Newry Innovation Centre

Generative Design Case Study

Peter Monaghan

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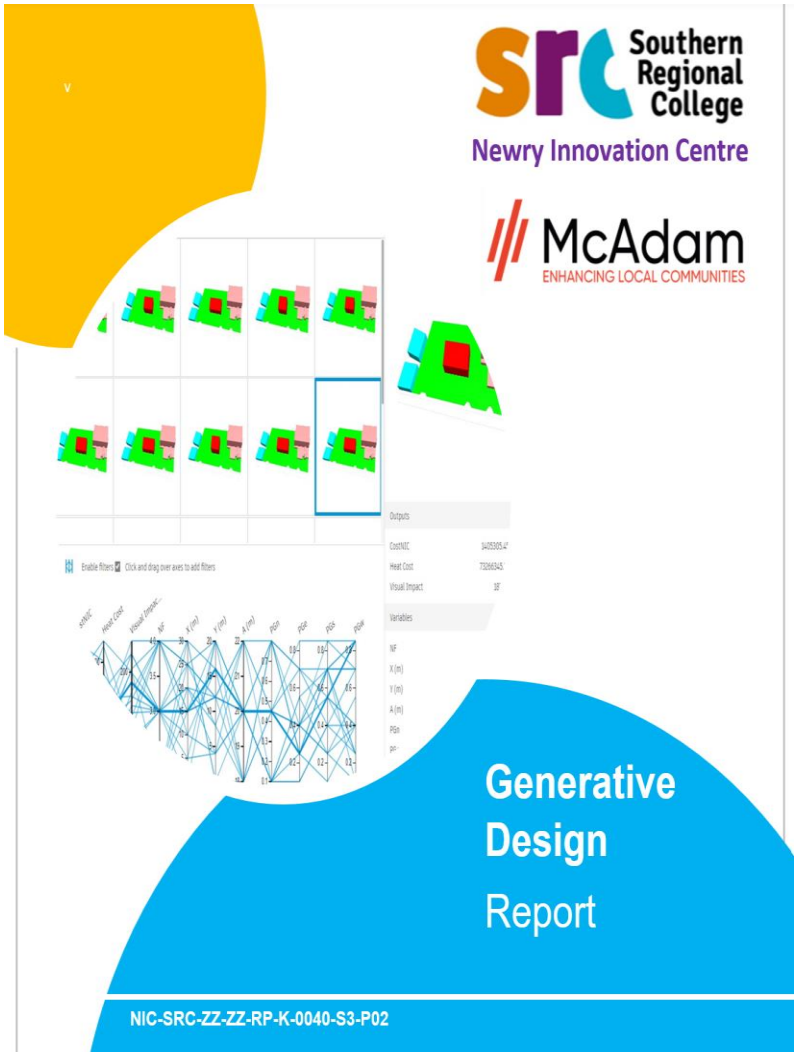
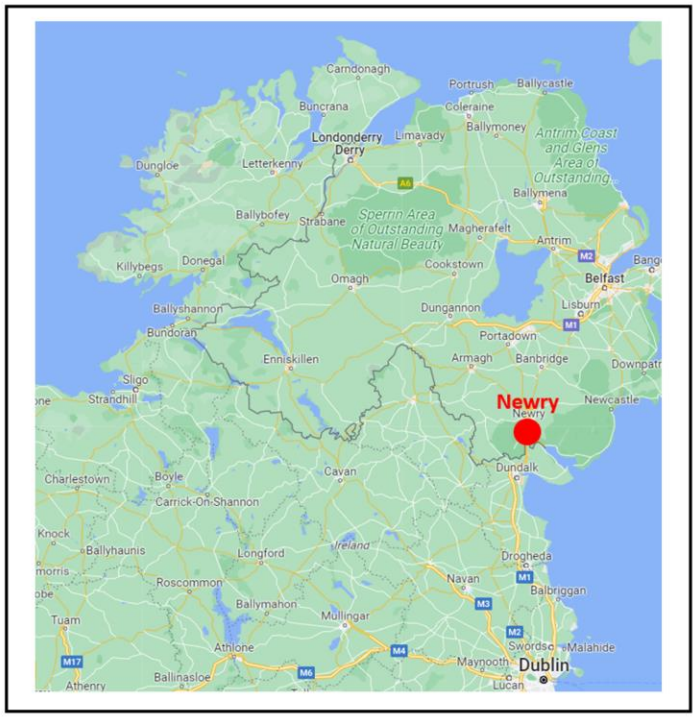
Innovation Clause

Output =**Report**
Roles = **Client & ICT**
Process = **4 Workshops**
Skills = **Design & Cost**





Location

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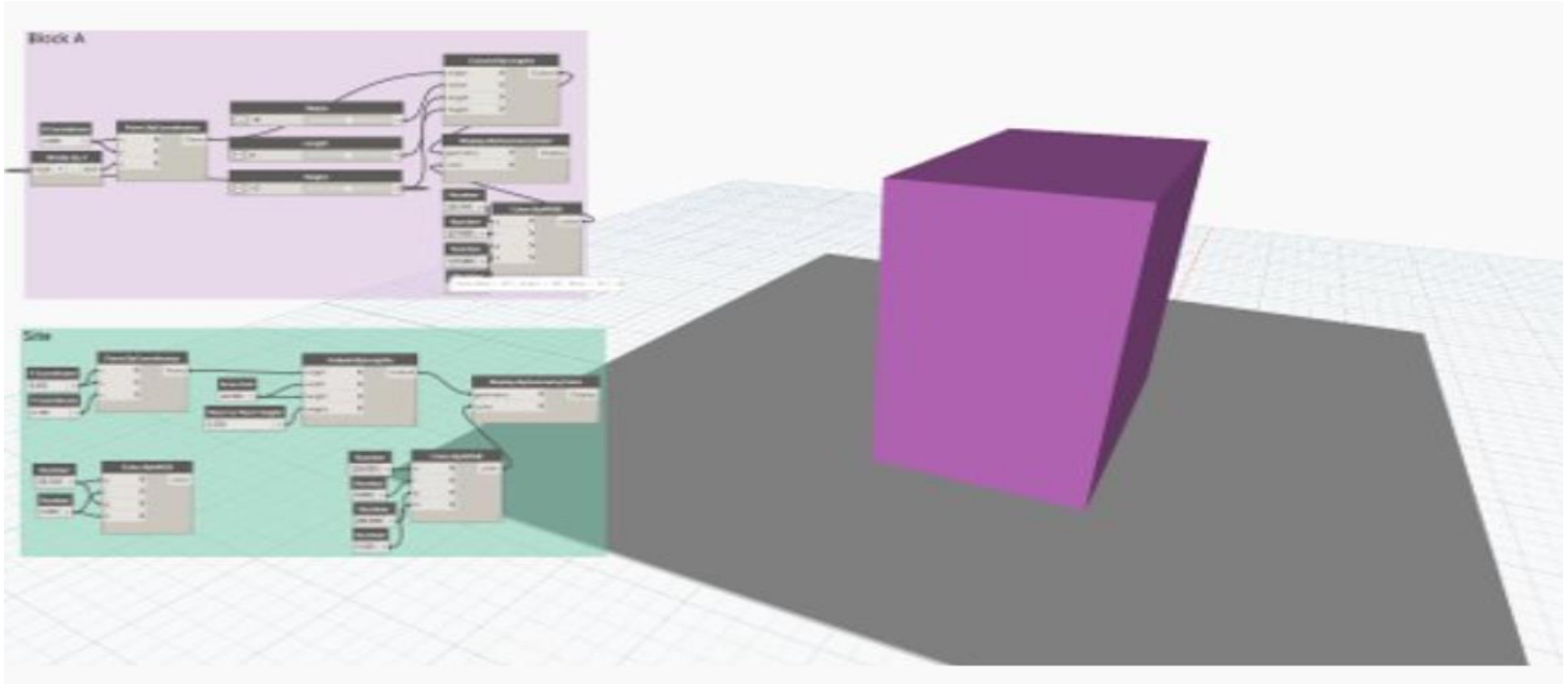
Gross Internal Floor Area 20,000m2



9 Design solutions

Goal: Find the lowest cost solution

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Dynamo

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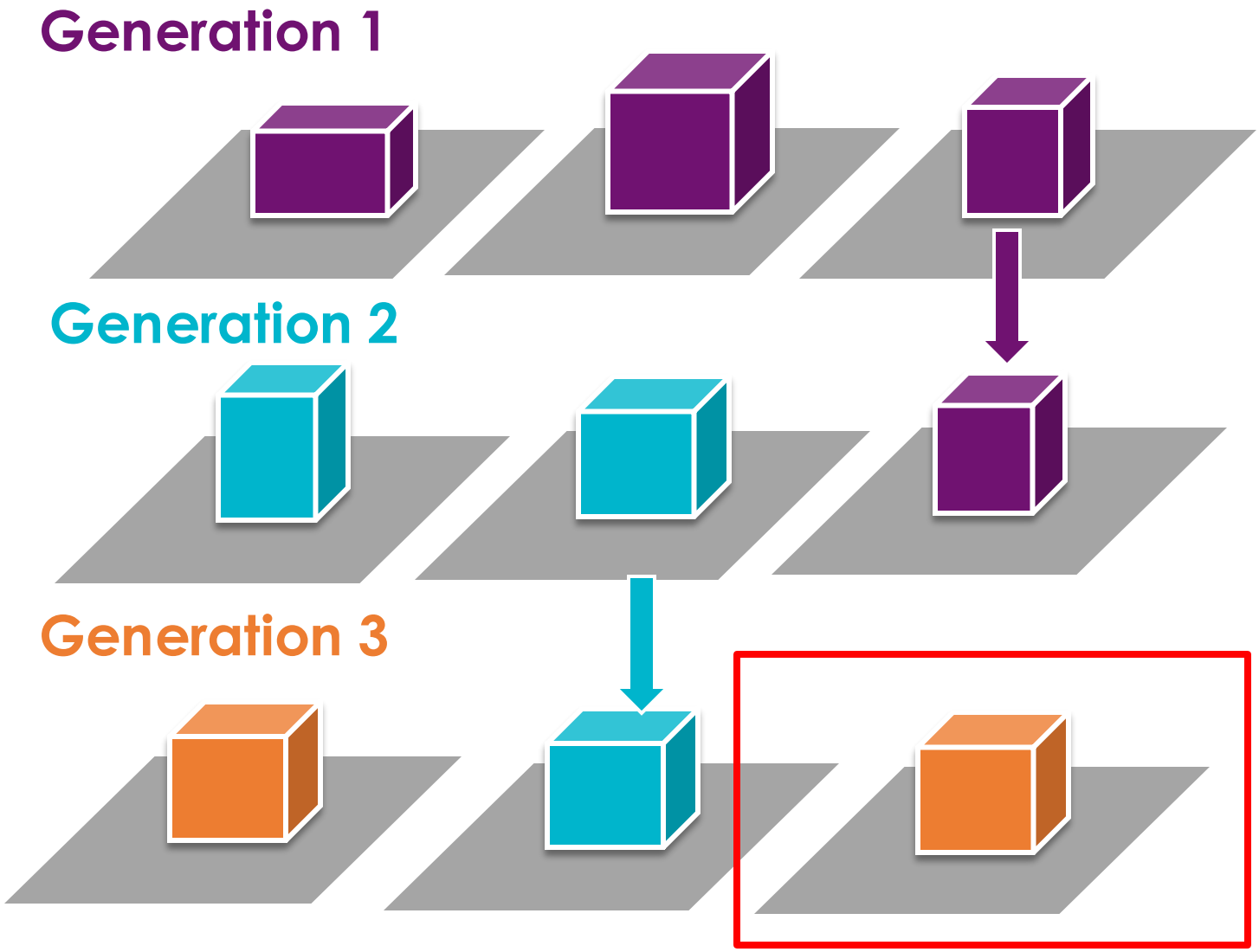

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Generative Design

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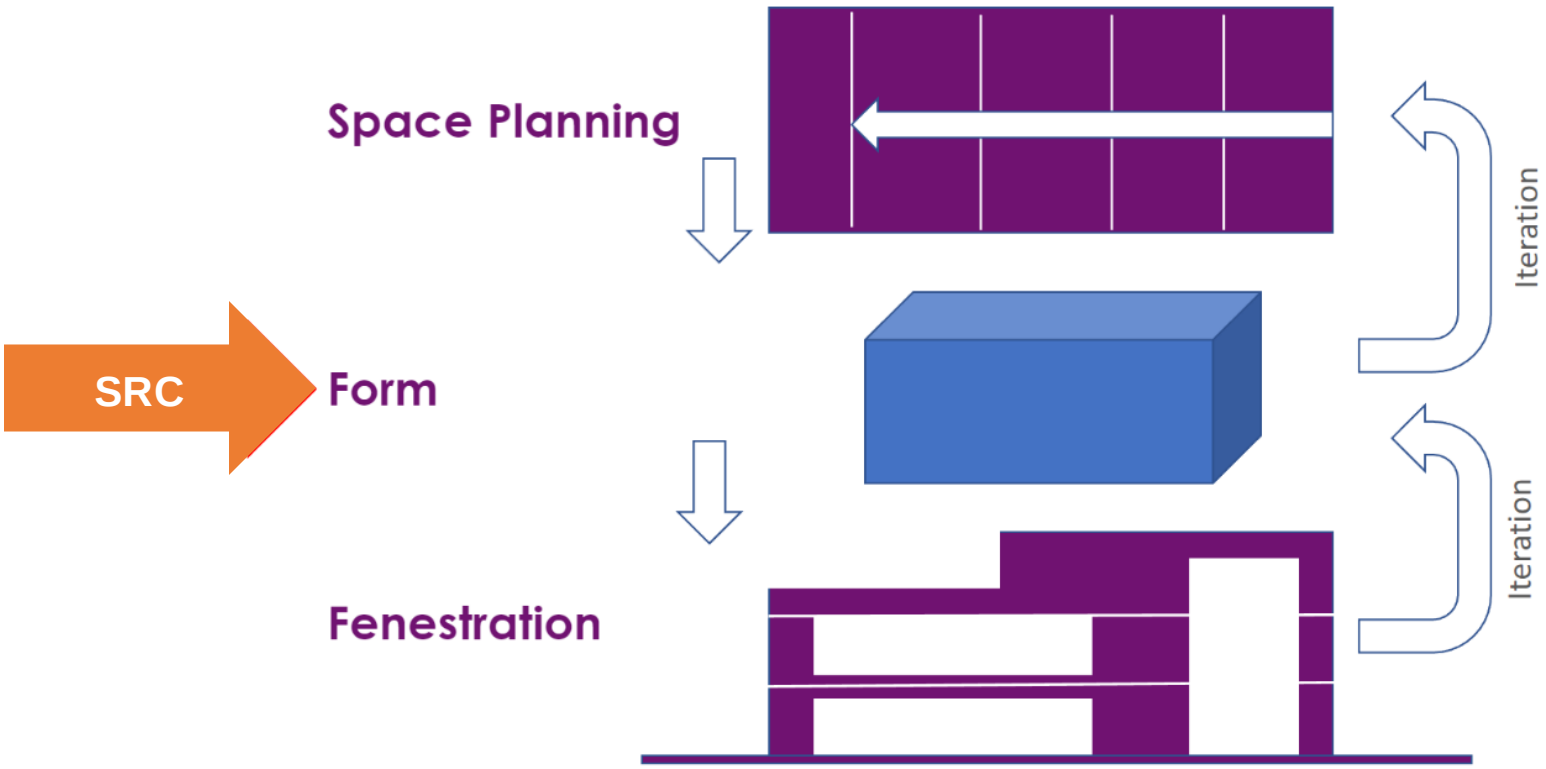

Design Process

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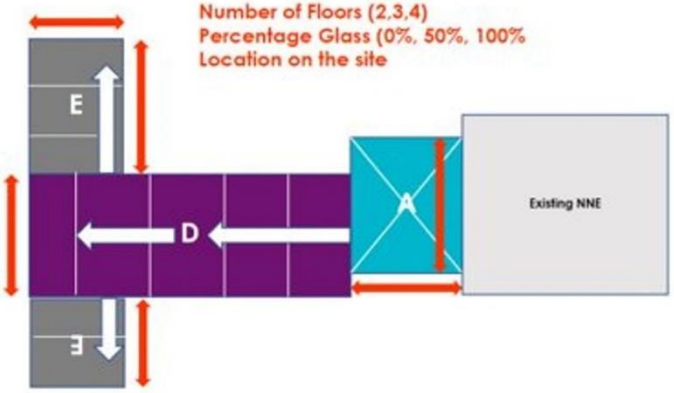
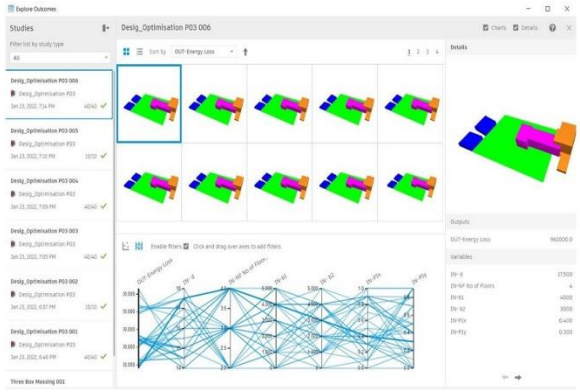
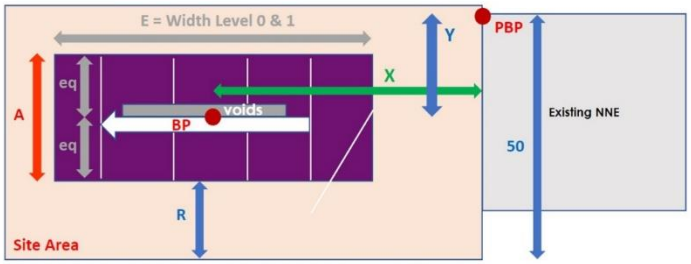
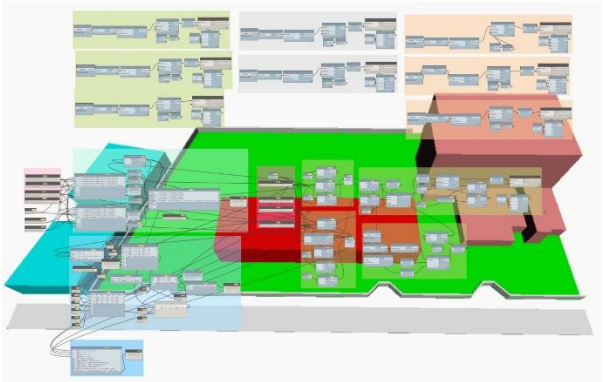




Step 1 **Proof-of-Concept**





Step 2 **MCA Concept**

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Process

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	A	B	C	D	E	F	G	H	I	J	K	L
1	Study type	Desig_Optimisation	Study name	Desig_Optimisation P07 002	Creation time	26/07/2023 14:23	Method	DOE Only	Seed	1	Number of	40
2												
3	ID	CostNIC	Heat Cost	Visual Impact	NF	A (m)	PGn	PGe	PGs	PGw	X (m)	Y (m)
4	fea0361b-a941-4d45-b172-a2d81dc1d339	1495687.366	61160484.34	121.079312	2	22	0.8	0.25	0.4	0.4	5	12
5	621d0a7e-6c15-4a23-9791-67899f631b43	1249679.992	34171801.14	150.7048495	3	22	0.1	0.1	0.7	0.4	5	12
6	2ad072ab-fcc7-443e-b4cd-995712b00f8d	1435950.578	111508101.2	188.7474361	4	18	0.45	0.7	0.25	0.85	5	12
7	6f88a9ec-fc42-4e00-a67e-35b8048f19f0	1338197.404	80662892.7	188.7474361	4	18	0.1	0.55	0.85	0.4	5	12
8	f27d8832-e815-48ca-ae69-f4cdda0dcbec	1472431.995	40520070.42	126.6140729	2	20	0.1	0.25	0.4	0.4	5	12
9	01e8c392-c685-4824-ae40-6e36bc8ad8d5	1471470.477	46926172.41	133.7448721	2	18	0.1	0.4	0.25	0.1	5	12
10	5f626a39-d6e4-4212-843a-2704a6574586	1360257.557	80201274.04	175.8142665	4	20	0.45	0.25	0.85	0.7	5	12
11	d33bad62-0198-4c6e-a39e-a6e4b5a42d20	1626211.906	94812298.39	126.6140729	2	20	0.45	0.7	0.85	0.4	5	12
12	164f44f1-ea99-43b5-a718-5adaf0776684	1397849.379	100295911.1	175.8142665	4	20	0.45	0.55	0.7	0.7	5	12
13	f008bce6-97c8-4056-9912-ee565627f38b	1295798.242	46441602.85	159.414202	3	20	0.1	0.25	0.7	0.4	5	12
14	e10e3bc3-2723-4721-90ce-897cd70fb7d5	1561586.661	76899886.98	126.6140729	2	20	0.45	0.55	0.4	0.4	5	12
15	079abc6b-a642-4f02-bcf0-3b7497eebf19	1255293.407	59671189.88	150.7048495	3	22	0.45	0.4	0.4	0.1	5	12
16	2932781c-6000-4586-9991-ca7d31612eb2	1555282.615	83048145.07	126.6140729	2	20	0.8	0.55	0.4	0.25	5	12
17	075ef5fa-c2d9-4216-bbb9-265d3c314143	1382264.655	95672685.15	150.7048495	3	22	0.8	0.55	0.7	0.25	5	12
18	d107843a-afe7-42f4-a19c-e3019da753f2	1319448.431	67856910.18	150.7048495	3	22	0.45	0.4	0.25	0.55	5	12
19	f0cd5d4a-cbf8-461d-a23f-9596b93ffedf	1498611.352	132958647.4	188.7474361	4	18	0.8	0.7	0.7	0.7	5	12
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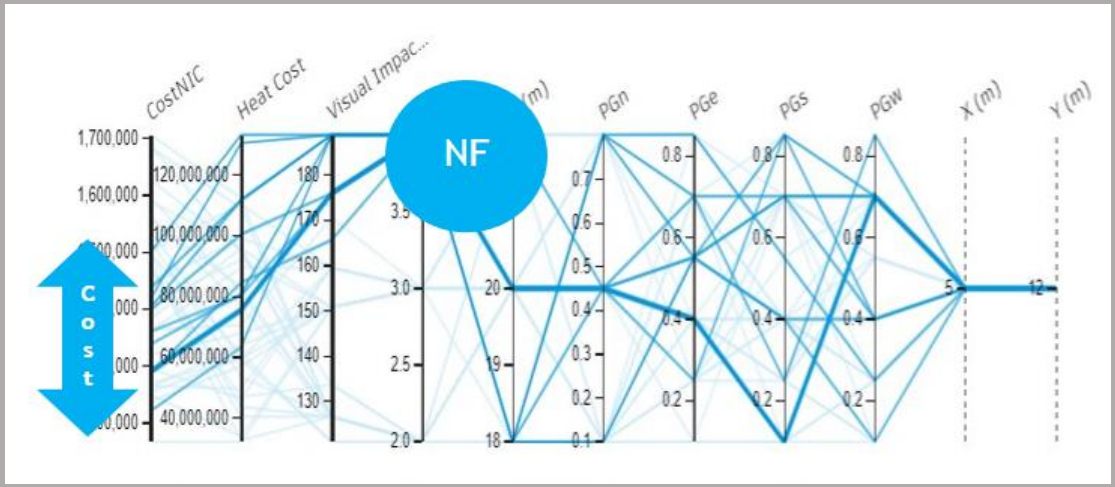
28	bb76483f-7f17-4ff5-893a-7c9b55c51b65	1537502.801	59266374.4	121.079312	2	22	0.45	0.25	0.55	0.7	5	12



Step 3 **Data Analysis**

Step 4 **Lessons Learned**

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Process

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1. Cost & nrm

1	Substructure
1.1	Substructure
2	Superstructure
2.1	Frame
2.2	Upper floors
2.3	Roof
2.4	Stairs and ramps
2.5	External walls
2.6	Windows and exte
2.7	Internal Wall and
2.8	Internal doors

Substructure

Roof

External Walls

Windows & External Doors

nrm 1

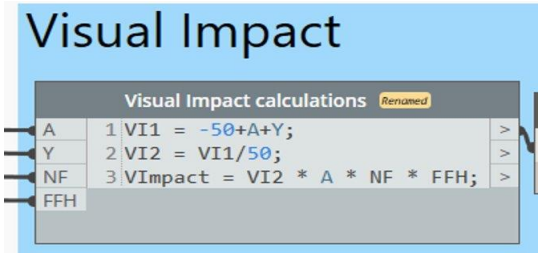
RICS new rules of measurement

Order of cost estimating and cost planning for capital building works

2. Energy & PHPP

Annual Space Heat Demand		Transmission Heat Losses		Ventilation Heat Losses		Utilization factor for free heat gains		Solar Gains		Internal Heat Gains
Q_H	=	Q_T	+	Q_V	-	η	×	(Q_S	+	Q_I)
2,211 kWh/a		5,835 kWh/a		759 kWh/a		0.94		2,937 kWh/a		1,722 kWh/a
q_H	=	q_T	+	q_V	-	η	×	(q_S	+	q_I)
14 kWh/(m²a)		37.4 kWh/(m²a)		4.9 kWh/(m²a)		0.94		(18.8 kWh/(m²a)		11.0 kWh/(m²a))

3. Visual Impact & ?



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Algorithms

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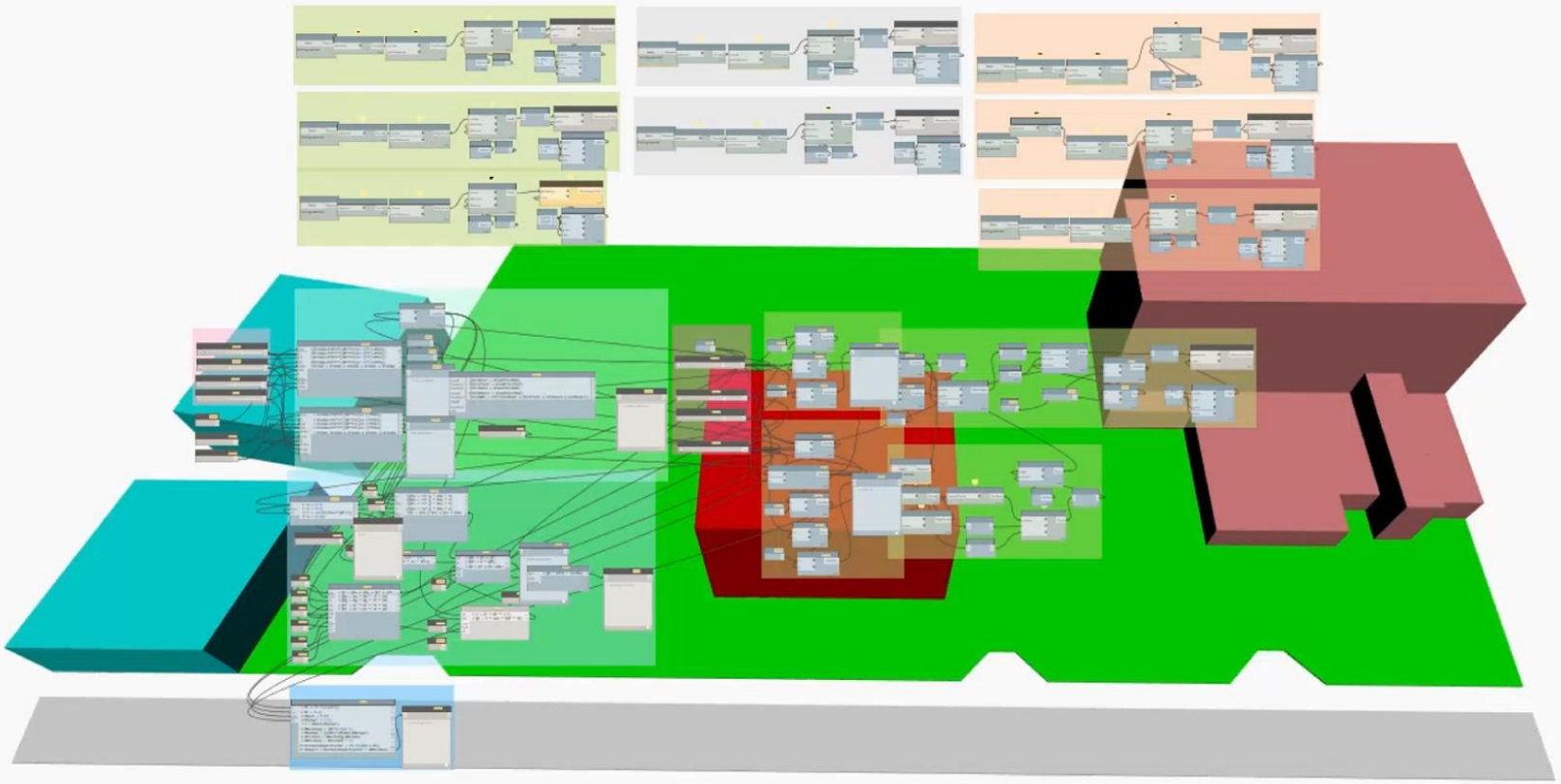

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Stage 2 Concept

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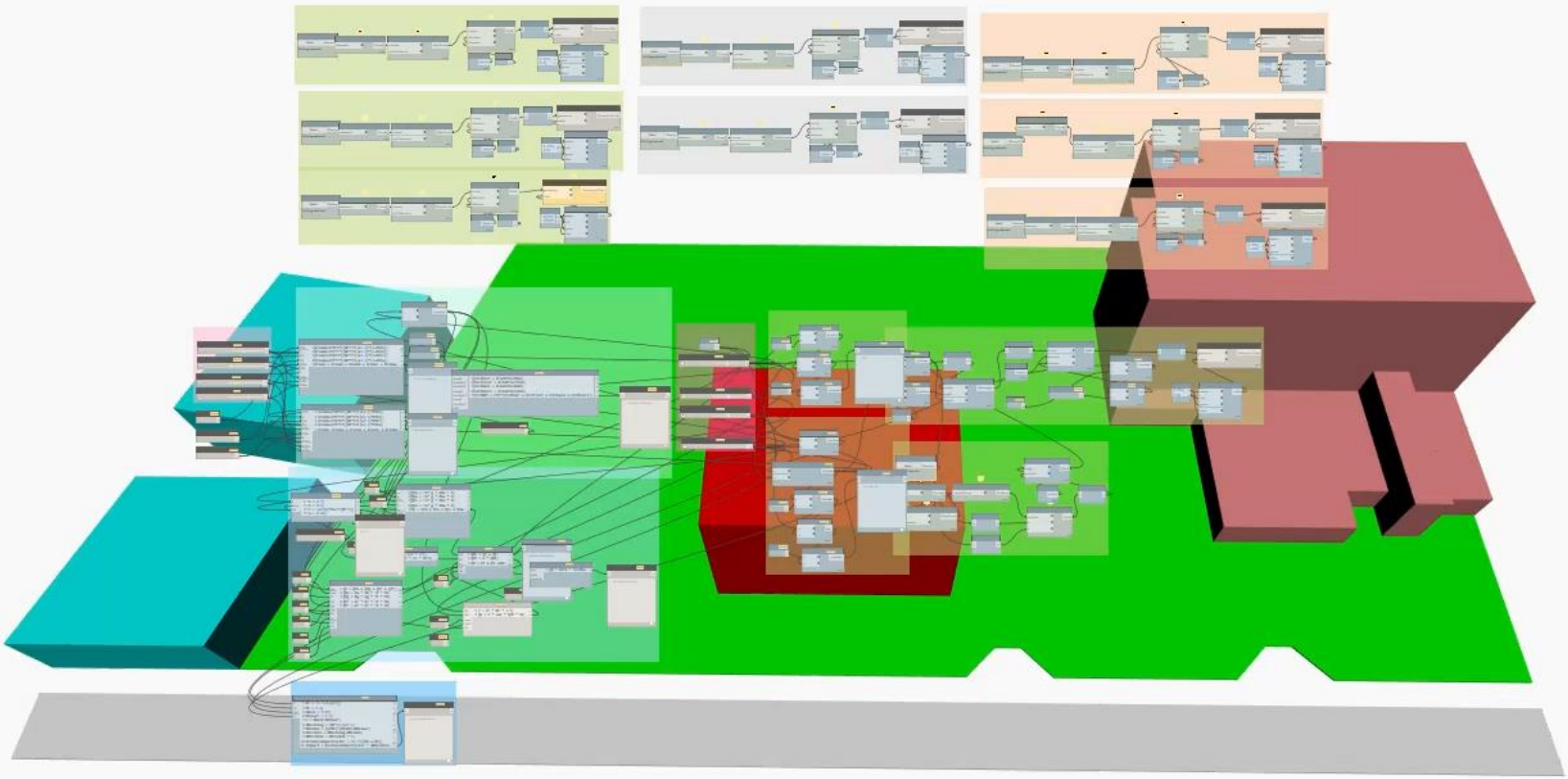

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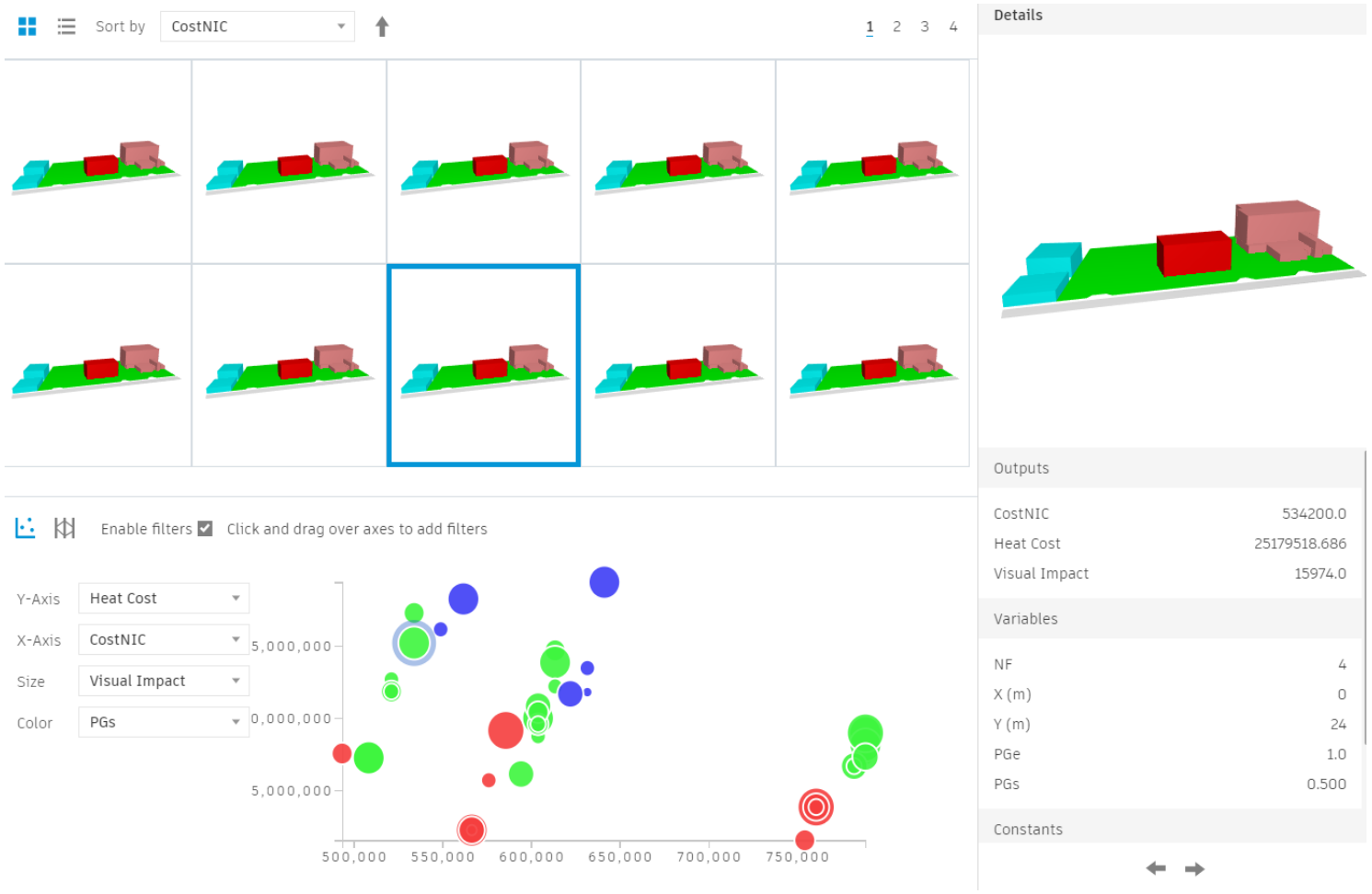
Stage 2 Concept

src Southern Regional College



Data Analysis

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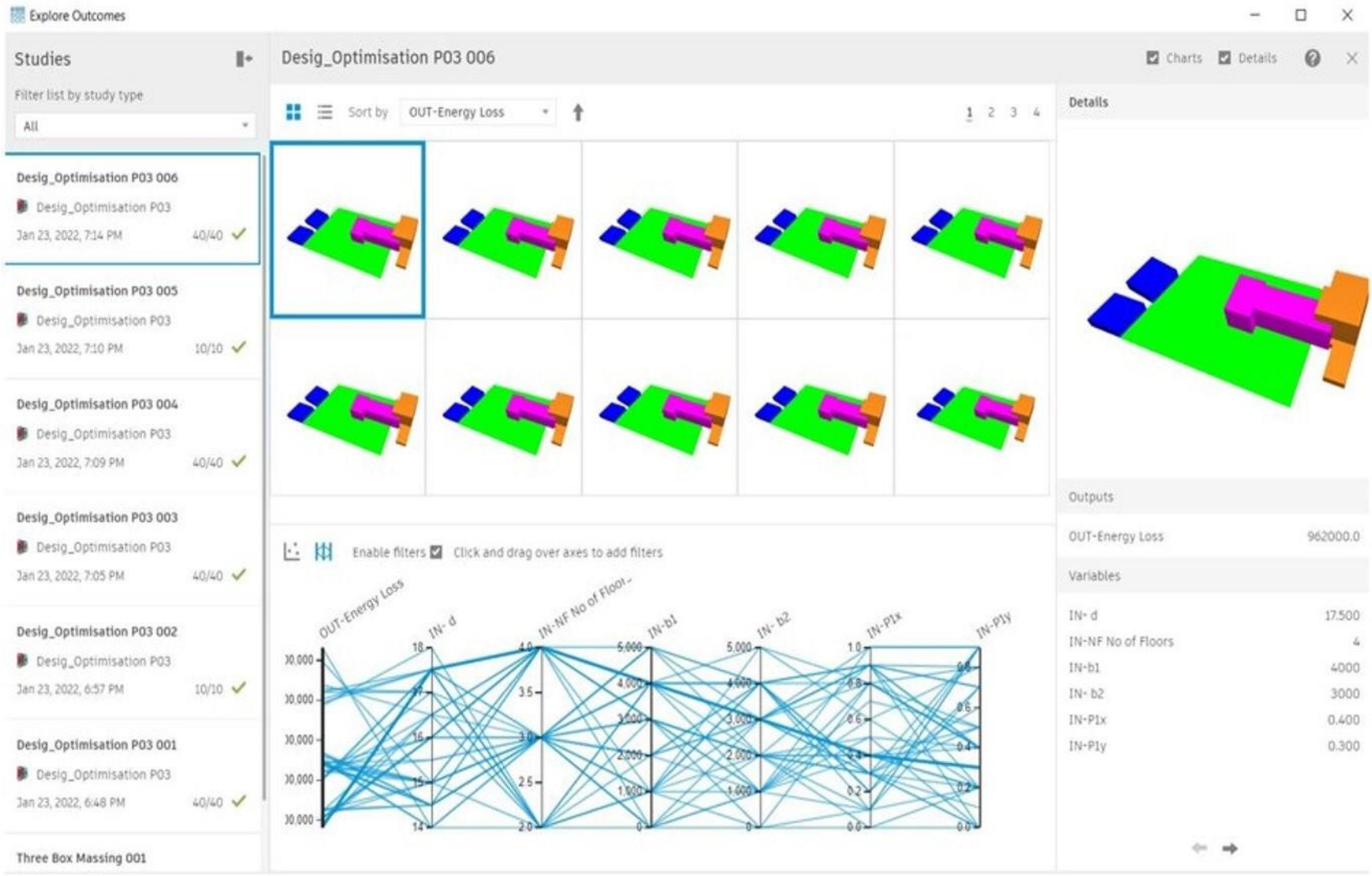

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Data Analysis

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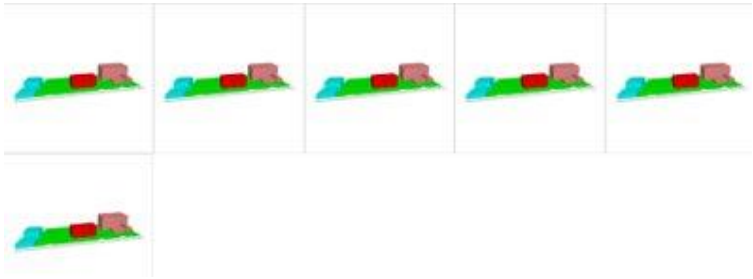

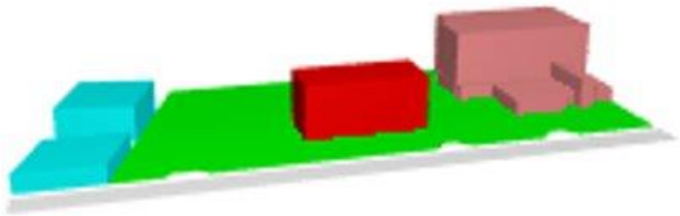

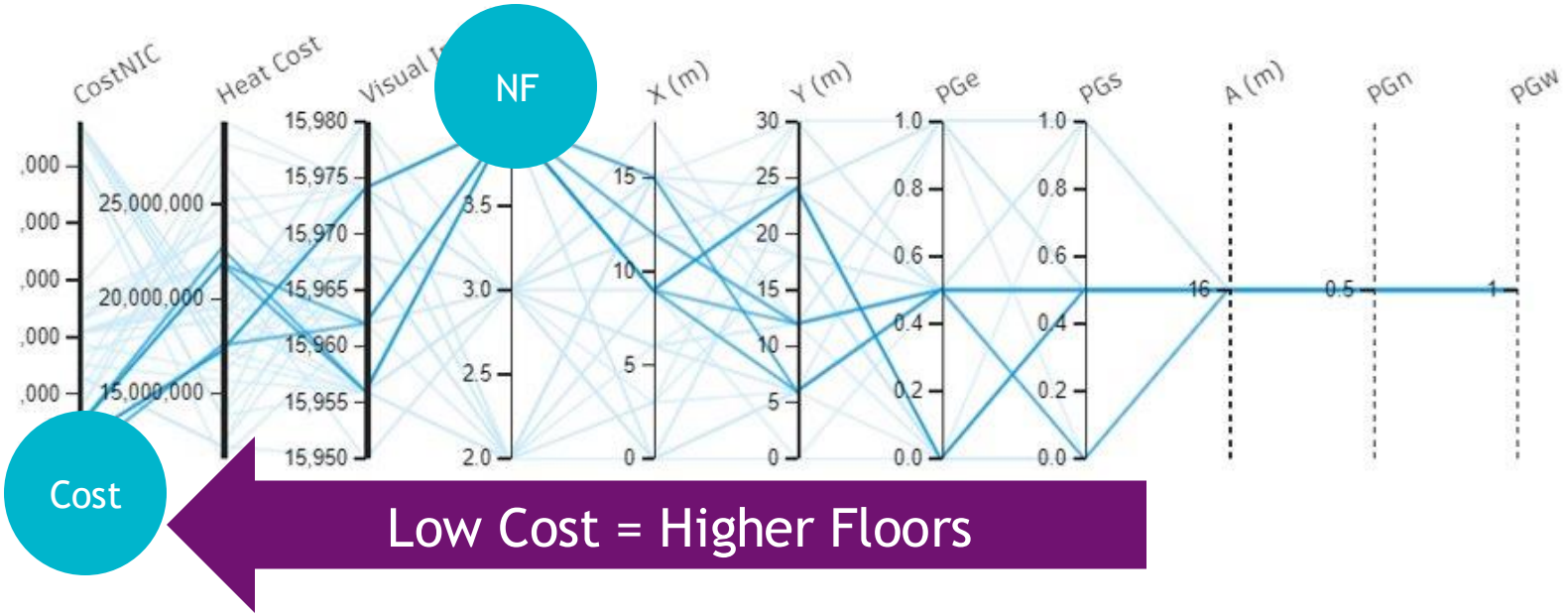
CostNIC
Heat Cost
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NF
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Y (m)
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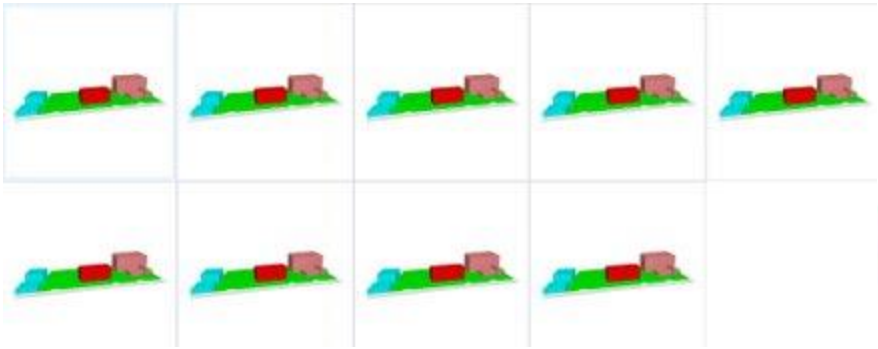
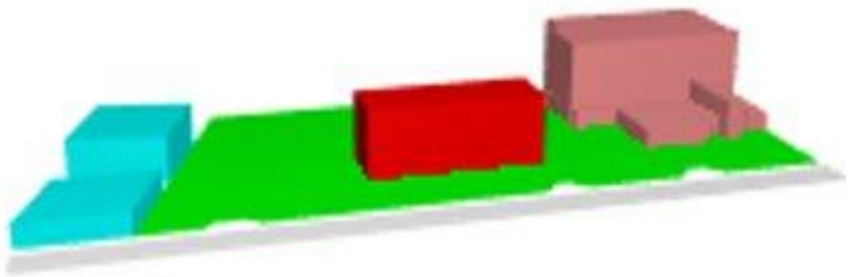
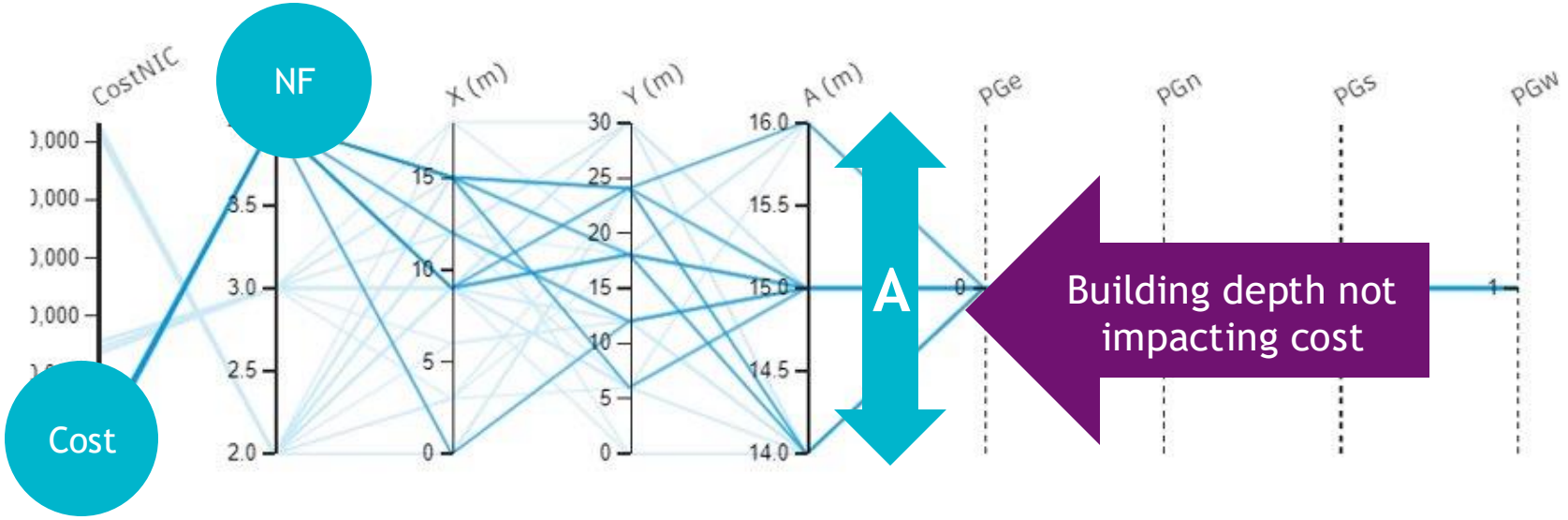
0.5
1
Cost
Low Cost = Higher Floors

Cost Study **1**







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Cost Study **2**

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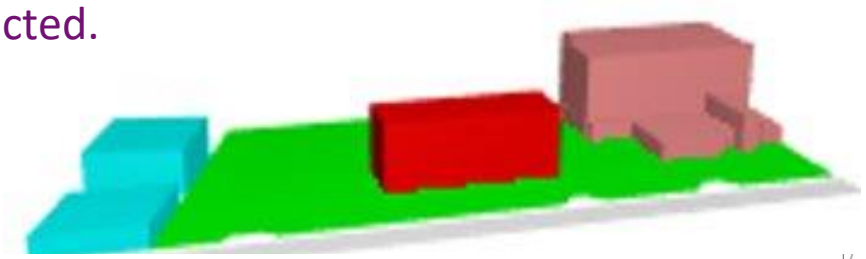
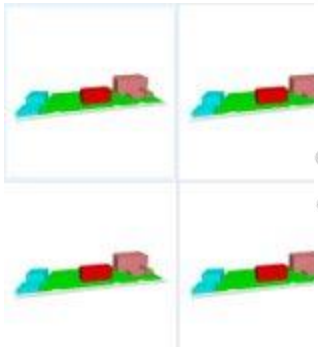
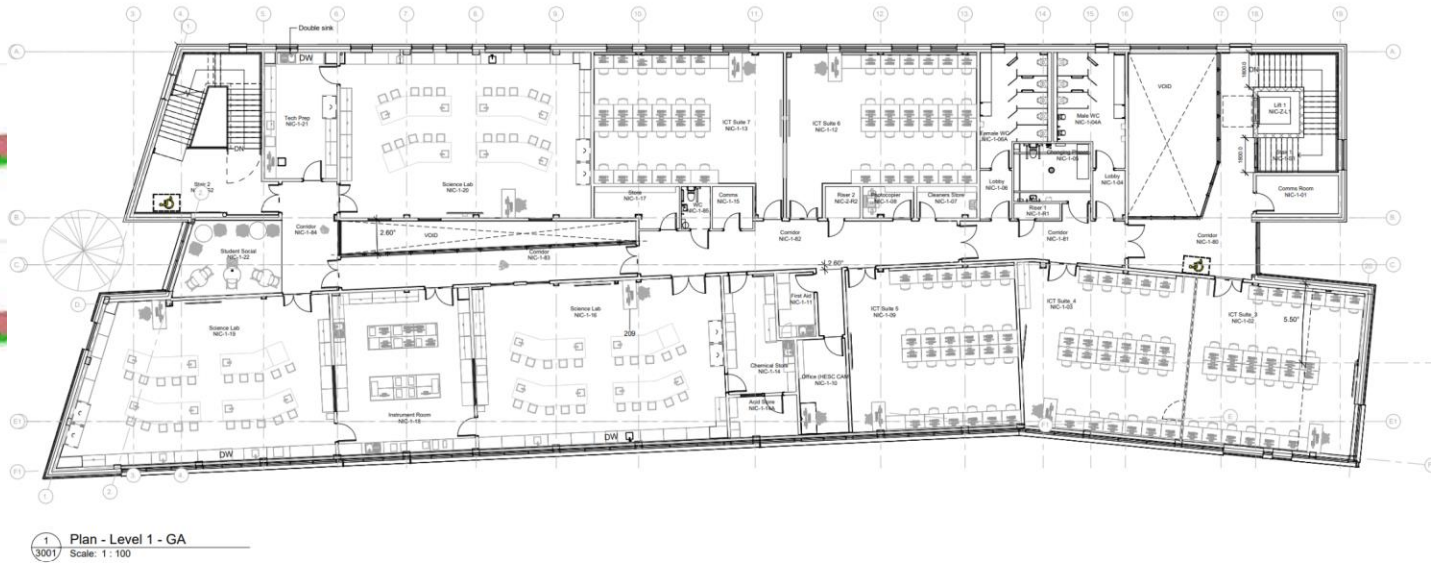
1. **GD model simplified the Concept Design.** Calibration Factor added.
2. **GIFA excluded voids.** Voids added.
3. **Mathematical errors.** These were corrected.
4. **NIFA required.** Lesson learned.







Calibration

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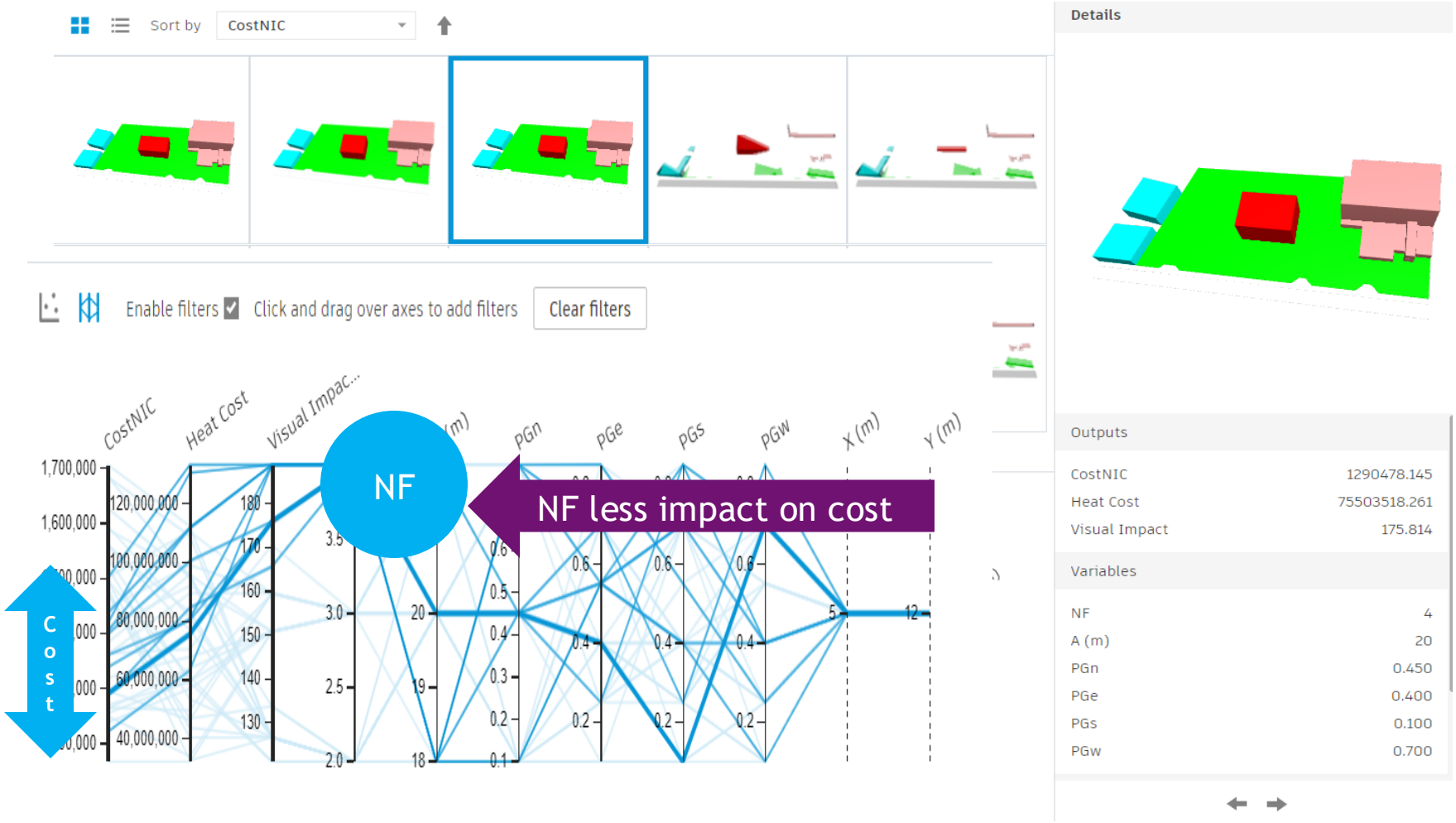

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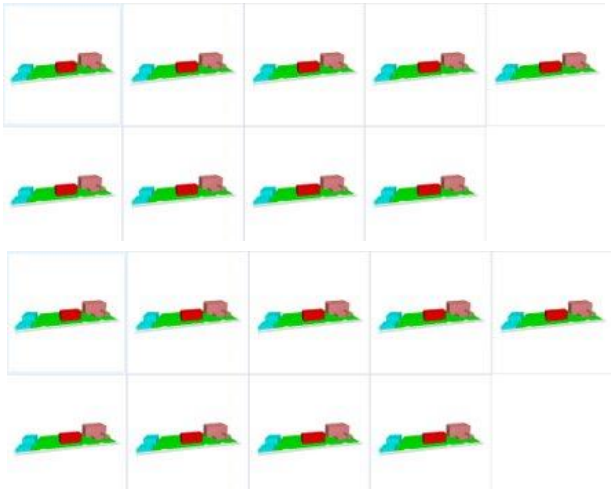
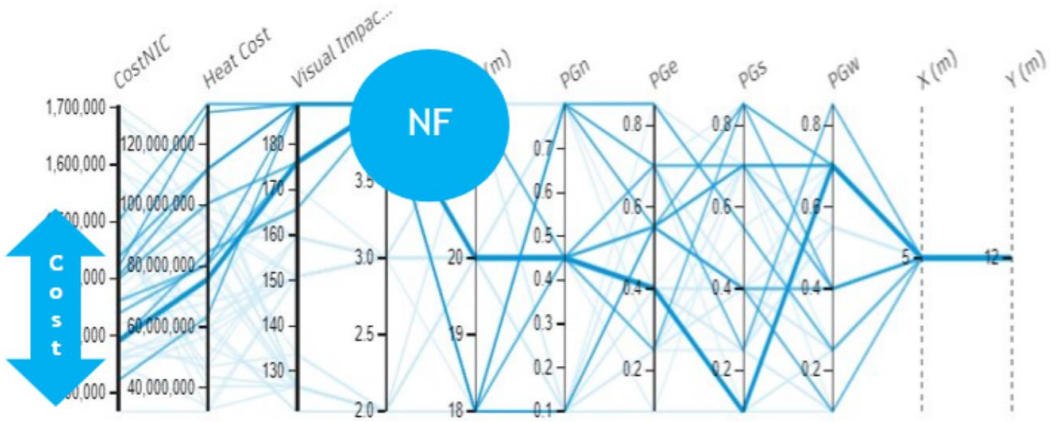
Cost Study **3**

Southern Regional College





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17	075ef5fa-c2d9-4216-bbb9-265d3c314143	1382264.655	95672685.15	150.7048495	3	22	0.8	0.55	0.7	0.25	5	12
18	d107843a-afe7-42f4-a19c-e3019da753f2	1319448.431	67856910.18	150.7048495	3	22	0.45	0.4	0.25	0.55	5	12
19	f0cd5d4a-cbf8-461d-a23f-9596b93ffedf	1498611.352	132958647.4	188.7474361	4	18	0.8	0.7	0.7	0.7	5	12
20	e1ca9f21-4ed6-44aa-bdad-cda496446808	1290478.145	75503518.26	175.8142665	4	20	0.45	0.4	0.1	0.7	5	12
21	20d4ffd0-0c69-4815-994f-1f0bdb045472	1363108.317	70537112.9	170.4132481	3	18	0.45	0.4	0.4	0.4	5	12
22	d7bd48b1-8ef9-40db-8465-3fdb27ade32d	1270282.717	59460373.76	159.414202	3	20	0.45	0.4	0.1	0.25	5	12
23	9e3fdf49-edb6-46e4-8c78-122f34e20f2a	1704431.347	112108049.7	126.6140729	2	20	0.8	0.7	0.7	0.7	5	12
24	f27fedcd-d719-4b84-9c0b-58efad512fe1	1167616.067	32304353.94	150.7048495	3	22	0.45	0.1	0.1	0.1	5	12
25	14228444-3f74-4b3b-9146-d319867fe0ed	1221413.07	63288998.29	188.7474361	4	18	0.1	0.55	0.4	0.1	5	12
26	aac6044a-bd5b-4b09-8690-02aaf0eff565	1494302.445	43805633.49	126.6140729	2	20	0.1	0.25	0.7	0.4	5	12
27	32c2aa66-eb52-4d92-8b65-8ce7b0fd7ad2	1265179.612	49732443.08	159.414202	3	20	0.1	0.4	0.4	0.25	5	12
28	bb76483f-7f17-4ff5-893a-7c9b55c51b65	1537502.801	59266374.4	121.079312	2	22	0.45	0.25	0.55	0.7	5	12

Max Cost	1577535.712
Min Cost	1267337.146
Range Cost	310198.566
Average Cost	1398350.434
% Range of Average	22%
4 storey Saving over RIBA Stage 2 Solution	£ 257,797.85
3 Storey saving ver RIBA Stage 2 Solution	£ 174,956.55

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Cost Analysis Tools

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General

- Generative Design opens the door to **Optimisation**
- Software **Complex**
- **Export** Data
- Space Adjacency Matrix with **Tolerances**.

Cost

- Cost **Consultants**
- Measure **NIFA**

Visual Impact

- Measurable with **Viewpoints**.
- Score is **Subjective**.

Energy

- **Leaner Calculations** especially for shading.
- Optimise **Cost v Insualtion** types
- **Good plugins**

ID	Activity Space	Area m2	Adjacencies	Tolerance m2
001	Science Lab	110	002	-5,+10
002	Tech Prep	40	001	-5,+5
003	IT HUB	30		0,+20
004	Toilet	3.52		0,+2

1. **Data**

2. **Optimisation**

,3. **Geometry**

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Data & Design

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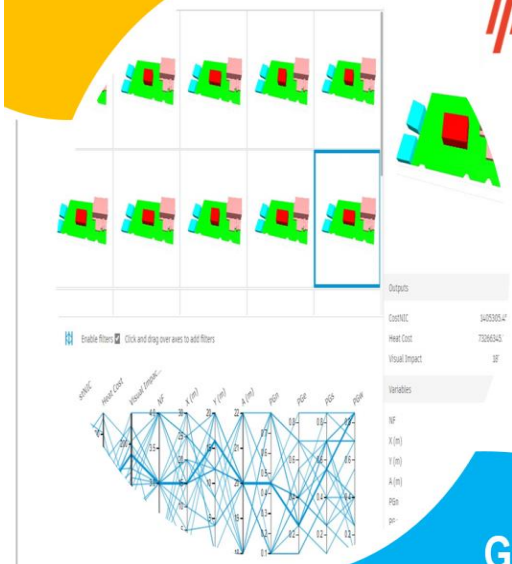

Generative Design Report

NIC-SRC-ZZ-ZZ-RP-K-0040-S3-P02

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Generative Design

Peter Monaghan

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