



Capability-Building Competition in Design: Case Study

IGLC28 Paper 0116

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DPR Construction



Health Futures Center



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Competitiveness Criteria



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No.	Name	Description
1	Eliminate Redesign	Design process that eliminates costly re-design
2	Model Cost of Program Space	Package cost information by program typology, massing, building performance, and site
3	Budget Drives Decision-Making	Inform stakeholders of challenging budget issues that require prioritization and help them make informed decisions before design begins
4	Costing Detailed Options Prior to Selection	Prescribe specific costs accompanied by detailed options for design teams use during the design process
5	Schedule Savings	Save time by eliminating re-designs and minimizing Value Engineering
6	Accuracy	The Guaranteed Maximum Price (GMP) is within 1% or less than the first baseline estimate.

Stakeholder Commitment



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DFDG
CO ARCHITECTS

ASU Arizona State University

AEI Affiliated Engineers

DPR
CONSTRUCTION

WOOD/PATEL
MISSION: CLIENT SERVICE®

FLOOR
a s s o c i a t e s



Data-mining



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ASU HSIC

Comparables :: Side-by-Side :: Cost Comparison Ta...

	ASU HSIC Phoenix, AZ 165,802 sf 9/13/2017 RS Means CCI : AZ - Phoenix RSMMeans: 5% Escalation : 1/1/20		ASU: Downtown Campus AZ C Phoenix, AZ 260,000 sf 6/30/2014 Total Cost Index: 12.28% RS Means CCI (AZ - Phoenix): 0.00% RSMMeans: 5% Escalation (1/1/2014):		Biomedical Science Partnershi 475 N. 5th Street, Phoenix, AZ. 8 235,137 sf 1/5/2015 Total Cost Index: 10.53% RS Means CCI (AZ - Phoenix): 0.00% RSMMeans: 5% Escalation (1/1/2015):	
	Total Unit Cost	Total	Total Unit Cost	Total	Total Unit Cost	Total
01 - DEMOLITION sf	\$1.01	\$167,651	\$0.52	\$135,684	\$1.50	\$352,810
02 - SITEWORK sf	\$14.74	\$2,444,615	\$13.89	\$3,611,582	\$15.60	\$3,667,587
03 - FOUNDATIONS sf	\$5.64	\$935,236	\$3.17	\$823,319	\$8.11	\$1,908,077
04 - SUBSTRUCTURE sf	\$8.63	\$1,431,581	\$10.55	\$2,741,836	\$6.72	\$1,580,836
05 - SUPERSTRUCTURE sf	\$64.29	\$10,659,292	\$68.64	\$17,846,712	\$59.94	\$14,093,492
06 - EXTERIOR SKIN sf	\$60.12	\$9,968,188	\$62.81	\$16,331,507	\$57.43	\$13,503,586
07 - ROOFING sf	\$3.14	\$520,083	\$3.29	\$855,319	\$2.98	\$701,614
08 - INTERIOR CONSTRUCTION sf	\$55.26	\$9,162,859	\$64.66	\$16,810,905	\$45.87	\$10,785,828
09 - CONVEYING sf	\$5.58	\$925,156	\$5.75	\$1,493,798	\$5.41	\$1,273,124
10 - SPECIAL CONSTRUCTION sf	\$8.38	\$1,389,203	\$0.03	\$7,489	\$16.73	\$3,933,507
11 - PLUMBING/PROCESS PIPING sf	\$10.94	\$1,814,139	\$4.46	\$1,160,091	\$17.42	\$4,096,393
12 - FIRE PROTECTION sf	\$3.70	\$614,131	\$2.95	\$767,500	\$4.46	\$1,047,791
13 - MECHANICAL sf	\$57.49	\$9,531,788	\$35.72	\$9,286,091	\$79.26	\$18,637,483
14 - ELECTRICAL sf	\$36.45	\$6,042,965	\$32.01	\$8,321,849	\$40.89	\$9,613,962
15 - JOBSITE MANAGEMENT sf	\$32.57	\$5,400,556	\$19.21	\$4,994,912	\$45.93	\$10,800,654
16 - PROJECT REQUIREMENTS sf	\$0.65	\$107,397	\$1.30	\$336,828		
21 - CONTINGENCY sf	\$43.03	\$7,134,774	\$74.09	\$19,262,979	\$11.98	\$2,815,860
22 - INDIRECTS sf	\$40.85	\$6,773,104	\$22.37	\$5,815,202	\$59.33	\$13,951,843
Total	\$452.48	\$75,022,718	\$425.40	\$110,603,601	\$479.57	\$112,764,446

Room Finishes Info



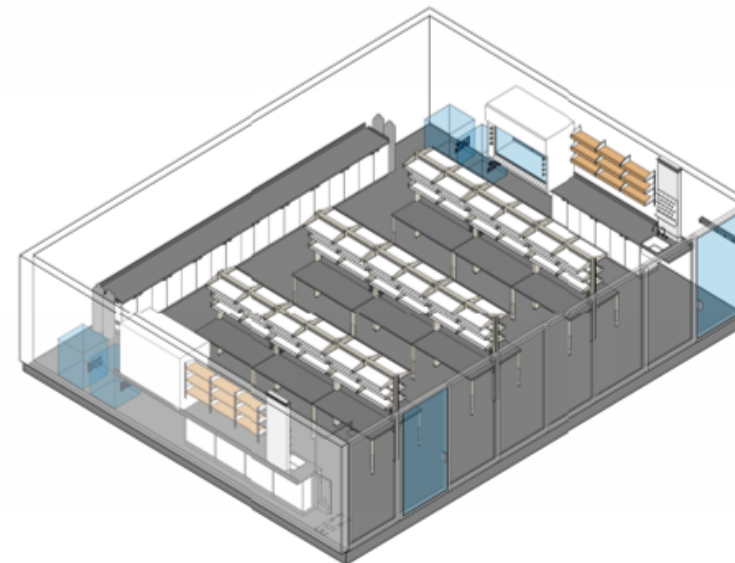
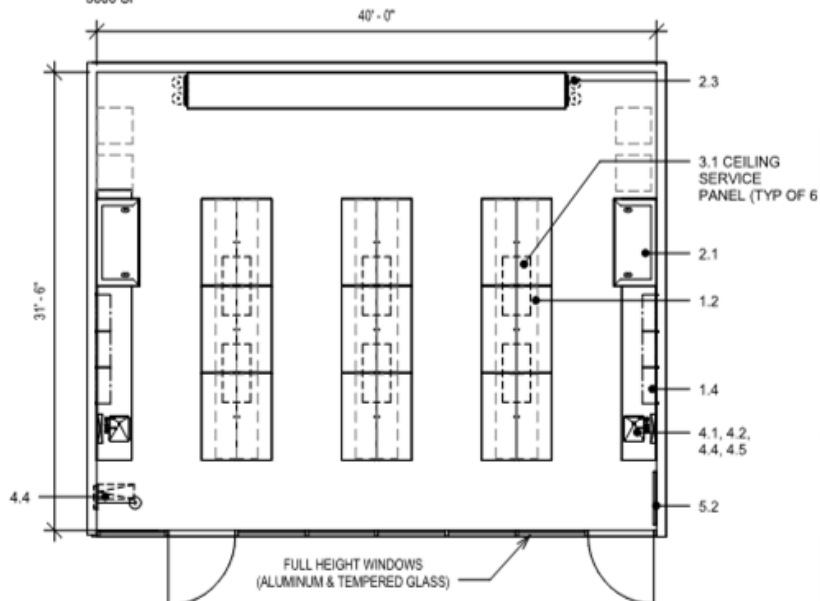
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INDEX NUMBER: R2.3
DEPARTMENT: RESEARCH & INNOVATION
SPACE NAME: OPEN WET LAB
STATIONS: 12 MODULES 300SF
AREA: 3600 SF

INDEX NUMBER: R2.3A
DEPARTMENT: RESEARCH & INNOVATION
SPACE NAME: OPEN WET LAB
STATIONS: 12 MODULES 300SF
AREA: 3600 SF



CASEWORK/STORAGE

- 1.1 Moveable, Adjustable Height Table - Ptd. Metal
- 1.2 Mobile Work Bench w/shelving - Ptd. Metal
- 1.3 Countertop - Epoxy U.N.O.
- 1.4 Wall-mounted Adjustable Shelving - P.Lam
- 1.5 Tall Storage Cabinet - Ptd. Metal
- 1.6 Upper Cabinets - Ptd. Metal
- 1.7 Base Cabinets - Ptd. Metal
- 1.8 Knee Opening - Ptd. Metal
- 1.9 Verticed Storage Cabinet - Metal
- 1.10 Moveable Storage - Ptd. Metal
- 1.11 Not Used
- 1.12 Not Used
- 1.13 Moveable Demonstration Bench - Ptd. Metal
- 1.14 Steel Storage Rack - Stainless Steel
- 1.15 Equipment Space/Carts (OFO)
- 1.16 UL Listed Chem Storage Cabinet - Ptd. Metal
- 1.17 Book shelves - Ptd. Metal
- 1.18 Not Used

LABORATORY EQUIPMENT

- 2.1 Fume Hood - Ptd. Metal
- 2.2 Sneezeel - Aluminum and Polypro
- 2.3 Gas Cylinder Restraint - Ptd. Metal
- 2.4 Biosafety Cabinet - Ptd. Metal, recirculating

ELECTRICAL/DATA

- 3.1 Overhead Power and Data
- 3.2 Video Projector (Ceiling-Mounted)
- 3.3 Projection Screen (Recessed Drop-down)
- 3.4 Power and Data Wire Mould - 2 channel alum.
- 3.4-E Emergency Power Outlet
- 3.5 Floor Outlets (Power and Data)
- 3.6 Task Lighting
- 3.7 Flat Panel Monitor
- 3.8 Card Reader
- 3.9 AV Cart

PLUMBING

- 4.1 Laboratory Sink - Epoxy
- 4.2 Industrial Hot and Cold Water
- 4.3 Laboratory Gases - Air, Vac, Nat Gas
- 4.4 Safety Shower/Eyewash - St. St
- 4.5 Pipe Drop Enclosure with Drying rack
- 4.6 Overhead Service Piping - Air, Vac, Nat Gas
- 4.7 Pure Water
- 4.8 Drench Hose

OTHER

- 5.1 Marker Board - Glass
- 5.2 Coat Hooks - St. St
- 5.3 Chalkboard
- 5.4 Laser Curtains
- 5.5 Blackout Curtains

FINISHES

- Ceilings:
- Walls:
- Floor:
- Windowcovering:

Program Space Cost

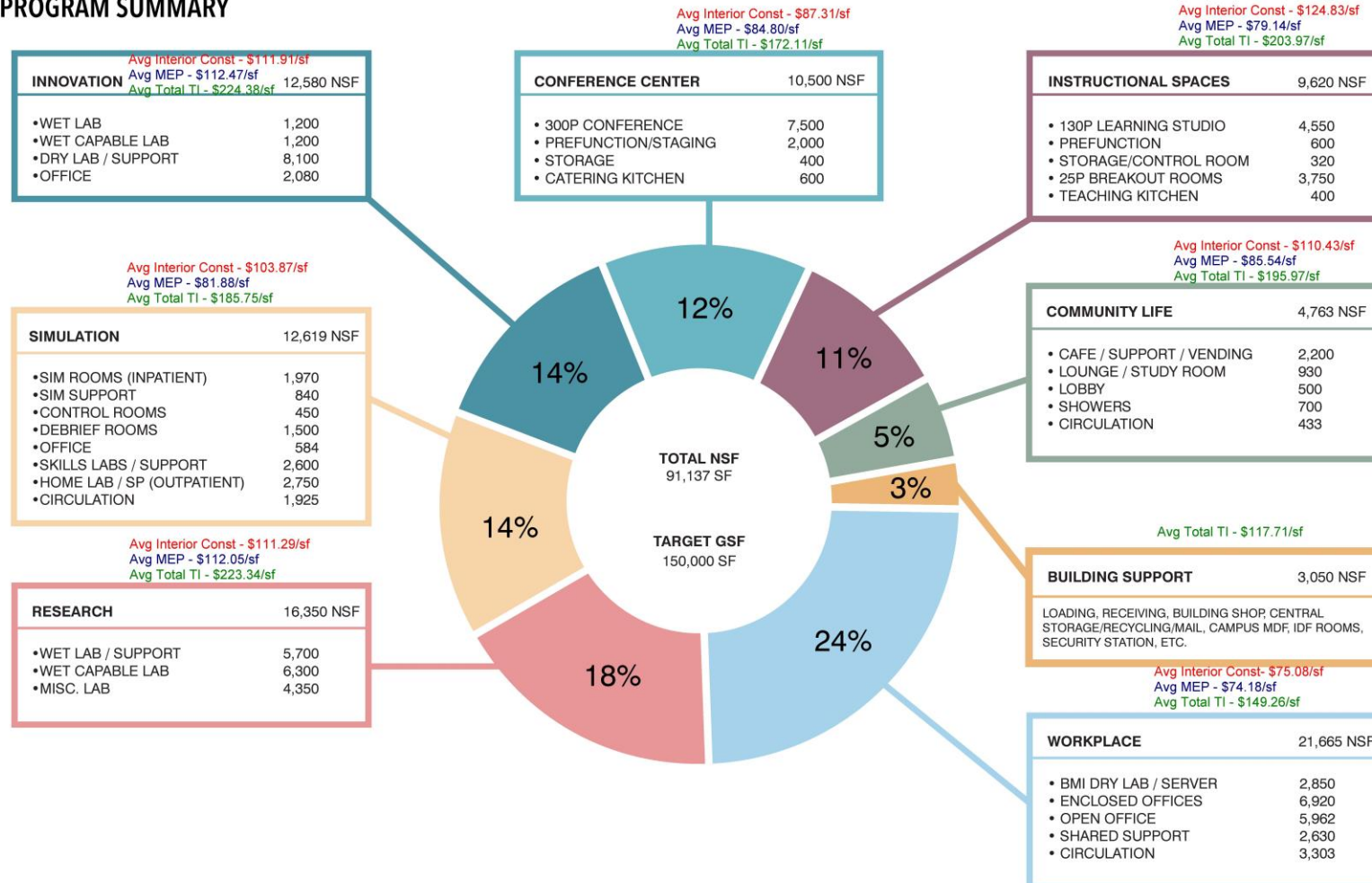


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PROGRAM SUMMARY



Massing Options



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Core/Shell Costs Only

	12/11/17 "SkySong" Model Mass 6A		Scheme E		Scheme G		Scheme H		Scheme I	
		cost/sf		cost/sf		cost/sf		cost/sf		cost/sf
03 Foundations	\$488,780	\$3.26	\$583,280	\$3.89	\$442,790	\$2.95	\$689,930	\$4.60	\$518,750	\$3.46
04 Substructure	\$642,390	\$4.28	\$689,640	\$4.60	\$619,395	\$4.13	\$742,965	\$4.95	\$657,375	\$4.38
05 Superstructure	\$5,214,679	\$34.76	\$6,098,747	\$40.66	\$6,243,147	\$41.62	\$6,113,780	\$40.76	\$5,971,242	\$39.81
06 Exterior Skin	\$3,916,863	\$26.11	\$6,885,070	\$45.90	\$7,303,520	\$48.69	\$7,588,770	\$50.59	\$7,434,370	\$49.56
07 Roofing	\$1,017,882	\$6.79	\$1,354,583	\$9.03	\$1,070,975	\$7.14	\$2,021,483	\$13.48	\$1,233,153	\$8.22
08 Interior Construction	\$154,800	\$1.03	\$453,550	\$3.02	\$426,175	\$2.84	\$688,050	\$4.59	\$783,600	\$5.22
09 Conveying	\$694,100	\$4.63	\$694,100	\$4.63	\$814,100	\$5.43	\$694,100	\$4.63	\$739,100	\$4.93
10 Special Construction	\$7,500	\$0.05	\$7,500	\$0.05	\$7,500	\$0.05	\$7,500	\$0.05	\$7,500	\$0.05
11 Plumbing/Process Piping	\$1,163,471	\$7.76	\$1,163,471	\$7.76	\$1,163,471	\$7.76	\$1,163,471	\$7.76	\$1,163,471	\$7.76
12 Fire Protection	\$0	\$0.00	\$14,400	\$0.10	\$6,000	\$0.04	\$14,400	\$0.10	\$14,400	\$0.10
13 Mechanical	\$2,250,000	\$15.00	\$2,250,000	\$15.00	\$2,250,000	\$15.00	\$2,250,000	\$15.00	\$2,250,000	\$15.00
14 Electrical	\$1,545,000	\$10.30	\$1,545,000	\$10.30	\$1,545,000	\$10.30	\$1,545,000	\$10.30	\$1,545,000	\$10.30
15 Jobsite Management	\$1,863,883	\$12.43	\$1,863,883	\$12.43	\$1,863,883	\$12.43	\$1,863,883	\$12.43	\$1,863,883	\$12.43
16 Project Requirements	\$378,472	\$2.52	\$378,472	\$2.52	\$378,472	\$2.52	\$378,472	\$2.52	\$378,472	\$2.52
	\$19,337,820	\$128.92	\$23,981,696	\$159.88	\$24,134,428	\$160.90	\$25,761,803	\$171.75	\$24,560,316	\$163.74
5% Construction Contingency	\$966,891	\$6.45	\$1,199,085	\$7.99	\$1,206,721	\$8.04	\$1,288,090	\$8.59	\$1,228,016	\$8.19
Payment & Performance Bond	\$203,047	\$1.35	\$251,808	\$1.68	\$253,411	\$1.69	\$270,499	\$1.80	\$257,883	\$1.72
SDI Insurance	\$205,078	\$1.37	\$254,326	\$1.70	\$255,946	\$1.71	\$273,204	\$1.82	\$260,462	\$1.74
Builders Risk	\$57,996	\$0.39	\$71,923	\$0.48	\$72,381	\$0.48	\$77,262	\$0.52	\$73,659	\$0.49
Contractors Liability	\$197,323	\$1.32	\$244,709	\$1.63	\$246,267	\$1.64	\$262,873	\$1.75	\$250,613	\$1.67
Fee	\$1,037,924	\$6.92	\$1,287,176	\$8.58	\$1,295,373	\$8.64	\$1,382,720	\$9.22	\$1,318,232	\$8.79
Sales Tax	\$1,232,340	\$8.22	\$1,528,280	\$10.19	\$1,538,014	\$10.25	\$1,641,721	\$10.94	\$1,565,154	\$10.43
	\$23,238,419	\$154.92	\$28,819,003	\$192.13	\$29,002,542	\$193.35	\$30,958,173	\$206.39	\$29,514,335	\$196.76
Cost Delta			\$ 5,580,584	\$ 37.20	\$ 5,764,123	\$ 38.43	\$ 7,719,754	\$ 51.47	\$ 6,275,916	\$ 41.84

Exterior Envelope Qty Delta
Soffits Qty Delta

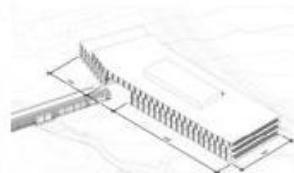
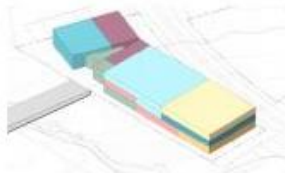
60,200 VSF
0 SF

69,520 VSF
3,600 SF

64,082 VSF
1,500 SF

68,200 VSF
3,600 SF

64,700 VSF
3,800 SF



Detailed Line Items Cost Model



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DESCRIPTION	COMMENTS	QUANTITY	UNIT	UNIT COST	TOTAL
Subtotal: Electrical System					\$27,755
Lighting					
Lighting & Lighting Controls Allowance		3,050	sf	\$17.00	\$51,850
Subtotal: Lighting					\$51,850
Low Voltage Systems					
AV Systems / Security / Structured Cabling		-	nic	-	\$0
Subtotal: Low Voltage Systems					\$0
Subtotal: 14-ELECTRICAL					\$79,605
Subtotal: (none)					\$344,000
Subtotal: (none)					\$344,000
Subtotal: BS - Building Support					\$344,000
CC - Conference Center					
CC - MEP,FP&LV					
CC - MEP,FP&LV					
08-INTERIOR CONSTRUCTION					
Interior Items					
Misc. Accessories		1	ls	\$3,500.00	\$3,500
Subtotal: Interior Items					\$3,500
Subtotal: 08-INTERIOR CONSTRUCTION					\$3,500
11-PLUMBING/PROCESS PIPING					
Plumbing System					
Domestic Cold / Hot Water Return/Supply		10,500	sf	\$3.33	\$35,000
Sanitary Waste / Vent		10,500	sf	\$2.38	\$25,000
Plumbing Fixtures Allowance		10,500	sf	\$4.00	\$42,000
Subtotal: Plumbing System					\$102,000
Subtotal: 11-PLUMBING/PROCESS PIPING					\$102,000
12-FIRE PROTECTION					
Fire Protection System					
Fire Protection		10,500	sf	\$3.25	\$34,125
Subtotal: Fire Protection System					\$34,125

92 pages of
estimate detail –
at programming

Cost Model Simulations



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ASU HSIC Program Scenarios - Detail

	Scenario A: Current Mass, Current 157,133 GSF Program. How much grey shell?			Scenario B: Cost Model Mass (BCLS, BSPB Blend), Current 157,133 GSF Program. How much grey shell?			Scenario C: Cost Model Mass (BCLS, BSPB Blend), Cut to 150,000 GSF Program. How much grey shell?			Scenario D: SkySong 3/4 Mass, Current 157,133 GSF Program. What to add back in?			Scenario E: SkySong 3/4 Mass, Cut to 150,000 GSF Program. What to add back in?		
	Area	Unit	Subtotal												
Sitework Infrastructure			\$ 7,201,500			\$ 7,201,500			\$ 7,201,500			\$ 7,201,500			\$ 7,201,500
Site	157,133	19.42	\$ 3,051,887	157,133	19.42	\$ 3,051,887	150,000	19.42	\$ 2,913,000	157,133	19.42	\$ 3,051,523	150,000	19.42	\$ 2,913,000
Core/Shell	157,133	299.35	\$ 47,037,712	157,133	200.00	\$ 31,426,600	150,000	200.00	\$ 30,000,000	157,133	96.00	\$ 15,084,768	150,000	96.00	\$ 14,400,000
Program Spaces - Interior	157,133	145.15	\$ 22,808,059	157,133	145.15	\$ 22,808,059	150,000	145.15	\$ 21,772,500	157,133	145.15	\$ 22,807,855	150,000	145.15	\$ 21,772,500
BS - Building Support	3,050	112.79	\$ 344,000	3,050	112.79	\$ 344,000	3,050	112.79	\$ 344,000	3,050	112.79	\$ 344,000	3,050	112.79	\$ 344,000
CC - Conference Center	10,500	152.18	\$ 1,597,856	10,500	152.18	\$ 1,597,856	10,500	152.18	\$ 1,597,856	10,500	152.18	\$ 1,597,856	10,500	152.18	\$ 1,597,856
CL - Community Life	4,763	188.79	\$ 899,224	4,763	188.79	\$ 899,224	4,763	188.79	\$ 899,224	4,763	188.79	\$ 899,224	4,763	188.79	\$ 899,224
IN - Innovation	12,580	192.96	\$ 2,427,411	12,580	192.96	\$ 2,427,411	12,580	192.96	\$ 2,427,411	12,580	192.96	\$ 2,427,411	12,580	192.96	\$ 2,427,411
IS - Instructional Spaces	9,620	227.83	\$ 2,191,729	9,620	227.83	\$ 2,191,729	9,620	227.83	\$ 2,191,729	9,620	227.83	\$ 2,191,729	9,620	227.83	\$ 2,191,729
R - Research	16,350	202.60	\$ 3,312,496	16,350	202.60	\$ 3,312,496	16,350	202.60	\$ 3,312,496	16,350	202.60	\$ 3,312,496	16,350	202.60	\$ 3,312,496
SS - Simulation/Skills	12,619	208.44	\$ 2,630,366	12,619	208.44	\$ 2,630,366	12,619	208.44	\$ 2,630,366	12,619	208.44	\$ 2,630,366	12,619	208.44	\$ 2,630,366
WP - Workplace	21,655	155.85	\$ 3,374,997	21,655	155.85	\$ 3,374,997	21,655	155.85	\$ 3,374,997	21,655	155.85	\$ 3,374,997	21,655	155.85	\$ 3,374,997
Gross Factor	65,996	91.37	\$ 6,029,980	65,996	91.37	\$ 6,029,980	65,996	91.37	\$ 6,029,980	65,996	91.37	\$ 6,029,980	65,996	91.37	\$ 6,029,980
TOTAL DIRECT COST			\$ 80,099,158			\$ 64,488,046			\$ 61,887,000			\$ 48,145,646			\$ 46,287,000
Mark-Ups (Contingency, Insurances, Taxes, Fee)		0.167851282	\$ 16,156,663			\$ 12,897,609			\$ 12,377,400			\$ 9,629,129			\$ 9,257,400
TOTAL Construction Cost			\$ 96,255,821			\$ 77,385,655			\$ 74,264,400			\$ 57,774,775			\$ 55,544,400
TOTAL Target Budget			\$ 59,500,000			\$ 59,500,000			\$ 59,500,000			\$ 59,500,000			\$ 59,500,000
Budget Variance			\$ 36,755,821			\$ 17,885,655			\$ 14,764,400			\$ (1,725,225)			\$ (3,955,600)
Grey Shell Average of Interior Spaces	157,133	-145.15	\$ (22,807,855)	123,222	-145.15	\$ (17,885,673)	101,718	-145.15	\$ (14,764,368)	Add MRI or Other		\$ 1,725,225	Add MRI or Other		\$ 3,955,600
New Target Budget			\$ 73,447,966			\$ 59,499,982			\$ 59,500,032			\$ 59,500,000			\$ 59,500,000
	Does not work, Still Over Budget			On Budget - Only 33,911 SF Built Out			On Budget - Only 55,415 SF Built Out			Under Budget - \$1.7M To add Back in. MRI? Or Other			Under Budget - \$3.95M To add Back in. MRI? Or Other		

Target Value Tracking



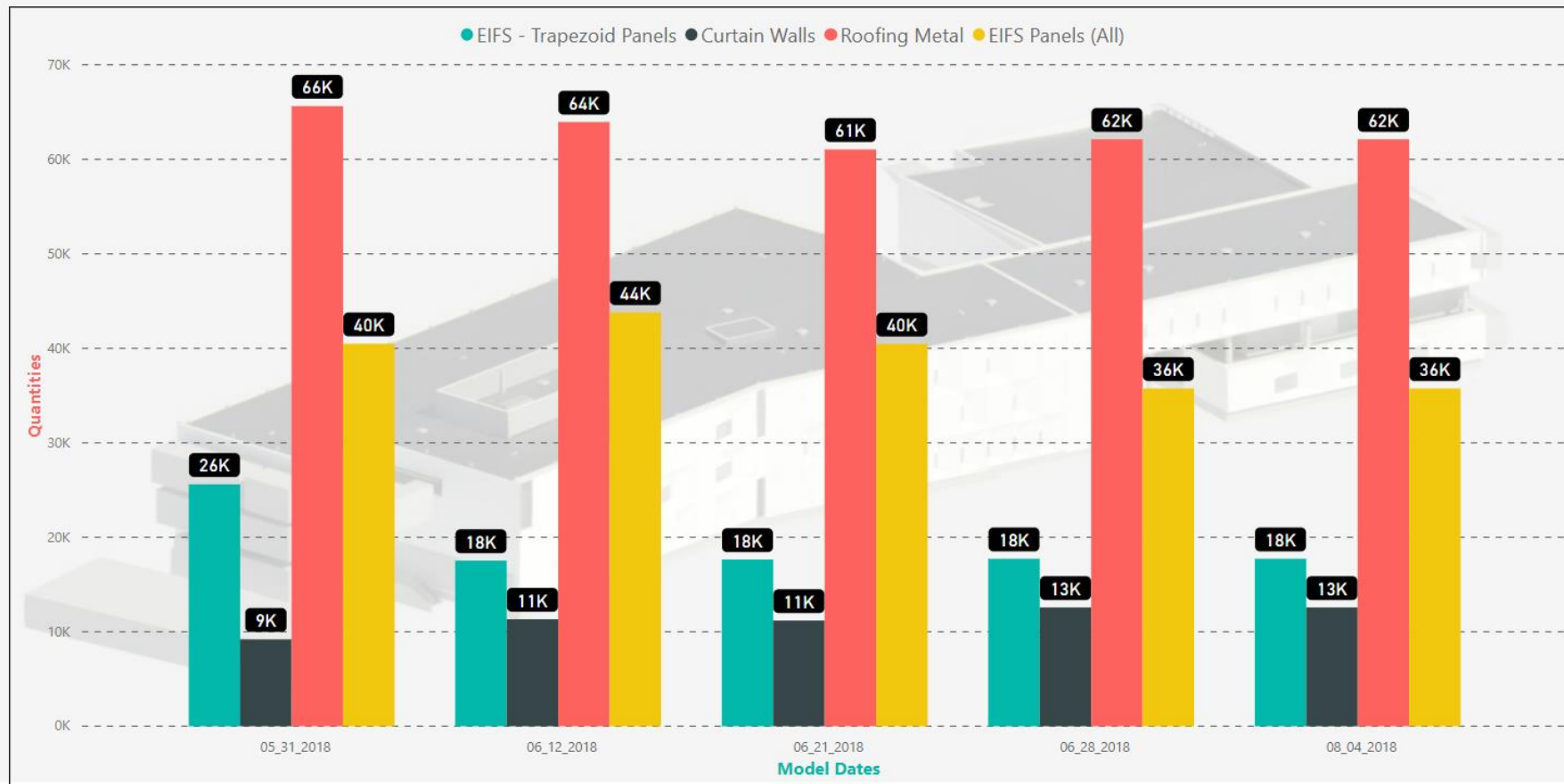
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Architectural Quantity Trending (Sq. Ft.)



Target Value Tracking



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Project Model Quantities Measurement Spreadsheet Interface

Extract Quantities More Options... Report

Browse (HSIC - Exterior Skin) Model Selection (Component: varies) (Count: 227)

System Component Category FamilyType TypeName

Name

- Asset (Count=4107)
- Electrical (Count=22)
- Exterior (Count=1380)
 - Curtain Mullions (Count=416)
 - Curtain Panels (Count=205)
 - Curtain Walls (Count=8)
 - Doors Exterior (Count=15)
 - Walls Bearing Ext Concrete (Count=2)
 - Walls Ext Concrete (Count=23)
 - Walls Ext Other (Count=644)
 - Windows Exterior (Count=67)

Model Documents

Quantities (Demo) Measurement 20180531.100% SD Finish Materials Wall Masonry

Group Phase Name Phase Name

Group Phase Name	Phase Name	3D Property	3D Unit	Takeoff Qty	3D Quantity	3D Delta	Total Cost/Unit	Total	3D Total	Delta	3D	Phase	UF1	UF2	UF3
CONVEYING								\$530,000.0	\$530,000.0	\$0.0	Checked				
EXTERIOR SKIN								\$4,109,836.0	\$3,945,027.0	(\$164,809.0)	Checked				
Curtainwall								\$838,236.0	\$876,127.3	\$37,891.3	Checked				
EIFS Panels								\$981,000.0	\$935,347.0	(\$45,653.0)	Checked				
EXTERIOR SKIN	EIFS Panels	12 3" EIFS system	sf	61,420.0	58,377.0	-3,043.0	\$15.0	\$921,300.0	\$875,655.0	(\$45,645.0)	Checked	6.091002 EIFS Panels	B SHELL	B20 EXTERIOR VERTICA...	B2010 Exterior Walls
EXTERIOR SKIN	EIFS Panels	12 Stucco Soffits	sf	5,970.0	5,969.2	-0.8	\$10.0	\$59,700.0	\$59,692.0	(\$8.0)	Checked	6.091002 EIFS Panels	B SHELL	B20 EXTERIOR VERTICA...	B2010 Exterior Walls
Metal Framing								\$1,943,595.0	\$1,891,855.5	(\$51,739.5)	Checked				
Metal Siding								\$230,180.0	\$134,823.9	(\$95,356.1)	Checked				
Preformed Metal Paneling								\$14,925.0	\$14,923.0	(\$2.0)	Checked				
Wall Louvers								\$91,650.0	\$85,247.5	(\$6,402.5)	Checked				
Waterproofing								\$10,250.0	\$6,702.8	(\$3,547.2)	Checked				
FOUNDATIONS								\$664,532.0	\$658,070.6	(\$6,461.4)	Checked				
ROOFING								\$1,017,000.0	\$984,424.5	(\$32,575.5)	Checked				
								\$10,445,627.5	\$10,142,706.6	(\$302,920.9)	Checked				

EIFS Panels

2D Estimate

3D Estimate

[3D] = 'Checked'

Edit Filter

Competitive Routines

ID	Routines Contribution % by Project	1	2	3	4	5	6	7
1	Stakeholder commitment	0	0	1.6	3.7	2.6	0	2.6
2	Work methods alignment	0	0	0	4.2	0	0	2.6
3	Data-mining space cost	0	0	0	4.2	3.2	3.7	1.6
4	Room finishes info	0	0	0	4.2	3.7	2.6	4.2
5	Programmatic spatial BIM	0	0	0	4.2	2.6	0	1.6
6	Costs and categories alignment	0	0	0	4.2	2.6	0	2.6
7	Owner program benchmark cost model	1.1	0	1.1	4.2	3.7	3.7	1.6
8	Program draft cost model	0	0	0	4.2	3.2	3.7	1.6
9	Massing options cost model	0	2.1	0	4.7	2.6	2.6	2.6
10	Detailed line-item cost models	0	0	0	4.7	3.2	3.7	2.6
11	Cost model simulations	0	2.1	0	4.7	2.6	2.6	3.7
12	Finalize building program	0	0	0	4.2	3.2	3.7	3.7
13	Establish target value buckets	1.1	0	1.1	4.7	3.2	4.2	3.2
14	Target value tracking	1.6	0	1.1	4.7	3.2	4.2	5.3%
15	Schematic design estimate	1.6	2.1	1.6	4.7	2.6	3.2	4.7%
16	Continue target value tracking	1.6	1.6	1.6	4.7	2.6	4.2	5.3%
17	Design Development / GMP estimate	1.6	2.1	1.6	4.7	2.6	3.7	4.7%
18	Program cost data for re-use	0	0	0	4.7	3.7	4.2	5.3%
19	Construction Documents estimate	1.6	1.6	1.6	4.7	2.6	4.7	4.7%
	Improvement in Competitiveness %	10	12	11	85	54	55	64



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Multi-path System Emergence & Evolutionary Learning Capability



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Project	RC	EC	EV	KT	RT	PRC	ELC
1	37%	0%	0%	32%	0%	13%	0%
2	32%	0%	16%	21%	0%	14%	16%
3	42%	0%	0%	37%	0%	23%	0%
4	100%	0%	68%	37%	0%	37%	74%
5	95%	0%	5%	95%	0%	40%	5%
6	89%	0%	0%	89%	0%	51%	0%
7	95%	5%	16%	95%	0%	69%	5%