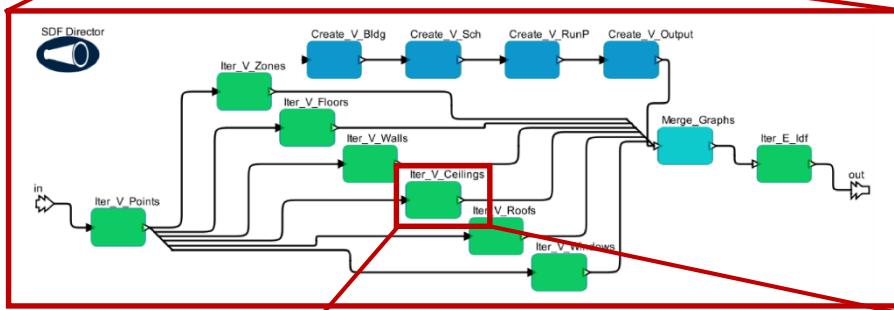
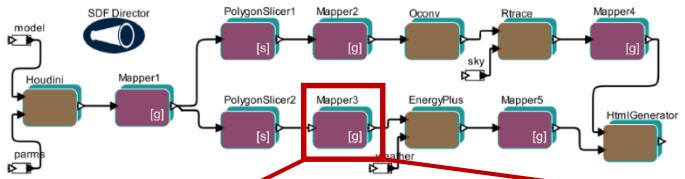
Urban Optioneering Platform

- A future web-based platform
 - Möbius, GIS, and BIM
 - Dexen
- Collaborators
 - Prof Gerhard Schmitt, ETH
 - Prof Leslie Norford, MIT
 - Prof Paul Waddell, UC Berkeley
 - Prof Koen Steemers, UCam
 - Prof Jin Ying, UCam
 - Prof Rudi Stouffs, NUS

Urban Optioneering Method



Urban Optioneering Platform



Each Gremlin node has parameters where the user enters Gremlin commands

code

Gremlin command

Parameter	Parameter value																														
Filter graph: Select	<pre>g.V.has('Entity','polygon').has('Type','ceiling').as('result') .out('boundary_is').has('Entity','polygon').back('result')</pre>																														
Generate vertices: Vertex properties	<table> <tbody> <tr> <td>Object</td><td>:</td><td>'BuildingSurface:Detailed'</td></tr> <tr> <td>Name</td><td>:</td><td>x.Name</td></tr> <tr> <td>Surface_Type</td><td>:</td><td>'CEILING'</td></tr> <tr> <td>Construction_Name</td><td>:</td><td>'light ceiling'</td></tr> <tr> <td>Zone</td><td>:</td><td>x.in('group_contains').Name</td></tr> <tr> <td>Outside_Boundary_Cond</td><td>:</td><td>'SURFACE'</td></tr> <tr> <td>Outside_Boundary_Cond_Object</td><td>:</td><td>x.out('boundary_is').Name</td></tr> <tr> <td>Sun_Exposure</td><td>:</td><td>'NOSUN'</td></tr> <tr> <td>Wind_Exposure</td><td>:</td><td>'NOWIND'</td></tr> <tr> <td>Points</td><td>:</td><td>x.Points</td></tr> </tbody> </table>	Object	:	'BuildingSurface:Detailed'	Name	:	x.Name	Surface_Type	:	'CEILING'	Construction_Name	:	'light ceiling'	Zone	:	x.in('group_contains').Name	Outside_Boundary_Cond	:	'SURFACE'	Outside_Boundary_Cond_Object	:	x.out('boundary_is').Name	Sun_Exposure	:	'NOSUN'	Wind_Exposure	:	'NOWIND'	Points	:	x.Points
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The End.