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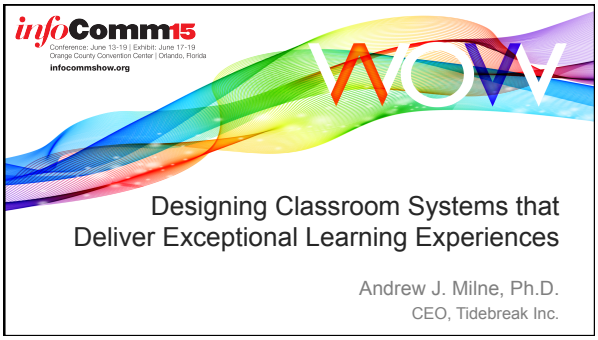


Designing Classroom Systems that Deliver Exceptional Learning Experiences

Andrew J. Milne, Ph.D.
CEO, Tidebreak Inc.

Globalization of the Workplace

- New Emerging Markets
- Internationalized Standards
- Geo-Distributed Teams
- Increased Competition
- Reduced Time-to-Market
- Increased Remote Work

Emerging Terms

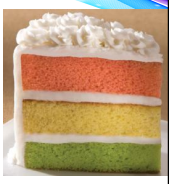
- Active Learning
- Collaboration
- Unified Communication
- Huddle Spaces

Overheard at INFOCOMM Connections '15

- User Interface (UI) vs. User Experience (UX)
- Impact of IT products (e.g. Microsoft Surface Hub)
- Consumer technologies (e.g. iPad) change expectations
- Customized solutions vs. Off-the-Shelf systems
- Focus on AV technology vs the overall experience
- Huddle room design – what needed for good communication?
- Architectural design process impedes "consultative" delivery

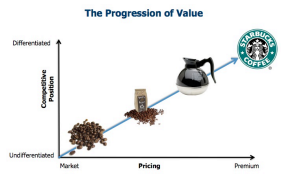
A Big Question

Q: Where do AV professionals add value in a world where manufacturers sell direct to end-users and all "equipment" (some of it is actually software) runs on the IT network?



A: Shift differentiation from technical design to designing the human communication experience

Economic Value of the Experience



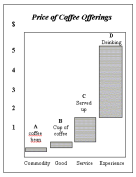


Diagram in Robertson (2001) from Pine & Gilmore, The Experience Economy (1999).

"The future is already here – it's just not evenly distributed."

– William Gibson
(quoted in The Economist, December 4, 2003)

Today's Higher Education Environment

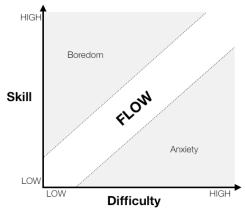
- Value Propositions to Justify Tuition Rates
  - "Boutique" MBA's, other programs
- Retention-Based Funding Schemes
  - Faculty remediation initiatives
- Alternative Educational Delivery Models
  - MOOCs, Badging
- Growing emphasis on collaboration / active learning

A New Landscape

- Schemas for "going to class" and "taking a class" have changed
- Students expect:
  - Access to high-quality online learning content
  - To be able to use connect with any computing device they bring
  - To be engaged in active learning during class, not passive listening
- Need: Design for learning spaces to support active participation

On Experience

Cognitive Flow



- Psychology Research:
  - When one is properly engaged, i.e. skill balances with difficulty, task becomes "effortless"
    - Csikszentmihalyi, M. (1990)
- Corollary for Technology:
  - Technology becomes transparent when it properly matches the human communication requirements

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"Any sufficiently advanced technology is indistinguishable from magic."

- Arthur C. Clarke

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InfoComm Strategic Plan

Provide leadership that drives the transformation of human communication while creating exceptional experiences through technology.

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DISRUPTION

TRANSFORMATION

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SAMR Model for Technology Adoption

- Substitution
  - Tech acts as a direct tool substitute with no functional change
- Augmentation
  - Tech acts as a direct tool substitute with significant functional improvement
- Modification
  - Tech allows for significant task redesign
- Redefinition
  - Tech allows for the creation of new tasks, previously inconceivable

Ref: Ruben Puentedura, Ph.D.
President, Hippasus

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Dimensions of the "AV Experience"

- Visual experience
- Audio experience
- Project experience
- Presenting experience
- Audience experience
- **Human communication experience**

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Not an Exceptional Experience

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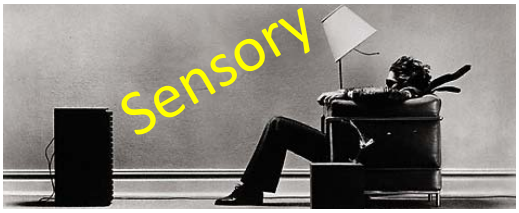
The "Blown Away" Experience



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Aspects of Exceptional Experience

(Milne, 2015)

- Provides something unusually "good" by current standards
- "Good" relates to the target activities + group objectives
- Experience has a measurable positive impact
- Experience is somehow sustainable
  - How does exceptional become the norm?
  - How do we make them repeatable?
  - How do we make them scalable?

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"Physics" of the Experience

- Space design
  - Lighting, color, air quality, temperature
- Sound
  - Acoustics, intelligibility, ambient noise levels, reinforcement, program audio
- Visual
  - Resolution, sight lines, readability, contrast ratio
- Cross-Platform
  - Translates the experience across different technology platforms, interprets according to the environment's idiosyncrasies

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Content of the Experience

- Digital images
- Digital audio
- Digital audio-video
- Videoconferencing
- Interactive information sources
- Real-time analytics (polling)
- Co-created content
- Ad-hoc content sources

(Consider: "Audience" vs. "Participant" perspective)

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Process of the Experience

- Presentation
  - With Slides, With multimedia elements, With interactive elements
- Media-augmented discussion
- Collaborative work
  - Co-located, Distributed, Hybrid
- Creative Design
- Agility – able to redesign the process at will DURING the process

(Consider: Group-User perspectives)

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Connectedness of the Experience

- Emotional response (positive or negative)
- Relevance to participants' focus points ("pain")
- Compelling involvement
- Impact on Empowerment

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Measuring the Experience

- Analytics to measure team performance
  - Identify best practices
  - Remedy problem areas
  - Optimize team performance
  - Promote agility
- Feedback designed to coach best practices
  - Meta awareness
  - Comparison against best practices

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Dimensions of Telepresence (Steuer 1993)

Steuer examined "mediated environments"
- virtual reality or physical reality accessed via mediated electronic connection

- Vividness – made up of "sensory breadth, which refers to the number of sensory dimensions simultaneously presented, and sensory depth, which refers to the resolution within each of these perceptual channels"
- Interactivity – the representational richness of a mediated environment as defined by its formal features; that is, the way in which an environment present information to the senses

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On Need-Finding

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Levels of Transformation: Control / Interaction

- IP-based device monitoring and AV control with hardware infrastructure
  - Layers remote management/monitoring over hardware control
- iPad used with AV control system over IP network connection
- IP-based AV control with software infrastructure
  - Bypasses traditional hardware control units
- IP-based collaboration environments
  - Cloud-based application environments that are shared
  - Interaction technologies that work over an IP network

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How Disruptive is your Thinking?

Requirement	Traditional	Evolutionary	Transitional	Transformational
Manage devices	Control system touchscreen	iPad app interface to control system	Software-based control infrastructure	No "control"
Play video clip	Play DVD	Play Blue-Ray	Stream desktop wirelessly	YouTube, Hulu, other cloud media
Manage content	Analog matrix switch	Digital media switch	Remote desktop control app	Interact directly across devices

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"A lot of times, people don't know what they want until you show it to them."

- Steve Jobs

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Design Thinking

Design thinking is a formal method for practical, creative resolution of problems and creation of solutions, with the intent of an improved future result.

- Multidisciplinary teams vs. specialists
- Need-finding vs. Needs analysis
  - Empathy
  - "Lead users"
- Iterative prototyping vs. conceptual design & specification

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Sample Classroom Technology Specification

Classroom Tier 1
Small classroom <40 seat

- All systems HD
- Projector: 4-5k lumens
- Screen: CSR manual 16 X 10 models B or C. Size TBD
- Audio: 40 wall min. stereo amp. Existing or new wall or ceiling mounted speakers
- Input switching system: Laptop VGA, HDMI, PC HDMI, Blu-Ray, spare input for doc cam and adapter ring
- Control system: System with remote monitoring/control
- Audio out: Future hearing assist system
- Rack: Houses switcher, amplifiers, Blu-Ray player, power strip, and PC and misc. equipment
- Power conditioner without front switch
- Built-in PC, backlit kb and mouse, monitor on Ergotron arm
- USB 4 port hub on lectern or rack
- Lighting control for lights over screen with control by lectern/rack
- New lectern or reuse existing if in good condition
- AC Outlets on lectern and/or on rack

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A Range of Learning Activity Approaches

- Faculty Presentation
- Student Presentation
- Flipped Classrooms
- Team-Based Learning
- Project-Based Learning
- MOOC-Augmentation
- Informal Team Meetings
- Distributed Team Meetings
- Self-Directed Work
- Simulated Situations
- Discussions
- Remote Speakers
- Panel Discussion

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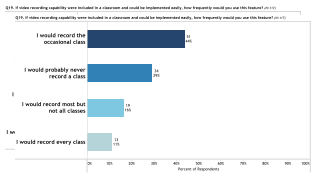
Need-Finding: Video Capture in the Classroom

If video recording capability existed and was easy to use, 44% of faculty respondents would record only the occasional class, and about 30% would never record. Only 11% would record every class

Students in focus groups noted a real benefit in being able to review recorded classes after-the-fact when there was something they didn't understand in class; and prior to mid-terms and finals.



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Poor Design Impacts the Experience

- More than half of faculty respondents (55%) said that the lack of a suitable teaching space hampered them from exploring new teaching methods. And 80% have had to adapt their teaching styles to conform to the classroom assigned.
- Overwhelming sentiment was **lack of flexibility to support multiple pedagogies** within same room.
- "Need reconfigurable spaces in which we can switch between lecture, breakout, and large discussion." "Need large lecture formats that are still intimate and allow for quick movement from whole group discussions to small groups."
- Not enough configurations that support students talking to each other.
- Not enough space for different groups of students to write on boards at the same time, present ideas, etc.
- Immovable chairs (e.g., Olin 11 and 12) constrict options.
- "Prefer to be in the middle of the room rather than at a lectern in front, but most rooms do not support this."
- "I would normally use multi-media resources in all pedagogical activities, but there is not a computer in the room and I do not have a laptop."

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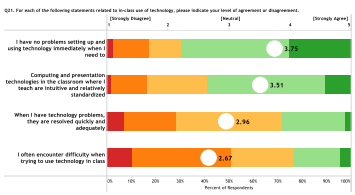
End-Users Anticipate a Poor Experience

Per survey, faculty seem to be able to use and manage technology easily in the room. However, focus groups and survey write-in comments suggest that there are some problematic areas (e.g., connecting Macs, trouble shooting and time involved in getting help from TTS, etc.)



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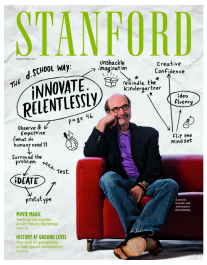

"The Deep Dive"
ABC Nightline News

Profile of IDEO design team engaged in need-finding and product prototyping.

https://www.youtube.com/watch?v=M66ZU2PCIcM

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Lessons from Higher Education

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An Issue of Perspective

"It has taken me 30 years as an educator
to rediscover
what was obvious to me as a student."

Dr. John Cowan
Former Director
Open University (Scotland)

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A New Landscape for Higher Education

- Schemas for "going to class" and "taking a class" have changed
- Students expect:
  - Access to high-quality online learning content
  - To be able to connect with any computing device they bring
  - To be engaged in active learning during class, not passive listening
- Need: Design for learning spaces to support active participation

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A Definition of Teaching

"Teaching is
The purposeful structuring of experiences
from which students cannot escape
without learning."

Dr. John Cowan
Former Director
Open University (Scotland)

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Reflection

- The best first 5 minutes of a class.
  - Prof. Russel Fernald, Stanford University
- Made social connections by introducing students
- Began review of the material from prerequisite courses
- Established a culture that encouraged collaboration
- Made it easy to ask questions or say "I don't know the answer, but let's figure it out together."

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Collaboration is Changing Teaching Approaches

Images provided by Winona State University

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Changing the Faculty Experience

"Students are using Google and Wikipedia to look things up on their mobile devices…
… and they correct me in class!"

Business School Faculty Member
RMIT University (Australia)

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Faculty Roles

- Give to students what technology cannot give them
  - Motivation
  - Empathy
  - Perspective
  - Adaptive teaching
  - Analysis
  - Context
  - Coaching

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Student Roles

- Independence
- Self-guidance
- Critical thinking
- Manage their resources
- Organize materials
- Pursue personal interests
- Harness technology
  - Appropriate uses of personal devices in class

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What They Have Already
(Incoming Freshmen 2022)

- 4th Grade Experience:
  - Collaborative team projects
  - The technology ownership "Arms Race"
  - School-issued email, Google Drive accounts
  - iPad as basic device
  - iMovie projects
  - Presentations on the IWB

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New User Expectations

- Digital lifestyles at home / outside of class influence
  - Dominance of the small screen
  - Customizable experiences
  - Media streaming over the network
- Personal digital environment in a pocket
  - Frequent, almost-immediate interaction with others
  - Anywhere, anytime access
  - Sensor analytics engine

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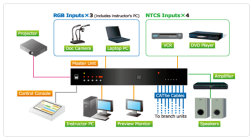
"Traditional" AV Systems Design

- Presentation-Focused
  - Participants as "Audience" or "Consumers"
- Aspects of System Design
  - Physical comfort
  - Visual access
  - Audio support
    - Reinforcement
    - Program
  - Internet Access
  - Power



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Active / Collaborative Learning

- Content access
- Content transfer
- Content capture / re-use
- Social connection
  - Real-time / Asynchronous
  - Co-located / Distributed
- Data analytics
  - Adaptive to student abilities (CBE)

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Phased Introduction of Best Practices

Interactive Presentation

Project-Based Learning

Team Collaboration

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Elements of the Learning Environment

- Physical Layout
- Furnishings
- Network Infrastructure
- Installed AV / IT Systems

- BYOD Components
- Software Applications
- Cloud-Based Services
- Faculty Skills
- Pedagogical Approach

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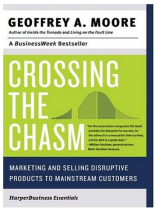
Considering the "Whole Product"



- Technology alone is not the product

- Physical environment
- Software apps / IT systems
- Mobile / BYOD
- Pedagogy

- Experience design approach
- Anticipate activity flows
- Develop new service offerings
- Change support skill sets

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Aspects of Design for Interaction Experiences

- "Whole Product" design approach
  - How do system design decisions affect the human experience?
  - What contributes to the experience besides technology?
- Exceptional relates to the planned activity
  - "Adaptable" systems vs. "Flexible" systems
- Details matter
  - Visual look & feel
  - Speed / Response time
  - Flow of the interface
- Different Expectations

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Elements of the User Experience Ecosystem

- Personal interface experience
  - BYOD
  - External to "the system" but Interfaces with the system
- Portable interface experience
  - Cloud-accessible resources
  - Re-use in alternate contexts
  - Field experiences brought into the learning space
- Software apps & workflow

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Layers of Interactivity Experience

Impact

Activity Pattern

Flow across capabilities

GUI and other control interface designs

Visibility, intelligibility, clarity, sightlines, power consumption

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Impact: An Engaging Environment

"In my 20 years as a teacher this is the most significant change I've seen. I'll never teach the old way again. Students used to sit in their desks and wait for the teacher to lecture and, with any luck, stay focused during class. Now we have an environment where students and teachers actively work together to solve problems and master the curriculum. The students are much more engaged in the learning process and the faculty members are more like guides who help students master the material."

Ken Graetz, Ph.D.
Director
Teaching, Learning and Technology Services
Winona State University

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Impact: Improving Learning Outcomes

Yvonne Ekern, J.D.
Legal Analysis, Research and Writing
School of Law
Santa Clara University

"I've always done some level of collaboration, but I've never received the work product from groups that I've gotten from the collaborative groups It's not a little bit more, it's a lot more. And it's not just a lot more, it's a lot better.

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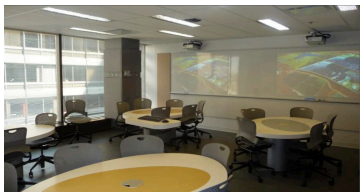
Assessing Learning Spaces



McGill University Active Learning Classroom

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Building Faculty Adoption

- Make interaction patterns more visible
  - Analogy: alternate seating maps / animations for furnishings
  - New tools to show mappings of activity flows
- Institutional Commitment
  - Biggest challenge
  - "Glacial Rheology" of higher education
- Role of Professional Societies
  - Articulating needs, research-informed recommendations
  - Develop cross-training approaches
  - Incorporate interactivity experience in design standards

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Measuring Exceptional Experiences

- Value to the teaching and learning process
  - Proxy: How much do features get used?
- Affective impact on students
- Product outcomes
- Learning outcomes
- Alignment around results

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"Support" Becomes "Coaching"

- Analogy: Re-inventing the Librarian
  - Past: Curator of books, physical media
  - Present: Guide to information, delivered physically or digitally
- Apply instructional design at the point of support
  - Support technologists trained to talk about pedagogy
  - Cross-training required
- Avoid using jargon / labels for new concepts
  - Make it sound like an incremental change (less work)
  - Tout technology advantages in terms of lesson plan

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Application to Non-Classroom Spaces

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Huddle Space "Needs"

(from INFOCOMM Connections 2105 session)

- Content Sharing
- Web Access
- Web Apps
- Room Control
- Screen Mirroring
- Content Preview
- Live Stream Decoding
- Web Conferencing

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Goal: High Performance Teams

- Focused towards a common end result
- Efficient use of time, resources
- Able to develop innovative solutions
- Good feeling from the process
- Aligned behind the outcome

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Value Proposition for Teams

Task Acceleration
Better Outcomes
Team Alignment
= High Performance

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Understanding Meeting Types

Presentation | Agenda Driven | Deliverable Development | Brainstorming | Decision Analysis | Product Design

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Performance Factors for Design Teams

- Gestural communications (Tang, 1989)
- Social process (Minneman, 1991)
- Information handling patterns (Baya, 1996)
- Role of prototyping in design (Brereton, 1999)
- Generative design questions (Eris, 2002)
- Information handling vs. team handling (Milne, 2001)
- Impact of visual access on innovation performance(Milne, 2004)
- Emotional balance of the team(Jung, 2011)
- Mapping interaction activities (Sonalkar, 2012)

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Gestural Communication in Design

Function	Text Activity	Draw Activity	Gesture Activity	
Store Knowledge	40	19	1	27%
Express Ideas	2	63	33	43%
Mediate Interaction	0	21	46	30%
	19%	46%	35%	

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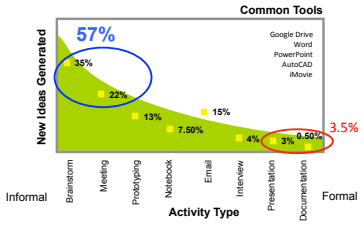
(Tang J. 1989. Ph.D. Dissertation, Stanford University)

Where New Ideas Develop



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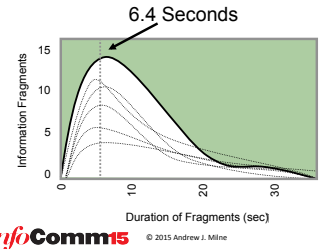
(Ref. Yen,S. 2001. Ph.D. Dissertation, Stanford University)

The "Six Seconds" Threshold



Individuals focus on a "fragment" of information (the basic unit of ideas) on average **6.4 seconds**. Interface actions that take close to this amount of time (e.g. emailing a file) interrupt the flow of ideas. Teams need **"near-invisible" interfaces**.

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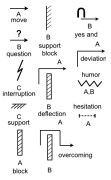
(Ref: Baya,V. 1996. Ph.D. Dissertation, Stanford University)

Design Thinking Interaction Notation



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(Ref: Sonalkar, N. 2012. Ph.D. Dissertation, Stanford University)

A Corollary for 21st Century Collaboration

(Milne, 2015)

Develop a technology-enabled user experience that guides teams to good meeting practices merely by virtue of their using the systems.

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Implications for the Industry: An Economic Analysis

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Cost Comparison – AV Switching vs. Software Interactivity

- Tier 1 Classroom
  - Display projector
  - Computer/monitor/keyboard
  - AV switching hardware — 28%
  - Blue-Ray player
  - Audio system
  - Mounting hardware
  - Cables
  - Equipment Rack — 8%
  - Lectern

$12,500

- Equivalent Classroom
  - Display projector w/ WiFi presentation
  - Small form factor computer
  - Interactivity software — 14%
  - Blue-ray player
  - Audio system
  - Mounting hardware
  - Cables

$11,000

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Cost Comparison – AV Switching vs. Software Interactivity

- Tier 2 Classroom
  - Display projector
  - Computer/monitor/keyboard
  - AV switching hardware — 26%
  - Blue-Ray player
  - Audio system
  - Mounting hardware
  - Cables
  - Equipment Rack — 6%
  - Lectern

$15,000

- Interactive Presentation
  - Display projector w/ WiFi presentation
  - Small form factor computer
  - Interactivity software — 10%
  - Blue-ray player
  - Audio system
  - Mounting hardware
  - Cables
  - Session capture — 22%
  - Videocamera
  - USB Document camera
  - Scanner

$15,000

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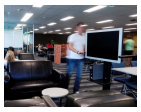
Off-the-Shelf, Mobile Classroom Technology

Installed Components

"AV 4" Configuration	$ 19,879
Labor:	$ 6,375
	$ 26,254
Replacement time:	**2 weeks**



Mobile Components

"MoCoW" Units	$ 7,106
Labor	$ 516
	$ 7,622
Replacement time:	**1 day**

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The New Business Opportunity
(A Hypothetical Case)

Hardware Approach (Traditional)

100 Rooms	Cost	Margin	Profit
HW Equipment	500,000	12%	60,000
Installation Svcs	50,000	56%	27,895
Maintenance Svcs	20,000	65%	13,000
Software			
Post-Install Svc			
Total	570,000		100,895

Software-centric Approach

100 Rooms	Cost	Margin	Profit
HW Equipment	330,000	12%	39.600
Installation Svcs	30,000	56%	17,000
Maintenance Svcs	33,000	65%	13,808
Software	17,600	20%	8,580
Post-Install Svc	36,000	60%	21,600
Total	488,950		100,588

Customer Savings: $81,050 = 14%
Reseller Gross Profit Difference: ($ 307) = 0.30%
Additional Customer Value: Professional Development Program

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Implications for Our Industry: A Professional Practice Analysis

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Trending

- Rising threshold for delivering "Magic"
  - Mobile devices have changed expectations
- Convenience trumps high-quality
  - Easy to use, powerful capabilities
- Economics of hardware are changing
  - Innovation takes place in software systems
- Design for information flows and "whole product" experiences
  - Not enough to just think about hardware system connections
- Higher-order service needs are emerging
  - Opportunities for those who adapt (Partnerships?)

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"AV Professional" →"InfoComm Professional"

- Focus on the User Experience, Interaction Experience
- Participants as actors ("Sources", Users, Producers,…)
- Experience spreads across heterogeneous screens
  - Primary, Secondary, Personal, Wearable
- Personalized performance
- Content portals for media delivery
  - Access to The Cloud
- Social interaction mechanisms
  - Technology-mediated
  - Non-mediated

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Design Approach

- Begin from the perspective of business objectives
- Develop deeper understanding of human communication activities across different communication scenarios
  - Consider timescale, other parameters of collaborative interaction
- Broaden the scope of what is designed
  - Develop visualization tools to represent activity patterns
  - Software apps are part of the designed experience
- Be transformational, present this thinking to clients, end-users

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Elements of Group Experience "Flow"

- Not a matter of the control system user interface (GUI) anymore

- Mobile devices as content sources and portals to the cloud
- Designing a good first 30sec jumpstart
- Transitioning between activity modes
- Setting up a good post-session experience
  - Affective aspects of session
- Building continuity to next group session
  - How to share & incorporate old information

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An Incomplete List of Recommendations…

- Reconceive "AV Professional" as "InfoComm Professional"
  - Define new scope of responsibilities and expertise
- Develop a new design process that departs from the traditional architectural process to encourage innovative design
  - Need-finding vs. needs analysis
- Collaborate with manufacturers to influence product experience
  - Encapsulate user experience in the products themselves
- Design user experiences that builds in guidance
  - Move to "best practices" for various transformative activities

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Innovation Considered

"We are cleverness-limited. We have technology available to do all manner of things, but we need to determine what those things are."

- Prof. Stephen Cioffi
  Stanford University

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