Lighting and CONTROL

Opportunity and Incentives for Innovation

Michael Poplawski

Now:

Pacific Northwest National Laboratory
Data-driven lighting: using data for digital validation and verification, energy management, maintenance, and grid-interaction

Previous:

Semiconductor Industry
Multiple jobs: ON Semiconductor, Magnachip, Motorola
Multiple roles: R&D, Design, Reliability

Michigan
MSE Electrical Engineering, Solid-State Physics

Star Davis

Now:

Starting something new

Previous:

WeWork
Global Head of Lighting

Arup
Project Manager + Lighting Consultant

Carpenter Norris
Daylighting Designer

Wharton	EMBA candidate (current)
Parsons	MFA Architectural Lighting
Duke	BSE Structural + Architectural Engineering

Jessica Collier

Now:

Pacific Northwest National Lab
Lighting Research Engineer
New tech evaluations, simulations, digital design

Previous:

Lighting Designer

Parsons MFA Architectural Lighting

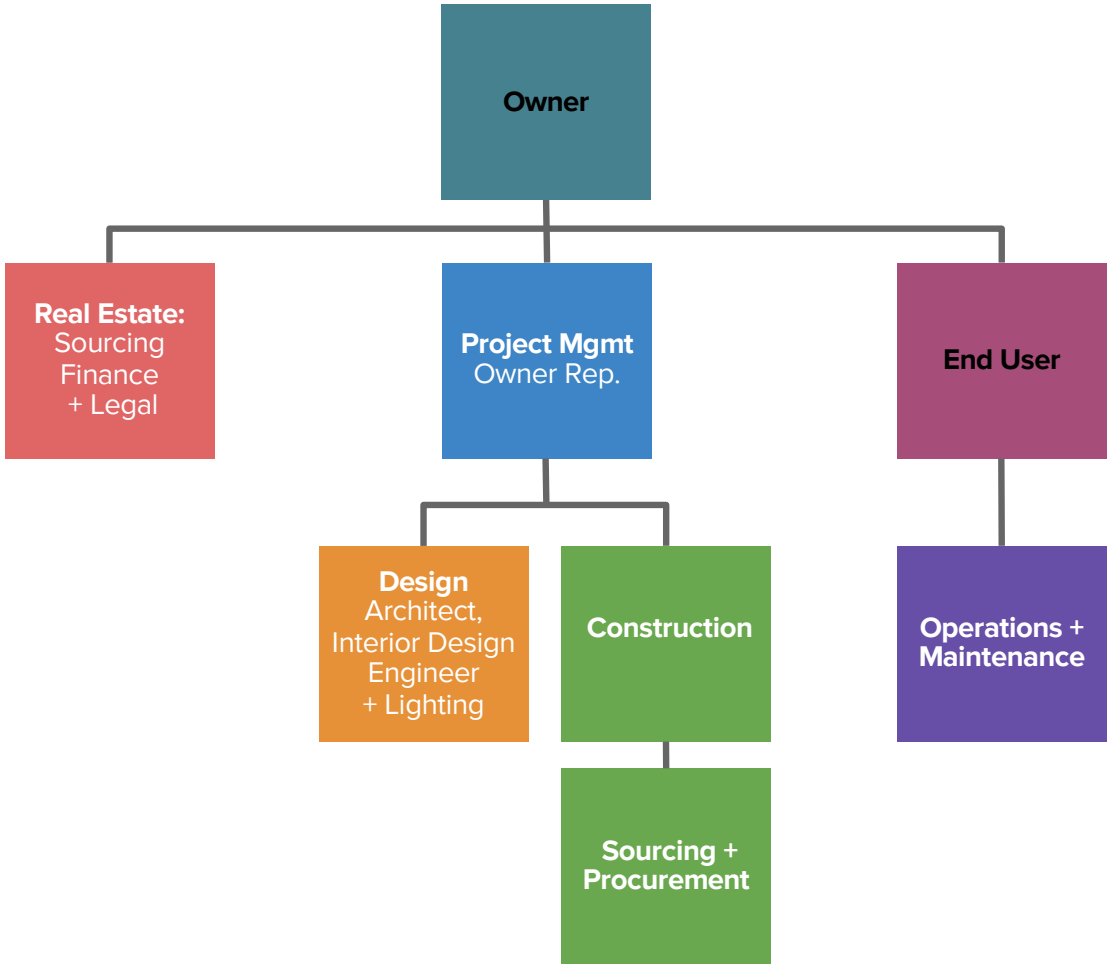
RPI Architecture

(Many) Lessons Learned

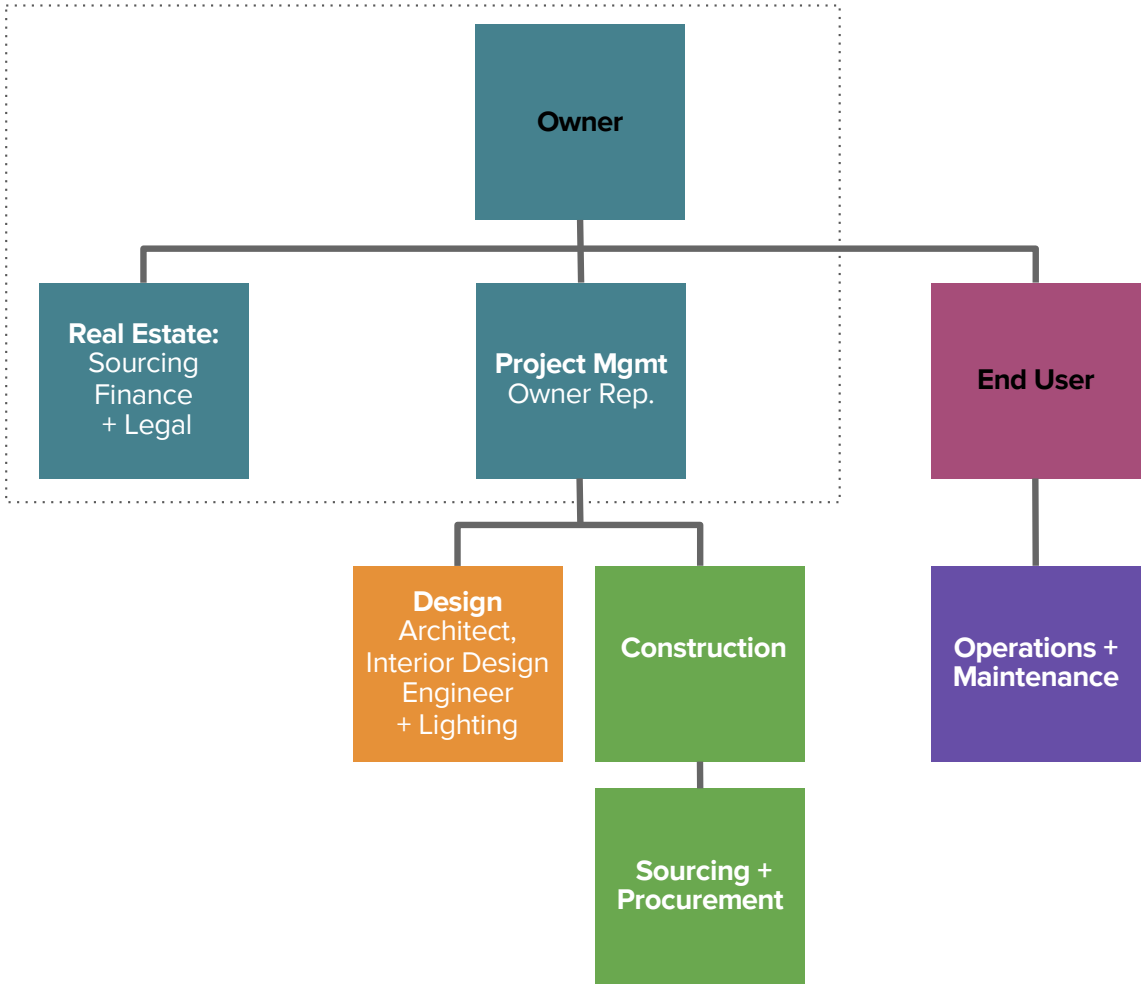
TGIM

Image courtesy of WeWork

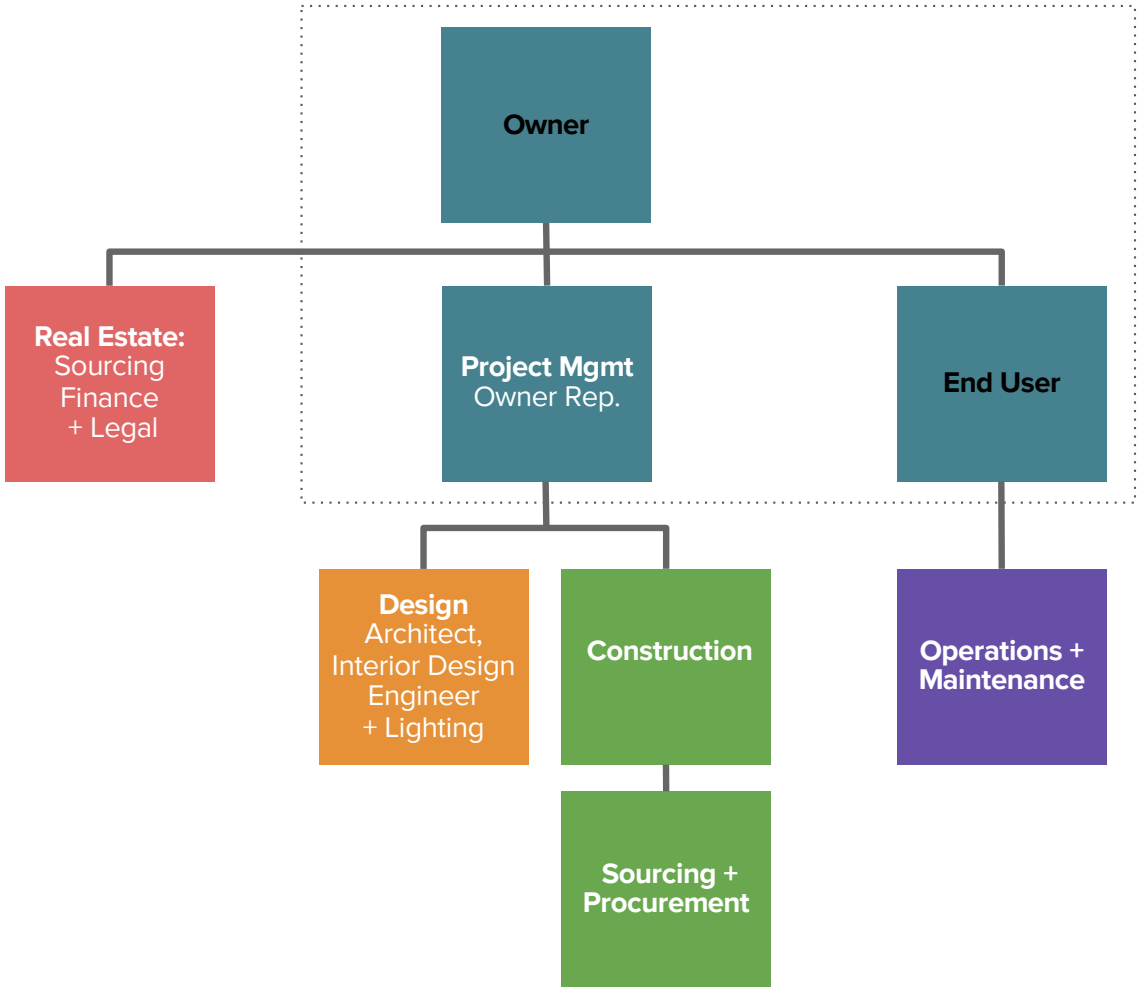
A Typical Project Organization . . .



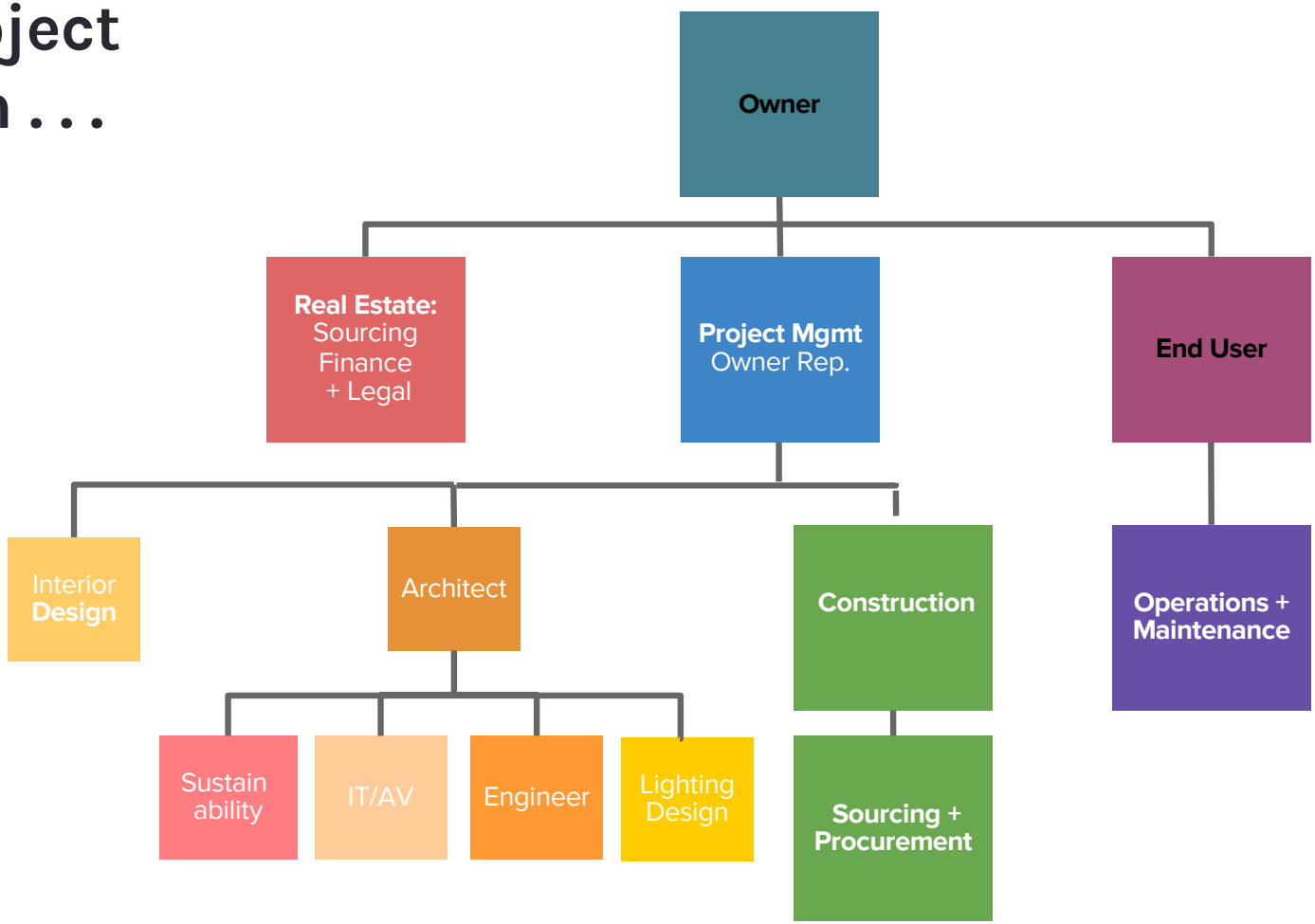
Real Estate Developer Org



Institutional Organization . . .

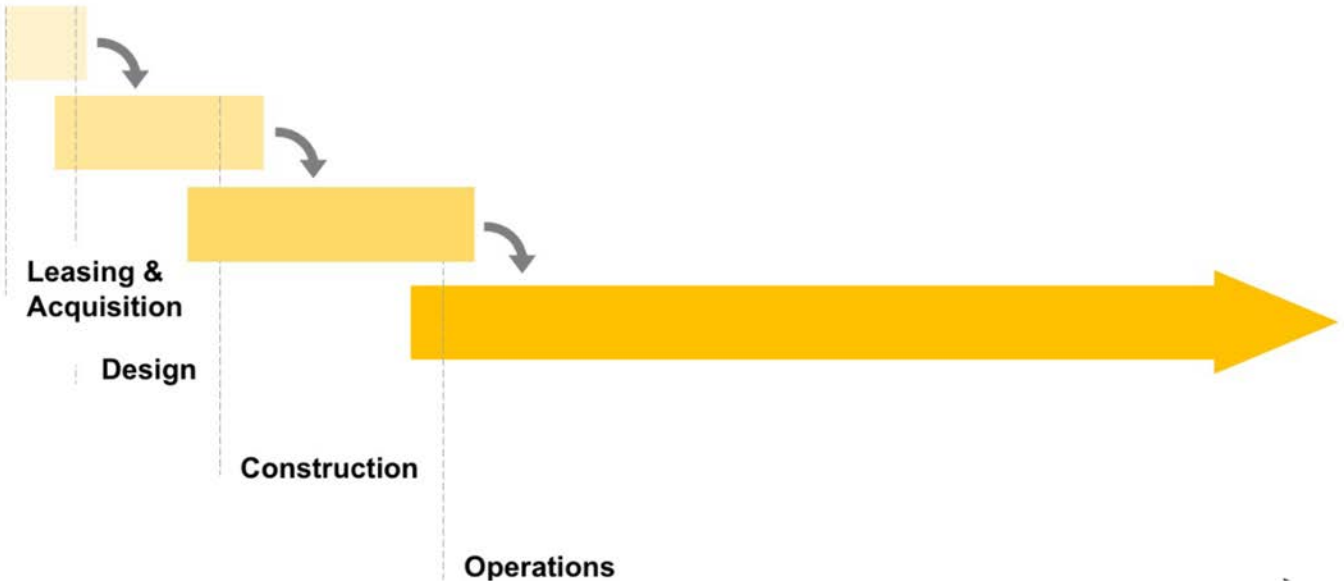


A Typical Project Organization . . .



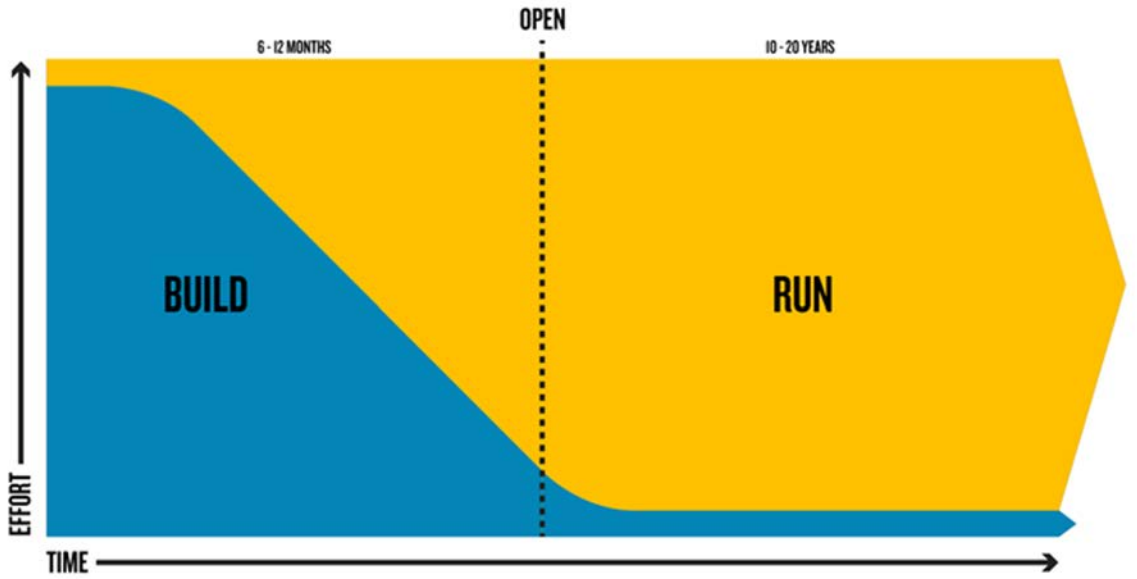
Vertically Integrated Organization . . .

Process:
Parallel + Aligned

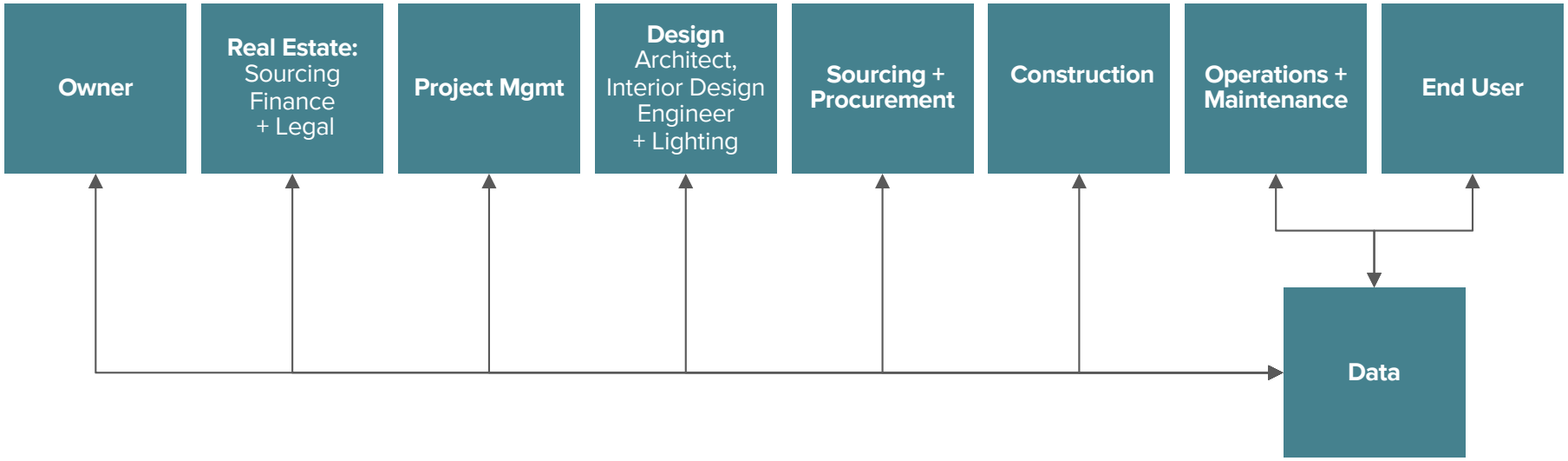


Design Build Operate

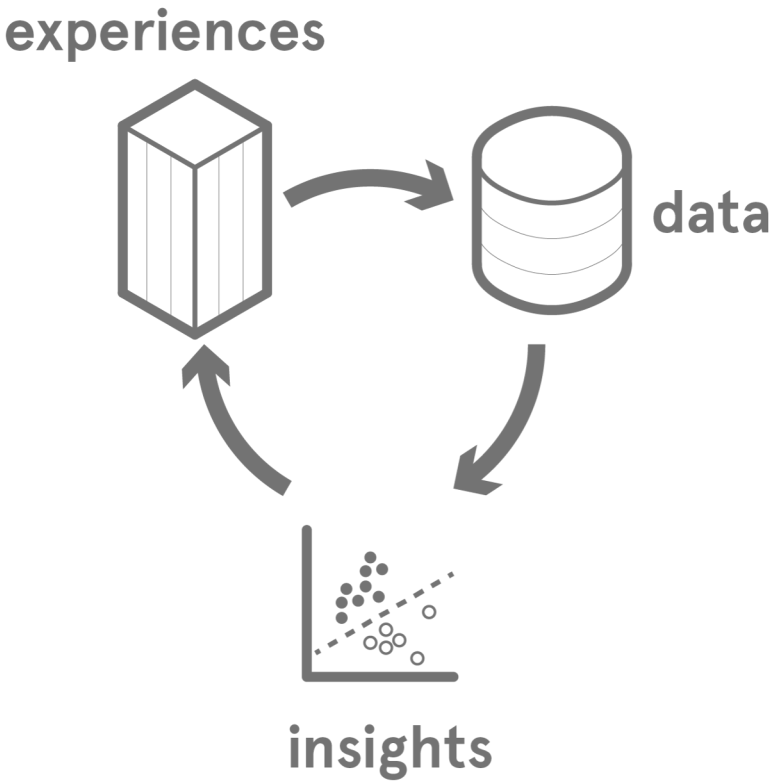
WeWork is unique vs. a typical design-build firm in that we are not only designing and building, but also sourcing our spaces and operating them after construction is complete.



Vertically Integrated Feedback Loop . . .



Evolve Sustainably

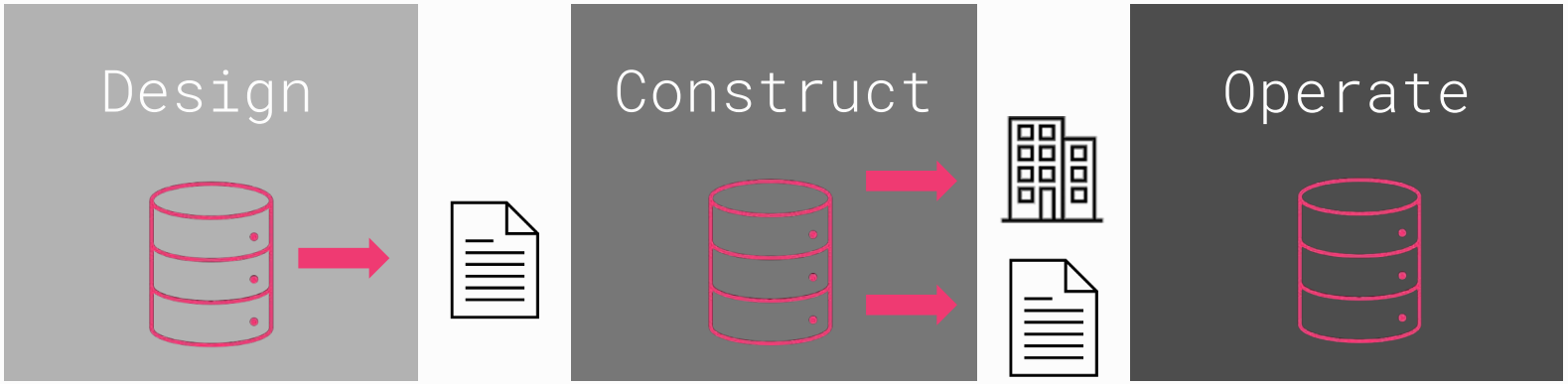


~~Reinvent~~
iterate + improve

Vertical Integration Efficiencies

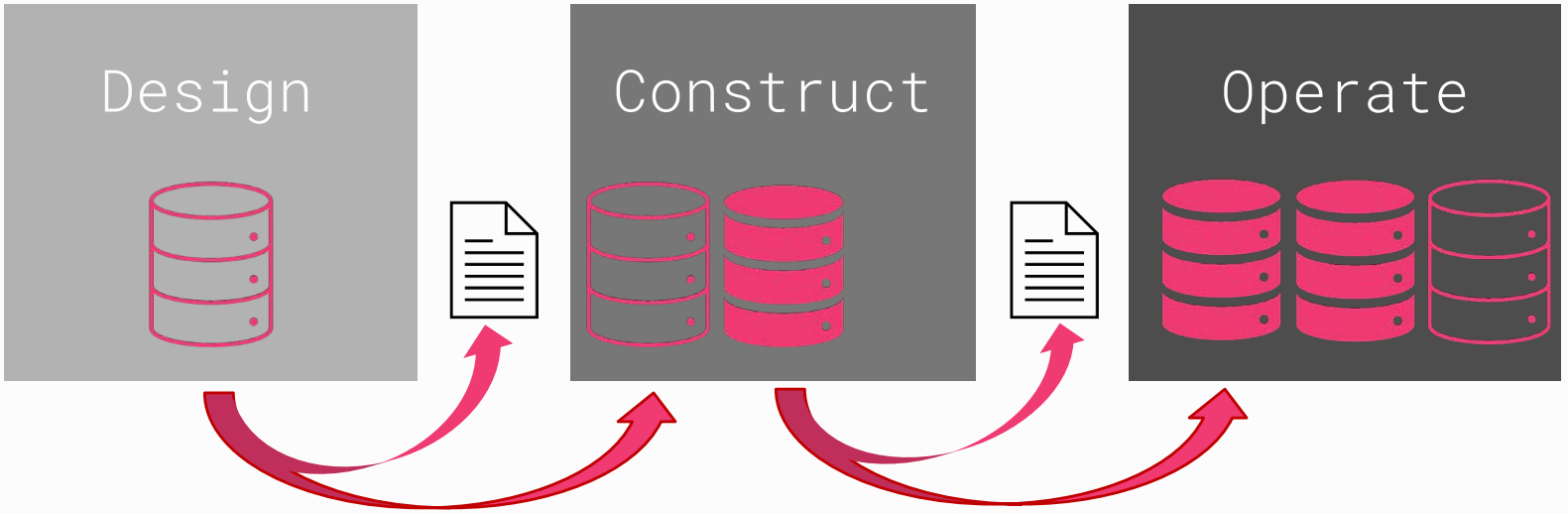
1. Reduce **repetitive workflows**
2. **Reduce errors** as the **same base model** moves from phase to phase
3. **True Collaboration with Trust** (!) less CYA
4. **Automation: from document production to commissioning**
5. Automate error checking, code compliance and standard verification
6. **Operations** feedback into **design evolution**

1. Reduce Repetitive Workflows

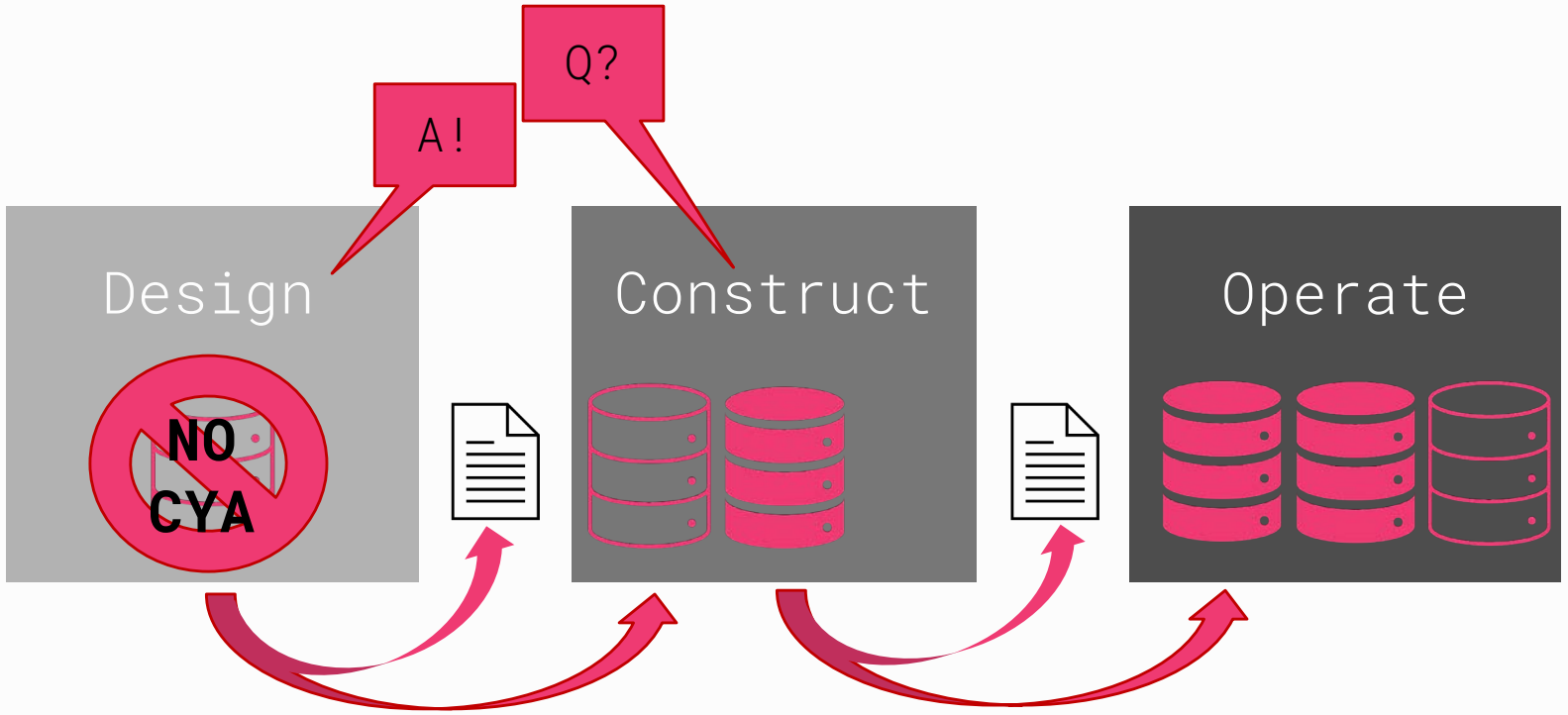


2. Reduce Errors through

Data Continuity



3. True Collaboration with Trust



4. Automation Efficiencies

Starts with standards (not with computers)

01 →	02 →	03 →	04
Define: the extents of “standard” solutions (80/20) Set clear, achievable targets	Design: Think systemically, simple, modular. LIMIT YOUR TOOLBOX	Automate Listen, Adapt, + Evolve	Let go. Use the new space and time to be creative again!

Standards are
~~Boring~~
excellent.

Favorite
Solutions

systematized
for
implementation

Image courtesy of WeWork

Image courtesy of WeWork

Image courtesy of WeWork

80% 20%

Standard Unique

Automate what you can …

Focus on the FUN!

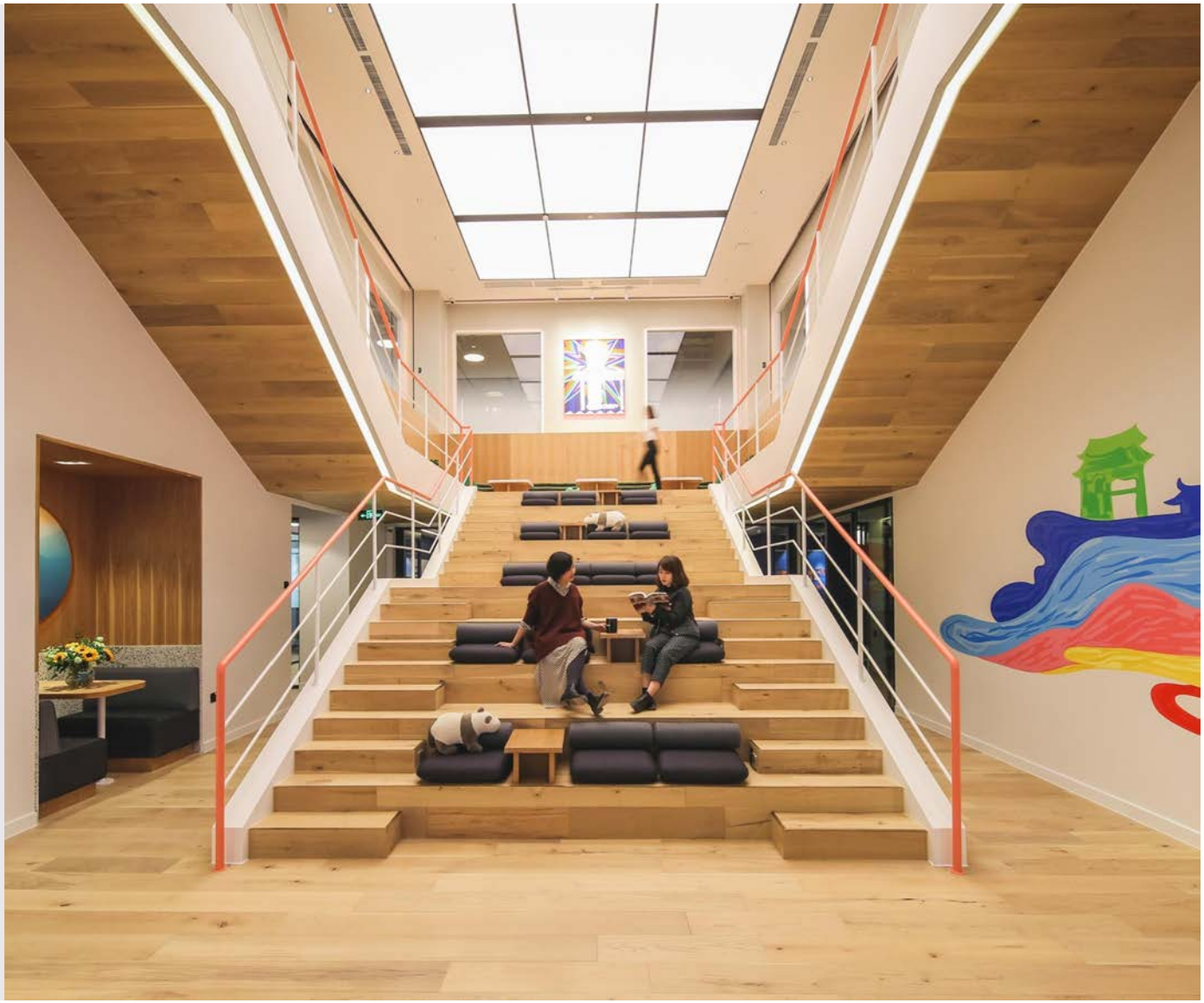


Image courtesy of WeWork

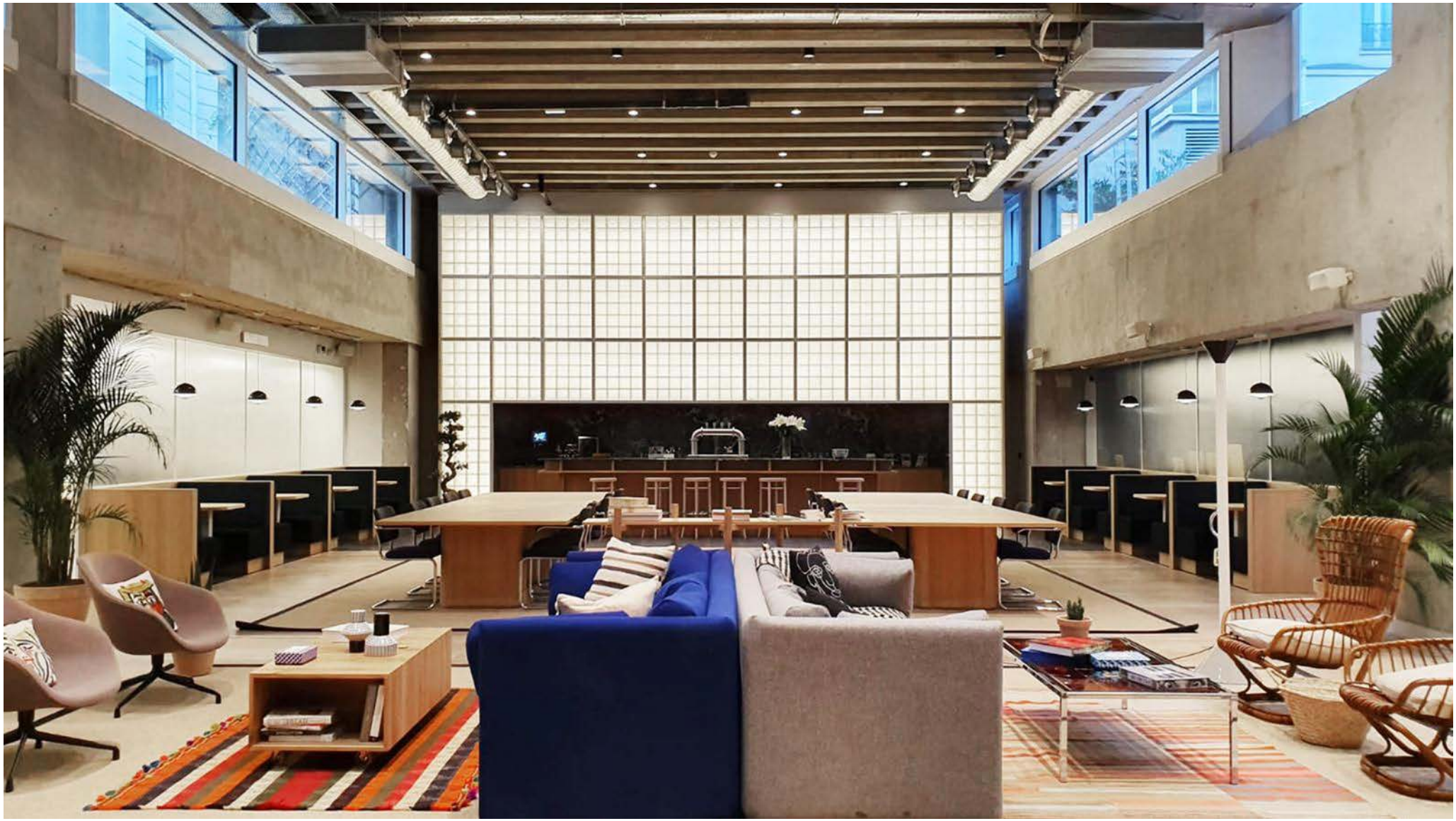
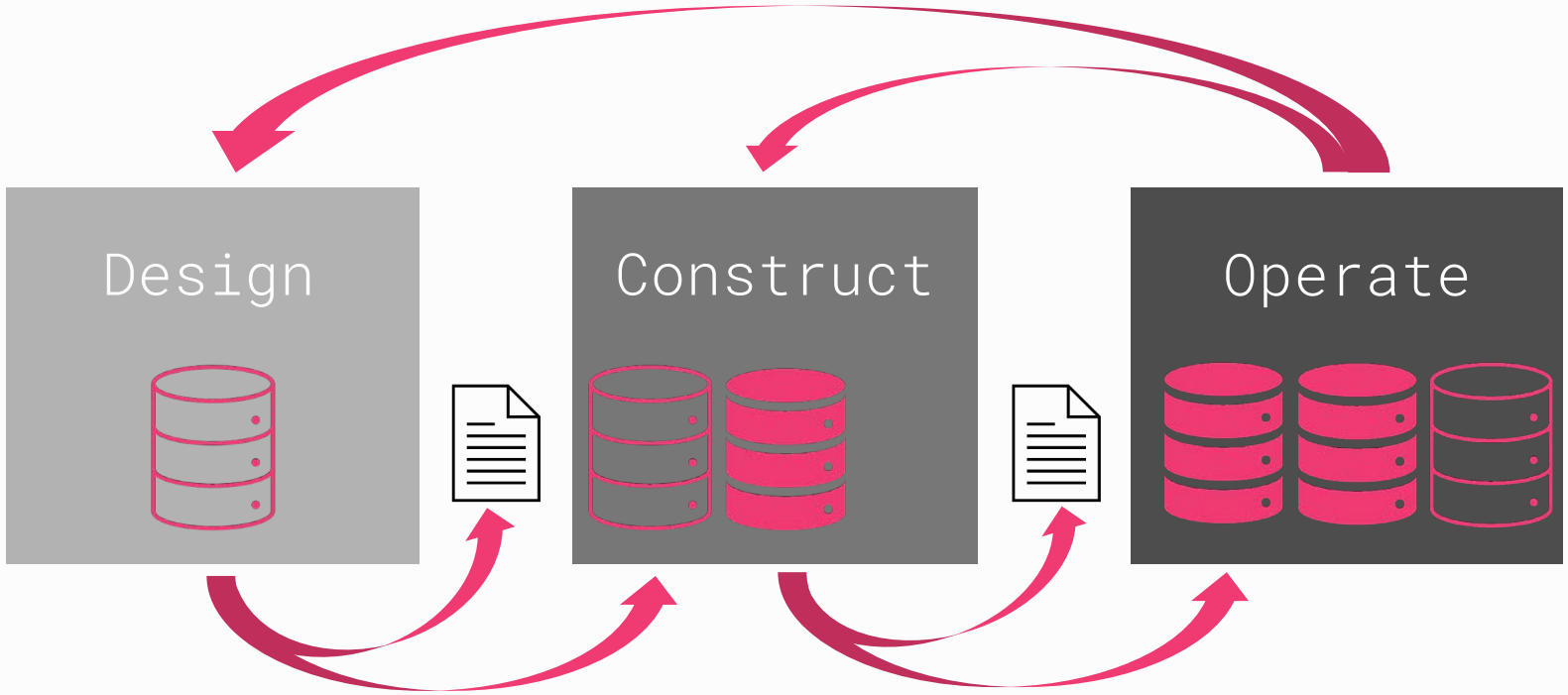
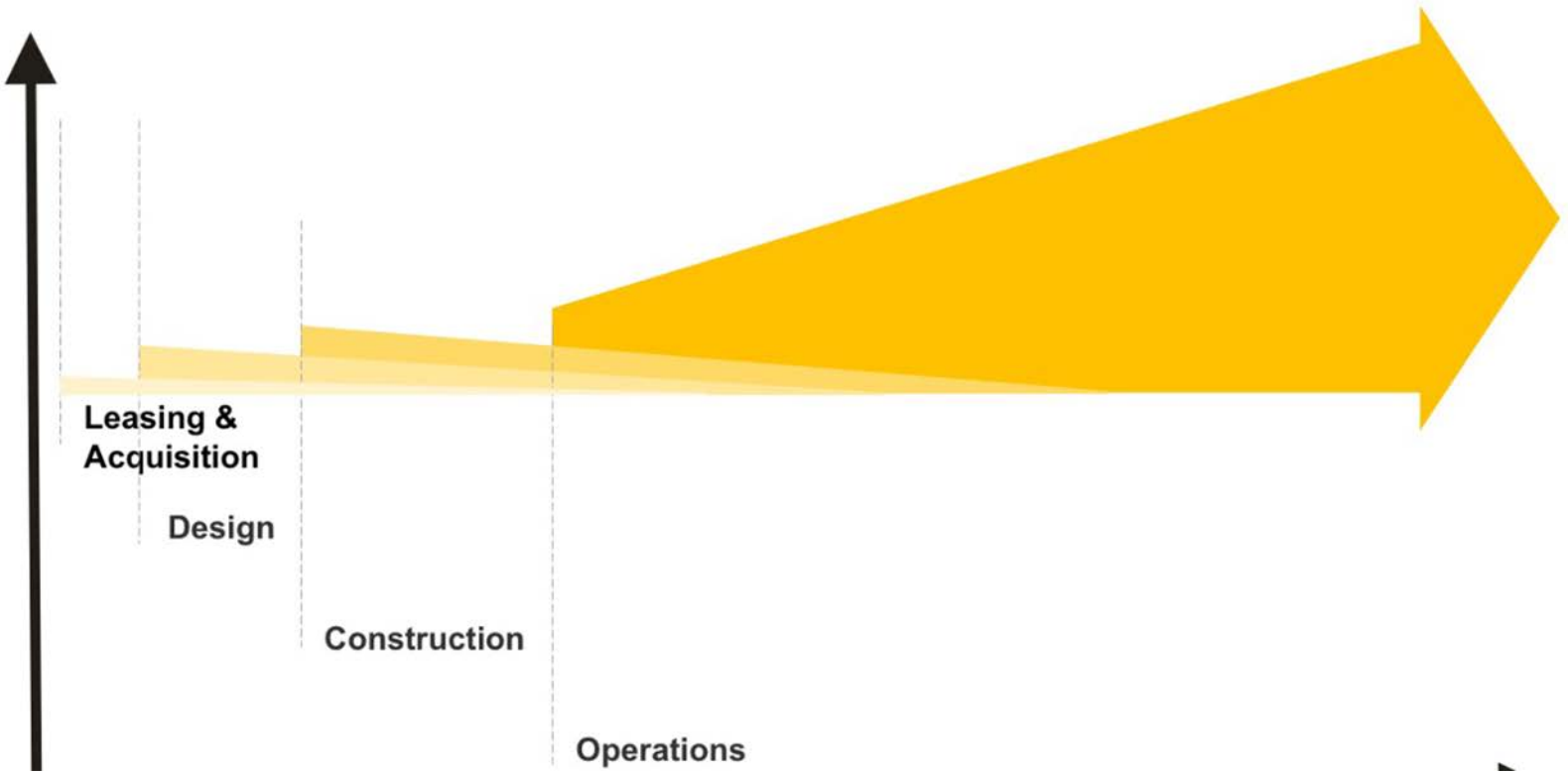


Image courtesy of WeWork

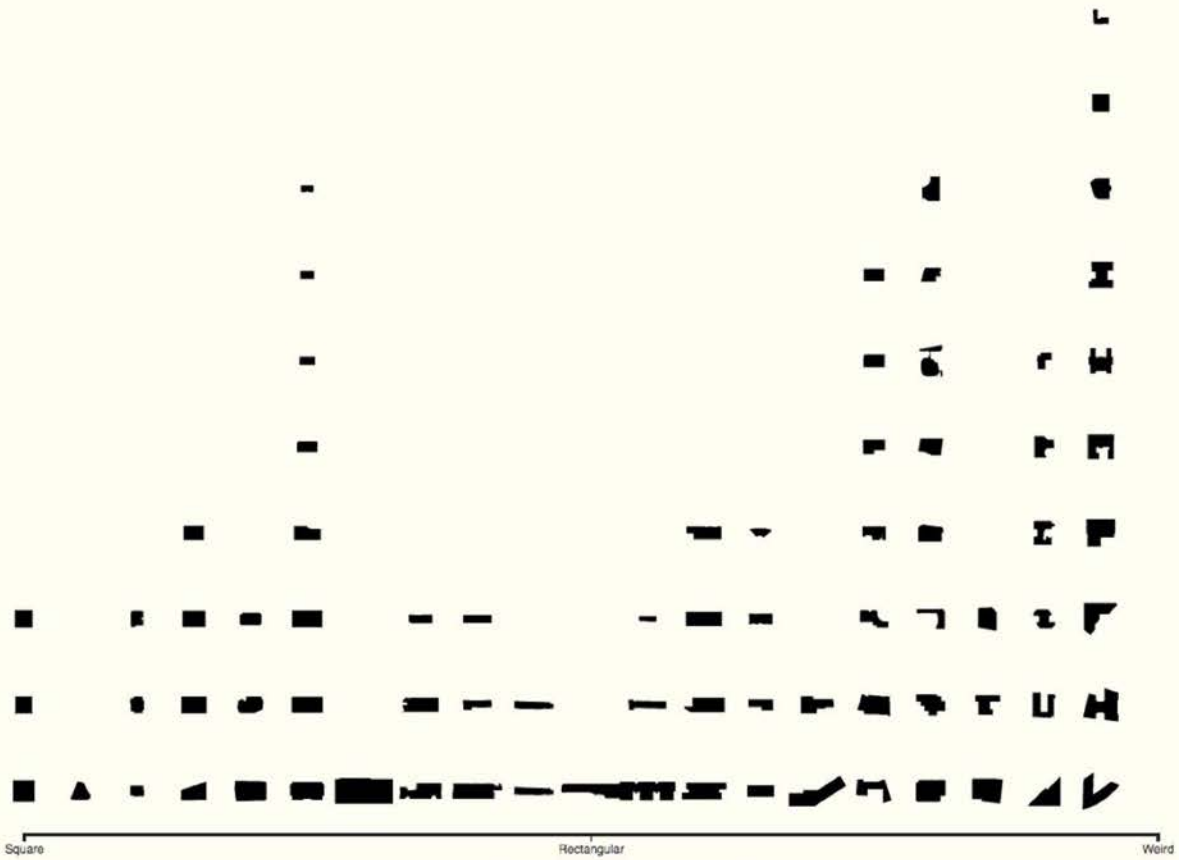
6. Operations feedback into design



Buildings = Data



The WeWork Porfolio



wework

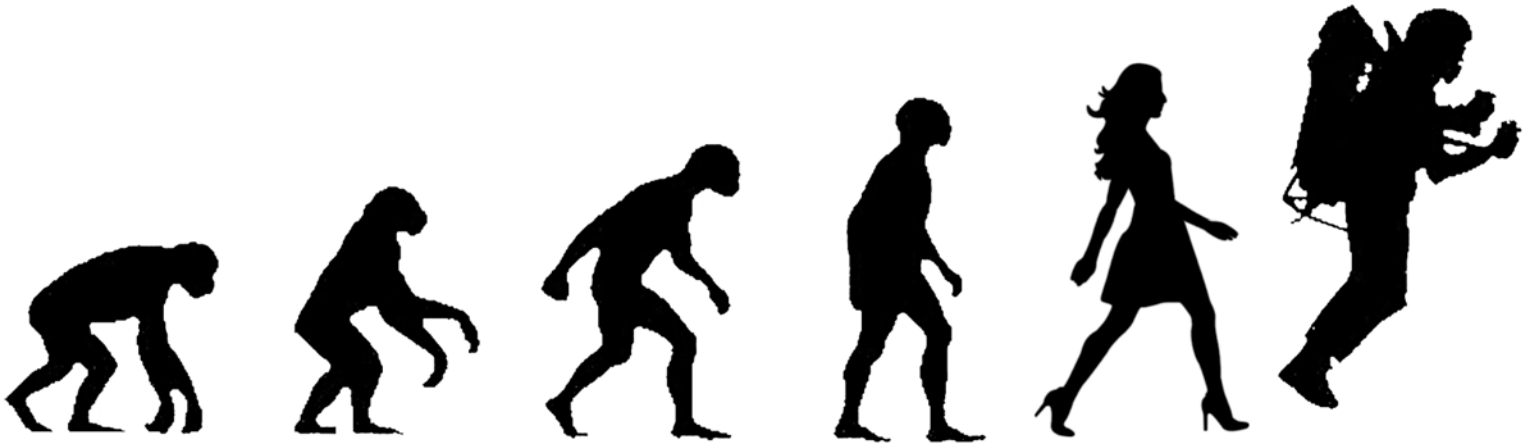
Wouldn’t it be nice?

Save time … Save money

Prevent Errors

Allow for Progress?

We’ve come a long way



Ancient History:
Hand Drawing

Past:
2D CAD

Now:
- BIM
- BIM Integrated Tools
- Automation

Future:
…

Implemented + in Progress

Level of Detail:

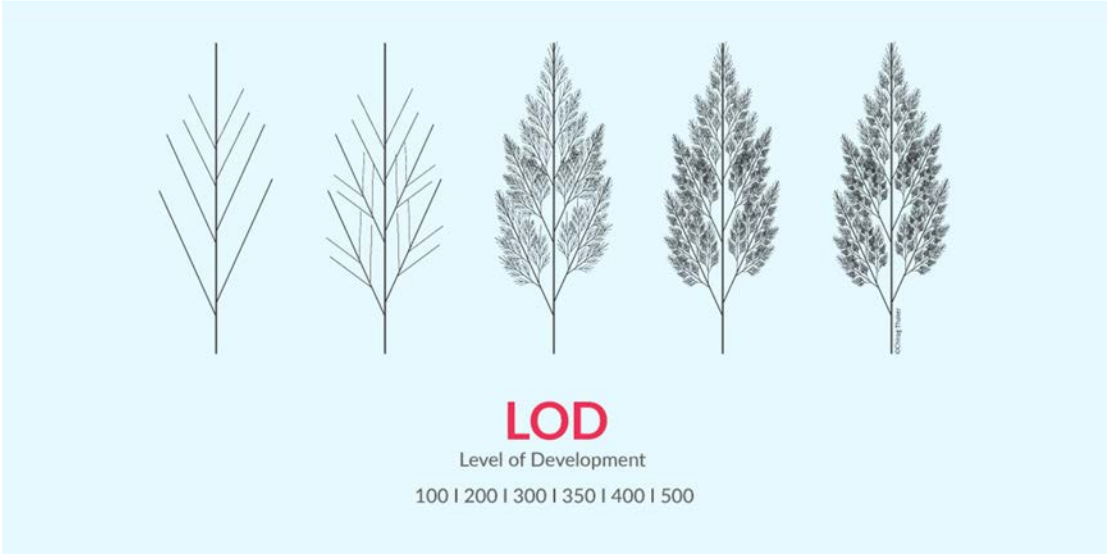
The way a model looks. The level of detail refers to *the input* of the model.

Example: Specific shapes and measurable location of steel pipes in a model.

Level of Development:

The depth of thinking applied to the model. The level of development refers to *the reliability* of the model.

Example: Whether the pipes in a model have been engineered and the permanence of their placement.

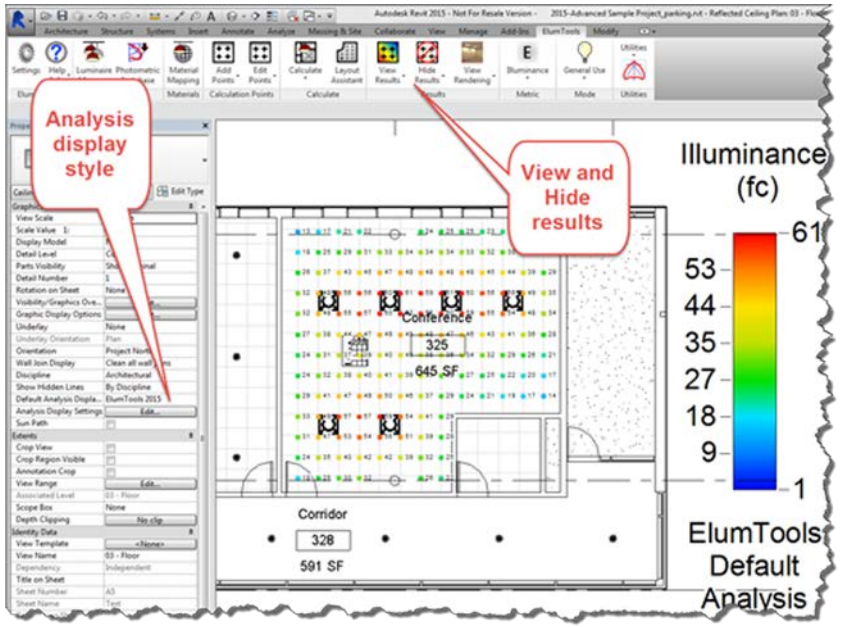


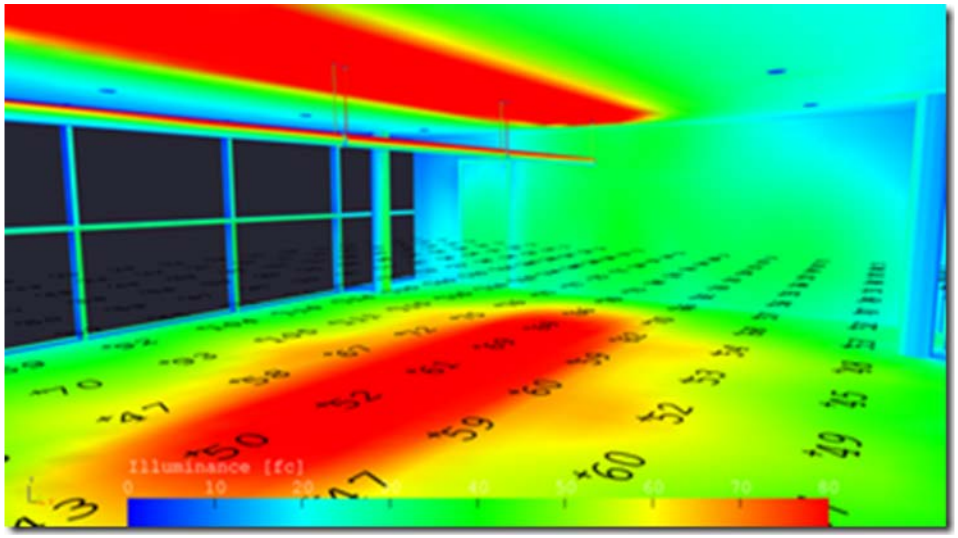
source: United Bim: https://www.united-bim.com/bim-level-of-development-lod-100-200-300-350-400-500/

Implemented + in Progress

BIM Integrations

ElumTools
(by LightingAnalysts)





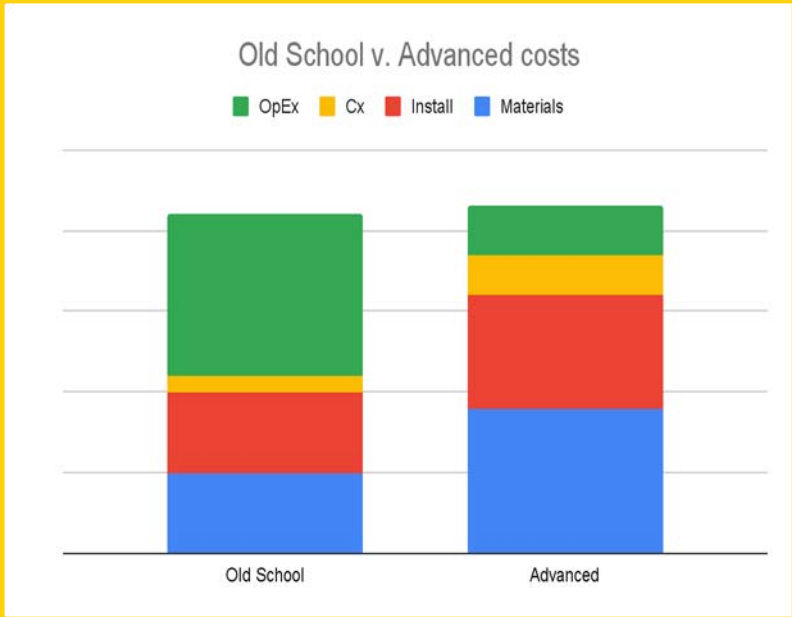
More Opportunities

- Automate Pre-Cx of control systems
- Semi-automate commissioning

- Reduce time and labor
- Allow for more complexity in the solution without adding risk of failure
- Reduce energy demand
- Verify performance
- Bring operations into the loop early + hand over completely.

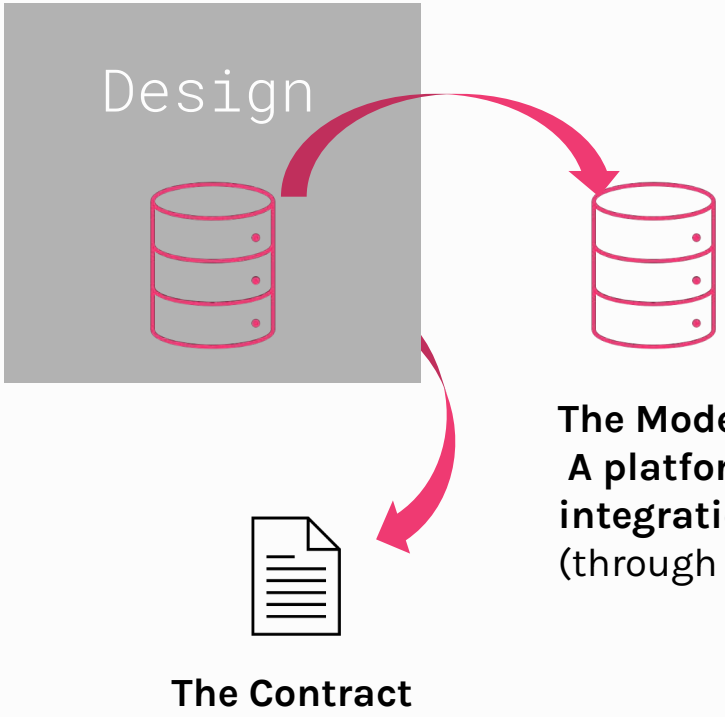
Q: Why are we stuck right now?

A: No incentive.



Advanced controls **cost more,**
take more time and
have low return for the owner

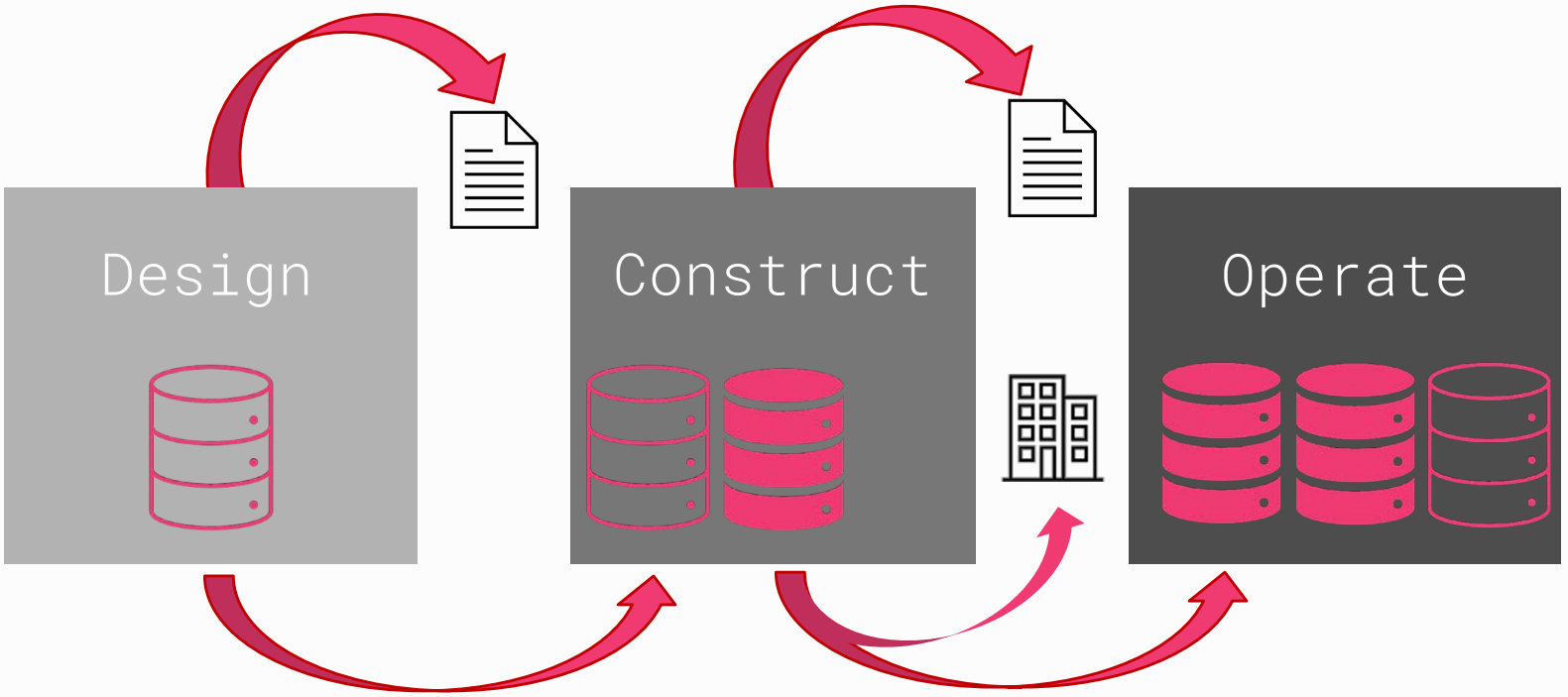
Legal/Contract Realities.



The Model:
A platform allowing for integration + automation
(through shared data)

The Contract

Can be resolved!



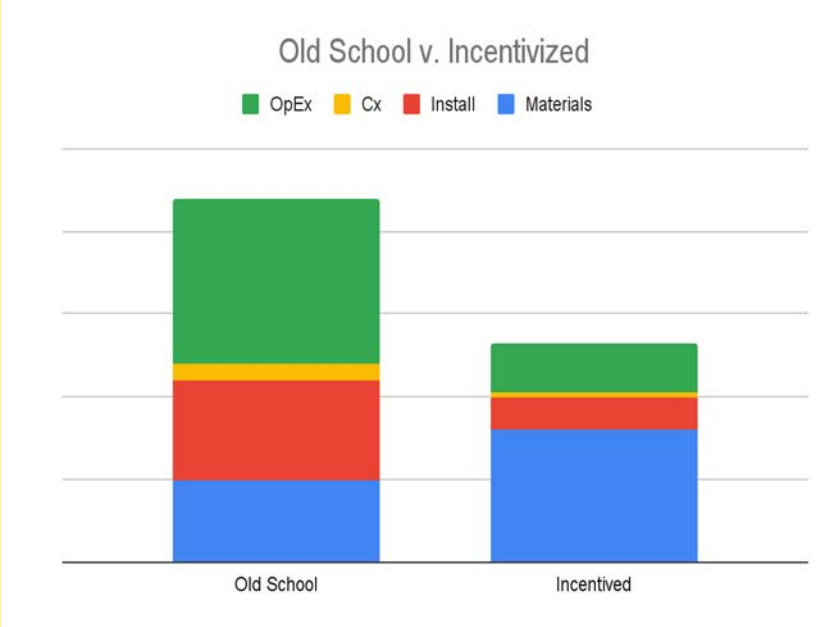
Accountability for Errors

Feedback is a gift!

The greatest learning comes from mistakes!

5: Align Incentives for Change

This is not a technology barrier – it's been done!
This is a people/industry *behavior* problem



- **Automate Install and Labor**
- **Reduce Errors/Checking**
- **Support Ops Handover**
- **Verify Performance**
- **Communicate with Facilities**

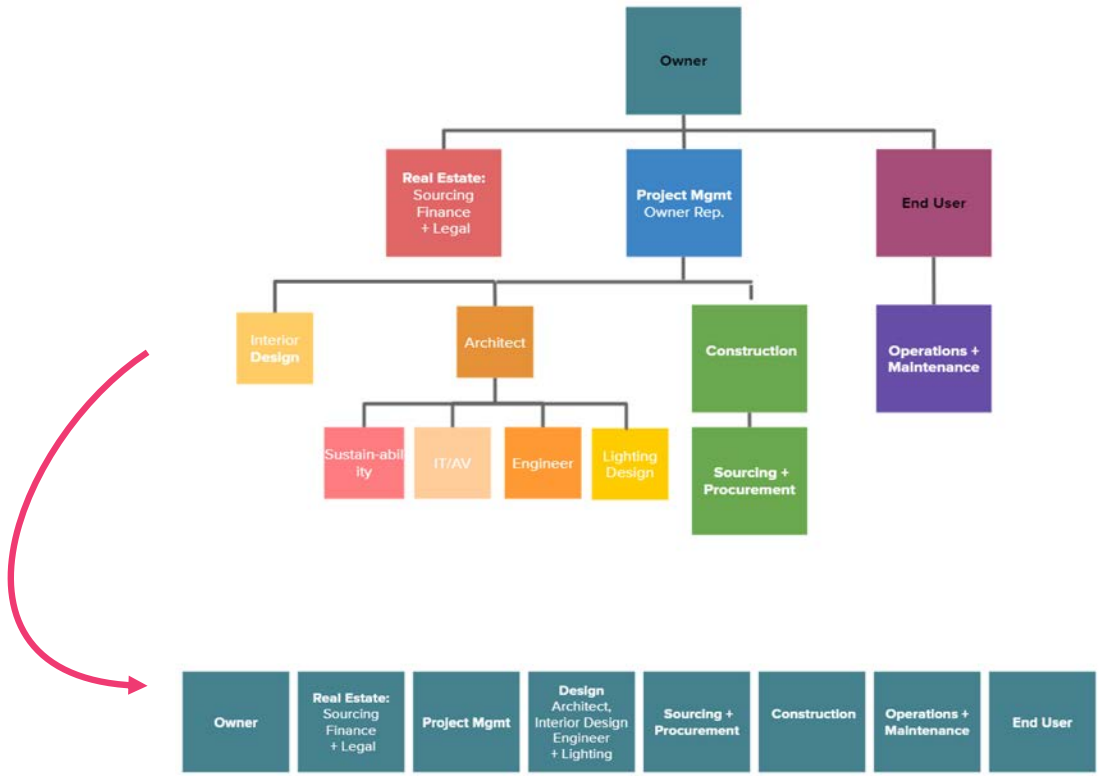
SAVE costs upfront & long term!

How do we get there - what's next?

	The anchors are here	**The industry is here**	The leaders are mainly here	The evangelists are here	Some enlightened companies are here
	-1	**0**	1	2	3
Contribution of Architect/Engineer/Designer	Design Intent only. Paper based deliverables.	**Design Intent with some discussion. Introducing an independent digital approach.**	Design Intent with increasing digital collaboration. May now be part of GC team.	Design incorporating catalog parts and DfMA approach.	Design by assembling catalog parts

Digital Communication & Collaboration

Identify workflow weaknesses and develop tools to fill gaps in traditional project communication and collaboration.



Where are the gaps and needs?

- Vertical integration and software can deliver significant improvements
- Independent disciplines (e.g., architects, designers, contractors) can evolve too, but will need to rely on software and data even more
- Workflows need to be discovered and demonstrated, software gaps need to be identified and resolved, standards need to be targeted for the critical paths

Connecting the dots

High-Fidelity Model Development

Automation & Data Export

Validation & Verification Measures

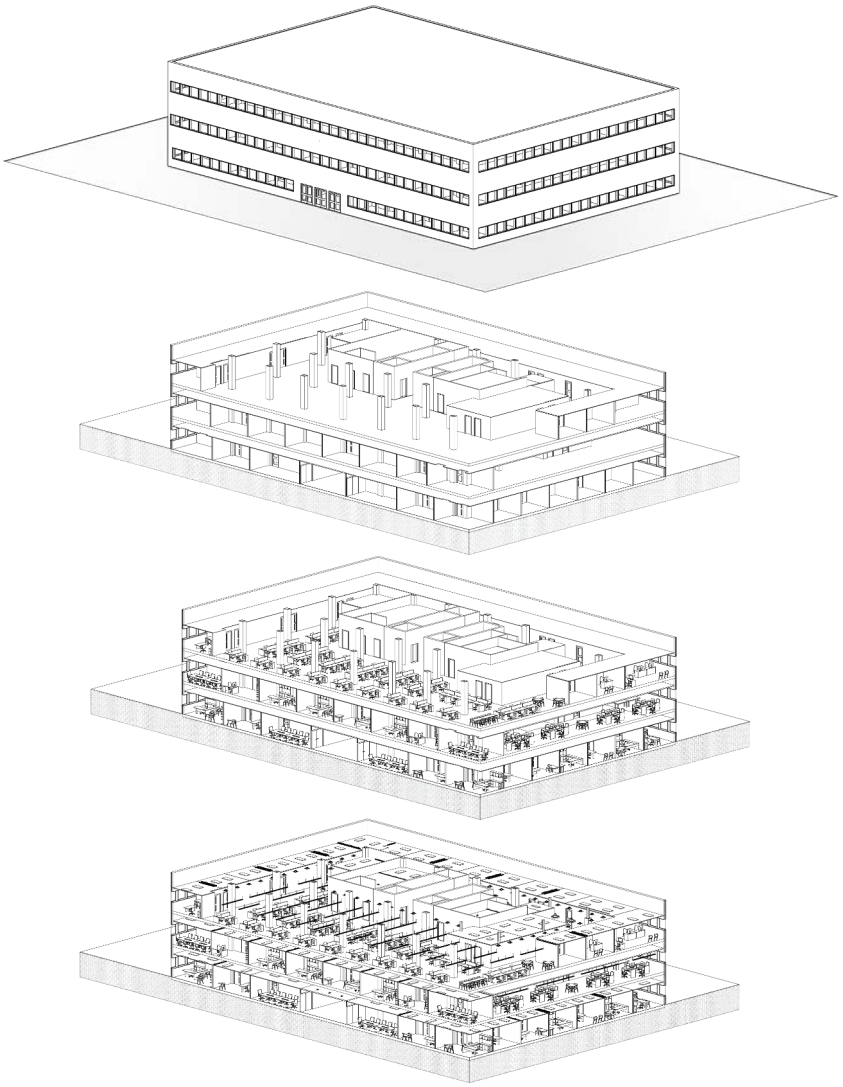
FUTURE

High-Fidelity Model Development

Medium Office Prototype Building

- **PNNL Modifications:**
  - Interior Architecture
  - Furniture (Occupancy)
  - Lighting and Control System

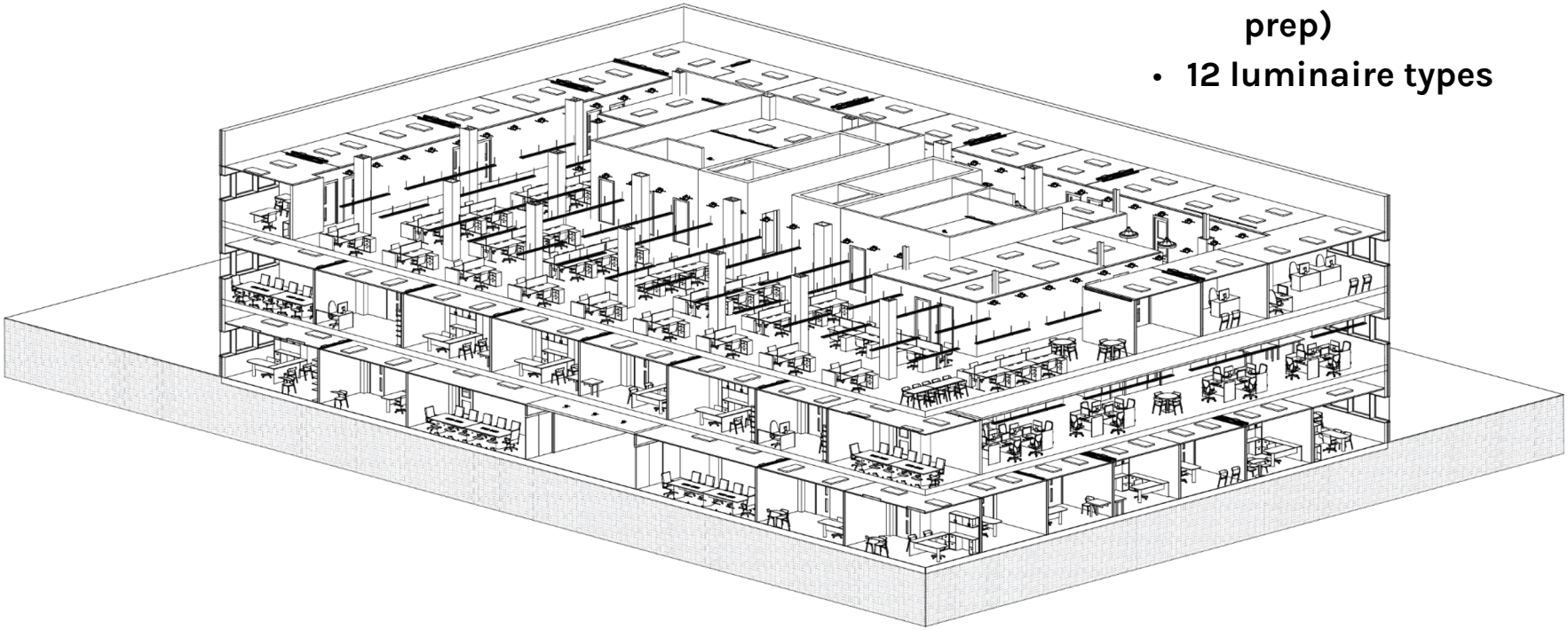
- **Modeled in Autodesk Revit**
  - Explore capabilities and limitations
  - Understand dataflows and associations behind building information modeling



High-Fidelity Model Development

Medium Office Prototype Building

- 53,000 sq ft.
- 286 Occupants
- 12 Space types
  (e.g., enclosed/open office, conference, storage, dining/food prep)
- 12 luminaire types

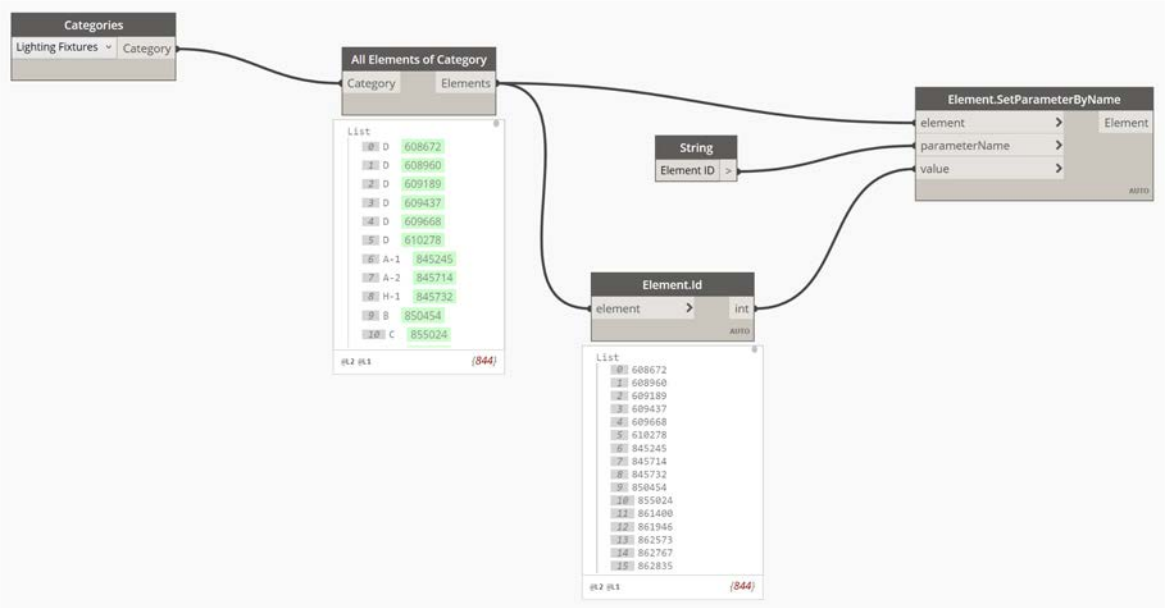


Automation & Data Export

- **How can you intentionally automate and standardize your workflows?**
- **Just because you have reached the limitations of one piece of software doesn’t mean it is impossible.**
- **Patchwork solutions are here to stay, but will lead to standardization and development of best practices.**

Dynamo

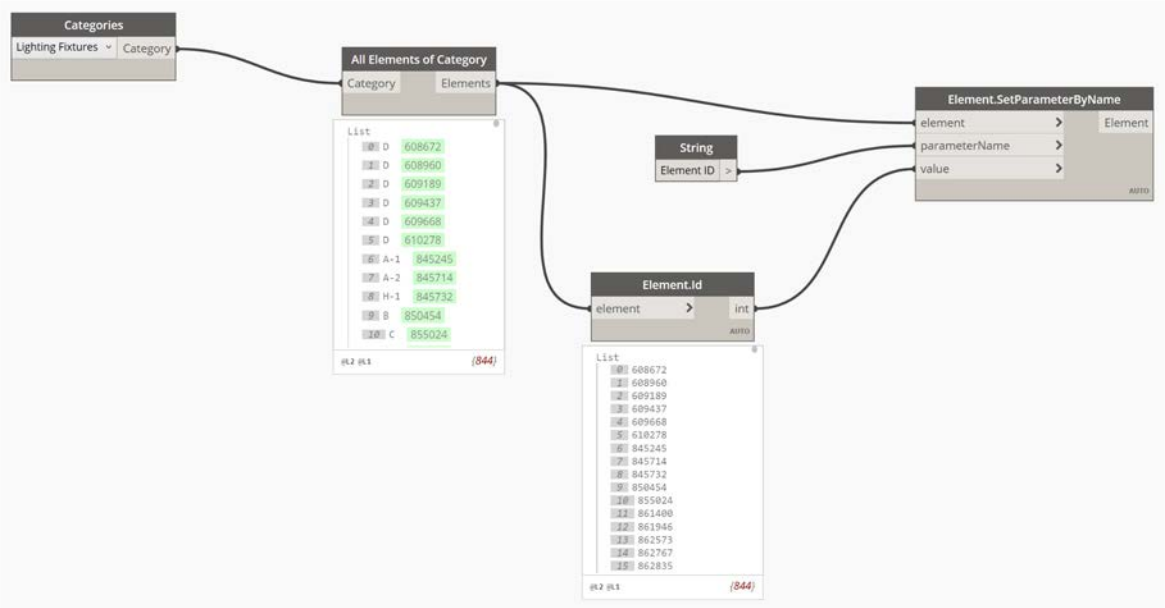
A visual programming plug-in for Autodesk Revit.



- Automate repetitive processes
  - Associations
  - Sheet creation
- Minimize human error
  - Coordinating tags and notes
- Export data
  - 2-way data flow with excel
- Generative design analysis
  - Explore design options
  - Verify design performance
  - Automate standard designs

Dynamo

A visual programming plug-in for Autodesk Revit.



Project Parameters:

- **X, Y, and Z coordinates**
- **Unique identification number**
- **Associated room number**

ODBC Export

A database management protocol that organizes all the Revit BIM data in a set of structured and coordinated tables.

PROS

- Contains detailed component tables and relational tables
- Repeatable and predictable
- Searchable and queryable
- Link to other software
- Platform for real-world building system or occupant data

CONS

- Additional work required to associate components between tables
- Lots of data! Can be difficult to decode and find what you need

ODBC Export

A database management protocol that organizes all the Revit BIM data in a set of structured and coordinated tables.

Lighting Fixtures

STANDARD COMPONENT PARAMETERS					USER DEFINED COMPONENT PARAMETERS			
Id	TypeId	PhaseCreated	Dimming	Emergency Luminaire	COORD_X	COORD_Y	COORD_Z	Room-luminaire Association
862573	862665	118390	0.8	0	130.1	49.7	9.6	125
862767	869652	118390	0.8	1	112.5	74.2	9.5	123
862835	869652	118390	0.8	1	100.0	78.2	22.5	210
871042	845374	118390	0.9	1	82.0	8.2	9.6	101
872232	845981	118390	0.9	0	103.0	44.3	9.6	102

ODBC Export

A database management protocol that organizes all the Revit BIM data in a set of structured and coordinated tables.

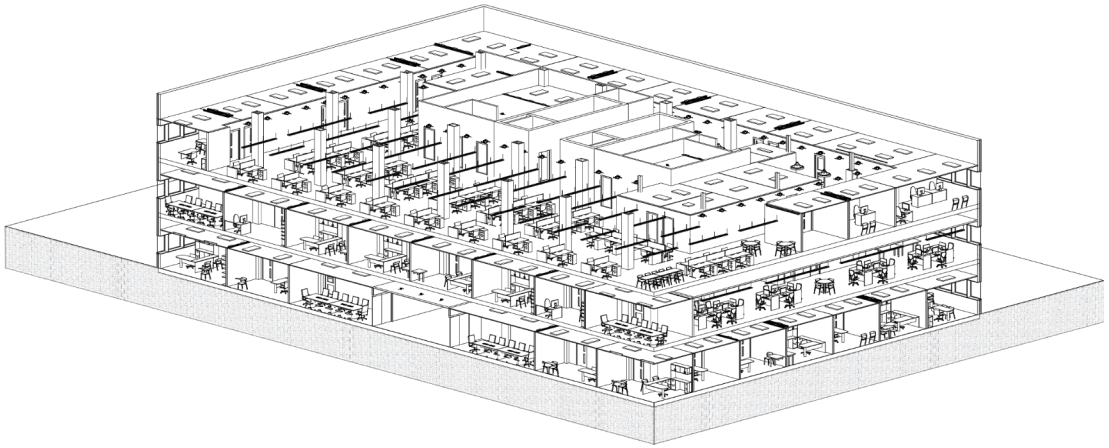
STANDARD COMPONENT PARAMETERS					USER DEFINED COMPONENT PARAMETERS			
Id	**TypeId**	**PhaseCreated**	**Dimming**	**Emergency Luminaire**	**COORD_X**	**COORD_Y**	**COORD_Z**	**Room-luminaire Association**
862573	862665	118390	0.8	0	130.1	49.7	9.6	125

Lighting Fixture Types

Id	Type Name	Description	Mounting	Efficacy	Wattage	Color Temperature	Photometric Web File	Luminous Flux
862665	G	Perimeter slot linear LED wall grazer	Recessed in ceiling	73	28	3500	Type G WG.ies	2044

Design and Information Models

Design Model



Highly Structured Information Model

Id	Occupancy	Area	Number	Name
698132	4	25	120	Private Office
698133	1	19	116	Private Office
698134	1	19	117	Private Office
698153	1	20	115	Private Office
698154		43	109	Storage
698155		24	107	Mechanical
698156		25	137	Restroom
698158		33	103	Lobby
698159	6	33	114	Private Office
698160	4	27	113	Private Office
698161	12	37	112	Conference Room
698162	12	37	135	Conference Room

Verification & Validation

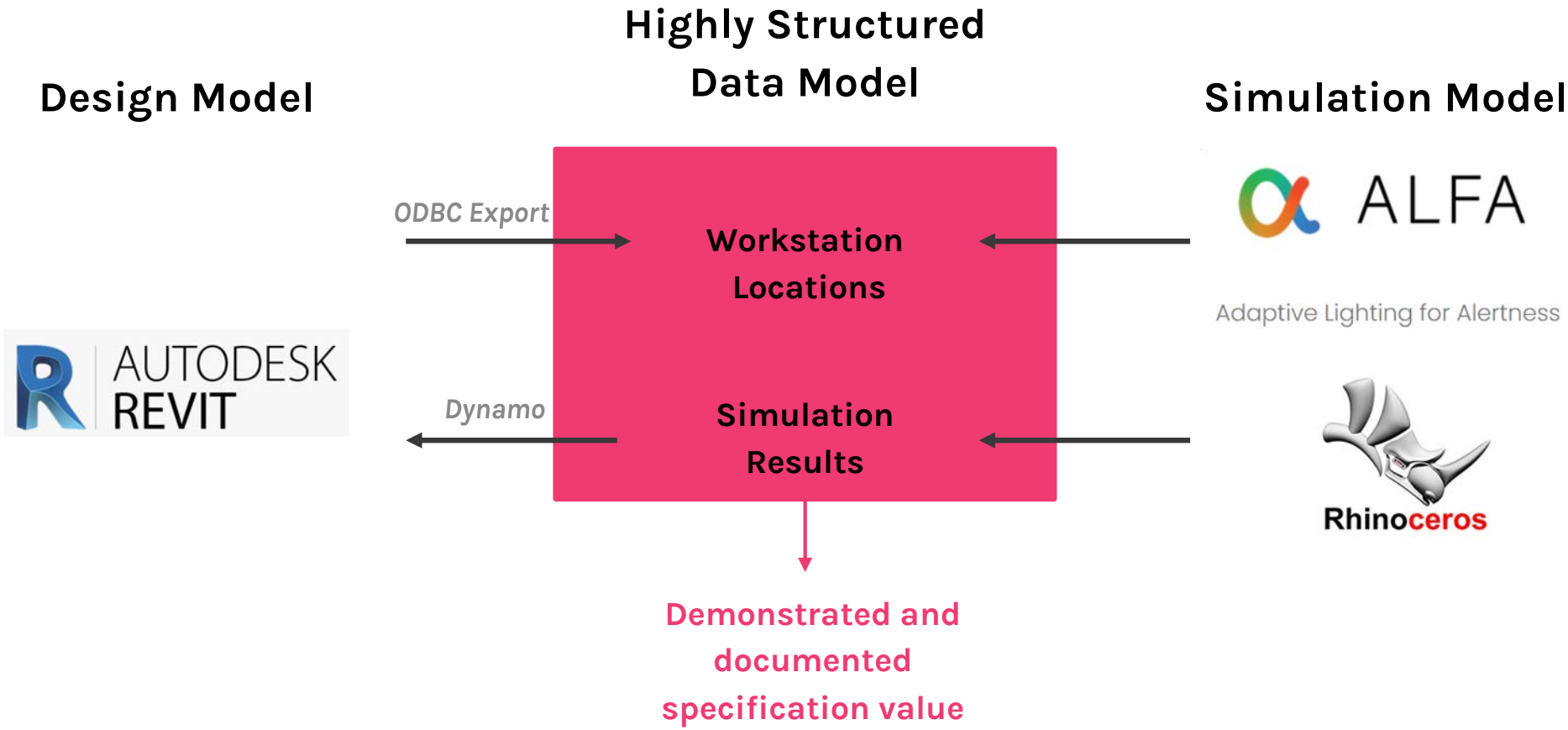
Part 1: Define
Part 2: Data
Part 3: Document

Design Validation

Design data > design intent

- Validation and verification procedures can support specifications and reduce assumptions
- Verification can be as simple as evidence of meeting a specification or project goal
- Avoid room for interpretation
- Not just about filling BIM with data - validation measures raise flags that enforce boundaries when they are passed along project channels

Link simulation outcomes to design model



Opportunities for Validation and Verification

REPLACE PATCHWORK SOLUTIONS WITH A REIMAGINED STANDARD PRACTICE

Near-Term

PNNL research activities

LPD Verification
- Automated in real-time, including control strategies

Control Narrative Errors/Omissions
- Define expected performance, verify sufficient data to accomplish commissioning

Long-Term

Industry standardization activities

Control Narrative Templates
- Greater standardization would pave the path for automated configuration

System Performance
- Data-producing building systems monitor and verify over time

What's Next?

- Be the change - ask for more!
- Be open to the possibilities, but don't expect an easy experience
- Consider developing and implementing near-term, low-hanging fruit solutions
- Imagine (and plan for!) long term wants and goals
- Recognize your strengths - and out source when you need to

Reconsider your current practice and contract terms regarding BIM and LOD:
Design data > design intent

Final deliverables will include the contract drawings, not the BIM file. If the general contractor would like to use the BIM file for their purposes, a standard release form will need to be signed.

- If you want to work at a more mature level, find others with the same vision and look to the future!
- If you want to help define, develop, demonstrate, and standardize new digital tools and workflows, contact us!