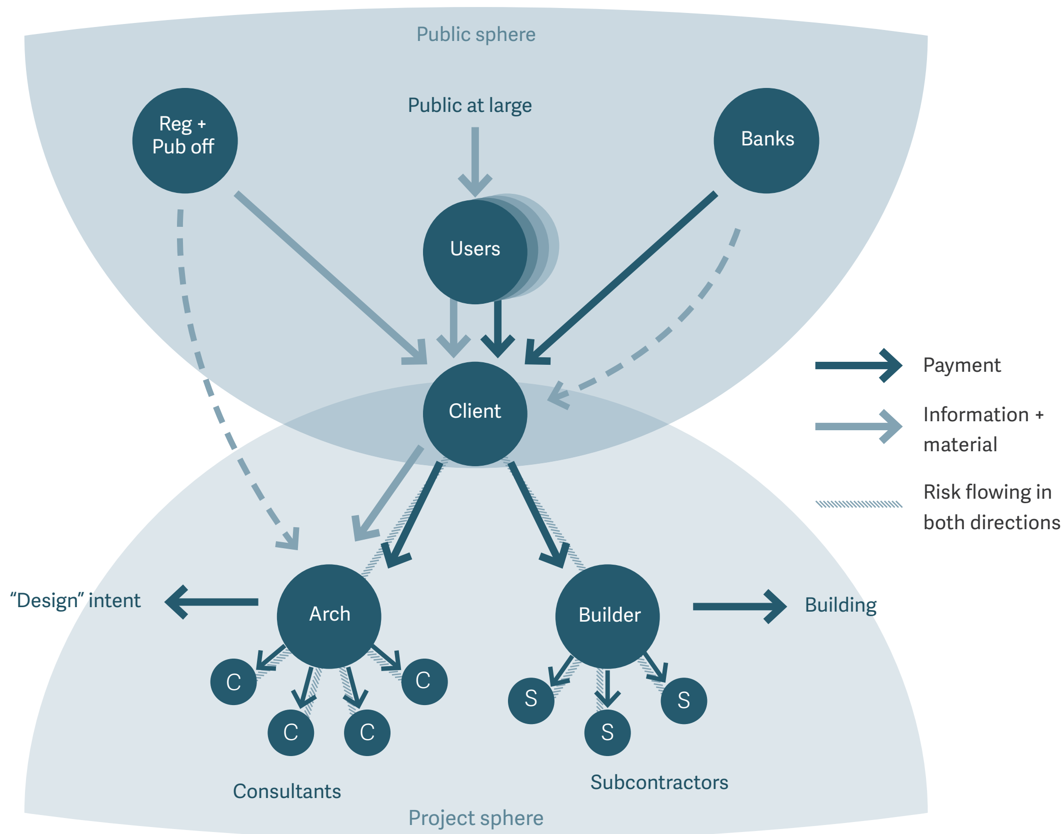
Provocation 1 - Barriers to Innovation in AEC Project Delivery

AIA Project Delivery Knowledge Community 2020 Symposium – Workshop

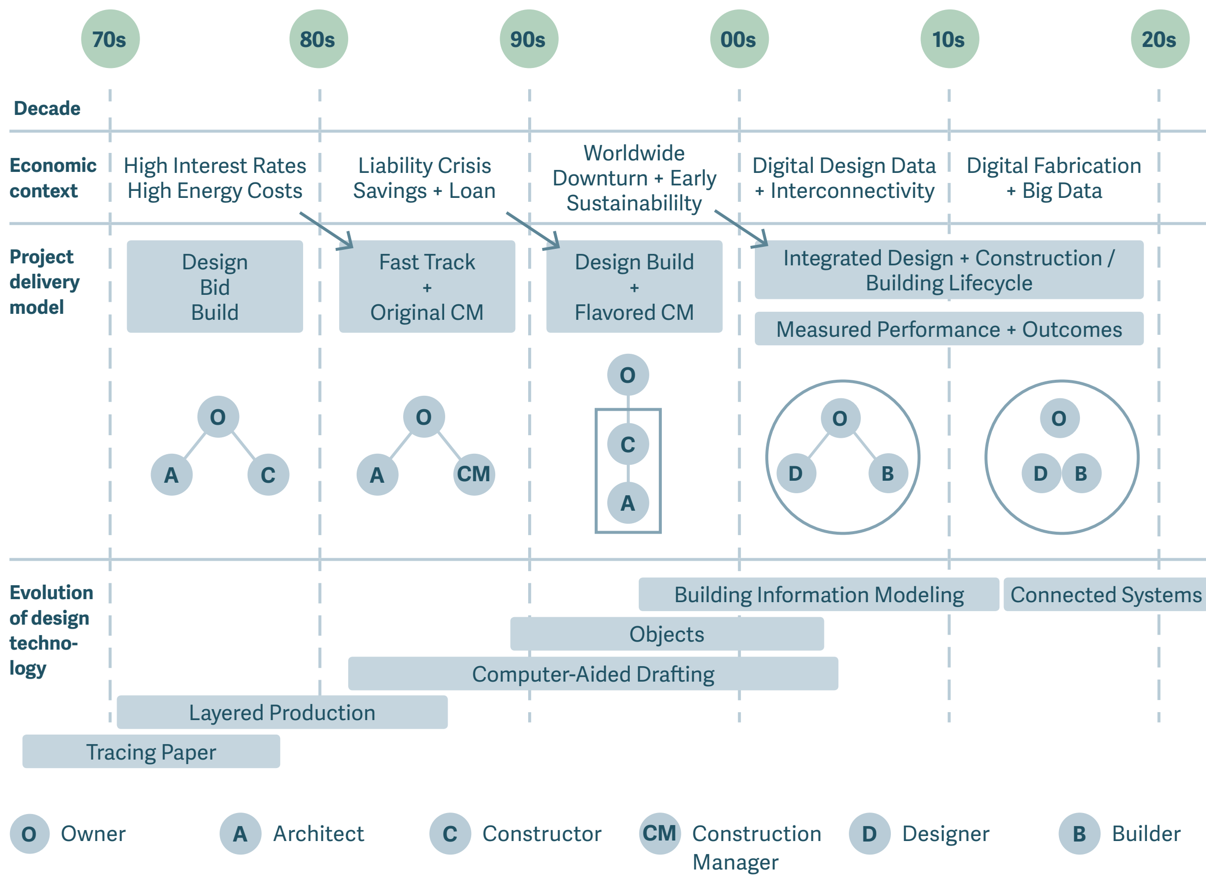
03.09.2020

Phil Bernstein FAIA NOMA RIBA LEED AP ©
Associate Dean and Senior Lecturer
Yale School of Architecture

History



Source: *Architecture Design Data: Practice Competency in the Age of Computation by P. Bernstein (2018)*



Source: *Architecture Design Data: Practice Competency in the Age of Computation by P. Bernstein (2018)*

Sources of Project Uncertainty

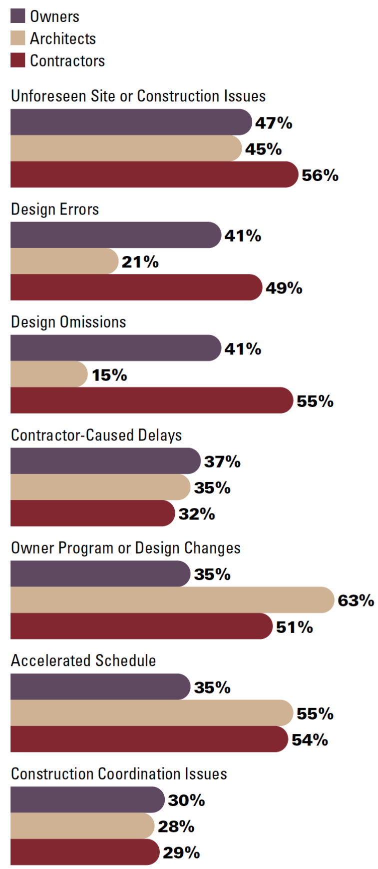
Top Causes of Overall Uncertainty for Owners, Architects and Contractors

Source: McGraw Hill Construction, 2014

	Ranking of Causes by Player		
Causes of Uncertainty	**Owners**	**Architects**	**Contractors**
Unforeseen Site or Construction Issues	1	3	1
Design Errors	2 (tie)	6	5
Design Omissions	2 (tie)	7	2
Contractor-Caused Delays	4	4	6
Owner-Driven Changes	5 (tie)	1	4
Accelerated Schedule	5 (tie)	2	3
Construction Coordination Issues	7	5	7

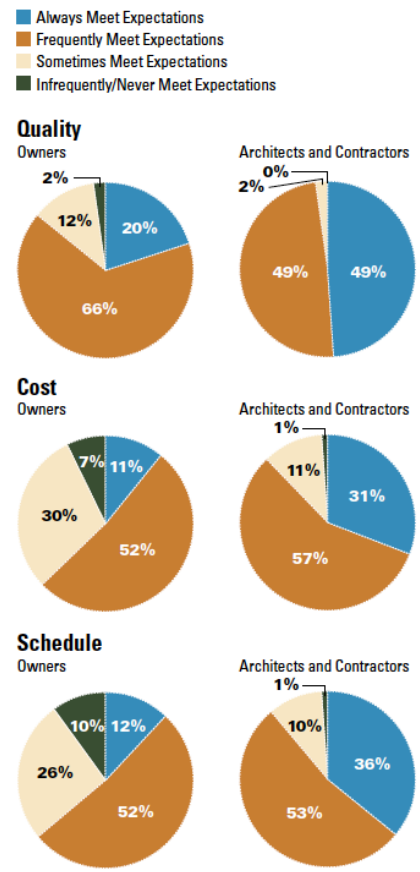
Top Factors That Cause Uncertainty

Source: McGraw Hill Construction, 2014



Frequency With Which Projects Meet Expectations

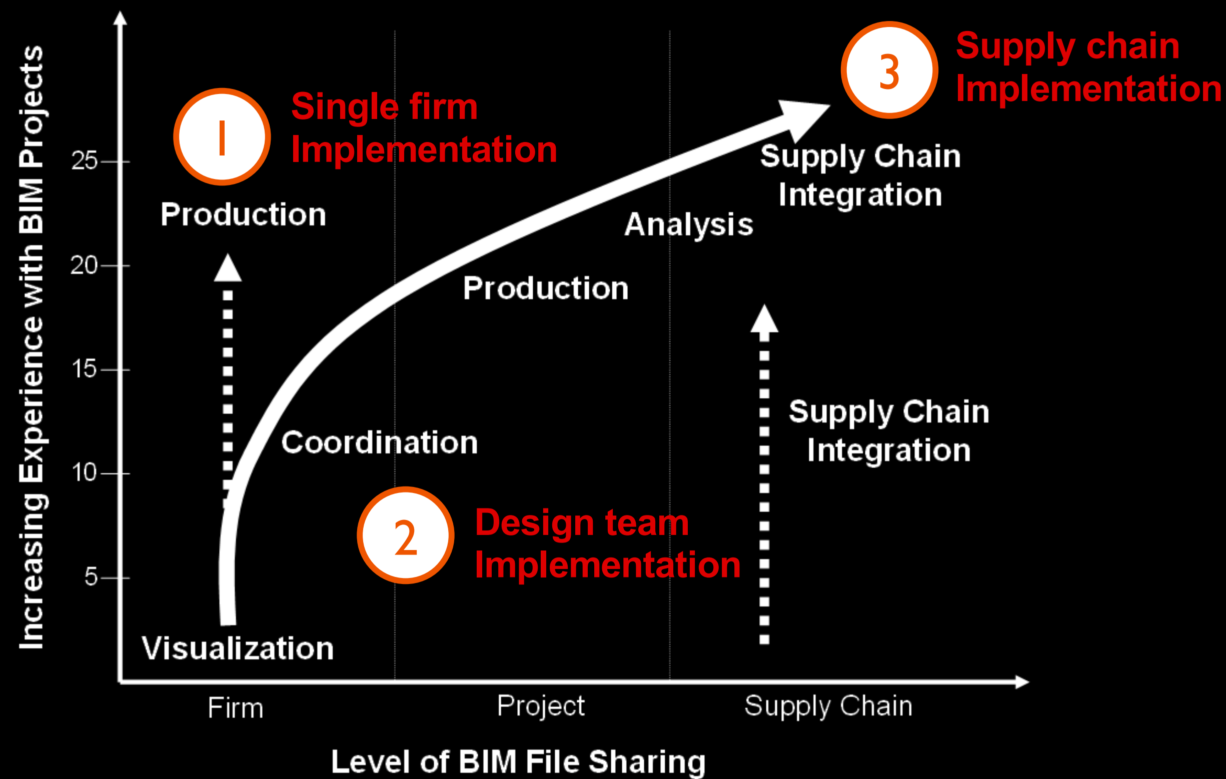
Source: McGraw Hill Construction, 2014

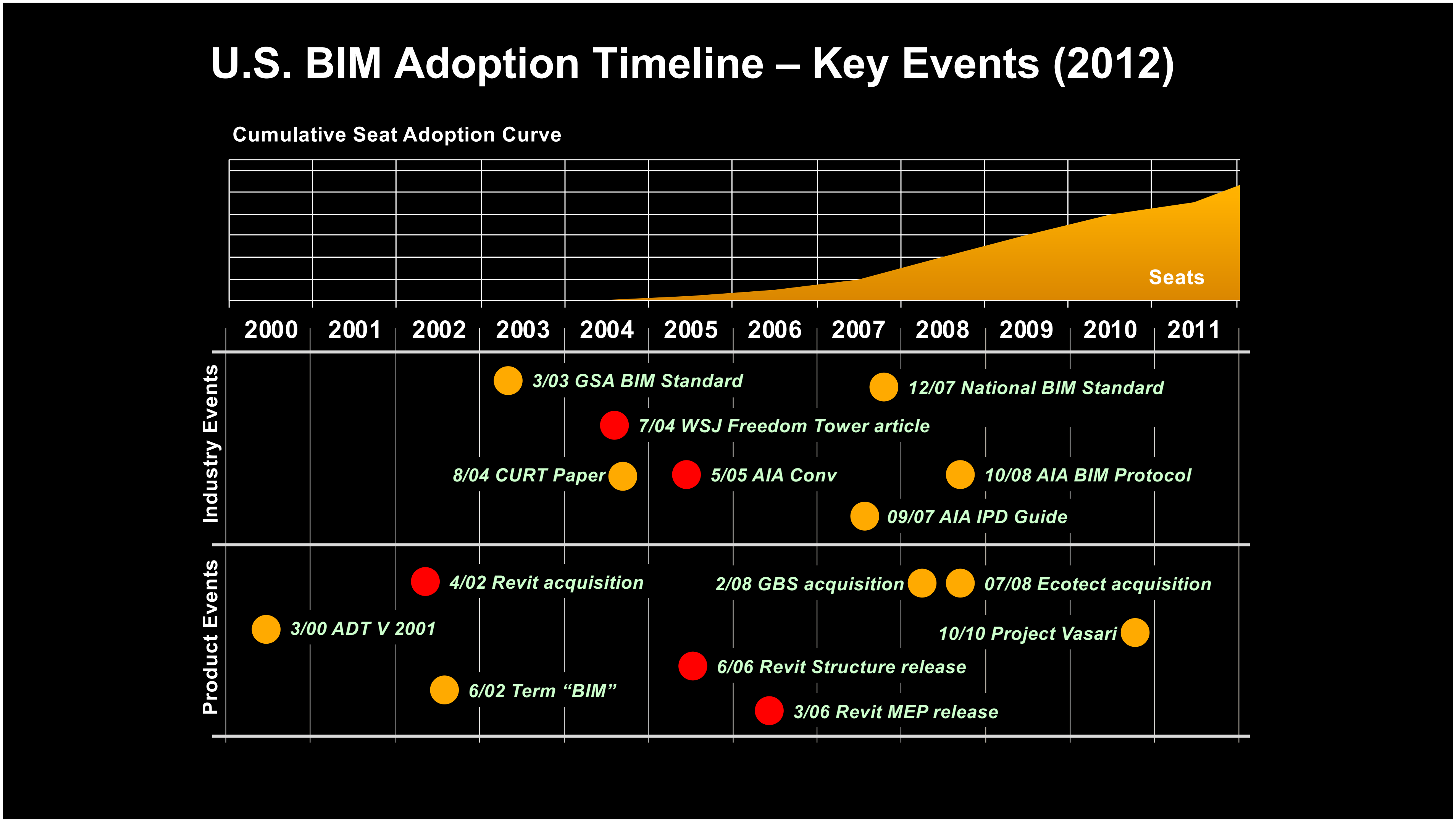


Source: McGraw Hill Construction "Managing Uncertainty in Building Design and Construction" Smart Market Report 2014

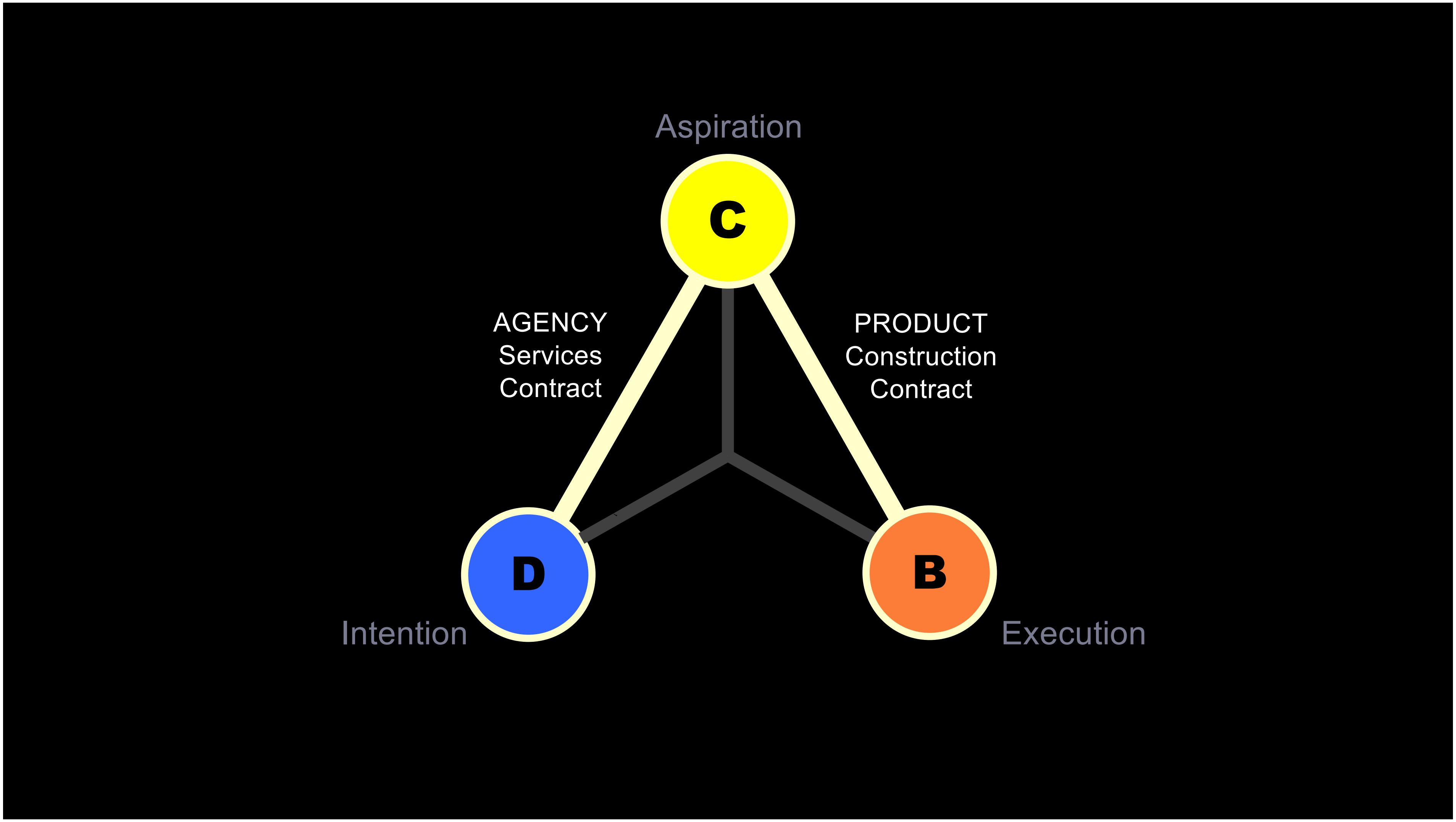
Evolution Towards BIM

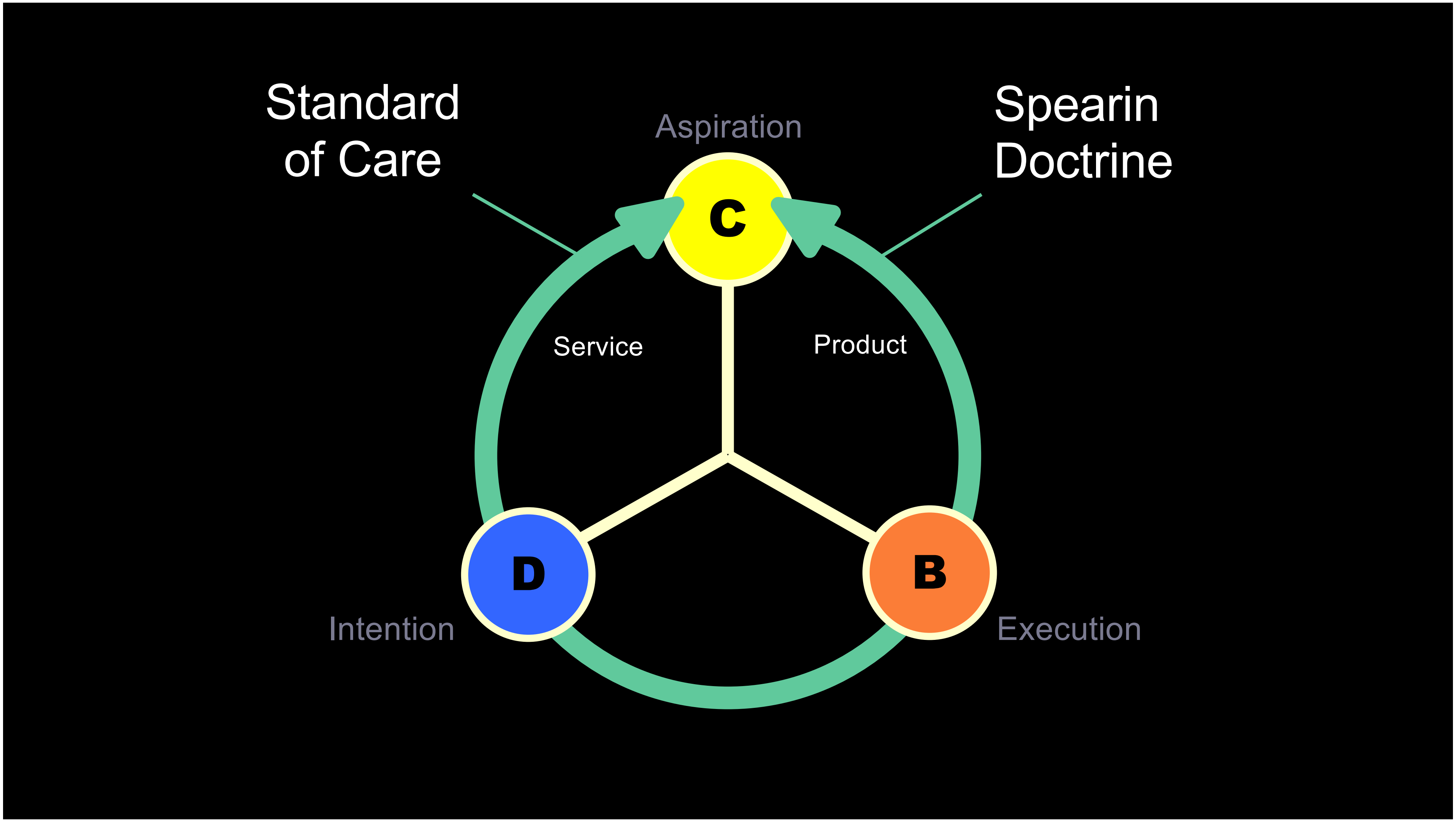
Source: **"Digital Building Process Business Practice Evolution: Your Paradigm or Mine?"** Autodesk/Stanford CIFE Study 1/31/05




U.S. BIM Adoption Timeline – Key Events (2012)
Cumulative Seat Adoption Curve
Seats
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Industry Events
3/03 GSA BIM Standard
12/07 National BIM Standard
7/04 WSJ Freedom Tower article
8/04 CURT Paper
5/05 AIA Conv
10/08 AIA BIM Protocol
09/07 AIA IPD Guide
Product Events
4/02 Revit acquisition
2/08 GBS acquisition
07/08 Ecotect acquisition
3/00 ADT V 2001
10/10 Project Vasari
6/06 Revit Structure release
6/02 Term “BIM”
3/06 Revit MEP release

Legal


Aspiration
C
AGENCY
Services
Contract
PRODUCT
Construction
Contract
D
B
Intention
Execution


Standard
of Care
Aspiration
C
Spearin
Doctrine
Service
Product
D
B
Intention
Execution

What is the Standard of Care?

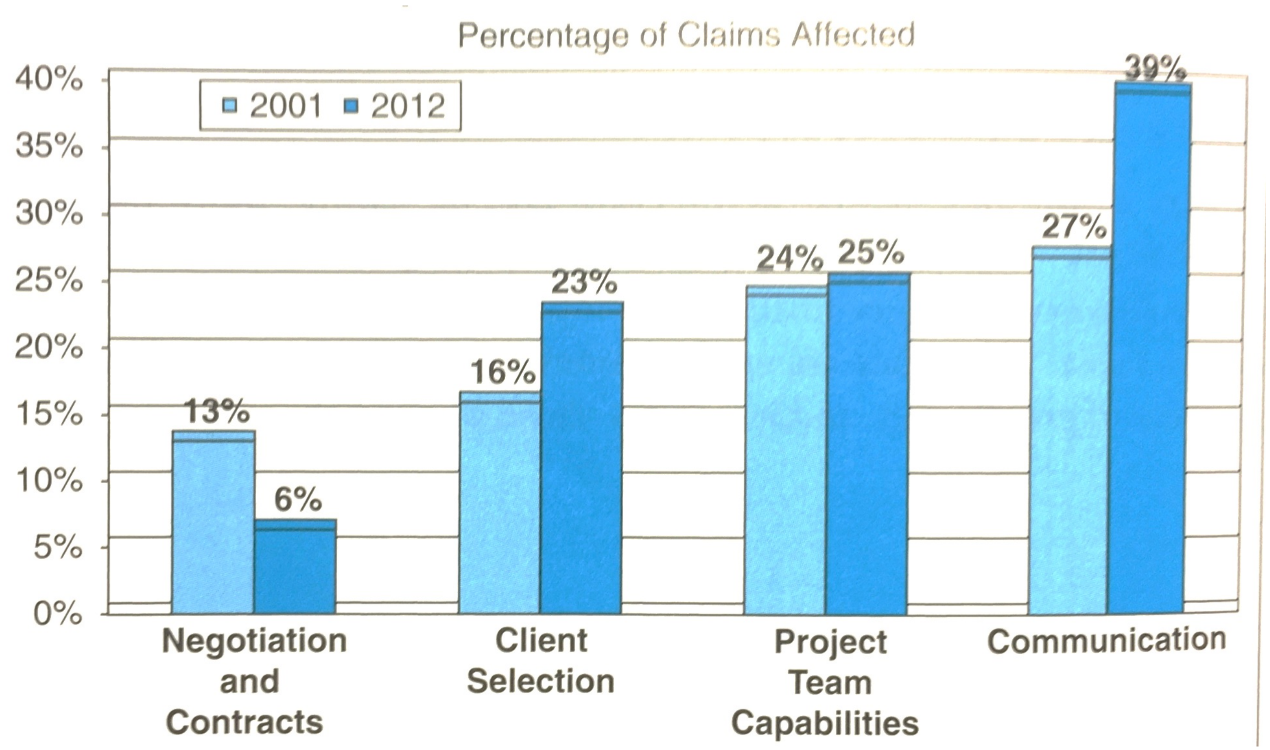
"Architects, doctors, engineers, attorneys, and others deal in somewhat inexact sciences and are continually called upon to exercise their skilled judgment in order to anticipate and provide for random factors which are incapable of precise measurement. The indeterminable nature of these factors makes it impossible for professional service people to gauge them with complete accuracy in every instance.... Because of the inescapable possibility of error which inheres in these services, the law has traditionally required, not perfect results, but rather the exercise of that **skill and judgment which can be reasonably expected from similarly situated professionals**."

Klein v. Catalano, 386 Ma. 701, 719 (1982).

AIA says "…by architects practicing in the same or similar locality under the same or similar circumstances."

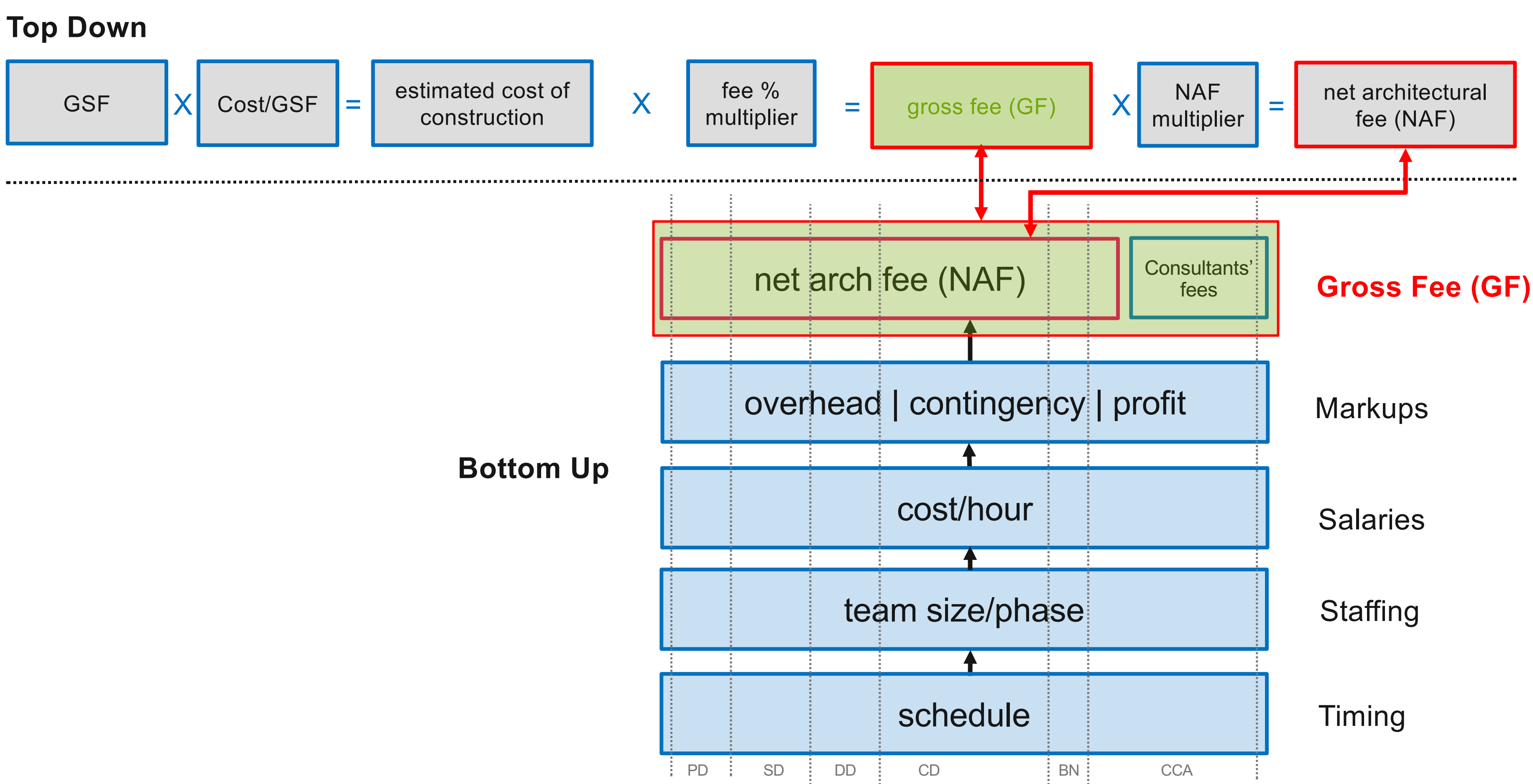
Source: Leslie King, Esq.

Sources of Liability: Non-Technical Risk (from AIA HPP 15th Ed)



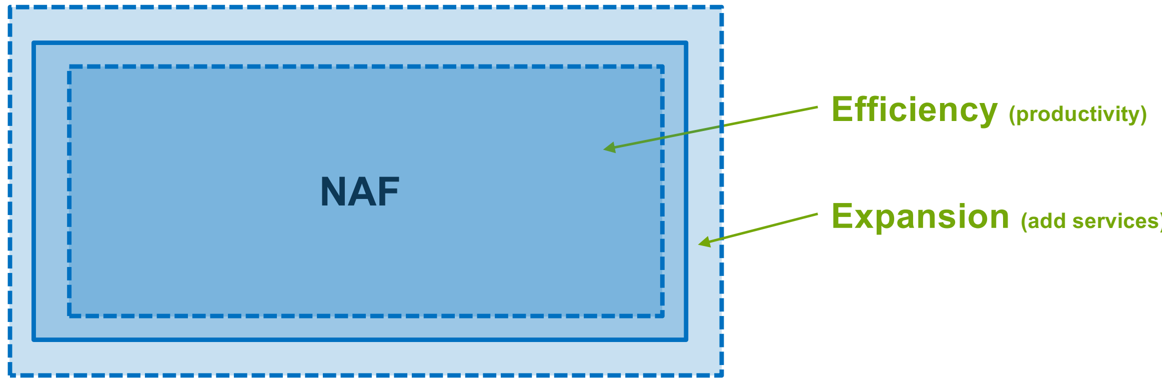
Business Models

Traditional Compensation Calculations



Selected Business Strategies

Fixed Fees	*Fixed Fee*
	Percentage of Cost
	Unit Cost
Variable Fees	*Hourly Rate*
	Cost Plus Fixed Fee
	Outcome-based

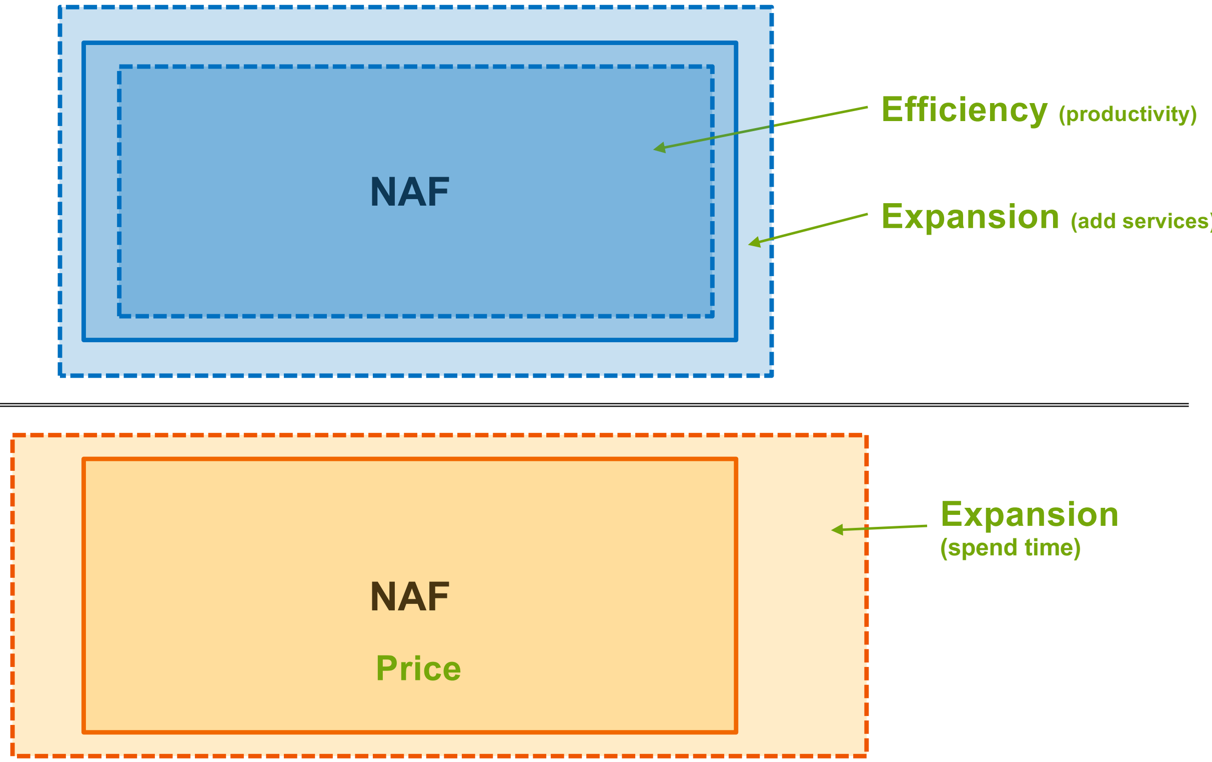


Selected Business Strategies

Fixed Fees	*Fixed Fee*
	Percentage of Cost
	Unit Cost
Variable Fees	*Hourly Rate*
	Cost Plus Fixed Fee
	Outcome-based

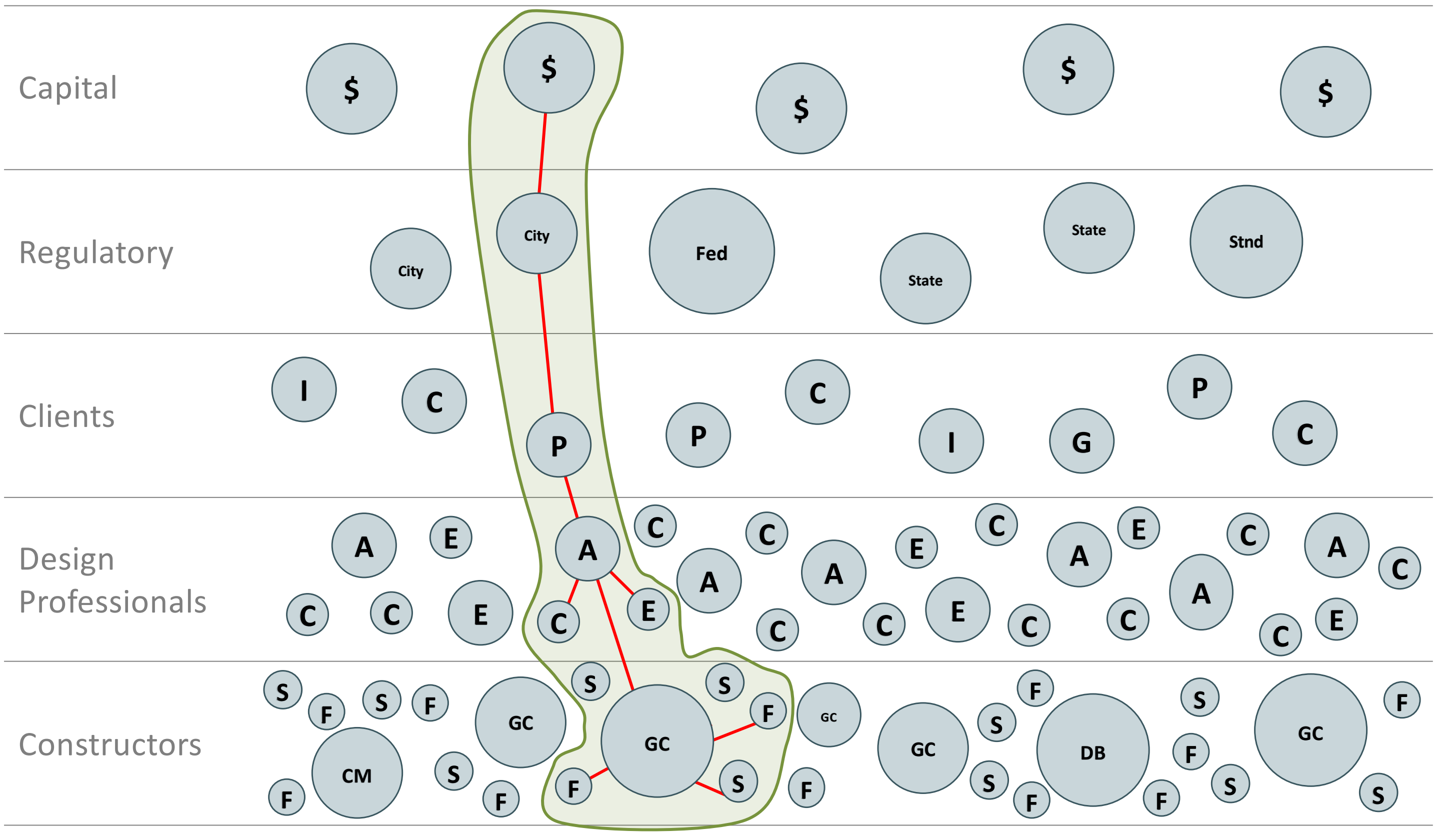
Selected Business Strategies

Fixed Fees	*Fixed Fee*
	Percentage of Cost
	Unit Cost
Variable Fees	*Hourly Rate*
	Cost Plus Fixed Fee
	Outcome-based



Social / Cultural

The Building Supply Chain



SUPPLY INTEGRATION PRACTICES (SCIP)

Modular v. systemic

Systemic (project)

Systemic (segment)

Systemic (industry)

Source: "Identifying the Role of Supply Chain Integration Practices in the Adoption of Systemic Innovations" (Hall, Levitt, Algiers)

Supply Chain Integration Practices

“Collaborative governance”

Project co-location

Local owner representation

Fiscal transparency

Interorganizational BIM

Multiparty incentivized contracts

Early involvement

Inter-firm board

Target value design

Last planner

Source: "Identifying the Role of Supply Chain Integration Practices in the Adoption of Systemic Innovations" (Hall, Levitt, Algiers)

Impact of Team Integration and Group Cohesion on Project Delivery Performance

Bryan Franz, Ph.D., A.M.ASCE[1]; Robert Leicht, Ph.D., A.M.ASCE[2]; Keith Molenaar, Ph.D.[3]; and John Messner, Ph.D.[4]

Abstract: The architecture, engineering, and construction (AEC) industry is often criticized for its fragmented approach to project delivery. Traditional procurement and contracting intentionally serves to isolate designers from contractors to provide checks and balances, but limits opportunities for collaboration. This research presents a structural modeling approach to studying the role of integration in the performance of building construction projects. A sample data set of 204 completed projects was collected to compare cost, schedule, and quality performance under different delivery methods. Integration of project teams was proposed and tested in the form of two latent constructs—team integration and group cohesion—that mediate the link between delivery methods and performance. More integrated teams interacted with more participants from all levels of the building construction process, from designers to specialty trade contractors. These interactions included design charrettes, joint goal setting, and multidisciplinary building information modeling (BIM) uses. The selected project delivery method had a significant effect on team integration. Delivery methods that involved the builder and specialty trade contractors before schematic design achieved higher levels of integration and were more equipped to control project schedule growth. Cohesive teams were characterized by better chemistry, goal commitment, and timeliness of communication. Project delivery methods that included cost transparency with open-book contracts and qualification-based selection of the builder resulted in more cohesive teams and a lower average project cost growth. Additionally, the owner's perception of their turnover experience and building system quality was rated higher for cohesive teams. Understanding how delivery decisions influence the integration and development of their project teams will make building owners more aware of how those decisions ultimately affect the project's performance. **DOI: 10.1061/(ASCE)CO.1943-7862.0001219.** *© 2016 American Society of Civil Engineers.*

Author keywords: Contracting; Integrated project delivery (IPD); Structural equation modeling (SEM); Collaboration.

Introduction

There is a growing consensus in the architecture, engineering, and construction (AEC) industry that integration of people and processes is an effective means of improving project performance (Walker and Hampson 2003; Smyth and Pryke 2008). Authors also suggest that some project delivery methods are more integrated than others. Building on Konchar and Sanvido's (1998) seminal work, follow-on studies found that design-build (DB) and construction manager at risk (CMR) yield higher levels of integration than a traditional design-bid-build (DBB) approach (Mollaoglu-Korkmaz et al. 2013). As a result, some owners are considering alternative delivery options, including integrated project delivery (IPD), that promote the integration of design and construction disciplines. Success stories from IPD projects are seeing publication in trade magazines and empirical performance comparisons are beginning to appear in the literature (El Asmar et al. 2013). Despite these reported successes, owners, architects, and contractors have reservations about IPD as a delivery method that are limiting its widespread adoption (Kent and Becerik-Gerber 2010). For many, the benefits of integration are clear—improved teamwork, better communication, and reliable coordination to name a few. However, it is less clear which project delivery methods are more conducive to integration and to what extent integration affects performance.

Recognizing this gap in knowledge, the authors attempt to model the concept of integration to better understand its role in project performance. Adopting Baiden and Price's (2011) conceptualization of an integrated team in construction, the authors define *integration* as the "merging of different disciplines or organizations into a single cohesive and mutually supporting unit, with alignment of processes and cultures." This definition weaves together two distinct streams of research relating to integration that are examined separately in this study: (1) a focus on interfirm interactions and (2) the development of a common culture. Labeled *team integration* in this study, the former refers to the degree to which organizations engage in interfirm interactions. Construction projects are a dynamic social network of interdependent, yet contractually disjointed organizations (Chinowsky et al. 2010). Many authors (Love et al. 1998; Moore and Dainty 2001; Bromley et al. 2003) view the removal or diminishing of formal organizational boundaries in these project networks as a necessary step toward integration. With fewer boundaries, team members are theorized to be more collaborative and willing to interact with individuals outside their own organization. The latter stream of integration research, referred to

[1]Assistant Professor, M.E. Rinker, Senior School of Construction Management, Univ. of Florida, 573 Newell Dr., Gainesville, FL 32603 (corresponding author). E-mail: bfranz@ufl.edu

[2]Associate Professor, Dept. of Architectural Engineering, Pennsylvania State Univ., 104 Engineering Unit A, University Park, PA 16801. E-mail: rmleicht@engr.psu.edu

[3]Professor, Construction Engineering and Management, Univ. of Colorado Boulder, ECOT 444, Boulder, CO 80309. E-mail: keith.molenaar@colorado.edu

[4]Professor, Dept. of Architectural Engineering, Pennsylvania State Univ., 104 Engineering Unit A, University Park, PA 16801. E-mail: jmessner@engr.psu.edu

Note. This manuscript was submitted on January 21, 2016; approved on June 24, 2016; published online on August 5, 2016. Discussion period open until January 5, 2017; separate discussions must be submitted for individual papers. This paper is part of the ***Journal of Construction Engineering and Management***, © ASCE, ISSN 0733-9364.

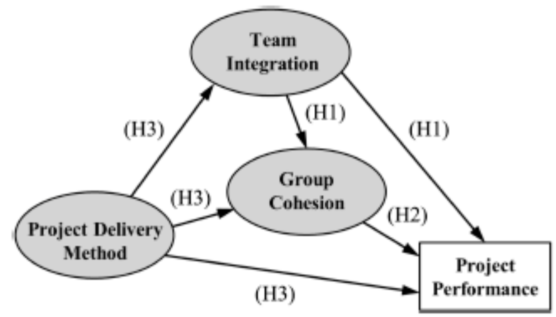
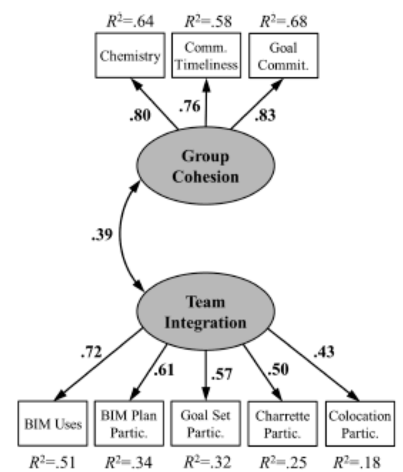


Fig. 1. Conceptual model

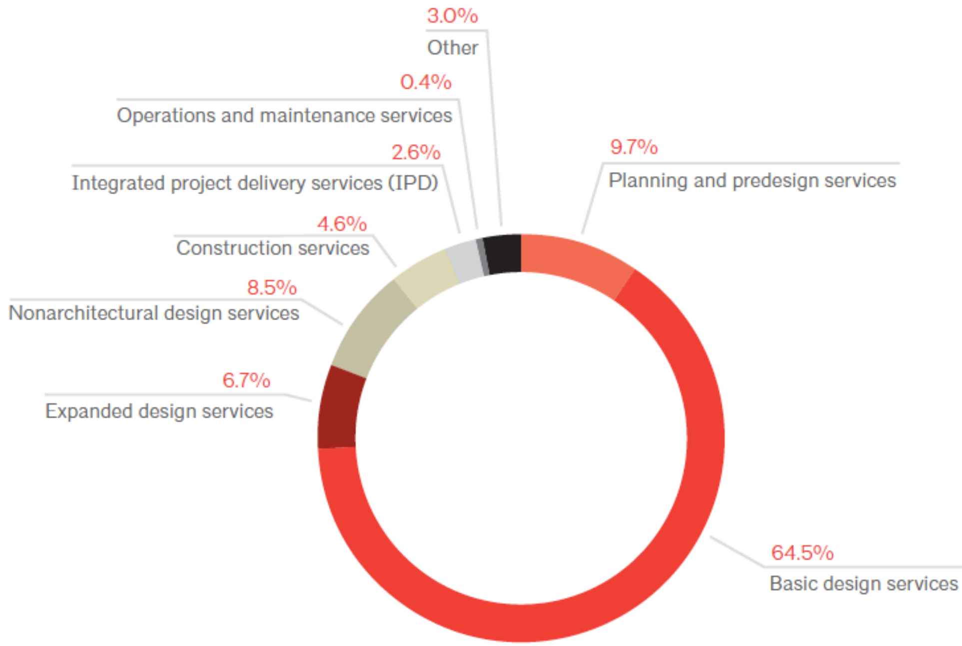


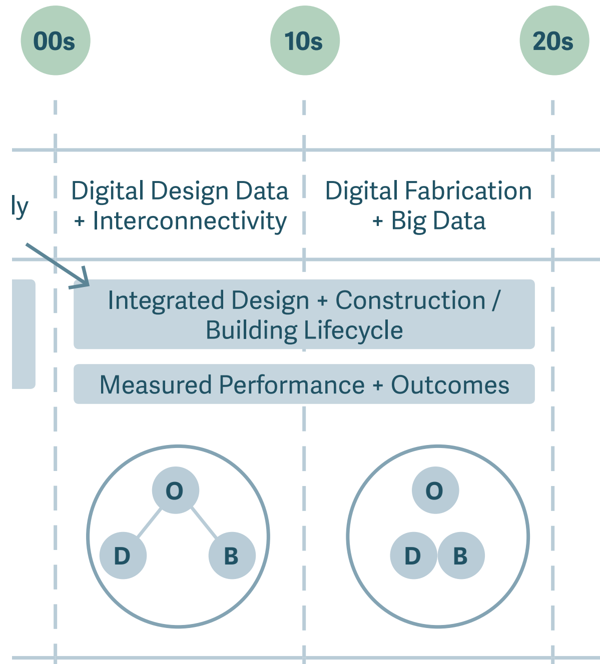
Notes: Goodness-of-fit summary: CFI=1.0, RMSEA=.00

Fig. 2. Confirmatory factor analysis with standardized estimates

FIGURE 20: **Basic design services dominate as the top source of firm revenue**

% of firm revenue

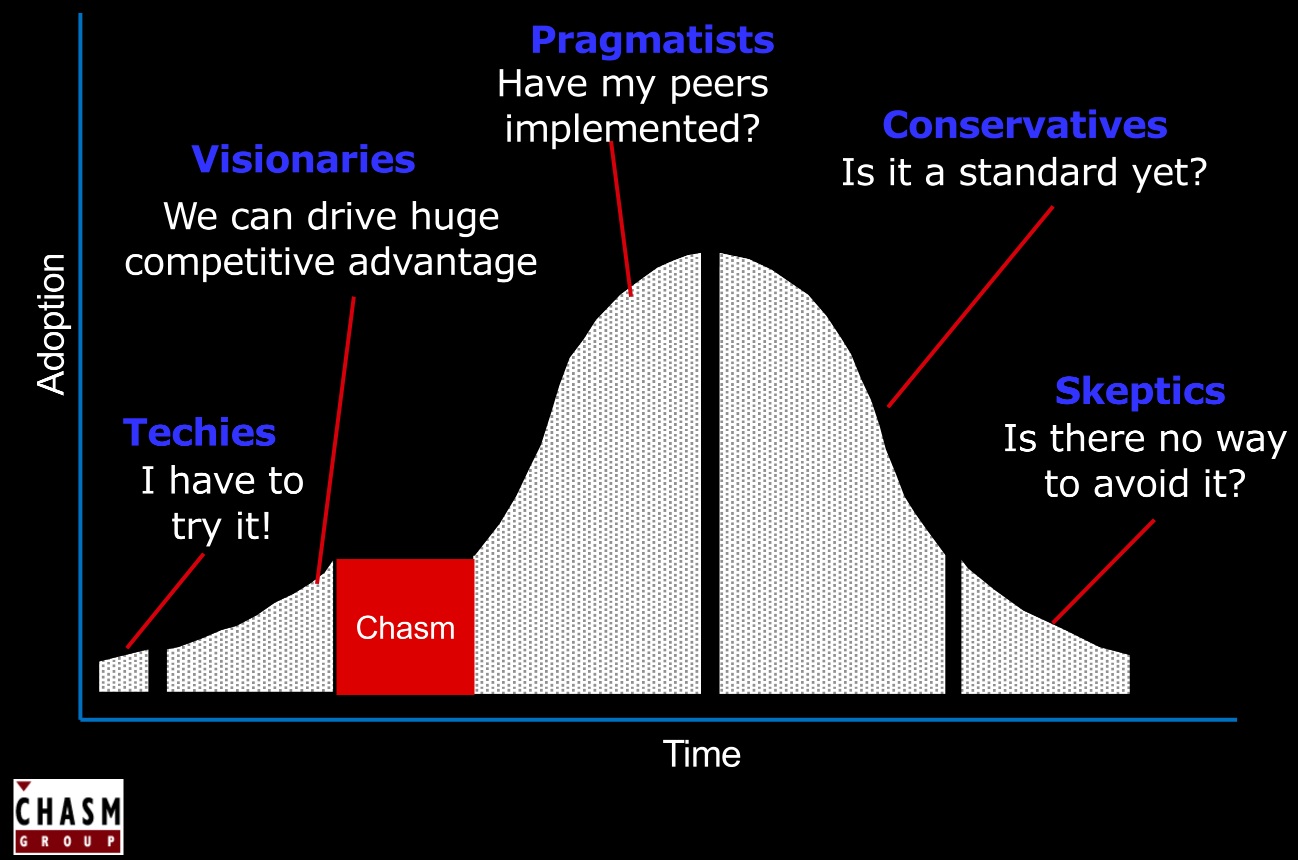




Source: AIA Firm Survey 2018 *The Business of Architecture*,. K. Baker

Technology

Crossing the Chasm (Geoffrey Moore)



Innovation Adoption in the U.S. (2012)

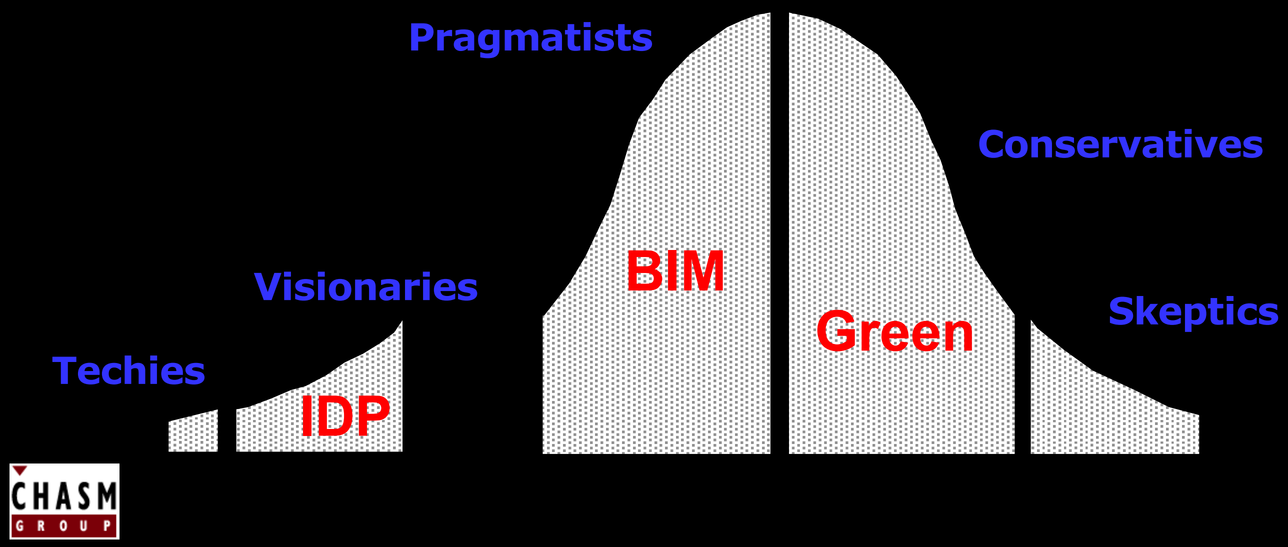


FIGURE 23: **Share of firms using BIM for billable projects continues to expand over time, even for smaller firms**

% of firms

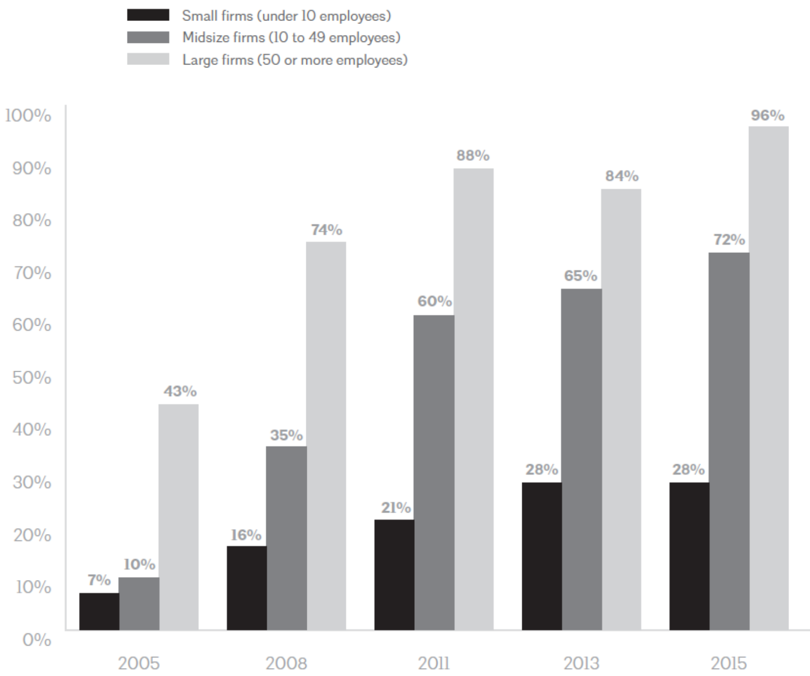
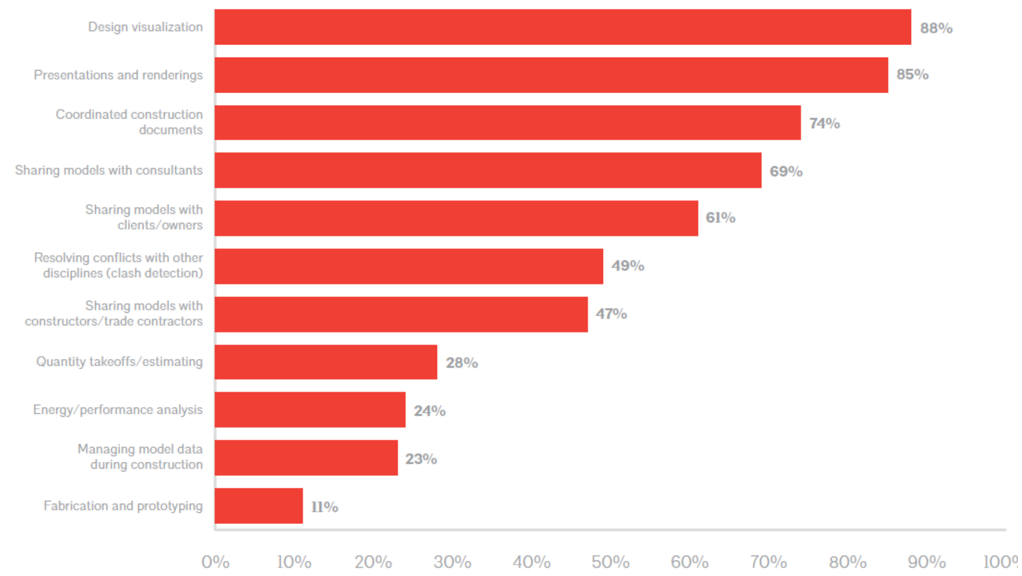


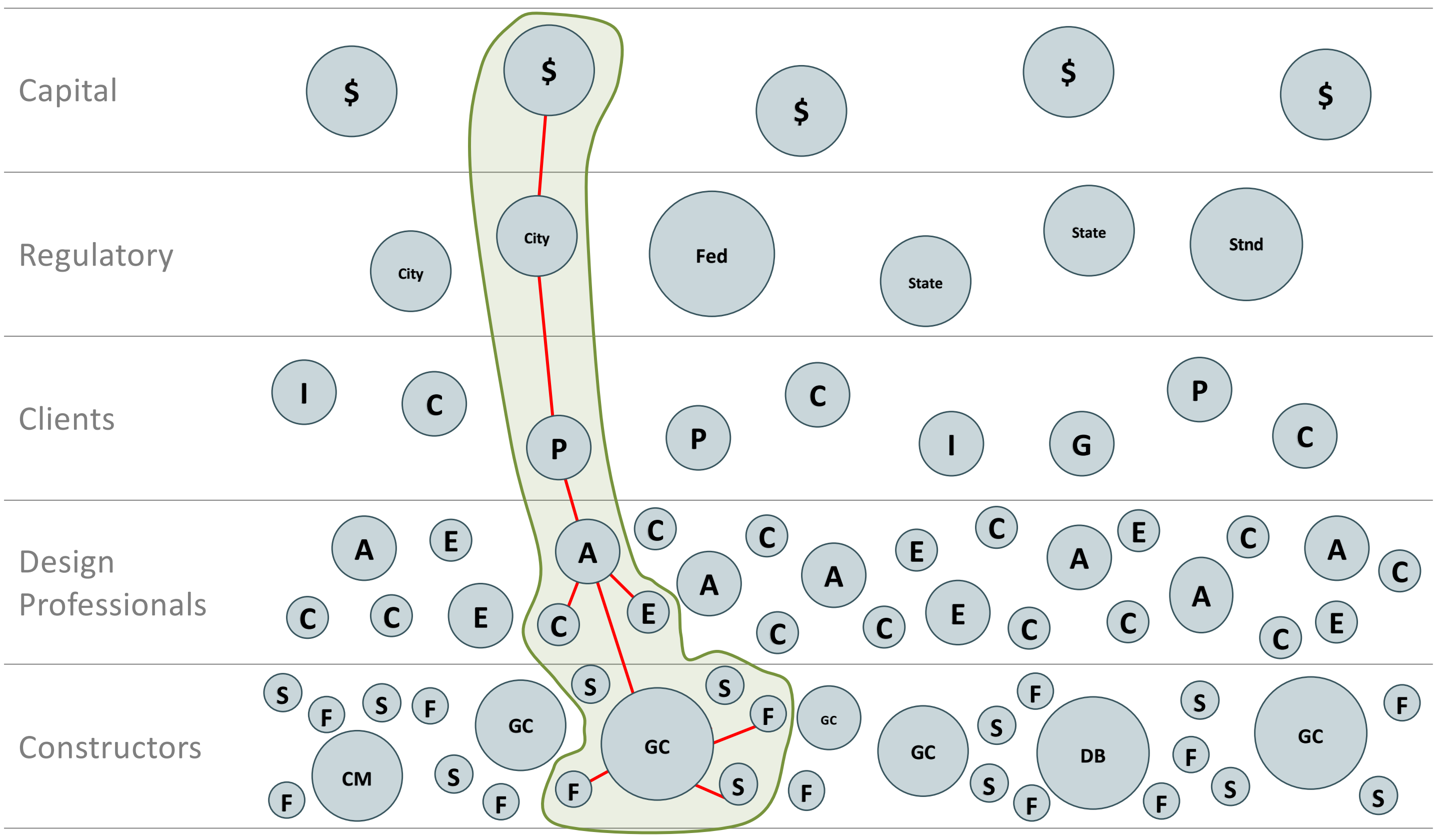
FIGURE 24: **Most firms use BIM for design visualization, presentations, and renderings**

% of firms, of firms using BIM for billable work



Source: AIA Firm Survey 2018 *The Business of Architecture*,. K. Baker

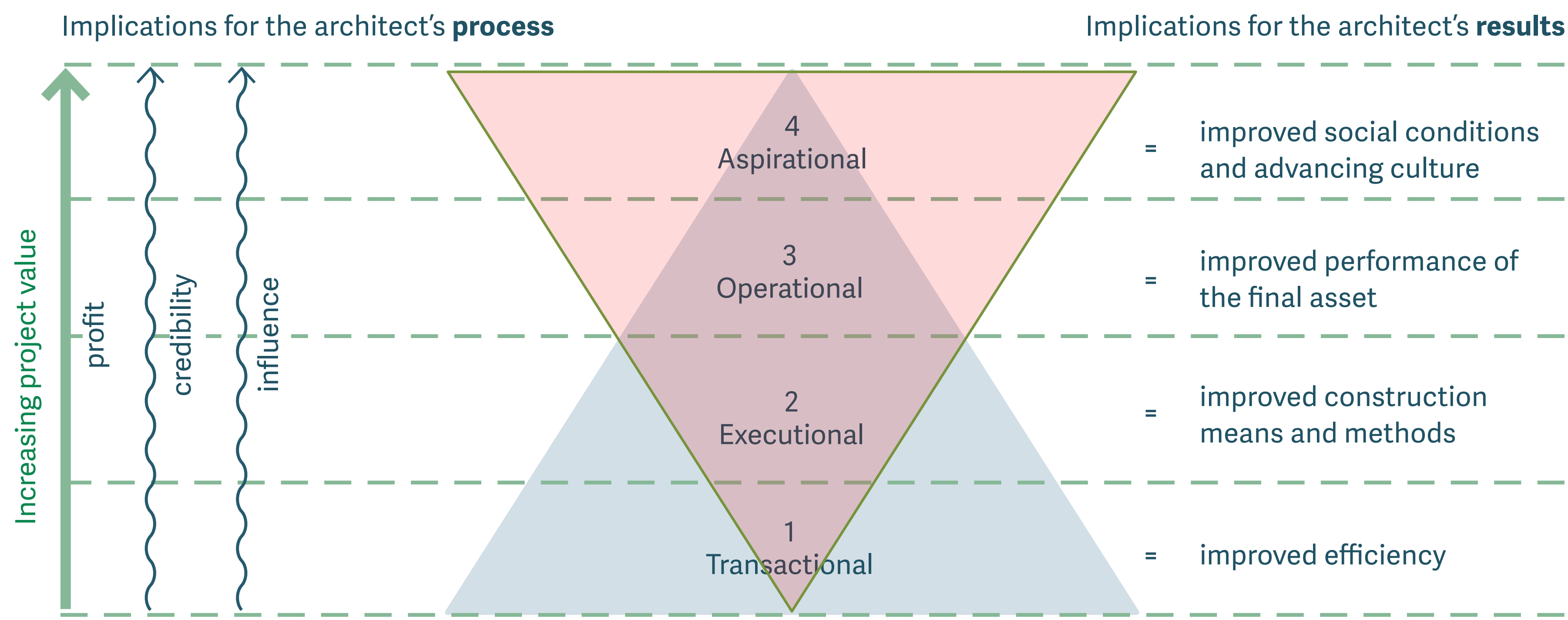
The Building Supply Chain



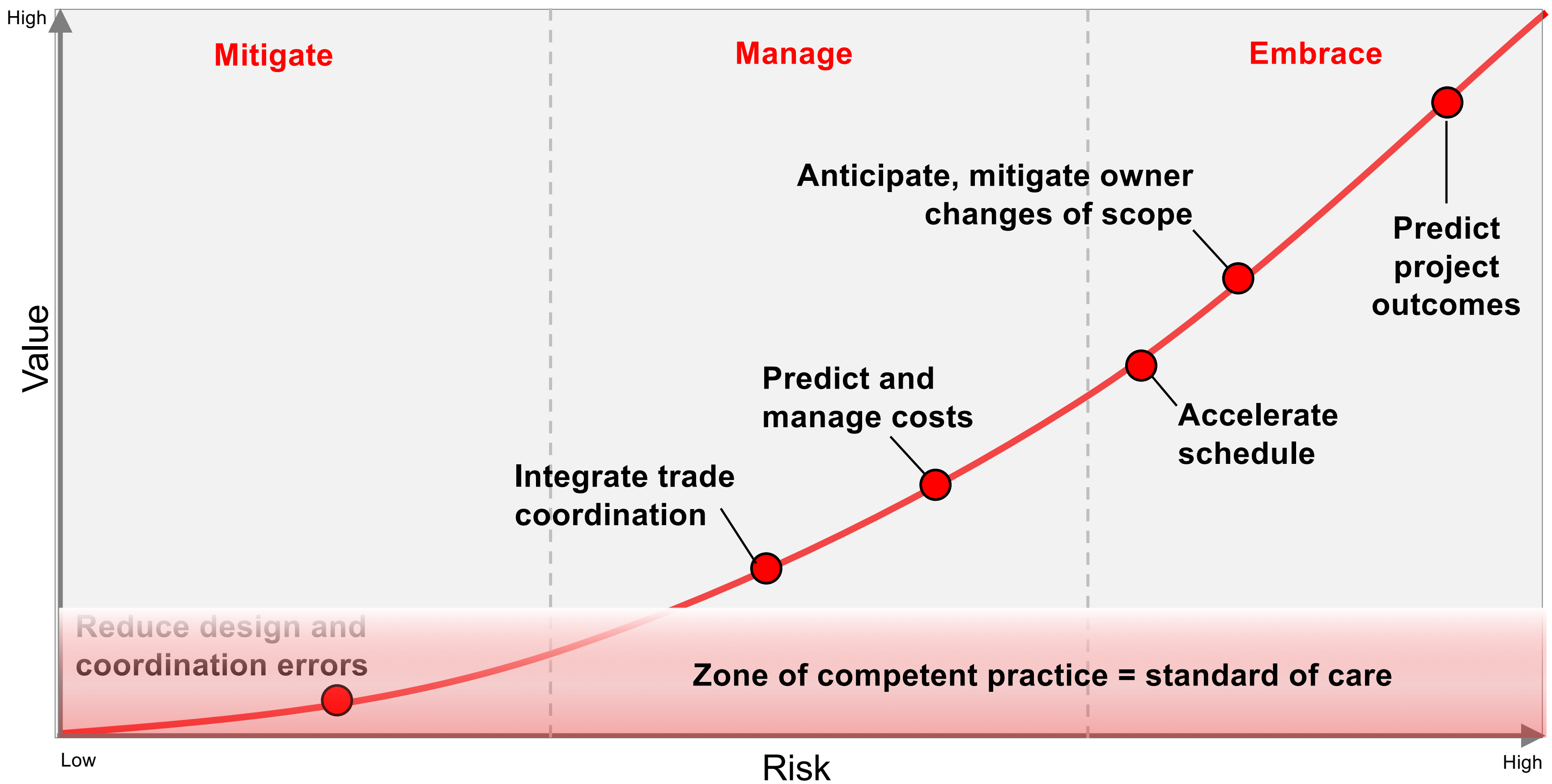
How does an innovation affect the entire project network?

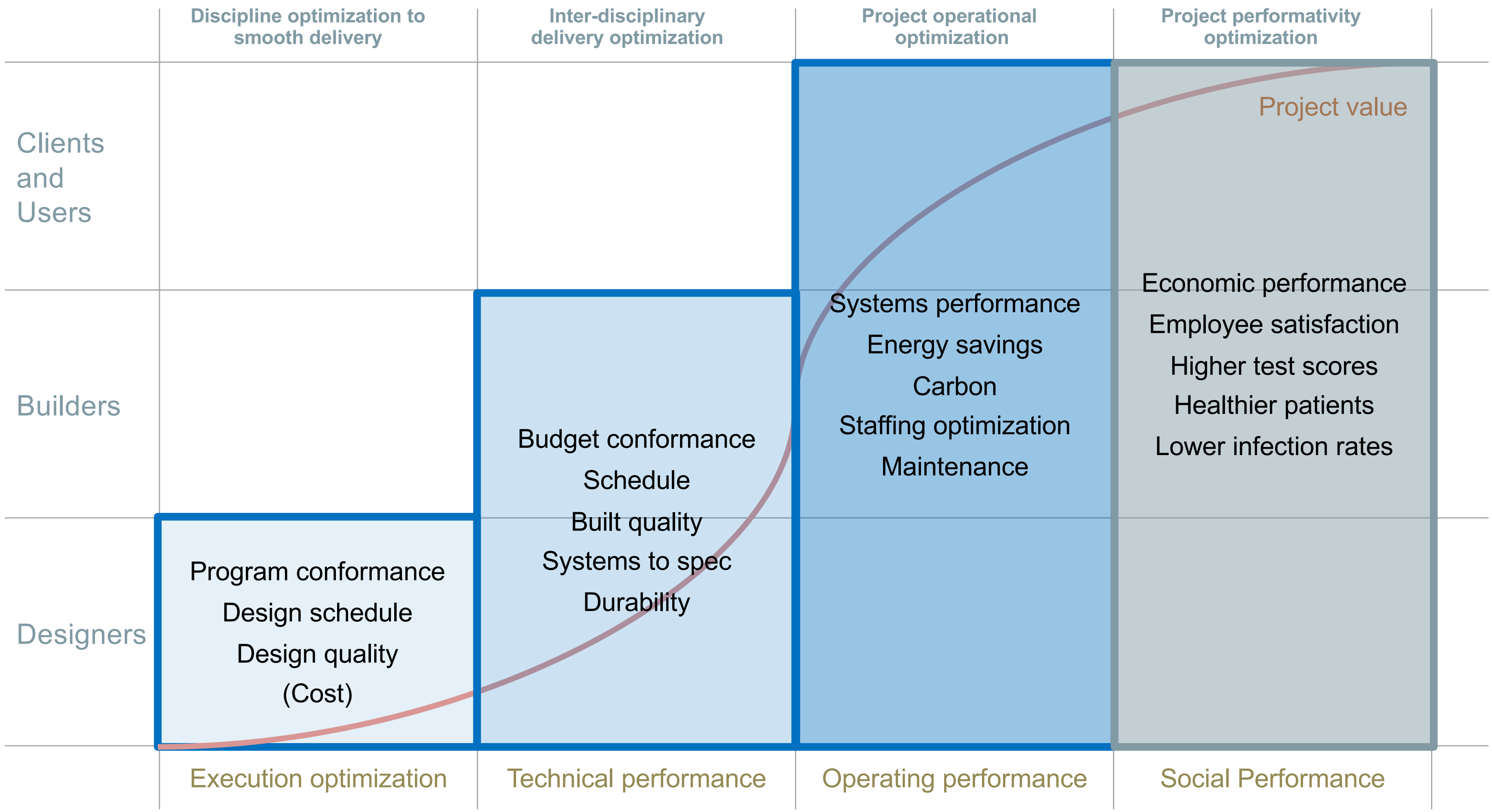
Source: "Identifying the Role of Supply Chain Integration Practices in the Adoption of Systemic Innovations" (Hall, Levitt, Algiers)

Future



Source: *Architecture Design Data: Practice Competency in the Age of Computation by P. Bernstein (2018)*


High
Mitigate
Manage
Embrace
Value
Anticipate, mitigate owner changes of scope
Predict project outcomes
Predict and manage costs
Accelerate schedule
Integrate trade coordination
Reduce design and coordination errors
Zone of competent practice = standard of care
Low
Risk
High


Discipline optimization to smooth delivery
Inter-disciplinary delivery optimization
Project operational optimization
Project performativity optimization
Clients and Users
Builders
Designers
Project value
Program conformance
Design schedule
Design quality
(Cost)
Budget conformance
Schedule
Built quality
Systems to spec
Durability
Systems performance
Energy savings
Carbon
Staffing optimization
Maintenance
Economic performance
Employee satisfaction
Higher test scores
Healthier patients
Lower infection rates
Execution optimization
Technical performance
Operating performance
Social Performance

Innovation

Business judgment rule

Shareholders challenging the wisdom of a business decision taken by management must overcome the business judgment rule. . . . . For efficiency reasons, corporate decision makers should be permitted to act decisively and with relative freedom from a judge's or jury's subsequent second questioning. It is desirable to encourage directors and officers to enter new markets, develop new products, innovate, and take other business risks." 1 A.L.I., Principles of Corporate Governance (1994) § 4.01(c) comment, p. 174

Source: Leslie King, Esq.

Yale School of Architecture
ARCH 2230B: Exploring New Value for Design Practice
(Version 1.1)
Spring Term, 2019

1 - Abstract: Are architects undervalued in the systems of delivery and if so, how do we make design a more profitable practice? Design practice has traditionally positioned building as a commodity in the delivery supply chain, valued by clients like other products and services purchased at lowest first cost. Intense market competition, sole focus on differentiation by design quality, and lack of innovation in project delivery and business models have resulted in a profession that is grossly underpaid and marginally profitable, despite the fact the building sector in its entirety operates in large capital pools where significant value is created and profits taken. Innovation in practice is largely deployed in the service of traditional design objectives rather than value generation opportunities. <u>The profession must explore new techniques for correlating the real value of an architect's services to clients and thereby break the downward pressure on design compensation</u>.

This course will reimagine and re-design the value proposition of architecture practice, explore strategies used by better compensated adjacent professions and markets, and investigate methods and models by which architects can deliver--and be paid for-- the value they bring to the building industry. Using the platform of business plans—where value generation is defined through specific business parameters—we will compare and contrast value generation strategies. Students will form firms and propose new practice paradigms as a final project.

The course is designed achieve the following outcomes:

a. Understand the relationship of the architect to the economic systems of building.
b. Understand the role of the architect in various models of building delivery.
c. Define value creation challenges inherent in the current architect's role and speculate on future options.
d. Understand and be able to deploy essential principles of strategic and business planning in defining value propositions and how they are instantiated, including financial analysis and business planning.
e. Understand and be able to manipulate operating models of practice and the relationship of those models to money, risk and value.
f. Create a viable business plan for an alternative value practice.

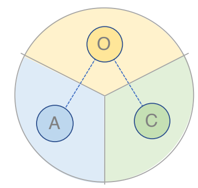
2 – Students/Prerequisites: The course is designed for students with either substantial office experience or nearing graduation who want to understand more specifically how architects practice might change in the future. The course is open to M.Arch students with either three or more years of office experience or those who successfully completed 2031A/Architectural Practice. The course is open to all M.Arch II students, but please note that an appropriate background in professional practice will be necessary in order to understand and execute the class requirements.

3 - Class design, schedule: Class will meet twice weekly: Tuesday lectures from 3:00PM– 4:00 PM in Loria B51, and Wednesday section/discussions from 11:00-12:30 also in Loria B51 Most Tuesday lectures will be accompanied the following day by an interactive discussion with a guest who will join the class for a relevant discussion about the weekly topic. Topics will cover one or more of three course components:

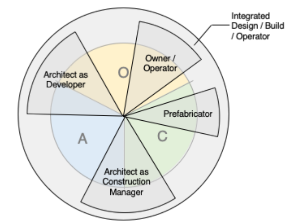
1. **Context**: what is the environment in which architects currently work, and what are the structural challenges? Why are new value propositions necessary?

2. **Tools**: what are the technical characteristics of business planning and generation? What is a business plan, a strategy, a firm financial model, a compensation method?

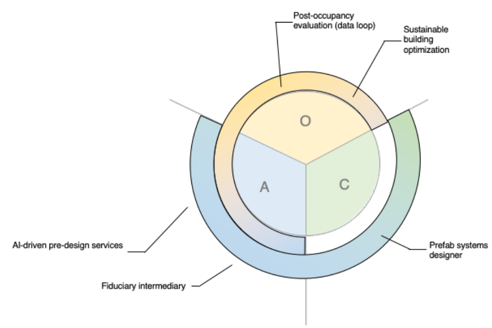
Delivery Relationships



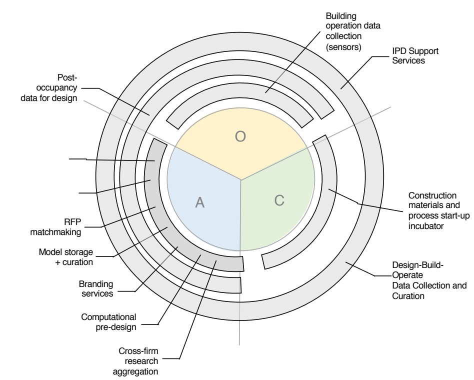
O – Owner
A – Architect
C - Contractor



Verticalization Strategies
Integrating A/E/O (11 projects)

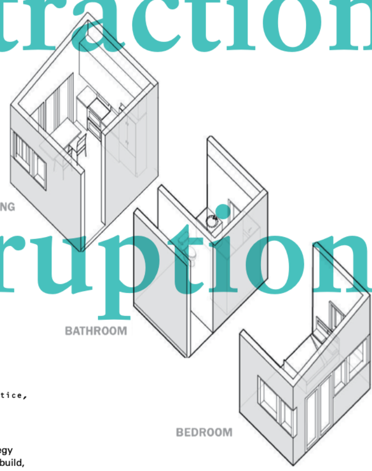


Spanning Strategies
Expanding scope (7 projects)



Supporting Strategies
Supporting the delivery chain (17 projects)

The Distractions of Disruptions



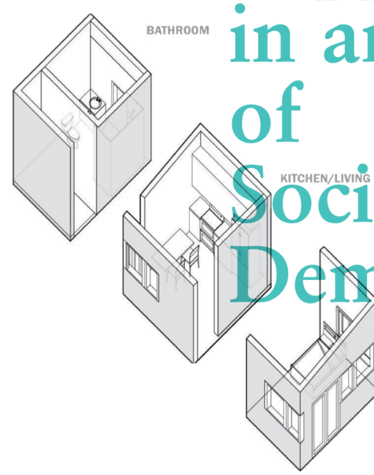
Jennifer Fontenot, Jeremy Jacinth and Brittany Olivari, A+Design, Exploring New Value Propositions for Design Practice, Yale School of Architecture, New Haven, Connecticut, 2017

The A+Design student team proposed a prefabrication strategy based on standard configurations, making the units easy to build, deliver and install.

Architect and Associate Dean at the Yale School of Architecture, **Phil Bernstein** sees a tsunami of change brewing for the architectural profession, conditioned by artificial intelligence, big data, the ubiquitous cloud and robotics. Yet the delivery and procurement of buildings is often inhibited by pre-digital structures of the construction industry. He argues that architects need to rethink their processes from first principles.

Phil Bernstein

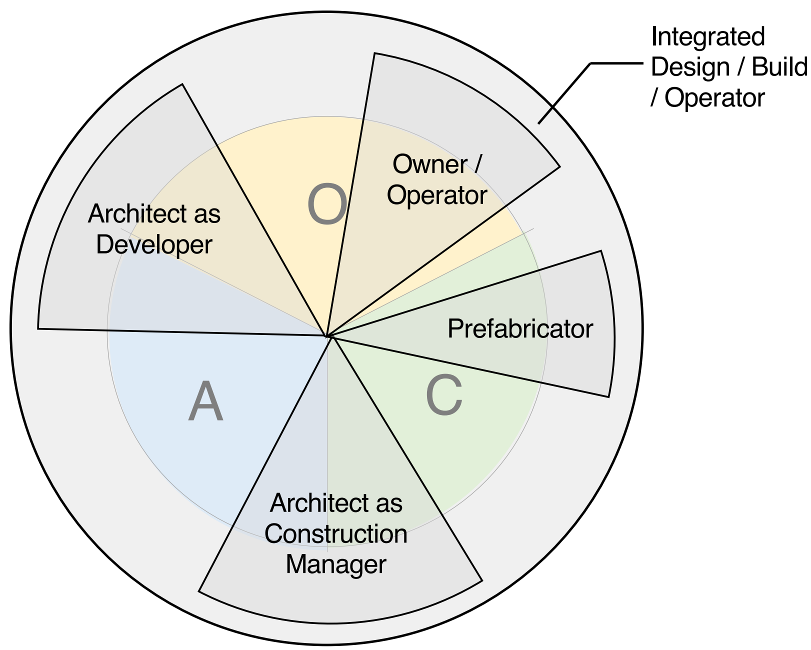
Technical Supply in an Era of Social Demand

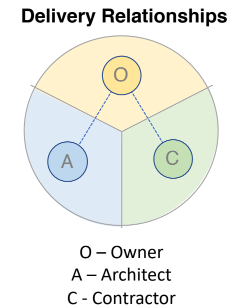


In the spring of 2013, a new course was offered at the Yale School of Architecture, one of only two in its professional practice curriculum. Exploring New Value Propositions for Design Practice was a small seminar designed to interrogate current business models, examine other models both within and outside of the building industry, and propose new strategies for the practice of architecture. Its first students had vivid memories of the recent world financial crisis, and despite the relative isolation caused by studio-based design education they were very much aware of the general 'start-up' zeitgeist among their peers on college campuses elsewhere. Since that first trial run, the course has grown in popularity and size as one of few opportunities for architects-in-training to experiment beyond the boundaries of building design in the innovation era.

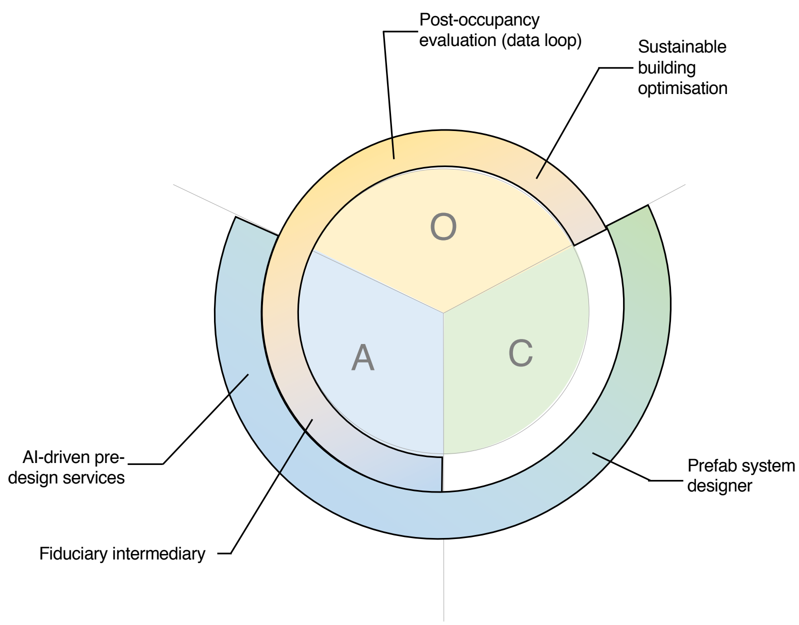
The expanding interest in the course is a product of a general questioning of the efficacy of traditional practice among today's generation of students. Having experienced the worst downturn in modern history, and saddled with the daunting financial obligations of paying for a graduate education in the US, students seem far more engaged in questions of professional efficacy and economics than their peers of even a decade ago. Traditional design education – and its aesthetic solutions – seems hardly up to the challenges of globalisation, emergent nationalism, climate change and income inequality. Architects need new approaches and new tools – not just software – and thus interest in start-up culture reaches beyond mere economic self-interest.

Verticalization

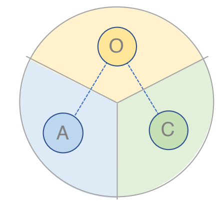




Spanning

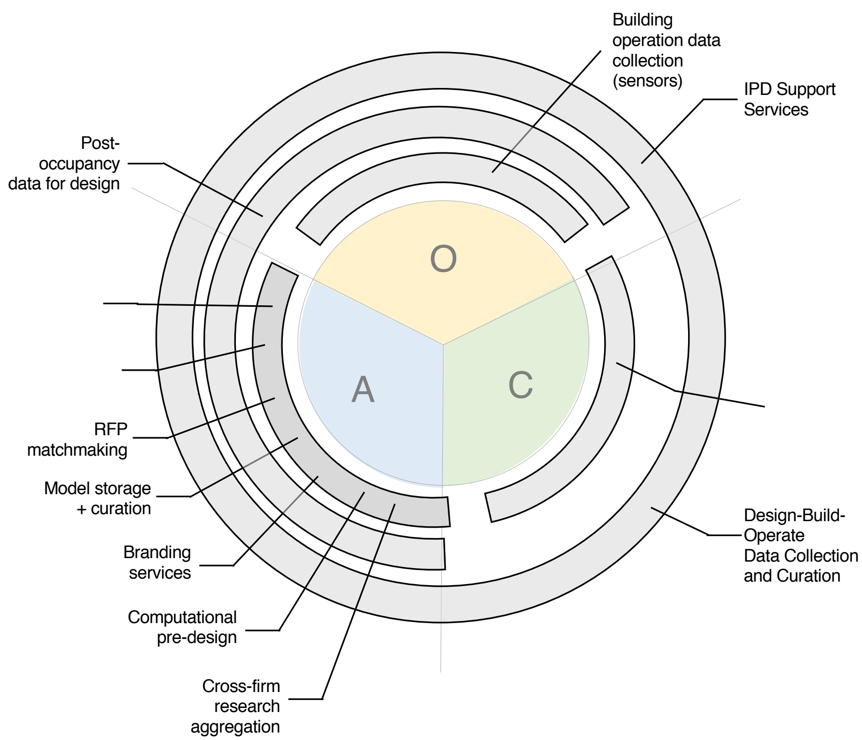


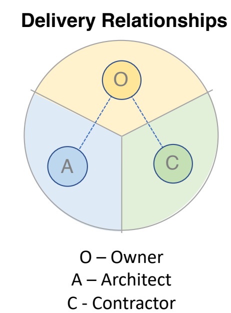
Delivery Relationships

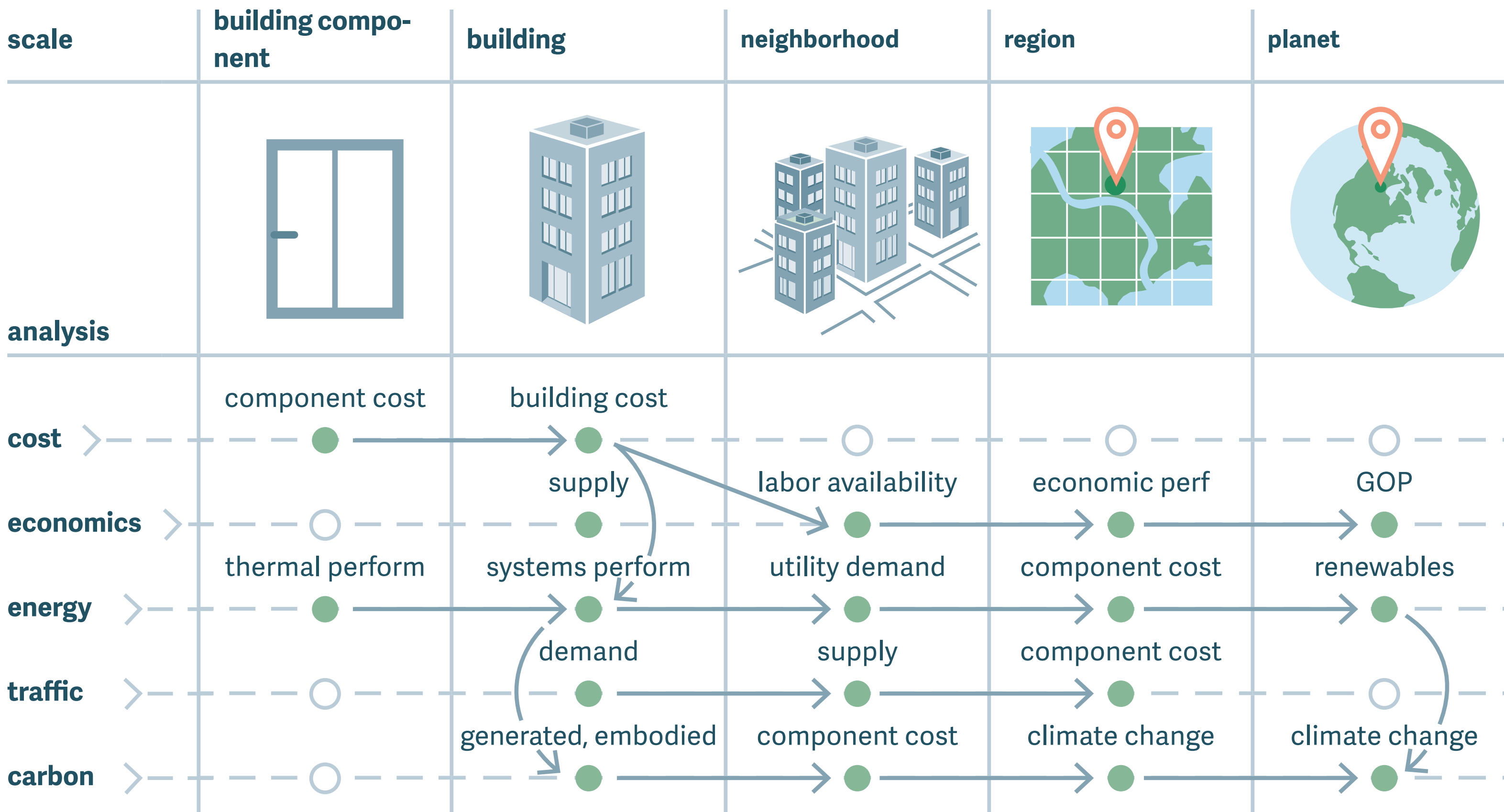


O – Owner
A – Architect
C - Contractor

Supporting


Building
operation data
collection
(sensors)
IPD Support
Services
Post-
occupancy
data for design
O
A
C
RFP
matchmaking
Model storage
+ curation
Branding
services
Computational
pre-design
Cross-firm
research
aggregation
Design-Build-
Operate
Data Collection
and Curation


Delivery Relationships
O
A
C
O – Owner
A – Architect
C - Contractor



Source: *Architecture Design Data: Practice Competency in the Age of Computation by P. Bernstein (2018)*