Finding the Fulcrum

a research practice mechanism for academy and industry
In-house research positions firm as market expert, limited sharing of proprietary knowledge

Research meets University standards for tenure and promotion, dissemination through academic venues

Identify issues relevant to profession

New techniques or recommendations based on research

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did you know?
The AIA’S GOAL is to reach net zero carbon emissions by **2030**
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...the means to achieve this are not currently understood.
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...the means to achieve this are not currently understood.

We have **13** years to discover, and implement, what it takes to reach this goal.
did you know?
The globe has warmed $1.2^\circ F$ from pre-industrial levels. The 2015 Paris agreement accepts $1.5^\circ F$ as the new normal.

Source: AIA Architecture 2030 “Converging Events”
The globe has warmed 1.2°F from pre-industrial levels.

The 2015 Paris agreement accepts 1.5°F as the new normal.

2016 was the warmest year on record.

NASA scientists predict further warming of 3.6 to 7.2°F, creating an entirely new planet.

“I think we have a very brief window of opportunity to deal with climate change... no longer than a decade, at the most”

-NASA scientist James Hansen, forefront leader of American climate researchers

**did you know?**

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The 2015 Paris agreement accepts $1.5^\circ F$ as the new normal.

2016 was the warmest year on record.

NASA scientists predict further warming of 3.6 to 7.2$^\circ F$, *creating an entirely new planet*.

To avoid this, we have *less than 4 years* to enact change.

Source: “Warming expert: Only decade left to act in time” MSNBC.com
did you know?
did you know?

Energy consumption is measured in “Quads” (Quadrillion Btus)

One Quad = 40 large nuclear power plants
The world uses approximately 400 Quads of energy annually.

400 Quads = 16,000 large nuclear power plants
25% of the world’s total energy expenditure comes from one country.

**Did you know?**

The world uses approximately 400 Quads of energy annually.

The United States alone uses approximately 100 Quads of energy annually.
did you know?

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The United States alone uses
approximately 100 Quads of energy annually.

Of that 100 quads, 48% is from buildings.
did you know?
did you know?

The United States construction industry spends $650 billion annually.

Source: 2006, Construction Users Roundtable (CURT) Whitepaper 1003
The United States construction industry spends $650 billion annually.

Inefficiencies, mistakes and delays account for $200 billion annually.

Source: New Wiring, The Economist, January 13, 2000
The United States construction industry spends $650 billion annually.

Inefficiencies, mistakes and delays account for $200 billion annually.

$15.8 billion annually is lost due to lack of interoperability.

Source: 2004 National Institute of Science and Technology (NIST), Cost Analysis of Inadequate Interoperability...
did you know?
The construction industry lost productivity between 1964 and 2004.
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...while all other non-farm industries more than doubled.
did you know?
If you draw a curve showing where the majority of design activities occur...

did you know?

Source: Patrick MacLeamy, HOK, 2004
If you draw a curve showing where the majority of design activities occur...

...they are too late to optimize cost savings

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If you draw a curve showing where the majority of design activities occur...

did you know?

...they are too late to optimize cost savings...

integrated, informed design needs to occur earlier

Source: Patrick MacLeamy, HOK, 2004
did you know?
the design and construction cost of a building...

...account for only 25% of its total life cycle cost.
the design and construction cost of a building...

...account for only 25% of its total life cycle cost.

reducing the remaining 75% could yield the largest untapped savings in the AEC industry.

Source: buildingSMARTalliance, BIM-GIS initiative 2010
did you know?
most disaster-related, fracture-critical failures could have been avoided with better design?
most disaster-related, fracture-critical failures
could have been avoided with better design?

... and the cost of Super Storm Sandy exceeds $42 billion

Source: Designing to Avoid Disaster, Tom Fisher, 2012
did you know?
it takes an average of 7.6 years after graduation to become a licensed architect?

did you know?

Source: Assuming a 4+2 professional program, data from NCARB by the Numbers, June 2015
it takes an average of 7.6 years after graduation to become a licensed architect?

which means, in real time, its a 13.3 year path... which is longer than law or medicine
there is a leaky pipeline to architectural leadership for women and people of color?

did you know?

Source: Missing 32%, Renée Cheng, AM Magazine Oct 2015, Graphic adapted from Cozy Hannula, Honors Thesis
there is a leaky pipeline to architectural leadership for women and people of color?

which means, the profession loses the proven benefits that come from diversity - innovation and creativity

Source: Missing 32%, Renée Cheng, AM Magazine Oct 2015, Graphic adapted from Cozy Hannula, Honors Thesis
do you think...

the value proposition in the AEC industry needs to change?
do you think...

the value proposition in the AEC industry needs to change?
architects need to show the value of design?
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the value proposition in the AEC industry needs to change?
architects need to show the value of design?
arquitecultural education is at a cross road?
do you think...

the value proposition in the AEC industry needs to change? architects need to show the value of design? architectural education is at a cross road? the next generation of architect leaders can thrive?
Is my education equipping me to play a role in the future of the built environment?
students, ask...

Is my education equipping me to play a role in the future of the built environment?

Do I have the willingness to take on large, messy, complex problems?
faculty, ask...

Am I instilling the passion for lateral, creative thinking— in other words, design?
Am I instilling the passion for lateral, creative thinking— in other words, design?

Am I inspiring my students to ask questions that I could never imagine?
AEC firms, ask...

Is my firm going to be part of the solution?
AEC firms, ask...

Is my firm going to be part of the solution?

Do we have the willingness to be a collaborative partner in this effort?
What if...

...there was a way for recent graduates
to have a better path to licensure?

...substantive leadership in areas of research
linking faculty expertise with firm needs?

...a consortium of firms
collaborated with a school to create...
Consortium for Research Practices and Master of Science in Architecture, Research Practices at the School of Architecture University of Minnesota
INDIVIDUALS AND ORGANIZATIONS

SCHOOL

FACULTY

STUDENT

STUDENT

STUDENT

STUDENT

FIRM

FIRM

FIRM

FIRM

CONSORTIUM
RELATIONSHIPS

FACULTY

STUDENT

STUDENT

STUDENT

STUDENT

STUDENT

SCHOOL

CONSORTIUM

FIRM

FIRM

FIRM

FIRM
RESEARCH GOALS

GOAL 1

GOAL 2

FACULTY

SCHOOL

STUDENT

FIRM
RESEARCH GOALS

CONSORTIUM GOAL 1

CONSORTIUM GOAL 2

FACULTY

STUDENT

FIRM

SCHOOL

STUDENT

FIRM

STUDENT

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RESEARCH GOALS

STUDENT

SCHOOL

CONSORTIUM GOAL 1

CONSORTIUM GOAL 2

FACULTY

STUDENT

FIRM

STUDENT

FIRM

STUDENT

FIRM
SHARED RESEARCH KNOWLEDGE

FACULTY

CONSORTIUM

GOAL 1

CONSORTIUM

GOAL 2

STUDENT

SCHOOL

FIRM
## CURRENT RESEARCH PRIORITIES

### INDUSTRY IMPROVEMENT
- Aging in Place
- Digital Fabrication
- Energy Modeling
- Integrated Design
- Lean Processes
- Learning Environments
- Materials
- Off-Site Fabrication
- Patient Safety
- Pre/Post-occupancy Evaluation

### EMERGING PRACTICES
- Climate Change/
  Water Issues/Resilient Design
- Designing for Millennial Generation
- Health and welfare in developing countries
- Human Factors
- Public Interest Design
- Robotic/Drone Tech
- Use of Big Data
- Virtual/Augmented Reality
- Wearable/Interactive Tech
PROGRAM DEVELOPMENT

0-5 YEARS

EMERGING PRACTICES: 25%
INDUSTRY IMPROVEMENT: 75%
REGIONAL IMPACT

5-10 YEARS

EMERGING PRACTICES: 50%
INDUSTRY IMPROVEMENT: 50%
NATIONAL IMPACT

10+ YEARS

EMERGING PRACTICES: 75%
INDUSTRY IMPROVEMENT: 25%
INTERNATIONAL IMPACT
in 4 years, 25 students involved in 28 research projects
80% of MSRP students from underrepresented groups
CONSORTIUM GOALS

- Pre/post occupancy
- Materials
- Human factors
- Energy modeling
- Big data
- Climate water resilience
- Public interest design
- Offsite/digital fab
- Project delivery
- Virtual reality
RESEARCH GOALS EXAMPLE

FACULTY UMN

FIRM HGA

TUNED SURFACES

PROJECT

UNIVERSITY OF MINNESOTA

SCHOOL

STUDENT UMN

DIGITAL FABRICATION

CONSORTIUM GOAL

CONSORTIUM

CONSORTIUM GOAL

BIG DATA

CONSORTIUM GOAL
**QUESTION**
How can variable formed panels be made?

**QUESTION**
What are effective applications of variable formed panels?

**QUESTION**
How would variable formed panels be applied in practice?
Marc UMN Fabrication Expertise

Blair and Houminn Practice.

Phil as RA

Alex HGA facade specialist

Jim HGA Research Council

QUESTION
How can variable formed panels be made?

QUESTION
What are effective applications of variable formed panels?

QUESTION
How would variable formed panels be applied in practice?
How can variable formed acoustic panels be used in concert halls?

What tools do designers need to work in informed ways with acoustic panels?

Economics. A variety of shapes and forms can be the same price as mass production.
How can variable formed acoustic panels be used in concert halls?

What tools do designers need to work in informed ways with acoustic panels?

Marc UMN Fabrication Expertise
Blair and Houminn Practice.

KNOWLEDGE
Economics. A variety of shapes and forms can be the same price as mass production.

Marc UMN Fabrication Expertise
Blair and Houminn Practice.

ACOUSTIC consultants

BETA LEVEL TOOL FOR DESIGNERS
OFFICE PROTOCOLS ON ROLE ACOUSTIC CONSULTANTS

NATIONAL R&D AWARD
ACADEMIC PUBLICATIONS

HGA facade specialist
Jim HGA Research Council

RESEARCH PROJECT
What tools do designers need to work in informed ways with acoustic panels?

ACOUSTIC consultants

HGA Research Council

Phil as RA

Acoustic consultants
TUNED SURFACES

ACOUSTICAL STRATEGY
ORDWAY PERFORMING ARTS CENTER / NORTHROP AUDITORIUM
TUNED SURFACES

ORDWAY PERFORMING ARTS CENTER
ACOUSTICS / FABRICATION STUDY
RESEARCH GOALS EXAMPLE

FACULTY UMN

FIRM CUNINGHAM

SCHOOL

CONSORTIUM

HUMAN FACTORS

CONSORTIUM GOAL

PRE/POST OCCUPANCY

CONSORTIUM GOAL

PhD STUDENT College of ED, UMN

STUDENT UMN

PROJECT

F.R.E.E.
F.R.E.E.
Free Range Learning in Elementary Education
An ongoing project for the understanding, development, discovery and design of open learning environments in elementary education.

design with, not for!

2nd Grade
- Construction of 2nd Grade Classroom July-Sept. 1

Charrette
- April 26, Design Charrette

3rd Grade
- Construction of 3rd Grade Classroom July-Sept. 1

Charrette
- May 9, 1st design charrette
- May 27, 2nd design charrette

2012

Charrette
- May 30, Design Charrette
- June 27, Design Charrette

Master Plan
- March 5, Master Plan submission by CGA
- June 28, 1st Master Plan meeting
- July 25, 2nd Master Plan meeting

Evaluation
- Evaluation of 2nd and 3rd grade classrooms by Matt Tracy, University of Minnesota School of Architecture

4th Grade
- Construction of 4th Grade Classroom July-Sept. 1

Feedback!
so where did it **start?**

**the 4c’s**
Creativity  
Communication  
Critical Thinking  
Collaboration

“It became obvious that without a flexible, collaborative space there would always be a missing piece to this puzzle. Hence, the Learning Studio was born.”

Jeff Cacek, Principal

it works because of the **people**

North Park  
Cunningham  
University of Minnesota
3rd Grade - MRI's

Curriculum
Phase 2B
3rd Grade - Curriculum

Observed:
- Identify scenarios where the 4c’s are apparent
- Curriculum; Creativity, Collaboration, Communication, Critical Thinking

Math - Critical Thinking; Use education analysis to determine what aspect of ‘critical thinking’ is trying to be taught during this activity.
INITIAL OUTCOMES

**TOOLS**

- Excel spreadsheet populated with reliable data on climate, demographics, energy systems
- Template for applying software “Tally” to projects in office
- Parametric software for graphic interface of acoustical design
- Parametric software for energy optimization

** PROCESSES**

- Framing the business proposition for Public Interest Design
- Developing tracking metrics for project success
- Understanding the range of parametric tools and their uses
- Use of Virtual Reality in design and construction processes
- Tracking user behavior in schools countries
- Tracking impact of virtual processes
EARLY SUCCESSES

PRESENTATION/PAPERS

Research Practices Model:
AIA National Convention
ACSA National Meeting
ACSA Administrators
NCARB Regional Meeting
NCARB IDP Coordinators
National Meeting
National Professional Education convening on innovation

Research published:
Structures for Inclusion
CEFPI National Conf
Intern’tl Union of Architects
World Congress
EDRA 2015
MASA 2017
MSBA Leadership 2016
BaseCamp (SketchUp)
PW Journal
Contract Magazine

RECOGNITION

Architectural Record, “NCARB Supports Faster Path to Licensure” June 2014

Architect Magazine “Trimming Years Off Licensure” October 2013

Mentions in Archinect, Architizer and other social media

Discussed as a model at: LFRT, AIA Emerging Practitioners Summit, AIA Culture Collective, Design Futures Sustainable Design Summit

Research base for acoustic panel project won Architect
## RETURN ON INVESTMENT

### STUDENTS ARE....
- earning advanced degree: M.S. in Architecture, Research Practices track.
- working as a Research Assistant for the School, earning stipend
- working as an intern, earning salary
- acting as a researcher in practice
- gaining Architectural Experience Program (AXP) hours required for license
- taking the Architect Registration Exam (ARE) required for license

### FACULTY ARE....
- connected to practice experts
- receiving research support
- identifying new research opportunities
- advancing their career for tenure and promotion
- publishing research results

### FIRMS ARE....
- connected to academic experts and resources
- developing an internal research culture
- enhancing their reputation
- expanding services
- attracting best talent
- accessing funded research opportunities
RETURN ON INVESTMENT

CONSORTIUM IS....

sharing knowledge
sharing resources
sharing research
gaining collective competitive edge
developing relevant industry research agenda
RESEARCH/PRACTICE

GROWING THE NETWORK, SPURRING A MOVEMENT...
INDIVIDUALS AND ORGANIZATIONS

SCHOOL

STUDENT

FACULTY

FIRM

CONSORTIUM

STUDENT

FIRM

STUDENT

FIRM

STUDENT

FIRM
EXPANDED INDIVIDUALS AND ORGANIZATIONS

F = Firm
S = Student
RELATIONSHIPS

F = Firm
S = Student
RELATIONSHIPS

F = Firm
S = Student
RESEARCH GOALS

CONSORTIUM GOAL 1

CONSORTIUM GOAL 2

CONSORTIUM GOAL 3

CONSORTIUM GOAL 4

F = Firm
S = Student
RESEARCH GOALS

SCHOOL

FACULTY

CONSORT

CONSORT

CONSORT

CONSORT

GOAL 1

GOAL 2

GOAL 3

GOAL 4

F = Firm
S = Student
SHARED RESEARCH KNOWLEDGE

F = Firm
S = Student
THANK YOU

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University of Minnesota