Improvisation Design of Engineering Alternatives

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TOPICS

- Innovation & Creativity
- Improvisational Approaches to Innovation
- Improvisational Approaches to Technical Innovation
- Preliminary Results
- Cultural Issues
- Summary
Motivation: Innovation

- Governmental Push for Innovation
- “Creativity is what societal progress...is all about,” J. Bordogna NSF COO
- “Engineering innovation requires creativity,” – Editor of Power Electronics Today
- KAIST Admissions Criteria now includes criteria
- NSF-ERC now require educational programs to produce creative engineers
- NSB seeks to improve engineering student creativity
Creativity & Innovation

Design + Creativity = Technical Innovation
Creativity of Engineers

A study comparing the creativity of music and engineering students concluded that, while music students were statistically more artistically creative than engineering students, there was no statistical difference between the measured scientific creativity levels of these same students.

Interaction with Design Protocols

- Design protocols organize relevant design variables and design conflicts
- Act as the precursor to divergent thinking
- Should work with numerous protocols (e.g. TRIZ)

Теория решения изобретательских задач
TRIZ
The Theory of Inventor’s Problem Solving
Humor & Innovation

- Improvisational comedy has been used in business for over several decades.
- John Sweeney of the Brave New Workshop (BNW) is the current guru.
- An article in Mechanical Engineering Management implied this will work for technical innovation.
Sweeney’s Funnel Process

- Uses the BIG LIST approach
- No group evaluation of initial idea (critically important for technical ideas)
- Hundreds of initial ideas to produce viable ideas
Technical Application

“...we are GREAT at helping clients with two things: 1) generating a lot of ideas at the TOP of the brainstorming funnel (we are NOT really suited to help technical teams further refine and develop ideas, as we are based in improvisation not engineering) and more generally, 2) BEHAVIORAL change—we help individuals and teams shift their own behaviors that affect the culture of innovation (or lack thereof) within their organization.”

Julia Schmidt
President, Brave New Workshop
Humor = Innovation

Arthur Koestler – Art of Creation
Humor = Innovation - Example

There’s this new website that shows you nearby sexual predators when you enter your zip code.

FIGURE 1. Schematic of the incongruency in both humor and innovation. The joke is provided courtesy of Nikki Glaser who has appeared several times on “Last Comic Standing.”
Arthur Koestler - Bisociation
Statistical Mechanics

Ludwig Boltzmann

Paul Ehrenfest
Optics of photolithography determine the size of features in a microchip.

Size features can be decreased (increase density of memory and processing power) using block co-polymers that phase separate.

Under what conditions (polymer structure, molecular wt., surface conditions) this happens is being studied by simulation.
Simulation of Defects

Narrow M.W. Distribution

Broad M.W. Distribution
More Statistical Mechanical Applications

Molecular Dynamics

\[ P \propto e^{-\Delta E/kT} \]

Variable Space = Idea Space
Ludovice, P.; Lefton, L.; Catrambone, R.

Georgia Tech Center for 21st Century Universities

Improvisational Design of Engineering Alternatives (IDEA)
More Statistical Mechanical Applications

Improvisational Design of Engineering Alternatives (IDEA)

Traditional Brainstorming

\[ P \propto e^{-\Delta \text{Infeasibility/Humor}} \]

INFEASIBILITY

IDEA SPACE

Humorous Improv Space

Marketing Idea Space

Improvisational Design of Engineering Alternatives (IDEA)
Traditional Brainstorming

- Coined by Alex Osborn, founding partner of the BBDO advertising firm in the 50s *
- Four Rules: (i) no criticism, (ii) wild ideas, (iii) big list and (iv) combinations are good
- Still widely used today

Fixing Brainstorming

- Eliminate Production Blocking due to Topic Fixation
- Periodic Breaks
- Reduce Social Inhibition
- Social Loafing (artifact)
- Experts are good
- Diversity (GroupThink)
- Improvisational Groups for Complex Tasks
IDEO Modification

- IDEO modified Osborne’s approach to achieve innovation success
- Two New Rules: (v) be visual & physical, (vi) keep focused on the innovation goal
Rules So Far

1. No Criticism
2. Wild Ideas
3. Big List
4. Combinations are Good
5. Visual & Physical
6. Keep focused on the goal
7. Reduce topic fixation
8. Reduce Social Inhibition
9. Experts are good
10. Improvisational Groups
11. Eliminate Social Loafing
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List approach generates many more BAD ideas
- (Purdue, 1961)
Improvisational Design of Engineering Alternatives (IDEA)

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Limit Size of Groups (Yale 1953)

Groups Help
Improvisational Design of Engineering Alternatives (IDEA)

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Improvisation
Humorous Improvisation
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Focus on the goal

Sample Diverse Ideas
Rules So Far

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Take Advantage of Emergent Ideas
New Rules

1. Use Humorous Improvisation to generate DIVERGENT ideas
2. Filter these independently to CONVERGE on design or innovation task
3. Discuss these with a group to produce an EMERGENT idea
4. Use appropriate sized groups
Three Step Process

\[ D = \frac{kT}{m \eta} = \frac{H}{R} \]

- ENERGY OR INVERSE FEASIBILITY
- Improvisation (DIVERGENT)
- Technical Idea (CONVERGENT)
- Evaluate (EMERGENT)
- Marketing or Business

Humor drives this

IDEA SPACE

Improvisational Design of Engineering Alternatives (IDEA)
Application

Infeasible ideas (left)
technical ideas (right)
Improvisational Design of Engineering Alternatives (IDEA)

**Improv Techniques**

**GOOD habits**
- Yes and … (add new information)
- Over accept, raise stakes
- Specificity
- Make others look good - build trust
- Work at the top of your intellect

**BAD habits**
- Blocking – Denying offers
- Wimping – Accepting but not building
- Thinking – Instead just be curious what you’re going to say next
Improvisational Design of Engineering Alternatives (IDEA)

Improv Suggestions

Practical Suggestions

• Start with simple improv games
• Remind people that failure is usually the best outcome
• Technical Facilitator?
• Simultaneously generate step toward technical problem
• Everyone writes and contributes (bandwidth increase)
A Rose by any other Name

- Lateral Thinking (de Bono)
- Procrastination (Jorge Cham)
- Backing Up (Randy Olson)
- Explorer, Artist Judge (Roger von Oech – Kick in the Seat of the Pants)
- Edge of Chaos (M. Mitchel Waldrop)

"...the edge of chaos is where the components of a system never quite lock into place, and yet never quite dissolve into turbulence either. This chaotic region is where an infusion of creativity energy creates just enough chaos to efficiently sample idea space but not so much that the ideas generated are totally unreasonable.

Typical Audiences

- Mech. Eng. Design classes
- Chem. Eng. Product Design classes
- SWE
- AIChE
- ASEE
- Frontiers in Education (Eng. & Computing)
- Inventure Competition Participants
- Cal State Fresno (videoconference)
Example: Shoe Deodorizer

Improvisational Design of Engineering Alternatives (IDEA)

Reed diffusers (CONVERGENT)

Capillary channels in insole (EMERGENT)

Bear in the Woods

Improvisation (DIVERGENT)

Energy or Inverse Feasibility
Particle Coating Reactor

Improvisational Design of Engineering Alternatives (IDEA)

Fart Joke

Improvisation (DIVERGENT)

Multiphasic Fart Joke (CONVERGENT)

Gaseous Acid on Water Coated Particles (EMERGENT)

IDEA SPACE

The Bucket List

ENERGY OR INVERSE FEASIBILITY

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Improvisational Design of Engineering Alternatives (IDEA)

Preliminary Data

ME2150 class (N=8), CHBE4535 (N=32), Fresno State ME Design (N=9)
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ME2150 class (N=8), CHBE4535 (N=32), Fresno State ME Design (N=9)
Preliminary Data

- **Chem. Prod. Design**: 4
- **ME remote**: 10
Other Benefits of Humor

- Produces a number of physiological benefits – Berk (endorphins)
- Helps put students in the correct frame of mind – Berk
- Exploits the novelty effect
- Perceived poorly by technical managers
Industrial Examples

- Lockheed-Martin Skonk (Skunk) Works
- Produced high density of innovation
- Humorous environment
- Ambuuity in environment*
- Others include W.L. Gore, IDEO, modern software firms

More Industrial Examples

- Humor Room – Kodak
- Think Loft – Solvay Advanced Polymers
- Triangle Room – Hoechst Celanese

Think Loft
Solvay Advanced Polymers
Alpharetta, GA
Barriers in Industry

“Despite the success of this project, Collier points out that many Kodak managers believed this approach was inappropriate and resisted promoting it in the company newsletter and secretly hoped it would disappear, despite its very positive publicity in external print and TV. “

Lindsey Collier, consultant
Role of Intermediate Ideas

Apology over Pope 'condom' memo

The Foreign Office has apologised for a "foolish" document which suggested the Pope's visit to the UK could be marked by the launch of "Benedict" condoms.

Called "The ideal visit would see...", it said the Pope could be invited to open an abortion clinic and bless a gay marriage during September's visit.

The Foreign Office stressed the paper, which resulted from a "brainstorm" on the visit, did not reflect its views.

The Bishop of Nottingham said, if anything, it was "appalling manners".

The Rt Rev Malcolm McMahon said: "I think it's a lot worse that we invite someone into our country - a person like the Pope - and then he's treated in this way. "I think it's appalling manners more than anything else."

The junior civil servant responsible had been put on other duties, the Foreign Office said.

Details of the document emerged after it was obtained by the Sunday Telegraph.
Hypotheses to be Tested

1. There exists an optimal amount of humor for this approach
2. Biasing is of critical importance in using improv for technical innovation
3. Technical personnel can be taught this approach
4. Experience makes a difference
5. Is there an institutional barrier
What’s Next

- Controlled Study on Effectiveness (Pending NSF Proposal)
- Investigation of Cultural Barriers (Pending SOO Proposal)
- Test with Industrial Collaborators
- Write and Distribute Video Primer (Pending Proposal)
Other Issues

- Can this protocol be automated? (probably not, because humor is equivocal)
- Can it be asynchronous? (hopefully for engineers)
- Is culture a constraint? (improvisation is a product of culture)
- Age Dependence?
Class Clown Effect (Millennials)

Once on campus, these students have a high level of respect for the institution, but this respect comes with an equally high level of expectation, and an administrator or professor that “fails to live up to those expectations will lose a great deal of trust—and may find it very difficult to earn back.” In the classroom, a new generation gap seems to be opening between professors who value questioning authority and Millennial students who are more inclined to trust that the authorities and their institutions are telling them the truth.

Summary

- Humorous improvisation can potentially help in innovation
- Three step approach (i) divergent, (ii) convergent, (iii) emergent
- Specific relevant hypotheses need testing on optimal sized groups
- Cultural Barrier must also be overcome
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