First Principles Innovation: Compass, Contradiction, Complexity

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Kobus Cilliers

IEEE SISIG Bracknell, 23 September 2019
A Tragedy

Natasha Ednan-Laperouse
17 July 2016

artichoke, olive & tapenade baguette
A Tragedy

Natasha Ednan-Laperouse
17 July 2016

200+ failures/year
35+ hospitalizations
7+ deaths
‘inherently unsafe’
In Search Of ‘InnovationDNA’

- MILLIONS of systems
- HUNDREDS of different problems
- TENS of successful solutions
Innovation Assistance?
98% of QFD-sparked innovation attempts fail
98% of Lean-sparked innovation attempts fail
98% of 6Sigma-sparked innovation attempts fail
98% of Design-Thinking innovation attempts fail
98% of JTBD-sparked innovation attempts fail
98% of OBI-sparked innovation attempts fail
98% of WOIS-sparked innovation attempts fail
98% of Blue-Ocean innovation attempts fail
98% of i4i-sparked innovation attempts fail
98% of Agile-sparked innovation attempts fail
98% of Scrum-sparked innovation attempts fail
99.5% of Open Innovation attempts fail
InnovationDNA - What The ‘2%’ Did

Complexity

Compass

Contradiction
Complexity Landscape Model

System

External Environment

<table>
<thead>
<tr>
<th>SIMPLE</th>
<th>COMPLICATED</th>
<th>COMPLEX</th>
<th>CHAOTIC</th>
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Complexity Landscape & W. Ross Ashby

![Image of the Complexity Landscape Diagram]

- **Ashby Line**
- **Disintegration Line**

System

External Environment

- SIMPLE
- COMPLICATED
- COMPLEX
- CHAOTIC

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Complexity Landscape - Resilience Zone

- **System**
  - SIMPLE
  - COMPLICATED
  - COMPLEX
  - CHAOTIC

- **External Environment**
  - SIMPLE
  - COMPLICATED
  - COMPLEX
  - CHAOTIC

**Ashby Line**

**Disintegration Line**

**Resilience Zone**
Complexity Landscape - ‘Natural’ Forces

- Standardisation
- Globalisation & the 2nd Law of Thermodynamics

External Environment

Simple

Complicated

Complex

Chaotic

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Complexity Landscape - Heuristic #1

If there are 2+ humans involved, the system is complex.
Boeing 737

100/200 Series

300 Series

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Boeing 737

External Environment

AntiFragile Line

Ashby Line

Disintegration Line

System

productionisation

designers solve contradiction

need for new engines
Boeing 737 Max

What is new on Boeing’s 737 MAX

**Winglets**
Dual-feather winglet reduces fuel consumption by up to 1.8% compared with existing winglets.

**Strengthening**
Wings, fuselage and main landing gear strengthened at strategic locations to carry heavier engines.

**Quieter aircraft**
737 Max has a 40% smaller noise footprint than existing single-aisle airplanes.

**Nose landing gear**
Raised to lift the wing slightly and allow the relocation of the engines on the wing.

**Tail cone**
Streamlined for better air flow.

**MAX FAMILY:**

- **737-MAX 7**
  - Wingspan: **117 feet, 10 inches**
  - Length: **116 feet, 8 inches**
  - Passengers: **172 (maximum seating)**

- **737-MAX 8**
  - 117 ft., 10 in.
  - 129 ft., 8 in.
  - 189 (maximum seating)

- **737-MAX 9**
  - 117 ft., 10 in.
  - 138 ft., 4 in.
  - 220 (maximum seating)

**Propulsion installation**
New strut, fairing, nacelle, fan and primary duct chevrons.

**New engines**
CFM LEAP-1B has superior fuel efficiency which reduces carbon emissions.

Source: Boeing

MARK NOWLIN / THE SEATTLE TIMES
Boeing 737 Max

- AntiFragile Line
- Ashby Line
- Disintegration Line

System

External Environment

- SIMPLE
- COMPLICATED
- COMPLEX
- CHAOTIC

- need for bigger plane
- designers solve contradictions

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Boeing 737 Max

System

External Environment

AntiFragile Line

Ashby Line

Disintegration Line

需要更大的飞机

设计者解决矛盾

“我们晚了”
Complexity Landscape - EpiPen

External Environment

- SIMPLE
- COMPLICATED
- COMPLEX
- CHAOTIC

System

- SIMPLE
- COMPLICATED
- COMPLEX
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Ashby Line

Disintegration Line

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Natasha’s Law

All food from all outlets will require ingredient labelling’
For every complex problem there is an answer that is clear, simple, and wrong.

H. L. Mencken
Complexity Landscape - Natasha’s Law

System

External Environment

- SIMPLE
- COMPLICATED
- COMPLEX
- CHAOTIC

Ashby Line

Disintegration Line

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For every complex problem there are thousands of clear, simple, wrong answers.

For every complex problem there is a clear, simple, right one.

If we understand and affect the first principles.
First Principles

Kids need to eat dirt to develop immune system. The human body is antifragile... if correctly primed ("use it or lose it")
InnovationDNA

Complexity

Contradiction

Compass
Most people overestimate what they can do in one year and underestimate what they can do in ten years.

— Bill Gates —
stuff we’d like to improve

STRAIGHT

STRUGGLE

STRIDE

STUCK

time
Solve The ‘STUCK’ Contradiction
InnovationDNA Pillar #2

Everything evolves to a ‘free, perfect, now’ end-state

(all of the benefits, none of the downsides)
Two Ways To Get There:

Add new (self) functions

Solve a contradiction
InnovationDNA Pillar #3

Contradiction-Solving

(based on 10.1M case studies)

3: External Exaptation
4. Radical Exaptation

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Innovation DNA

Complexity

Compass

Contradiction
How To Not Solve Contradictions - EpiPen

Delivery Efficacy vs Strength (Safety)

Length Of Needle vs 'optimum' (OR: 'how to kill patients')
Contradiction Matrix

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<th>Physical</th>
<th>Performance</th>
<th>Efficiency</th>
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Contradiction Matrix & Boeing 737-100

Increase Diameter but...

Insufficient Ground-Clearance

solutions already found by others
InnovationDNA - The Golden Triangle

External Environment ('Super-System')

System

- SIMPLE
- COMPLICATED
- COMPLEX
- CHAOTIC

Disintegration Line

Golden Triangle

- Complexity
- Compass
- Contradiction

Ashby Line

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Thank You

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