Annual Meeting 2015
Philadelphia, PA

New Paradigms for
Manufacturing Excellence

Innovating the Capital Appropriation Process

Jose Rivera, P.E.

Barry Holtz, Ph.D

Brent Pilgrim

BECK THINK. DESIGN. BUILD.

HOLTZ BIOPHARMA CONSULTING

BECKTECH INNOVATION IN ALL DIMENSIONS

DESTINI PROFILER

klyo collaborative

Innovating the Capital Appropriation Process

- **Jose Rivera**, P.E. – HC Beck, Ltd.
  - Project Executive
- **Barry Holtz**, Ph.D – Holtz Biopharma Consulting
  - Principal Consultant
- **Brent Pilgrim**, Beck Technology
  - Director of Services

BECK THINK. DESIGN. BUILD.

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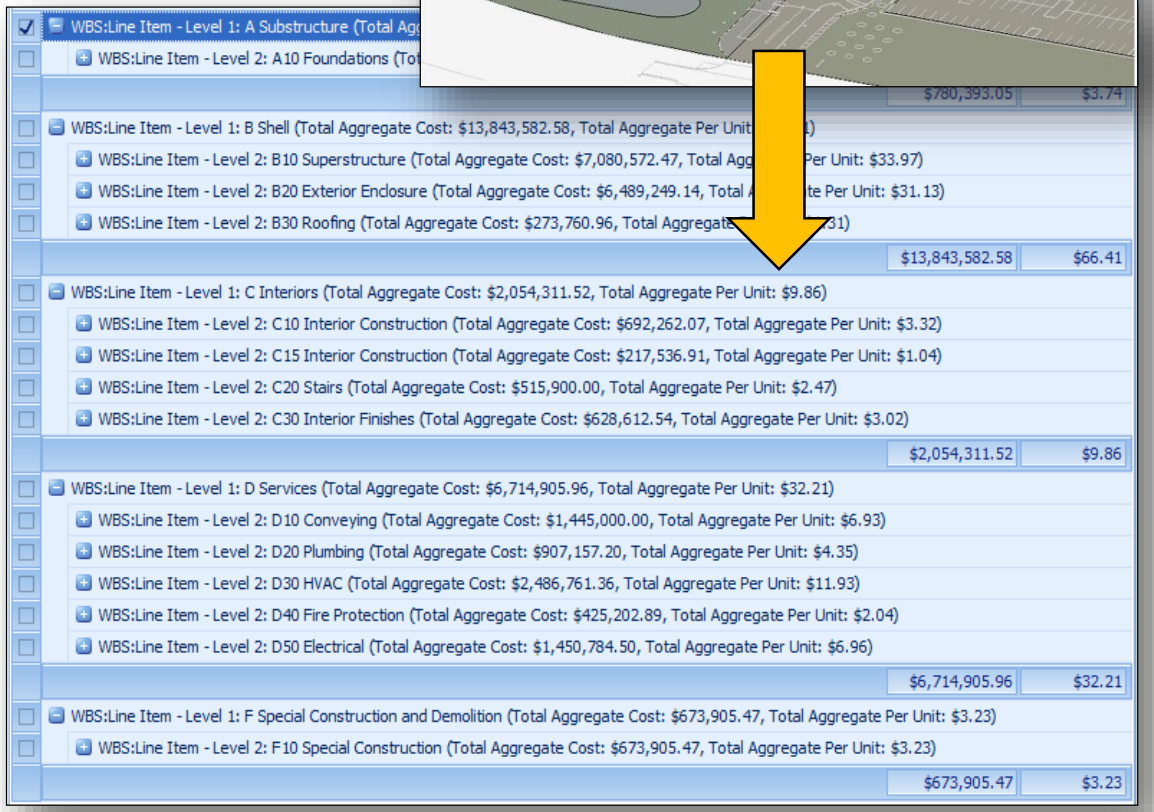
Members of the Klyo Collaborative

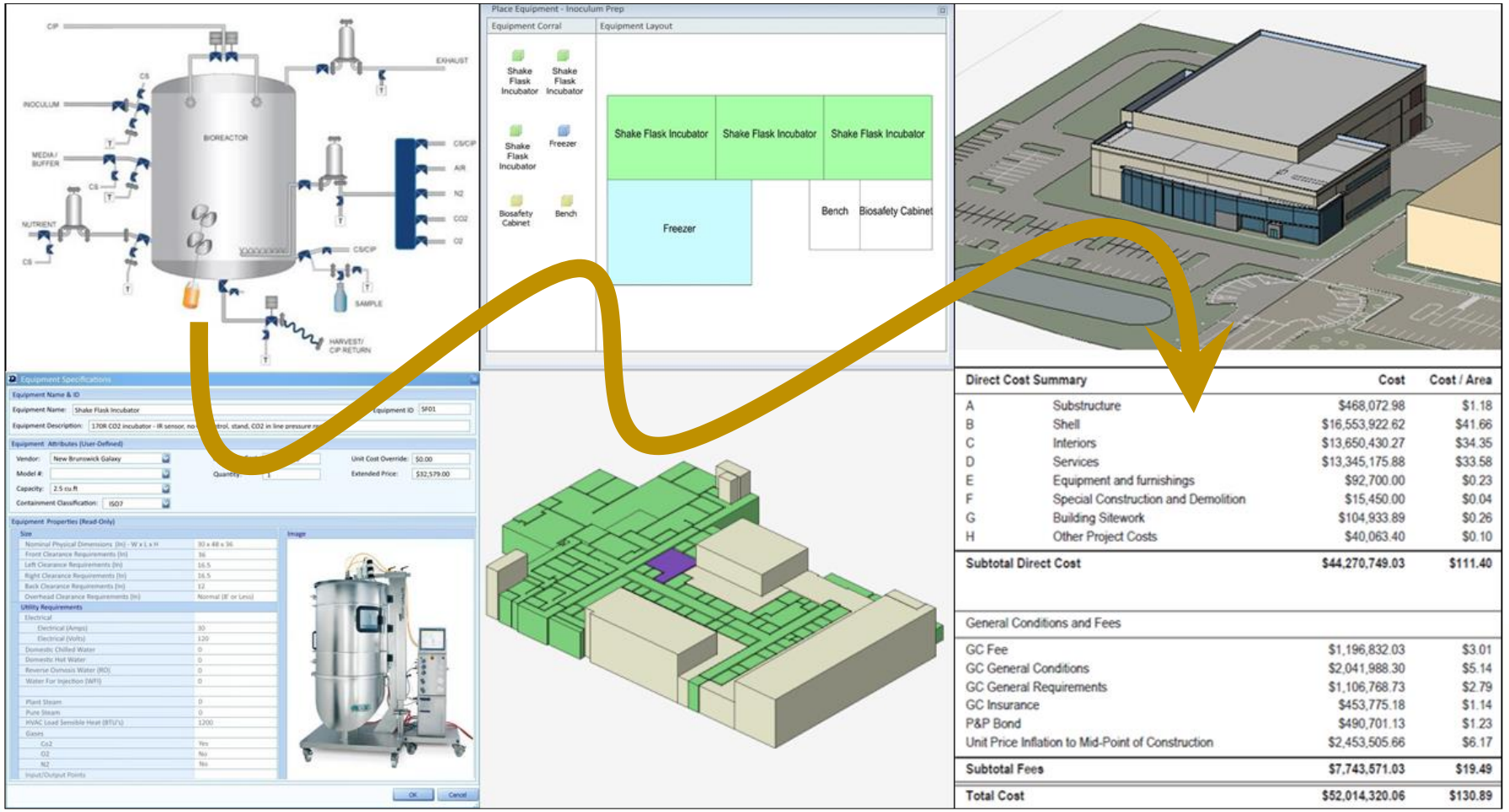
Presentation Outline

- Innovation in Process/Facility Design & Planning
- Business Drivers for Process/Facility Design & Planning
- Regulatory Changes/Drive Toward “Design Space”
- Relevant Technology Improvements
- Innovative Solution – DESTINI Profiler
- DESTINI Profiler Introduction & Video
- Benefits of this Solution



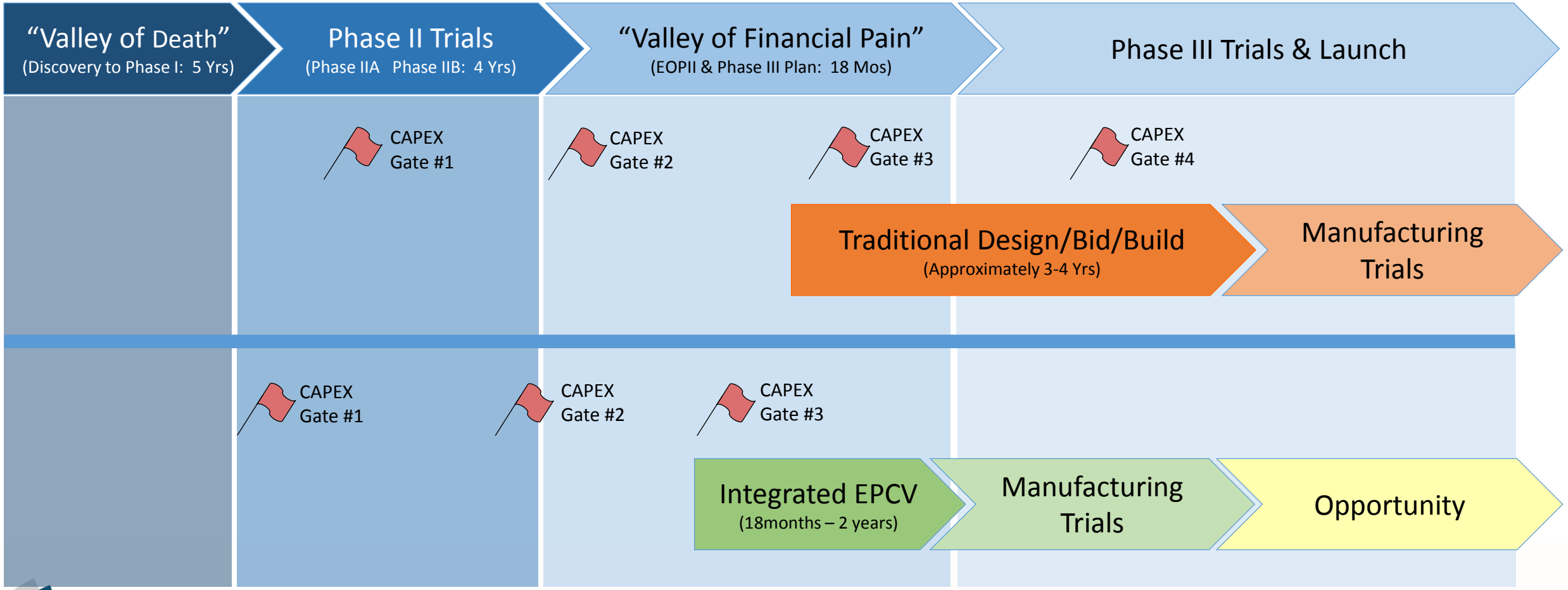
DESTINI PROFILER

"Virtualizing the Planning of Manufacturing Processes within Facility Design, using Parametric Tools"



DESTINI PROFILER

Clinical Timelines & Facility Requirements



Early Facility Design and Process Integration Decreases Time to Market!

Business Drivers: A Changing Paradigm

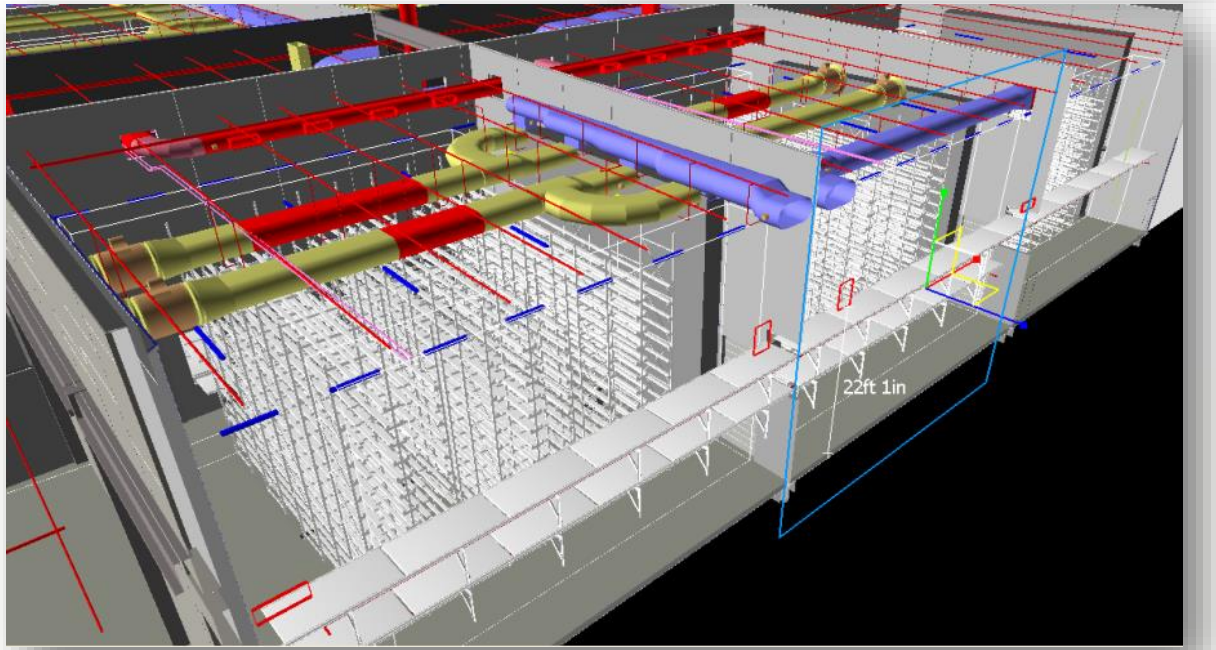
- **Big Pharma**
  - Reduced engineering staffs
  - Facility management outsourcing
- **Mid-Stage Pharma**
  - Dependent upon external expertise
- **Early-Stage Pharma**
  - No investment in early facilities planning

Business Drivers: Facilities Design

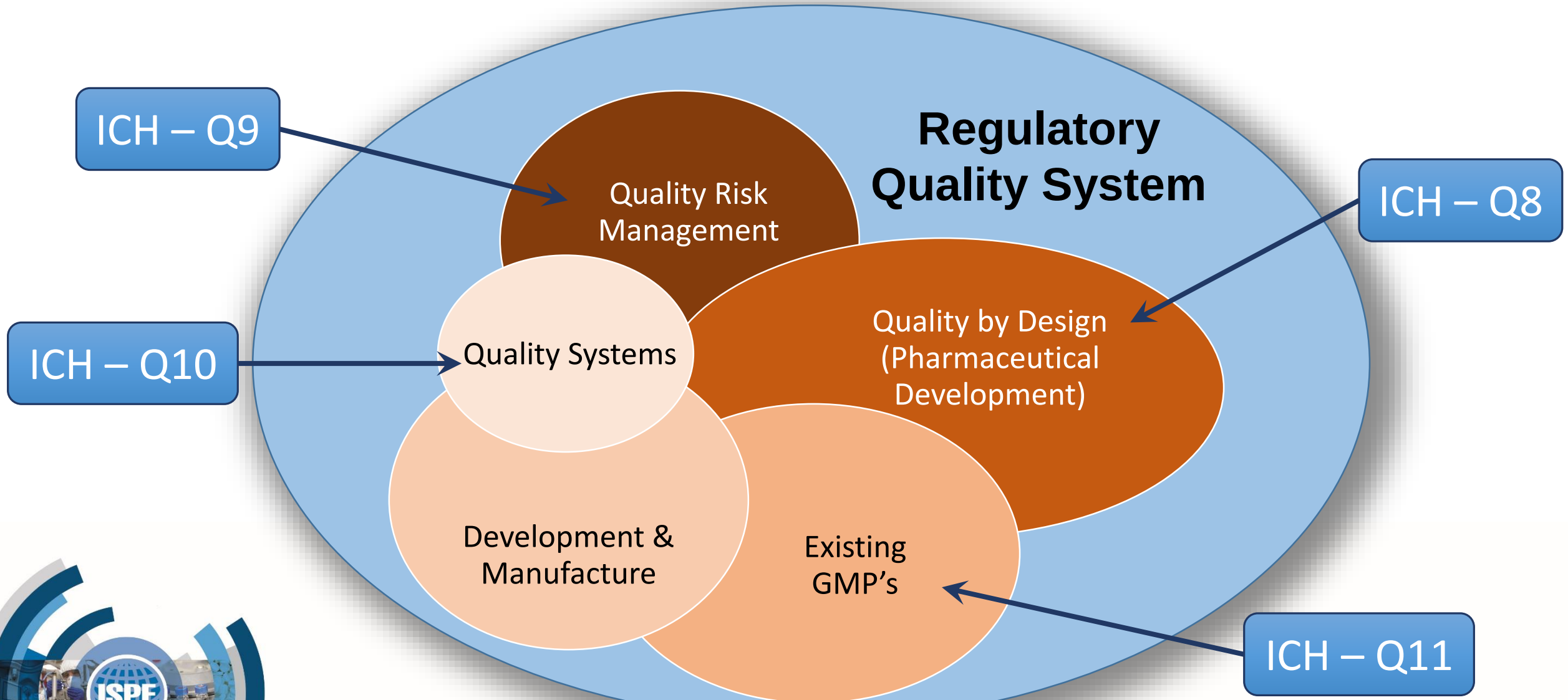
- Broader Product Portfolios
- Patient Specific Medicine
- Smaller Targeted Patient Populations
- Global Competition
- New Manufacturing Platform
- Multiple Product Facilities
- New Technologies

Process/Architecture/Engineering Challenges

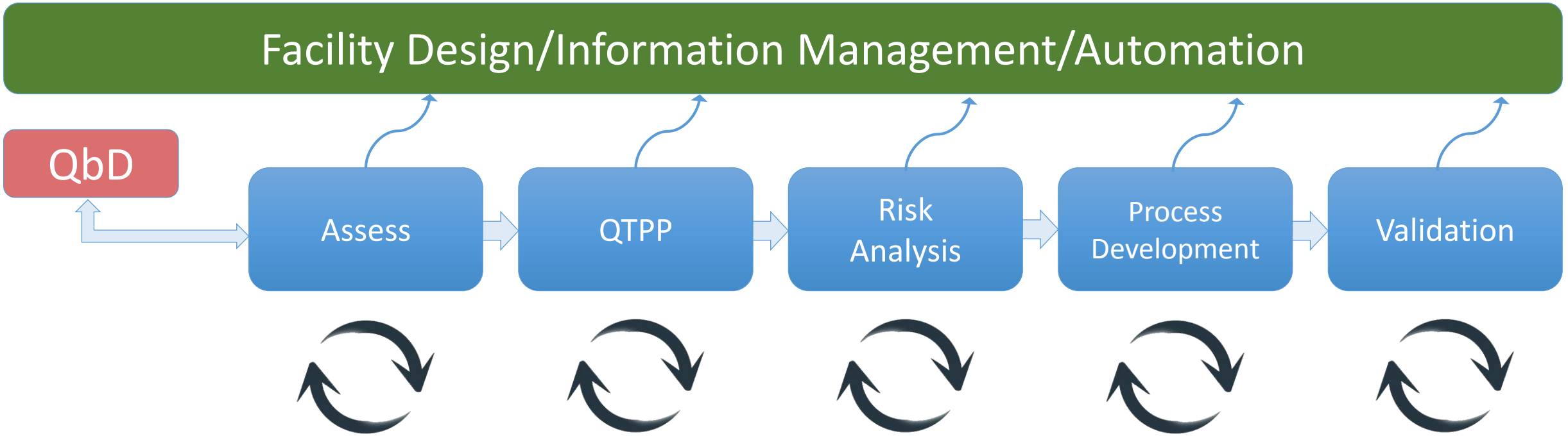
- Planning & Design Process is Slow & Imprecise
- Prolonged Decisions Making
- Costly Initial Work & Costlier Rework
- Delayed Product Delivery



Regulatory Paradigm & “Quality by Design”



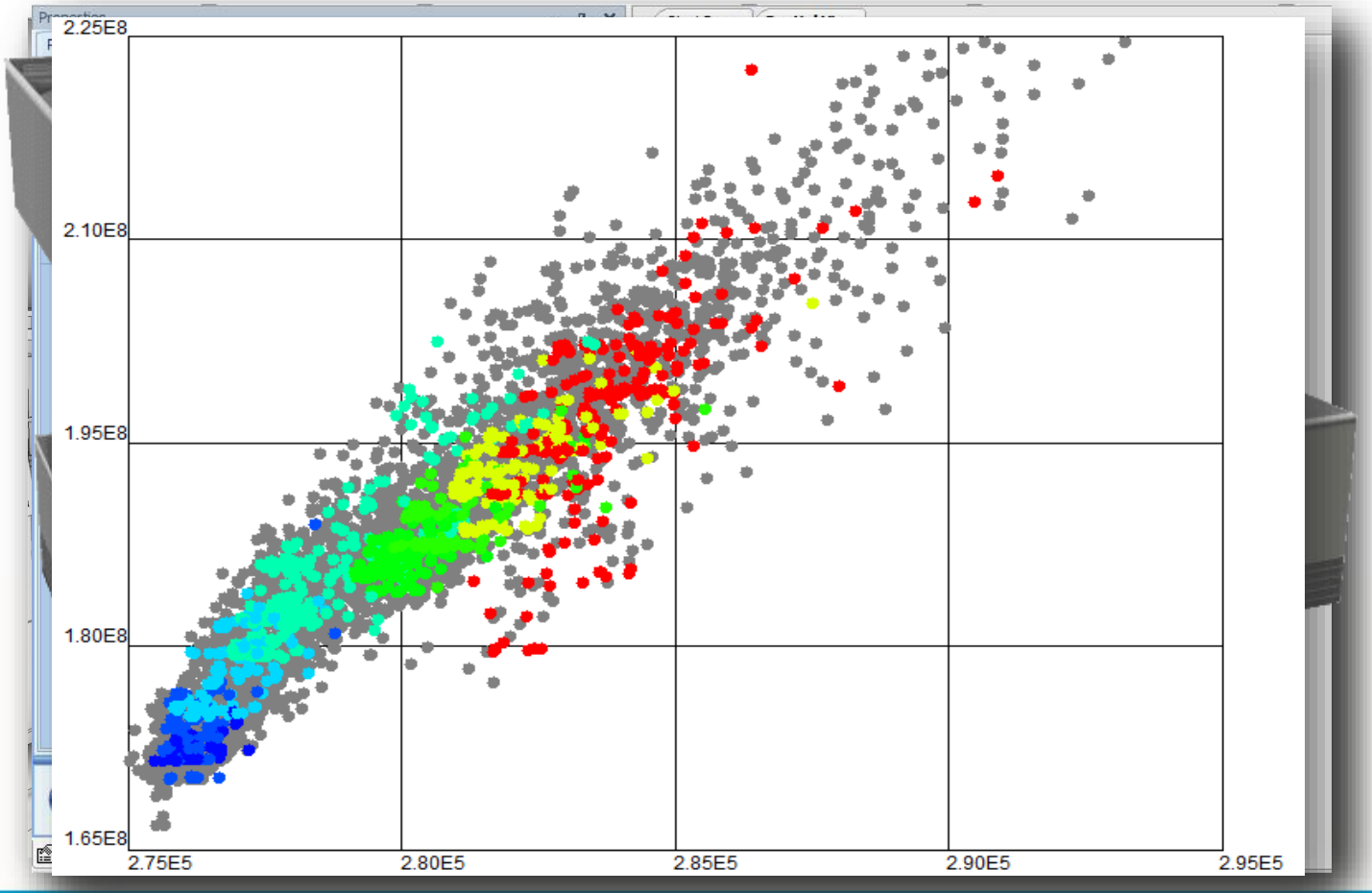
QbD Should Initiate a Design Continuum



Rework loops occur at each step, but the continuum starts at the benchtop!

Relevant Technology Improvements

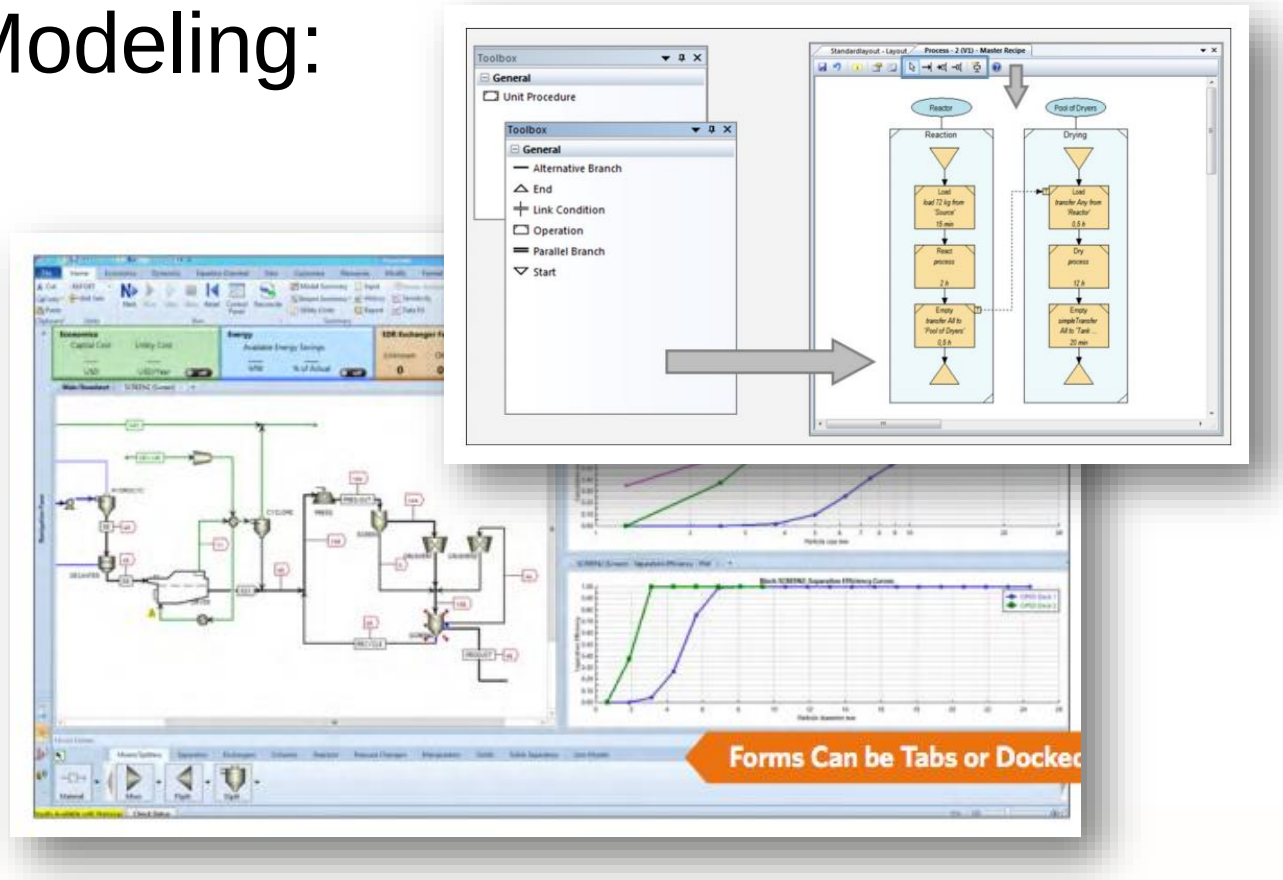
- Process Modeling
- Building Information Modeling (BIM)
- Intelligent Objects
- Rapid Prototyping
- Virtual Analysis



Simulation & Modeling Systems

Current Software for Process Modeling:

- Intelligen – SuperPro Designer
- INOSIM – Process Edition
- AspenTech – AspenOne
- BioPharm – Biosolve Process



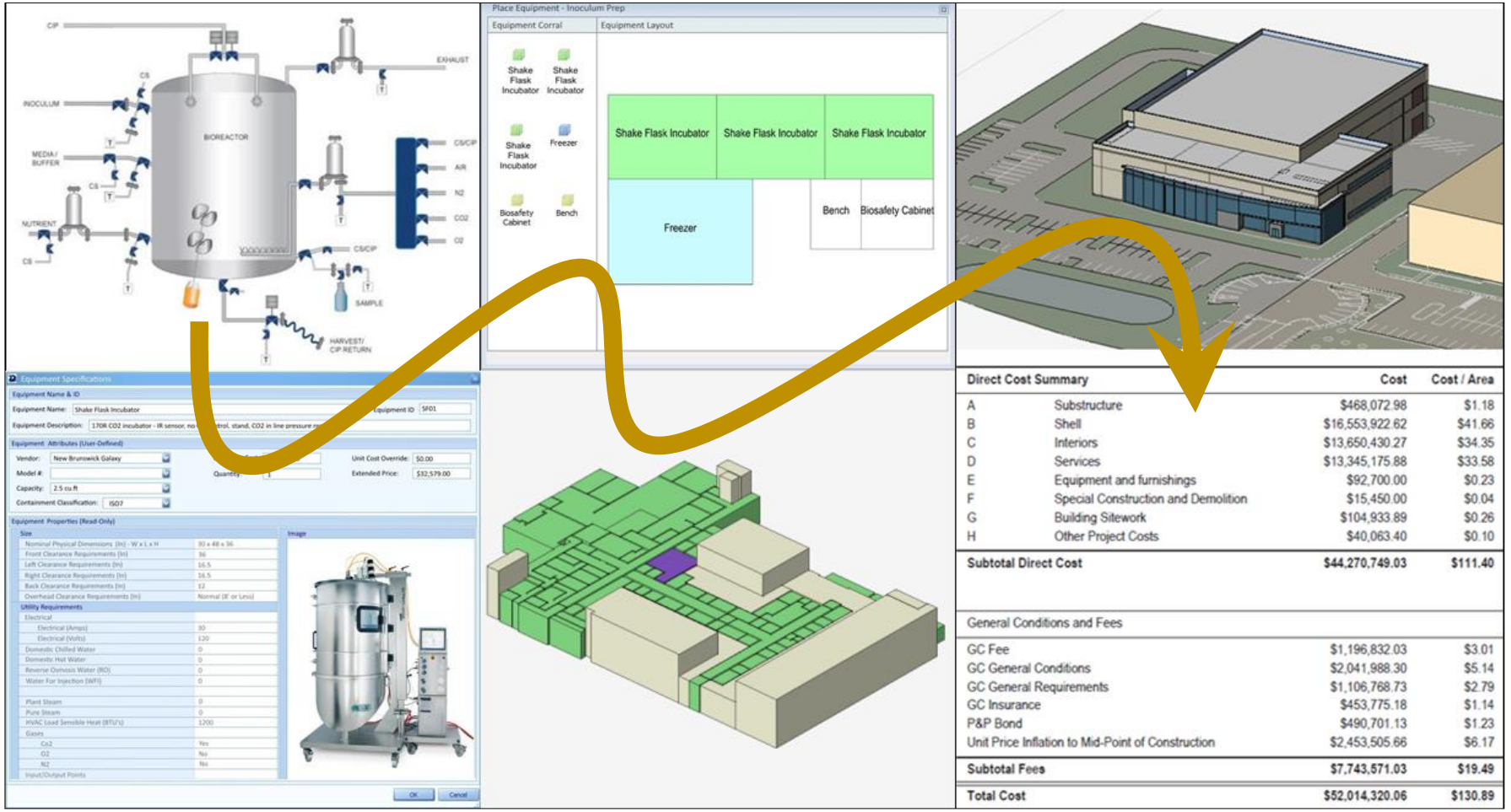
No current simulation system offer parametric process modeling and facility design simultaneously!

Simulation & Modeling Systems

DESTINI Profiler

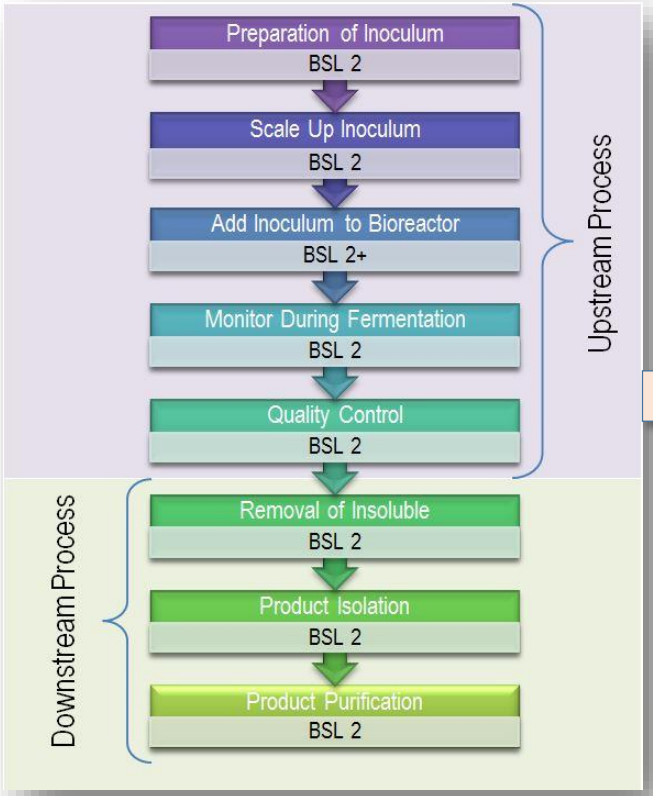
- Planning stage conceptual modeling
- Equipment based space planning
- Real-time costing
- What-if scenario analysis testing

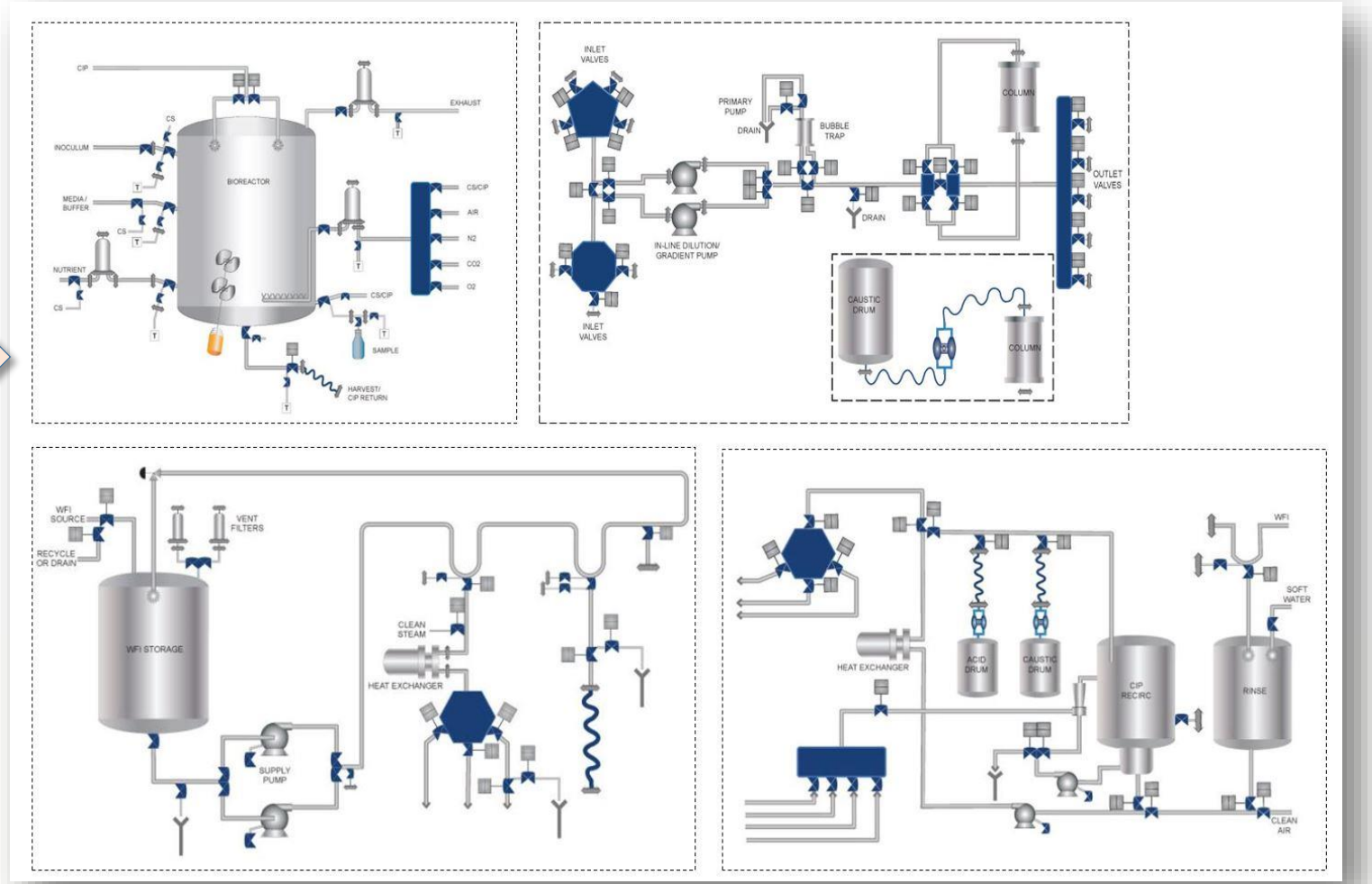
"Virtualizing the Planning of Manufacturing Processes within Facility Design, using Parametric Tools"



3D Cost Modeling with Process Integration

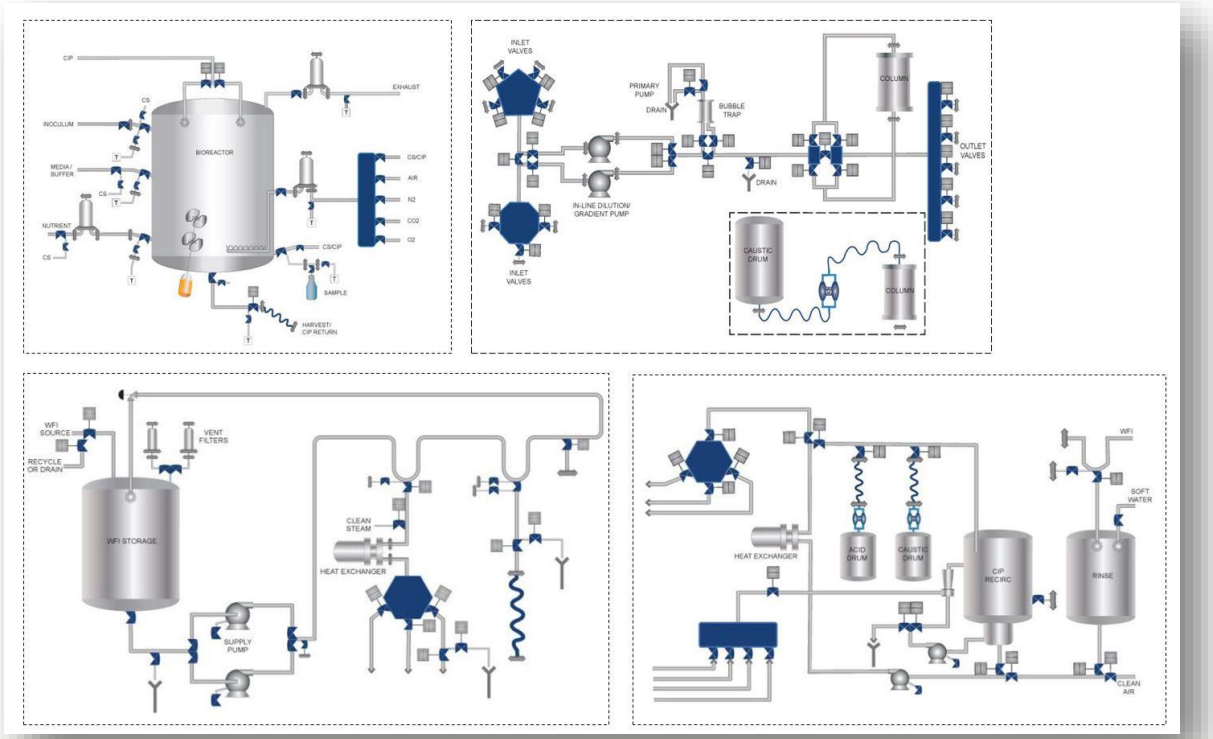
Block Diagram → *Process Flow Diagram*





3D Cost Modeling with Process Integration

Process Flow Diagram → *Equipment Specifier*



Equipment Specifications

Equipment Name & ID

Equipment Name: Shake Flask Incubator — Equipment ID: SF01

Equipment Description: 170R CO2 incubator - IR sensor, no O2 control, stand, CO2 in line pressure regulator

Equipment Attributes (User-Defined)

Vendor:	New Brunswick Galaxy	Catalogue Cost:	$32,579.00	Unit Cost Override:	$0.00
Model #:		Quantity:	1	Extended Price:	$32,579.00
Capacity:	2.5 cu.ft				
Containment Classification:	ISO7				

Equipment Properties (Read-Only)

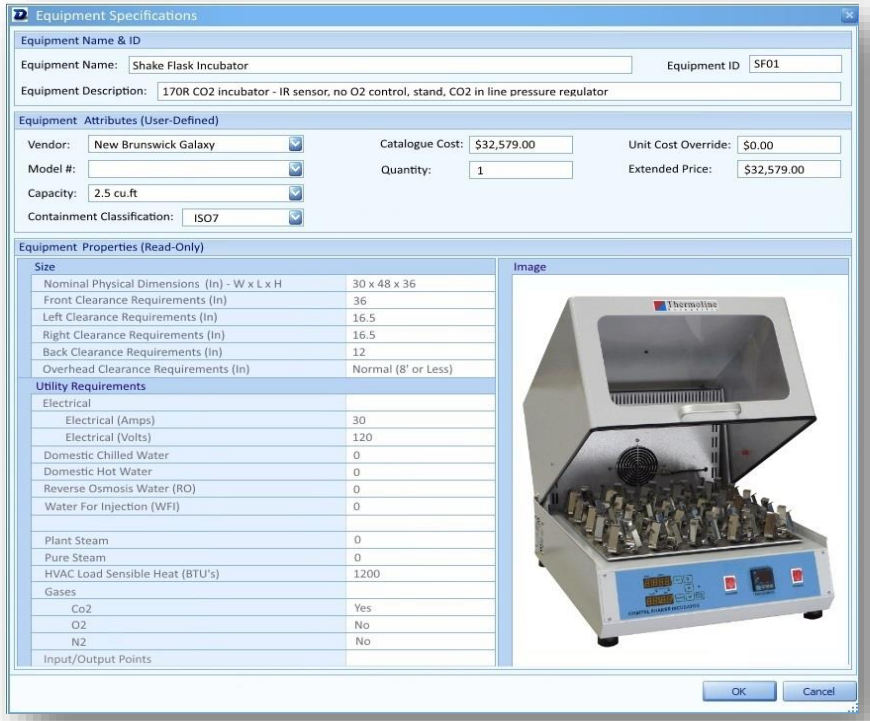
Size	
Nominal Physical Dimensions (In) - W x L x H	30 x 48 x 36
Front Clearance Requirements (In)	36
Left Clearance Requirements (In)	16.5
Right Clearance Requirements (In)	16.5
Back Clearance Requirements (In)	12
Overhead Clearance Requirements (In)	Normal (8' or Less)
Utility Requirements	
Electrical	
Electrical (Amps)	30
Electrical (Volts)	120
Domestic Chilled Water	0
Domestic Hot Water	0
Reverse Osmosis Water (RO)	0
Water For Injection (WFI)	0
Plant Steam	0
Pure Steam	0
HVAC Load Sensible Heat (BTU's)	1200
Gases	
Co2	Yes
O2	No
N2	No
Input/Output Points	

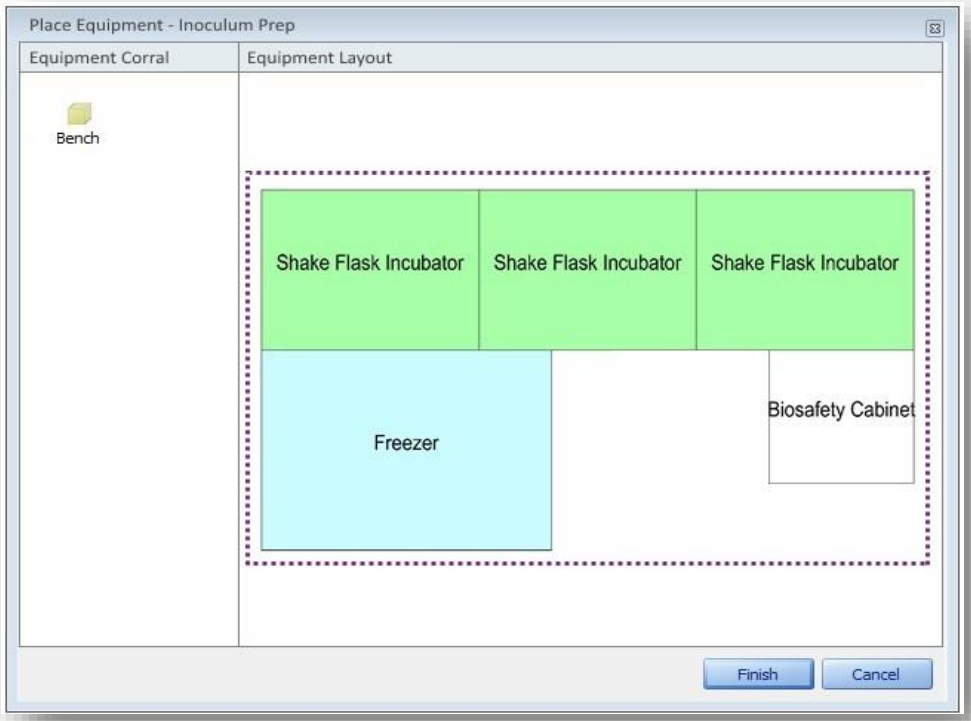
Image

OK Cancel

3D Cost Modeling with Process Integration

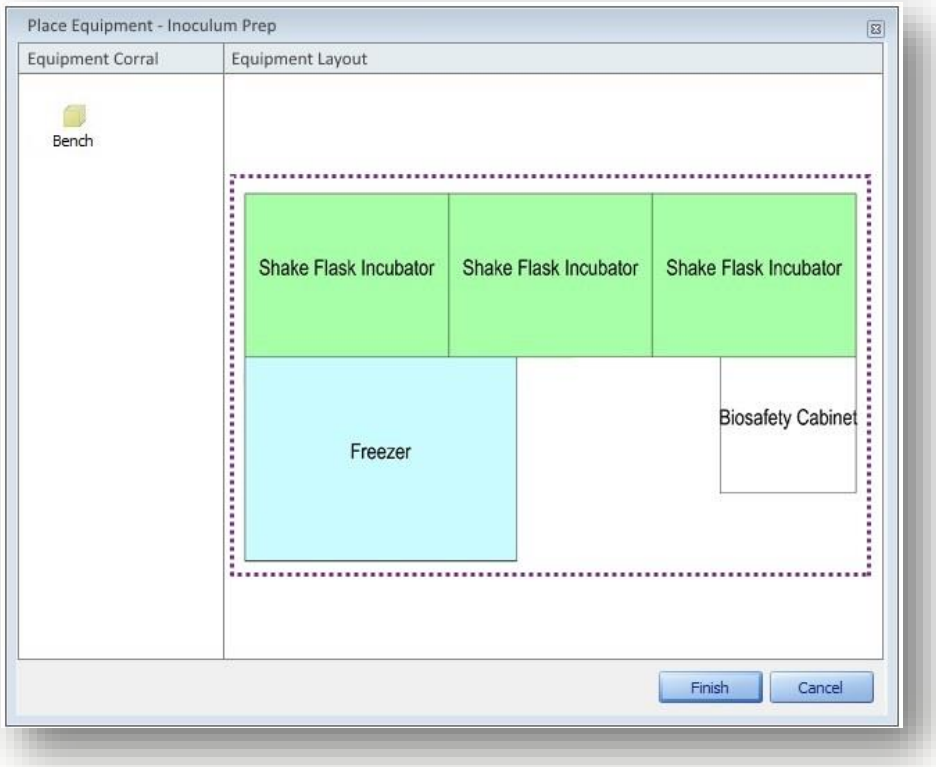
Equipment Specifier → *Equipment Placement*



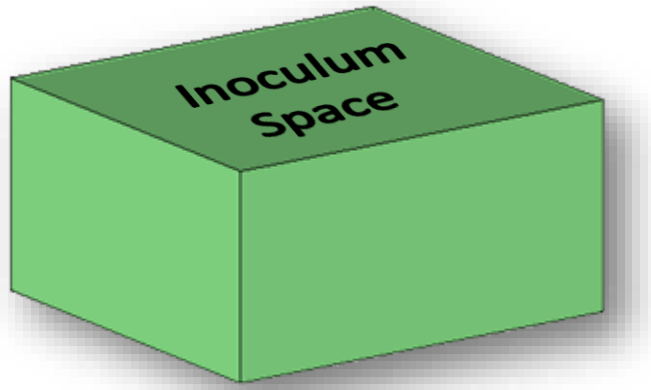


3D Cost Modeling with Process Integration

Equipment Placement



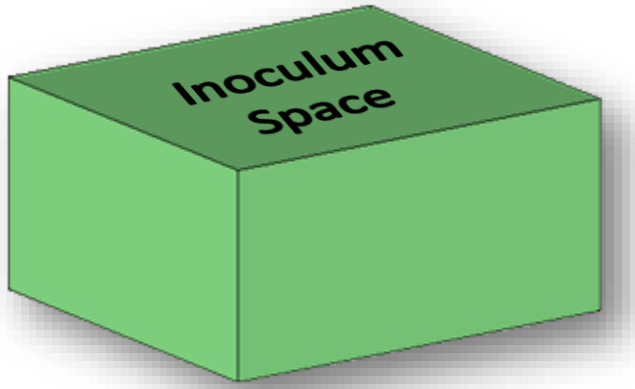
Convert to Model Object
(Space or Program Requirement)



Intelligent object with:
-Physical dimensions
-Utility requirements
-Room Finishes, etc.
-Detailed Cost

3D Cost Modeling with Process Integration

Convert Space → *Populate Room Card*



Room Card Editor

Room Designations

Room Name:	Inoculum Prep	Room ID:	IP100	Mal Required:	1	Size:	100 sqft
Department Name:	Manufacturing	Size (Plan Area):	285 sqft	Pal Required:	2	Size:	100 sqft
Area Classification:	Controlled Not Classified	Minimum Ceiling Height:	8'-6"	Occupancy:	2		
Containment Classification:	Biosafety Level 1	Room Volume:	2,242 cuft				

Room Finishes

Wall Construction Type:	Gypsum Board	Ceiling Type:	Cleanroom Tile	Flooring Type:	3/16" Troweled Epoxy
Wall Finishes Type:	Epoxy Paint	Door Type:	Hollow Metal	Base Type:	4" Rubber Cove Base
Wall Protection:	Crash Rails & Corner Guards	Door Qty:	2	Coved Corners:	Yes

Utilities

HVAC Requirements	
Target Operating Temperature (F)	
Temperature Tolerance (+/- F)	
Total CFM	
Relative Humidity	
Relative Humidity Tolerance (+/-%)	
Required Air Changes per Hour	
Filtration Type	
Supply	
Return	
Relative Pressure	
Environmental Monitoring	
Vaccum	
Internal Lighting Loads (W/SF)	
Internal Equipment Loads (W/SF)	

Fire Protection Requirements	
Type of System	
Density (GPM/S.F.)	
Head Type	
Portable Fire Extinguishers (Qty)	

Process Utilities	
Reverse Osmosis Deionization Water (RO)	
Water for Injection (WFI)	
Domestic Water (DM)	
Gas (Co2)	
Gas (N2)	
Gas (O2)	
Compressed Dry Air (CDA)	
Compressed Air Instrument (CAI)	
Plant Steam	
Pure Steam	

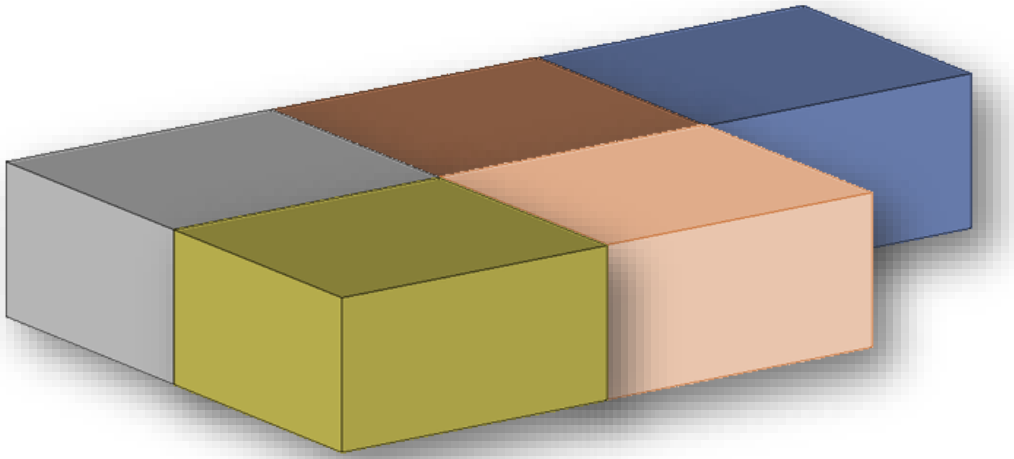
Electrical Requirements	
Lighting (Foot Candles)	
Lighting - Fixture Type	
Power for Equipment	
Power for General Purpose	
EPS/UPS	
Communications (Phone/Data)	
Special Grounding Requirements	
Fire Alarm	
Security	

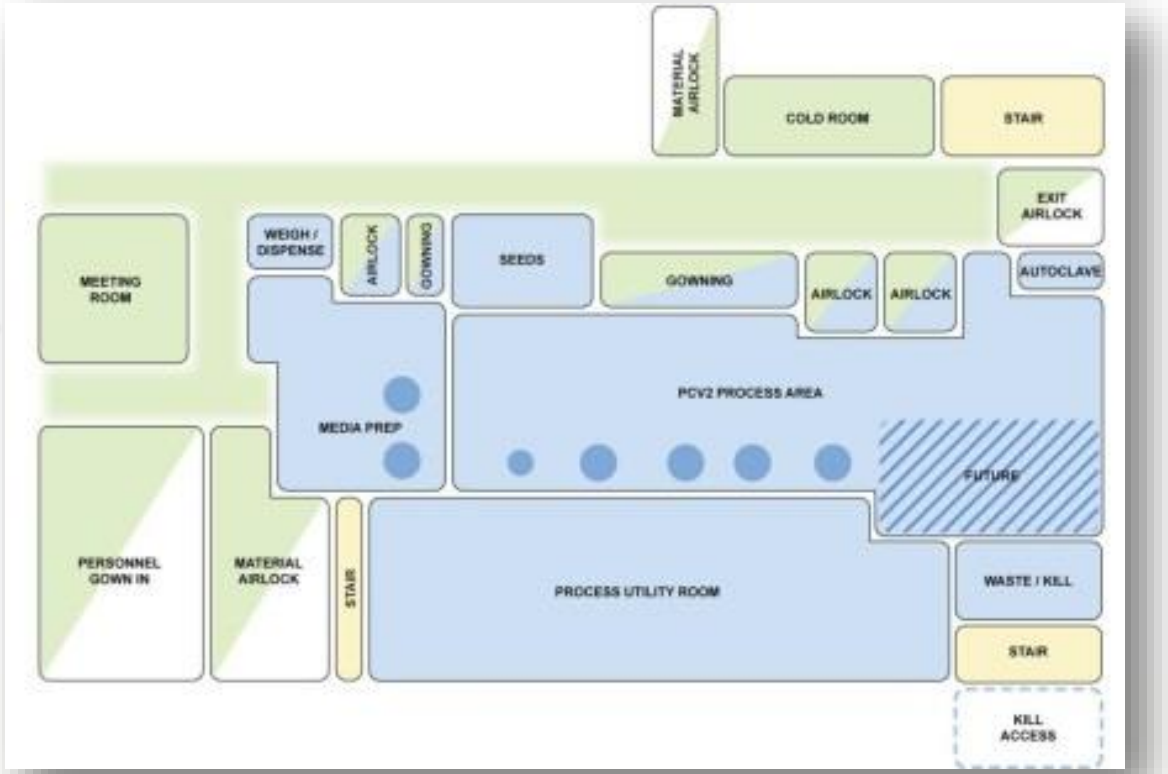
Equipment	
Shake Flask Incubator	3
Freezers	2
Biosafety Cabinet	1
Bench	1

OK Cancel

3D Cost Modeling with Process Integration

Layout Spaces in Model → *Convert to Functional Plan*



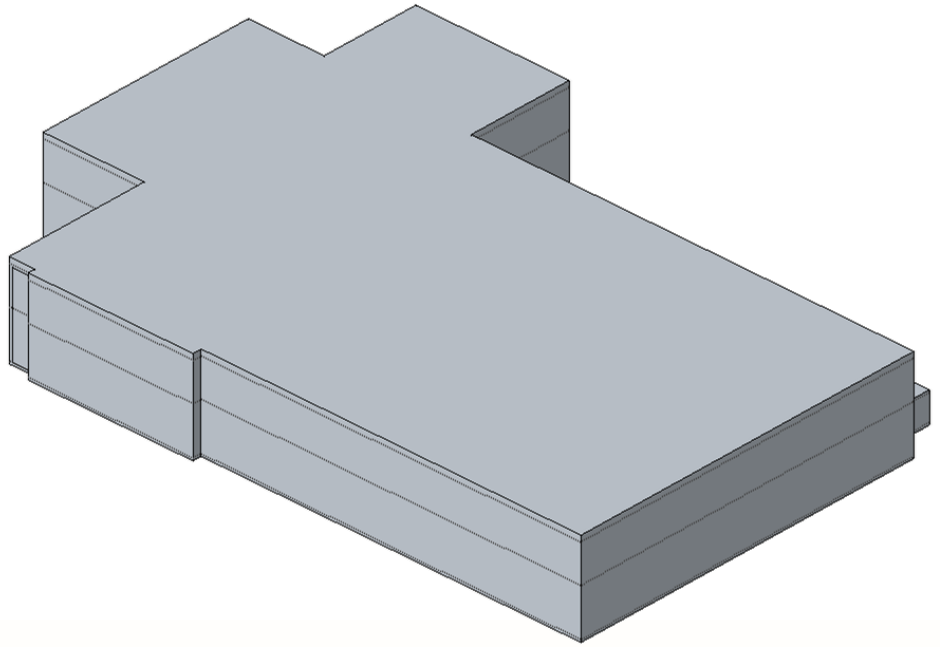


3D Cost Modeling with Process Integration

Floor Plan

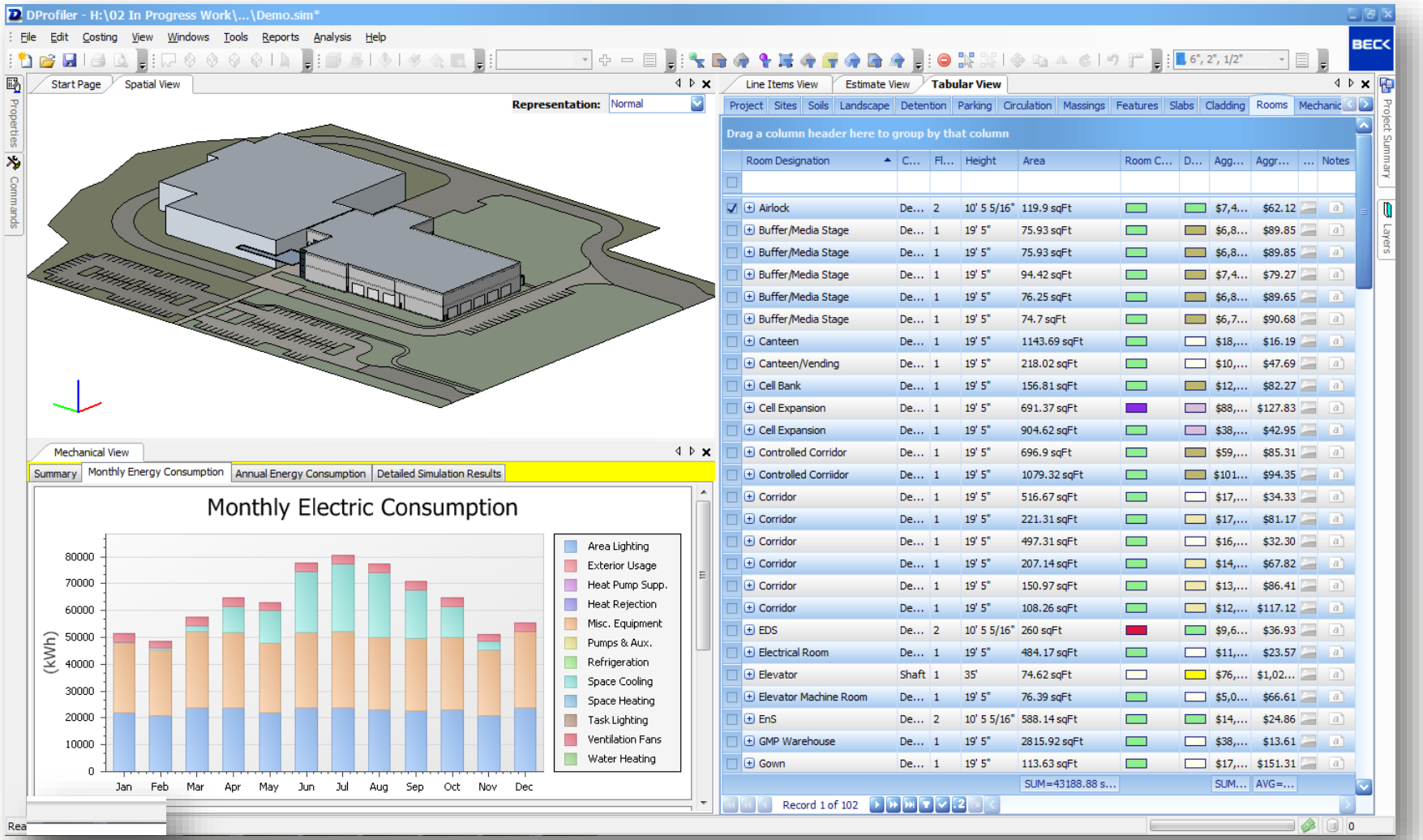
(Product, Material, Waste, & People Flow)

Convert to Baseline Building Model



3D Cost Modeling with Process Integration

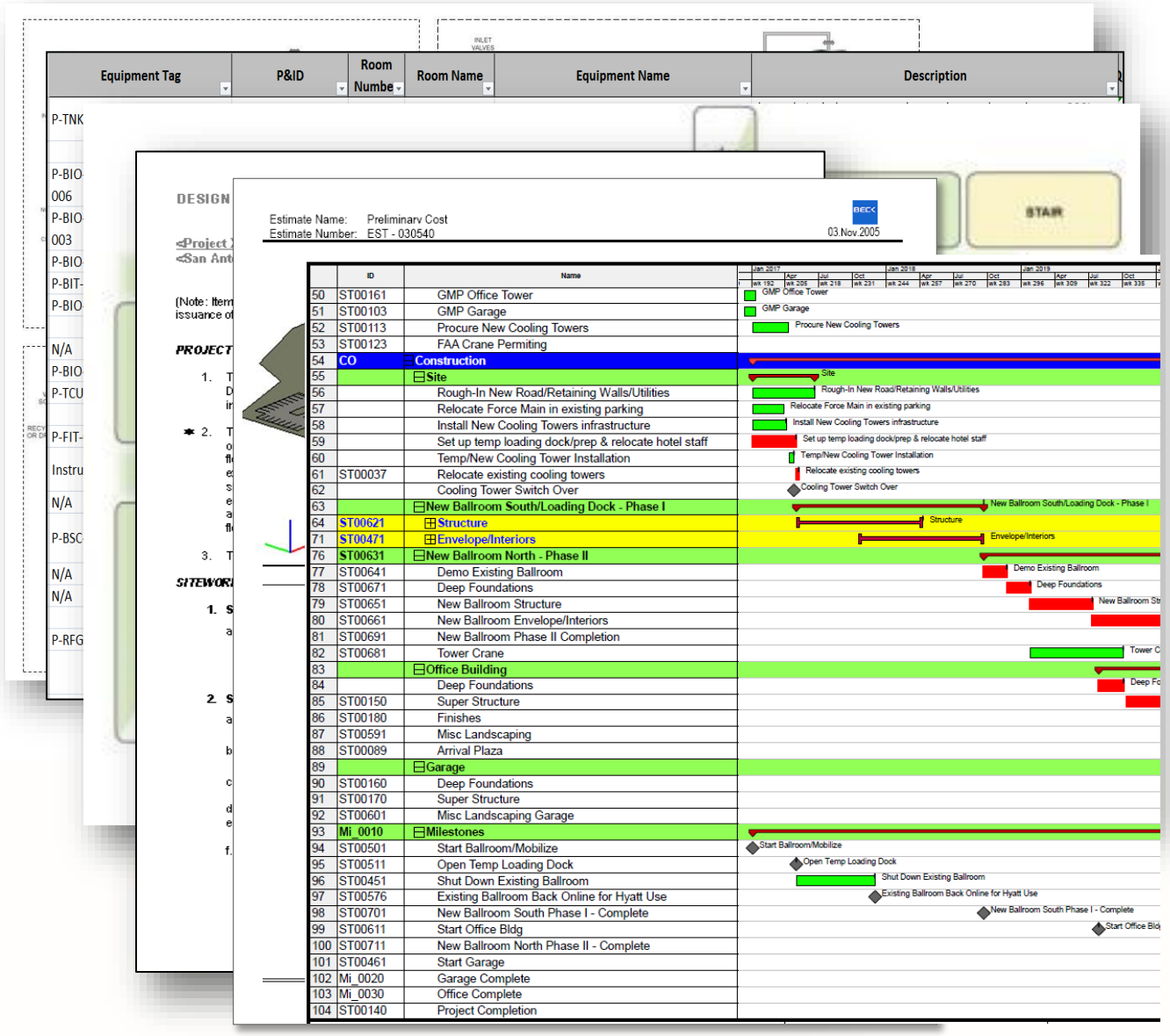
Begin Detailed Analysis & Scope Refinement



3D Cost Modeling with Process Integration

Reports & Other Deliverables

- Process Flow Diagram
- Equipment List
- Floor Plan
- Design Criteria
- Detailed Construction Cost
- Schedule

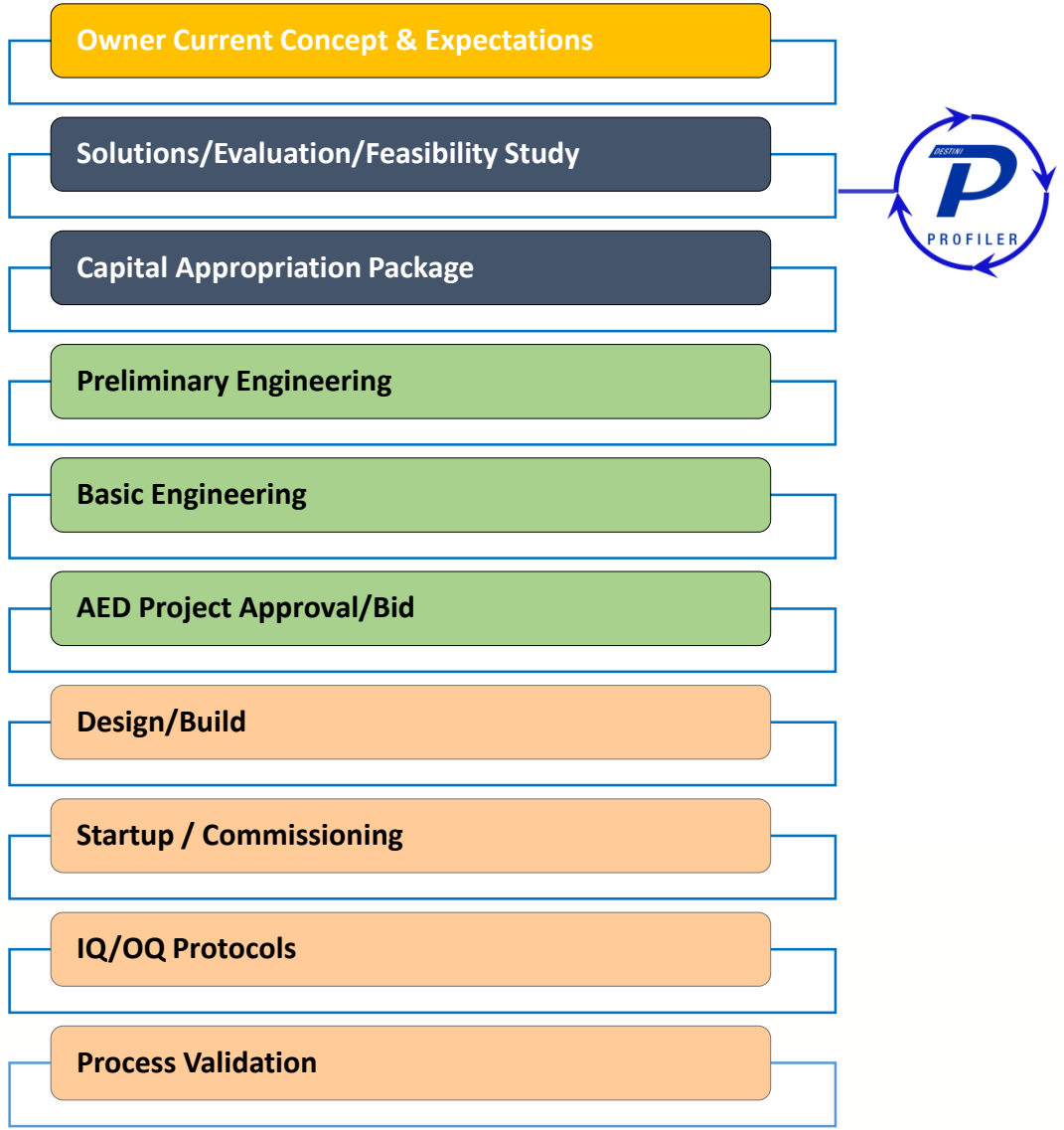


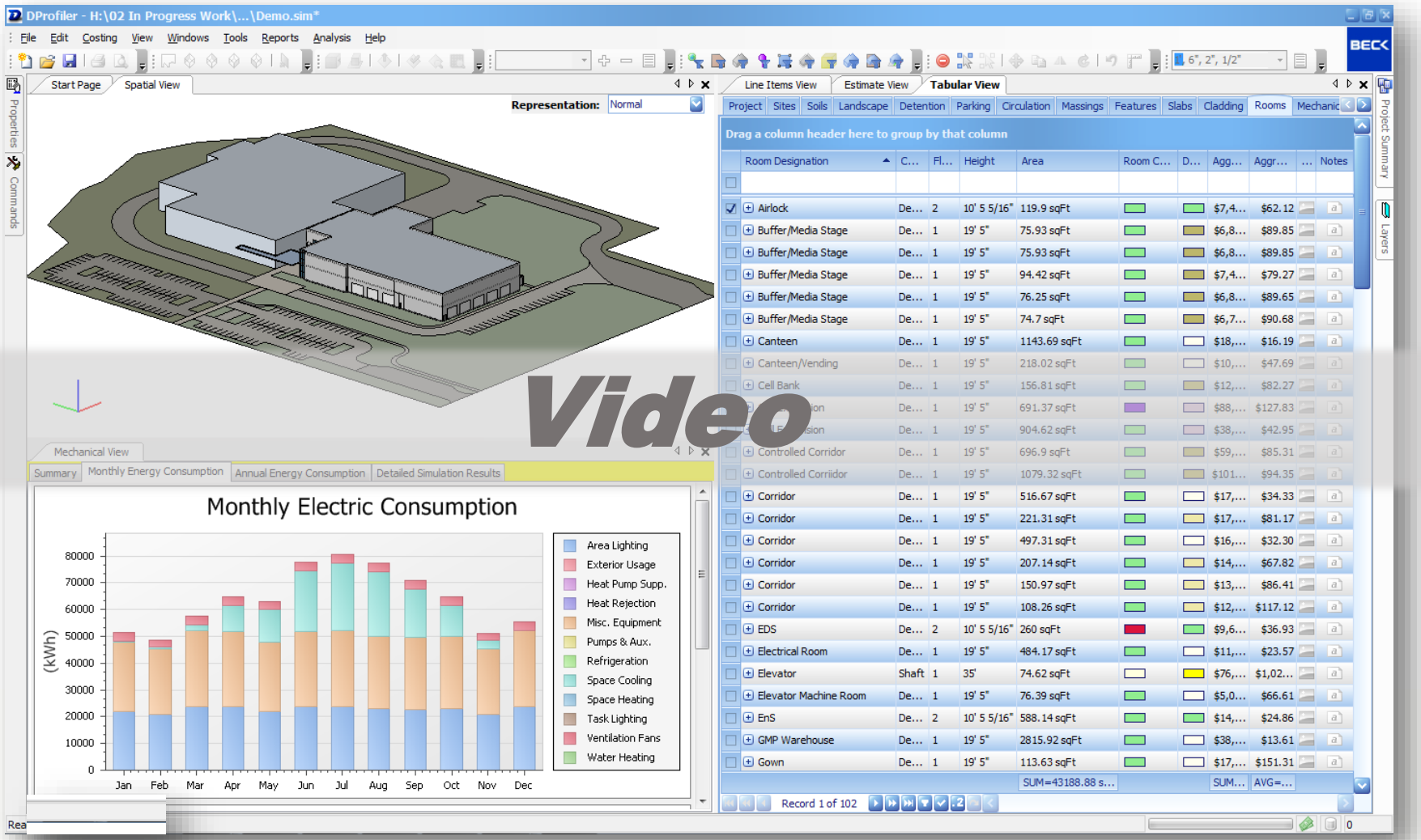
	ID	Name
50	ST00161	GMP Office Tower
51	ST00103	GMP Garage
52	ST00113	Procure New Cooling Towers
53	ST00123	FAA Crane Permiting
54	CO	Construction
55		Site
56		Rough-In New Road/Retaining Walls/Utilities
57		Relocate Force Main in existing parking
58		Install New Cooling Towers infrastructure
59		Set up temp loading dock/prep & relocate hotel staff
60		Temp/New Cooling Tower Installation
61	ST00037	Relocate existing cooling towers
62		Cooling Tower Switch Over
63		New Ballroom South/Loading Dock - Phase I
64	ST00621	Structure
71	ST00471	Envelope/Interiors
76	ST00631	New Ballroom North - Phase II
77	ST00641	Demo Existing Ballroom
78	ST00671	Deep Foundations
79	ST00651	New Ballroom Structure
80	ST00661	New Ballroom Envelope/Interiors
81	ST00691	New Ballroom Phase II Completion
82	ST00681	Tower Crane
83		Office Building
84		Deep Foundations
85	ST00150	Super Structure
86	ST00180	Finishes
87	ST00591	Misc Landscaping
88	ST00089	Arrival Plaza
89		Garage
90	ST00160	Deep Foundations
91	ST00170	Super Structure
92	ST00601	Misc Landscaping Garage
93	Mi_0010	Milestones
94	ST00501	Start Ballroom/Mobilize
95	ST00511	Open Temp Loading Dock
96	ST00451	Shut Down Existing Ballroom
97	ST00576	Existing Ballroom Back Online for Hyatt Use
98	ST00701	New Ballroom South Phase I - Complete
99	ST00611	Start Office Bldg
100	ST00711	New Ballroom North Phase II - Complete
101	ST00461	Start Garage
102	Mi_0020	Garage Complete
103	Mi_0030	Office Complete
104	ST00140	Project Completion

3D Cost Modeling with Process Integration

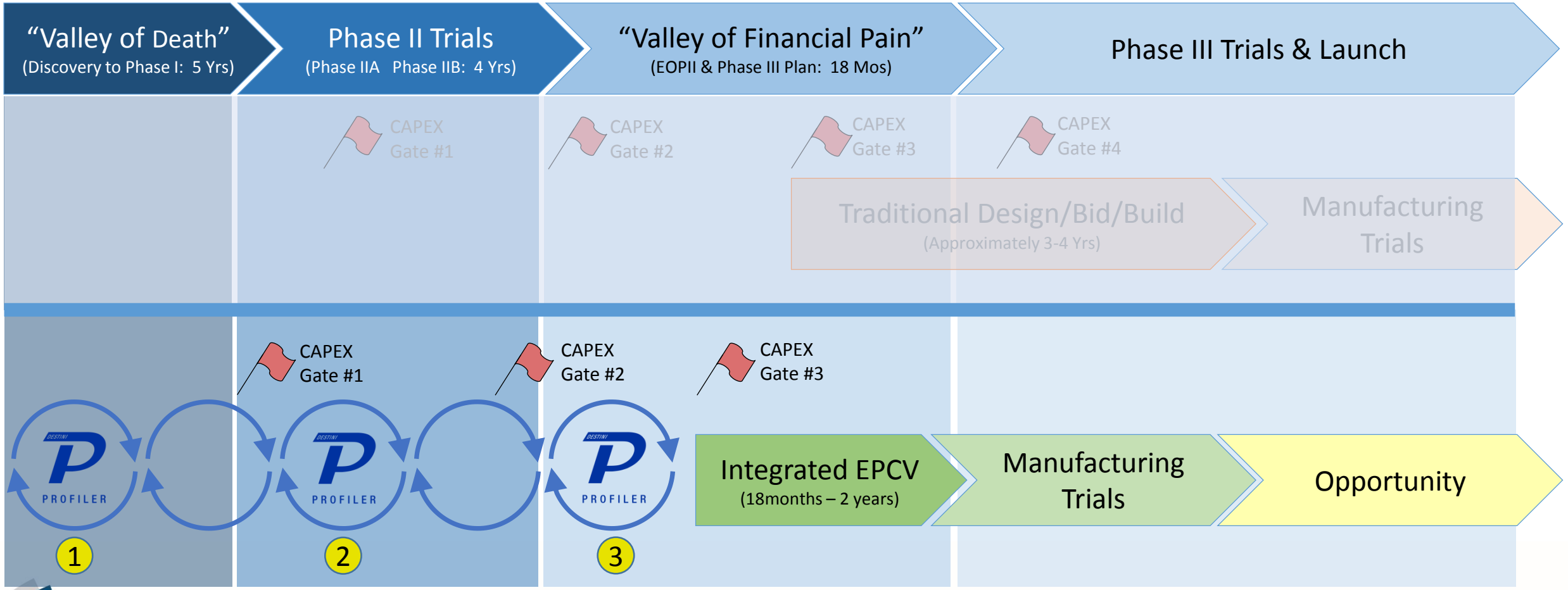
Capital Appropriation Package

- Design Costs (A/E, Process)
- Automation Costs
- Capital Costs (Construction Cost)
- Commissioning/Startup (2%-4%)
- Validation (4%)
- Owner Management Cost (5%)
- Land/City/State/Fed Costs
- Permits




DProfiler - H:\02 In Progress Work\...\Demo.sim*
File Edit Costing View Windows Tools Reports Analysis Help
Start Page
Spatial View
Representation: Normal
Video
Line Items View
Estimate View
Tabular View
Project Sites Soils Landscape Detention Parking Circulation Massings Features Slabs Cladding Rooms Mechanic
Drag a column header here to group by that column
Room Designation C... Fl... Height Area Room C... D... Agg... Aggr... ... Notes
Airlock De... 2 10' 5 5/16" 119.9 sqFt $7,4... $62.12
Buffer/Media Stage De... 1 19' 5" 75.93 sqFt $6,8... $89.85
Buffer/Media Stage De... 1 19' 5" 75.93 sqFt $6,8... $89.85
Buffer/Media Stage De... 1 19' 5" 94.42 sqFt $7,4... $79.27
Buffer/Media Stage De... 1 19' 5" 76.25 sqFt $6,8... $89.65
Buffer/Media Stage De... 1 19' 5" 74.7 sqFt $6,7... $90.68
Canteen De... 1 19' 5" 1143.69 sqFt $18,... $16.19
Canteen/Vending De... 1 19' 5" 218.02 sqFt $10,... $47.69
Cell Bank De... 1 19' 5" 156.81 sqFt $12,... $82.27
De... 1 19' 5" 691.37 sqFt $88,... $127.83
De... 1 19' 5" 904.62 sqFt $38,... $42.95
Controlled Corridor De... 1 19' 5" 696.9 sqFt $59,... $85.31
Controlled Corriidor De... 1 19' 5" 1079.32 sqFt $101... $94.35
Corridor De... 1 19' 5" 516.67 sqFt $17,... $34.33
Corridor De... 1 19' 5" 221.31 sqFt $17,... $81.17
Corridor De... 1 19' 5" 497.31 sqFt $16,... $32.30
Corridor De... 1 19' 5" 207.14 sqFt $14,... $67.82
Corridor De... 1 19' 5" 150.97 sqFt $13,... $86.41
Corridor De... 1 19' 5" 108.26 sqFt $12,... $117.12
EDS De... 2 10' 5 5/16" 260 sqFt $9,6... $36.93
Electrical Room De... 1 19' 5" 484.17 sqFt $11,... $23.57
Elevator Shaft 1 35' 74.62 sqFt $76,... $1,02...
Elevator Machine Room De... 1 19' 5" 76.39 sqFt $5,0... $66.61
EnS De... 2 10' 5 5/16" 588.14 sqFt $14,... $24.86
GMP Warehouse De... 1 19' 5" 2815.92 sqFt $38,... $13.61
Gown De... 1 19' 5" 113.63 sqFt $17,... $151.31
SUM=43188.88 s... SUM... AVG=...
Record 1 of 102
Mechanical View
Summary Monthly Energy Consumption Annual Energy Consumption Detailed Simulation Results
Monthly Electric Consumption
(kWh)
80000 70000 60000 50000 40000 30000 20000 10000 0
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
Area Lighting
Exterior Usage
Heat Pump Supp.
Heat Rejection
Misc. Equipment
Pumps & Aux.
Refrigeration
Space Cooling
Space Heating
Task Lighting
Ventilation Fans
Water Heating

Technology Implementation Timeline



1 **Early Evaluation Bench/Pilot**

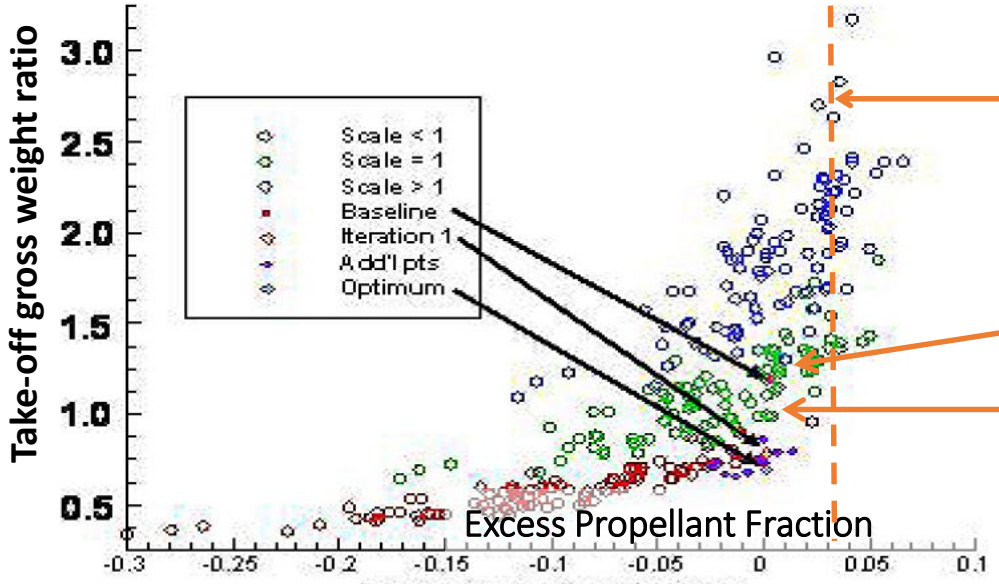
2 **Mid-Stage Eval Process Optimization**

3 **Design & Budget for Design/Build**

The Future of This Innovation – "Optioneering"

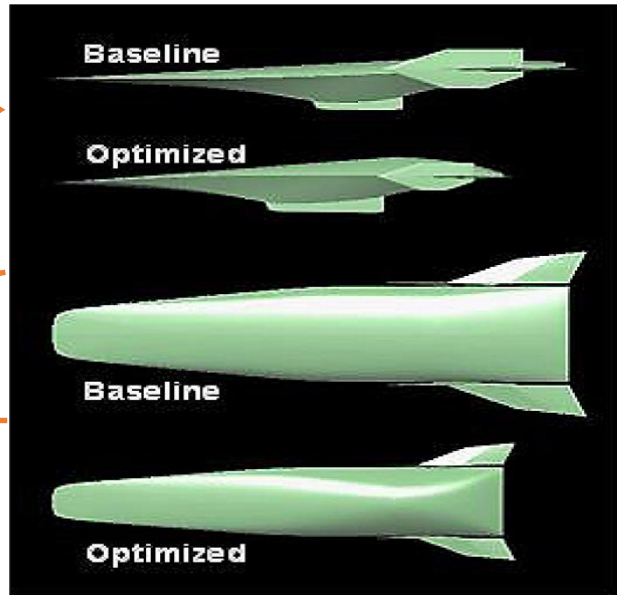
Inspiration: Boeing's RCD Process

(Vandenbrande 2006)

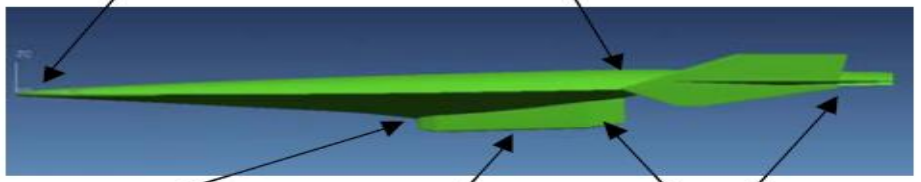


Feasible Range

TOGW -38%



- Upper Nose Angle
- Body Waterline Angle
- Maximum Body Height
- Maximum Height Station



Engine Cant

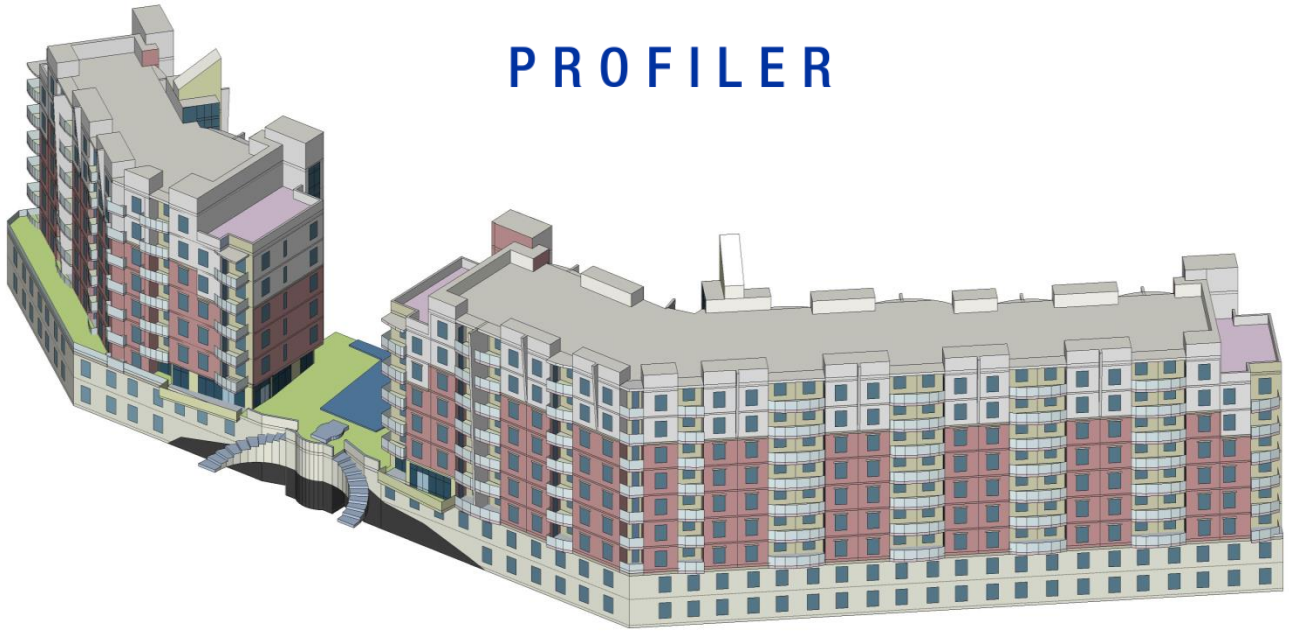
- Design Mach Number
- Horizontal Cowl Lip Station
- Internal Contraction Ratio
- Nozzle Cowl Length
- Nozzle Expansion Ratio

The Future of This Innovation

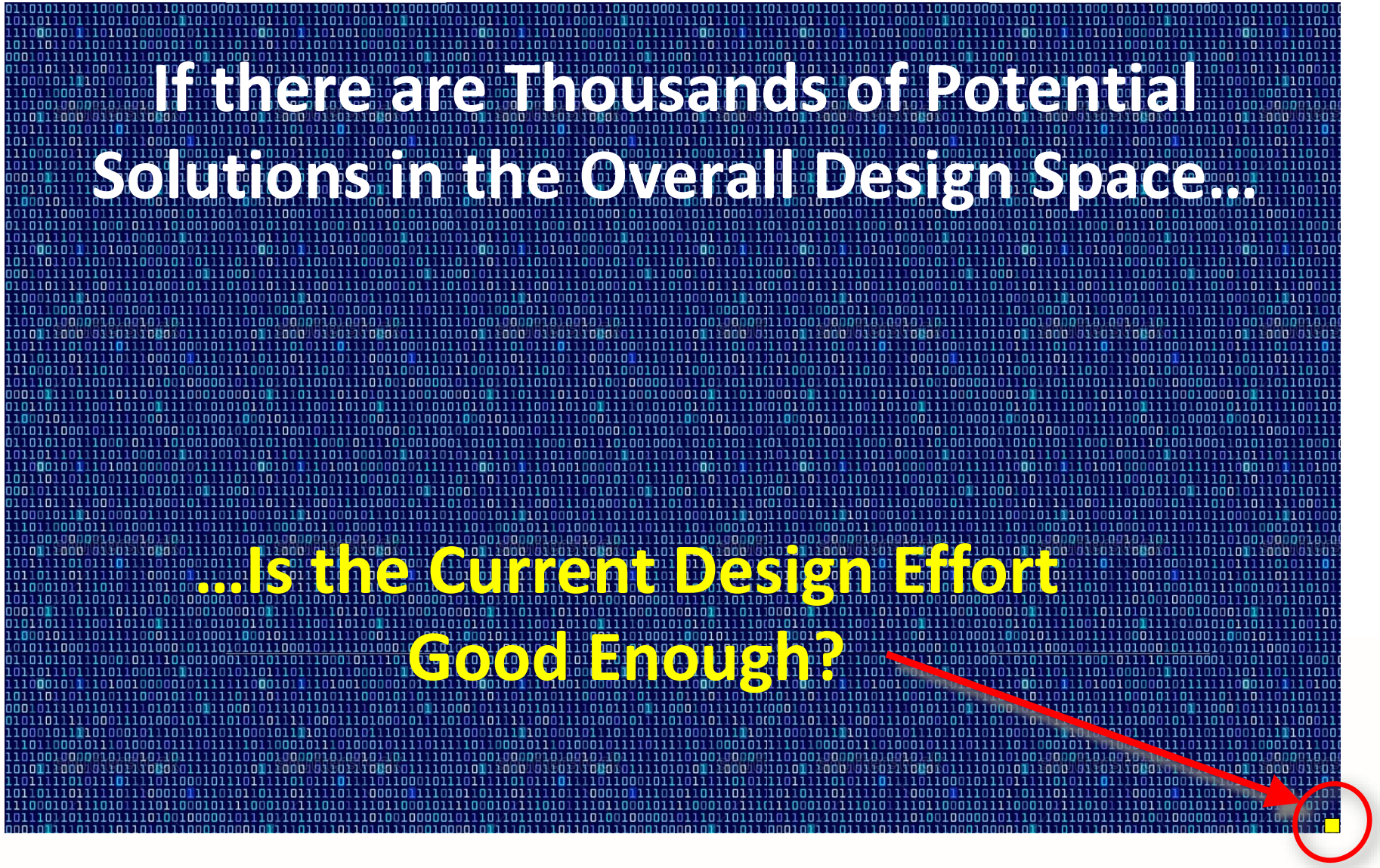
Today's Design Practice

- Allows for 5-9 Design Options
- Focuses on 3-4 Major Issues
- Takes 6-8 Months
- Spends Money
- Wastes Time

DESTINI PROFILER



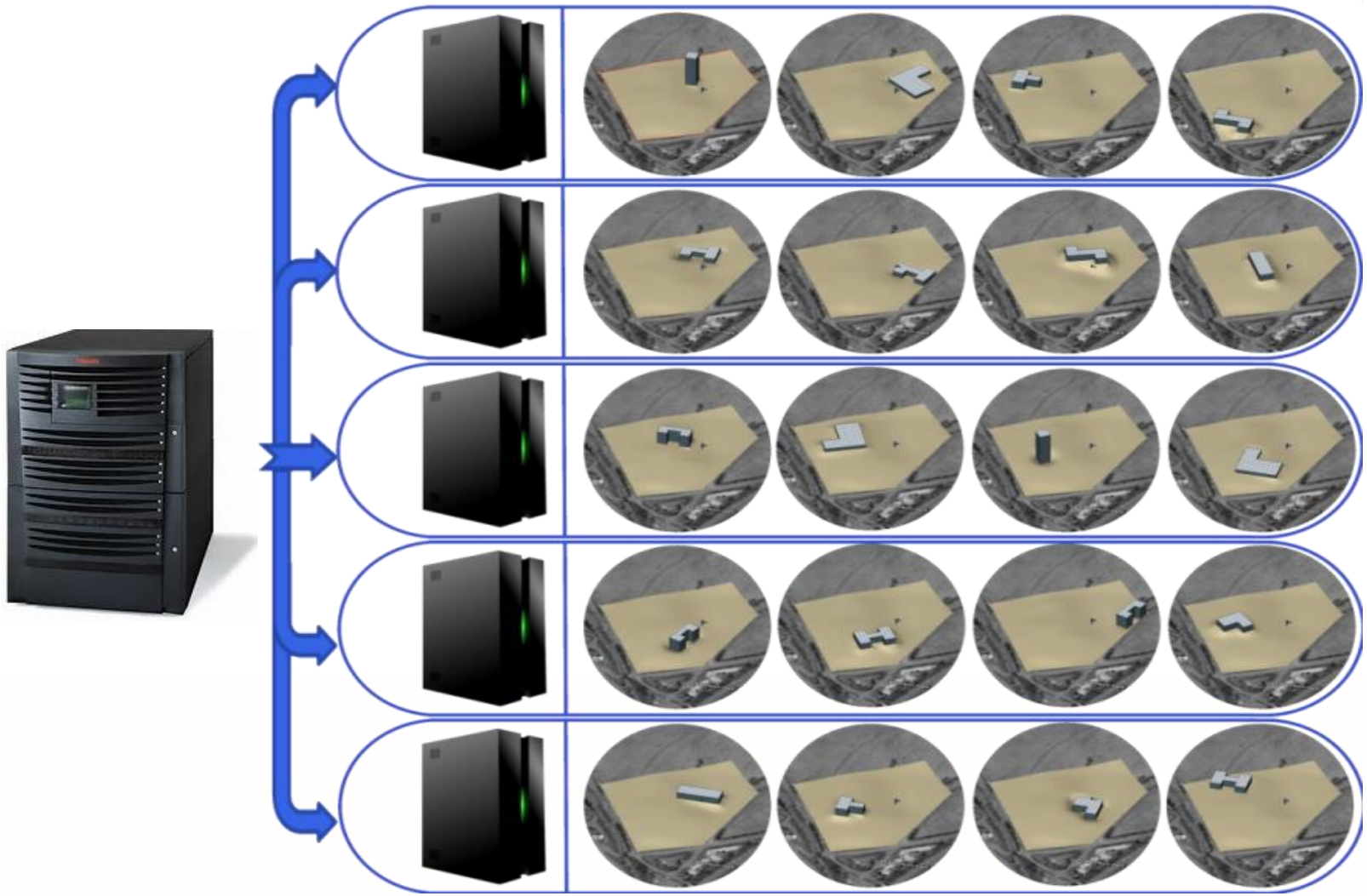
The Future of This Innovation



The Future of This Innovation

Tomorrow:

- Thousands of options
- Multiple parameters
- Two weeks
- SAVES money
- SAVES time
- ADD value

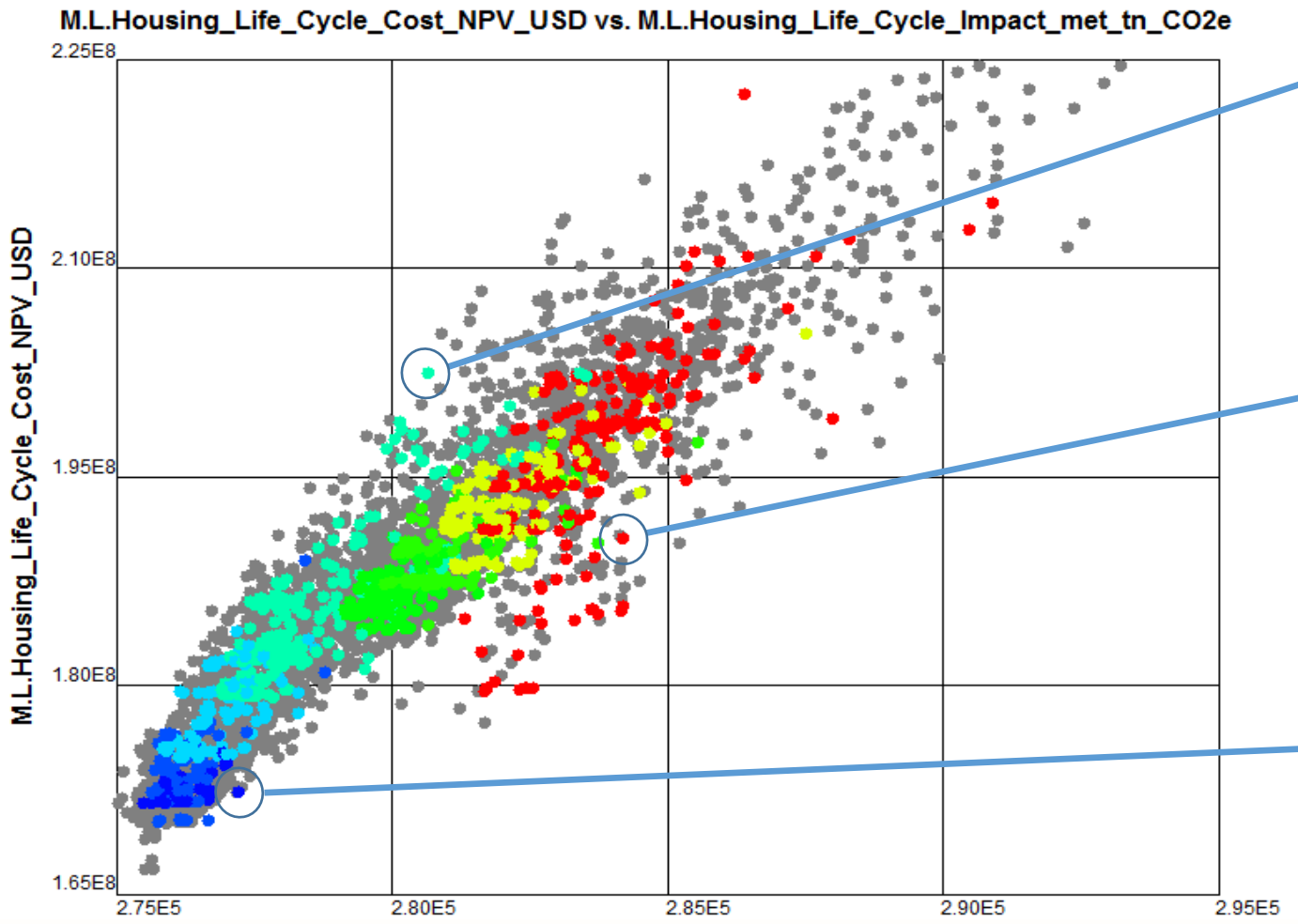


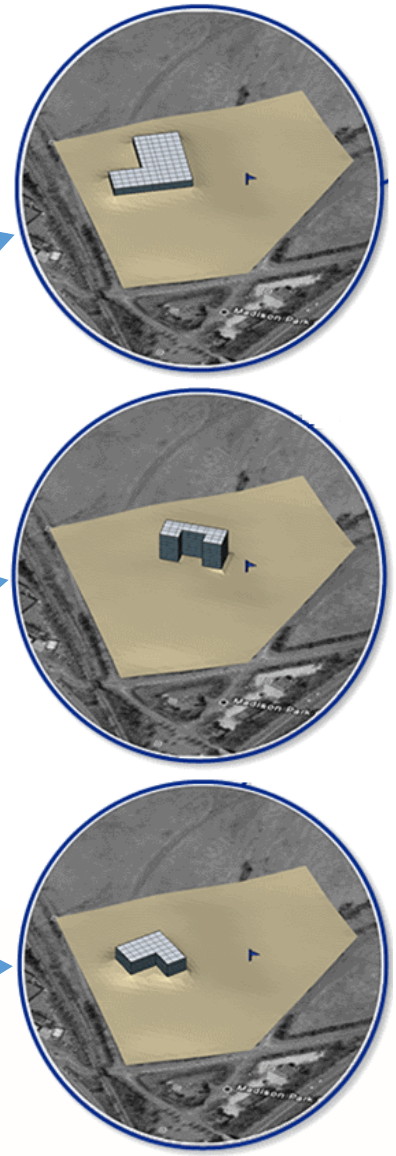
The Future of This Innovation

Optioneering at 50,000 ft

KEY

- Baseline
- Lowest Cost
- Lowest Carbon Footprint
- Infeasible Solution
- 3 Buildings, 5 Stories
- 3 Buildings, 6 Stories
- 3 Buildings, 7 Stories
- 3 Buildings, 8 Stories
- 4 Buildings, 5 Stories
- 4 Buildings, 6 Stories
- 4 Buildings, 7 Stories
- 4 Buildings, 8 Stories





Questions

- **Jose Rivera**, P.E. – HC Beck, Ltd.
  - Project Executive
- **Barry Holtz**, Ph.D – Holtz Biopharma Consulting
  - Principal Consultant
- **Brent Pilgrim**, Beck Technology
  - Director of Services

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