Теория решения изобретательских задач

Establishing TRIZ in BAE Systems

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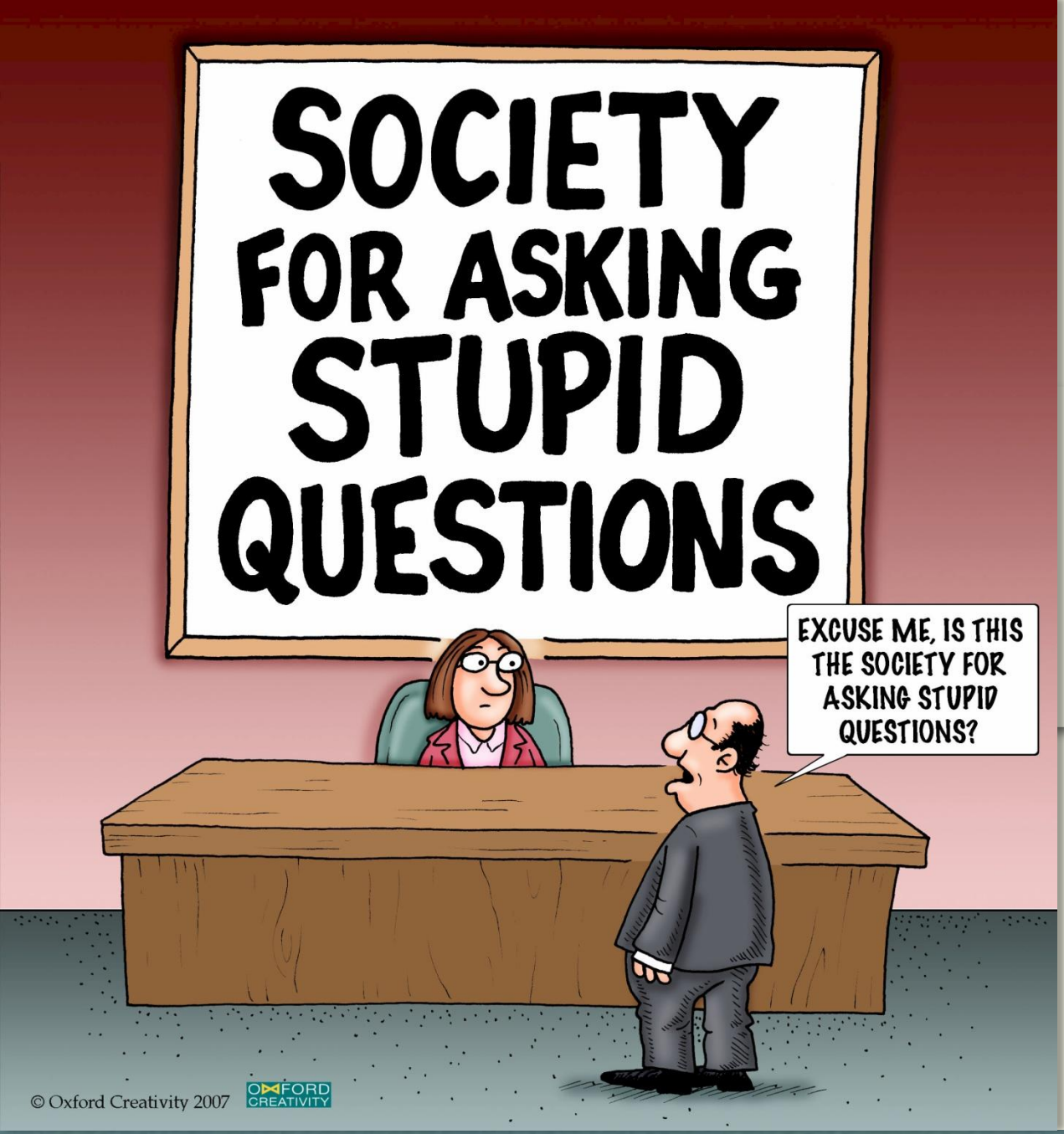

Please ask questions, there are no stupid ones

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The international and successful BAE Systems describe themselves as

global defence and security company employing around 100,000 people worldwide.

Our wide-ranging products and services cover air, land and naval forces, as well as advanced electronics, security, information technology, and support services'

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1998 TRIZ Workshop in the Directors Box of the Reebok Football Stadium

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BAE TRIZ Kick started .....

- TRIZZING of 1000 ++ BAE Systems' engineers
- Solving of difficult problems – many case studies
- Development of Practical TRIZ Training (5 days)
- Geographic variability and fixity (Global good venues)
- Humour (new version of 40 Principles)
- TRIZ easily available to everyone
- Football themes for Oxford Creativity...

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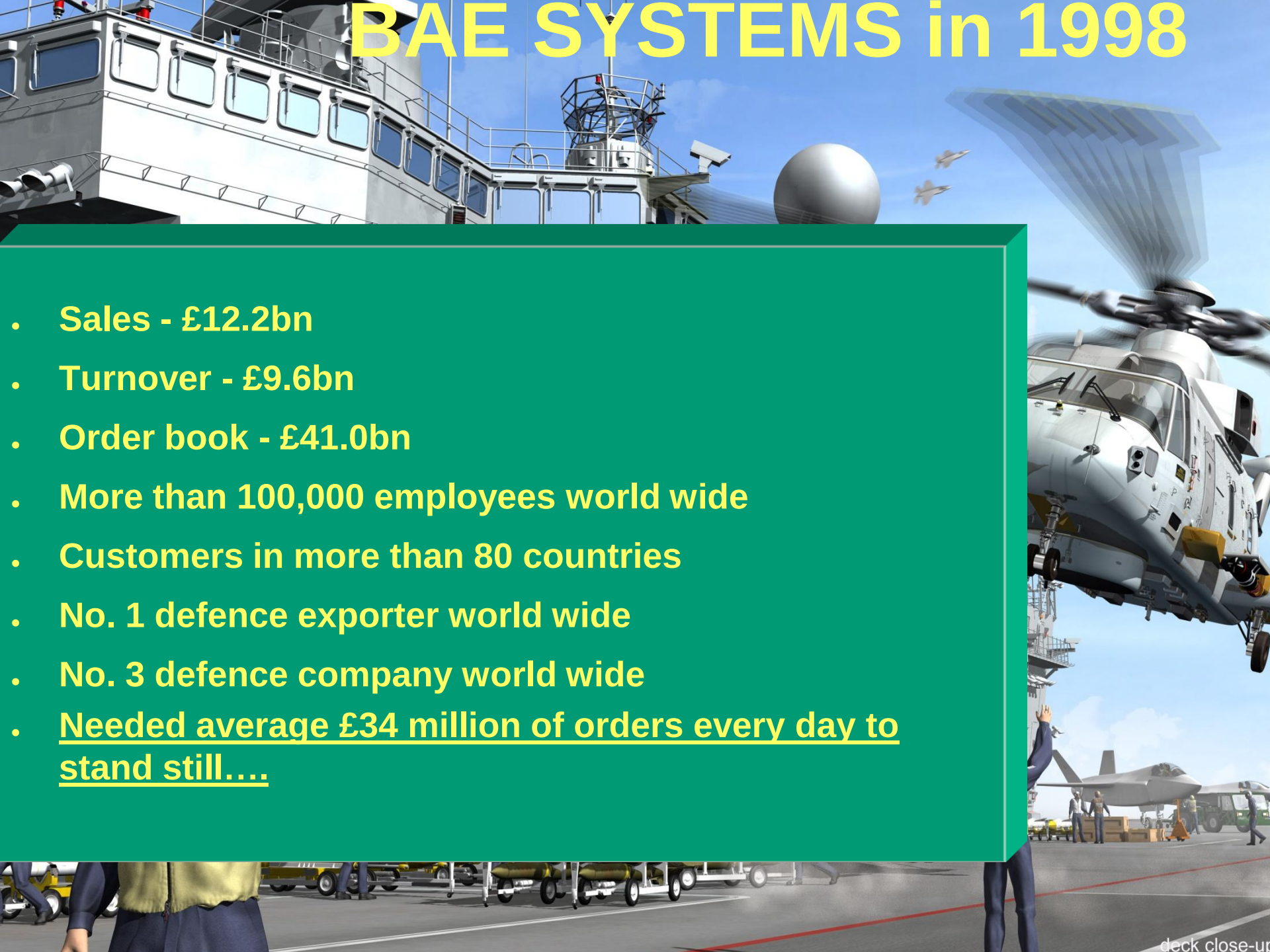
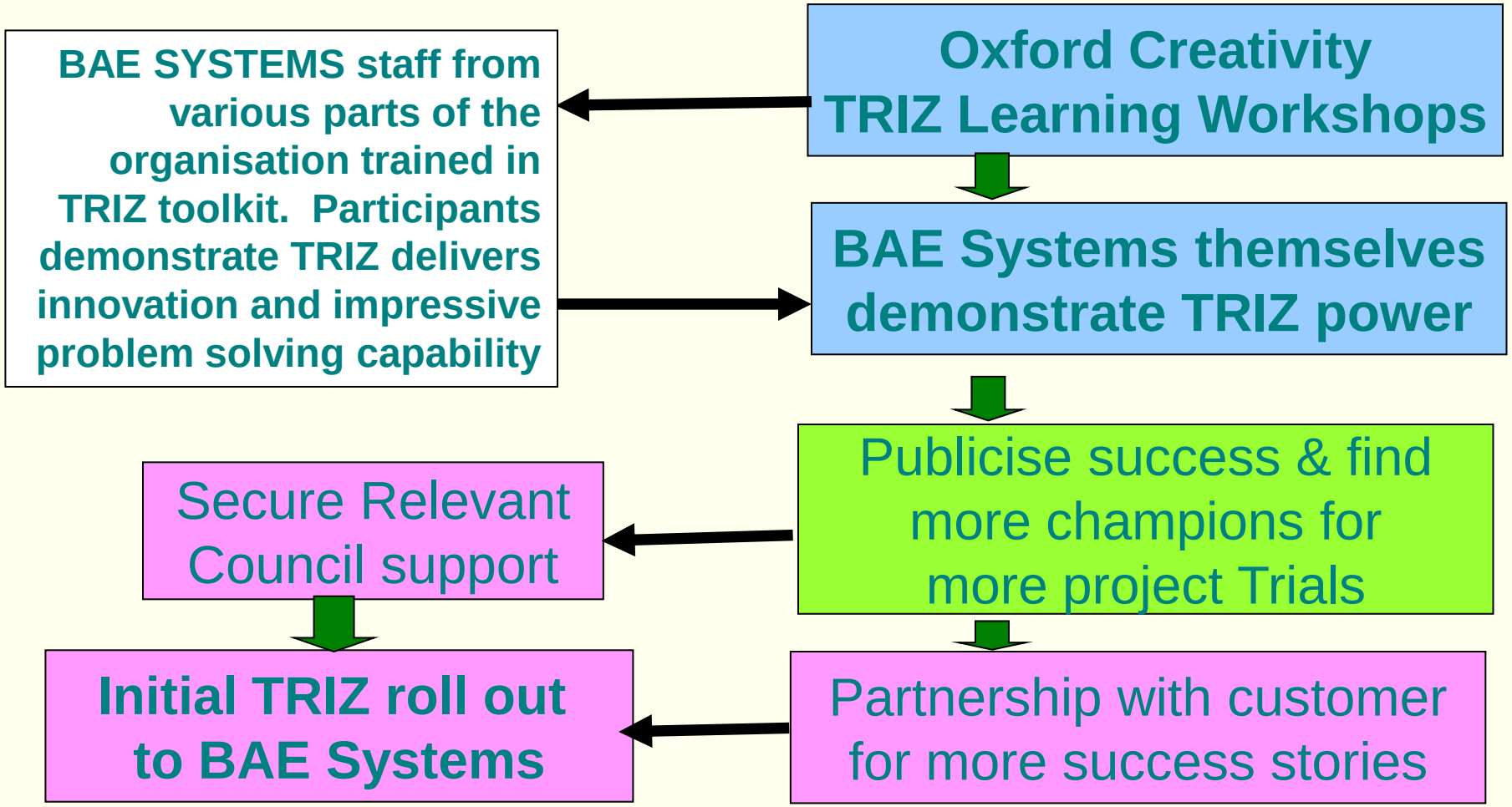
Football theme for Oxford Creativity

BAE SYSTEMS in 1998

- Sales - £12.2bn
- Turnover - £9.6bn
- Order book - £41.0bn
- More than 100,000 employees world wide
- Customers in more than 80 countries
- No. 1 defence exporter world wide
- No. 3 defence company world wide
- <u>Needed average £34 million of orders every day to stand still….</u>



1998 Plan for TRIZ in BAE Systems
The First 'TEST'



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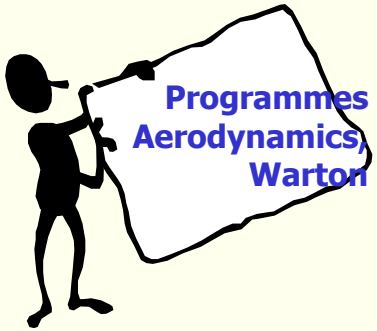
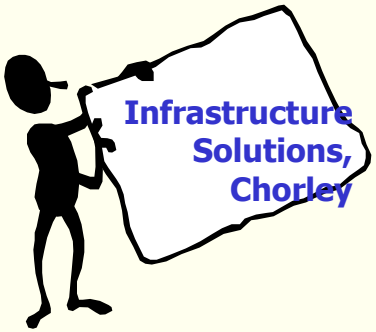
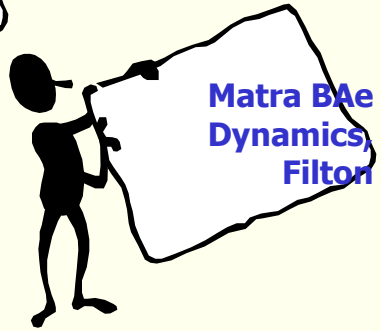
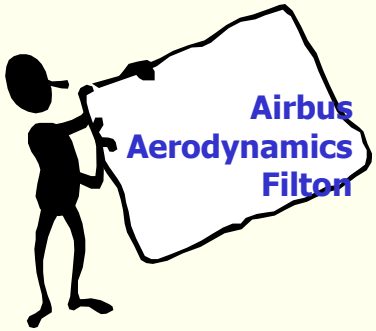
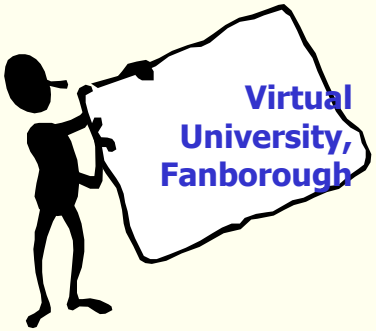
WHO was INVOLVED?

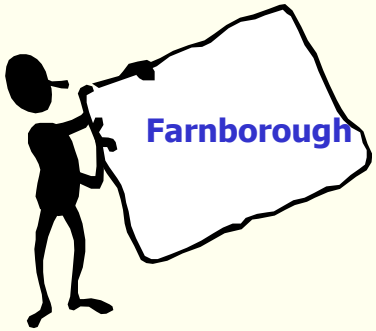


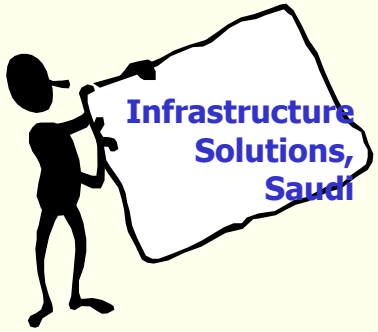












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Some Problems Tackled

- Next generation submarines
- Weapons systems
- Escape systems from submarines
- Aircraft training systems optimum locations
- Location of airports in remote locations
- Management of airports
- Design of aircraft components
- Persuading UK Government to change/clarify the regulations for aircraft maintenance for Royal Air Force
- Innovation Culture change for processes and non-TRIZ toolkits
- and many, many more....
-

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1999 -Regional Aircraft Cabin Air Quality

1999 Future Strategic Tanker Aircraft

FSTA Re-fuelling Drogue

The Challenge/ Contradiction:

Devise an autonomous Refuelling Drogue that is stable in space during air to air refuelling but can be easily manoevred.

TRIZ Tools Applied to Challenge:

- **Ideality & Ideal Outcomes**
- **Smart Little People**
- **Contradictions**
- **Mobilising Resources**
- **Functional Analysis**
- **Standard Solutions**

Smart Drogue:

One of 8 concepts developed using TRIZ.

(Patent applied for by Aircraft Services Group - Woodford.)

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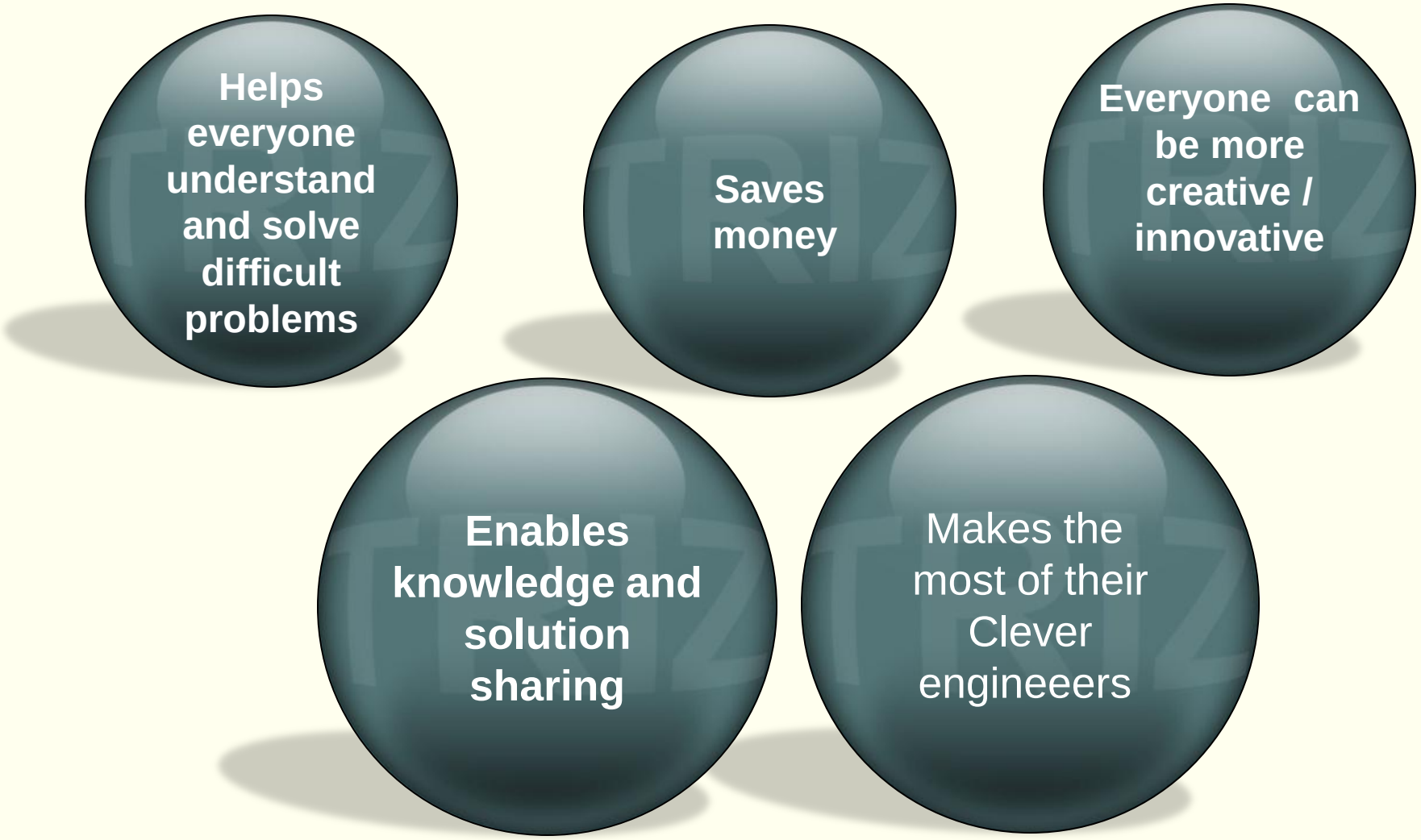
Anticipated Benefits of TRIZ Success TRIZ in large companies



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Unanticipated Benefits of TRIZ Success TRIZ in large companies

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Making it easily and quickly accessible to everyone

Ideas from the whole team – Establish 'Bad Solutions' Culture

Adding to the more famous and well established toolkits

Establishing TRIZ

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Making TRIZ easily accessible

- After the ‘TEST’ - BAE Systems made Oxford Creativity TRIZ learning workshops universally available. Also **practical problem solving** as well as IP, clear thinking and innovation skills.
- TRIZ Intranet available to everyone for problem sharing, information, TRIZ community and confidential case studies
- A university research project evaluated the high effectiveness of TRIZ in Rolls-Royce (and BAE Systems). This has been continued by Lilly of Oxford Creativity .....

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- We had to find out what worked
- We only had 5 days to teach TRIZ
- We found one basic approach which makes very

  TRIZ session work....

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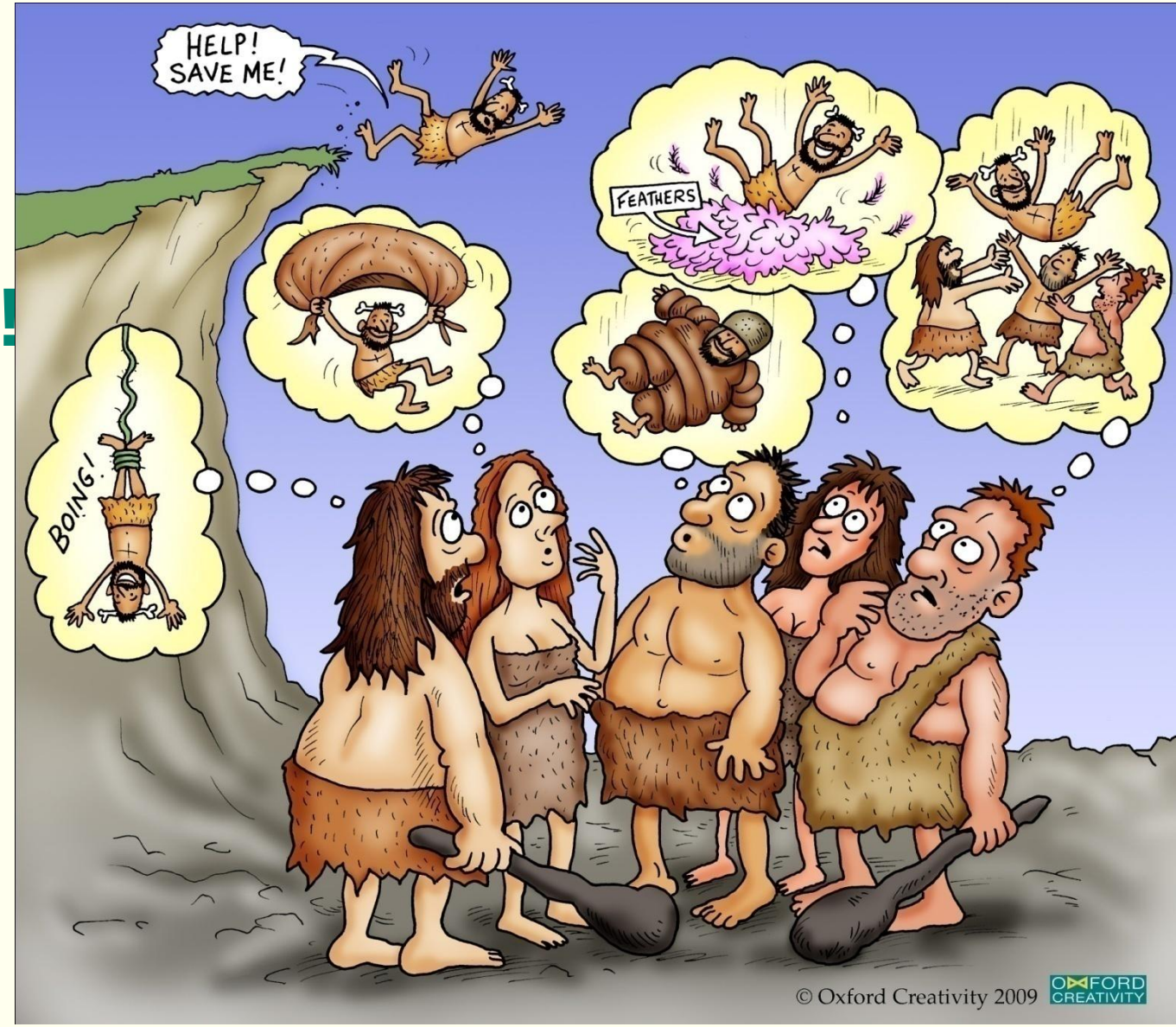
Faced with PROBLEMS!

Everyone thinks of answers FAST!



Everyone enjoys jumping to solutions!

Once I see **my solution** I can't see anything else

My solution came from **my** creativity and **my** experience and **my** genius

I love my solution

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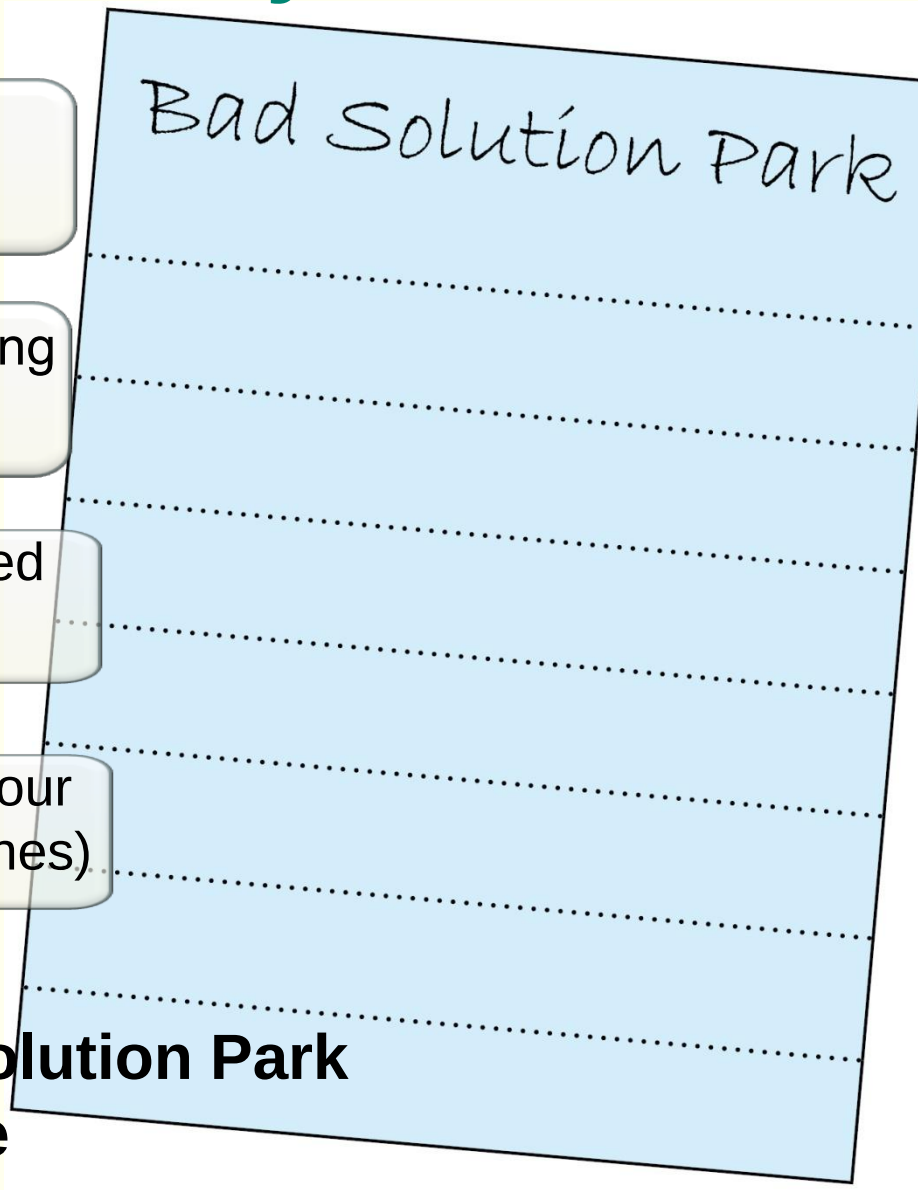
Park all ideas as they occur

We all love our own Solutions
- my ugly baby - my bad solution

Once I see **my solution** I can't see anything else – so we ask you to park your idea

Parking ideas will keep everyone engaged with the process – keep listening

Parking ideas helps you briefly let go of your solution (& frees your brain for the next ones)



Using post-it notes and a Bad Solution Park allows EVERYONE to contribute

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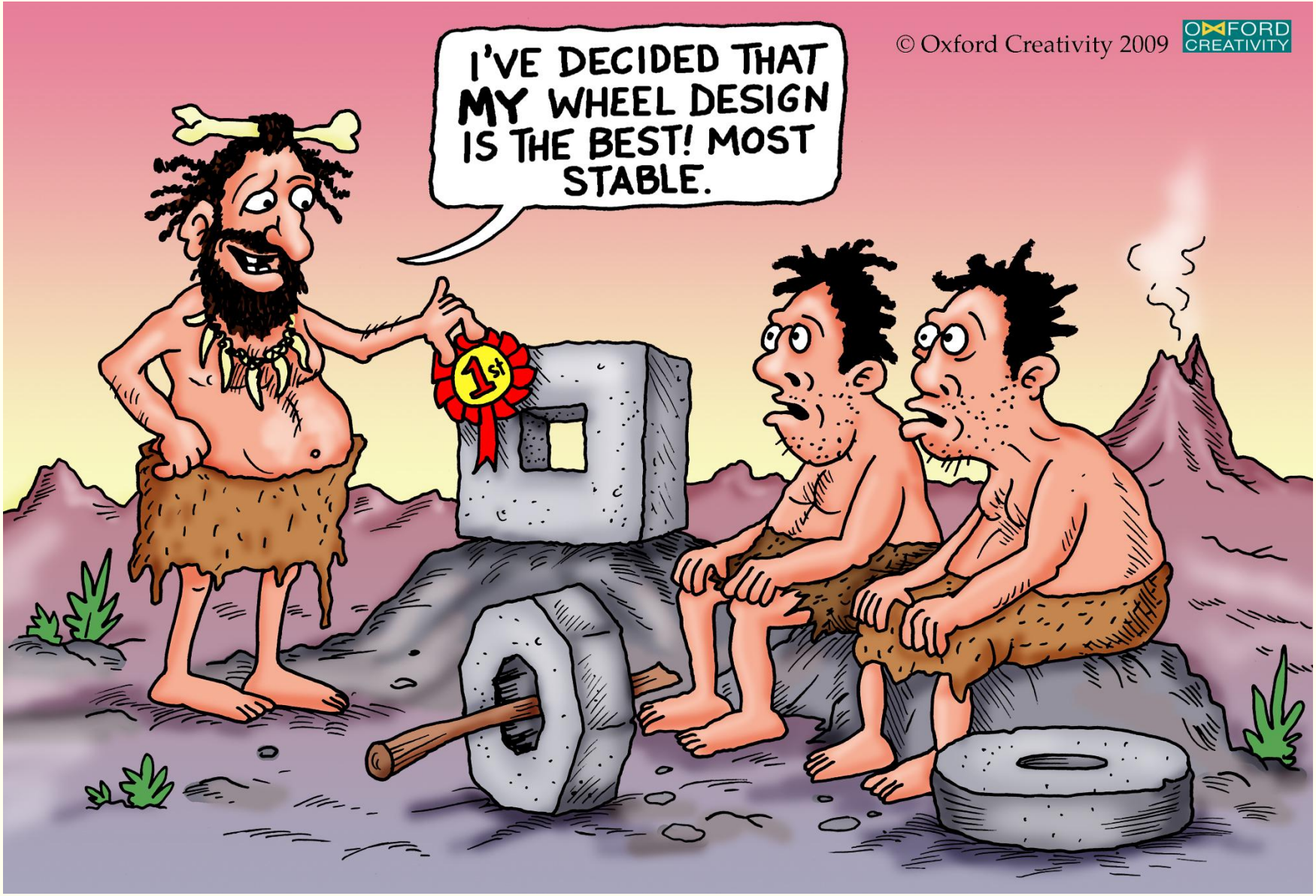
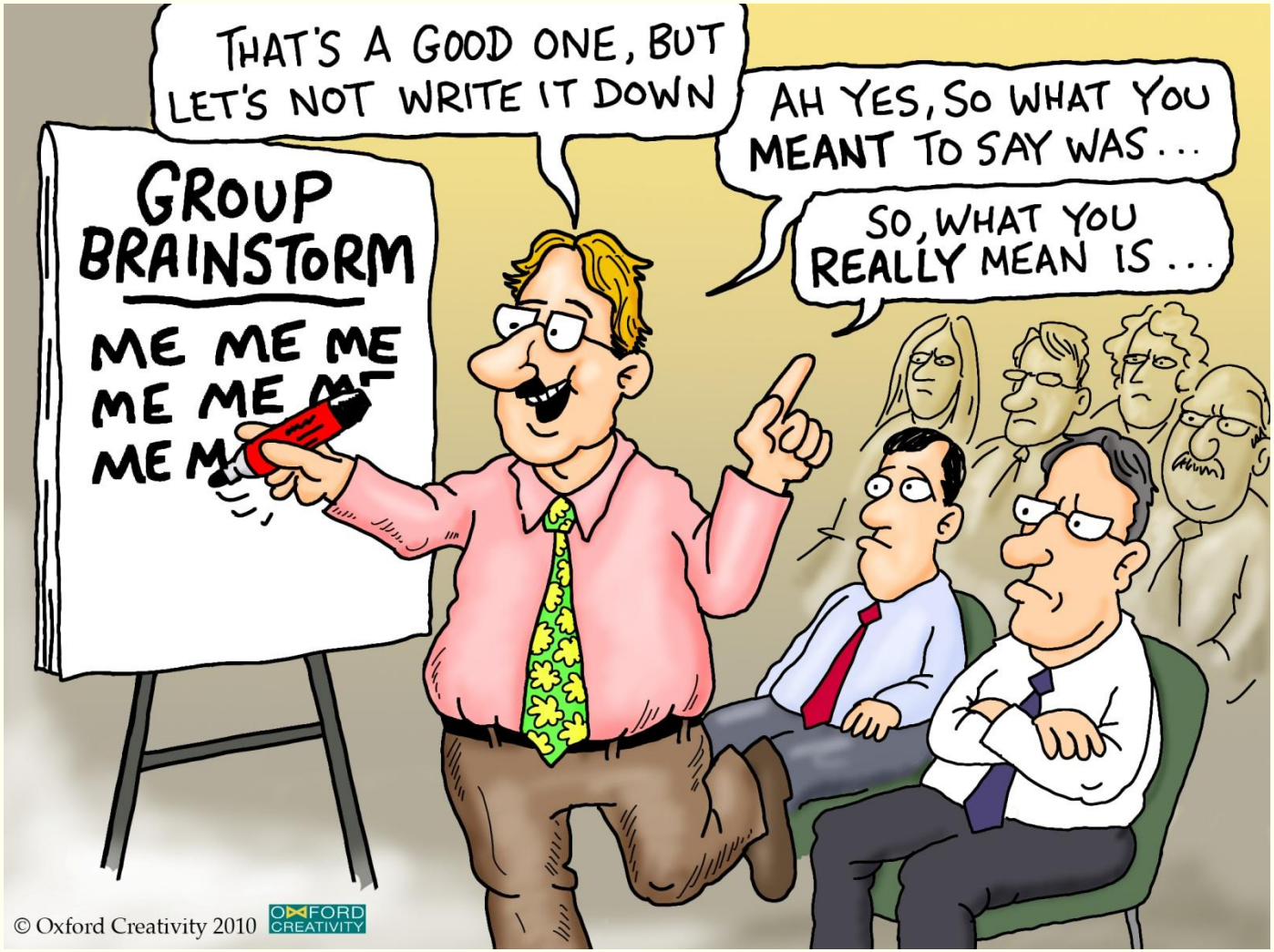


Fighting for your Solution

Don’t stop Brainstorming this is the start of TRIZ BUT Beware of non TRIZ Facilitators



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Oxford Creativity KISS

- TRIZ for BAE Systems (5 days is not a Phd in TRIZ)
- Simple
- Rigorous
- Fun
- International
- Flexible
- Confident

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Good Materials /Trainers /Rooms

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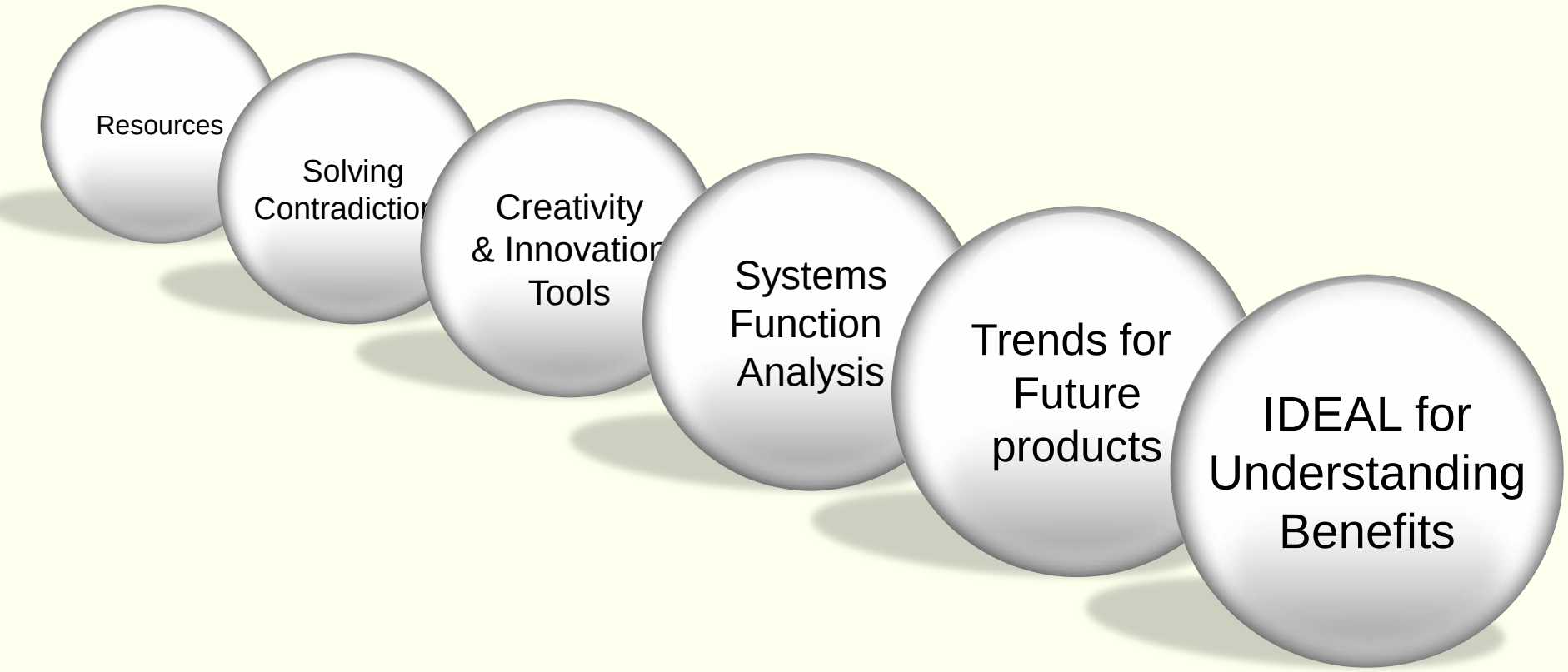
Five day TRIZ Workshop



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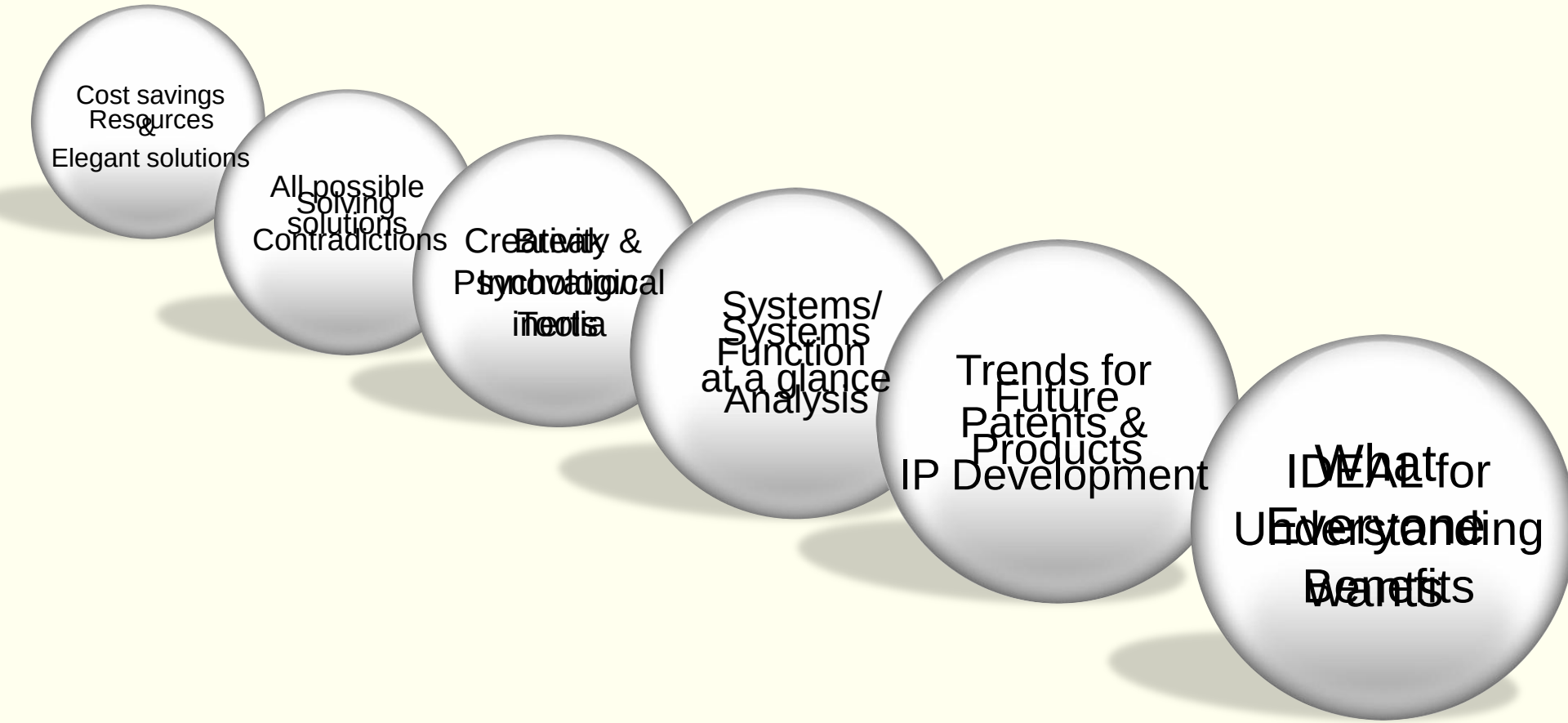
Five day TRIZ Workshop



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Problem Definition & Problem Solving

Make it Easy to Understand & Accessible

TRIZ has all recorded solutions distilled into 4 simple lists

40
Inventive Principles

8
Trends of Technical Evolution

76
Standard Solutions
24 for **Harms**
35 for **Insufficiency**
17- for **detection** & **measurement**

2,500 (?)
engineering & scientific concepts
arranged as questions and answers

Get all the materials right both before / during / after

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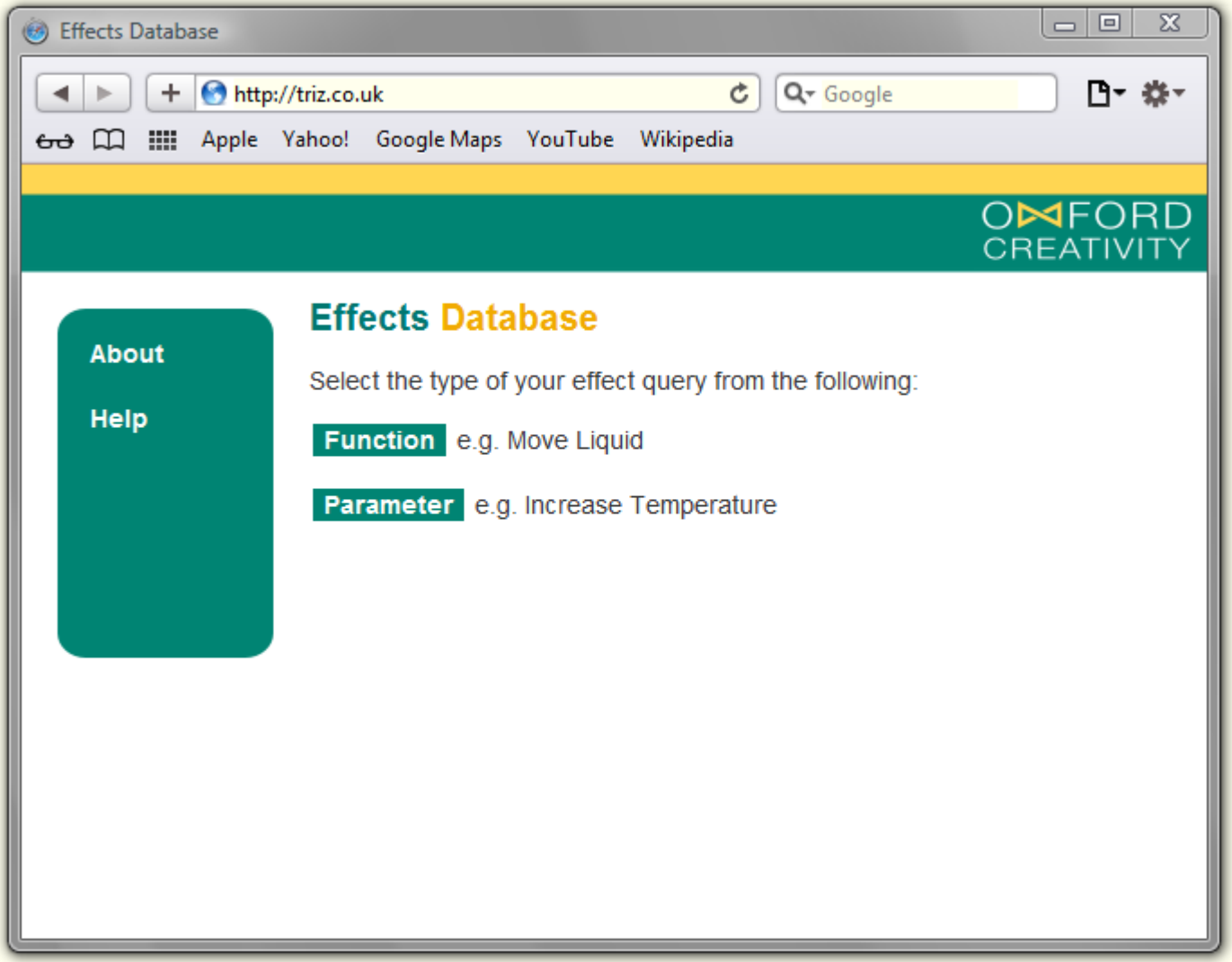
Oxford Creativity TRIZ Effects Database



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Absorption (physical)
Acoustic Cavitation
Adsorption
Advection
Aeration
Aerosol
Angular Momentum
Antibubble
Archimedes' Screw
Archimedes' Principle (Buoyancy)
Barus Effect
Bernoulli Effect
Boiling
Boundary Layer
Brownian Motion
Brownian Motor
Capillary Action
Capillary Condensation
Capillary Evaporation
Capillary Porous Material
Capillary Pressure
Capillary Wave Effect
Cavitation
Centrifugal Force
Chromatography
Coanda Effect
Colloid
Compression
Conic Capillary Effect
Convection
Converse Piezoelectric Effect
Coriolis Force
Creaming
Cyclone Separation
Desiccant Material
Desiccation
Diamagnetism
Diffusion
Displacement
Distillation
Ekman layer
Elasticity
Electric Field
Electro-Osmosis
Electrohydrodynamics
Electrolysis
Electromagnet
Electromagnetic Stirring
Electromechanical Film
Electro-osmotic Pump
Electrophoresis
Electrostatic Deposition
Electrostatic Induction
Electrostatics
Electrowetting
Evaporation
Explosion
Fan
Ferrofluid
Ferromagnetism
Fluid Hammer
Fluid Spray
Foam
Foil (fluid mechanics)
Force
Forced Convection
Free Convection
Free Fall
Freeze Drying
Funnel
Gel
Gravitation
Gravitational Convection (non heat)
Harmonic Oscillator
Heat Engine
Heat Pipe
Hydraulic Jump
Hydraulic Ram
Hydrodynamic Cavitation
Impact Force
Impeller
Inertia
Injector
Ion Exchange
Ionisation
Jet
Kármán Vortex Street
Kaye Effect
Leidenfrost Effect
Liquid Membrane
Lorentz Force
Lotus Leaf Effect
Magnetic Field
Magnetism
Magnetoelastic Effects
Magnetohydrodynamic Effect
Magnetostriction
Magnus Effect
Marangoni Effect
Mechanical Force
Mechanocaloric Effect
Microelectromechanical Systems
Mixed Convection
Negative Thermal Expansion
Nuclear Fission
Onnes Effect
Optical Tweezers
Opto-hydraulic Effect
Osmosis
Pascal's Law
Peristaltic Pump
Permeation
Pervaporation
Photophoresis
Piezoelectric Effect
Porosity
Pressure Gradient Pump
Rayleigh-Bénard Convection
Reaction (physics)
Resonance
Reverse Osmosis
Rocket
Rollin Film
Screw
Shock Wave
Sol
Soliton
Solvation
Sorption
Sound
Stirring
Supercavitation
Supercritical Drying
Superfluidity
Surface Acoustic Wave
Surface Tension
Syphon
Temperature Gradient
Tesla Turbine
Thermal Contraction
Thermal Expansion
Thermo-capillary Convection
Thermomagnetic Convection
Thermomechanical Effect
Thermophoresis
Thermosyphon
Thixotropy
Transpiration
Turbine
Turbulence
Ultrasonic Capillary Effect
Ultrasonic Vibration
Vacuum
Venturi Effect
Vibration
Weightlessness
Weissenberg Effect
Wetting
Wind

(160 answers)

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www.triz.co.uk

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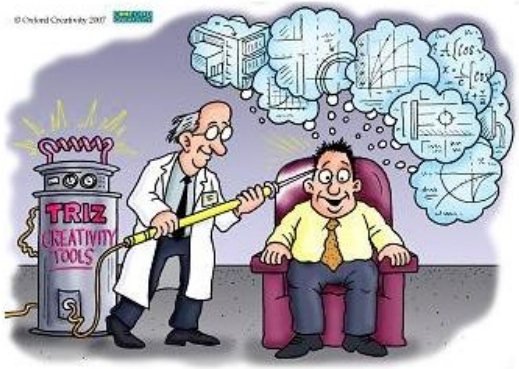
Search

TRIZ: Turns Good Engineers into Great Engineers

Oxford Creativity will show you how to be innovative and solve your problems systematically with TRIZ. We will help you nurture, develop and sustain a culture of creative innovation with your organisation.

TRIZ (Theory of Inventive Problem Solving) was created by engineers, for engineers (so we can be confident that it works) and it works for everyone. TRIZ is a problem solving toolkit; the principal TRIZ tools direct us to find all the ways of solving a problem, to find new concepts and the routes for developing new products. TRIZ offers systematic innovation; by learning TRIZ and following its rules we can accelerate creative problem solving for both individuals and project teams.



- Why use TRIZ?
- Why use Oxford Creativity?
- Innovation & Strategy
- What is TRIZ?
- What we Deliver
- TRIZ Problem Solving
- The TRIZ tools and process
- The Oxford Creativity Team
- TRIZ workshops

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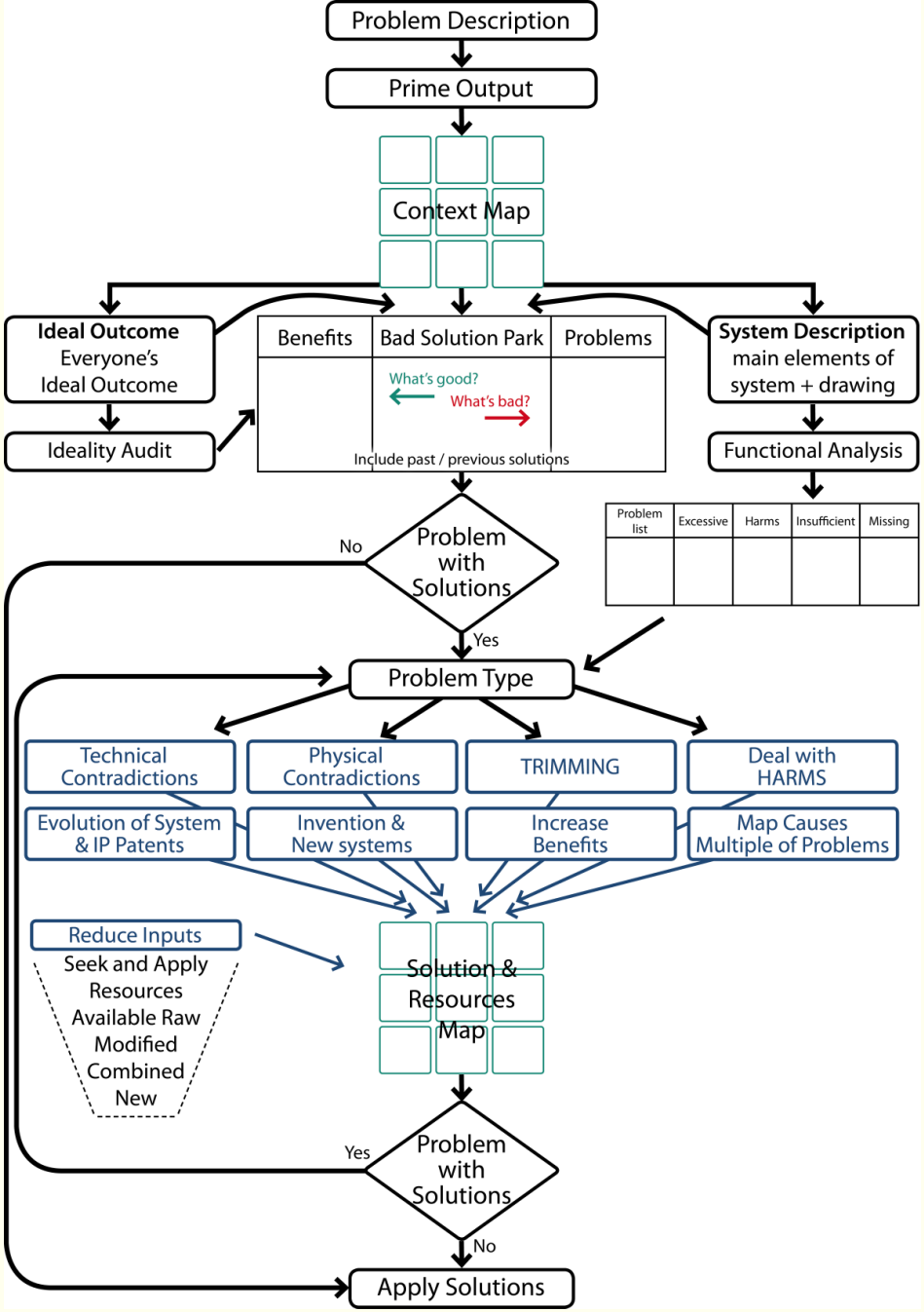
Problem definition steps

&

Problem Solving



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Get the TRIZ logic right - Problems are just gaps between benefits & systems

BAD Solutions offer an intuitive, clever but very quick analysis of both the **SYSTEM** & **REQUIREMENTS**

TRIZ Fast thinking to close the gaps

Don't get lost in irrelevant detail
KEEP sight of the problem context & high level issues

Ideality Requirements

Everyone's Benefits & acceptable costs & harms
(constraints)

Current
System
functions features & resources

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Defining requirements accurately is critical to finding the right system

Ideality Requirements

Everyone's Benefits & acceptable costs & harms (constraints)

Proposed or Current System

functions features & resources

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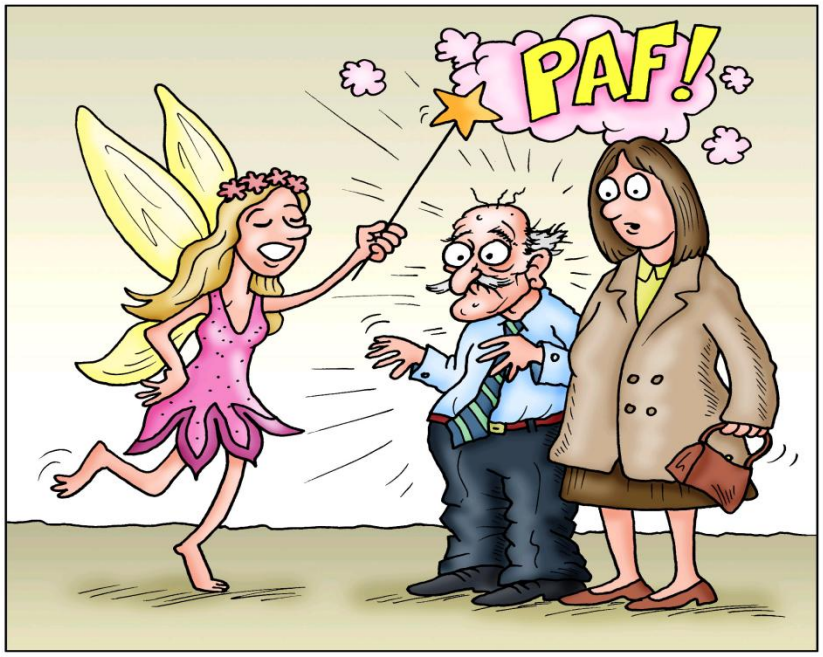

Premature Solutions

Define exactly what you want

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Publicise Success

- Write Case studies
- Make available TRIZ Facilitation Guides
- Use Innovation competitions -The first two problems described won the BAE Systems Chairman's Innovation award

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Providing Good TRIZ and telling everyone about it is not enough

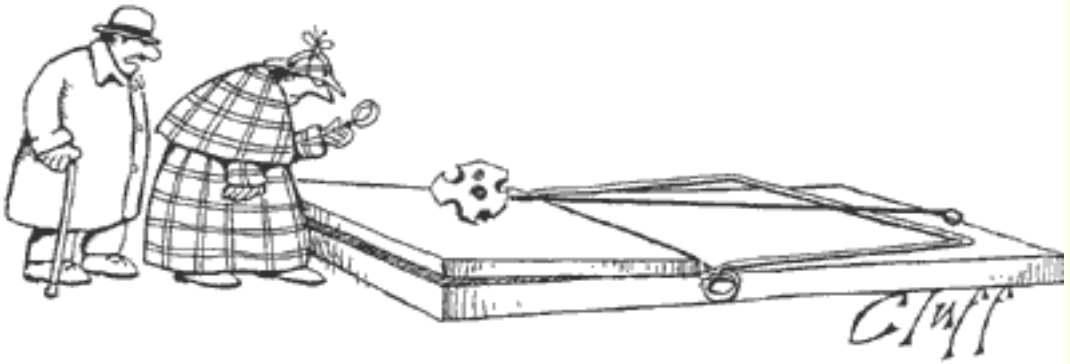
"If a man write a better book,

preach a better sermon,

or make a better mousetrap than his neighbour,

tho' he build his house in the woods,

the world will make a beaten path to his door" Ralph Waldo Emerson



"Careful, Holmes – it may be a trap"

A random selection of gags from past and present issues

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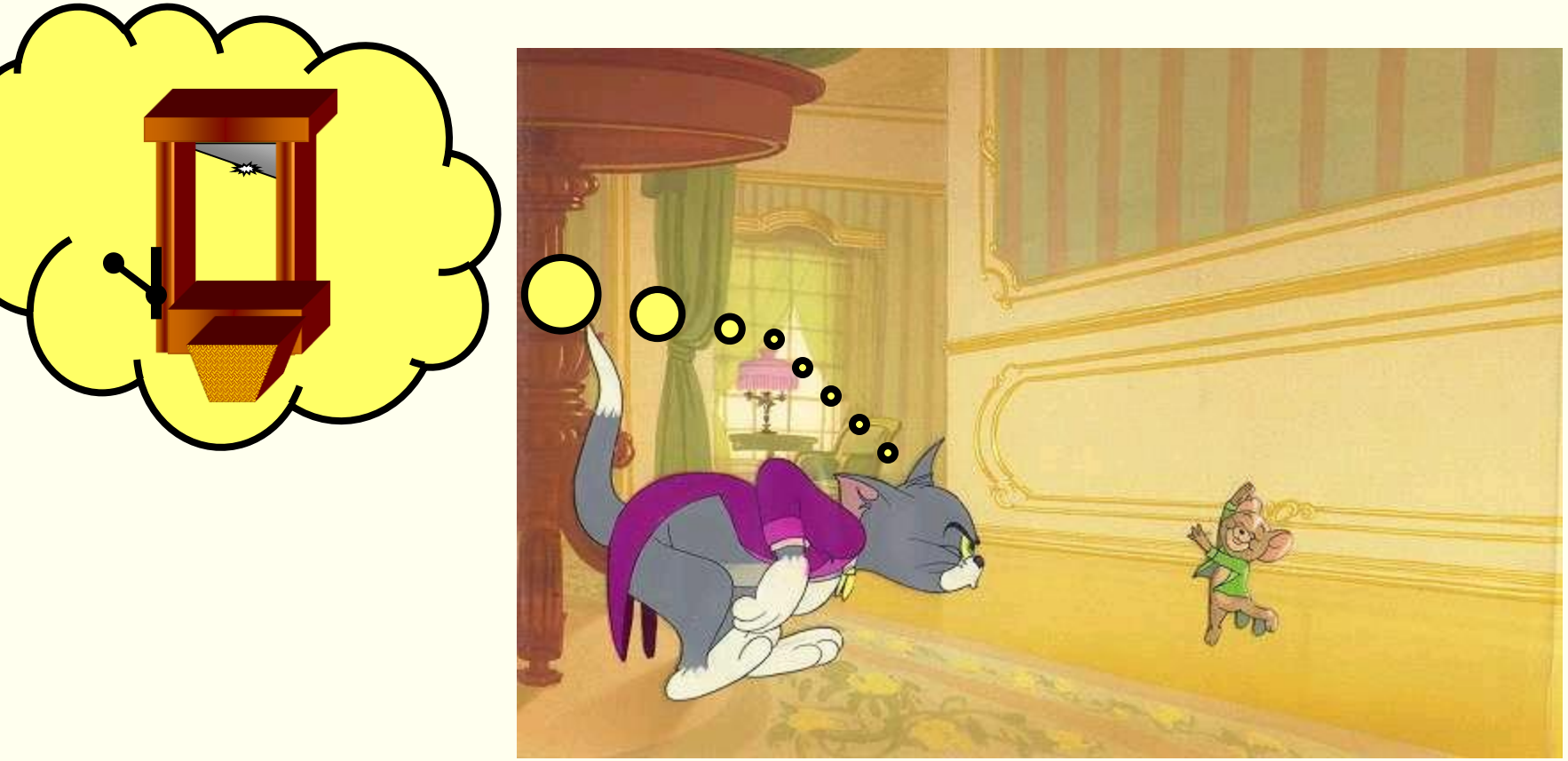
They must WANT to use TRIZ too!



"It is not sufficient to build a better mouse trap
you have got to sincerely want to kill mice" Bill Reichart

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Making TRIZ easily, consistently & quickly accessible to everyone (100,000 people) in BAE Systems

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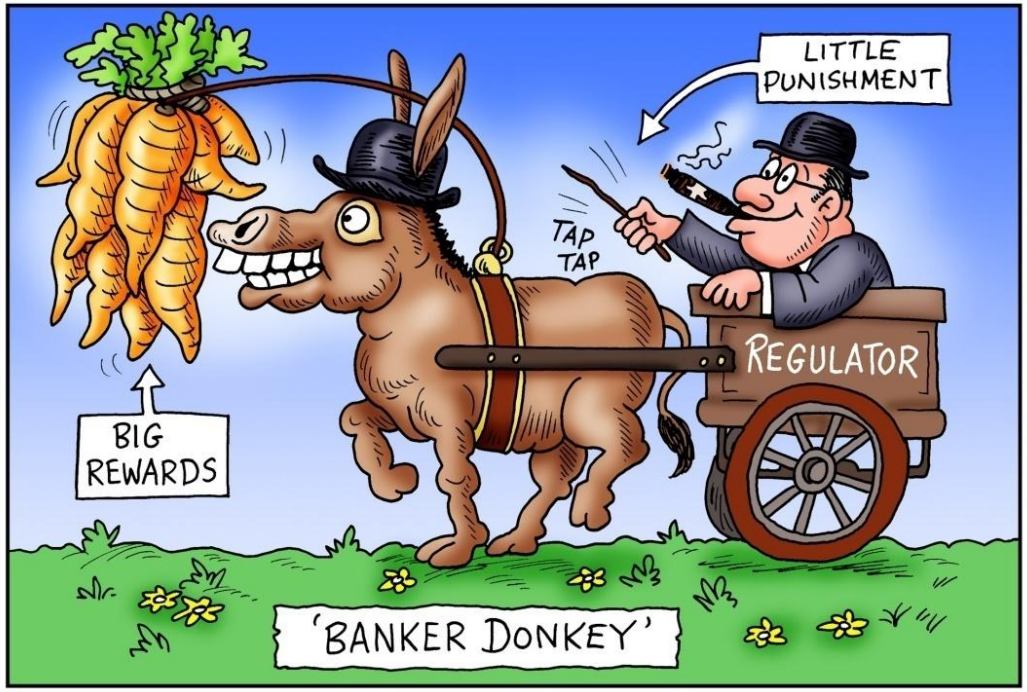

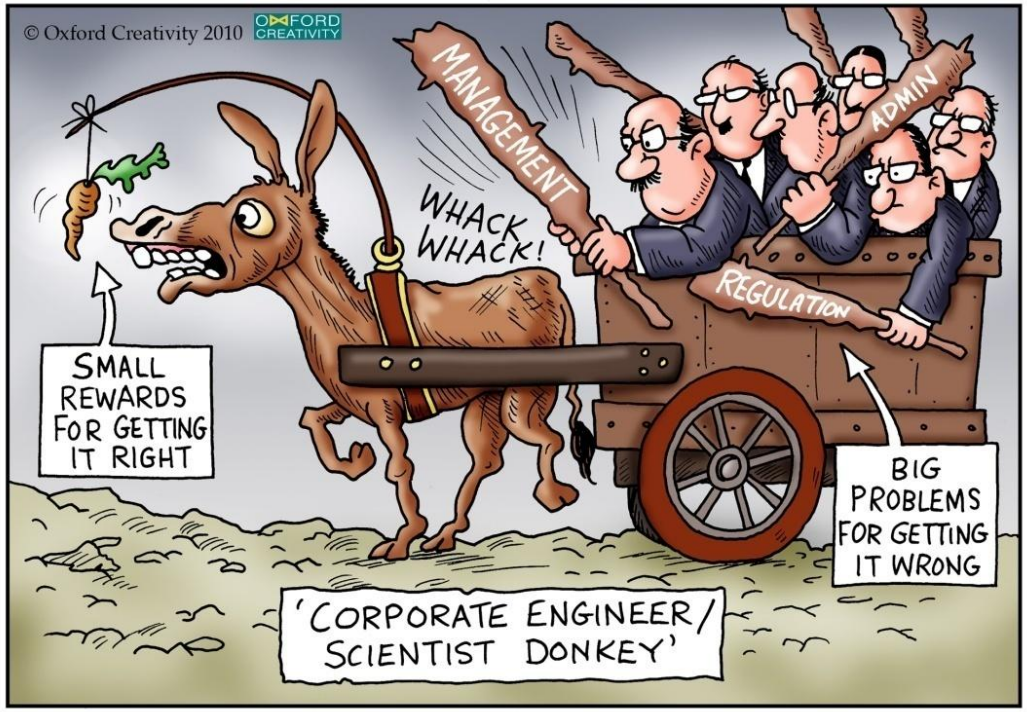

Tackle the Culture

Rewards for Innovation?

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Use TRIZ

- What's the IDEAL?
- Locate and mobilise Resources
- Think in Time and Scale

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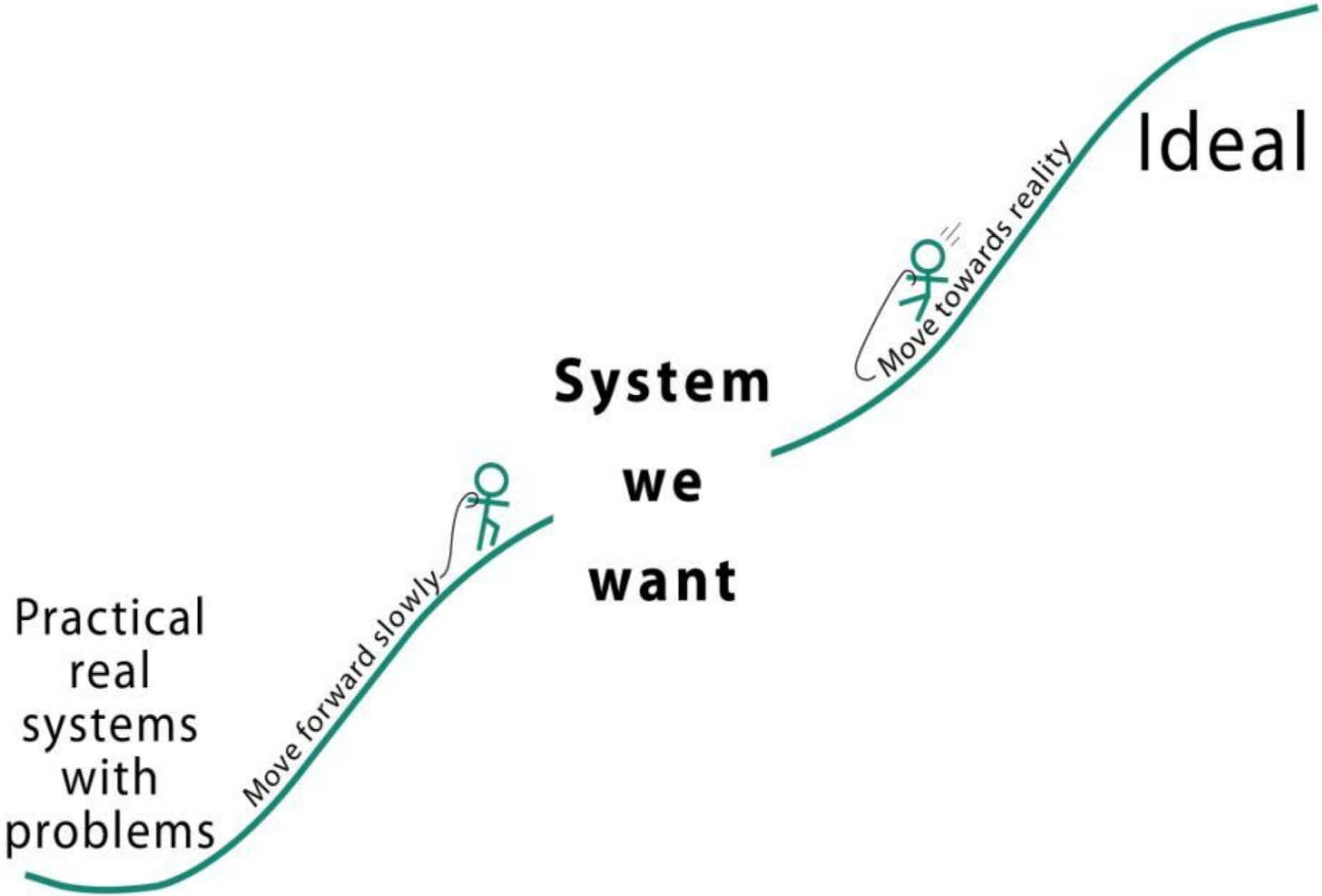

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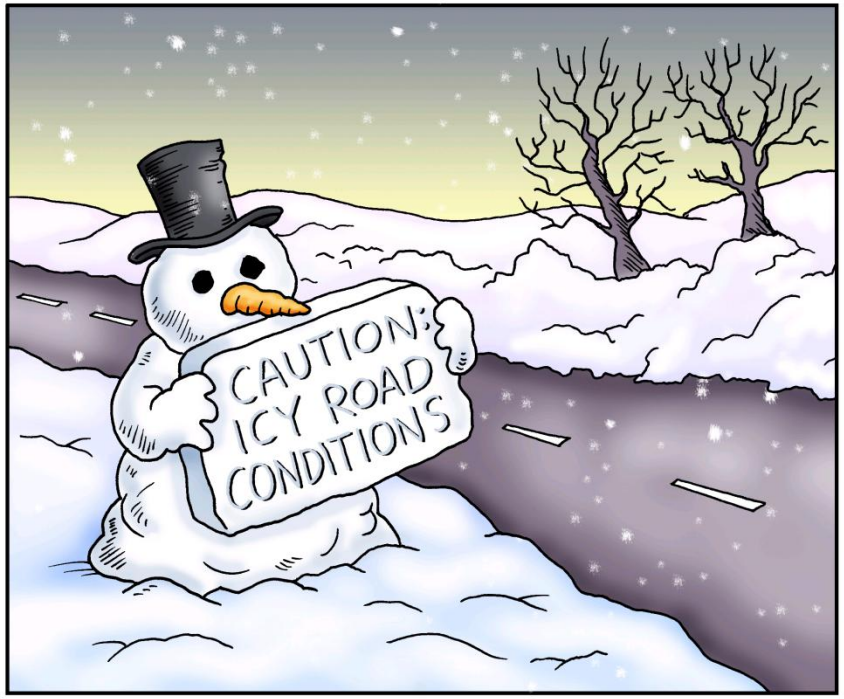

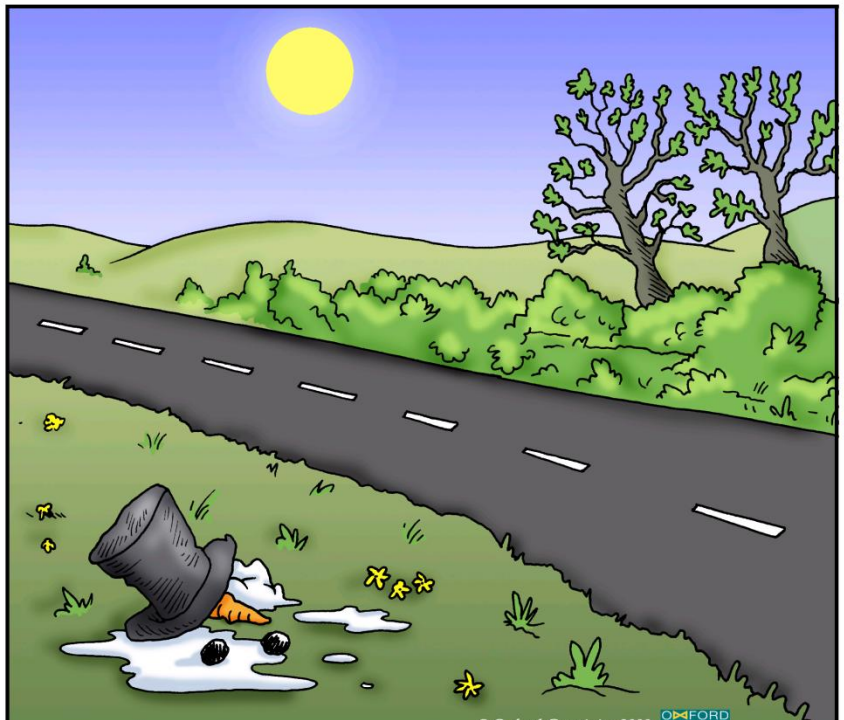

Ideal Systems =

Clever use

of available

Resources

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Resources in BAE Systems

- Life Cycle Management System (LCMS)
- BAE Systems training portals which were run by Xchanging
- TRIZ successes
- Intranets (Create a TRIZ intranet)
- TRIZ Enthusiasts (but beware of gatekeepers)

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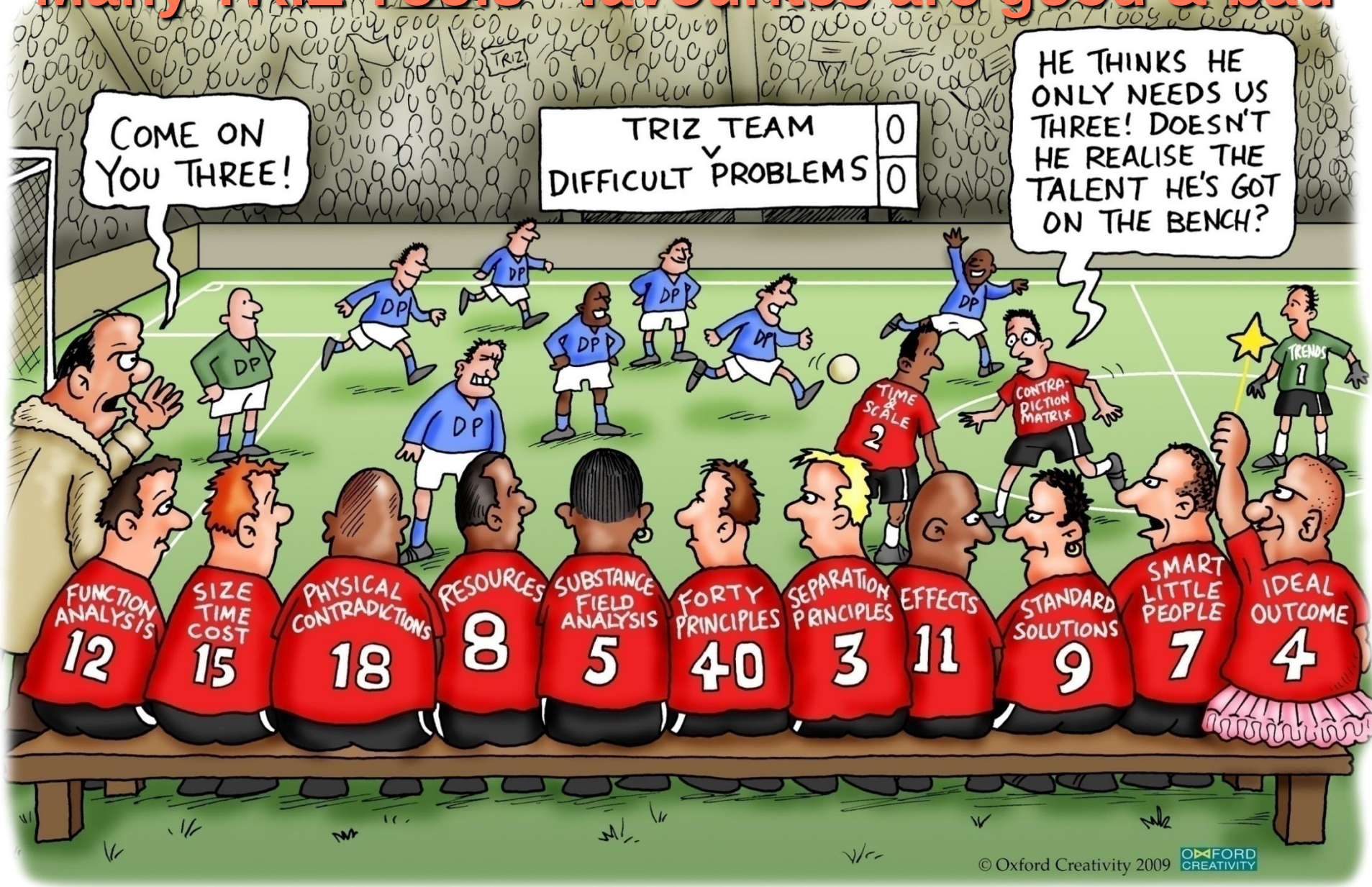
Many TRIZ Tools - favourites are good & bad



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The Ideal Solves the Problem by itself

Look for **Resources** close to the problem **Time** and **Place** for we need to think in **Time & Scale**

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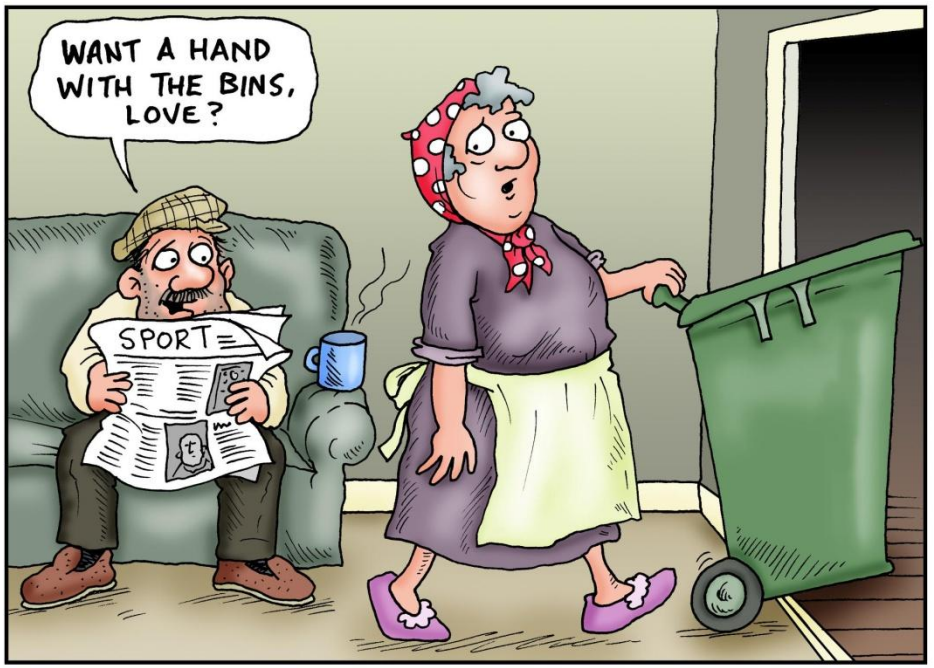
Combine resources to create better Solutions



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Use TRIZ to solve your problems of selling TRIZ

Look at all available resources

Also Map resources in the System

& Super-System & Sub-Systems

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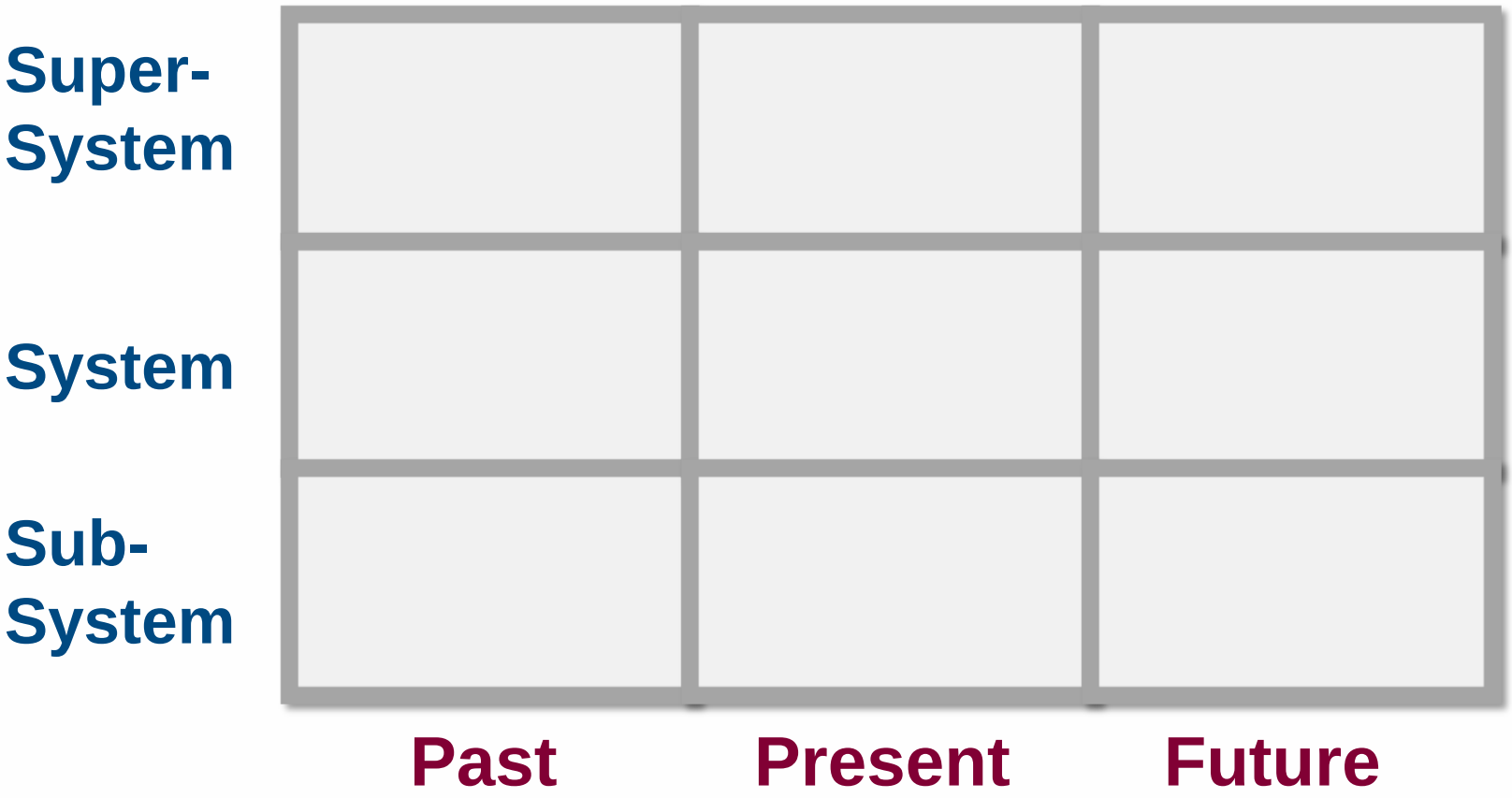
Time & Scale



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Time and Scale – TRIZ in BAE Systems

	PAST	PRESENT	FUTURE
Super-System BAE Systems	Seek innovation & problem solving	Current systems add TRIZ to enable access	Customers Suppliers know TRIZ
System Team or Department	TRIZ problem solving creates happy teams	Facilitated TRIZ Problem solving available	TRIZ is seen to work
Sub-Systems Individuals	Learn TRIZ & solve problems	TRIZ Training available – without Justification	Confident TRIZ migrates
	Sell & create enthusiasm for power of TRIZ	Embed TRIZ Problem-solving Enable TRIZ	TRIZ trained Community TRIZ Problem solving Self Sufficiency

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Why TRIZ success in BAE Systems?

TRIZ Learning	Consistent, well received, flexible learning workshops in many good locations
Problem Solving	Available, well facilitated, good maps, good documentation, good results well publicised, and clear teaching of how to run a TRIZ session
TRIZ Materials	Highest quality, clear, easy to use after the sessions, both books and Oxford Creativity A0 problem solving sheets
TRIZ Access	Instant, universal, mandated for innovation and problem solving, part of existing systems
Burden of TRIZ	TRIZ available but not burdensome to teams or managers - organisation done by Oxford Creativity or existing BAE resources and TRIZ slave
TRIZ Teams	Unexpected benefits of HAPPY teams and excited and confident engineers
TRIZ Value	Proved every time and passed every test

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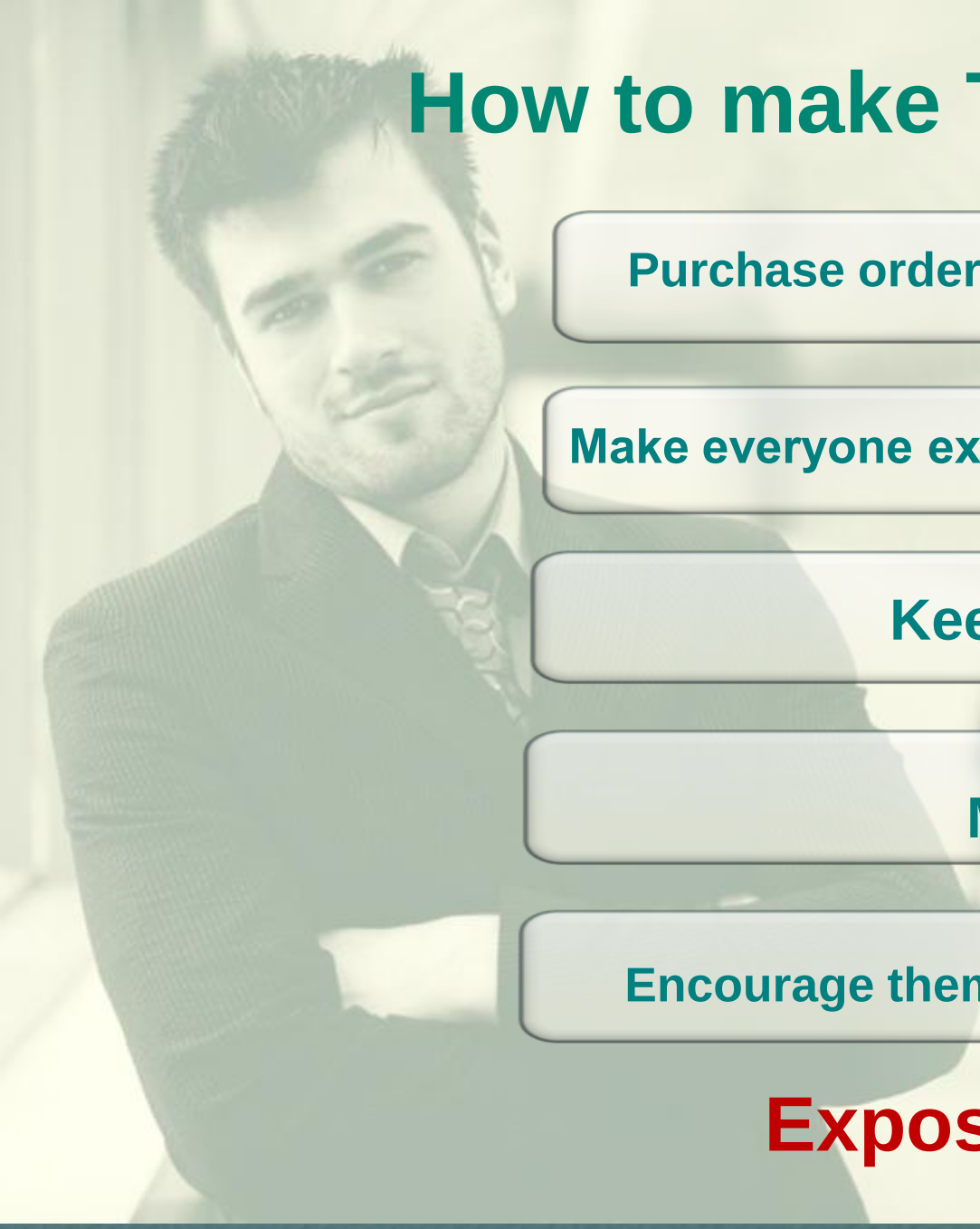
How to make TRIZ Fail



- Purchase orders for every person and session
- Make everyone explain to their boss ‘what is TRIZ’
- Keep saying its hard/difficult
- Make it just for a clever few
- Encourage them to spend lots on TRIZ software

Expose them to BAD TRIZ

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How to make TRIZ Fail

- Purchase orders for every person and session
- Make everyone explain to their boss ‘what is TRIZ’ before they are allowed to learn it
- Keep saying its hard/difficult
- Make it just for a clever few
- Encourage them to spend lots on TRIZ software
- Expose them to BAD TRIZ

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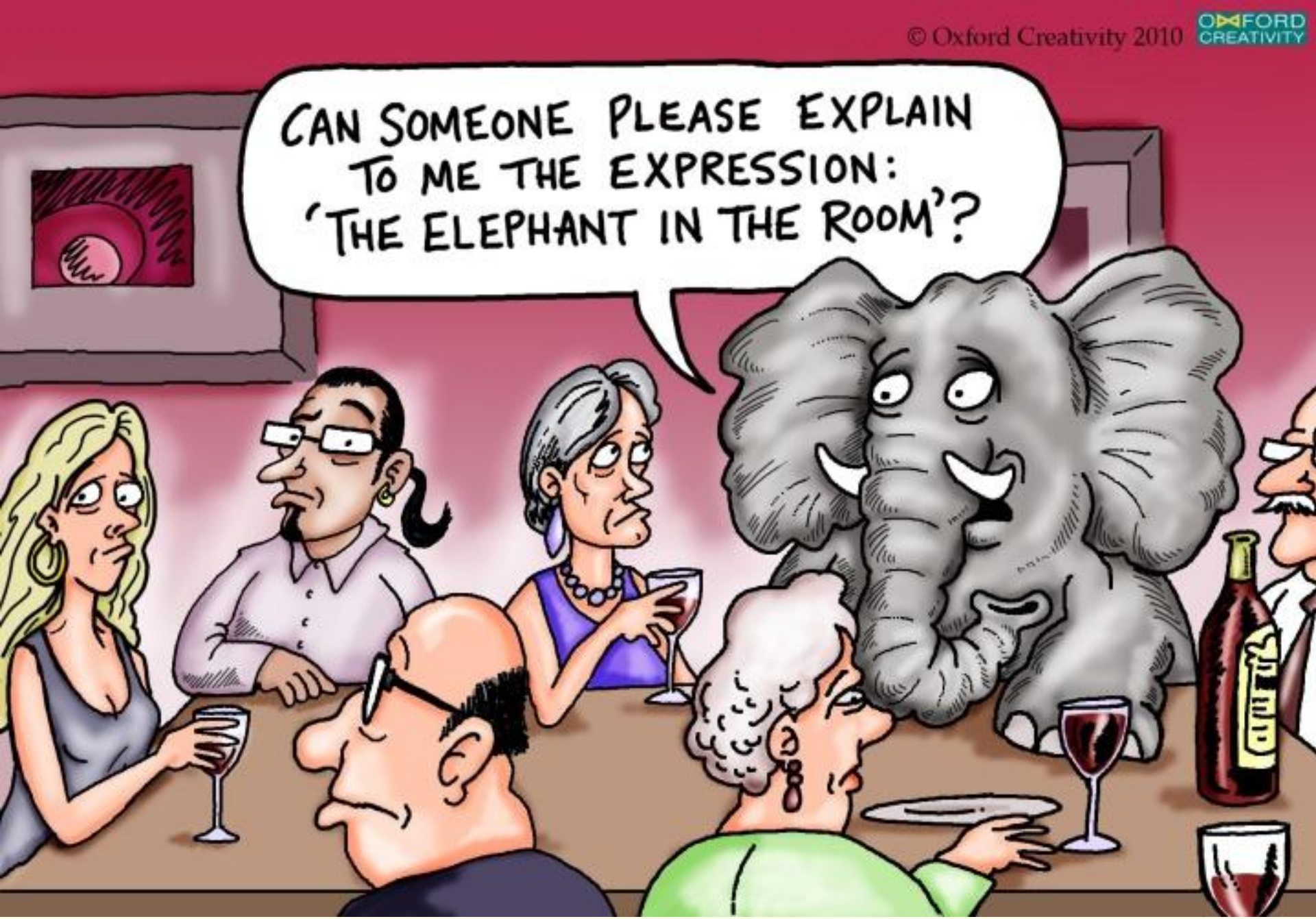

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