

Enchantment Chapter Monthly Meeting



9 Oct 2019 - 16:45-18:00 MT

Bioinspiration for Future Systems Engineering and Architecture
Randall Anway, AIA and Principal, New Tapestry, LLC

Abstract: “Bioinspired” refers to a range of novel approaches (biomimetics, bionics, biodesign, etc.) to design that make use of disciplined studies of natural systems. Recent and emerging developments in such design methods are enhancing the capacity of engineers and architects to move beyond conventional design set-points and identify effective strategies to address novel problem spaces. This program will provide an overview of the practice of bioinspired design as it may be applied toward future systems engineering and architecture project work. Additionally, practical approaches to near and long-term implementation will be discussed.

Download slides any time from the Library at www.incose.org/enchantment

NOTE: This meeting will be recorded

Today's Presentation

Things to think about

- How can this be applied in your work environment?
- What did you hear that will influence your thinking?
- What is your take away from this presentation?

Speaker Bio

Randall Anway, AIA is a Registered Architect in New York and Connecticut specializing in interdisciplinary architectural design research inspired by natural patterns and systems. Since 2011, he has studied emerging practices of bioinspired design and biomimetics applied to architecture and systems engineering. He holds a Master of Architecture from the University of Illinois, Urbana-Champaign and Bachelor of Fine Arts from the University of Connecticut. Randall's work draws on diverse experience in academic, industrial, non-profit, and small business settings involved with design and programmatic processes. As Co-chair of the Natural Systems Working Group for the International Council on Systems Engineering, and as Secretary of the Board of Directors for the Connecticut Chapter of the American Institute of Architects, he supports professional development for Architects and Engineers. Through a collaborative approach and consultancy, New Tapestry, LLC, he offers unique, innovative, and practical research concerning building capacity for innovation in design and engineering.

Today's Presentation



Things to think about

- How can this be applied in your work environment?
- What did you hear that will influence your thinking?
- What is your take away from this presentation?

Bioinspiration for Future Systems Engineering and Architecture

Randall Anway
New Tapestry, LLC
Old Lyme, CT
randy@new-tapestry.com

October 9, 2019

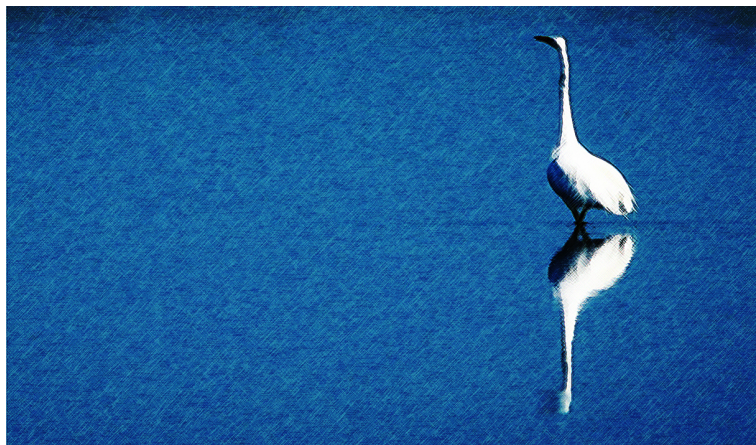


Changing set points: Complexity

Randall Anway

7

10/09/2019



How did we get here?

Randall Anway

8

10/09/2019



100 generations:
Hierarchies

10 generations:
Mechanization

1 generation:
Networks

A brief history of engineering

Randall Anway

9

10/09/2019

**Clichés of yesterday will no longer
do today, and will, no doubt, be
hopelessly out of date tomorrow.**
Albert Einstein, 1948

Creative Tension

**What I cannot create,
I do not understand.**
Richard Feynmann, 1988

Engineering Thinking

**...the more we think of ourselves as
designers, the less we think of
ourselves as modernizers.**
Bruno Latour, 2008

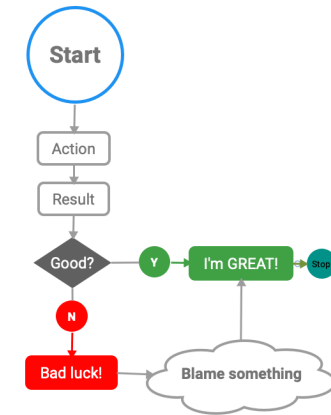
Design Thinking

**The major problems in the world are
the result of the difference between
how nature works and the way people
think.**
Gregory Bateson (as quoted by Nora Bateson, 2010)

Systems Wisdom

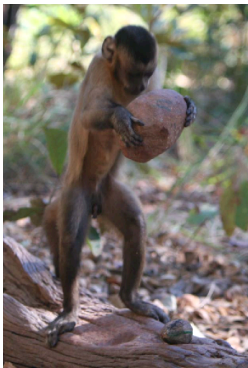
So, how *do* people think?

When you
come to a
fork in the
road...



Take it!
-Yogi Berra

Motivated reasoning



System 1

Thinking, Fast and Slow. Daniel Kahneman, 2011

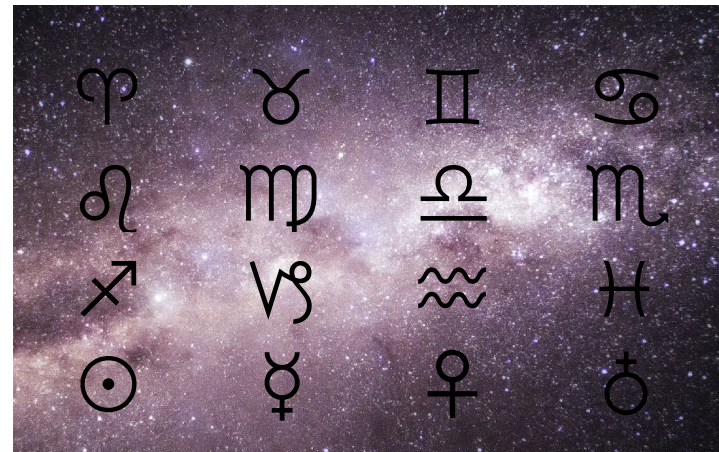


- Rene Magritte

System 2

Fast vs Slow

The Patterning Instinct. Jeremy Lent, 2017



Patterns

**Confirmation bias
Fast/Slow
Patterns
etc...**

The only choices for design?

How *does* nature work?

Why Evolution is True. Jerry Coyne, 2009

Aspects of Evolution:

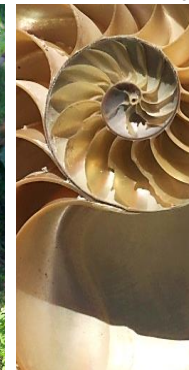
- Natural Selection
- Gradual
- Speciation
- Common Ancestry
- Other influences

Nature's 'Design Process'

The Beauty of Numbers in Nature. Ian Stewart, 2017



Branch



Spiral



Junction



Meander

Basic Patterns



Ecological Patterns

Randall Anway

22

10/09/2019

How else could 'design' be?

Exploring Problem Spaces

Randall Anway

23

5/15/2018

Bio-inspired, biomimetic, biophilic,
biodesigned

bios = life
spirare = breathe
mimesis = imitate
philia = love
designare = point out

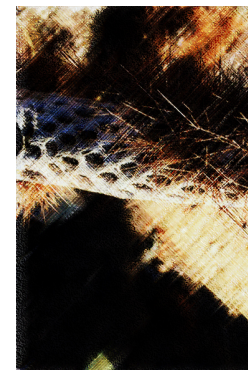


*Biomimicry Resource Handbook. Dayna Baumeister et al, 2014

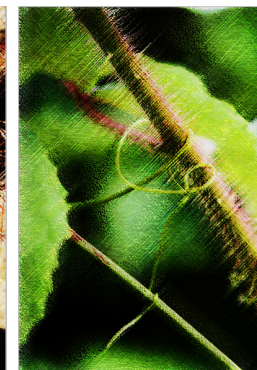
Randall Anway

24

10/09/2019



Structure



Behavior









Function

Researching Nature's strategies

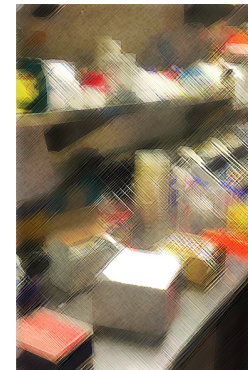
Randall Anway

25

10/09/2019

Worksheet: <i>Visualize Tradeoffs</i>	Functional Responses			
Functional Challenges	Plants	Tree	Cactus	Explore
	Transform flows			When? How?
	Channel flows			What? Where from/to?
	Balance flows			How? Why?

Discovering strategies



Lab Science



Experiential Learning



Speculative Manufacturing

Applying Strategies

Blue Ocean Strategy. Renée Mauborgne/W. Chan Kim, 2004

Technology	Resources	Climate
<ul style="list-style-type: none"> • Nanotech • Biotech • Robotics • ICT • Cognitive Science 	<ul style="list-style-type: none"> • Peak: <ul style="list-style-type: none"> - Oil - Water - Minerals - Agriculture - Fish 	<ul style="list-style-type: none"> • Health • Agriculture • Energy • Water • Organisms • Ecologies • Geography
Culture	Theory	Practice
<ul style="list-style-type: none"> • Media • Mobility • Land Use • Structures • Places 	<ul style="list-style-type: none"> • Science • Humanities • Religion • Economics • Governance 	<ul style="list-style-type: none"> • Organization • Goals • Processes • Roles • Plans

Novel Problem Spaces

Walking with Mentors Unpacking Complexity Feedback Loops

Short term -> Long term



Wisdom of the heart

Walking with mentors

Randall Anway

30

10/09/2019

Worksheet: <i>Understand Tradeoffs</i>	Functional Responses			
Functional Challenges	Plants	Tree	Cactus	Explore
	Transform flows	Cycle water and sunlight in canopy	Cycle water and sunlight in stem	When? How?
	Channel flows	Offer food and shade	Collect water and hold soil	What? Where from/to?
	Balance flows	Collaborate with neighbors	Compete with neighbors	How? Why?

Unpacking Complexity

Randall Anway

31

10/09/2019

Experiencing Change
Deep Structures that Connect
Wise Systems

Feedback Loops: Long Term Δ

Randall Anway

32

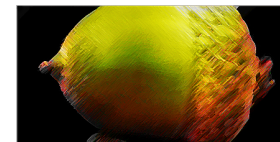
10/09/2019



Detect patterns?



Locate resources?



Respond in context?

Experiencing Change

Randall Anway

33

10/09/2019

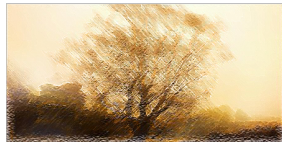
A Beautiful Question. Frank Wilczek, 2016



Mystery

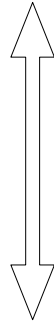


Beauty



Life Stories

Experience



Knowing

Deep Structures that Connect

Randall Anway

34

10/09/2019

Worksheet: <i>Prioritize Tradeoffs</i>	Functional Responses			
Functional Challenges	Plants	Tree	Cactus	Explore
	Transform flows	Minimize maximal flow	Maximize minimal flow	When? How?
	Channel flows	Attract & disperse	Capture & collect	What? Where from/to?
	Balance flows	Distribute abundant resource	Cultivate scarce resource	How? Why?

How does it fit?

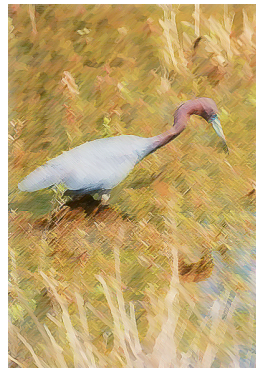
Randall Anway

35

10/09/2019



Beginners Mind
Simply connect



Finding Patterns
Attention Matters




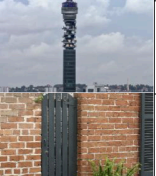

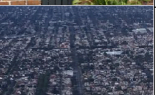
Discovering Place
Niche = Identity

Wise Systems | simple rules

Randall Anway

36

10/09/2019

Worksheet: <i>Translate Tradeoffs</i>	Functional Responses			
Functional Challenges	Plants	Tree	Cactus	Explore
	Transform flows			When? How?
	Channel flows			What? Where from/to?
	Balance flows			How? Why?

How to emulate?

Randall Anway

37

10/09/2019

**Bricolage
Products
Services
Architectures**

Applications

Randall Anway

38

10/09/2019

The Storm of Creativity. Kyna Leski, 2015



Technical Trials



Evolving Loops



Gathering Systems

Bricolage: Iteration and Evolution

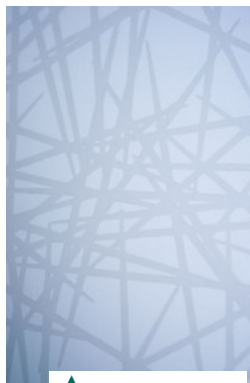
Randall Anway

39

10/09/2019



VELCRO®



ARNOLD GLAS



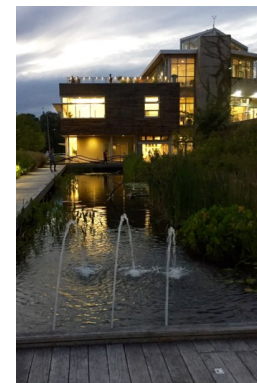
PAX
WATER TECHNOLOGIES™

Products

Randall Anway

40

10/09/2019



Phipps Center for Sustainable Landscapes,
Pittsburgh, PA



RW Kern Center
Amherst, MA



William Street Community Garden
New Haven, CT

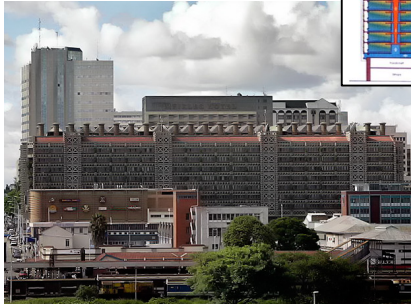
Services

Randall Anway

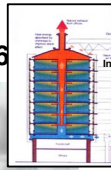
41

10/09/2019

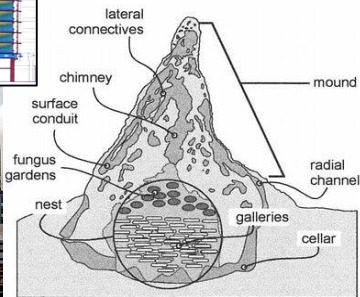
Eastgate Centre Harare, Zimbabwe, 1996



en.wikipedia.org/wiki/Eastgate_Centre,_Harare



inhabitat.com/building-modelled-on-termites-eastgate-centre-in-zimbabwe



content-usa-today.blogspot.com/2007_05_01_archive.html

Architectures

Randall Anway

42

10/09/2019

**The true voyage of renewal consists
not in visiting new lands but in seeing
with new eyes.**

Marcel Proust (translation)
(Remembrance of Things Past Vol. 5, 1923)

New Stories

Randall Anway

43

10/09/2019



Unlearning

Randall Anway

44

10/09/2019

Baumeister, Dayna et al. *Biomimicry Resource Handbook*, 2014.
Coyne, Jerry. *Why Evolution is True*, 2009.
Duke, Annie. *Thinking in Bets*, 2018.
Kahneman, Daniel. *Thinking, Fast and Slow*, 2011.
Lent, Jeremy. *The Patterning Instinct*, 2017.
Leski, Kyna. *The Storm of Creativity*, 2015.
Mauborgne, Renée & W. Chan Kim. *Blue Ocean Strategy*, 2004.
Stewart, Ian. *The Beauty of Numbers in Nature*, 2017.
Wilczek, Frank. *A Beautiful Question*, 2016.

Further reading

Randall Anway

45

10/09/2019

Bioinspiration for Future Systems Engineering and Architecture

Randall Anway
New Tapestry, LLC
Old Lyme, CT
randy@new-tapestry.com

Thank you!

October, 2019



Please

The link for the online survey for this meeting is

- https://www.surveymonkey.com/r/2019_10_MeetingEval

Look in GlobalMeet chat box for cut & paste link

Slide presentation can be downloaded now/anytime from:

- The library page at: www.incose.org/enchantment
- Recording will be there in the library soon