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TRIZ and Biomimicry

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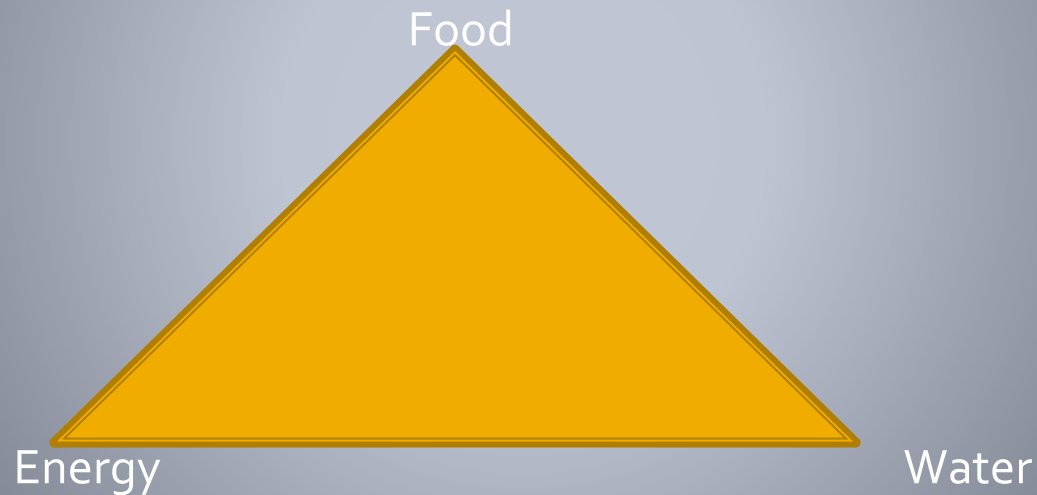
Me

- Professor of Marketing at Cardiff Metropolitan University and Director of the Executive MBA
- Taught in four Welsh Universities over the last 28 years
- Taught over 30,000 University students, of which 5,000 are MBA's
- I two degrees in Economics and a PhD in Marketing
- Holds the distinguished teaching award for the whole of Swansea University
- I have published over 60 academic journal articles including one in the Journal of Retailing
- Generated over £1 million in research grants in the last 15 years
- I am one of only 3,600 people in the world to be a '*Chartered Manager*' with the Chartered Managers Institute
- Recently achieved a POWIS award with a local company manufacturing cement out of landfill rubbish

The Toolbox

- TRIZ
 - A Russian rule based system for Invention and Innovation
 - Ninety Five percent of all business problems can be solved by TRIZ
 - Introduction to TRIZ (7.24 minutes)
<https://www.youtube.com/watch?v=z-gBnBfGVZk>
- Biomimicry
 - Using nature's 3.8 billion years of R&D to solve business problems. All business problems have been solved by nature
 - Introducing Biomimicry 3.8 : Janine Benyus (2.51 minutes)
 - <http://www.youtube.com/watch?v=GWiXIXIsJCc>

The Nexus



The problem is if you want more of one you trade off both of the other elements

There is enough energy from the Sun falling on our planet per day to power it per year and its free

However a new spray which is applied to both sides of a household window will turn each window into a solar cell – every home could become a mini power station. and energy will become very cheap– this based on German engineering . This product will be released in the near future

The Tesla company is working on roof tiles which are also solar cells – two things in one

Exponential Growth

The doubling time based on the magic number 70

If you divide a growth rate into the number seventy you get the doubling time. So if the growth rate of a country like China is 7% - the double time is 10 years. This means everything would need to double housing, banking system, road networks, schools etc.

Or if you pension fund grows at 7% per year in real terms in 10 years it doubles, in 20 years it increase 4 fold, in 30 years it increase 8 fold and in 40 years it increases 16 times. But in these times of QE and negative interest rates it is very difficult to get a positive real rate of return.

Oil use in the World 1850 to 2049

Oil usage has increased at 7% every year for the last 150 years

Period	Units of oil used	Period	Units of oil used	Period	Units of oil used	Period	Units of oil used
1850-59	1	1900-09	32	1950-59	1,024	2000-09	32,896
1860-69	2	1910-19	64	1960-69	2,056	2010-19	65,792
1870-79	4	1920-29	128	1970-79	4,112	2020-29	131,584
1880-89	8	1930-39	256	1980-89	8,224	2030-39	263,168
1890-99	16	1940-49	512	1990-99	16,448	2040-49	526,336

Resources and the World

- Current Population in the world
- 1850 1 billion
- 2012 7 billion
- What are the major problems facing the world
- Population growth, energy (Canadian tar sands, fracking), food, fresh water, housing, bees).
- If everyone on the planet lived like an American we would need 3 planets for the resources.

Solving Problems

- TRIZ is Russian for '*problem solving analysis and forecasting tool*'
- It was first developed by Soviet Patent inventor Genrich Saulovich Altshuller (1926 - 1997) in 1946.
- This work has been expanded and improved on by a number of colleagues. You can even study for a degree in TRIZ in a number of Russian Universities.
- Normally problems are solved in three class ways – a) trial and error (the way the light bulb was invented by Thomas Edison who *tried over 8,000 different experiments with different filaments until he found the one which worked*), brainstorming or the flash of pure brilliance (Eureka, the exclamation of Archimedes when he discovered that *the volume of water displaced in a bath was equal to the volume of the part of his body he submerged in the bath*).
- However the major drawbacks with all these types of methods is they do not guarantee a solution, are often very time consuming and less than optimal answers to our problems.

Alshullers 6 logical steps

- 1. be systematic.
- 2. be a guide through a broad solution space direct to the ideal solution.
- 3. be repeatable and reliable.
- 4. be able to access the body of inventive knowledge.
- 5. be able to add to the body of inventive knowledge.
- 6. be understandable.

Alshullers five levels of invention

Level	Degree of inventiveness	% Of solutions	Source of knowledge	Approx # of solution to consider
1	Apparent solutions	32%	Personal Knowledge	10's
2	Minor improvements	45%	Knowledge within company	100's
3	Major improvements	18%	Knowledge within the industry	1,000's
4	New concept	4%	Knowledge outside the industry	100,000's
5	Pure discovery	1%	All that is knowable	1,000,000's

The first 10 TRIZ rules

Rule #	TRIZ Rule, Explanation and Examples
1.	<p>RULE : SEGMENTATION. Divide the product/process into independent parts.</p> <p><i>Examples. Railway carriages can be joined together to form a train of any length, flat pack furniture takes up a very small space when not assembled.</i></p>
2.	<p>RULE : TAKE OUT. Extraction.</p> <p><i>Example. To frighten birds away from an airport, a recorded sound known to excite birds is used.</i></p>
3.	<p>RULE : LOCAL QUALITY</p> <p><i>Examples. A slow lane and a fast lane on a motorway, a pencil and rubber in one unit.</i></p>
4.	<p>RULE : ASYMMETRY</p> <p><i>Example. Make the outside of a car tyre stronger than the inside to withstand impact from a curb.</i></p>
5.	<p>RULE : MERGING. Combining, integrating or consolidation.</p> <p><i>Examples. A catamaran (two hulls) sailing boat increases stability but reduces friction on the water (two small hulls are more efficient than one very large hull).</i></p>
6.	<p>RULE : UNIVERSALITY. Multi functionality</p> <p><i>Example. Sofa, which can be converted into a bed.</i></p>
7.	<p>RULE : NESTING</p> <p><i>Example. Chairs designed so that they can stack on top of each other when not in use.</i></p>
8.	<p>RULE : COUNTERWEIGHT. Anti weight.</p> <p><i>Examples. A boat with hydrofoils or racing car with a rear wing.</i></p> <p>See the You Tube video of the sailing water speed record (51 knots). Hydroptère this tri-hull, French designed yacht which literally flies on three hydrofoils http://www.youtube.com/watch?v=2boayPZ3GbE</p>
9.	<p>RULE : PRIOR COUNTER ACTION</p> <p><i>Example. Concrete floor is constructed with pre stressed re-enforced steel bars to make it very strong.</i></p>
10.	<p>RULE : PRIOR ACTION</p> <p><i>Examples. A modelling knife blade made with a groove allowing the dull part to be broken off to reveal a brand new blade, pre pasted wall paper, microwave meals.</i></p>

The next 10 TRIZ rules

11.	RULE : CUSHION IN ADVANCE. Compensate for the low reliability of an object by countermeasures taken in advance. <i>Examples. Goods in a shop are magnetized to deter shoplifting, a first aid kit or fire extinguishers.</i>
12.	RULE : EQUIPOTENTIALITY. Remove tension or bring to the same height, change the working conditions. <i>Examples. Change the oil in a car engine by the mechanic working in a pit below the car and use gravity, use locks to raise or lower canal boats</i>
13.	RULE : INVERSION Do things the other way around, do the reverse. <i>Examples. Rotate/move the part not the tool, when using a sewing machine move the material not the needle and thread.</i>
14.	RULE : SPHEROIDALITY Replace linear parts with curved parts. <i>Examples. Corrugate cardboard for strength, ballpoint pens, spin dryer to dry clothes.</i>
15.	RULE : DYNAMICITY If an object is immovable, make it movable or interchangeable. <i>Examples. A flashlight with a flexible body, which can be wrapped around things, a baby buggy can be folded for storage and steel tape measure rolls up for storage.</i>
16.	RULE : PARTIAL OR EXCESSIVE ACTION Excess or shortage. <i>Examples. A cylinder is dipped in paint and then spun to remove the excess paint, make jewellery using silver plating instead of solid silver to reduce the cost, use masking tape to create a clean line on a surface from paint (remove masking tape when the paint is dry).</i>
17.	RULE : ANOTHER DIMENSION. Change to a new dimension. <i>Examples. A conservatory, which has a concave reflector to improve illumination to other parts of the house, an underground transportation system, 3D instead of 2D movies.</i>
18.	RULE : MECHANICAL VIBRATION. Oscillation. <i>Examples. Vibrate a casting mould while it is being filled to improve flow and structural properties, vibrating toothbrush.</i>
19.	RULE : PERIODIC ACTION. Replace a continuous action with an impulse. <i>Examples. An impact wrench loosens corroded nuts by impulses rather than continuous force, flashing lights on Police cars or Ambulances are more noticeable than constant lights.</i>
20.	RULE : CONTINUITY OF A USEFUL ACTION <i>Examples. A drill bit with cutting edges permit forward and reverse milling, a lorry carries loads in both directions does waste fuel with an empty load on the return trip, a ball in a ballpoint pen has a roller which supplies ink to the page. Friction which holds a screw in wood or a nut and bolt together.</i>

TRIZ challenge

Nasa found that ball point pens don't work in space as there is no gravity – What did they do? What did the Russians Space agency do?

A freezer containing ice lollies is left open by children on a hot day so the freezer starts to de-froze. Design a system to automatically closed the freezer – no resources can be used

You want a sailing boat to go as fast as possible – how do you do it – hint friction

Conclusion

- Both TRIZ and Biomimicry are incredibly powerful toolboxes and once understood can lead increase your level invention and innovation. Alternative techniques like brainstorming or trial and error can also produce great innovations and inventions but are very time consuming and don't use the whole body of inventive knowledge to solve problems.
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- It is thought that a number of large multi-national companies are already using TRIZ to solve problems, generate new designs and improve the performance of products and services (these include Boeing, Daimler-Chrysler, Dow Chemicals, Ford, Hewlett Packard, IBM, Johnson and Johnson, NASA, Otis Elevates, Procter and Gamble and Samsung).

The 39 engineering parameters

- 1. Weight of moving object
- 2. Weight of non-moving object
- 3. Length of moving object
- 4. Length of non-moving object
- 5. Area of moving object
- 6. Area of non-moving object
- 7. Volume of moving object
- 8. Volume of non-moving object
- 9. Speed
- 10. Force
- 11. Tension, pressure
- 12. Shape
- 13. Stability of object
- 14. Strength
- 15. Durability of moving object
- 16. Durability of non-moving object
- 17. Temperature
- 18. Brightness
- 19. Energy spent by moving object
- 20. Energy spent by non-moving object
- 21. Power
- 22. Waste of energy
- 23. Waste of substance
- 24. Loss of information
- 25. Waste of time
- 26. Amount of substance
- 27. Reliability
- 28. Accuracy of measurement
- 29. Accuracy of manufacturing
- 30. Harmful factors acting on object
- 31. Harmful side effects
- 32. Manufacturability
- 33. Convenience of use
- 34. Repairability
- 35. Adaptability
- 36. Complexity of device
- 37. Complexity of control
- 38. Level of automation
- 39. Productivity