accelerating sustained product innovation

design thinking in creative practice and theory
one man’s view

Larry Leifer

14th ISPE International Conference on Concurrent Engineering
Collaboration, Technology Innovation and sustainability for complex systems development
July 16-20, 2007, São José dos Campos, SP, Brasil
accelerating at Stanford
a French-Bavarian view
3 steps to sustained innovation
(Leifer 200X)

1 Designing is a socio-technically mediated activity.
   Learning is a socio-technically mediated activity.
   Coaching is a socio-technically mediated activity.

2 Designers must preserve ambiguity.
   Learners must preserve ambiguity.
   Coaches must preserve ambiguity.

3 All designing is re-designing.
   All learning is re-learning.
   All coaching is re-coaching.

... and the corollary that all learning requires UN-learning ...
(John Seely Brown 1998, CTO, Xerox PARC)
innovation
ideas and concepts that are successful in the world (market place)

is not a creativity metric
why do we care?
designing is a socio-technically mediated activity

step-1
people

Hasso Plattner Institute of Design at Stanford drives learning
design thinking

experiential

integrative

insight based

need & empathy driven
Hasso Plattner Institute of Design at Stanford
OUR INTENT: CREATE THE BEST DESIGN SCHOOL. PERIOD.

prepare FUTURE INNOVATORS to be breakthrough thinkers & doers

use DESIGN THINKING to inspire multidisciplinary teams

foster RADICAL COLLABORATION between students, faculty & industry

tackle BIG PROJECTS and use prototyping to discover new solutions

STANFORD DESIGN SCHOOL
the start-up team
The opportunity

"expanding the role of multidisciplinary research and teaching... is one of Stanford’s biggest opportunities (John Hennessy)"
the breakthrough

A tiny firm called IDEO redefined good design by treating experiences, not just products. Now it's changing the way companies innovate.

BY BRUCE NUSSBAUM

CEO Tim Brown (left) Founder David Kelley
intense collaboration
extreme product based “design learning”
a prototyping culture accelerates discovery
students engaged and confident about creating their own innovation process
“T” people in the making

DESIGN

THINKING

THINKING
surprise & delight
designers must preserve ambiguity

step-2

ambiguity management

d.310 industry projects drive academic learning
re-designing these designers

Abbott "Diabetes Care"
BMW "Enhanced Passenger Communication"
Daimler Chrysler "Touch screen haptics with branded applications"
Panasonic "New Human-Machine Interaction Method for Unfamiliar Functions"
Volkswagen "Novel In-Car Entertainment System"
The Teaching Team "Running the best damn class at Stanford"
laboratory project - A

need-finding, conceiving, and building
can you make a BMW 3-series
car door smart
product innovation
innovative learning
comparable courses deal with mechatronics, facilities engineering, computer science, satellite design, aircraft design, entrepreneurship, medical device design, environmental policy, human computer interaction research, film, video, bio-technology, communications
laboratory project - B

need-finding, conceiving, and building

can driver hand gestures be used to
mediate vehicle command & control
gesture control of remote functions
driver gesture control design studies
laboratory project - C

need-finding, conceiving, and building

Can you make a co-pilot for the Audi of 2020?
global design team
need-finding
to keep driving the real time task!
communication must be taken off-line!
Solution

- Data filter
- Social connection
- Information pacing
- Intuitive interface
solution part_a
solution part_b

- Data Management Strategy
Solution
design-knowledge management framework and laboratory
where is the laboratory
extreme project based learning in d.310 2006-2007

- **SAP (DE)** (global with HSG, CH)
  - User Interface for an Executive **Decision**-Context Device
- **Deutche Bahn (DE)** (global with HSG, CH)
  - Future **Workplace** of the Knowledge Worker
- **Audi (DE)** (global with TUMunich, DE)
  - Audi Artificial **Trainer**
- **Panasonic-ACC (JP)** (global with UTokyo, JP)
  - **Walkatronics**: wearable navigator for independent living
- **Panasonic-ATRL (JP)** (global with Helsinki, FI)
  - Wearable Consumer Technology for Sensing and **Relaxation**
- **DaimlerChrysler (DE)** (global with TUMunich, DE)
  - **GUI** Development
- **CEE (Stanford)** (global with Queensland, AU)
  - **iRoom** Transformer Space
- **VW-IRL (DE)** (global with UNAM, MX)
  - VW Intelligent **Display**
- **DCI International (USA)** (seeking global partner)
  - **Dental** Compressed Air & Vacuum Delivery System
- **GM (USA)** (global with KTH, SE)
  - Multi-media Information **Console**
- **NOKIA (FI)** (global with Helsinki, FI)
  - Very **Human** Technology
what does it look like?
global-team labs 2006-2007

- Stanford
- Stockholm
- Helsinki (2)
- Seoul ?
- Tokyo
- Munich (2)
- St. Gallen (2)
- Queensland
- Mexico City
University learning PROCESS and CONTENT delivered by Industry

- Instructor
- Teaching Assistant
- Student Team
- Coach
- Company Liaison
- Company Staff & Mgmt
design thinking research in context
(Leifer’04)
the team is the product
knowledge acquisition and management as observed in a major US automotive company

[Ozgur Eris, Larry Leifer, 2002]
knowledge acquisition and management as observed in engineering.310@Stanford

Learning Loop 1
Learning Loop 2
Learning Loop 3

Formal Content
Process Content
Informal Content

Discipline
Instructor
Course
Coach
Learners
Team

[Ozgur Eris, Larry Leifer, Ade Mabogunje, 2003]
coaching helps technology hinders

LIBRARY RESOURCES

PROCESS COACH

DESIGN LEARNER

PRODUCT KNOWLEDGE

Learning Loop 2

Learning Loop 3

Learning Loop 1

Coach

Design Team

Product

SMETE™

Informedia™

Footprints™

LauLima™
all designing is re-designing

step-3
re-designing designers

design-thinking research
what do we know from
instrumenting design
team activity
the power of observation
Tang ‘89, video interaction analysis
Curriculum Change

- negotiating
- preserving ambiguity
- tailoring talk
- performance metrics

learning paradigm
since Minneman’92 corporate field studies

observing
intervene
analyzing
artifacts
process relations
state
making sense
futures
the importance of mediation
(Tang’89)

<table>
<thead>
<tr>
<th>Function</th>
<th>Text Activity</th>
<th>Draw Activity</th>
<th>Gesture Activity</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Store Knowledge</td>
<td>40</td>
<td>19</td>
<td>1</td>
<td>27%</td>
</tr>
<tr>
<td>Express Ideas</td>
<td>2</td>
<td>63</td>
<td>33</td>
<td>43%</td>
</tr>
<tr>
<td>Mediate Interaction</td>
<td>0</td>
<td>21</td>
<td>46</td>
<td>30%</td>
</tr>
</tbody>
</table>

19% 46% 35%
the attention time constant
(Baya'97)

$\text{6.4 seconds}$

design information fragment duration across six activity categories
(2 each = receptive, expressive, search)
creative content matters
noun-phrases in formal documents predict awards in peer-reviewed design competitions

(Mabogunje, PhD'96)
performance is a function of knowledge baseline + rate of learning
questioning drives performance
(Eris’02)

better

design team performance score

combined rate of DRQ+GDQ (questions/hour)
DRQ = deep reasoning question
GDQ = generative design question
design thinking is about questions

Divergent Thinking

Convergent Thinking

Design Requirements

Design Concepts C1, C2, C3, C4, C5...

Design Decisions & Specifications
no decision can be better
than the questions posed
field research case

electronic arts corporation
programming teams in networks

does game programmer activity predict product code performance?  
Reiner’05
features of the computer games industry

- Multidisciplinary Teams of 75 to 200 people
- Producers, Designers, Artists, Engineers, Testers
- Most assets tracked in a database repository
- Word docs, 3D models, animation data, 2D art, audio, source code
- Yearly, “Fast Track” development cycles
- High performance teams
- Industry-wide recognition, high review scores
- Innovative, patented tech reused by other teams
- Sales quadrupled+ in last three years
Daily and Concurrent Edits TW 2005
8 Months - January through August

- Milestones
  - Alpha
  - Beta
  - Final

- Concurrent Module Edits
- Individual work
- Integration
- Collaborative refinement

Lines Edited

Concurrent Edit Events

M1 M2 M3 M4 E3 A1 A2 B1 B2 F1 F2

01/05/04 01/19/04 02/02/04 02/16/04 03/01/04 03/15/04 03/29/04 04/12/04 04/26/04 05/10/04 05/24/04 06/07/04 06/21/04 07/05/04 07/19/04 08/02/04 08/16/04 08/30/04

0 20 40 60 80 100 120 140 160

0 2000 4000 6000 8000 10000 12000 14000 16000

7 per. Mov. Avg. (Concurrent Module Edits)
7 per. Mov. Avg. (Daily Edits)
concurrent editing as a social network

Node = Person
Arc = Concurrent Edit
Arc weight = Num Concurrent Edits
Red = Top 5 Collaborator
Month & Milestone Indicators
1 Second = 1 Day
Working Solo

[SoNIA website: www.stanford.edu/group/sonia]
surprise without delight
an equation for success

\[ i_e = mc^x \]

innovation = minds in communication
radical, relevant, & rigorous
working creatively together