Facilities Design for Future Technologies

A Framework for Transformation

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September 2019

AIA Continuing Education Provider

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

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Course Summary

Campuses are shifting to new and exciting learning space models that provide opportunities for design innovation.

This course will explore a framework for planning this new breed of Higher Education facilities to support emerging practices in pedagogy and new enabling technologies.

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Learning Objectives

At the completion of the course, participants will be able to:

- Describe how student demographics and new pedagogies have changed expectations for higher education facilities
- Apply a framework to planning innovative learning environments
- Identify how emerging technologies impact the design of forward-thinking educational facilities
- Describe how to adapt architectural and interior design to meet new pedagogical options

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Agenda: Framework for Transformation

- Discussion throughout, please
  - No paper dolls …
    but please participate in *Quick Workshops*

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Quick Workshop

What is one expectation you have for today's session?

6

Five years from now you'll be able to find the best lectures in the world on the Web for free…

So… place-based learning will be five times less important than it is today.

Bill Gates
2010

7

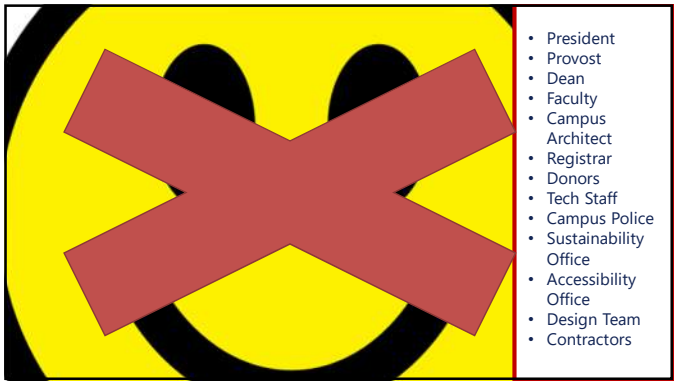
We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten.

Bill Gates

8

Don't be this guy!

9



- President
- Provost
- Dean
- Faculty
- Campus Architect
- Registrar
- Donors
- Tech Staff
- Campus Police
- Sustainability Office
- Accessibility Office
- Design Team
- Contractors

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Project Vision Example

The 108,000 NASF / 200,000 GSF building will contain office, instructional and research space, including state-of-the-art hacker space and maker space in which students, faculty, and industrial and community partners share knowledge and ideas via workshops, presentations and lectures, and work on projects individually or in collaboration. ~~DMACS~~ brings together faculty from a variety of disciplines that use powerful computing tools to address some of today's most pressing scientific and societal challenges in areas such as national defense, precision medicine, big data, cybersecurity and language and culture. This building will enhance their ability to collaborate with industrial and community partners and secure sponsored research grants.

- Usually handed to you and others
- May be beautifully articulated
- Must be central to all project efforts
- Continual touch-base with Shared Vision

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Shared Vision: supporting data

- Internal
  - Directives from President / Provost / Board
  - Institution Vision Statement
  - Institution Mission Statement
  - Campus Master Plan
  - Academic Plan
  - Utilization Study
  - Strategic Technology Plan
- External
  - Larger Higher Education context

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Shared Vision: supporting data

- Internal
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If the ladder is not leaning against the right wall, every step we take just gets us to the wrong place faster.

Stephen R. Covey

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STUDENT LEARNING OUTCOMES

Upon graduation the student will:

- Incorporate knowledge from arts, humanities and sciences in the planning and provision of professional nursing care.
- Demonstrate personal effectiveness as evidenced by progressing from awareness to knowledge to proficiency in the following competencies: Clinical/professional judgment, professional valuing/caring and professional role development.
- Demonstrate interpersonal effectiveness as evidenced by progressing from awareness to knowledge to proficiency in the following competencies: Communication, teaching/learning and technology utilization.
- Demonstrate effectiveness in human health outcomes as evidenced by progressing from awareness to knowledge to proficiency in the following competencies: Health promotion and disease prevention and evidence-based care.
- Demonstrate effectiveness within complex health systems as evidenced by progressing from awareness to knowledge to proficiency in the following competencies: Leadership/management, global perspectives and health care systems and policy.

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From Strategic Plan: Key Goals and Initiatives

Prepare students for the 21st century

- Develop expertise in at least one field
- Acquire familiarity with other disciplines
- Encourage lifelong habits that lead to understanding
- Inspire students
- Prepare for engaged, thoughtful participation in all aspects of life
- Teach students to acquire, evaluate, and apply knowledge
- Active and experiential learning
- Emphasize innovation and excellence in teaching and mentoring

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Defining the Outcomes

- What will make this project a success?
- Attributes of the project …
  - —Facility on Day 1
  - —Facility in Year 5
  - —Facility in Year 10
- "A Day in the Life" of … in 2025
  - —a student …
  - —a Faculty Member …
  - —the facility itself …

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What skills do employers prioritize?

- Creativity
- Emotional Intelligence (EI)
- Analytical / critical thinking
- Active learning with global mindset
- Judgement and decision making
- Interpersonal communication skills
- Leadership skills
- Diversity and cultural intelligence
- Technology skills
- Agility / flexibility to change




Forbes.com

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The "T-SHAPED Student"

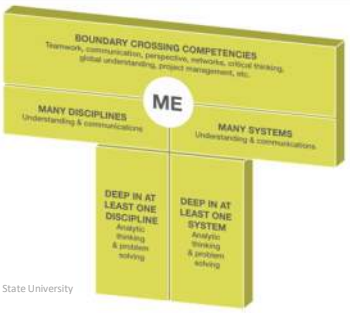

Image courtesy: Michigan State University

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Learning Theories … a partial listing

- **CONSTRUCTIVIST, SOCIAL AND SITUATIONAL THEORIES**
- Anchored Instruction (Bransford)
- Cognitive Apprenticeship (Collins et al.)
- Cognitive Dissonance (Festinger)
- Communities of Practice (Lave and Wenger)
- Connectivism (Siemens, Downes)
- Discovery Learning (Bruner)
- Ecological Theory of Development (Bronfenbrenner)
- Multiliteracies (New London Group)
- Semiotics (deSaussure, Barthes, Bakhtin)
- Social Development Theory (Vygotsky)
- Problem-Based Learning (PBL)
- Situated Learning (Lave)

- **DESCRIPTIVE & META THEORIES**
- Activity Theory (Vygotsky, Leont'ev, Luria, Engstrom, etc.)
- Actor-Network Theory (Latour, Callon)
- Bloom's Taxonomy (Bloom)
- Distributed Cognition (Hutchins)
- Social Network Analysis (Scott, Prell)
- **COGNITIVIST THEORIES**
- Attribution Theory (Weiner)
- Cognitive Load Theory (Sweller)
- Cognitive Theory of Multimedia Learning (Mayer)
- Elaboration Theory (Reigeluth)
- Expertise Theory (Ericsson, Gladwell)
- Functional Context Theory (Sticht)
- Gestalt Theory (von Ehrenfels)
- Information Processing Theory
- Metacognition (Flavell)
- Situated Cognition (Brown, Collins & Duguid)
- Stage Theory of Cognitive Development (Piaget)
- Theory of Mind, Empathy, Mindblindness (Premack, Woodruff, Perner, Wimmer)

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Learning Theories … a partial listing

- **BEHAVIORIST THEORIES**
- Classical Conditioning (Pavlov)
- GOMS Model (Card, Moran, and Newell)
- Operant Conditioning (Skinner)
- Psychological Behaviorism (Staats)
- Social Learning Theory (Albert Bandura)
- **MOTIVATION & HUMANIST THEORIES**
- ARCS Model of Motivational Design (Keller)
- Emotional Intelligence (Goleman)
- Experiential Learning (Kolb)
- Flow (Csikszentmihalyi)
- Grit (Duckworth, Matthews, Kelly, Peterson)
- Intrinsically Motivating Instruction (Malone)
- PERMA Theory (Seligman)
- Self-Determination Theory (Deci and Ryan)
- **IDENTITY THEORIES**
- Erikson's Stages of Development(Erik Erikson)
- Identity Status Theory (Marcia)
- Mindset: Fixed vs. Growth Mindset (Dweck)
- Narcissism (Kernberg)
- Self-Perception Theory (Bem)
- Self-Theories: Entity and Incremental Theory (Dweck)
- Social Identity Theory (Tajfel, Turner)
- Stereotype Threat (Steele)
- **MISCELLANEOUS LEARNING THEORIES & MODELS**
- Affordance Theory (Gibson)
- Andragogy – Adult Learning Theory (Knowles)
- Flipped Classrooms
- Model of Hierarchical Complexity
- Multiple Intelligences Theory (Gardner)
- Systems Thinking
- 21st Century Skills (P21 and Others)

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The Learning Pyramid – *Be Careful !*

10% of what we **READ**

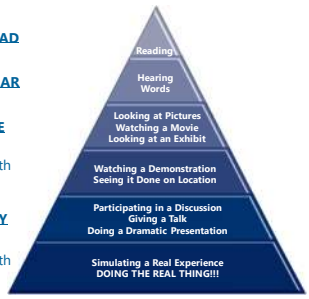
20% of what we **HEAR**

30% of what we **SEE**

50% of what we both **HEAR and SEE**

70% of what we **SAY**

90% of what we both **SAY and DO**



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Quick Workshop ideas …

What experiences do our students need to develop those skills?

Our students learn best when …

Our researchers are most effective when …

Our library staff is most effective when …

What will faculty and staff need to do in order to bring the Shared Vision to life?

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- There are plenty of visual aids and graphics; multiple modes of instruction

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Pedagogical Analysis Exercise

Learning Activities	Lecture Hall (150 – 200)	Large Classroom (60 – 75)	Active Learning (36 – 48)	Seminar Room (20 – 25)
Lecture / Didactic Instruction	90%	60%	5%	20%
Whole Group Discussion	5%	25%	25%	25%
Small Group Activities with Technology	0%	0%	40%	25%
Small Group Activities *without* Technology	5%	10%	20%	10%
Self-directed Learning / Individual Web-based Research or Visualization	0%	0%	0%	5%
Student Delivered Presentations / Demonstrations	0%	5%	10%	15%

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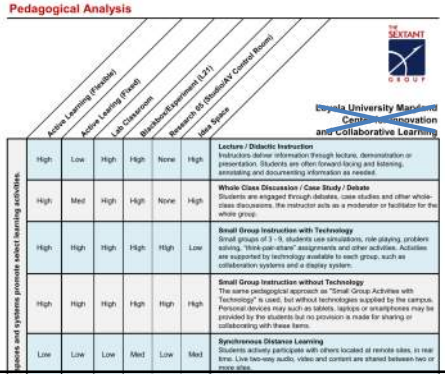
Pedagogical Analysis



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Framework for Transformation

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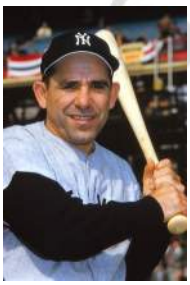

It is tough to make predictions, especially about the future.
– Yogi Berra

Prediction is very difficult, especially about the future.
– Niels Bohr

Physicist
Nobel Prize Winner

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There is no reason anyone would want a computer in their home.

– Ken Olson

President of Digital Equipment Corp., 1977

Nuclear-powered vacuum cleaners will probably be a reality in 10 years.

– Alex Lewyt

President, Lewyt Vacuum Company, 1955

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IFTF: "Becoming People of the Screen"

2009

- Video will dwarf all other media on the Internet
- New players in video content will quickly become market forces
- Video technologies will transform the inert physical surfaces around us into dynamic, interactive media portals
- Wiki-style collaborative video editing, streaming video, and interactive media will turn video into a constantly evolving, unique and personalized media experience
- Abundant video technologies will catalyze new opportunities in video production, distribution, and viewership
- Video will create opportunities and standards for authenticity

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Quick Workshop …

Develop a profile of the students that will use this building in the year 2025 …

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Student of the future

- Always on, connected
- Active, social and visual learners
- Expect full and immediate access to personalized media, information and course materials
- Reckless with technology
- Create *and* consume
- Visual, multi-sensory
- Connect living & learning
- Learning any time, any place
- Value the on-grounds, campus experience
- Environmentally conscious
- Consumer orientation towards their educational experiences
- Impatience with inefficiencies
- Want to collaborate
- Want alone time – for study and personal
- Want to use technology to express their creativity
- Prefer practical applications, authentic experiences
- Global thinkers; want to connect globally
- "Design" thinkers
- Gamers
- Blend their social and academic lives
- Participation and Personalization

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Quick Workshop …

Develop a profile of the _____ of this building in the year 2025 …

(students, faculty, staff, researchers, librarians, corporate partners, coaches …)

Think-Pair-Share

Whole group discussion

Paper & pencil exercises

Info gathering tools: surveys, intranet, wiki, "clickers", etc.

Do not expect 100% alignment !!!

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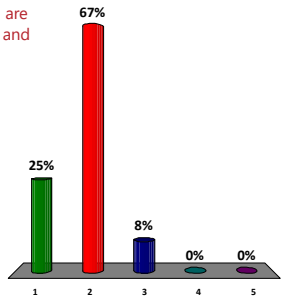
Sample Question … Audience Response System "Clickers"

On this campus, faculty members are generally willing to embrace new and innovative ways of teaching.

1. Strongly Agree
2. Agree
3. Undecided
4. Disagree
5. Strongly Disagree



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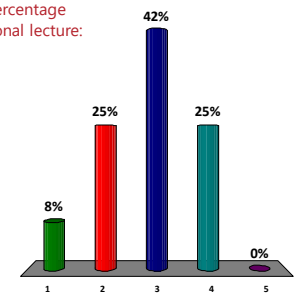
Sample Question … Audience Response System "Clickers"

For my classes, the following percentage of class time is spent on traditional lecture:

1. Less than 20%
2. 20% - 40%
3. 40% - 60%
4. 60% - 80%
5. More than 80%



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Technology Visioning

The Solution After Next

So what?

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"Traditional" Virtual reality

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New Virtual Reality … by the $$$ Billions

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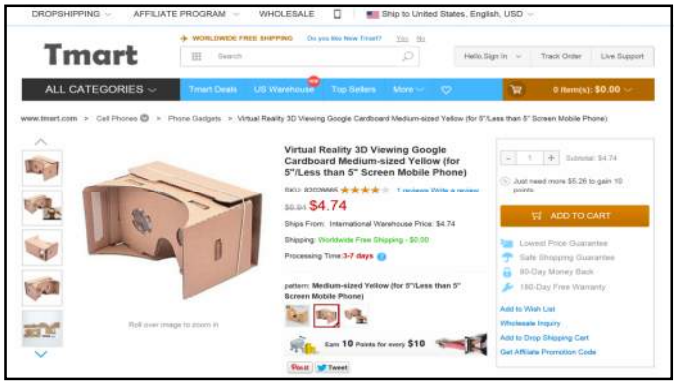

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We are on version 1.1

https://www.oculus.com/

http://salvationlinks.com

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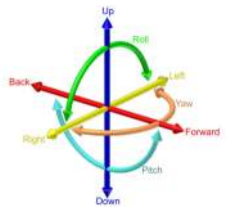
Three degrees of freedom vs. six degrees of freedom



https://en.wikipedia.org

46

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Samsung 837

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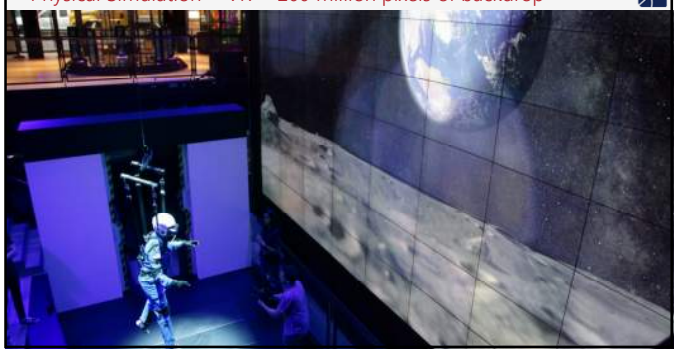
Physical Simulation + VR + 200 million pixels of backdrop



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Virtual worlds built over physical environments - Mixed VR

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Huge investment in MR by Microsoft & others

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Huge investment in MR by Microsoft & others

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Augmented Reality

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Creating content for virtual reality

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Ambisonics Microphone for 3d content for AR / VR / XR

- 4 mic capsules
- Capture spatial audio
- Software included

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Virtual Benchmarking – example of gaming areas

58

Design Directions … examples

- Prioritize network-based solutions; any source to any destination
- Invest in automation to minimize tech support staff
- Invest in data gathering around tech / room usage to inform future projects
- Plan for 4K but not 8K (other than Viz Wall, which will be ready for 8K)
- Move towards a single supplier of AV Control System Software for all systems, campus-wide; standardize with this project
- Use voice-based AV Control Systems for Seminar Rooms (assume passes Pilot Test)
- Lecture Capture for all classrooms (plus Seminar Rooms as budget allows)
- Retire in classrooms: DVD players, cable TV, chalkboards, doc cams (except labs)
- Black Box Classroom – ceiling pipe grid, raised floor, adjacent AV Control Room
- Active Learning – student groups of 7, tables, hybrid lecture/ALC, flat panel per student group, non-interactive, analog writing surfaces

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Framework for Transformation

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Quick Workshop … ideas

- What challenges will we face to realize the Project Vision?
- Related to *pedagogy*, the biggest challenges will be ….
- Related to *technology*, the biggest challenges will be ….

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Statement of Challenges

- Some faculty will be resistant to recording class sessions.
- Tech support is minimal.
- We will need to redesign our courses to support the flipped classroom concept.
- We can't afford what we want on Day 1, let alone have funding for technology replacement/refresh.
- Systems must be bullet-proof.
- Technology changes too rapidly. We can't plan for it.
- We can't always get cooperation from Central AV/IT staff if we deviate from their standard.
- At home, my VHS deck still blinks 12:00.
- The last time we tried _____, it was an epic fail.
- Chalk always works.

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Framework for Transformation

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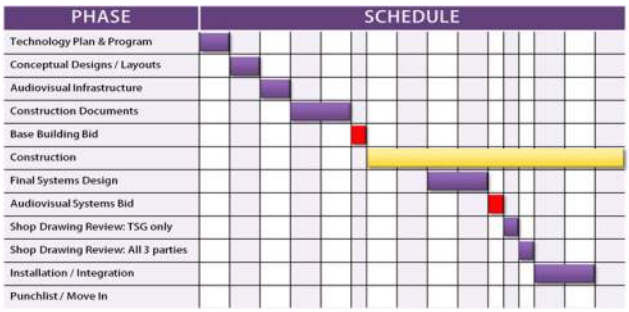
Make final product decisions at "last responsible moment"



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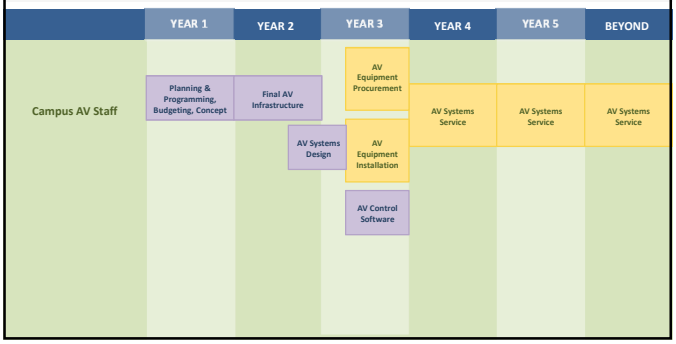
Approach to AV Systems: In-House Resources



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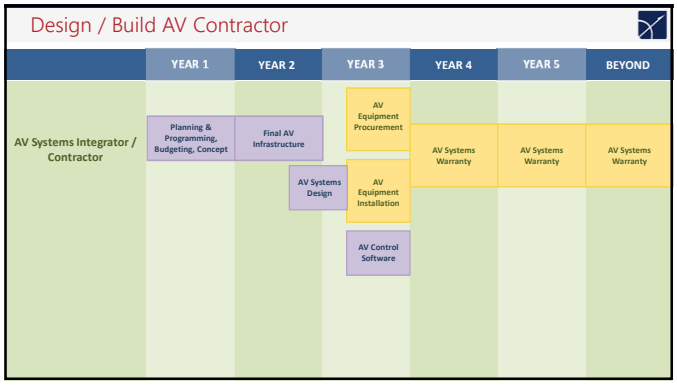
Design / Build AV Contractor
YEAR 1
YEAR 2
YEAR 3
YEAR 4
YEAR 5
BEYOND
AV Systems Integrator / Contractor
Planning & Programming, Budgeting, Concept
Final AV Infrastructure
AV Systems Design
AV Equipment Procurement
AV Equipment Installation
AV Control Software
AV Systems Warranty
AV Systems Warranty
AV Systems Warranty

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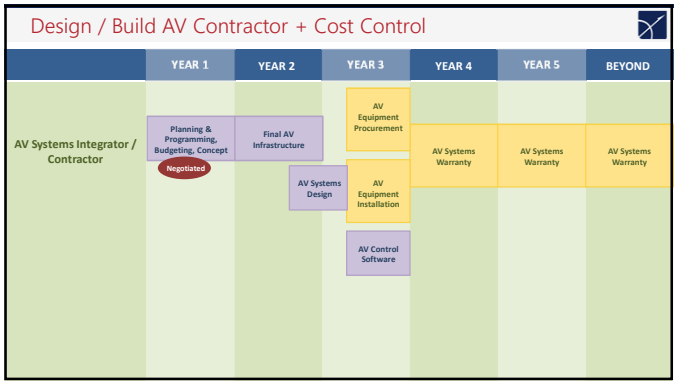
Design / Build AV Contractor + Cost Control
YEAR 1
YEAR 2
YEAR 3
YEAR 4
YEAR 5
BEYOND
AV Systems Integrator / Contractor
Planning & Programming, Budgeting, Concept
Negotiated
Final AV Infrastructure
AV Systems Design
AV Equipment Procurement
AV Equipment Installation
AV Control Software
AV Systems Warranty
AV Systems Warranty
AV Systems Warranty

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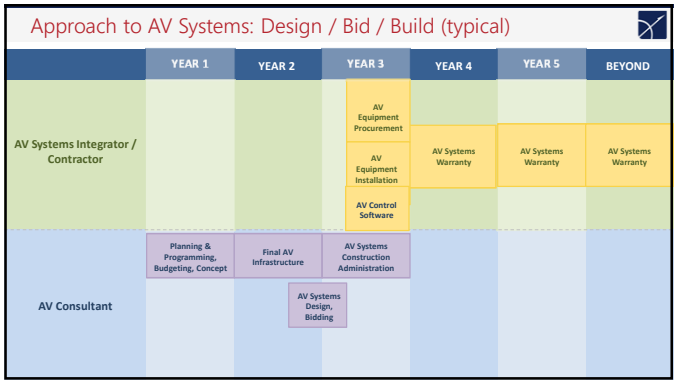
Approach to AV Systems: Design / Bid / Build (typical)
YEAR 1
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AV Equipment Procurement
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AV Control Software
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AV Systems Warranty
AV Systems Warranty
AV Consultant
Planning & Programming, Budgeting, Concept
Final AV Infrastructure
AV Systems Construction Administration
AV Systems Design, Bidding

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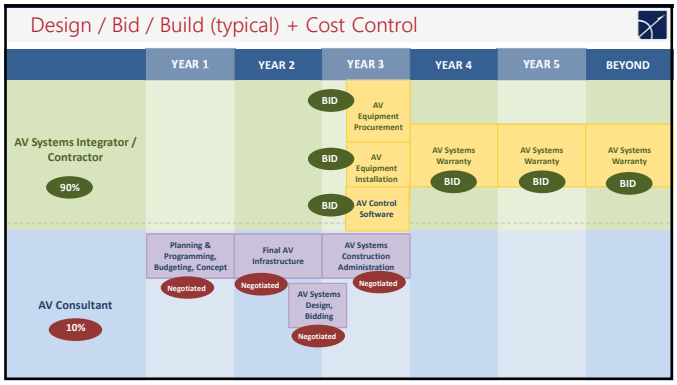
Design / Bid / Build (typical) + Cost Control



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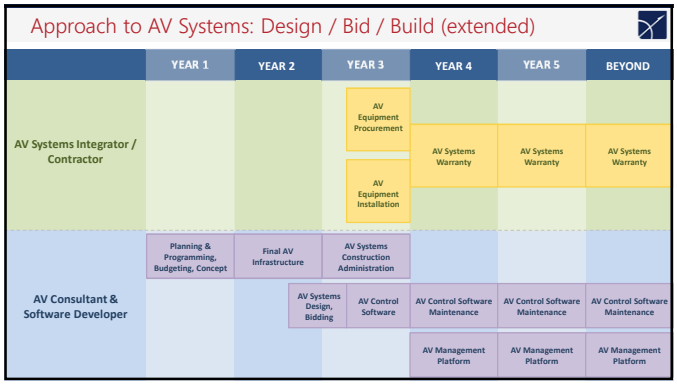
Approach to AV Systems: Design / Bid / Build (extended)



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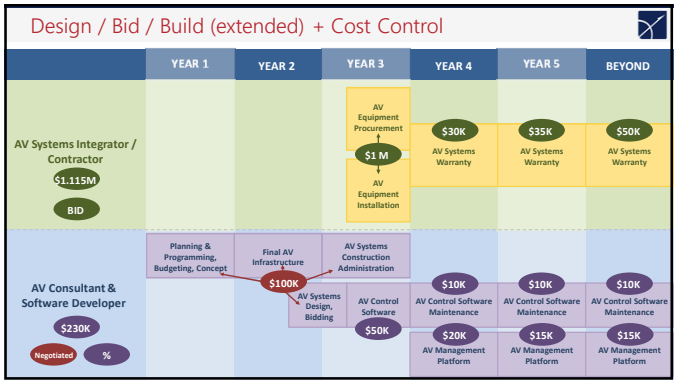
Design / Bid / Build (extended) + Cost Control



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Technology & This Project … 3 Rs

What should we *RETAIN*?

What should we *RETIRE*?

What should we *RE-IMAGINE*?

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Remember the Design Directions (examples)

- Prefer network-based solutions; any source to any destination
- Invest in automation to minimize tech support staff and accelerate user adoption
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Systems Design Process

- Create a Technology Program report defining the "Full Program"
  - Aspirational, beyond the budget and the basis of a roadmap for the future
  - Do not simply default to the "campus classroom standard"
- Focus on agreement on the Full Program
  - Day 1 budget is enormously important – but not let it limit the vision for the future
  - Delay the tough decision on priorities until later
- Get the building right !
  - Ceiling heights, column spacing, room geometries, acoustics, lighting, cable pathways, etc.
- Do not lock onto a single manufacturer / single solution
  - "Manufacturer independent infrastructure"
- Make it graphical for the end users

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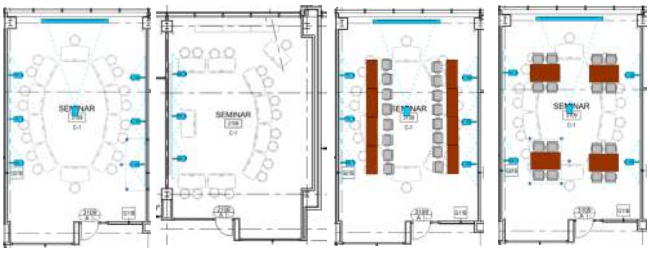
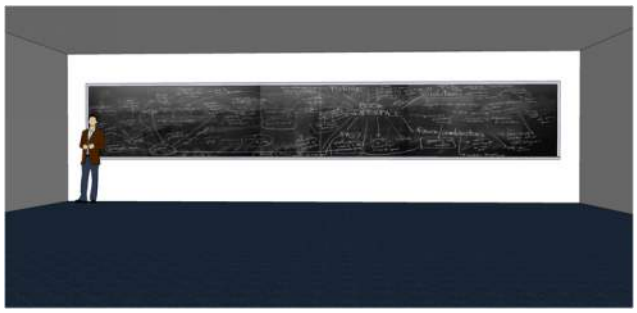
Equipment Plans make it graphical !



78

Attention Wall



79

Attention Wall

80

Attention Wall

81

Attention Wall

82

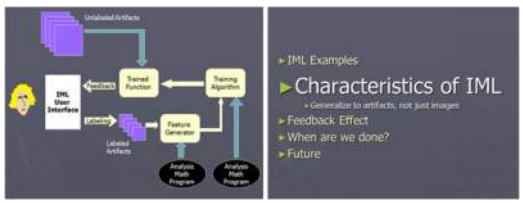
Multiple Images

Compare and Contrast

83

Multiple Images

Context and Discussion Points



84

Multiple Images

Problem and Solution

Ax = 0 *position of truck A*
Ay = 0
Bx = 0 *position of truck B*
By = -2

Related Rates

- At 3:00 PM, a truck A is 30 miles due north of truck B. If truck A is driving east at 14 miles/hour and truck B is driving north at 22 miles/hour. At 2:30 PM, what is the rate of change for the distance between them?

85

Attention Wall

86

Attention Wall

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Attention Wall

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Attention Wall

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Attention Wall

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Attention Wall

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Attention Wall

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Attention Wall

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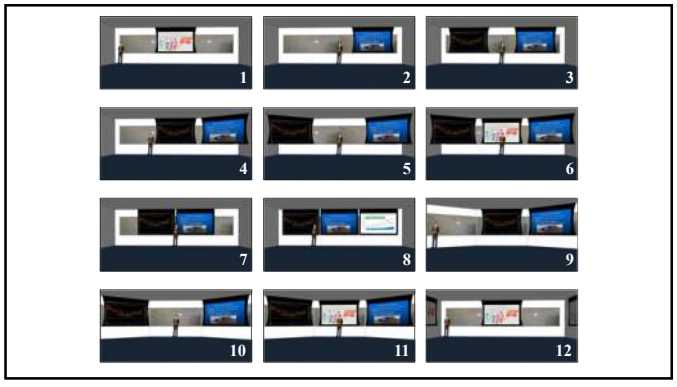

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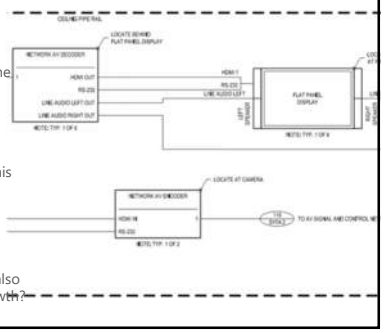
Systems Design: Concept Design (early), Detailed Design (late)

- Do the solutions …
  - Align with the Shared Vision?
  - Help faculty and students achieve the desired outcomes?
  - Enhance how students learn best?
  - Follow the trends and emerging technologies that were identified as relevant to this project?
  - Follow the Design Directions?
  - Address the Challenges that were identified?
  - Adhere to the Day 1 budget, while also providing a roadmap for future growth?



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Framework for Transformation

98

Our students learn best when …

- They work collaboratively, wrestle with the content – and articulate it to others – during class
- They are encouraged to use technology tools to help with assignments – tech as enabler not a distraction
- They are given the freedom to ask questions
- Individuality and creativity are encouraged
- ✓ The room – lighting, temperature, acoustics - does not get in the way of learning
- They have access to course materials 24x7
- ✓ They have a mix of lively, engaging collaboration spaces and quiet isolated spaces for critical thinking and studying tasks
- They are encouraged to take risks, make mistakes and learn from those mistakes, producing a far better outcome than just playing it safe
- They are held to high and clear expectations – and receive personalized and timely feedback about their work
- ✓ See and hear clearly – but only what should be seen and heard
- Learning environments include meaningful and realistic problem-based activities
- They are involved in the learning process
- ✓ Environment is free from distractions
- ✓ Are allowed to work cooperatively, with hands-on activities and access to tech for groupwork
- There are plenty of visual aids and graphics; multiple modes of instruction

99

Design from the inside-out (too)

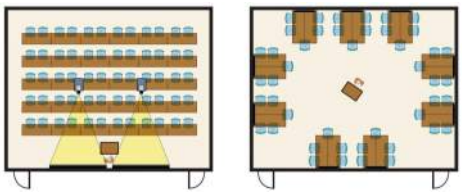
100

101

Classroom Study

Lecture Mode
60 Seats

Active Learning
45 Seats



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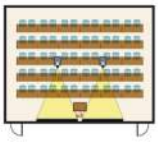
Classroom Study

1350 SF Classroom



FIXED LECTURE
60 seats

- *can be reconfigured to active format (by semester)*
- *22.5 SF / student*

FIXED ACTIVE
45 seats

- *can be reconfigured to lecture format (by semester)*
- *30 SF / student*

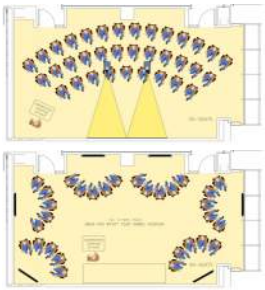
FIXED ACTIVE
60 seats

- *unusual proportion*
- *not reconfigurable*
- *most efficient layout for active learning*
- *22.5 SF / student*

103

Active Learning Decisions

- Number of students per group
- Define the flexibility needed
- Define the adaptability needed
- Students at tables, armchairs or hybrid
- Size / shape /configuration of furnishings
- Space for instructor at each student group
- Campus-provided tools per student group
- Writing surfaces per student group
- Role of lecture component
- Location of instructor "home base"
- Role of Teaching Assistants



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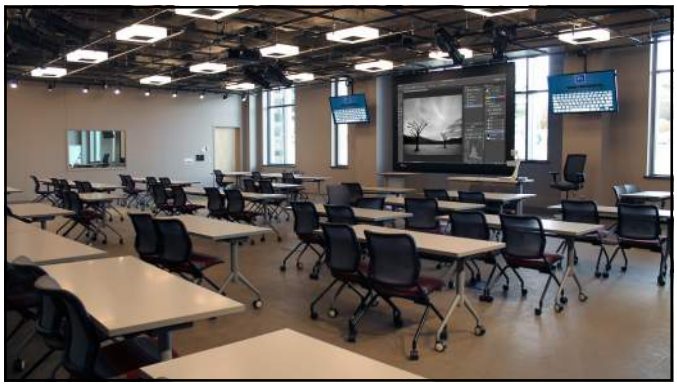

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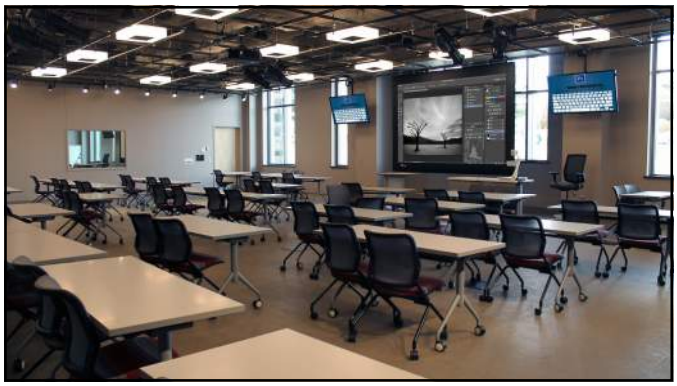

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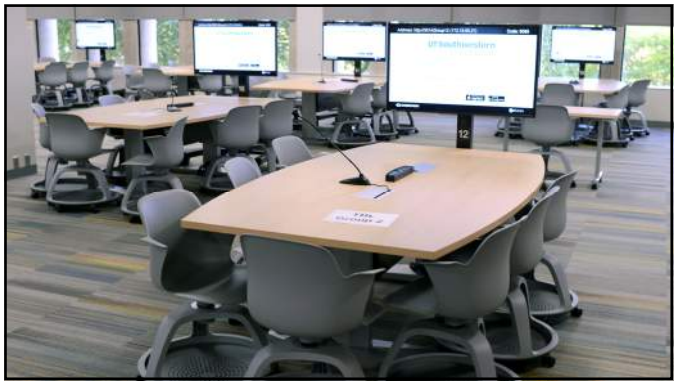
active learning

111



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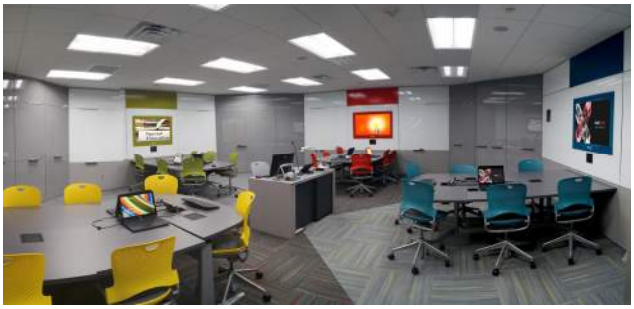
Fixed Active Learning



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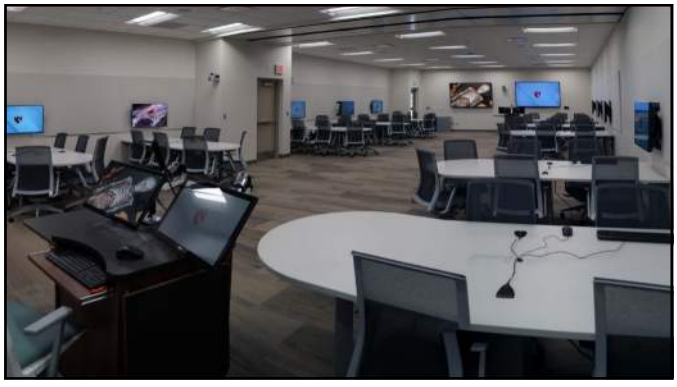

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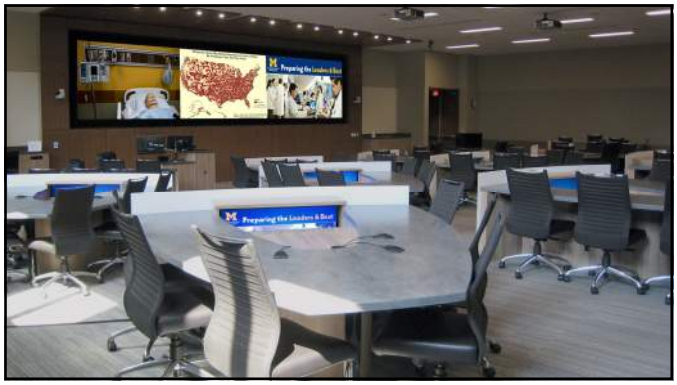

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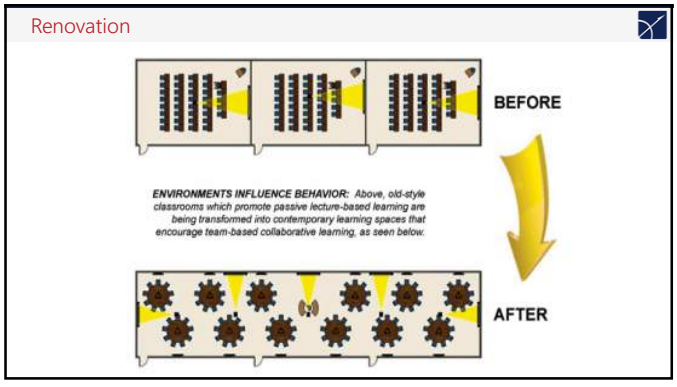
Renovation
BEFORE
ENVIRONMENTS INFLUENCE BEHAVIOR: Above, old-style classrooms which promote passive lecture-based learning are being transformed into contemporary learning spaces that encourage team-based collaborative learning, as seen below.
AFTER

117

118

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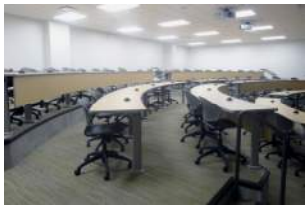
Tiered Lecture Hall



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Plan for circulation …

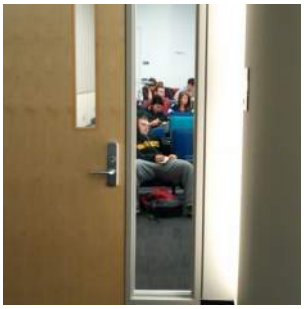
121

122

Active Learning

123

NOT Active …



124

NOT Active …

125

Who is learning?

126

Active Learning Decisions

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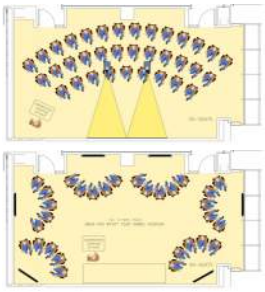
- Writing surfaces per student group
- Role of lecture component
- Location of instructor "home base"
- Role of Teaching Assistants



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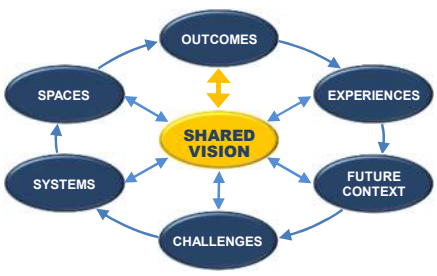
Questions …



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One last Quick Workshop …

- Identify one idea to take away from today's session. How can you implement it on your projects? Determine one action item …
- Share your contact info with each your colleague from today.
- Pick a date for the two of you to connect and update each other on your action item.

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THIS CONCLUDES THE AMERICAN INSTITUTE OF ARCHITECTS CONTINUING EDUCATION SYSTEMS COURSE

AIA Continuing Education Provider

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Finis!

APPA 548

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