

# ***BIM Implementation Strategies***

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## Who we are

- Dennis R. Shelden, Ph.D.,  
*Chief Technology Officer*  
*Gehry Technologies*
  - BIM Procedures
  - BIM Technologies
- Howard Ashcraft  
*Senior Partner*  
*Hanson Bridgett*
  - Contractual implications
  - Integrated Project Delivery

# Who are you?

## Target audiences

- Firms just starting out
- Firms getting their feet wet
- Firms who want to compare their view with others
- People interested in contractual and legal issues

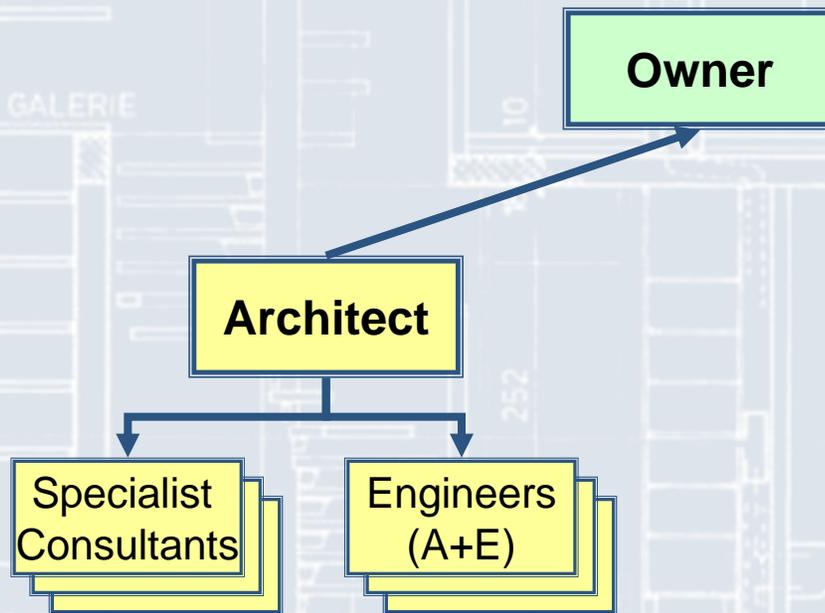
# What will be covered

- Technical issues
  - What software is used? Who uses what?
  - What are the technical and infrastructural requirements for using BIM software
  - How do you start? How do you manage it?
- Procedural
  - “Who owns the model”
  - How does each parties’ BIM play together
  - What are the hand-offs
- Contractual
  - What are the responsibilities of each party? How do they co-exist?
  - What is the “risk vs. reward” equation
  - How are the agreements structured?

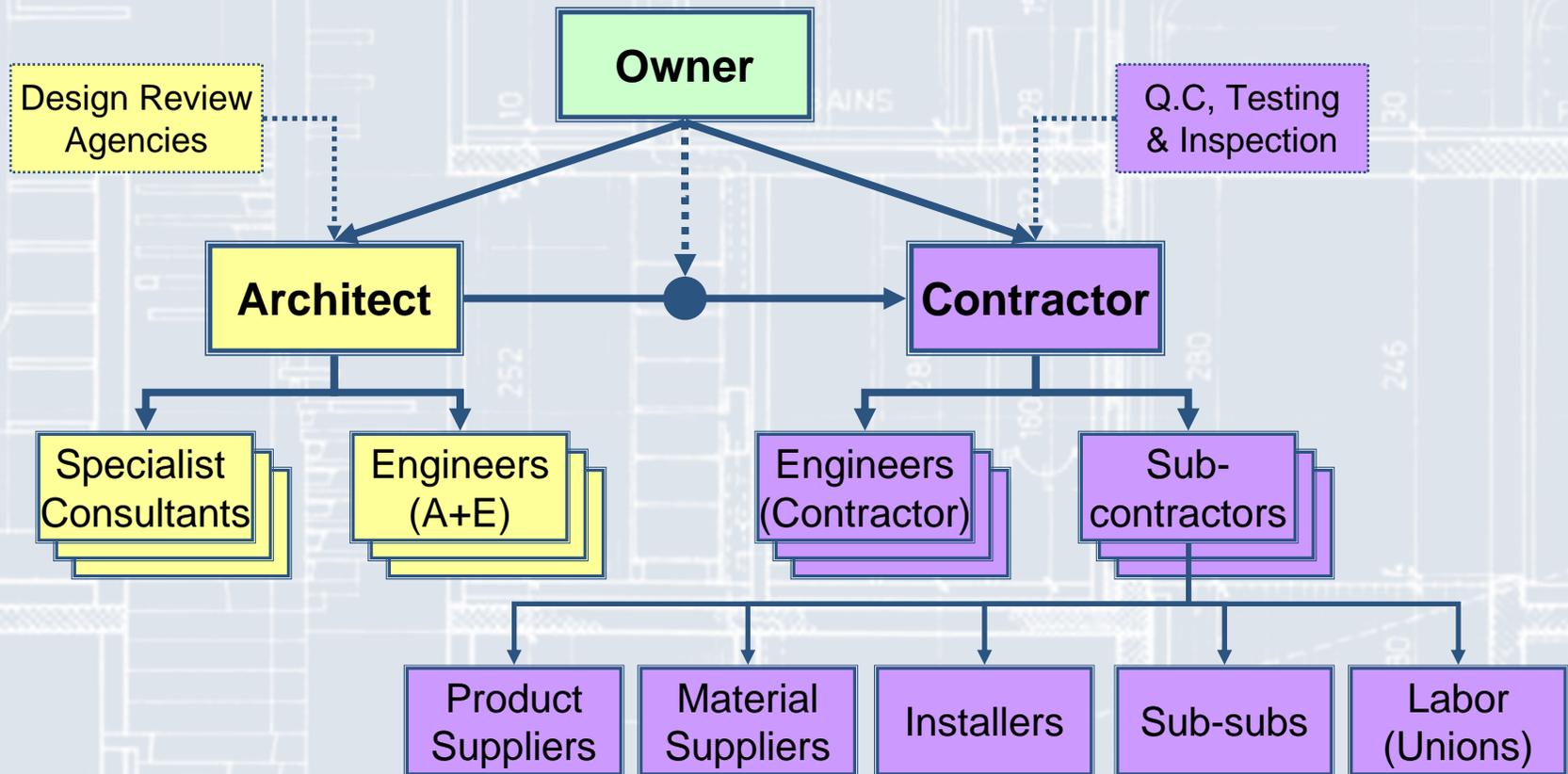
# Scope of consideration: Within the office

**Architect**

# Scope of consideration: Within the team



# Scope of consideration: Across the project



# What is BIM?

- It's "just a tool"?
- It's a methodology – a way of working
- It's both...

# Building Information Modeling

*Technologies and processes  
integrating building information  
through attributed 3D geometry*

# Building Information Modeling

*Technologies and processes  
integrating building information  
through attributed 3D geometry*

Data  
Technologies  
Work methods  
Scope  
Deliverables  
Contractual procedures  
...

# Building Information Modeling

*Technologies and processes  
integrating **building information**  
through attributed 3D geometry*

Design  
Engineering  
Owner & planning  
Cost  
Construction  
Logistics  
Fabrication & submittals  
Facilities management  
...

# Building Information Modeling

*Technologies and processes  
integrating building information  
through **attributed 3D geometry***

Solids  
Wireframe & surface  
2D Drawings  
Specifications  
RFIs  
Site scanned data  
...

# Building Information Modeling

*Technologies and processes  
integrating building information  
through attributed 3D geometry*

*Some of this happens “automatically”  
Some through the diligence of intelligent professionals*

# Building Information Modeling

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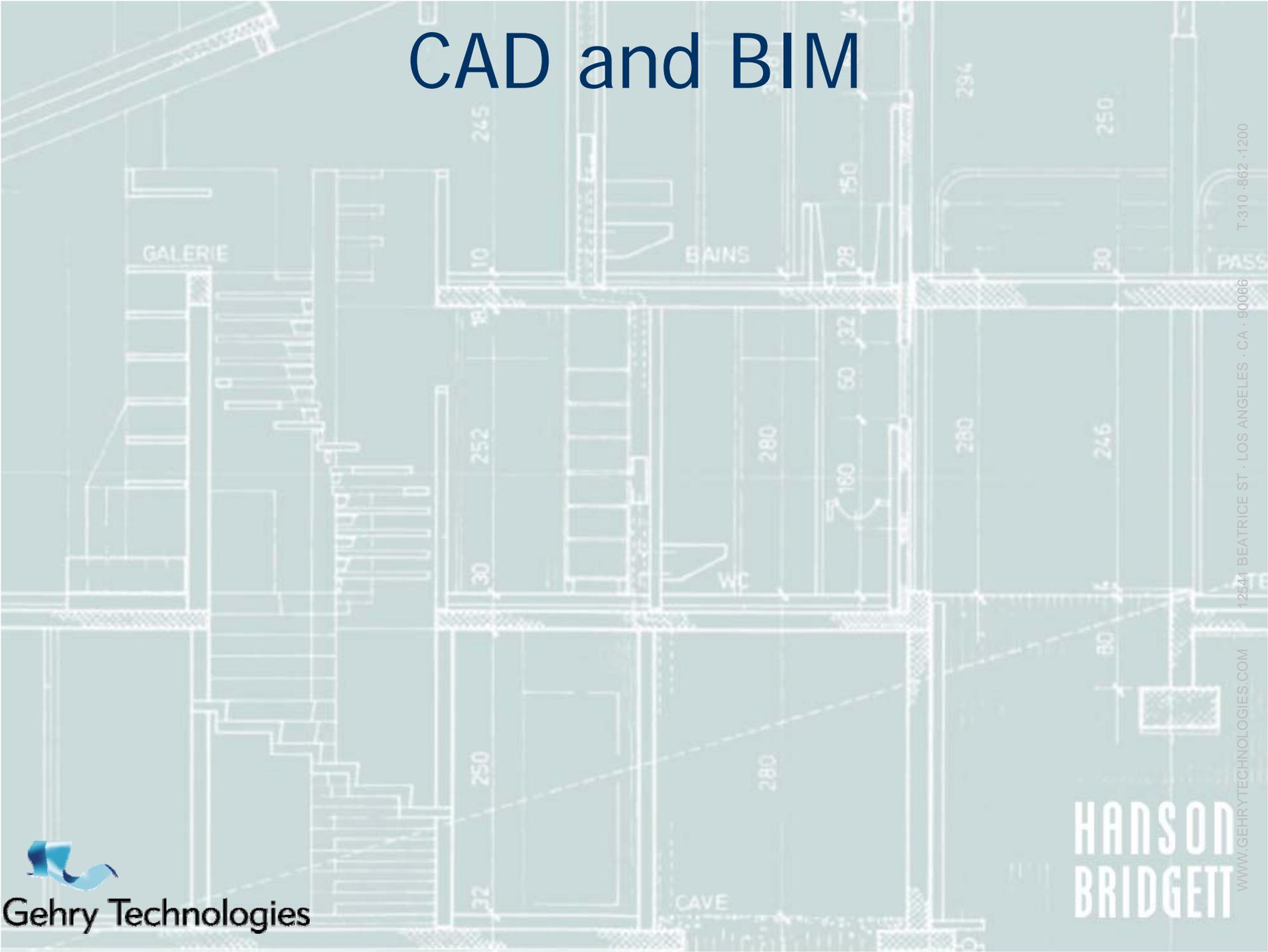
*Some of this happens “automatically”  
Some through the diligence of intelligent professionals*

*There’s no agreed on standard process yet*

*There’s a lot of different flavors*

*Firms and projects can define their own versions*

# CAD and BIM



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T-310-862-1200

# CAD and BIM

CAD is “BIM 1.0”

There are “intelligent objects” (blocks)

- We can track some information in these objects and
- There is the ability to repurpose information in different contexts
- (Backgrounds)
- There is an ability to integrate information in shared repositories
- There is 3D (but used mostly for client presentations and visualization)
- There were perceived risks of liability leak
- There were questions of ownership and copyright
- There were data translation, storage and corruption issues

# How is BIM different? Technical:

- There are identifiable objects that persist in different contexts  
The 3D object is the central representation
- 3D allows extraction of useful information  
(schedules, quantities, drawings, etc.)
- Alternative representations are linked.  
(drawings, schedules, budgets)
- Information aggregates –  
Integration of ALL spatial information  
Integration of geometry with reports  
*2D and Schedules*
- Information is repurposeable and inter-related  
Data is used for construction  
Data can be used for owner asset tracking and management

# How is BIM different? Procedural:

- We work in 3D
- 2D and other documents are reports from the 3D model
- We spend less time “red lining”
- We spend more time “getting the model right”
- More localized implications are resolved, less is left to “intent”
- There is a change in where we put our hours
  - Less is spent in “production”
  - More is spent in “design”

# How is BIM different? Contractual:

- BIM data is operative beyond the context in which it was created
- BIM supports – perhaps requires – a more collaborative way of working
- .... *(from your paper?)*

# Some applications

## Design and Engineering

- Project Definition
- Design (Conceptual, Architectural, Engineering)
- Document production
- Document Quality Control

## Project Management Construction Planning

- 4D Modeling (Scheduling)
- Value engineering

## Collaboration

- Information integration
- Information distribution
- Document management

## Bidding & Construction Management

- Quantity surveying
- Scope definition

## Construction Planning

- Shop drawing and Fabrication
- Surveying / Scanning
- Field positioning
- RFI Management

## Risk Assessment

- Metrics & Impact
- Scheduling
- Conflict Identification / Problem Identification
- Resource Assessment
- Visualization
- Scenario Analysis
- Feasibility & ROI

## Integrated Project Delivery

- Decision / Knowledge / Data aggregation
- Accelerated decision making
- Impact exposure
- Accountability & auditability

## Capital Allocation Planning

- Calibrating funding with execution

## Project Assurance

- Quality Control
- Predictability
- Delivery Optimization
- Visibility
- Cost & Risk avoidance
- Information control

## Project, Contract & Financial Controls

## Claims analysis

# A Note on Technologies

*There are many BIM applications...*

## Design / Engineering

Bentley Triforma  
Graphisoft ArchiCAD  
AutoDesk Revit  
AutoDesk Architectural Desktop  
Digital Project  
Nemetchek All Plan  
Rhinoceros

## Engineering

Tekla Engineer  
FEA (SAP, Staad, ...)

## Integration

Navisworks  
Innovaya  
Digital Project  
Rhinoceros

## 4D Modeling / Construction Management

Vicon Constructor  
Navisworks

## Facilities Management

Onuma Systems

## Shop Drawing

Tekla Structures  
SDS-2

*Many will co-exist on a given project, even within one office!*

# Barriers

- *Legal*
  - Fluid Collaboration v. Precisely Defined responsibilities
  - Distinction between Professional and IT Risks
- *Technical*
  - Interoperability
  - Standards
- *Commercial*
  - Inertia
  - Investment
  - Assymetric Risks & Rewards
  - No Standard Business Models
  - No Standard Contract Models

# BIM Implementation

1. Within an office
2. Across the design team
3. Across the project delivery team

# 1. BIM Implementation – Within an Office

1. Selecting software
2. Addressing IT issues
3. Training up & rolling out

# Selecting Software

## *Standard BIM packages*

Bentley Triforma  
Graphisoft ArchiCAD  
AutoDesk Revit  
AutoDesk Architectural Desktop  
Nemetchek All Plan

## *Specialized BIM packages*

Digital Project  
Rhinoceros  
Sketchup

## *All are conceptually similar*

- 3D modeling environment
- "Domain" toolkits
- Cutting drawings
- Import and export

## *There are some differences*

- Some are easier to use
- Some are more geared toward "traditional practice in 3D"
- Some handle more complex geometries
- Some handle larger scale

# How do you decide?

*Call the vendors*

*Talk to a consultant*

AEC Infosystems  
Gehry Technologies  
Jordani Consulting  
Christine Fallon Associates  
...

*Try a couple*

It is likely you will wind up using a couple before your office standardizes

Your firm may standardize on 1, but have others in mix

 Engineering firms often follow architects  
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# Hardware - Client

*Most current workstations and high end laptops will run BIM software*

Get some extra RAM (2 Gig suggested)

Get a better graphics card

50+ Gig hard drive

Multiple cores will have limited impact, but it's good to have a dual core

Cost: about \$3-4K buys you a great system

Vista issues

64 Bit OS issues

*Workstation power will impact size of model that can be run*

You may want 1 supped up station in the office

Presentations, heavy duty operations

8-32 gig ram

quad core

Best available graphics card

# Hardware - Network

## *BIM Files are Large!*

100 mByte or larger per version

May need ½ + terrabyte server!

Backup can be an issue.

Tape

Mirror off site

Fast network

License server

## *Shared access can be an issue*

VPN issues

FTP sites

External hosting services

Project web sites

More to come on this...

# Getting started

*Just start!*

*Limited deployment*

Start in SD

Use for drawing generation

***Critical: Project Leadership must get in the model!***



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## 2. BIM Implementation – Across the design team

1. Selecting software
2. Addressing IT issues
3. Legal and contractual

# Selecting Software

## 1. Using a common platform

*Many BIM tools support most AE Disciplines*

*Different parties may have investments in particular tools*

*Sometimes Engineers will "go with the Architect"*

Bentley Triforma

Graphisoft ArchiCAD

AutoDesk Revit

AutoDesk Architectural Desktop

Digital Project

Nemetchek All Plan

## 1. Using preferred tools

*Each party uses their preferred tools*

*Translation standards are adopted for the team*

*A common integration environment is selected*

Navisworks

Innovaya

Digital Project

# Wide Area Network issues

Where are the models stored?

*Good ol' FTP : who will host what pieces?*

Architect?

Owner?

*Project web sites*

*Mirrored drives*

*Shared network with VPN*

# Implementation Questions

- *Scope*
- *Ownership*
- *Status*
- *Specification*
- *Implementation*

# Scope

- *Design Only*
- *Coordination*
- *Estimating*
- *Scheduling*
- *Submittal Review*
- *Shop Drawings/Fabrication*
- *Agency Review*
- *Facility Management*



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# Who owns the model??

*Who authors the model(s)?*

*Who uses the model(s)?*

*Who is responsible for the information in the model(s)?*

*Who stores the model(s)?*

*Who has copyright on the model(s)?*

# Who owns the model??

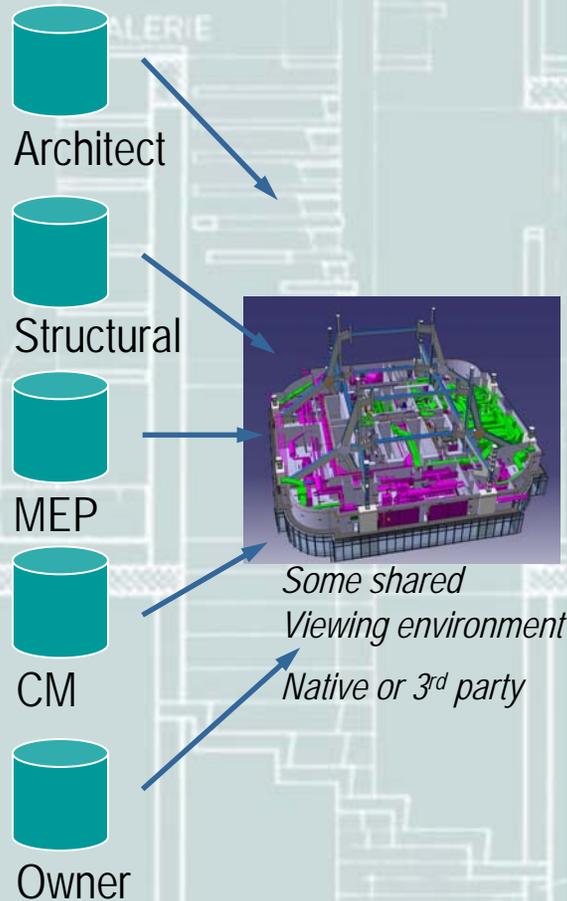
Simple answer:

- “The model” is actually a collection of sub-models
- Each party owns, maintains, and is responsible for their part of the model
- Models are read-write by the authoring party
- Models are read only by receiving parties
- Models are shared more or less along standard contractual bounds
- Models may be distributed as part of conventional document packages

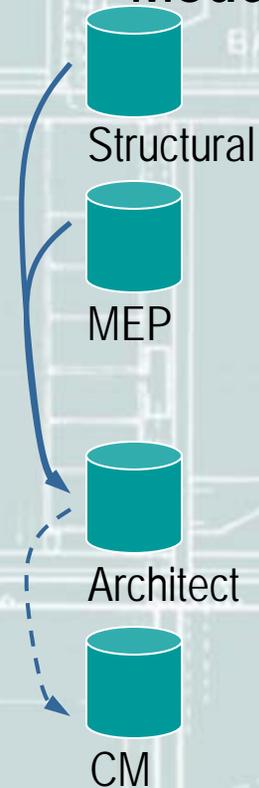
*More interesting answers are possible...*

# Who owns the model??

## Federated Model

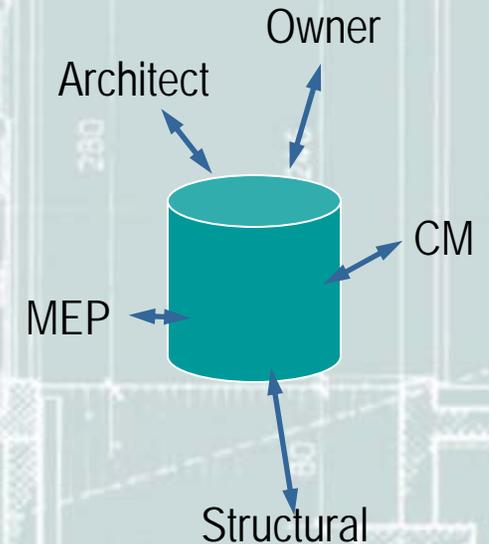


## Linked Database Model



## Object Database Model

*Doesn't exist yet*



# Ownership

- Owner
  - Embedded Copyrights
  - Protection of Confidential Data
  - Gatekeeping
  - DP as Licensee
    - *Publicity*
    - *Attribution*
    - *Liability for Reuse*
- Design Professional
  - Instrument of Service
  - Copyright
    - *Embedded Copyrights*
    - *Derivative Works*
  - Owner as Licensee
    - *Completion*
    - *Maintenance*
    - *Renovation/Expansion*
    - *Reuse*

# Status

- *Legal Status*

- Contract Document

- Precedence
- Allowable Reliance
- Relationship to:
  - *2D Drawings*
  - *Specifications*
- Conflict Resolution

- Interpretive Document

- Conflict Resolution

- Informal Document

- *Submittals*

- *RFIs/Clarifications*

- *Record Drawing*

- Who
- When
- How
- Format

# Specification

- *Detailed Spec*
  - Software Choices
    - Compatible
    - Interoperable
    - IFC Classes
  - Detail Level
    - Design
    - Submittal
  - Tolerances
  - Information Management
    - Administration
    - Infrastructure
    - Digital Rights
    - Gatekeeping

# Implementation

## ■ *Model Administration*

### ■ Who

- Owner/Owner Consultant
- Contractor
- Construction Manager
- Prime Design Professional

### ■ What

- Technical
- Administrative
- Substantive

## ■ *Model Management Process*

- Version Control
- Design Coordination
- Construction Coordination
- As-Built Information

## ■ *Job Site Use/Availability*

## ■ *Site Survey/Existing Conditions*

## ■ *Agency Review*

## ■ *Archiving*

## ■ *Insurance*

# Emerging Standards

- *NBIMS*
- *AIA*
  - IPD Use Guide
  - IPD Contract
  - C106 Digital Data Licensing
  - E201 Digital Data Protocol
- *AISC "Appendix A"*
  - Model Administrator
  - Logical Project Model
    - Design Model
    - Analysis Model
    - Manufacturing Model
  - Interoperable through CIS/2
  - Model Takes Precedence
  - Conditional Acceptance by Fabricator
  - Submittals Through Model
  - No Discussion of Legal Issues Involved
- *AGC*
  - Contractor's Guide to BIM
  - Consensus Docs
    - 200.2 Electronic Communications Protocol Addendum
    - Series 300 IPD
- *GSA*
  - Spatial BIM Required
  - BIM Design Center
- *USACE*
  - BIM is Superset of CAD
  - A/E to Provide Plan for BIM Use
  - BIM Will Be Sufficient for Costing
  - Model Elements That Are Shown on 1/4:1
  - Structural Model "As it Would Be Built"
  - No Unresolved Interferences from 20%!
- *CURT*
- *CIFE*

# Legal Issues

- *Inherent in the Use of BIM*
- *Arising from BIM as a Collaborative Framework*

# Issues Inherent in BIM

- *Data Translation*
- *Data Misuses*
- *Intellectual Property*
- *Valuable Papers/IT Risk*
- *Status of Model*
- *Standard of Care*
- *Design Delegation*

# Data Translation

- *Errors*
  - Professional Liability
  - Limited Software Warranties
- *Inconsistent Features*
- *Interoperability*

# Data Misuse

- *Currency*
- *Adequacy*
- *Tolerances*

# Intellectual Property

- *Ownership*
  - Collaborative Work
    - Copyright
    - Instrument of Service
- *Confidential Information*
- *Embedded Information*
- *What is the Design*
- *Gatekeeping*

# Valuable Papers/IT Risk

- *Data Loss*
- *Insurance*

# Status of Model

- *Contract Document*
- *Visualizes Intent*
- *Unofficial*

# Standard of Care

- *Conflict Resolution*
  - Depth of Modeling
- *Optimization*

# Design Delegation

- *Licensing*
  - Frankfort Digital Services v. Kistler
- *Responsible Charge*

### 3. BIM Implementation – Across the project team

1. Procedural Scope
2. Legal and contractual

# Procedural Scope

## 1. Who benefits

*Internal benefits*

*Team benefits*

*Owner benefits*

## 2. Who Pays?

# Suggested Scope

1. Project Site model
2. BIM as – or not as – a contract document
3. Subcontractor interface
  1. BIM provided for subcontractor work
  2. BIM as context for shop drawing review
4. Direct site integration
5. As builds

# BIM Coordination Workshop

## ■ Software Choices

- Compatible
- Interoperable
- IFC Classes

## ■ Detail Level

- Design
- Submittal

## ■ Tolerances

## ■ Coordinate system

## ■ Information Management

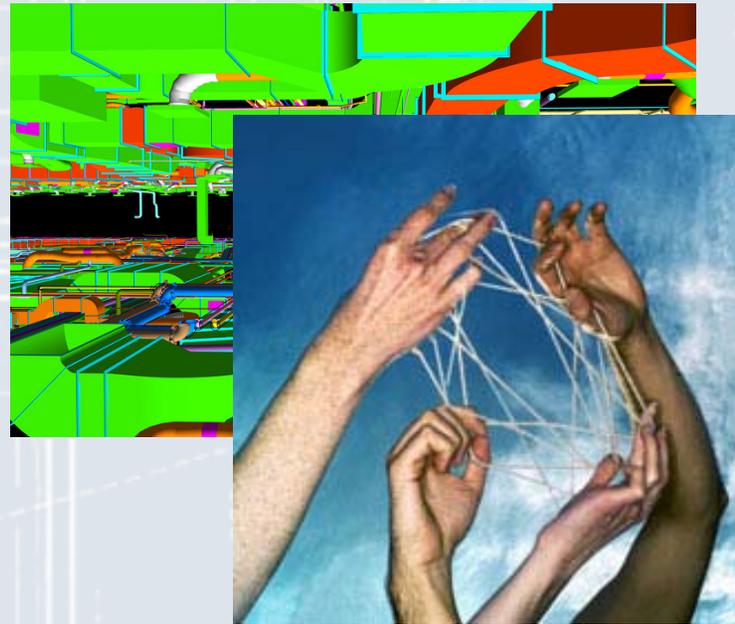
- Administration
- Infrastructure
- Digital Rights
- Gatekeeping

## ■ Coordination Process

- Organization
- Leadership

# Issues Arising from How Building Information Modeling is Used

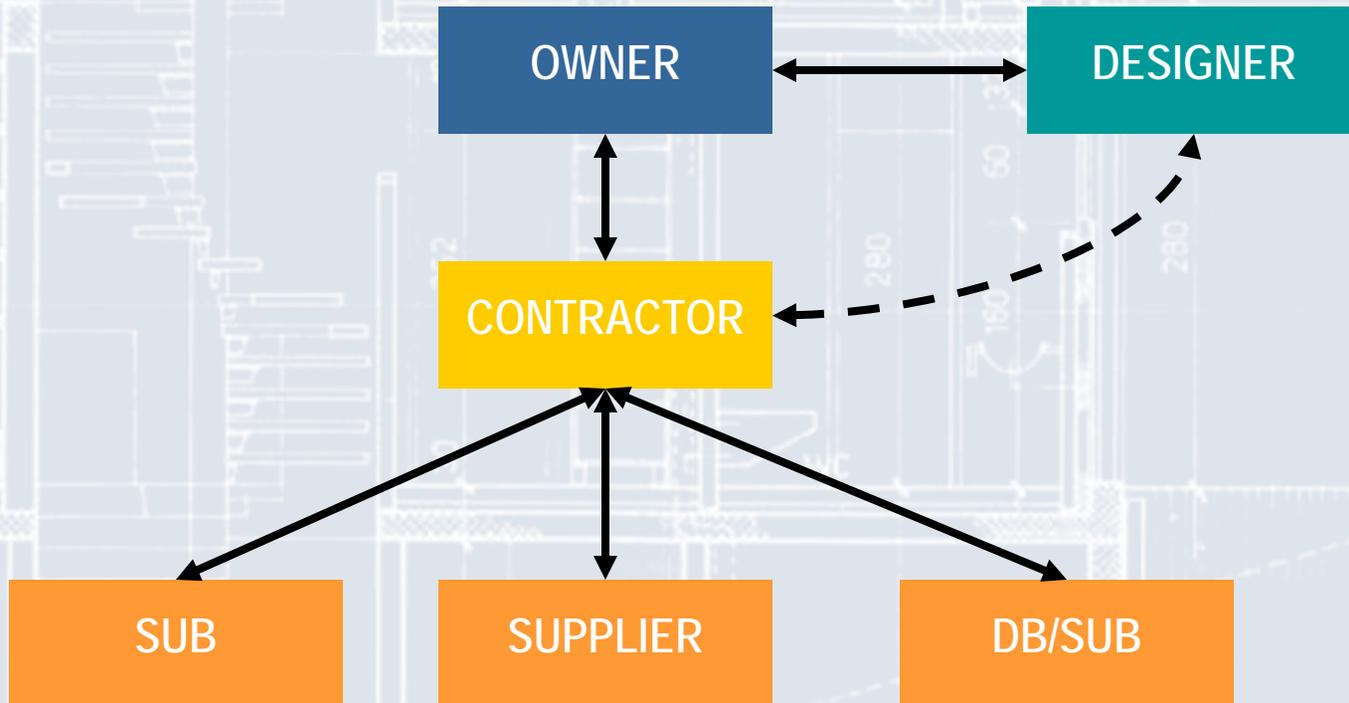
BIM as a Collaborative Framework



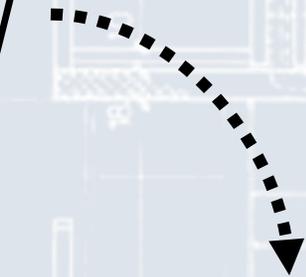
# Issues Arising From How BIM Is Used

- *Boundaries*
- *Vagueness*
- *3rd Party Reliance*
- *Contracts*
- *Intellectual Property*
- *Design Delegation*
- *Implied Warranties*

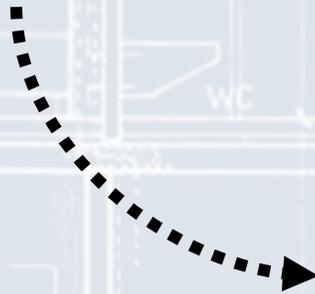
# The Boundary Dilemma



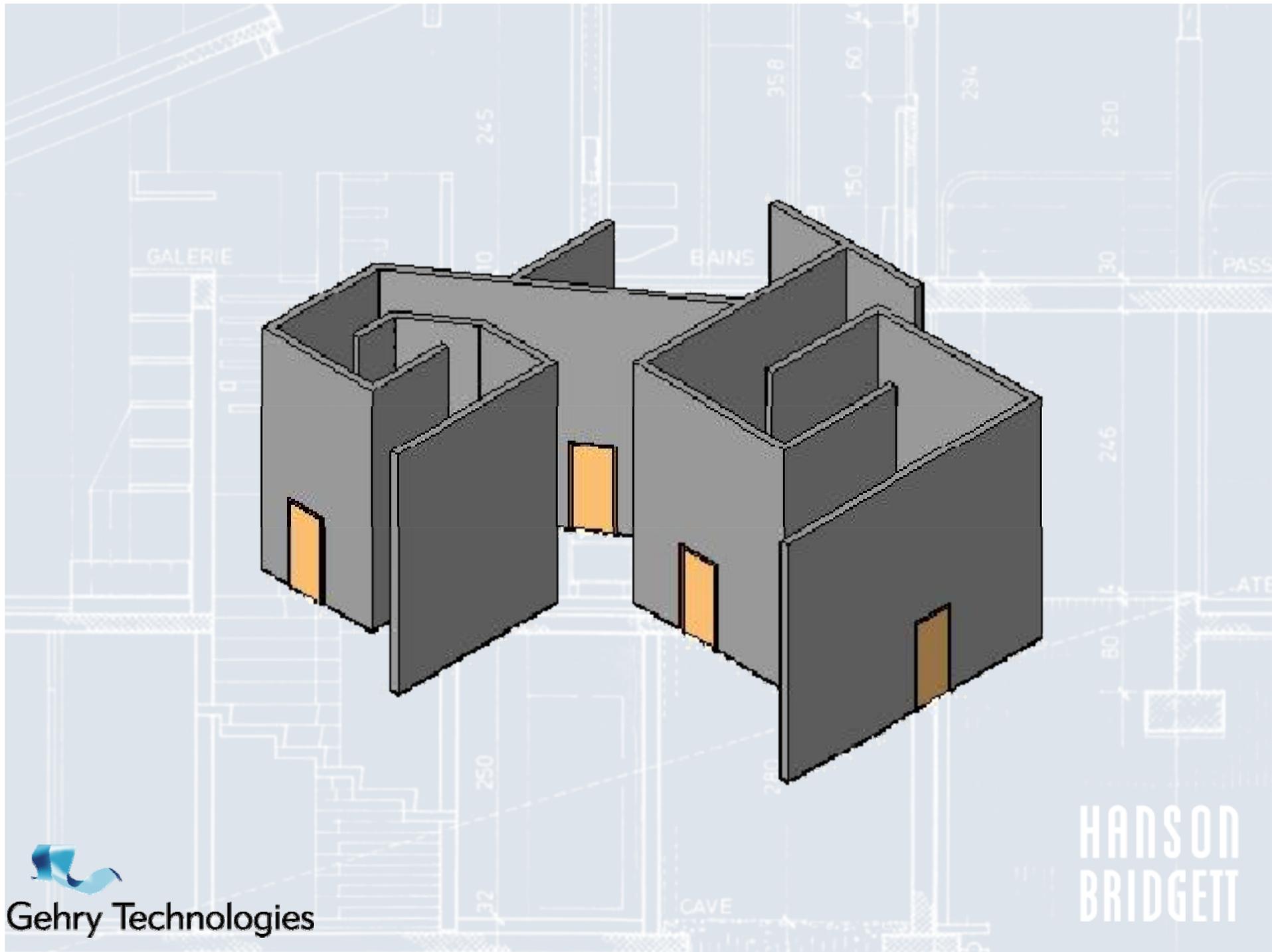
Authority



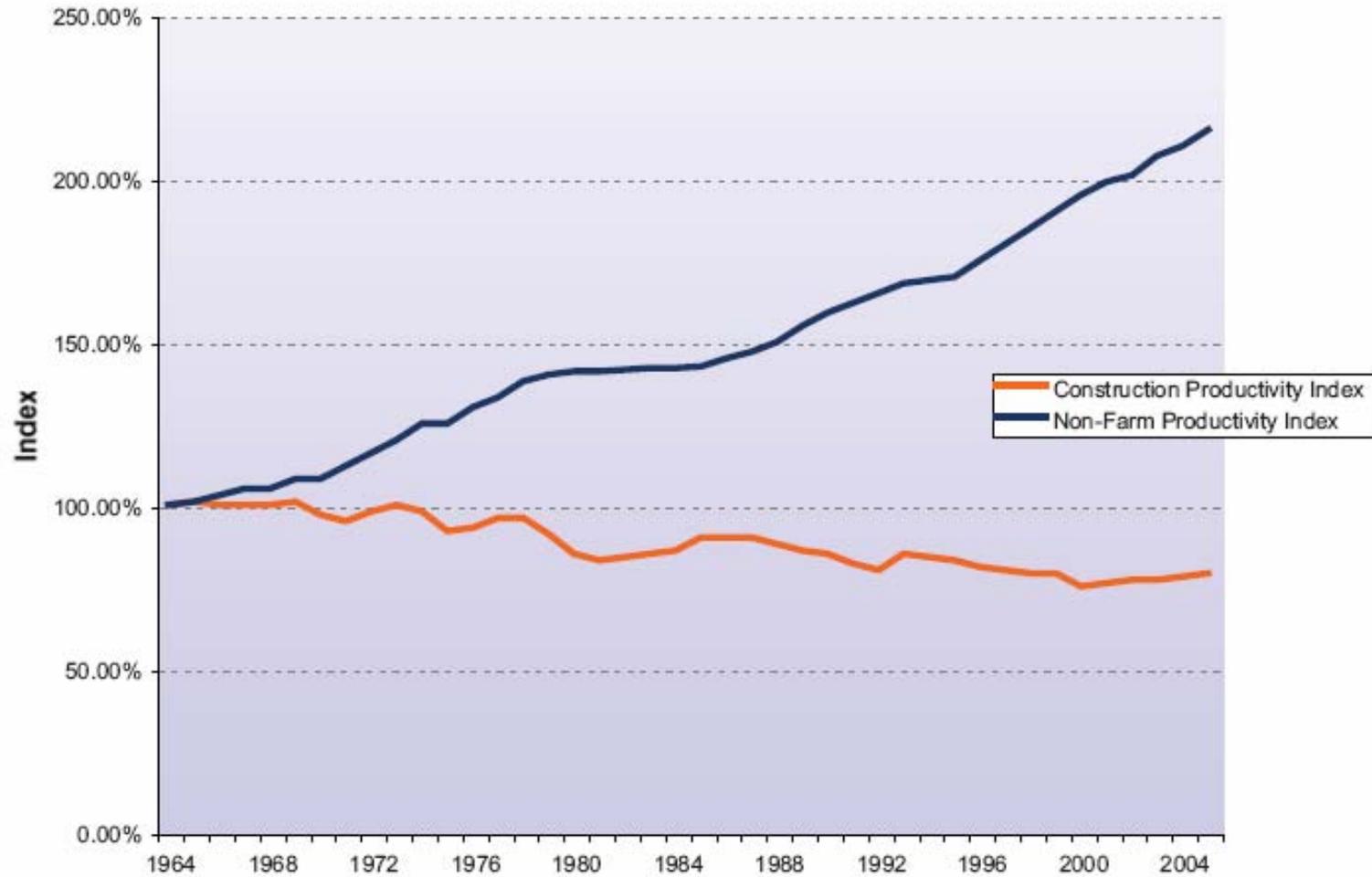
Responsibility



Liability



Constant \$ of Contracts/Workhours of Hourly Workers  
Sources: U.S. Dept. of Commerce, Bureau of Labor Statistics

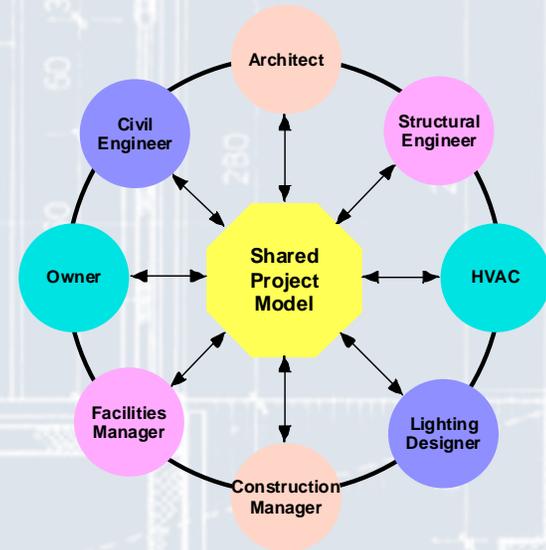
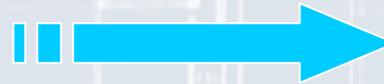
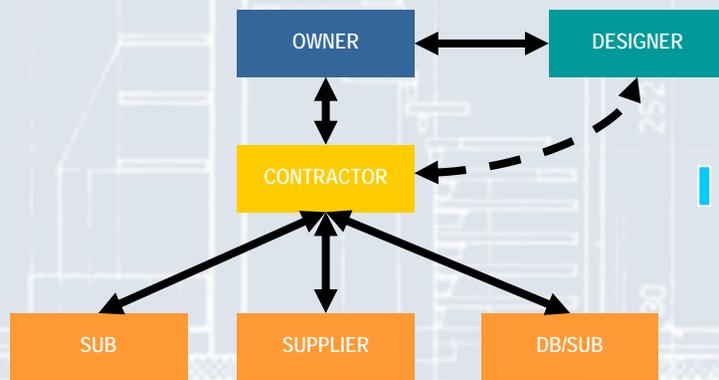


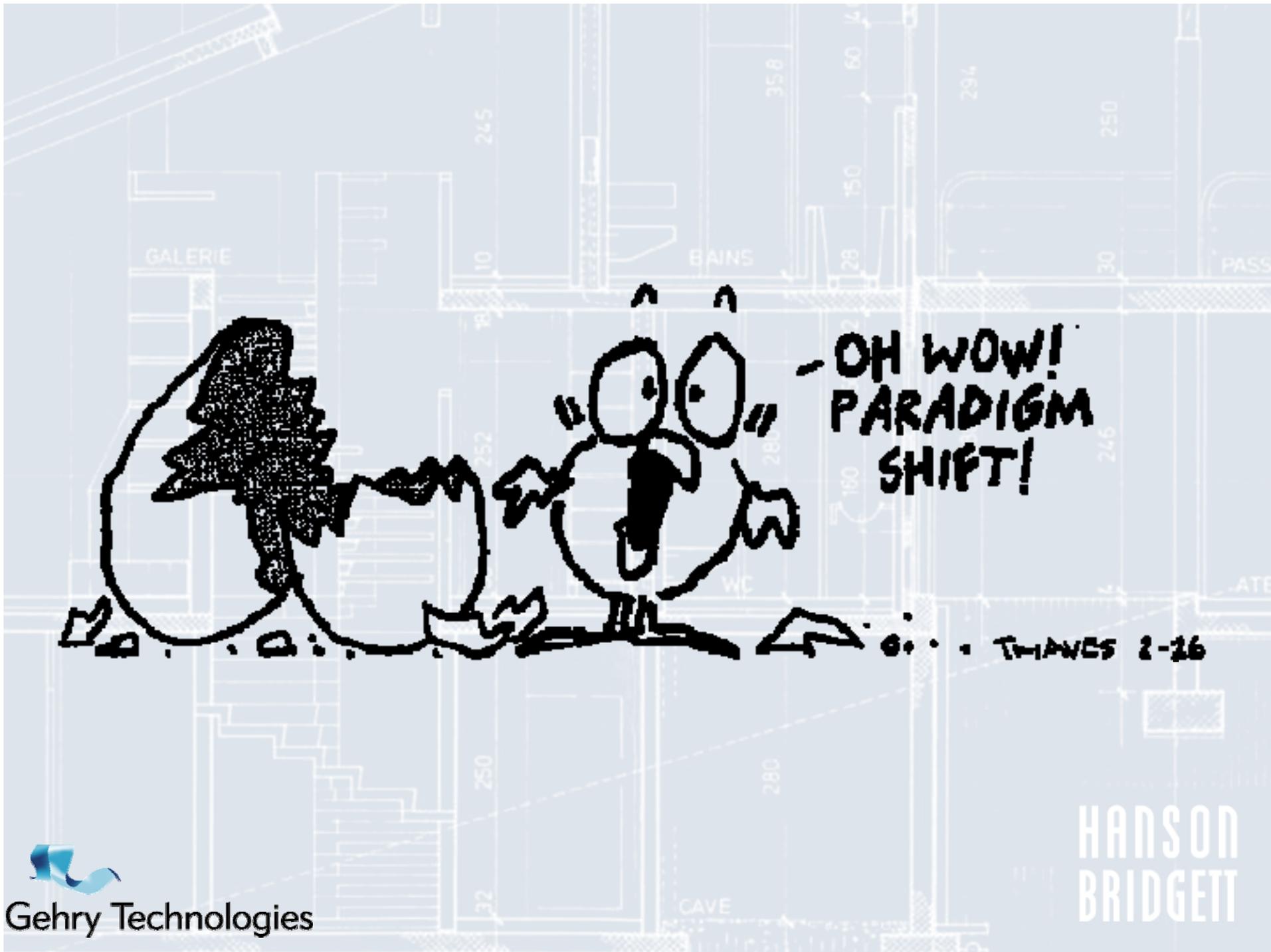
Reference: Paul Teicholz, Ph.D., Professor (Research) Emeritus, Dept. of Civil and Environmental Engineering, Stanford University

# CURT WP-1003 & 1202

- ***Integrated Project Structures:*** The building process cannot be optimized without full collaboration among all members of the design/build/own project.
- ***Open Information Sharing:*** Project collaboration must be characterized by open, timely and reliable information sharing.
- ***Virtual Building Models:*** Effectively designed and deployed technology will support full collaboration and information sharing and will lead to a more effective design/build manage process.

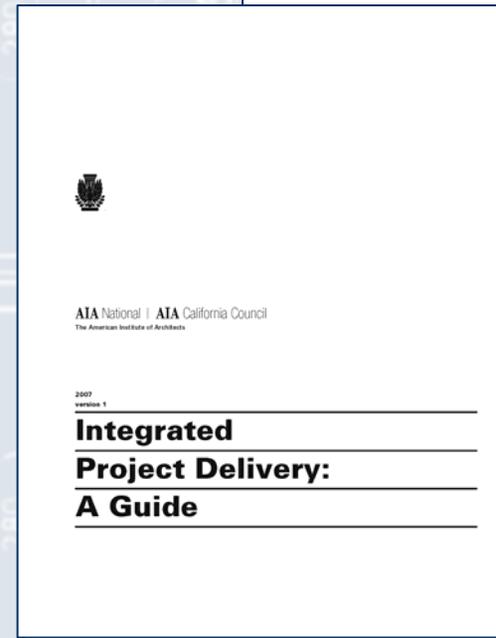
# From Hierarchy to Collaboration



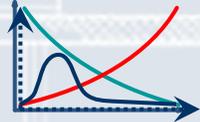
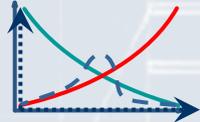
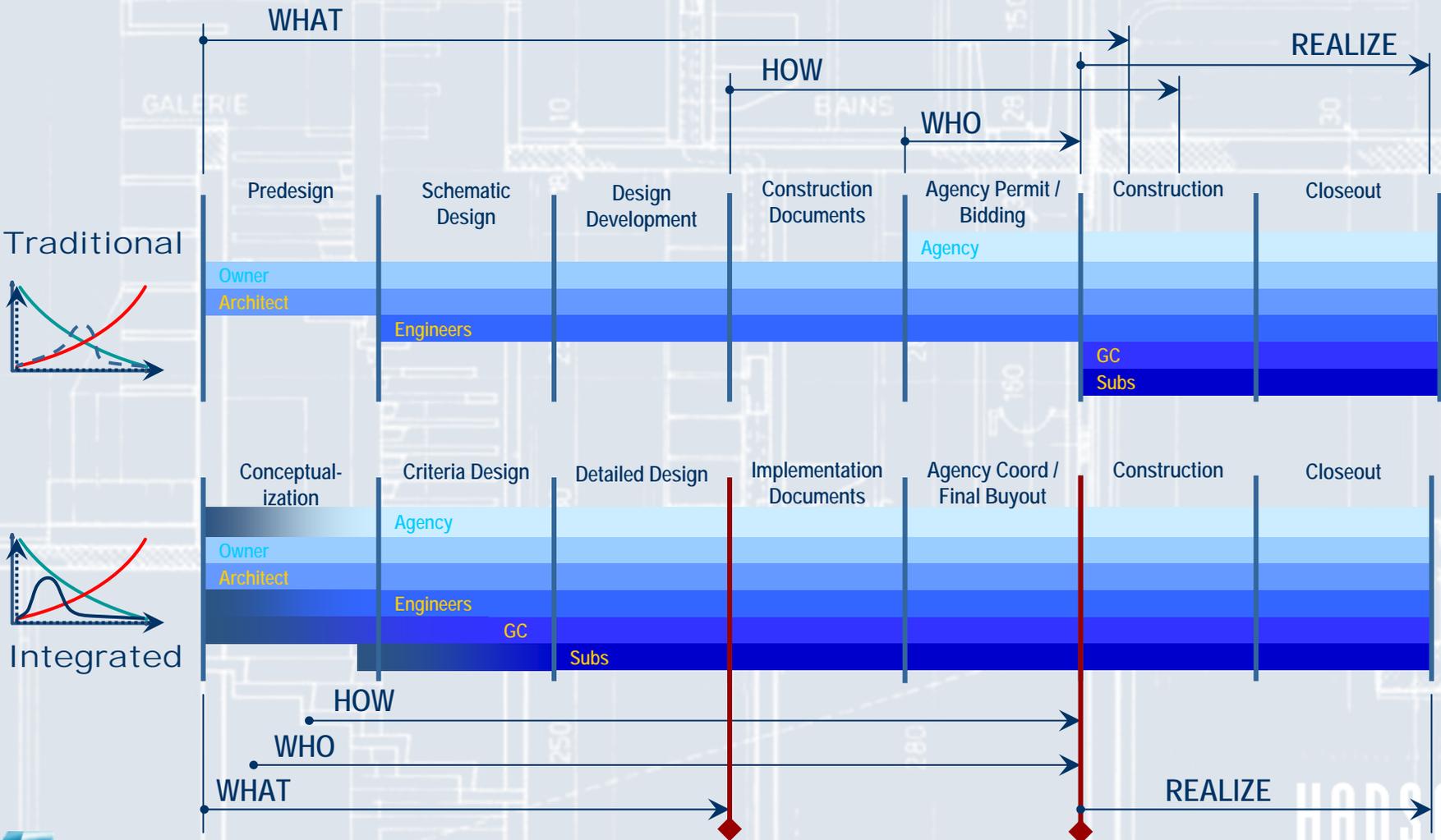


# AIA/AIACC Integrated Project Delivery

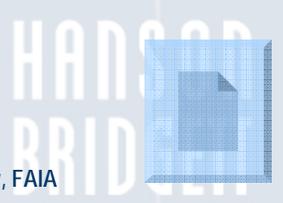
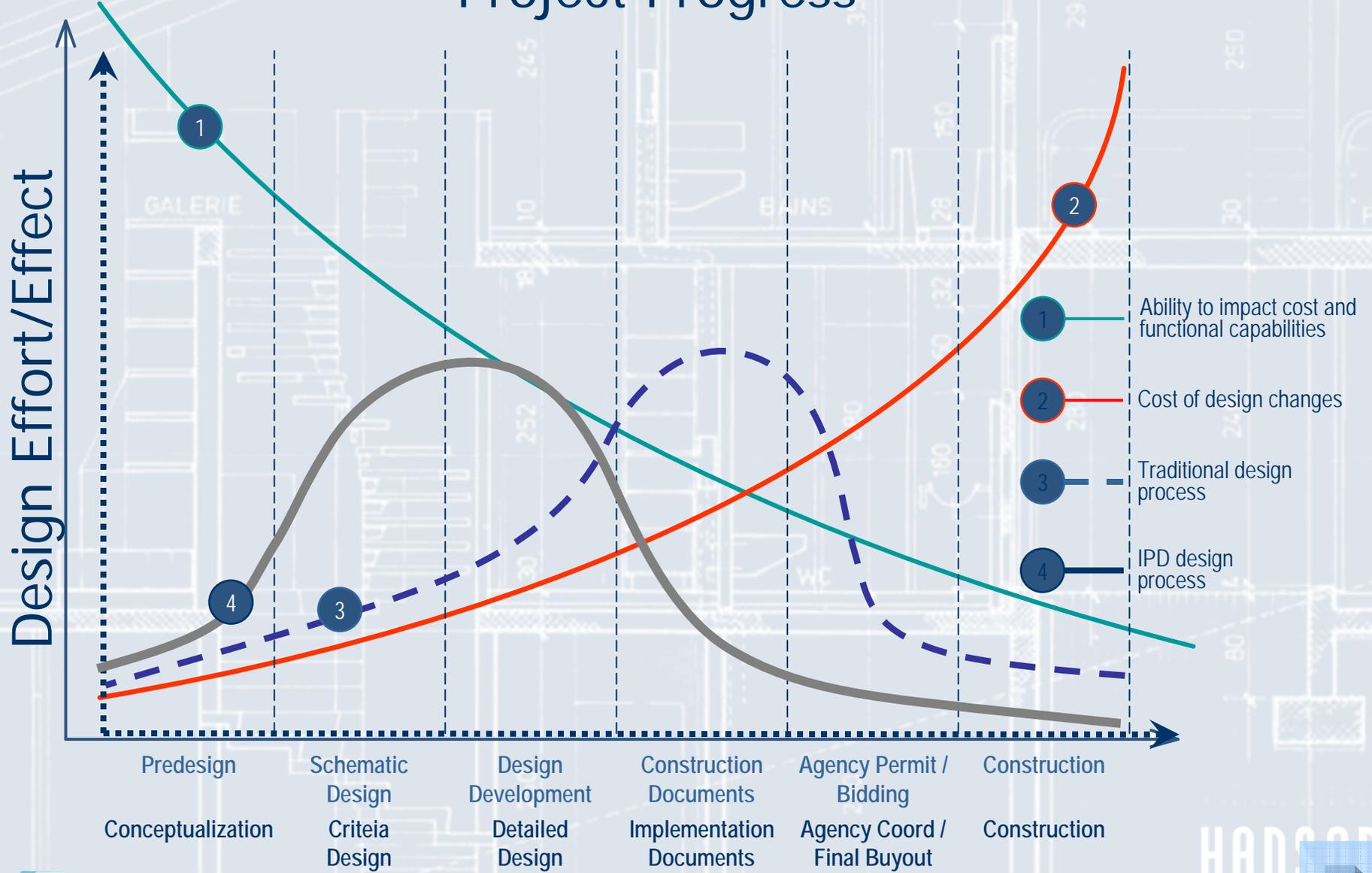
- AIACC IPD: A Working Definition
  - [www.ipd-ca.net](http://www.ipd-ca.net)
- AIA/AIACC IPD Use Guide
  - [www.aia.org/ipdg](http://www.aia.org/ipdg)
  - Essential Principles
  - Business Models
  - Building the Integrated Team
  - Integrated Project Workflow
  - Legal Considerations



# Delivery Process



# Project Progress



# Collaborative Contracts

- Be Collaborative
  - <http://www.constructingexcellence.org.uk/sectorforums/buildingstatesforum/bcc/index.html>
- Engineering & Construction Contract (NEC3)
  - [www.neccontract.co.uk/](http://www.neccontract.co.uk/)
- “Lean Construction”
  - [www.leanconstruction.org](http://www.leanconstruction.org)
- Consensus Docs – 300 Series
  - <http://www.consensusdocs.org>
- NBBJ Agreement
- AIA
  - IPD: A Guide
  - IPD Agreement(s) Spring 2008

# Additional Resources and Developments

- NBIMS [www.nibs.org](http://www.nibs.org)
- GSA [www.gsa.gov/bim](http://www.gsa.gov/bim)
- USACE [cadbim.usace.army.mil/BIM](http://cadbim.usace.army.mil/BIM)
- AIA [www.aia.org](http://www.aia.org)
- AIACC [www.ipd.ca.net](http://www.ipd.ca.net)
- AGC [www.consensusdocs.org](http://www.consensusdocs.org)
- CURT [www.curt.org](http://www.curt.org)
- CIFE [www.cife.stanford.edu](http://www.cife.stanford.edu)
- Lean Construction [www.leanconstruction.org](http://www.leanconstruction.org)