Matrix & Principles:
Past, Present & Future

Darrell Mann
A Tragedy

Natasha Ednan-Laperouse
17 July 2016

artichoke, olive & tapenade baguette
A Tragedy

Natasha Ednan-Laperouse
17 July 2016
A Tragedy

200+ failures/year
35+ hospitalizations
7+ deaths
‘inherently unsafe’

Natasha Ednan-Laperouse
17 July 2016

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Another Tragedy?

Matrix 2003
Updating the TRIZ Contradiction Matrix

Based on research of patents and other best-practice conflict resolution solutions from across the world 1985-2003

250,000 patents
1. Weight of moving object  
2. Weight of stationary object  
3. Length of moving object  
4. Length of stationary object  
5. Area of moving object  
6. Area of stationary object  
7. Volume of moving object  
8. Volume of stationary object  
9. Shape  
10. Amount of Subst  
11. Amount of Information  
12. Duration of action - moving object  
13. Duration of action - stationary object  
14. Speed  
15. Force/Torque  
16. Use of energy by moving object  
17. Use of energy by stationary object  
18. Power  
19. Stress/Pressure  
20. Strength  
21. Stability  
22. Temperature  
23. Illumination Intensity  
24. Function Efficiency  
25. Loss of Substance  
26. Loss of Time  
27. Loss of Energy  
28. Loss  
29. Noise  
30. Harmful Emissions  
31. Object Generated Side Effects  
32. Adaptability/Versatility  
33. Compatibility/Connectability  
34. Ease of Operation  
35. Reliability  
36. Repairability  
37. Security  
38. Safety/Vulnerabilty  
39. Aesthetics  
40. Object affected harmful effects  
41. Manufacturability  
42. Accuracy of manufacturing  
43. Automation  
44. Productivity  
45. System  
46. Control Complexity  
47. Ability to Detect/Measure  
48. Measurement Precision

1. Every Patent
2. Establish Level of Invention
3. Further Analysis? (Y/N)
   - Y: Contradiction Analysis
   - N: Standards Analysis
   - N: Knowledge/Effects Analysis
   - N: Trends Analysis
### Screenshot of Stand-Alone Version of Software Tool

#### Table: Worsening Features vs. Improving Features

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#### Patent Principle:

- **10(2)**
- **15(3)**
- **24(3)**
- **Others**

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Matrix Explorer – Principle Folders

This is the screen that opens when I click on each of the folders.
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**Hands-On Systematic Innovation**

1st Edition: 2004
2nd Edition: 2007
Parameter We Want to Improve - Size (Static)

<table>
<thead>
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<th>Worsening Parameter</th>
<th>List of Relevant Inventive Principles (decreasing order of frequency)</th>
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<td>Size (Dynamic)</td>
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<td>Amount of Data</td>
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<td>Interface</td>
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<td>Speed</td>
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<td>Accuracy</td>
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<td>Stability</td>
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<tr>
<td>Ability to Detect/Measure</td>
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<td>Loss of Time</td>
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<td>Loss of Data</td>
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<tr>
<td>Harmful Effects Generated By System</td>
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<tr>
<td>Adaptability/Versatility</td>
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<tr>
<td>Compatibility/Connectability</td>
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<td>Ease Of Use</td>
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<td>Reliability/Robustness</td>
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<td>System Complexity</td>
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<td>Control Complexity</td>
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<td>Automation</td>
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Rethinking The Principles

RESOURCES | IDEALITY | FUNCTION | CONTRA-DICTION | SPACE TIME INTERFACE

Blessing In Disguise | Self-Service | Change Function

Understanding Populations Better Than They Understand Themselves

Darrell Mann
Yekta Özözer

2009
26. Loss of Time  
27. Loss of Energy  
28. Loss of Information  
29. Noise  
30. Harmful Emissions  
31. Object Generated Side Effects  
32. Adaptability/Versatility  
33. Compatibility/Connectability  
34. Ease of Operation  
35. Reliability  
36. Repairability  
37. Security  
38. Safety/Vulnerability  
39. Aesthetics  
40. Object affected harmful effects  
41. Manufacturability  
42. Accuracy of manufacturing  
43. Automation  
44. Productivity  
45. System Complexity  
46. Control Complexity  
47. **Positive Intangibles**  
48. **Negative Intangibles**  
49. Ability to Detect/Measure  
50. Measurement Precision  

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ApolloSigma - Patent Quality Assessment

2009
PanSensic Contradiction Finder

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<tr>
<th>Design</th>
<th>Production</th>
<th>Supply</th>
<th>Support</th>
<th>Customer</th>
<th>Systems</th>
<th>Intangibles</th>
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<td>Production Spec/ Capability/ Flexibility</td>
<td>Supply Spec/ Capability/ Flexibility</td>
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### Business Matrix 3.0

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<th>Supply</th>
<th>Support</th>
<th>Customer</th>
<th>Systems</th>
<th>Intangibles</th>
</tr>
</thead>
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**Matrix: 2016**

**Book: 2018**
In Search Of ‘InnovationDNA’

- MILLIONS of systems
- HUNDREDS of different problems
- TENS of successful solutions
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
InnovationDNA

Complexity

Compass

Contradiction
Cynefin

- Complicated: Knowable, Unfamiliar
- Obvious: Known, Familiar
- Complex: Unknown
- Chaotic: Unknowable
- Disorder

Understanding → Complicated
Standardisation → Obvious
Control → Complex
Loss of control → Chaotic

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Complexity Landscape Model

System

SIMPLE  COMPPLICATED  COMPLEX  CHAOTIC

SIMPLE  COMPLICATED  COMPLEX  CHAOTIC

External Environment
Complexity Landscape Model

System

External Environment

Disintegration Line

COLLAPSE ZONE
Complexity Landscape & W. Ross Ashby

System

External Environment

Simple

Complicated

Complex

Chaotic

Ashby Line

Disintegration Line

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Complexity Landscape - Resilience Zone

- Ashby Line
- Disintegration Line

System

External Environment

- SIMPLE
- COMPLICATED
- COMPLEX
- CHAOTIC

RESILIENCE ZONE
Complexity Landscape - ‘Natural’ Forces

System

External Environment

- Standardisation
- Globalisation & the 2nd Law of Thermodynamics

Edge of Chaos

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
Boeing 737

- AntiFragile Line
- Ashby Line
- Disintegration Line

System

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<th>COMPLEX</th>
<th>CHAOTIC</th>
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<td>COMPLEX</td>
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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.
- **Propulsion installation**: New strut, fairing, nacelle, fan and primary duct chevrons.
- **New engines**: CFM LEAP-1B has superior fuel efficiency which reduces carbon emissions.

**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)

Source: Boeing

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Boeing 737 Max

System

External Environment

Disintegration Line

AntiFragile Line

Ashby Line

need for bigger plane

designers solve contradictions
Boeing 737 Max

Disintegration Line

AntiFragile Line

need for bigger plane

designers solve contradictions

“we’re late”

System

External Environment

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Complexity Landscape - EpiPen

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

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

- **Lines**
  - Ashby Line
  - Disintegration Line
How To Not Solve Contradictions - EpiPen

Delivery Efficacy

Length Of Needle
How To Not Solve Contradictions - EpiPen

- Delivery
- Efficacy
- Length Of Needle
- Strength (Safety)
- Strength (Safety)
How To **Not** Solve Contradictions - EpiPen

Delivery Efficacy

Strength (Safety)

Length Of Needle

‘optimum’ (OR: ‘how to kill patients’)
Contradiction Matrix

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<th>Illity</th>
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Contradiction Matrix & Boeing 737-100

- Insufficient Ground-Clearance
- Increase Diameter

solutions already found by others
When we developed the Galaxie®, we subjected drive concepts to a fundamental reassessment. The result: a brand new gearbox type. Its unique kinematics enable virtually full surface contact during power transmission. This means that the compact Galaxie® Drive Systems and gearboxes with hollow shaft achieve previously inconceivable performance data. These include extremely high torque density, torsional rigidity, smooth running, positioning accuracy and completely backlash-free operation.
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

- Ashby Line
- Disintegration Line
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.
Complexity Landscape - Complicated/Complex

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

- **External Environment**
  - SIMPLE
  - COMPlicated
  - Complex
  - Chaotic

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

- **Root causes**
  - Pareto
  - 'Right' answer

- **No root causes**
  - Butterfly Effect
  - No 'right' answer
Complexity & Divergent-Convergent Cycles

Divergent → Convergent → Divergent → Convergent

‘Situations’ → The Right Situation → Solutions → The ‘Best’ Solution

Contradiction Matrix
inventive Principles
COBRA+ a cyclic process for generating actionable progress-making solutions to wicked problems

...establish where you're heading...
...map stakeholder outcome needs...
...establish 'yes, but' barriers...
...identify available resources...
...generate solution clues...
...and's
...but's
resources
outcomes
compass

...establish how well solutions match need and deployment capabilities, then iterate as appropriate...
Cited as "portentous" and "thoroughly foreboding", "Sense of Doubt" is one of the darker tracks of 1977’s Heroes album, with a descending four-note piano motif juxtaposed with "an eerie synth line like a scrap of sound from a silent expressionist-era soundtrack". Brian Eno suggested that the contrasting themes were the result of him and Bowie each following an Oblique Strategies card to guide them in the track’s overdubbing, Eno’s directing him to "make everything as similar as possible" and Bowie’s to "emphasize differences".
Eight Fields of MATCEMIB Help Students to Generate More Ideas

Iouri Belsky*, Pavel Livotovb, Oliver Mayerc

*a Royal Melbourne Institute of Technology, Australia
b Offenburg University of Applied Sciences, Germany
c GE Global Research, Germany

* Corresponding author. Tel.: +613 9925 2984; fax: +613 9925 2007. E-mail address: iouri.belski@rmit.edu.au

Fig 4. The distribution of student ideas over the eight fields of MATCEMIB: RMIT students, Australia (C – Control, RW – Random Word, SF – Su-Field groups).

The Random Word and the Su-Field groups at RMIT showed statistically significant differences in four fields: Thermal: $Z=-3.590$, $p<0.001$; Electric: $Z=-3.072$, $p<0.005$; Intermolecular: $Z=-2.313$, $p<0.05$; Biological: $Z=-2.689$, $p<0.01$.

Fig 5. The distribution of student ideas over the eight fields of MATCEMIB: students from the Offenburg University of Applied Sciences, Germany (C – Control, RW – Random Word, SF – Su-Field groups).
Edward De Bono - Random Word

- Mobile Phone
- Dumbo
- Water Spray
- Strong
- Grey
- Memory
- Buns
- Flapping Ears
- Heavy
- Zoo
- Light
- Co-branded
- Personalized
- Water-Proof
- Different Colours
- Unbreakable
- More Memory
- Flexible
- Multi-Network
- Calorie Counter (new functions)

'Better mobile phone' solution space
Oblique Strategies

If I believe in the ideas of people who think I am stupid, then I am stupid.

If you have an extraordinary problem, don't try to solve it in the ordinary way.

Emphasize the flaws.
Think of a piece of music that makes you go ‘wow’.
What is it that evokes that emotion?

<table>
<thead>
<tr>
<th>Position</th>
<th>Measure</th>
<th>Beats</th>
<th>Durations (sec.)</th>
<th>Percentage of Duration</th>
<th>Ratio (or nearest rational approximate)</th>
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<tbody>
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<td>1</td>
<td>0.18 0.12 0.30</td>
<td>60.00 % 40.00 %</td>
<td>3 to 2</td>
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<td>2</td>
<td>0.20 0.12 0.32</td>
<td>62.50 37.50</td>
<td>5 to 3</td>
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<td>1</td>
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<td>11 to 7</td>
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<tr>
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<td>0.20 0.11 0.31</td>
<td>64.52 35.48</td>
<td>9 to 5</td>
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<td>66.67 33.33</td>
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<td>5 to 3</td>
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</table>

Inventive Principles 3, 16, 19
Think of a piece of music that makes you go ‘wow’. What is it that evokes that emotion?
Most ‘Wow’s Come From Expectation-Breaking

Like jokes….

Joke teller travels in this direction….

…convinces the listener to travel in this direction

Receiver ‘eliminates the contradiction’ and ‘gets’ the joke

…it’s about confounding expectations & about the building and release of tension…

…it’s about contradiction

Money

Pink Floyd
Mapping Oblique Strategies Onto TRIZ Inventive Principle

Inventive Principle 2, ‘Take Out’
Oblique StrateTRIZ

Reinvent anything with the universal rules for breaking rules

Systematic breakthrough in a box
Oblique Strategy: Connection-Direction

Remove the skeleton

Assume formlessness
Oblique StrateTRIZ: Connection-Direction

Remove the riff?
Remove time signature?
Remove key?
etc

Assume formlessness
Into The Future
InnovationDNA - The Golden Triangle

External Environment ('Super-System')

System

SIMPLE COMPPLICATED COMPLEX

CHAOTIC

Disintegration Line

Golden Triangle

Ashby Line

Complexity

Compass

Contradiction

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Compass

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

(all of the benefits, none of the downsides)
Contradiction

Contradiction-Solving

Function Transfer

1

(based on 10.8M case studies)

3: External Exaptation

4. Radical Exaptation

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Intangible Needs

- Temperature variation
- Price
- Durability
- Disposal
- Temperature profile
- Slow to chill
- Low Quality (interior)
- Noise (‘knock’)
- Energy efficiency
- Safety (medication)
- Transients
- Levelling
- Not ‘frost-free’
- Cleaning (interior)
- Cheap finish
- Noise (hum)
- Rust
- Licensing procedure
- Soggy salads
- Food freshness
- Slow to chill
- Food freshness
- Cleaning (interior)

Tangible Needs

- Temperature variation
- Price
- Durability
- Disposal
- Temperature profile
- Slow to chill
- Low Quality (interior)
- Noise (‘knock’)
- Energy efficiency
- Safety (medication)
- Transients
- Levelling
- Not ‘frost-free’
- Cleaning (interior)
- Cheap finish
- Noise (hum)
- Rust
- Licensing procedure
- Soggy salads
- Food freshness
- Slow to chill
- Food freshness
- Cleaning (interior)
Complexity & Appropriate Change Methods

- **System (Project Coordination)**
  - SIMPLE
  - COMPLICATED
  - COMPLEX
  - CHAOTIC

- **External Environment (‘Super-System’)**
  - SIMPLE
  - COMPLICATED
  - COMPLEX
  - CHAOTIC

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

- **C O B R A +**
- **Classical TRIZ**
- **x-SIT**

- **Anything!**
First Principles

Kids need to eat dirt to develop immune system
The human body is antifragile… if correctly primed (“use it or lose it”)
Thanks

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@darrellmann