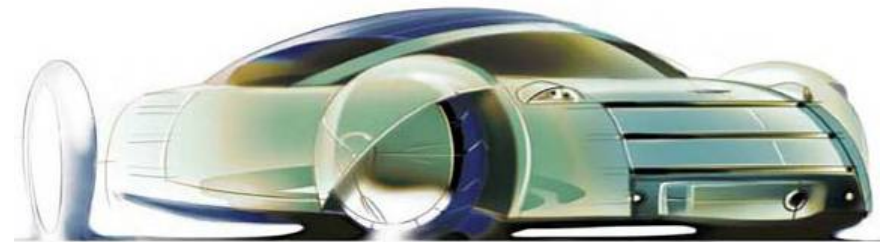


HIGH PERFORMANCE INTERDISCIPLINARY TEAMWORK, A CONTINUUM OF EXPERTISE

Revising Perceptions of Design and Engineering Roles in
Collaborative Product Development

Brigid O’Kane
Associate Professor of Design



Kevin Dohn, Pre-Junior

— Outline of Presentation

- Student Work in Presentation
- Introduction
- Overview of University of Cincinnati
- Designers and Engineers –
A Comparison
- Collaborative Process for Designers
and Engineers
- The Necessity for Collaboration
- High Performance Interdisciplinary
Teamwork
- New Model for Collaborative Practice



Gary Ragle, Senior



Nick Womldorff, Junior

Introduction

Brigid O'Kane

- Associate Professor of Design, College of DAAP
- Coordinator of Transportation Track
- Co-Coordinator for PACE activities
- 10 Years of industry experience



Brigid O'Kane Giving Demo

Introduction

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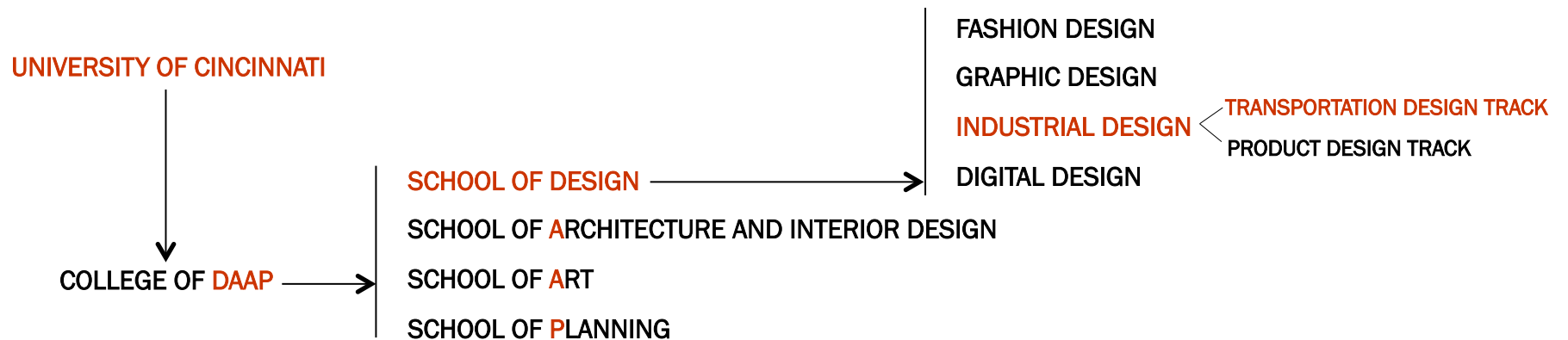
James O'Kane at General Motors Design Center, 10-15-1973

University of Cincinnati (UC)

- Public Institution
- 36,000 students at UC
- 16 Colleges at UC
- Quarter system
- Co-operative education
- 2400 students at DAAP



College of DAAP



Sample of Interdisciplinary Teams at UC

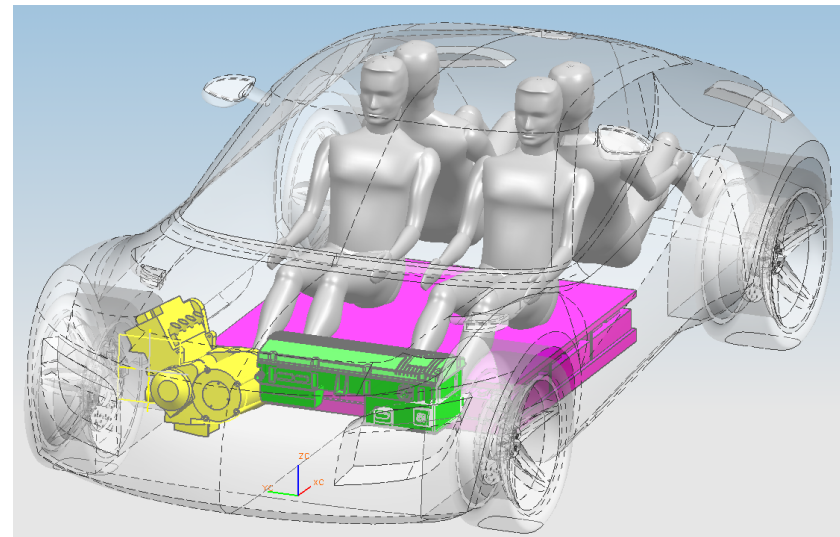
Senior Transportation Capstone → Industrial Design
 Mechanical Engineering
 Business / Marketing
 Fashion Design

Solar Decathlon → Industrial Design
 Mechanical Engineering
 Architecture/Interior Design
 Business / Marketing

Sea Orbiter → Industrial Design
 Biomedical Engineering
 Mechanical Engineering
 Architecture

Industry Partners

General Motors
 P&G
 JCPenny

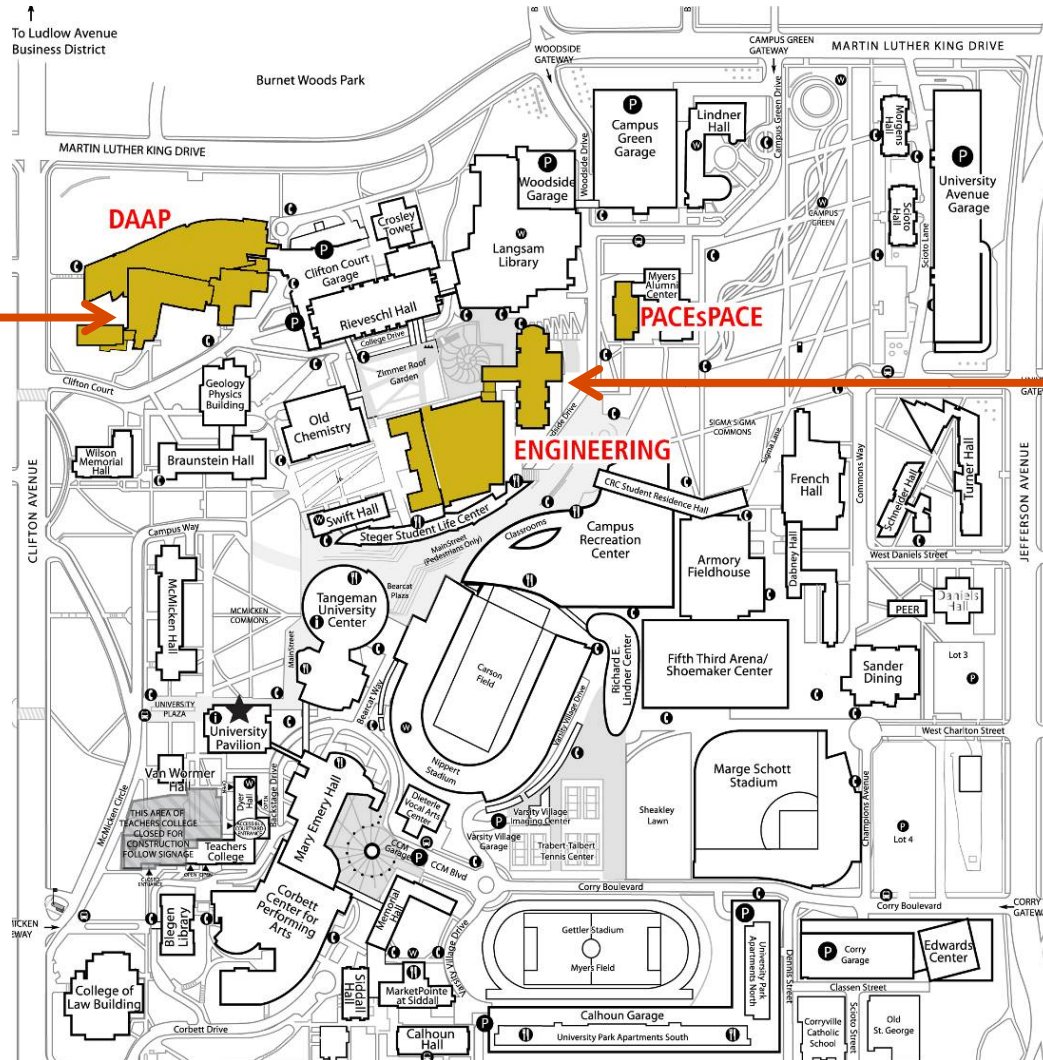


Industrial Design and Engineering, Senior Capstone

Colleges Involved in PACE Activities



Brigid O'Kane
Associate Professor of
Industrial Design
School of Design, DAAP



UC West Campus



Sam Anand
Professor of Mechanical
and Industrial Engineering
College of Engineering

— PACEsPACE

- Center for Global Design and Manufacturing
- Industrial Design and Mechanical engineering
- Participation of faculty members from other schools
- Dedicated space on campus
- Focal point for PACE projects and collaborative activities

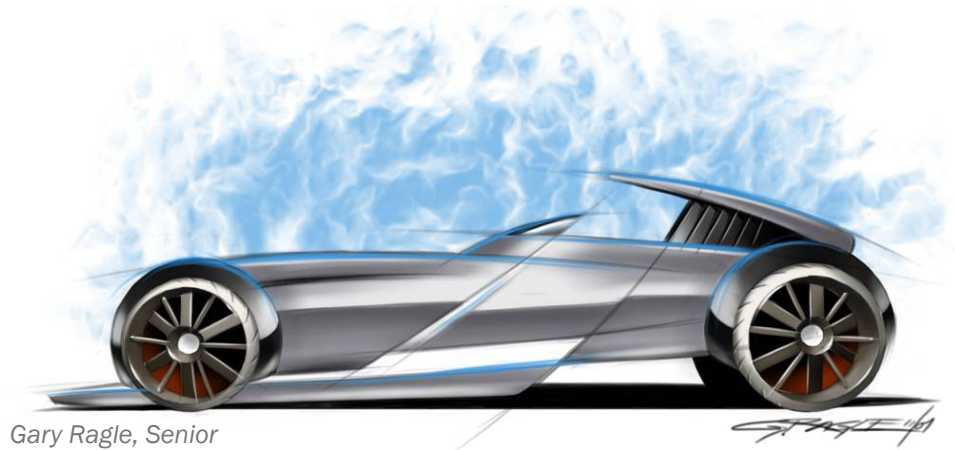


Engineering and Design Critique with Wayne Cherry



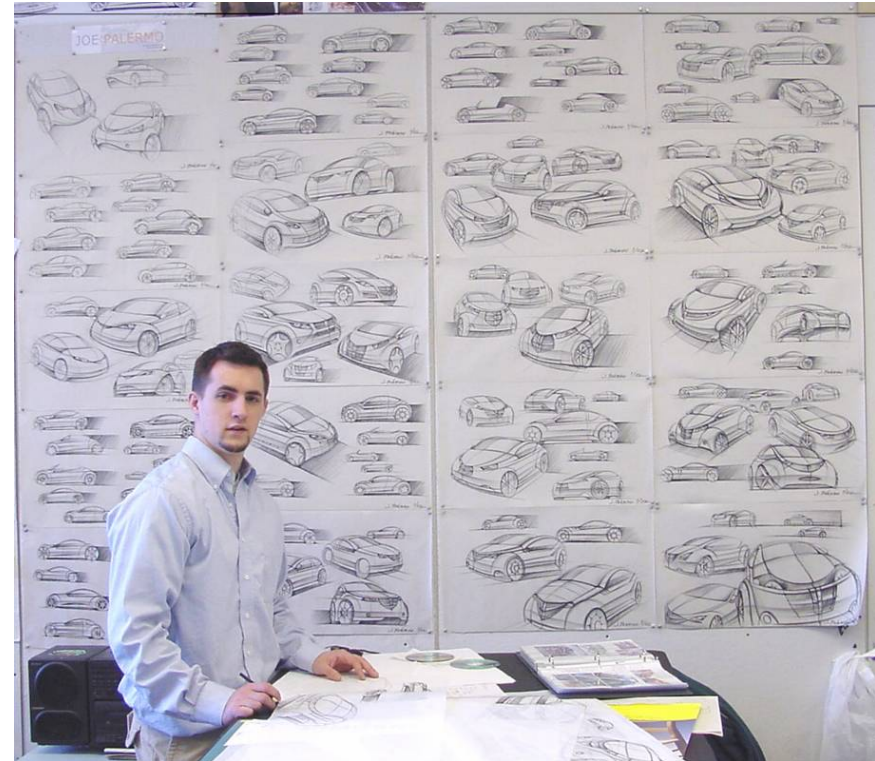
Final Presentation for a Senior Collaborative Project

Designers and Engineers A Comparison



— The Designer's Role

- To design
- Consider role of engineer
- Overall vision or “blue sky” ideas
- Product concept and innovation
- Passion for arrangement of form
- Focus on quality, aesthetics, function, and material
- Intuitive



Joe Palermo, Senior

— The Engineer's Role

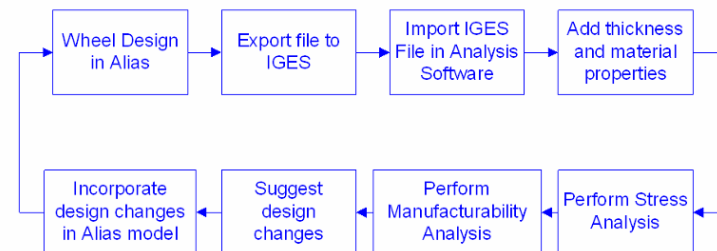
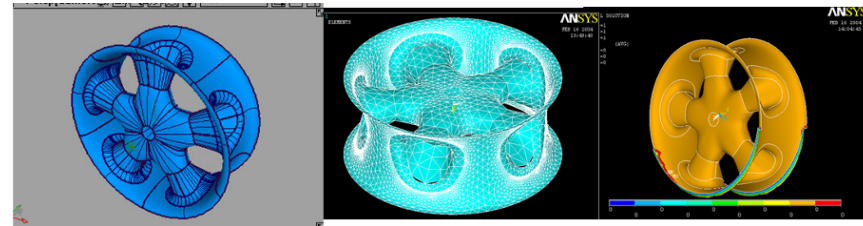
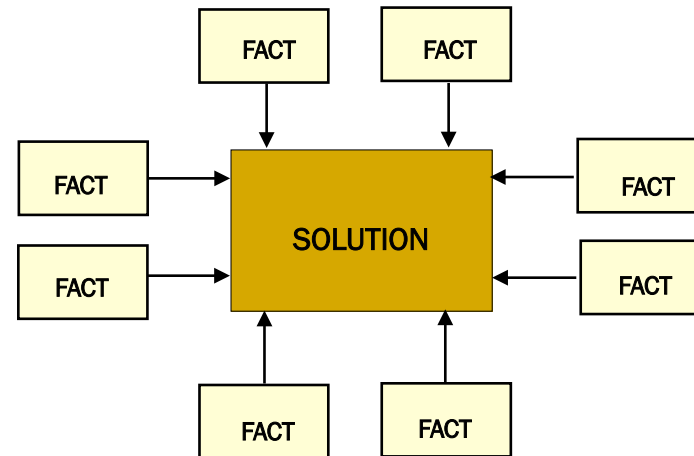
- To engineer
- Consider role of a designer
- Most direct path to the solutions
- Technological innovations
- Focus on performance, quality, technology, and manufacturing
- Speak technical language
- Thinker



Members of the Robotics Team with the Bearcat3 Robot

Convergent Thinking

- Engineering / Math / Science / Technology
- One correct answer
- Directed by a set of guidelines
- Clarifies specific pathways to a solution

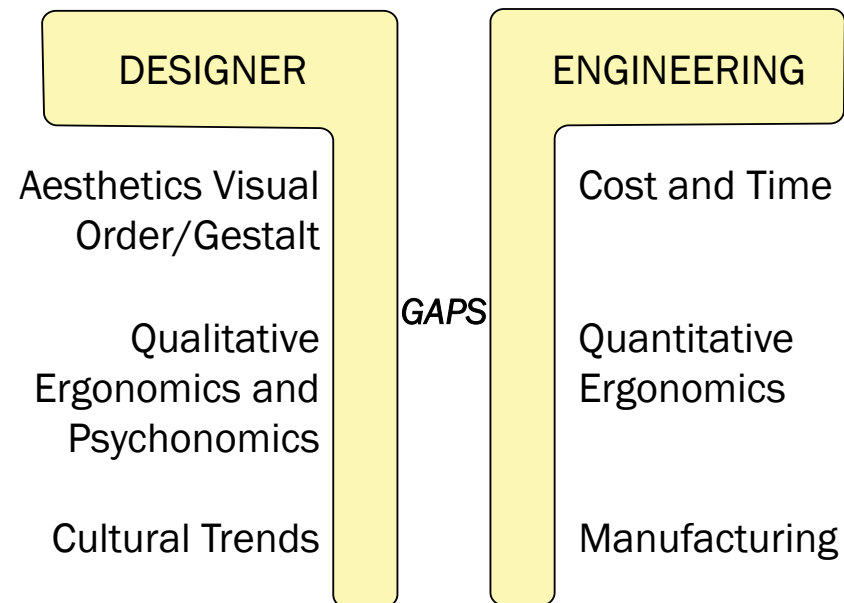


Collaborative Design and Engineering of an Automobile Wheel

Perceptual Gaps

- Discipline specific differences in perspectives that stem from thinking

- Vogel and Cagan 2002



Understanding the Difference is Critical in Effective Collaboration

— Perception of Each Other

Description from Designers

- They don't care about how the product looks as long as it works
- Math people
- Technical
- Orderly, boxy
- Unimaginative
- Simplistic and practical
- Function over form

Description from Engineers

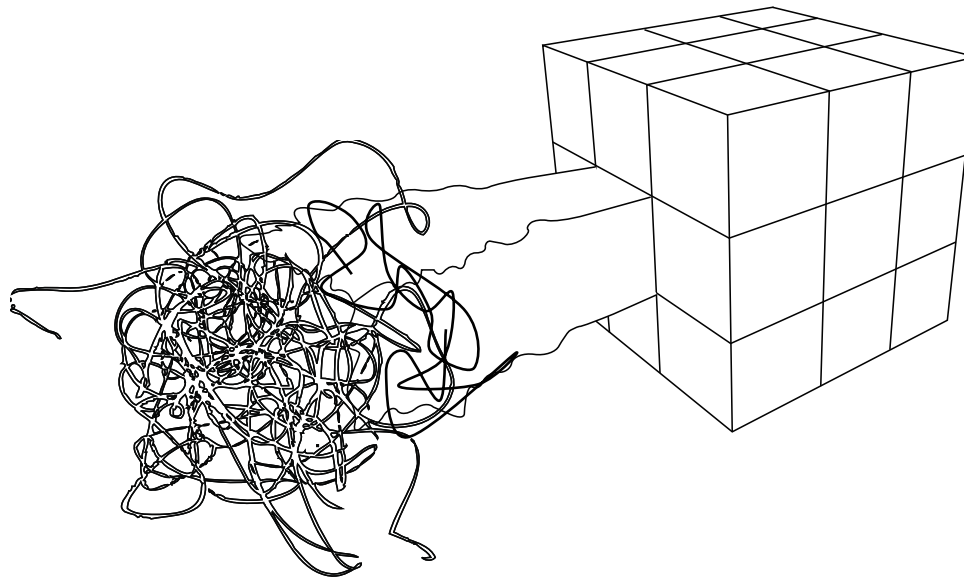
- Abstract
- Think outside the box
- Impractical
- Short sighted
- Eccentric
- Adds cost to a product for no reason
- Too good for their own good
- Hindrance to functional design

— The Hairball and the Cube

Two Different Languages

Designer

Chaos
Creativity
Emotion
Aesthetic/Form
Intuitive
Aesthetic Wisdom
Uncertainty
Open Ended Solution
Spontaneous
Subjective
Object Focus
Observation Driven
Geometry



Engineer

Order
Strategy
Technology
Scientific/Function
Rational
Chart Wisdom
Black and White
Specific Solution
Planned
Objective
Process Driven
Statistical Driven
Calculus

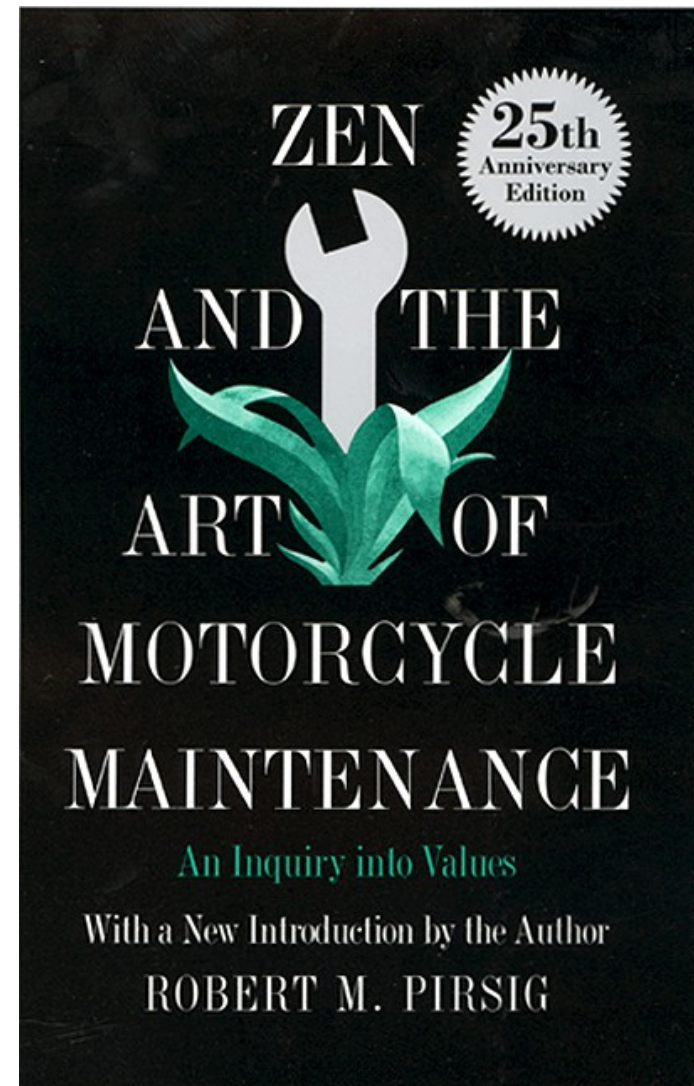
— Classical and Romantic Thinking

Human Understanding

- Classical – Engineers
- Romantic – Designers

“These tools for example...this wrench...has a certain romantic beauty to it, but its purpose is always purely classical. It's designed to change the underlying form of the machine.”

Pirsig, Robert M. *Zen and the Art of Motorcycle Maintenance*, 1975



— Can There Possibly be Similarities?

With all these differences can there
Possibly be similarities?

- Different functions
- Different views of product
- Different ways of thinking
- Perceptual gaps
- Perceptions of each other
- Hairball and the cube
- Classical and romantic thinking



— Dominance in Thinking is Not an Absolute

Left Brain

- Language dominant and works in a logical and sequential order



The key is that our dominance is a preference, not an absolute.

We use both sides of the brain, it is just that one side gets more use. Similar to being right or left handed.



Right Brain

- More visual and works intuitively, holistically, and randomly



The Body Paradox. Angela Katona - Batchelor, Boise State University

Form and Function

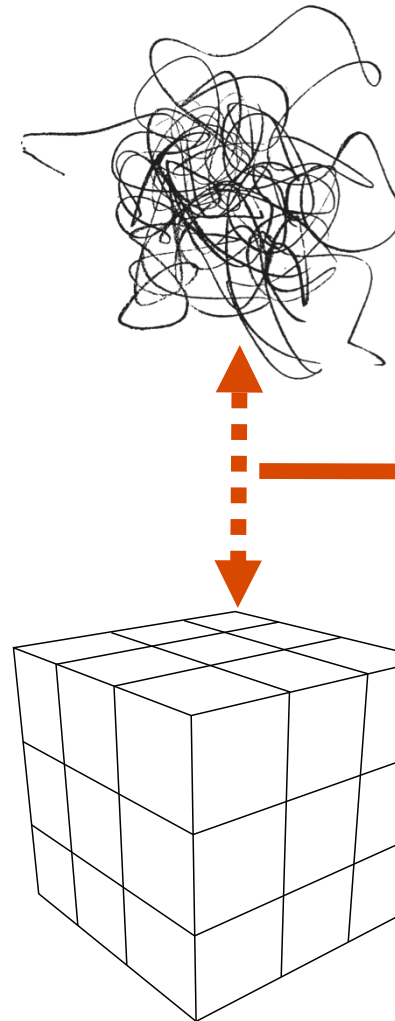
Function Follows Form - Designer

Form is Function

“Form follows function - that has been misunderstood. Form and function should be one, joined in a spiritual union.”

Frank Lloyd Wright

Form Follows Function – Engineer



FREE FORM?

Working from a common perspective generates relations and understanding.

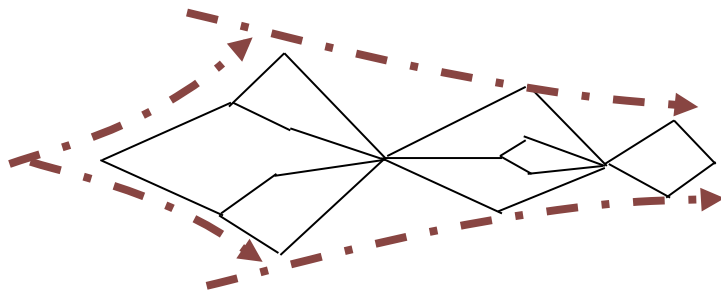
RIGID FORM?

The entire design process includes:

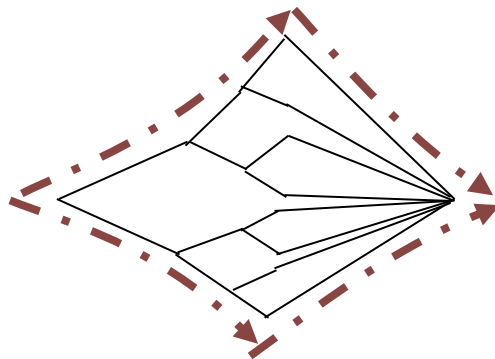
Divergent  **Convergent**

Designers and engineers experience both the divergent and convergent processes

There are several different models of this process:



1) Multiple Divergent and One-step Convergent Repeating Process



3) Multiple Divergent and One-step Convergent Process

•Divergent - Broadening Transformation Process:

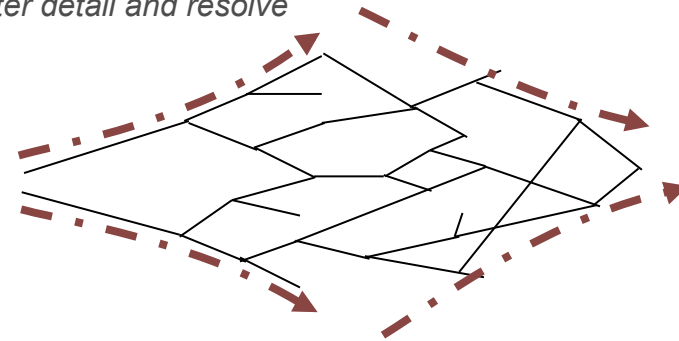
One idea generates more ideas

Design research, brainstorming, and engineering exploration expand innovation

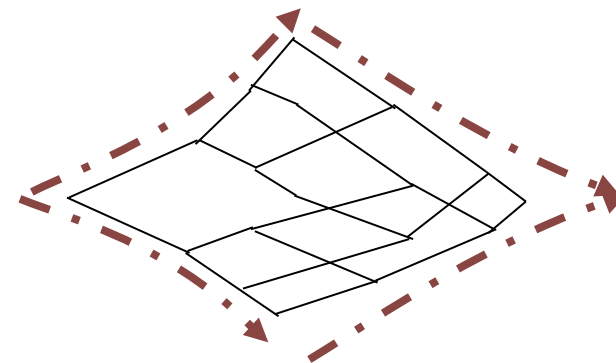
•Convergent - Deepening Transformation Process:

More ideas to one solution generates more details

Narrowing and optimizing design solutions creates designs greater detail and resolve



2) Random Multiple Divergent and Multiple Convergent Repeating Process



4) Structural Multiple Divergent and Multiple Convergent Process

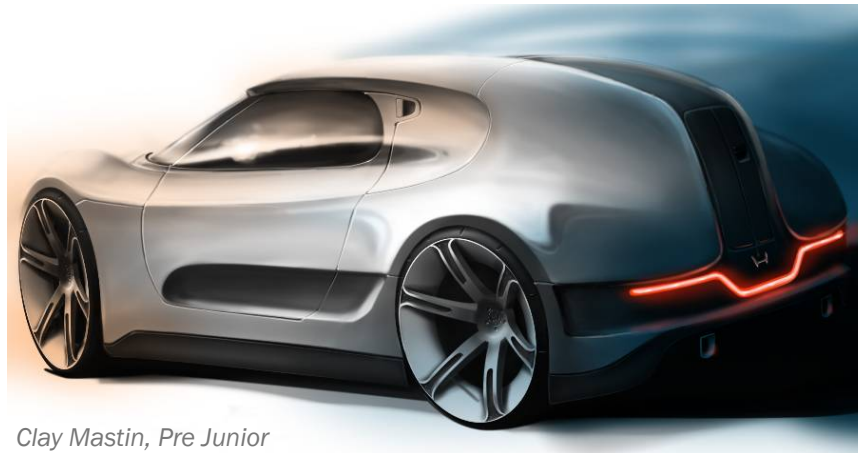
— The Logic of Intuition and Creative Engineering

DESIGNERS and ENGINEERS

- The term design/designer
 - Usability of product
- Form, function, and material
- Common platform of safety and reliability issues
 - The ergonomics / human factors
 - Selection of material
- Manufacturing / disassembly
 - Universal laws
- Emerging technologies

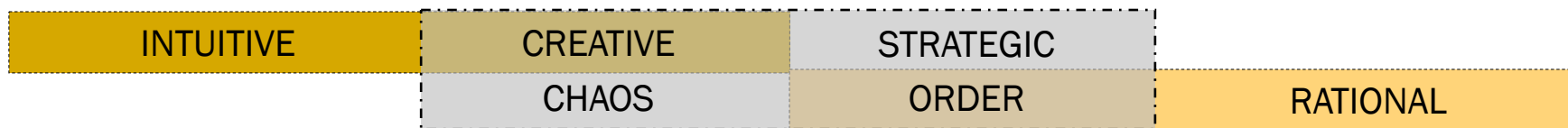
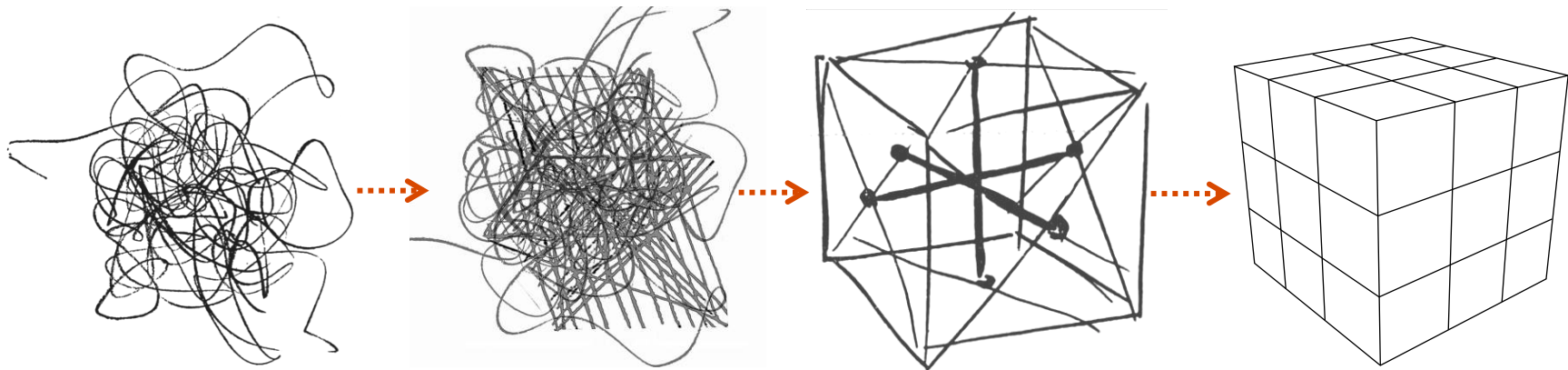
Understanding things in common builds a platform of understanding, which is critical to effective collaboration

Collaborative Process for Design and Engineering



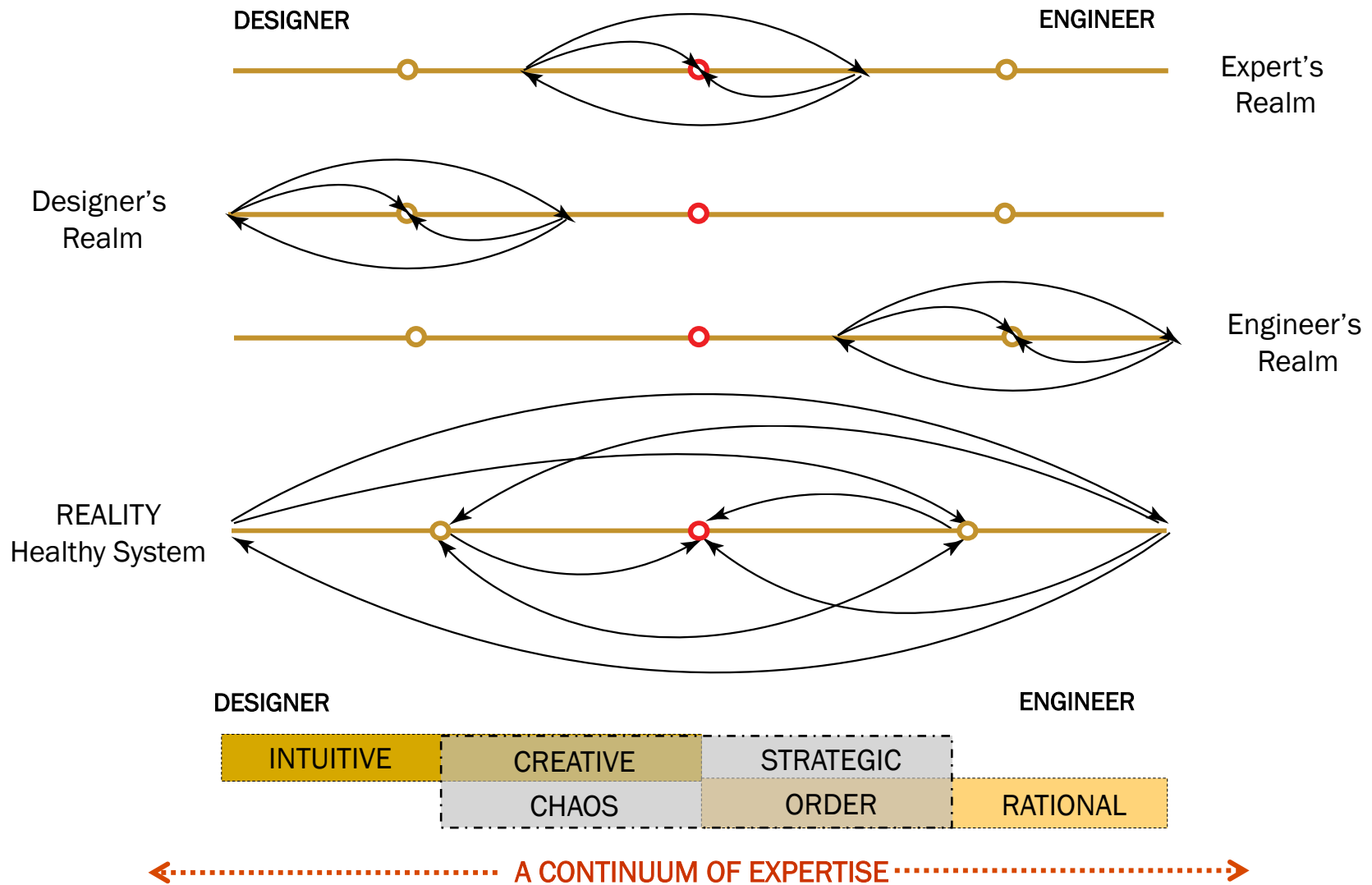
Clay Mastin, Pre Junior

Finding Common Ground in Collaborative Process



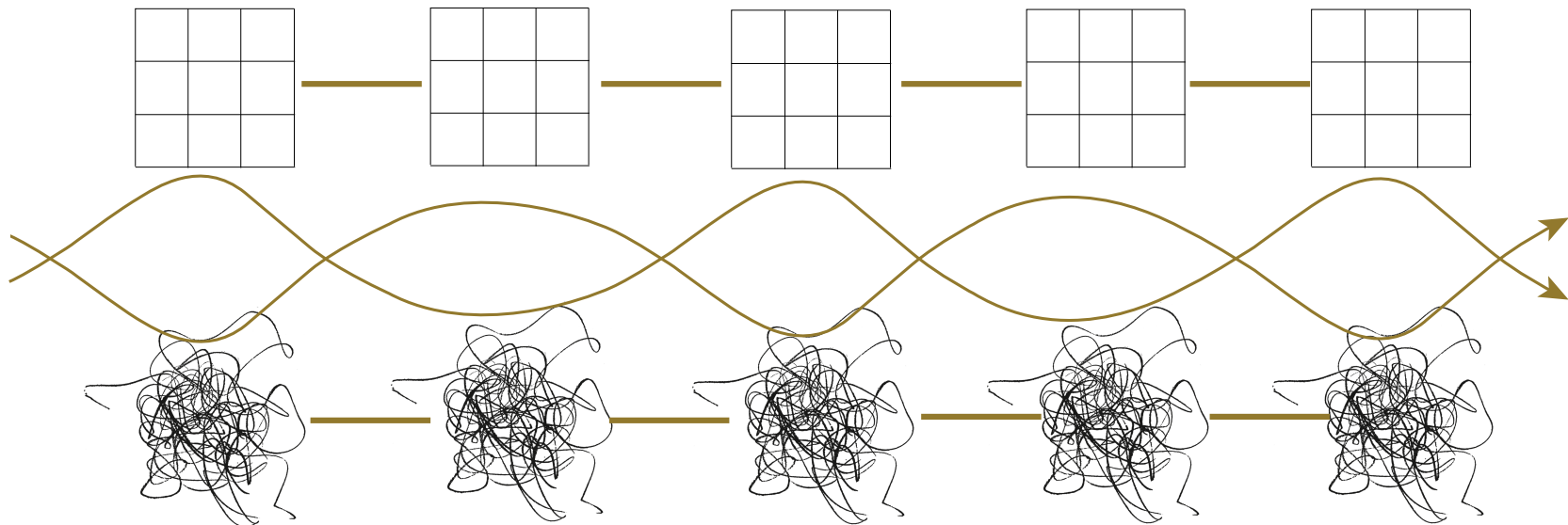
←..... A CONTINUUM OF EXPERTISE→

Organic Growth of Innovation



A Continuum of Expertise

Engineer's Realm



Designer's Realm

A Continuous Exchange Between Design and Engineering

Design and Engineering Survey

Colander



Toilet Brush



Ladle



Napkin Holder



Design and Engineering Survey

A Total of 34 Designers and Engineers Surveyed

Symbol	Function	Number of Surveys
E	Engineers	34
D	Designers	34

Colander



E	16
D	16



E	18
D	18

Ladle



E	20
D	18



E	14
D	16

Toilet Brush



E	14
D	02



E	20
D	32

Napkin Holder

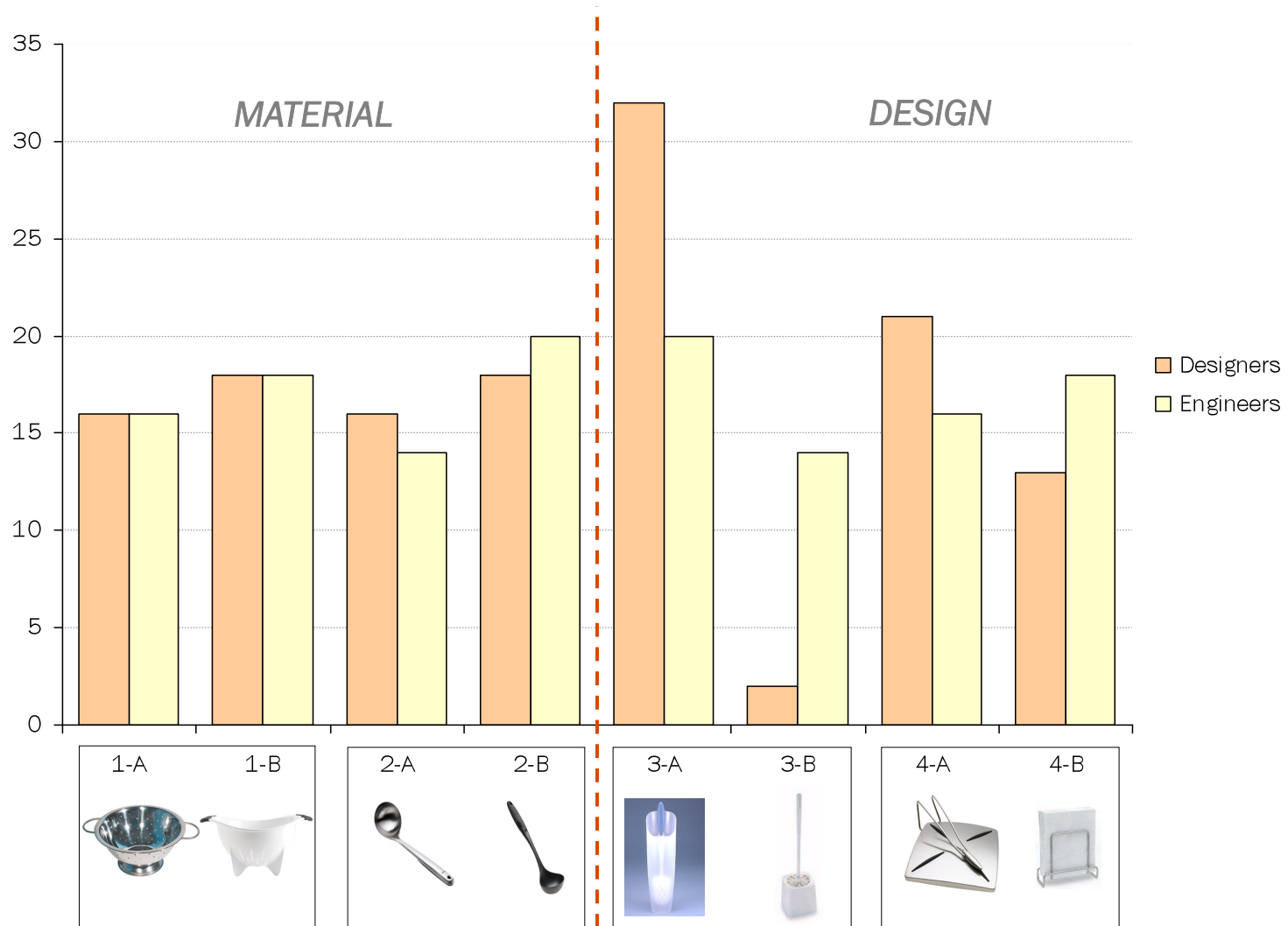


E	18
D	13



E	16
D	21

Design and Engineering Survey

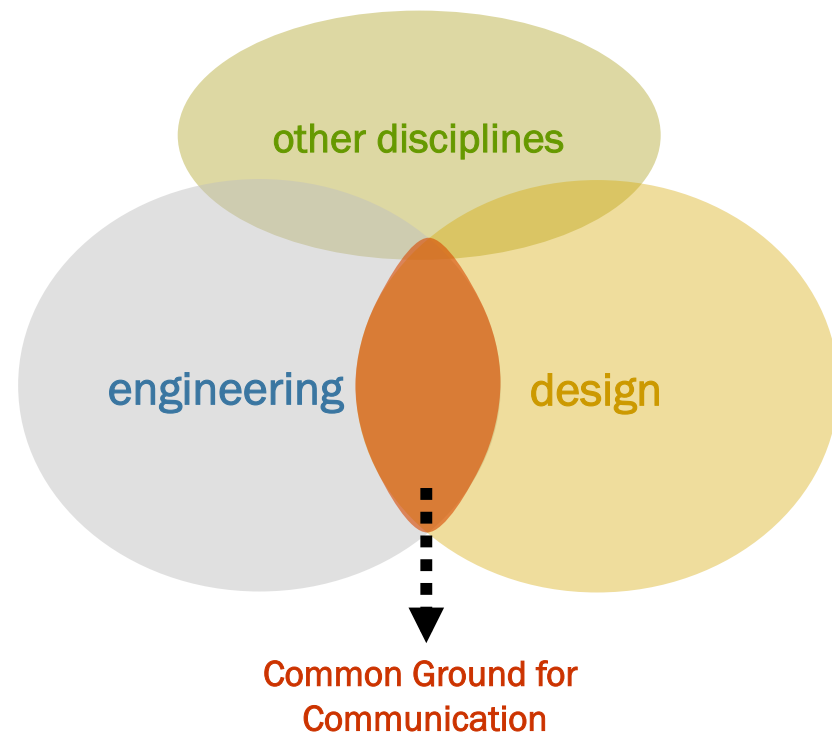


The Necessity for Collaboration



— The Necessity for Collaboration

- Teaching innovation – drive excellence
- High overall product performance
- Offer students a real world situation
- Students - addressing the most challenging issues of humanity
- Changing perceptions changes minds
- Industry motivated by profit
- Institutions of education driven by knowledge



— The Necessity for Collaboration

“Technology makes a difference, but it is the human dimension that ultimately determines the nature and extent of that difference.”

- Walton 2003. *Design Management Journal*

“Collaboration creates a feedback loop that you don't get on your own. The more different ideas you have the healthier your intellectual culture is. Working in a team environment is more likely to lead to new and surprising innovations.”

- Franz 2007. *Executive Director, Manifest Gallery*



Triad 02. Sun Kyoung Kim, University of Illinois Urbana Champaign

Creating High Performing Interdisciplinary Teamwork



Brian Hillner, Senior

— Greatest Challenges in Collaborative

- Differences are the single, most destructive factor within the product development process
- Communication between the two disciplines is key
- Understand the other person and take time to listen
- Understand that differences may be a misconception and not necessarily what is so



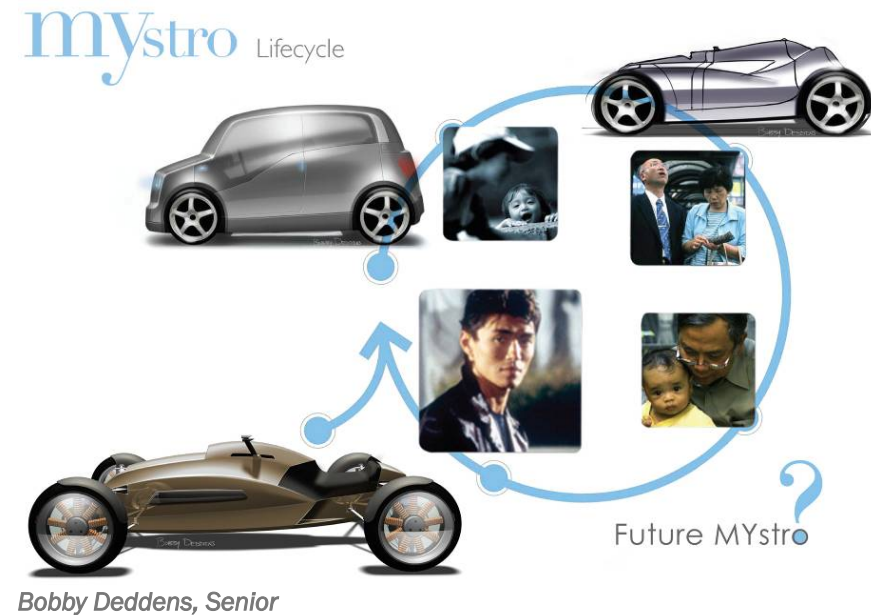
Engineering / Design Workshop



EV1 Disassembly

Creating High-Performing Interdisciplinary Teams

- Build trust
- Build balance
- Create an understanding of different disciplines
- Build common language for communication
- Overcome misconceptions



Engineering / Design Team Meeting

— Cultivating Strong Team Members

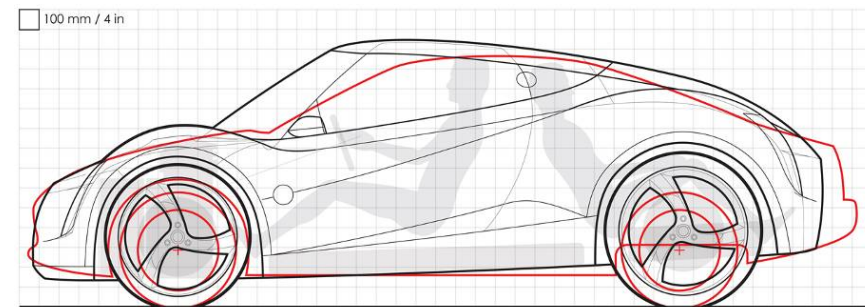
- A designer must maintain the designer's role
- An engineer must maintain the engineer's role
- Strong team members create powerful teams
- Keep everyone involved and empowered



Gary Ragle, Senior

“I wouldn't want to drive a car you engineered and you wouldn't want to drive a car that I designed.”

- Unknown Engineer to Wayne Cherry. *Former Vice President of General Motors Design*



GRO
 Wheelbase 2550 mm / 100.4 in
 Overall Width 1970 mm / 77.5 in
 Overall Length 3979 mm / 156.7 in
 Overall Height 1369 mm / 53.9 in
 Wheel Size Front 20 in x 9.8 in
 Rear 22 in x 11 in

EV1
 Wheelbase 2532 mm / 99.7 in
 Overall Width 1854 mm / 73 in
 Overall Length 4176 mm / 164 in
 Overall Height 1257 mm / 49.5 in
 Wheel Size Front 14 in x 7 in
 Rear 14 in x 7 in

Alex Walters, Senior

Philosophy of Non-Isolation



Industry / Academia



Students / Colleagues



Trans-Generational

— Creating Strong Interdisciplinary Leaders

Who Wears the Pants?

Engineer?

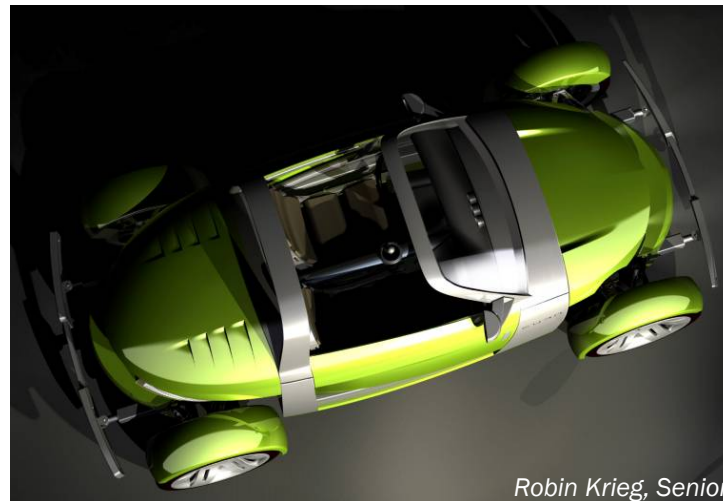
Or

Designer?



Finger-ware. Nathan Cline, University of Iowa

New Model For Collaborative Practice



Robin Krieg, Senior

— New Model for Collaborative Practice

- Change / Adapt / Preserve
- Have the wisdom to preserve what works and change what does not work
- Respect for each other's discipline
- Understand that different disciplines overlap
- Nurture organic growth within the PLM process
- Maintain respective roles



Collaborative Meeting



Final Presentation

— Collaborative Workshops

- Design workshop for engineering
- Engineering workshop for design
- Structured team meetings



Engineering Workshop for Designers



Design Workshop for Engineers



Engineering Workshop for Designers

Collaborative Workshops

Experimental Learning and
Active Teaching

Creative Activities and Exploration



Applied Knowledge

This Mixture Advances the
Collaborative Learning Process



Engineer Drawing



Designers Discussing

— Perceptions after the Collaborative Experience

Description from Designers

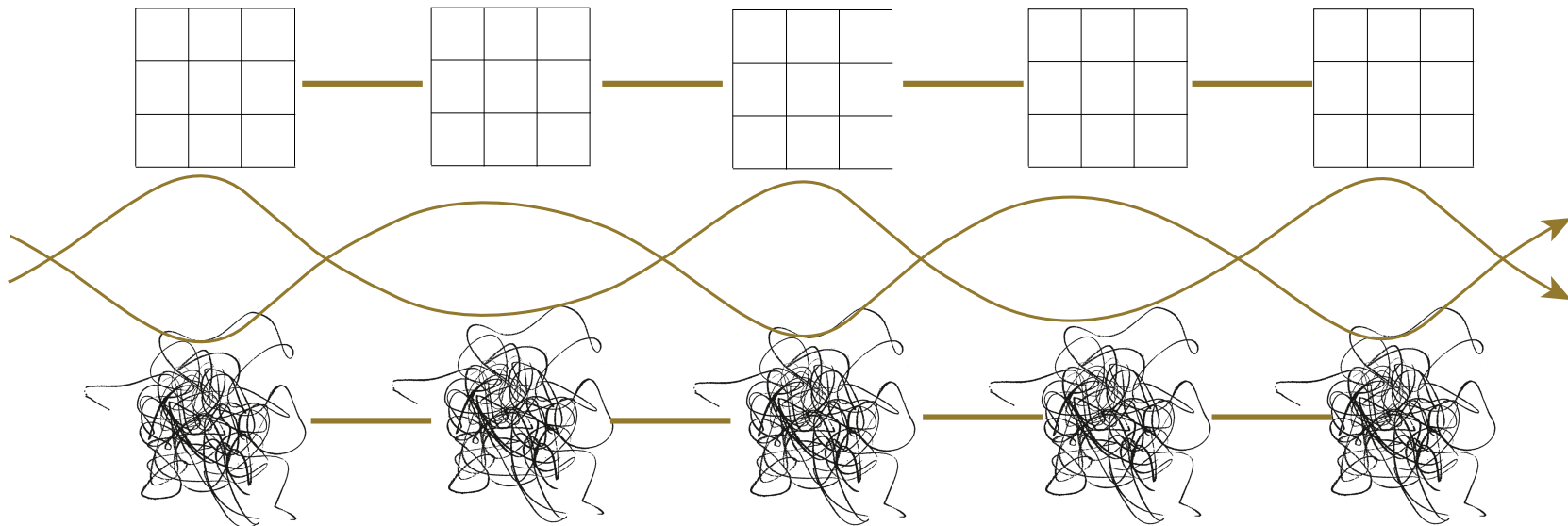
- Necessary
- Helpful
- Finding new / innovative mechanisms
- Good sense / respect for design

Description from Engineers

- Creative, skilled, and enthusiastic
- Dedicated, high energy
- Good presentation skills
- Good at brainstorming / finding alternatives
- Adaptive and positive attitude

— New Model for Collaborative Practice

Engineer's Realm



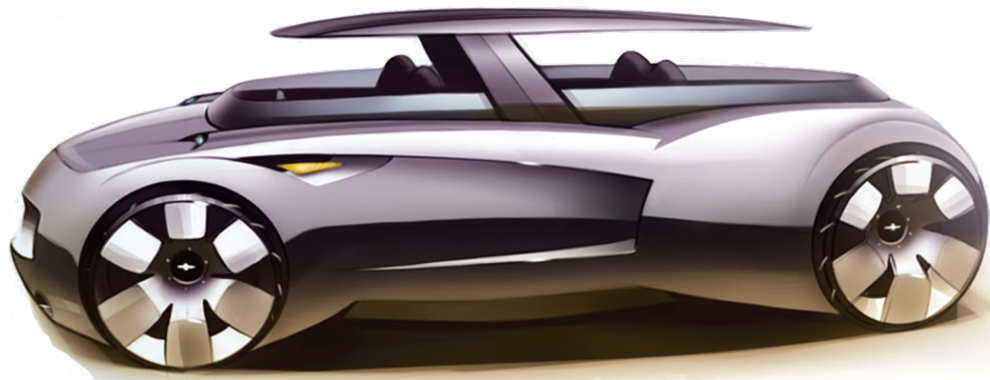
Designer's Realm

A Continuum of Expertise

Generates Powerful Interdisciplinary Teams

DRIVES EXCELLENCE IN INNOVATION

Thank You



Mark Chrapla, Senior