





**Hands-On**  
**Systematic Innovation**  
Evolving The World's Most Powerful  
Creativity & Innovation Processes

Darrell Mann

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**Hands-On Systematic Innovation**  
Evolving The World's Most Powerful  
Creativity & Innovation Processes

- 1) Big Picture Overview
- 2) Dynamics Of System Evolution
- 3) Eliminating Contradictions
- 4) Trends Of Evolution & Evolution Potential
- 5) Putting It All Together

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# Big Picture Overview





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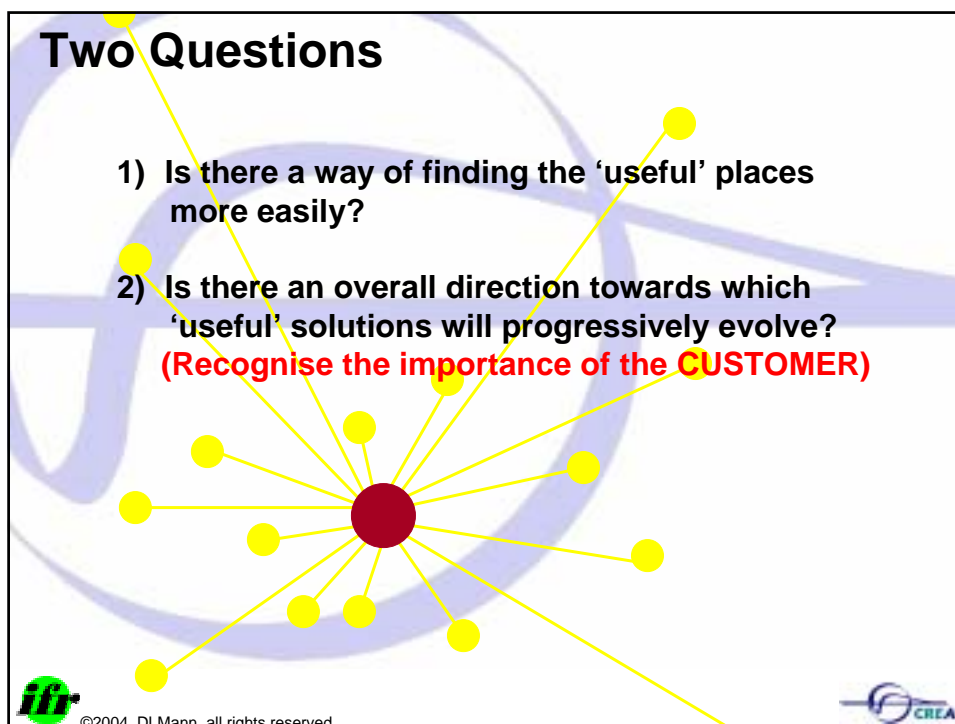
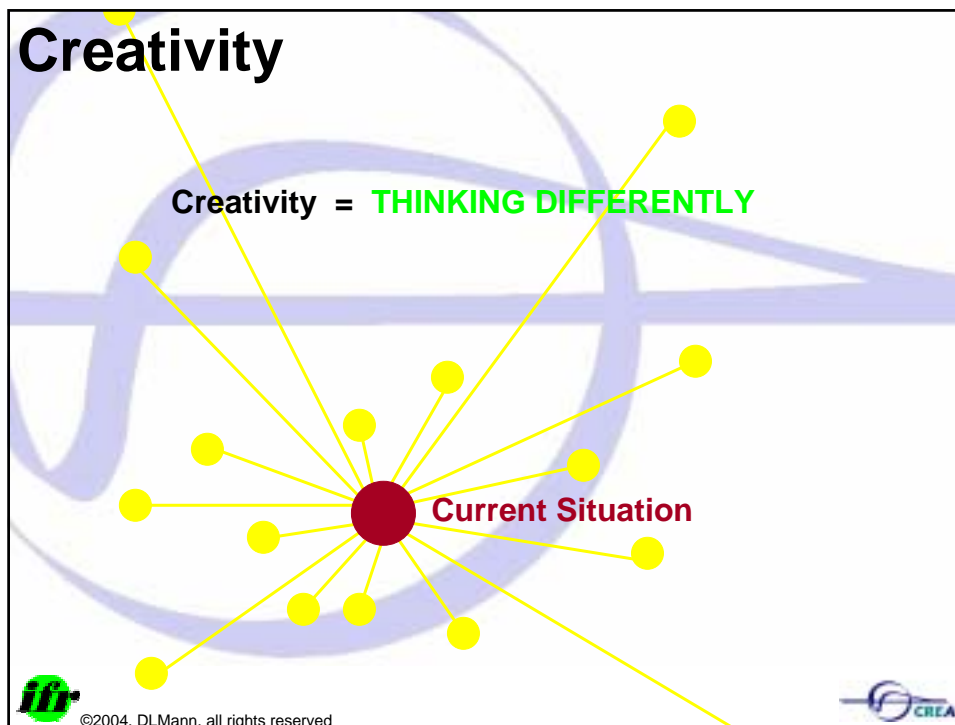
# Innovation

Innovation = **DOING THINGS BETTER**

Innovation = **ACTIONxKNOWLEDGExCREATIVITY**



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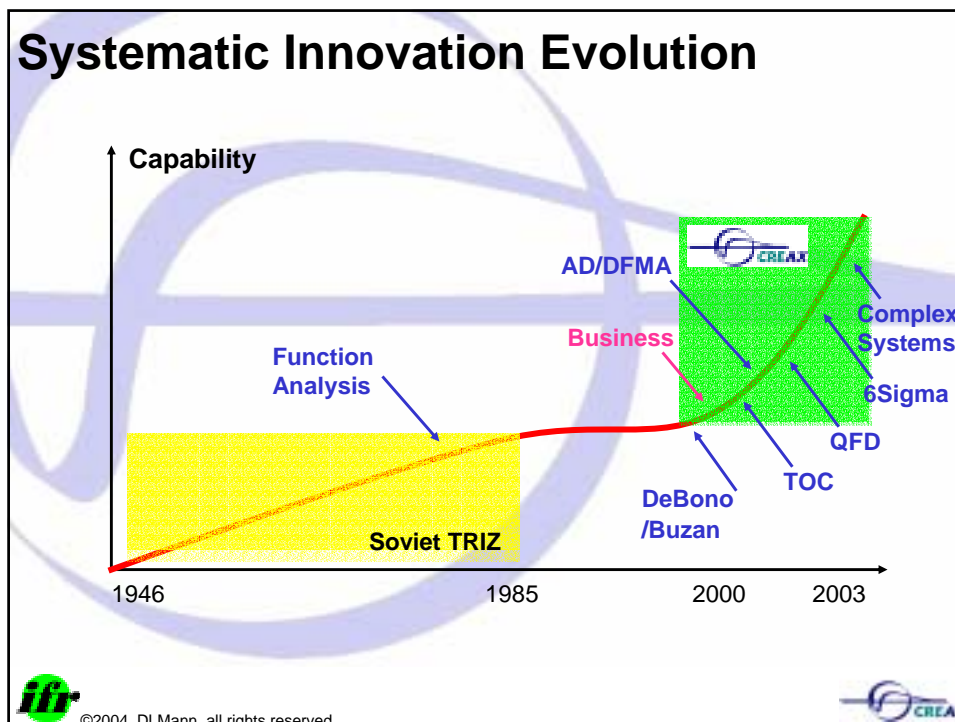


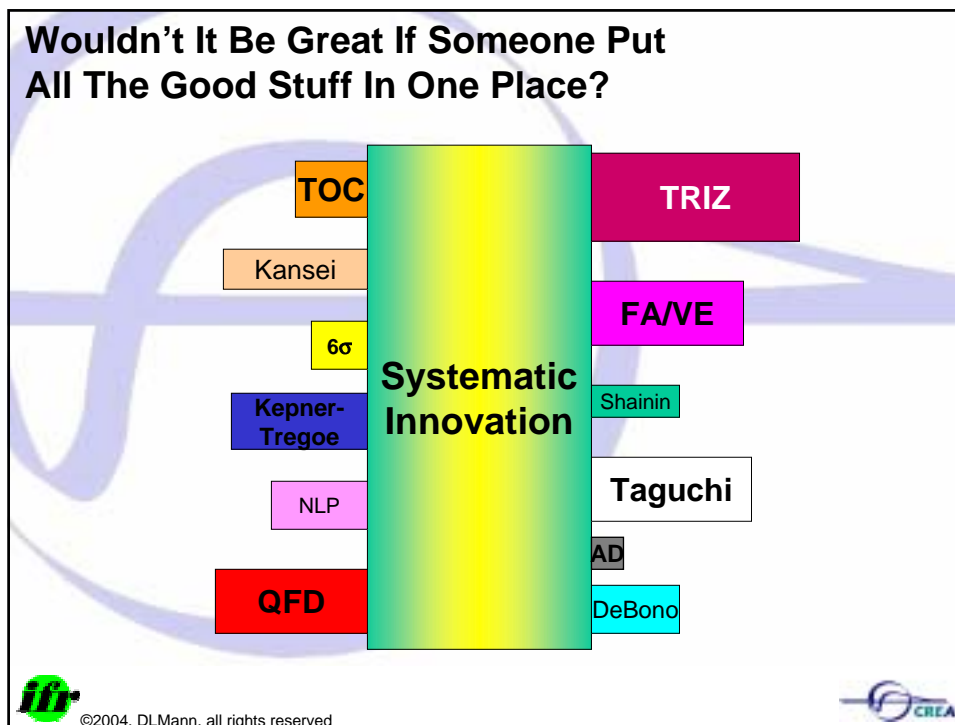
# TRIZ

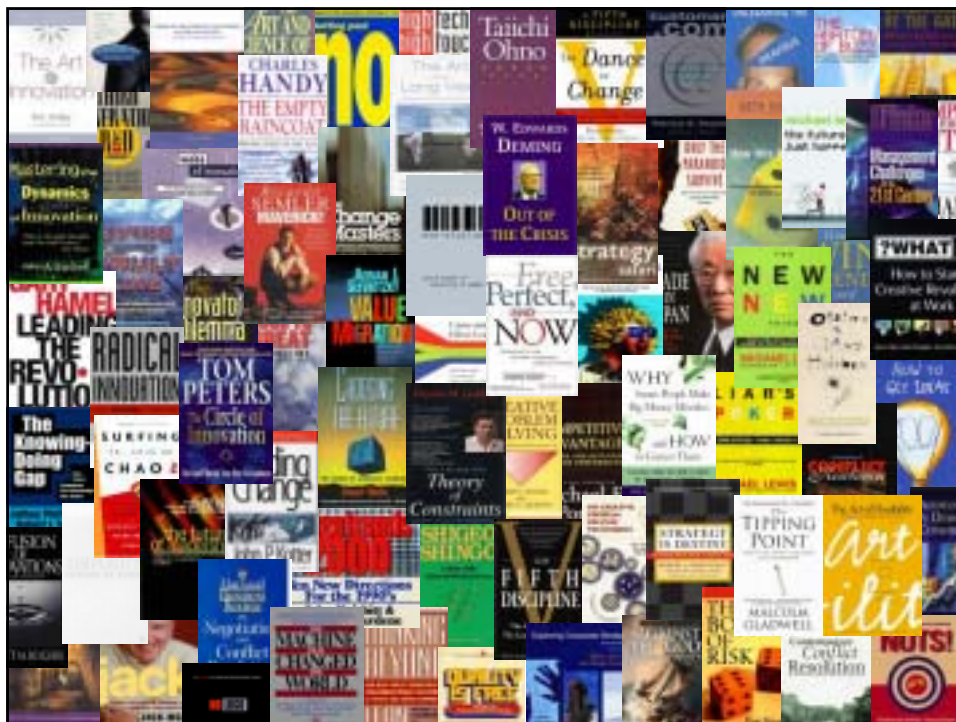
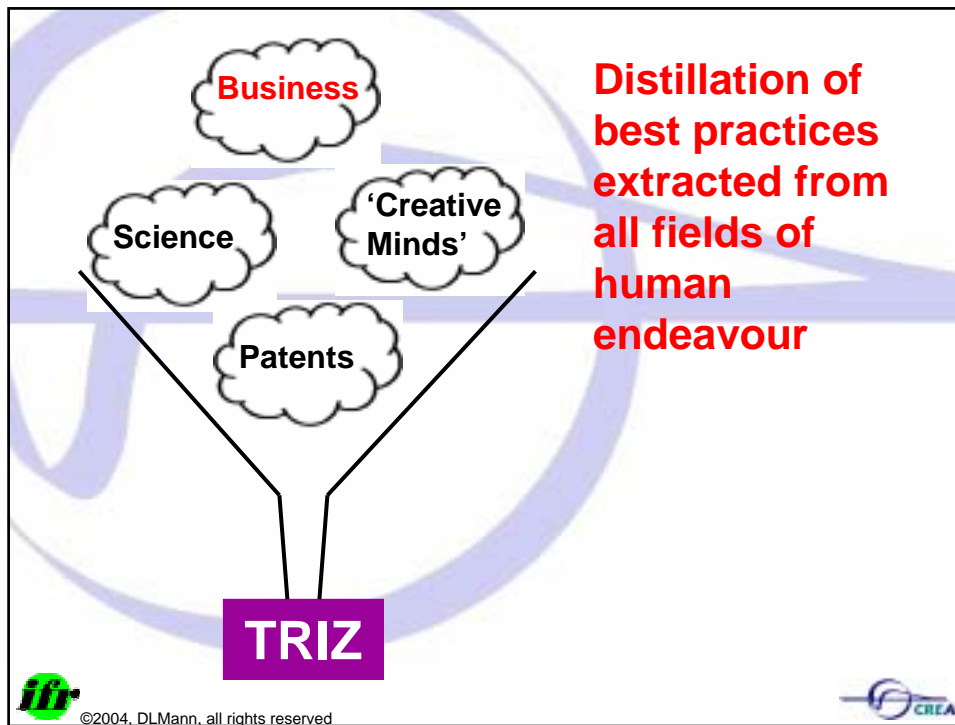
Teoriya Resheniya Izobreatatelskikh Zadatch  
Теория Решения Изобретательских Задач  
Theory of Inventive Problem Solving



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## Re-Organising TRIZ

An Altshuller TRIZ course would be 3+ months duration

This tells us:

- there is a lot of content in TRIZ
- there is a lack of appreciation for the time demands of industry

**IS IT POSSIBLE TO MAKE IT EASIER TO LEARN TRIZ?**

**IS IT POSSIBLE TO BEGIN DELIVERING REAL BENEFIT INSIDE 1 OR 2 DAYS?**

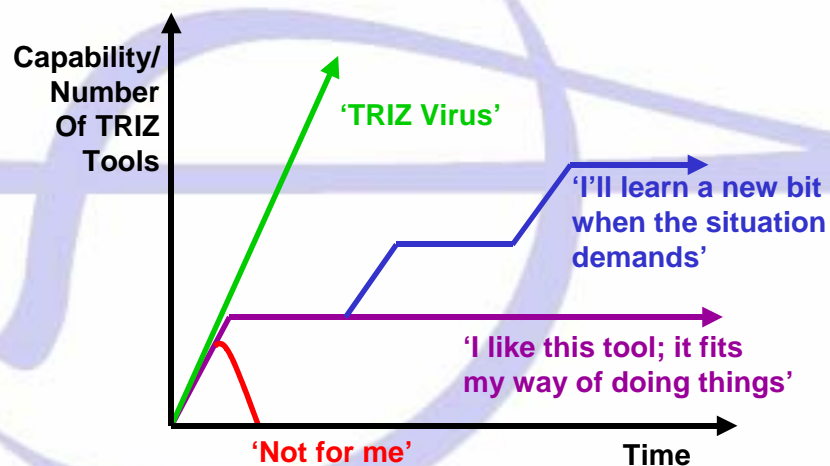


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## TOP 10 Teaching TRIZ Issues


- Different People Learn In Different Ways




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# TRIZ – Tool? Method? Philosophy?




A Collection of Tools



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# TRIZ – Tool? Method? Philosophy?




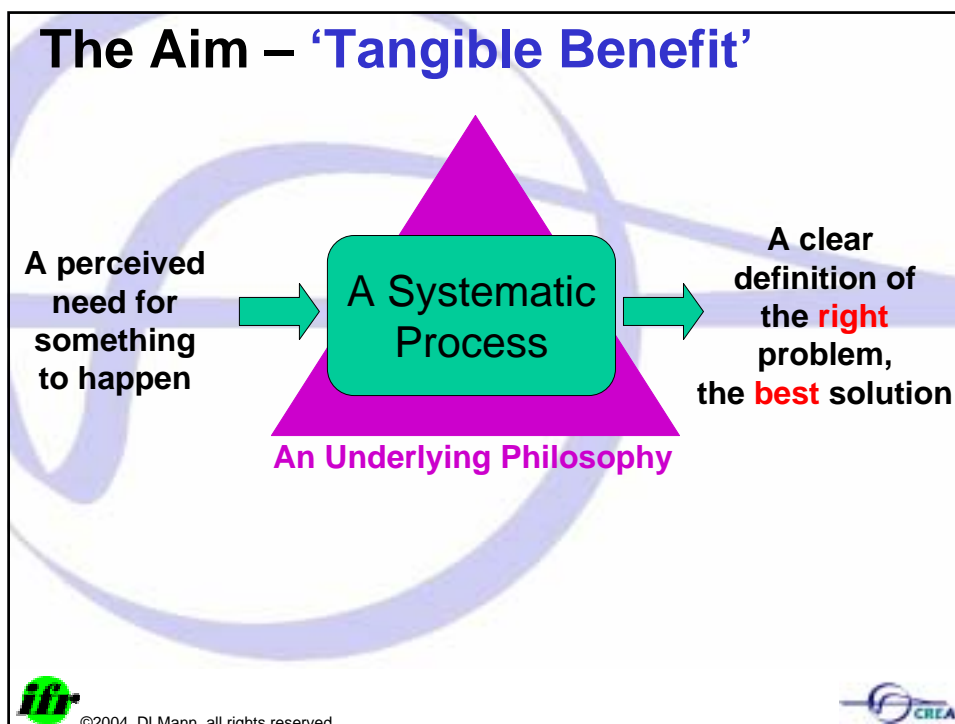
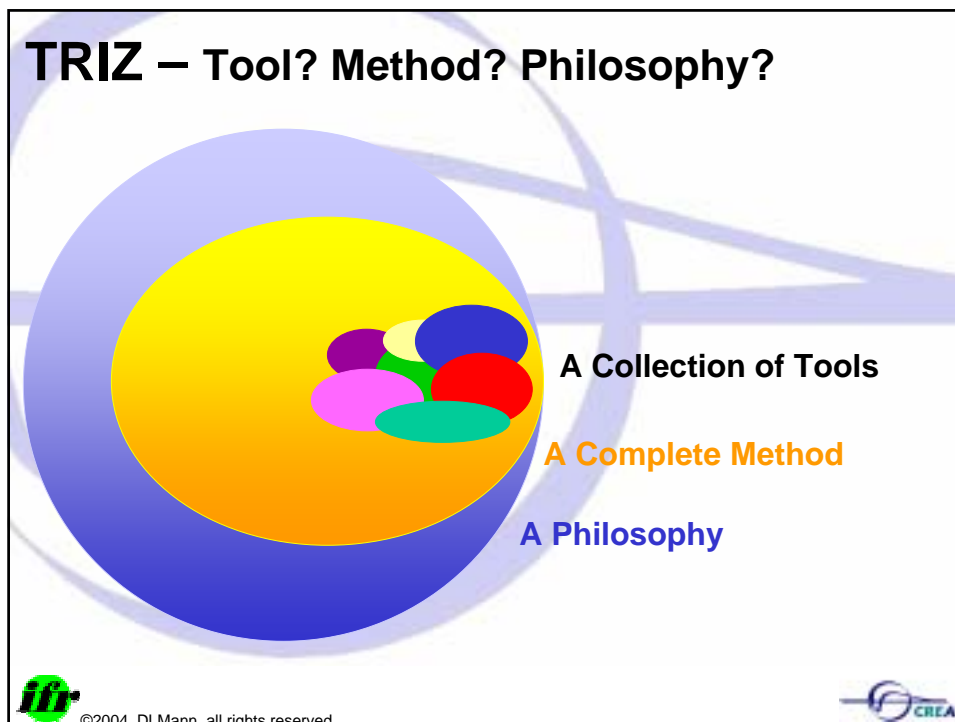
A Collection of Tools

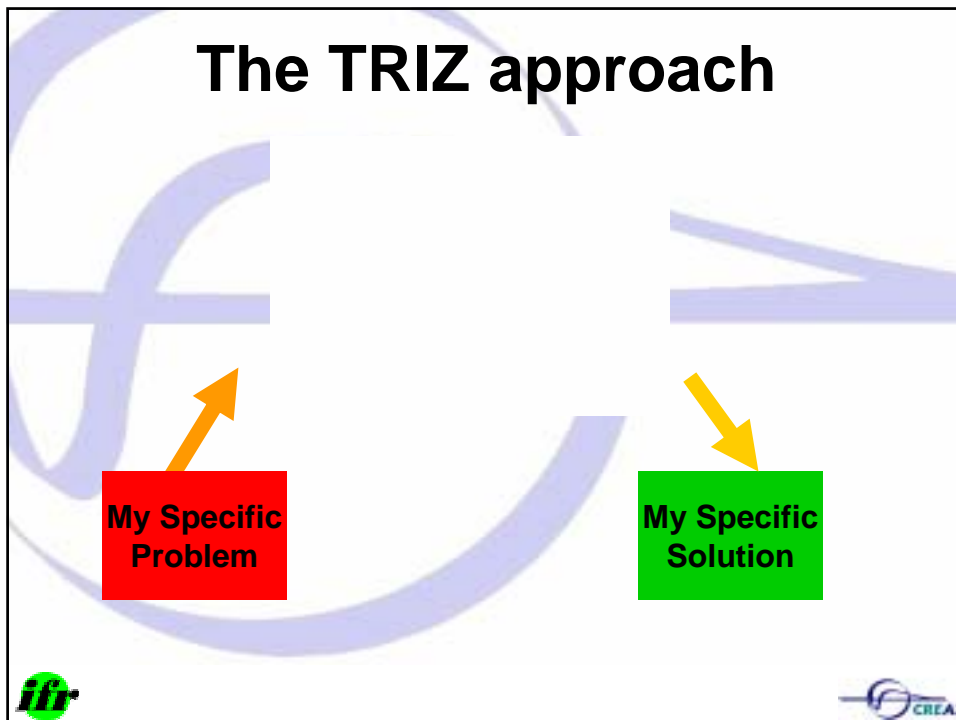
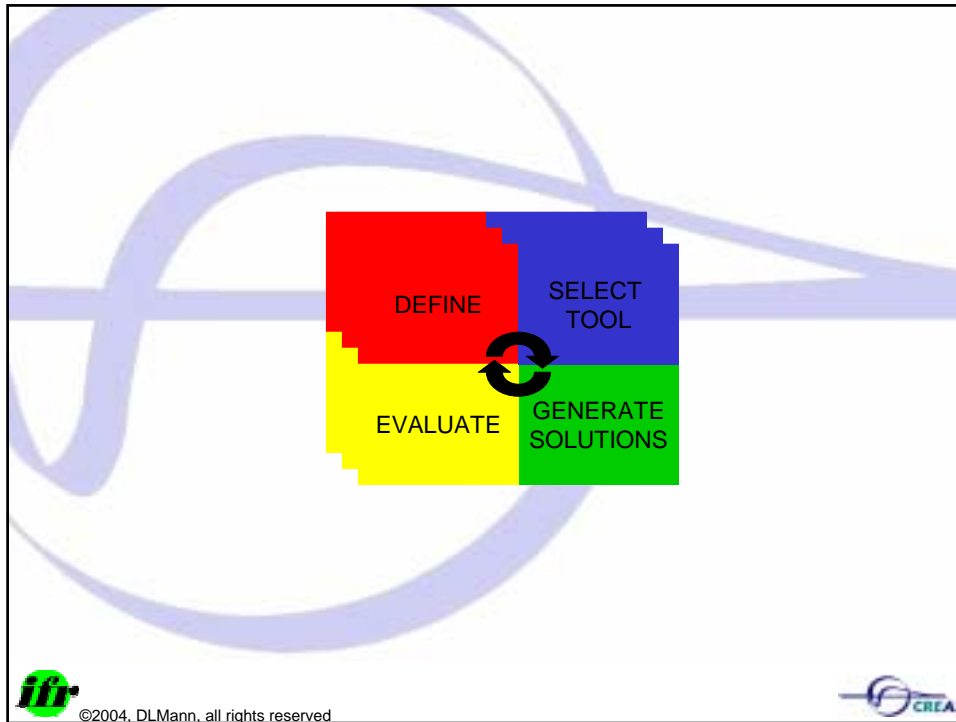
A Complete Method

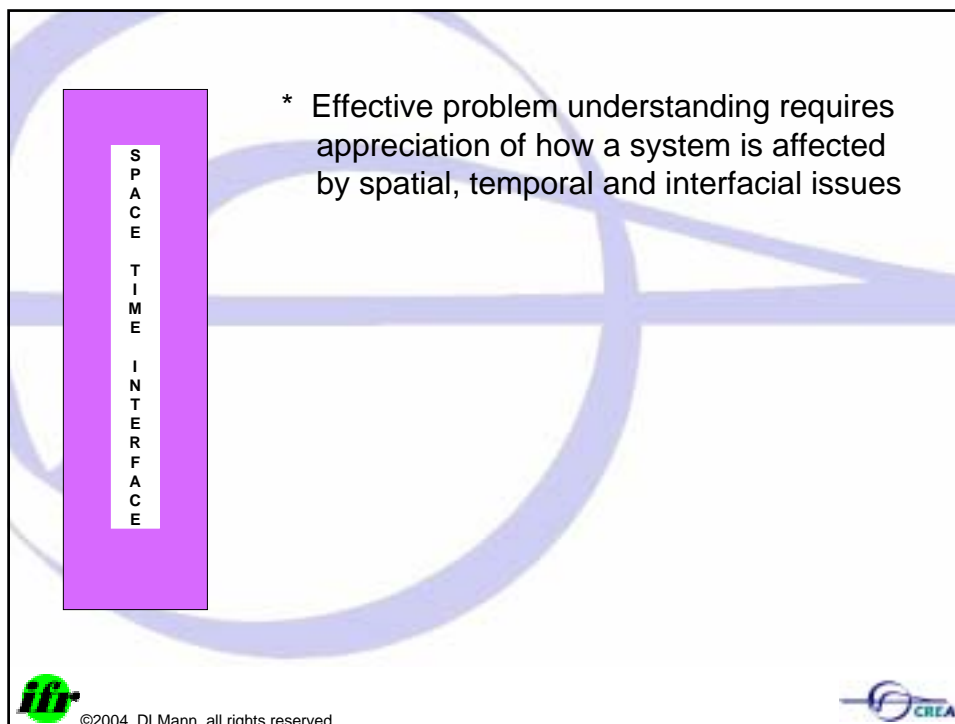
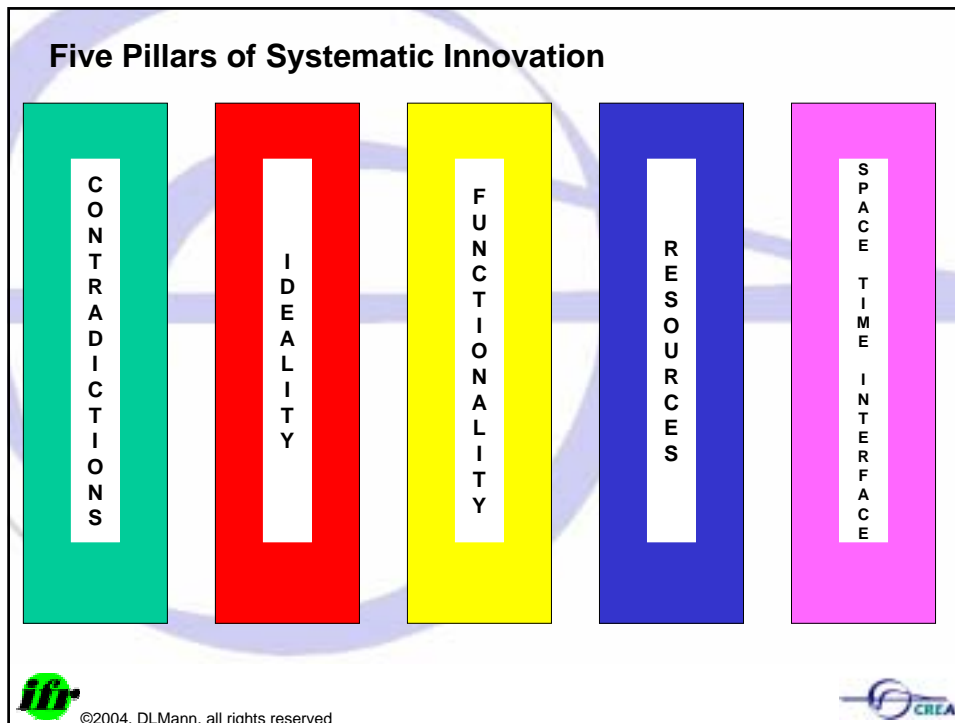


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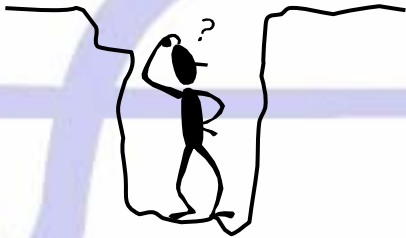










### Systematic Creativity






- \* Problem solving is like digging for treasure in a field
- \* If a hole already exists, our inclination is to dig it deeper
- \* The deeper the hole, the more difficult it is to see what's happening in other parts of the field
- \* If someone else comes along, we encourage them to jump in the hole with us
- \* The overall effect is called **PSYCHOLOGICAL INERTIA**

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### SYSTEM OPERATOR ('9 Windows')


SUPERSYSTEM	<input type="text"/>	<input type="text"/>	<input type="text"/>
SYSTEM	<input type="text"/>	<input type="text"/>	<input type="text"/>
SUBSYSTEM	<input type="text"/>	<input type="text"/>	<input type="text"/>
	PAST	PRESENT	FUTURE

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RESOURCES

- \* Everything in and around a system which is not being used to its maximum potential is a resource
- \* ...Even the harmful things
- \* Examples:-
  - Pressure, centrifugal forces, resonance
  - 'Dave Payne'
  - Competitors
  - 'Over indulgent' customers?




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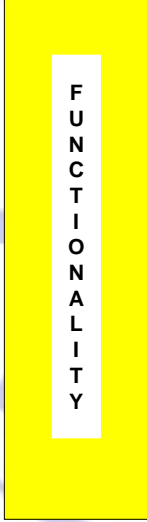


CONTRADICTIONS



- \* **All** systems contain contradictions
- \* The large majority of our improvement strategies assume 'compromise' and 'trade-off' as the only way of dealing with contradictions
- \* Powerful solutions are the ones that don't accept the trade-offs
- \* There are ways of 'eliminating' compromise
- \* We should actively look for contradictions



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- \* Understanding function and functionality at the most basic level is fundamental to successful application of TRIZ
- \* **'Solutions Change; Functions stay the Same'**  
(we will all continue to want to achieve the function 'communication' but we will not necessarily want a mobile phone to achieve it)
- \* Knowledge classification by function allows ready access to the solutions of others



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### Customers Buy **FUNCTIONS**

Proctor and Gamble  
**Washing Powder Business** → **Cleaned Clothes**

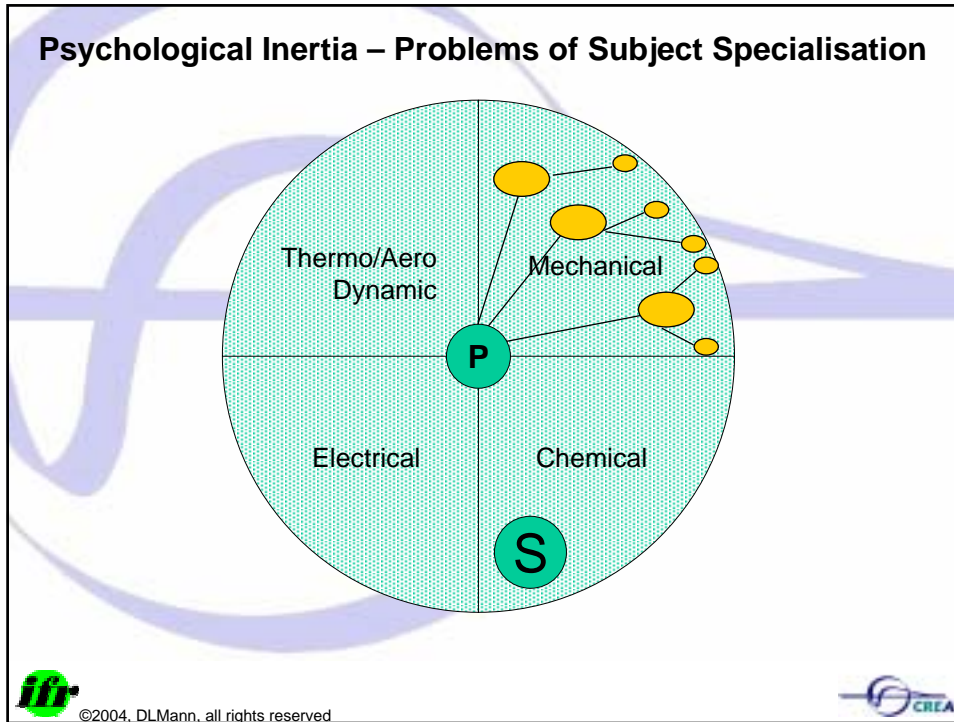
Rolls-Royce  
**Jet Engine Business** → **'Power-by-the-Hour'**

Interface  
**Selling Carpets** → **'Floor Management'**

Electrolux  
**Selling Washing Machines** → **'Home Laundry'**



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### Other Means of Delivering The 'Move Air' Function

**Online Function Database**

Classifying knowledge by function rather than by alphabet, CREAX is constructing the largest database of functions enabling you to access the world's knowledge within seconds.

Select Function

Solid  Liquid  Gas  Field

**Function:**  
Move Air


Solid  Liquid  Gas  Field

**Search Found 23 Results**



- Acoustic Vibrations
- Archimedes' Principle
- Bernoulli's Theorem
- Chelesky Effect
- Coanda Effect
- Diffusion
- Ejector
- Electrosapillary Effect
- Electrosmear
- Electrophoresis
- Electrostatic Induction
- Fan/Compressor
- Ferromagnetism
- Gravity
- Inertia
- Jet Flow
- Pascal Law
- Rankine-Hugoniot Effect
- Shock Wave
- Spiral
- Thermal Expansion
- Venturi Pump
- Viscous Velocity Effect

www.creax.com

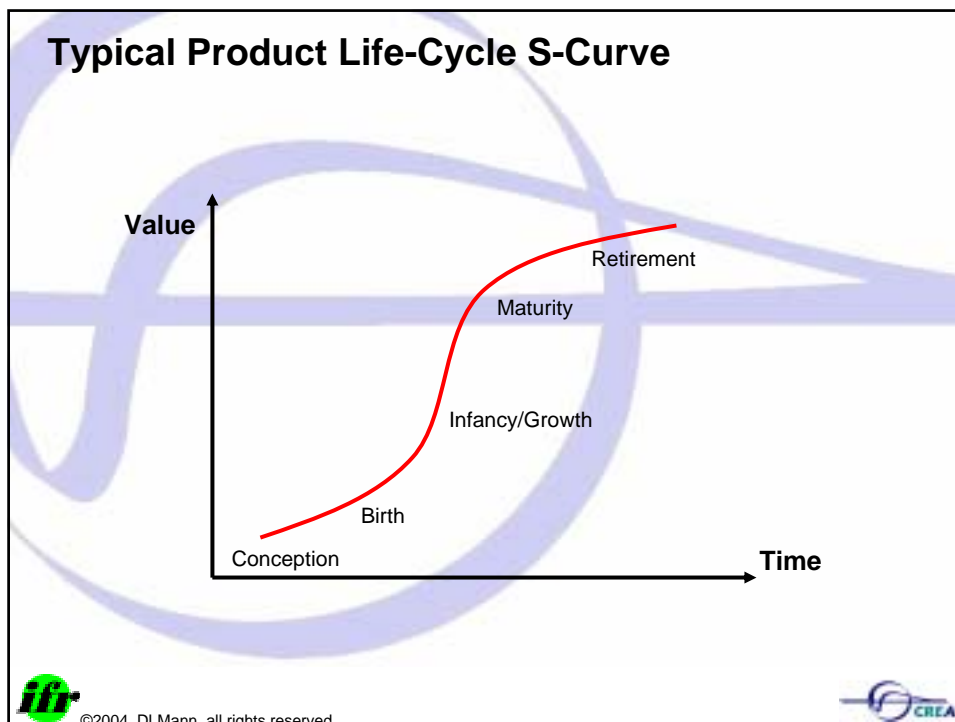
**TRIZ** ©2004, DL Mann, all rights reserved **CREAX**

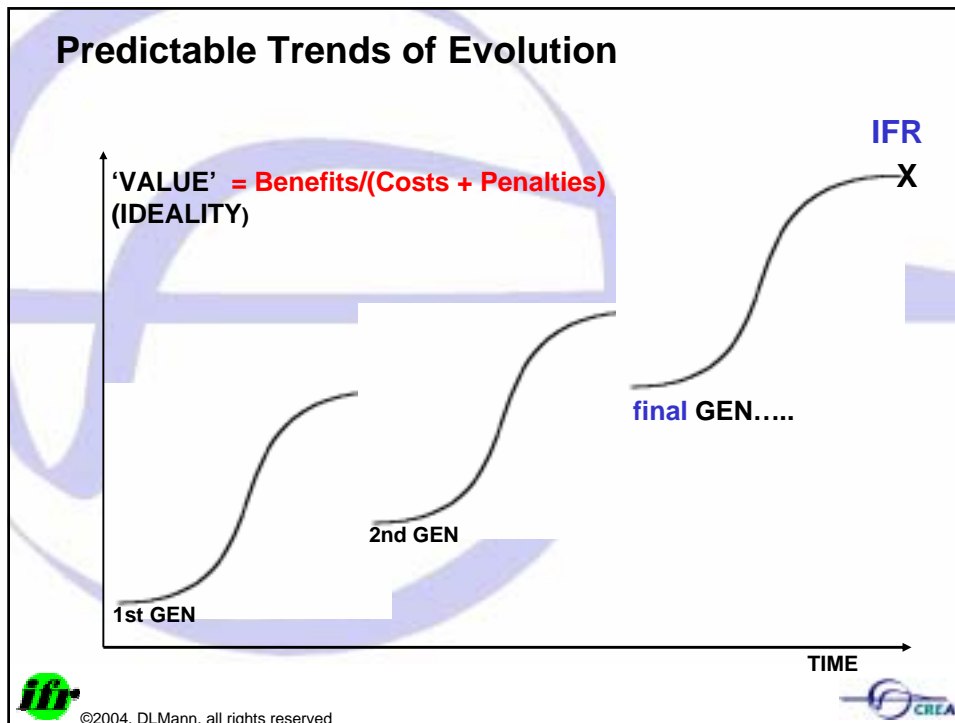


- \* Ideality is the over-riding driver for system evolution
- \* Ideality is about increasing the good, decreasing the bad
- \* Ideality = 'Value' =  $\frac{\text{Benefits}}{(\text{Cost} + \text{Harm})}$
- \* IDEAL FINAL RESULT – all the benefits, none of the cost or harm
- \* *'free, perfect & now'*
- \* **'SELF'**





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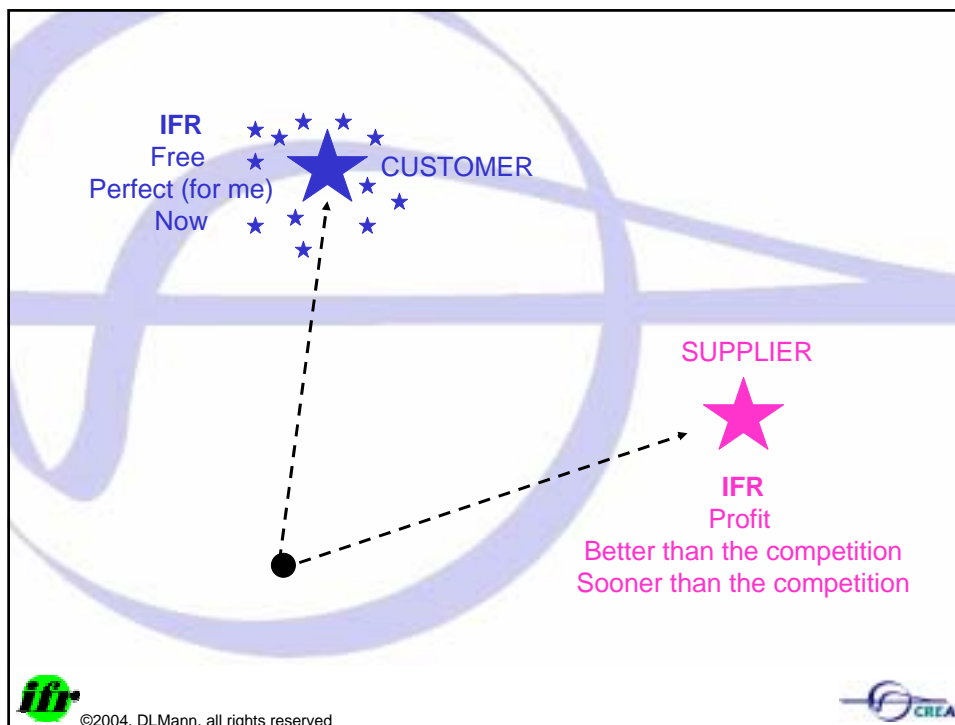


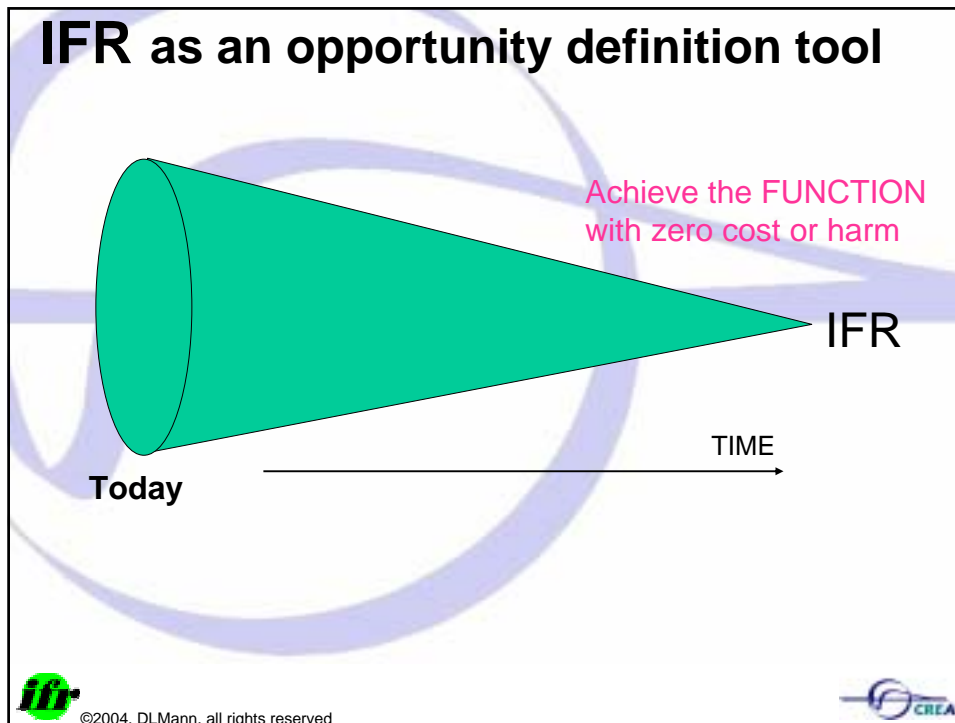


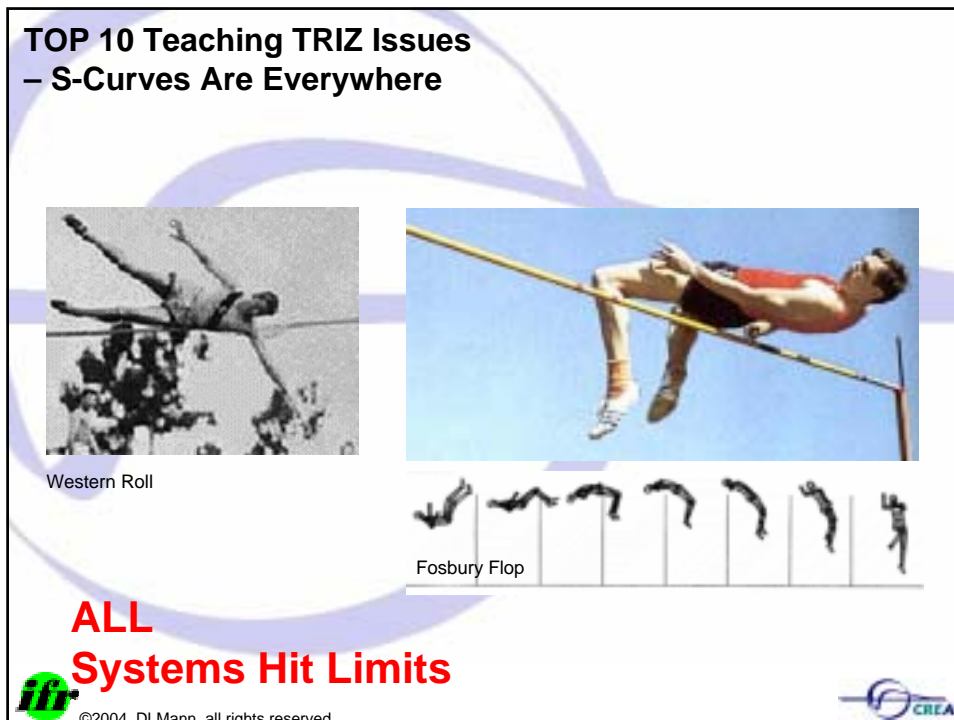
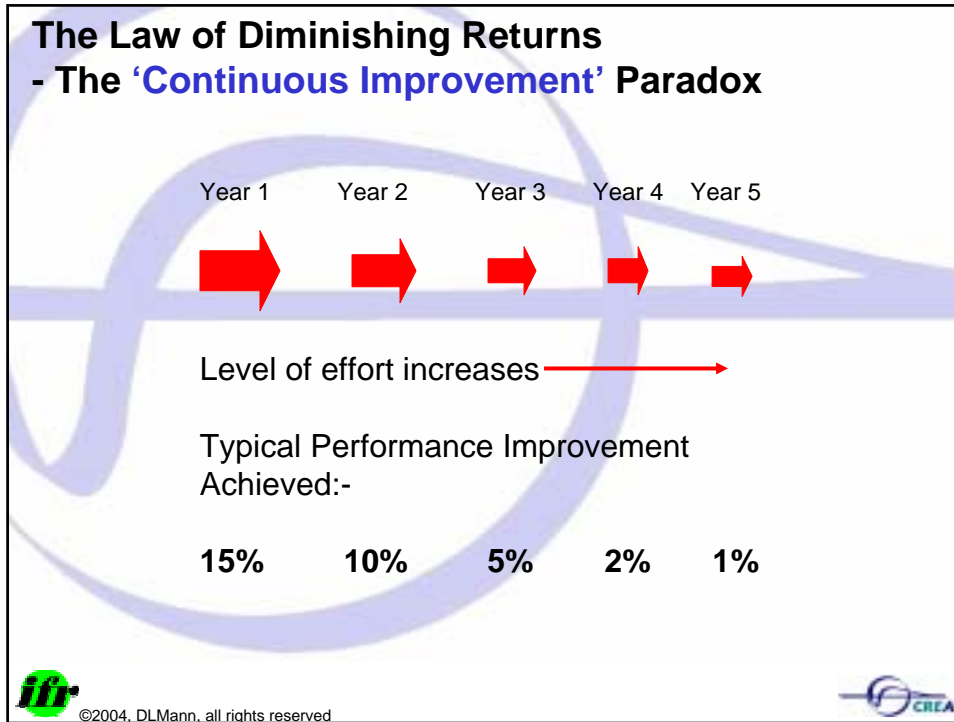
# WHOSE IDEAL FINAL RESULT ?

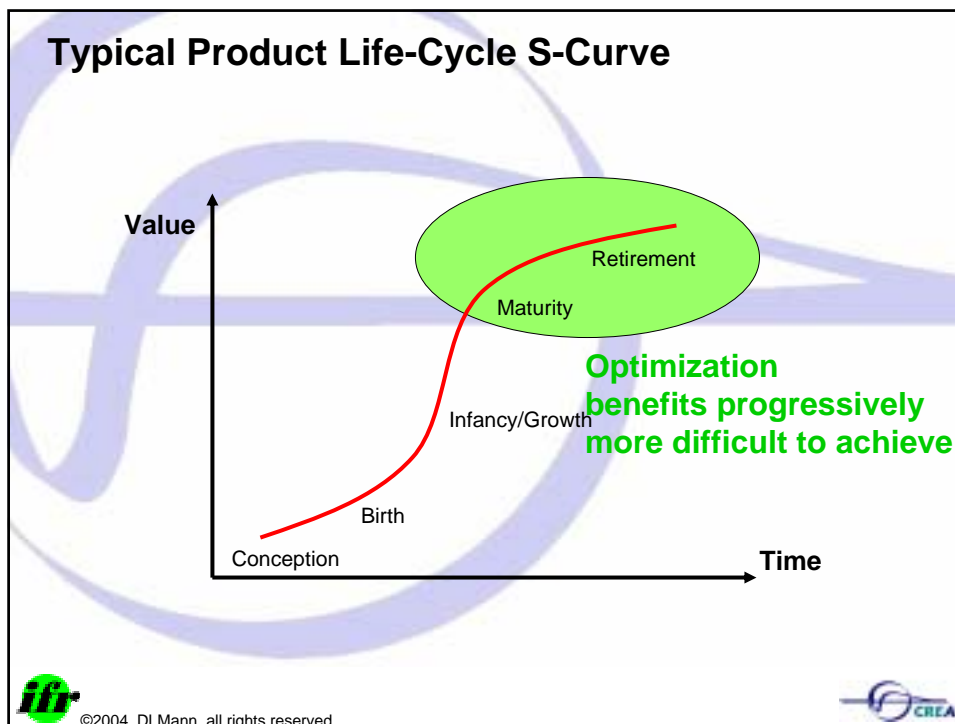
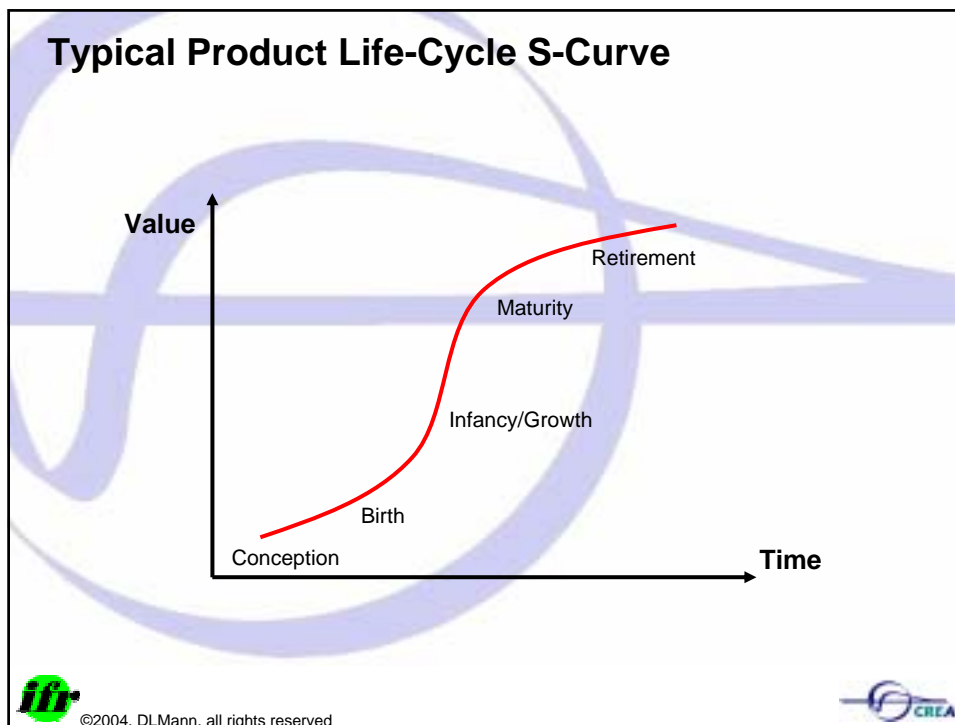
Customer ? Supplier ?

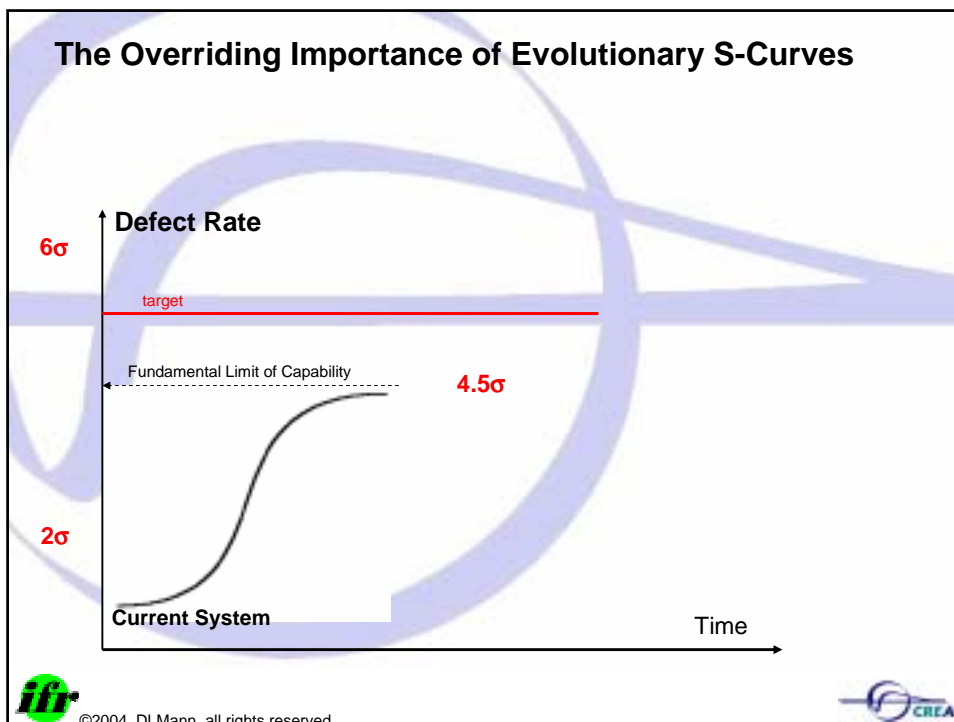
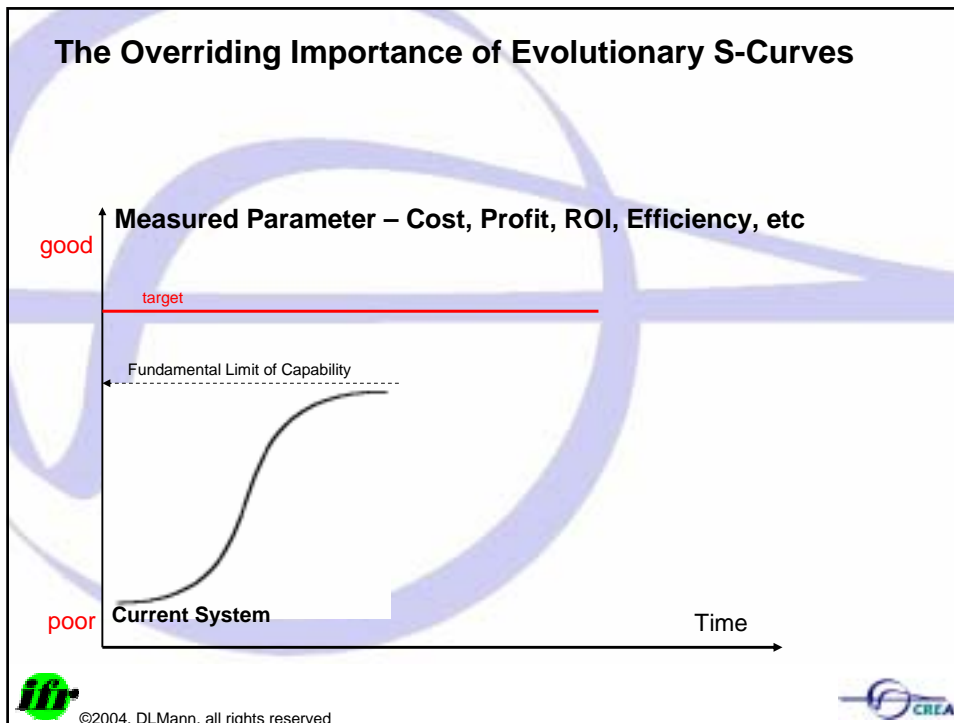
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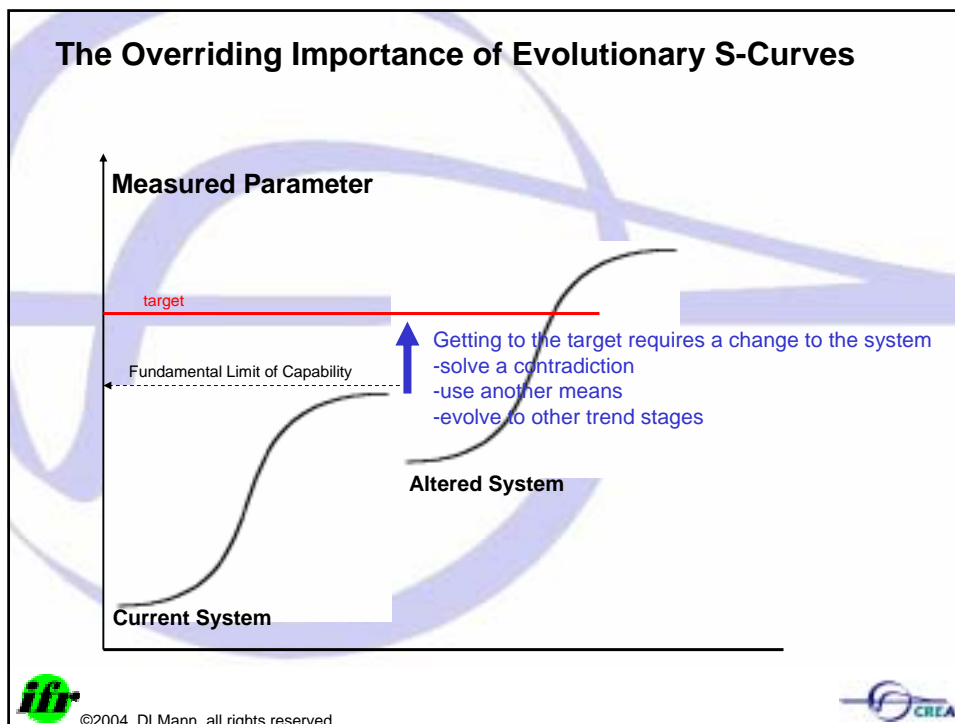
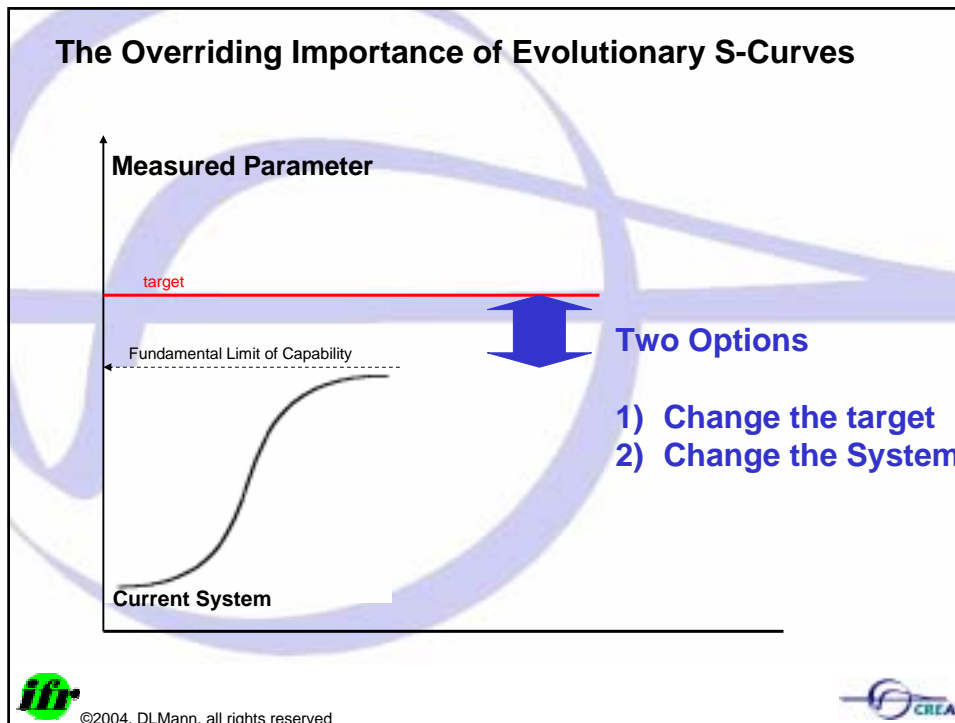




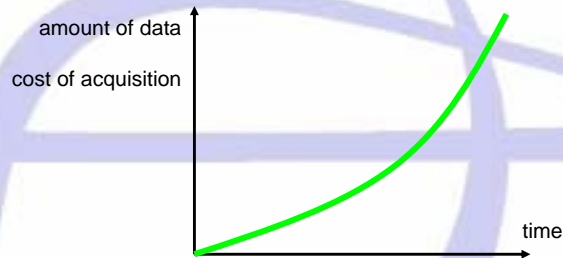








## Root Cause Analysis Paralysis (How do I know when to stop?)



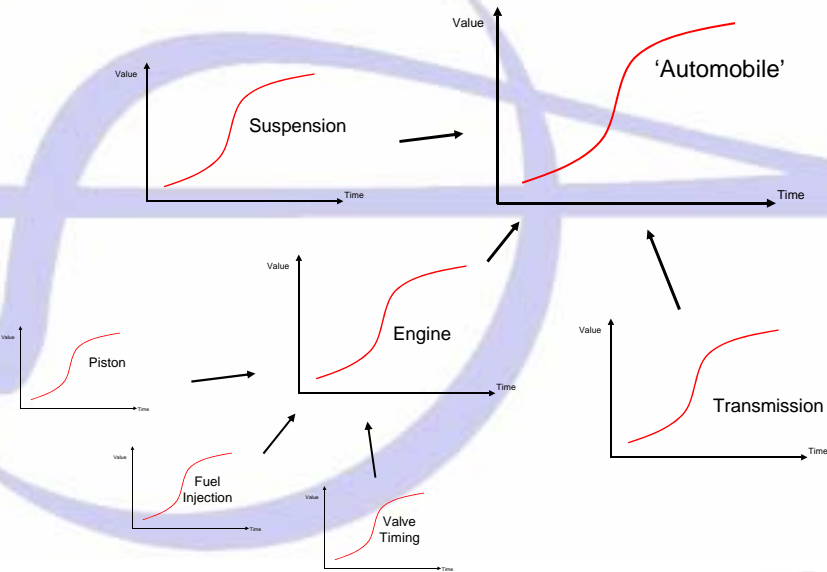
If you have spent a week looking for a root cause without success, perhaps the actual root cause is that your system has simply hit a **fundamental limit**?



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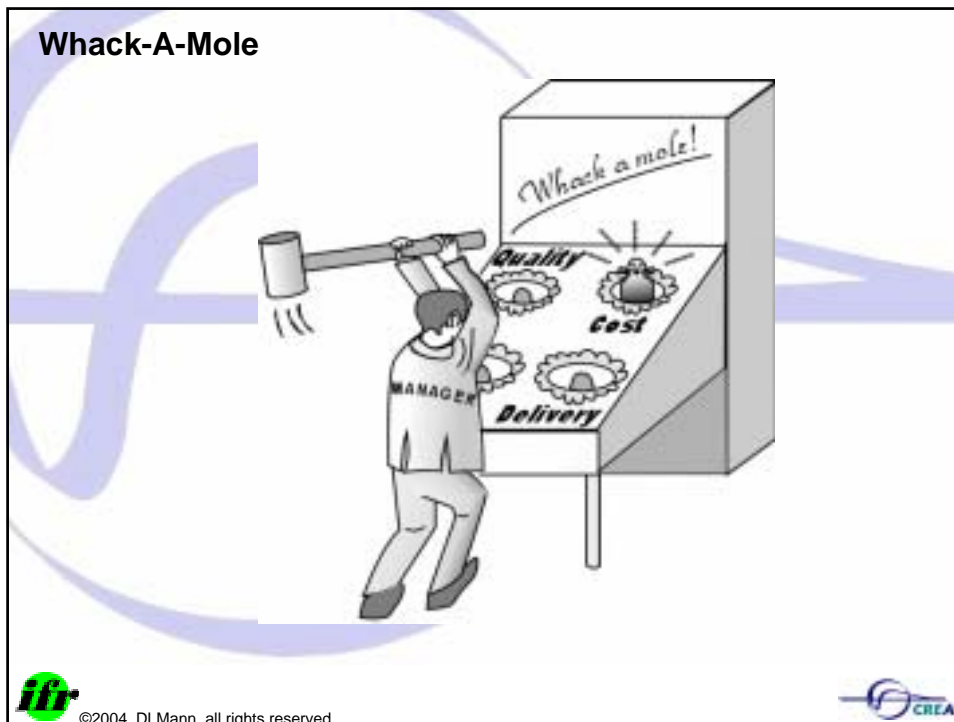


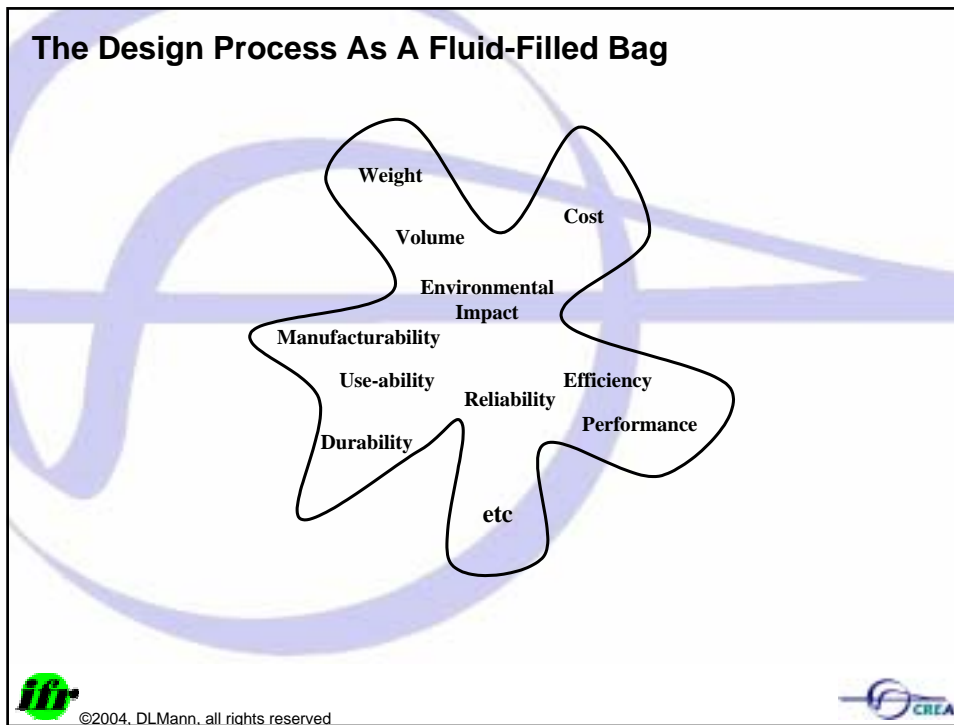
## S-Curve Families



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### Growth Experiences of Some Industry Leaders:

	(%) Industry average growth '88-'95	(%) Industry -leader growth in same period
Securities Brokerage	90	520
US Domestic Airlines	80	370
Home Improvement Retailing	40	1500


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## Trade-Off versus Breakthrough Thinking

High Quality <b>or</b> Low Cost	High Quality <b>and</b> Low Cost
Affordable <b>or</b> Customized	Affordable <b>and</b> Customized
First Cost <b>or</b> Life Cycle Cost	First Cost <b>and</b> Life Cycle Cost
Flexible <b>or</b> Rigid	Flexible <b>and</b> Rigid
Big <b>or</b> Small	Big <b>and</b> Small
Adaptor <b>or</b> Innovator	Adaptor <b>and</b> Innovator
<b>A or B</b>	<b>A and B</b>




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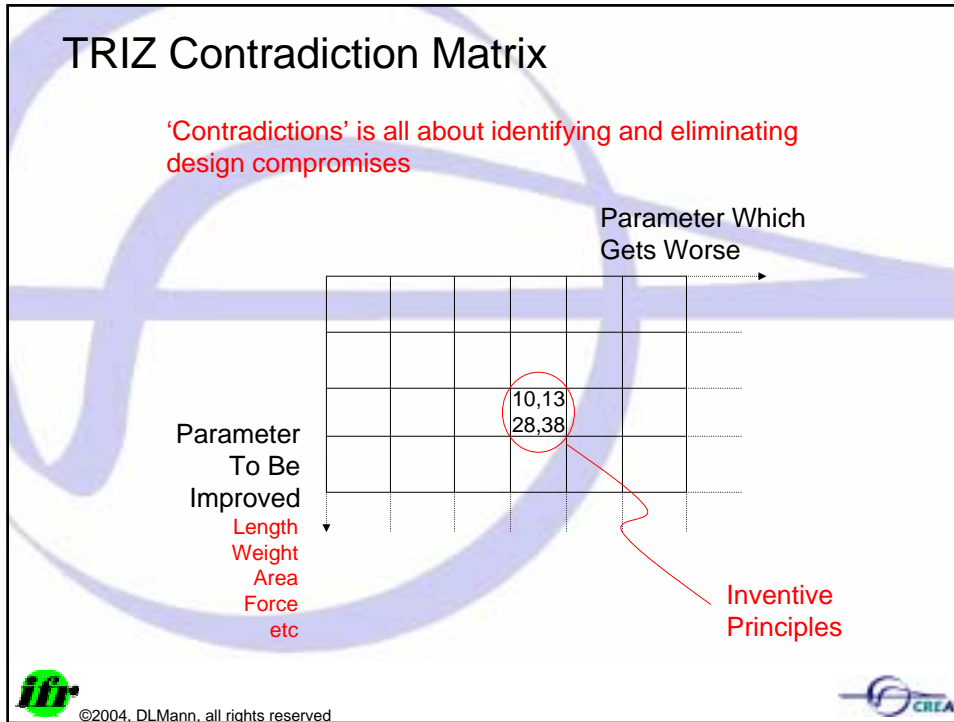
## TRIZ - Contradiction Matrix Elements



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



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- ### TRIZ - The 40 Inventive Principles
- |                                 |                                |
|---------------------------------|--------------------------------|
| 1. Segmentation                 | 21. Skipping                   |
| 2. Extraction                   | 22. 'Blessing in Disguise'     |
| 3. Local Quality                | 23. Feedback                   |
| 4. Asymmetry                    | 24. Intermediary               |
| 5. Combination                  | 25. Self-Service               |
| 6. Universality                 | 26. Copying                    |
| 7. 'Nested Doll'                | 27. Cheap/Short Living         |
| 8. Counterweight                | 28. Mechanics Substitution     |
| 9. Prior Counter-Action         | 29. Pneumatics and Hydraulics  |
| 10. Prior Action                | 30. Flexible Shells/Thin Films |
| 11. Prior Cushioning            | 31. Porous Materials           |
| 12. Equi-potentiality           | 32. Colour Changes             |
| 13. 'The Other Way Round'       | 33. Homogeneity                |
| 14. Spheroidality               | 34. Discarding and Recovering  |
| 15. Dynamics                    | 35. Parameter Changes          |
| 16. Partial or Excessive Action | 36. Phase Transitions          |
| 17. Another Dimension           | 37. Thermal Expansion          |
| 18. Mechanical Vibration        | 38. Strong Oxidants            |
| 19. Periodic Action             | 39. Inert Atmosphere           |
| 20. Continuity of Useful Action | 40. Composite Materials        |
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### 40 Inventive (Management) Principles

<ol style="list-style-type: none"> <li>1. Segmentation</li> <li>2. Extraction</li> <li>3. Local Quality</li> <li>4. Asymmetry</li> <li>5. Combination</li> <li>6. Universality</li> <li>7. 'Nested Doll'</li> <li>8. Counterweight</li> <li>9. Prior Counter-Action</li> <li>10. Prior Action</li> <li>11. Prior Cushioning</li> <li>12. Remove Tension</li> <li>13. 'The Other Way Round'</li> <li>14. Curvature</li> <li>15. Dynamics</li> <li>16. Slightly Less/Slightly More</li> <li>17. Another Dimension</li> <li>18. Resonance</li> <li>19. Periodic Action</li> <li>20. Continuity of Useful Action</li> </ol>	<ol style="list-style-type: none"> <li>21. Hurrying</li> <li>22. 'Blessing in Disguise'</li> <li>23. Feedback</li> <li>24. Intermediary</li> <li>25. Self-Service</li> <li>26. Copying</li> <li>27. Cheap/Short Living</li> <li>28. Another Sense</li> <li>29. Fluidity</li> <li>30. Thin &amp; Flexible</li> <li>31. Holes</li> <li>32. Colour Changes</li> <li>33. Homogeneity</li> <li>34. Discarding and Recovering</li> <li>35. Parameter Changes</li> <li>36. Phase Transitions</li> <li>37. Relative Change</li> <li>38. Enriched Atmosphere</li> <li>39. Calmed Atmosphere</li> <li>40. Composite Structures</li> </ol>
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### 40 Inventive (Management) Principles

#### Principle 1. Segmentation

*A. Divide an object into independent parts.*


- Divide an organisation into different product centres.
- Autonomous profit centres.
- Use a work breakdown structure for a large project.
- Franchise outlets
- Kano Diagram – Excitement, Performance, and Threshold product attribute parameters.
- Marketing segmentation by demographics, sociographics, psychographics, lifestyles, etc (creation of 'micro-niches')
- Segmentation of 'idea management' process into Fertilization, Seeding, and Incubation phases
- Strength/Weakness/Opportunity/Threat (SWOT) analysis

*B. Make an object easy to disassemble.*


- Flexible pensions
- Use of temporary workers on short-term projects
- Flexible Manufacturing Systems
- Modular furniture/offices
- Container shipment

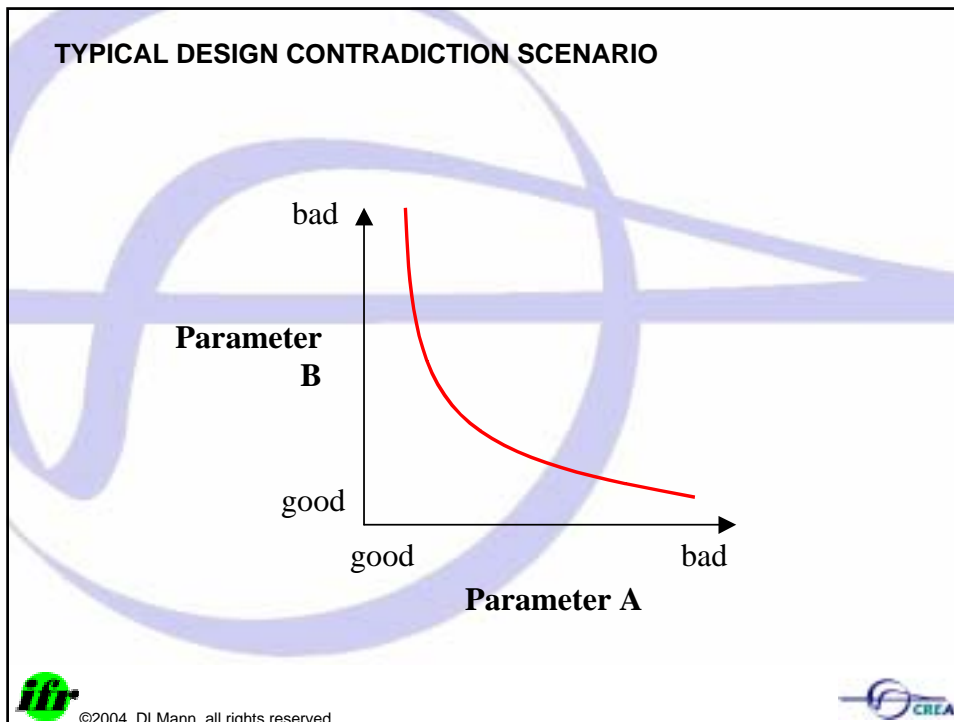
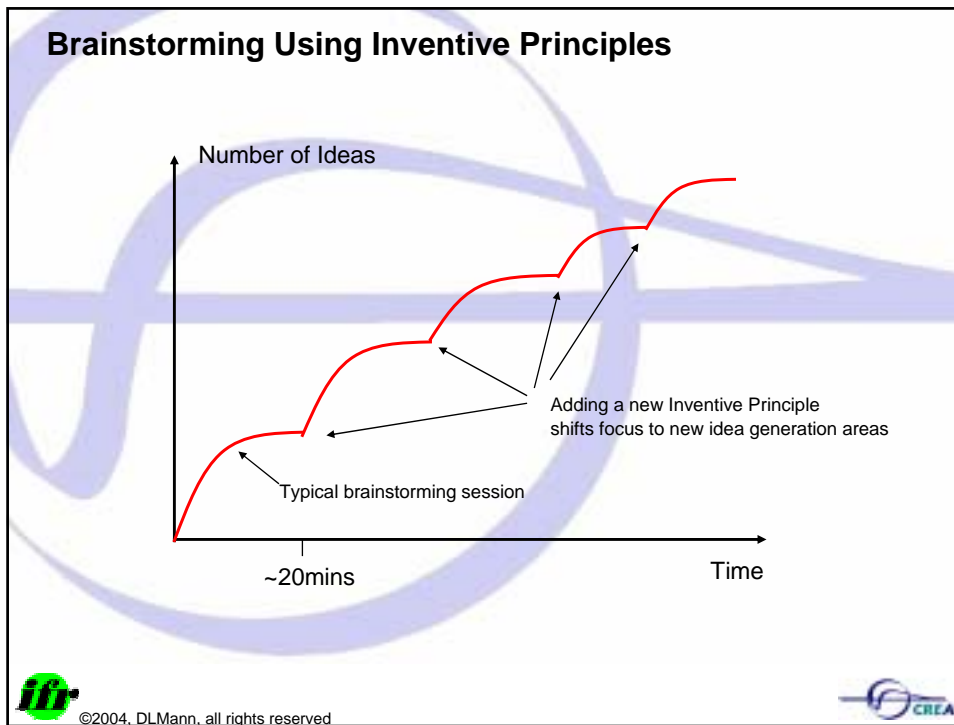
*C. Increase the degree of fragmentation or segmentation.*

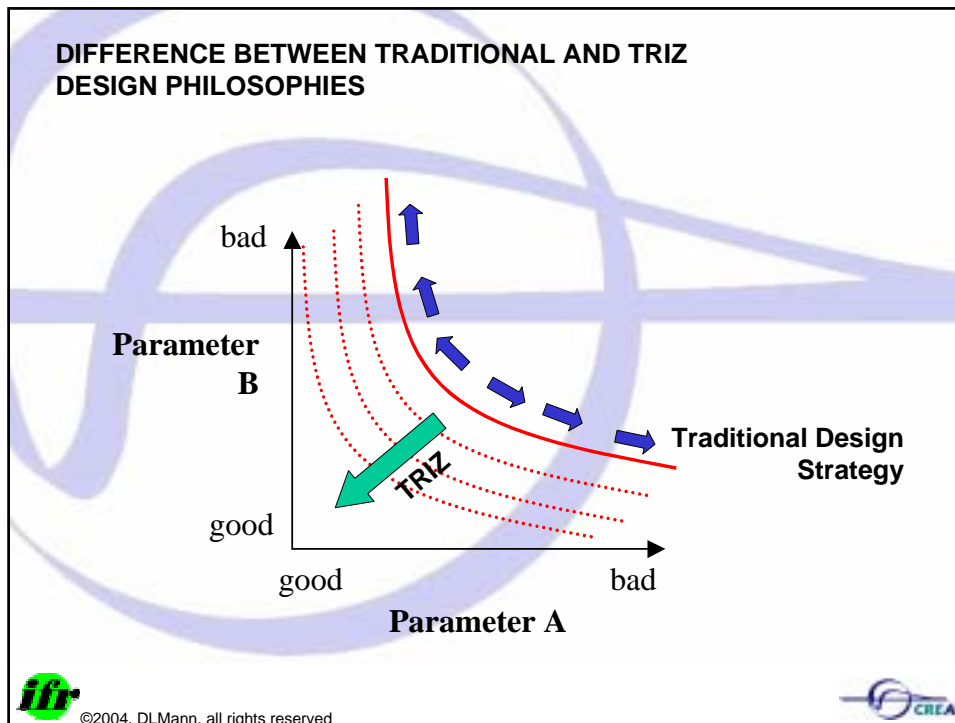
- Quality Circles.
- 'Empowerment' – segmentation of decision making.
- Distance learning (also 'Taking Out')
- Virtual office/remote working (also 'Taking Out')
- 'Creative Segmentation' – 'high performance small car', 'easy to use SLR', 'cordless power tool'



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### Matrix 2003



Matrix 2003  
Updating the TRIZ Contradiction Matrix

creax/ideation

Update of the contradiction matrix from Classical TRIZ

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



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

### Management Contradiction Matrix Parameters

1. R&D Spec/Capability/Means	16. Product Reliability
2. R&D Cost	17. Support Cost
3. R&D Time	18. Support Time
4. R&D Risk	19. Support Risk
5. R&D Interfaces	20. Support Interfaces
6. Production Spec/Capability/Means	21. Customer Revenue/Demand/Feedback
7. Production Cost	22. Amount of Information
8. Production Time	23. Communication Flow
9. Production Risk	24. System affected harmful effects
10. Production Interfaces	25. System generated side effects
11. Supply Spec/Capability/Means	26. Convenience
12. Supply Cost	27. Adaptability/Versatility
13. Supply Time	28. System Complexity
14. Supply Risk	29. Control Complexity
15. Supply Interface	30. Tension/Stress
	31. Stability



# Evolutionary Potential, Trends of Evolution





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## Technology Forecasting

- Began in 1950's
- Mid 1970's resulted in establishment of techniques such as:
  - Trend exploration
  - Morphological modeling
  - Delphi process
  - Kondriateff/Schumpeter Waves
  - Others

All are based on probabilistic modeling of future characteristics of various systems

**ALL ARE WRONG**



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## Predictable Technology Evolution

- \* TRIZ trends are already beginning to have a profound effect on the generation of intellectual property
- \* They are useful in designing around someone else's patent
- \* Even stronger at strengthening our own.



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## If technology evolution trends are predictable...

Engineers have an additional new role to play

Engineering



Business/  
Commercial

New opportunities  
Limits of existing systems  
Maximisation of R&D benefit



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### General Principles of Evolution Trend Operation

Trend : Dynamization

Immobile Single Joint   Multiple Joint   Completely flexible   Liquid Gas   Field

**Think of each of these pictures as a generic new S-curve**

**(This is an over-simplification, but is helpful for the moment)**

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### TRIZ Evolution Trends

**INTERFACE**

- Mono-Bi-Poly (Similar) – Interface
- Mono-Bi-Poly (Various) – Interface
- Mono-Bi-Poly (Inc.Diff.) – Interface
- Damping
- Sense Interaction
- Colour Interaction
- Transparency
- Customer Purchase Focus
- Market Evolution
- Design Point
- Degrees of Freedom
- Boundary Breakdown – Interface
- Trimming
- Controllability
- Human Involvement
- Design Methodology
- Reducing Energy Conversions

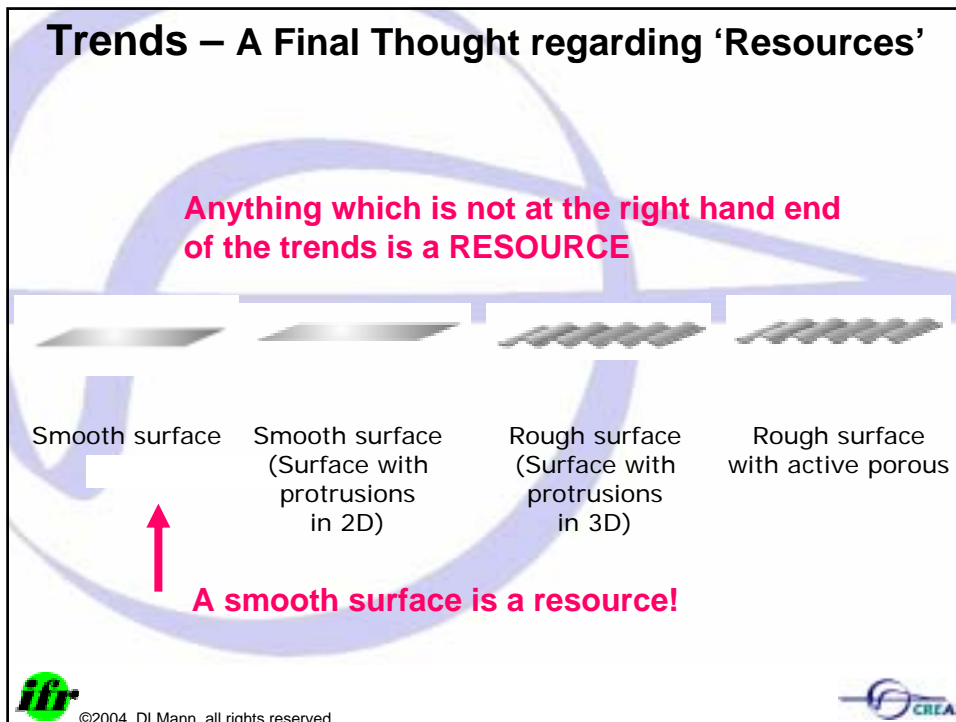
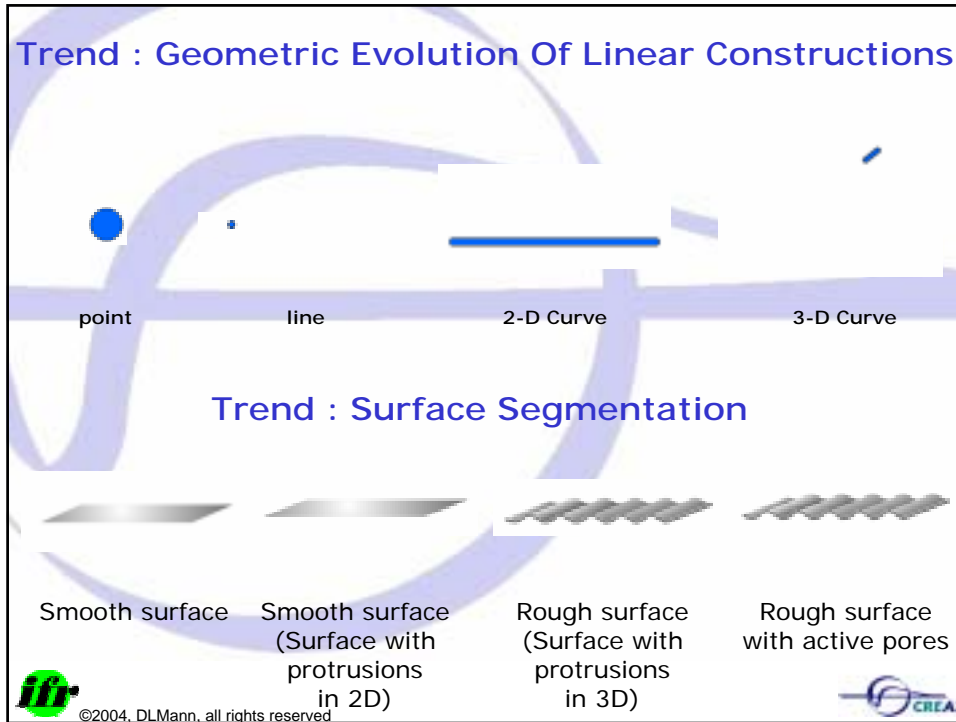
**SPACE**

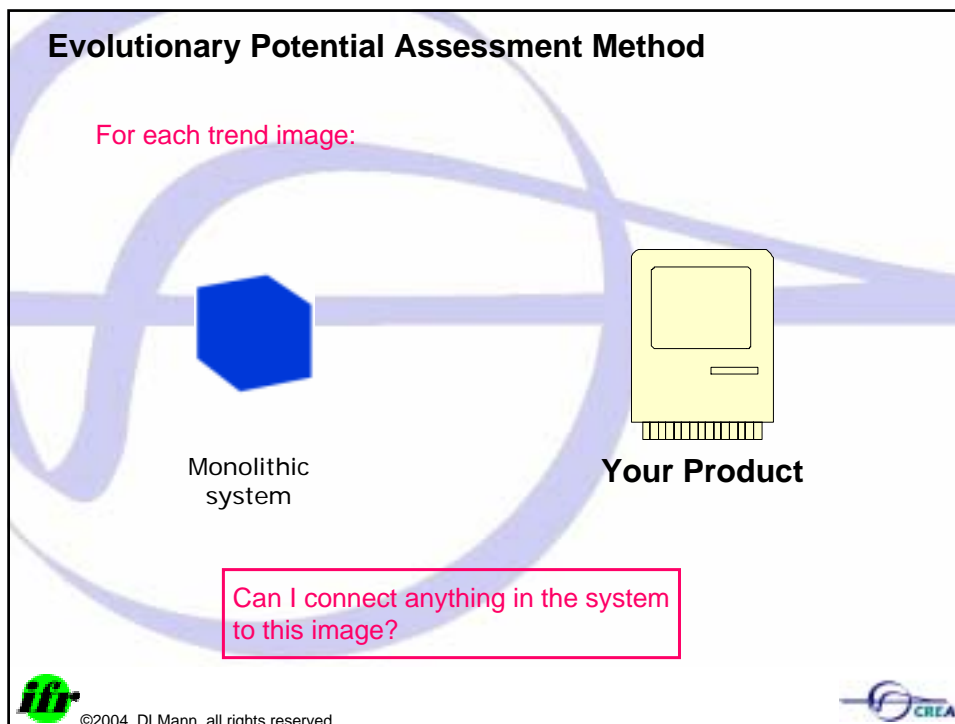
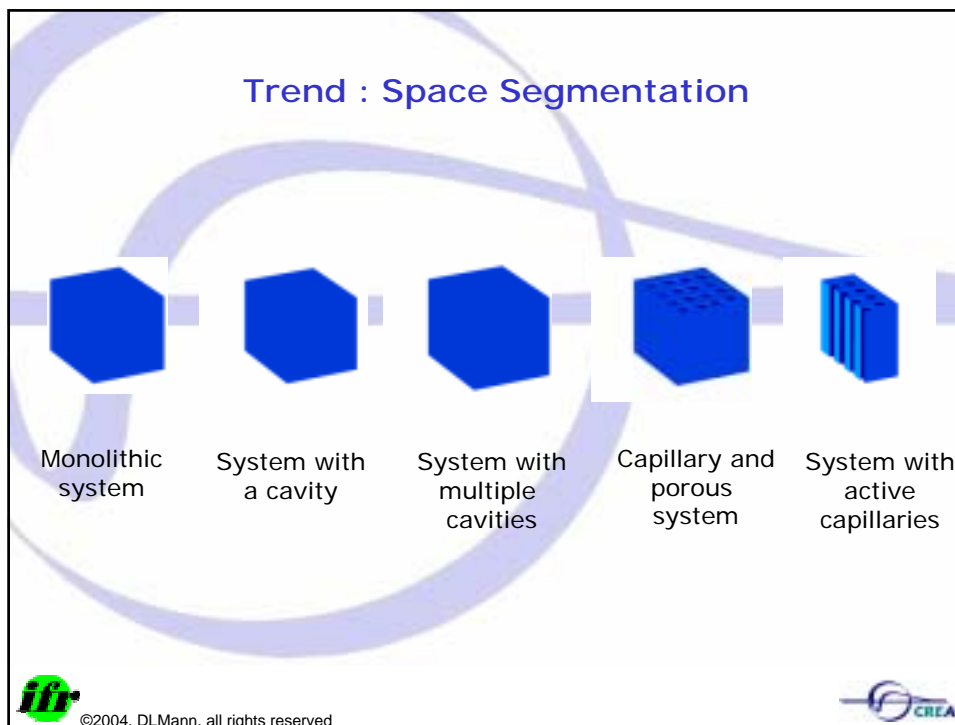
- Smart Materials
- Space Segmentation
- Surface Segmentation
- Object Segmentation
- Macro to Nano Scale – Space
- Webs and Fibres
- Decreasing Density
- Asymmetry
- Boundary Breakdown - Space
- Geometric Evolution (Lin)
- Geometric Evolution (Vol)
- Dynamisation

**TIME**

- Action Co-ordination
- Rhythm Co-ordination
- Non-Linearity
- Mono-Bi-Poly (Sim) – Time
- Mono-Bi-Poly (Var) – Time
- Macro to Nano Scale – Time

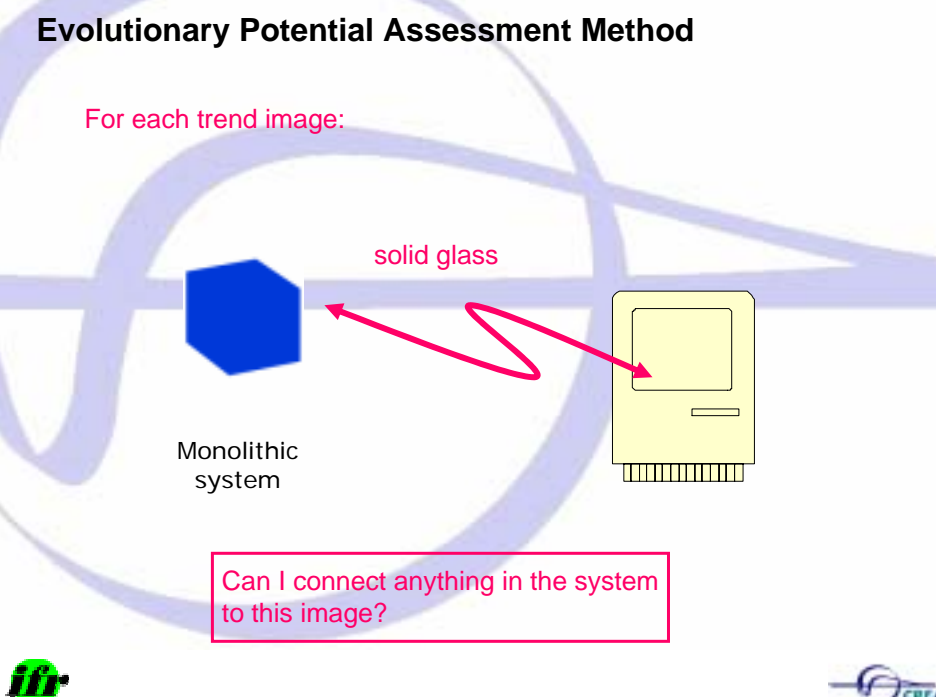
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### Evolutionary Potential Assessment Method



For each trend image:



Monolithic system

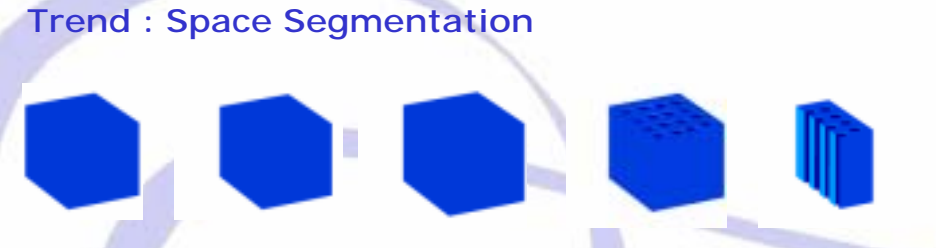
solid glass

Can I connect anything in the system to this image?






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### Trend : Space Segmentation

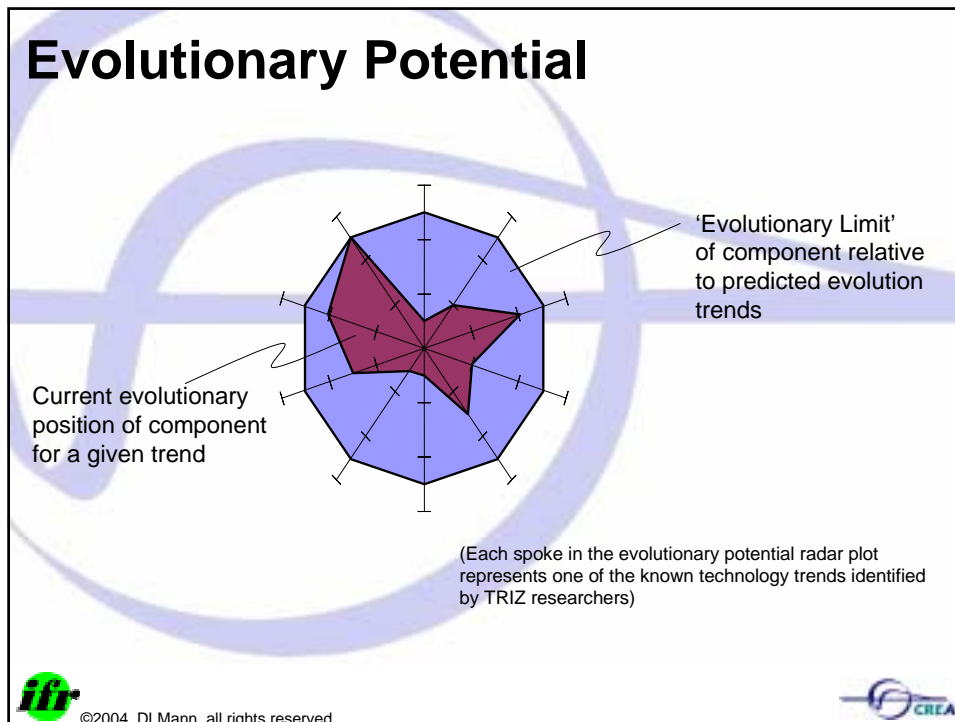
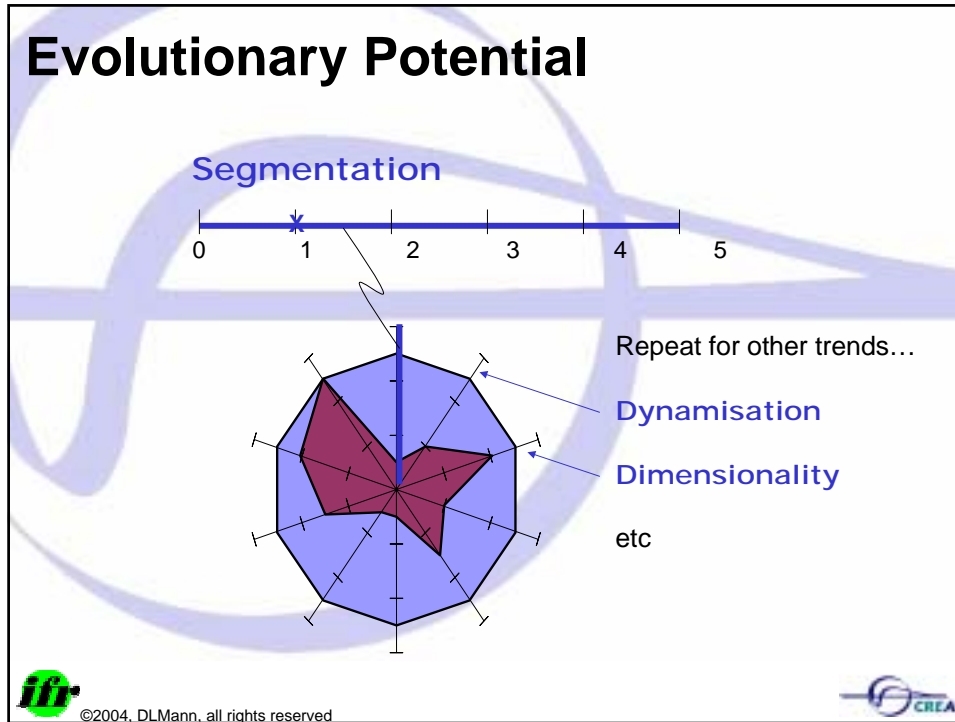


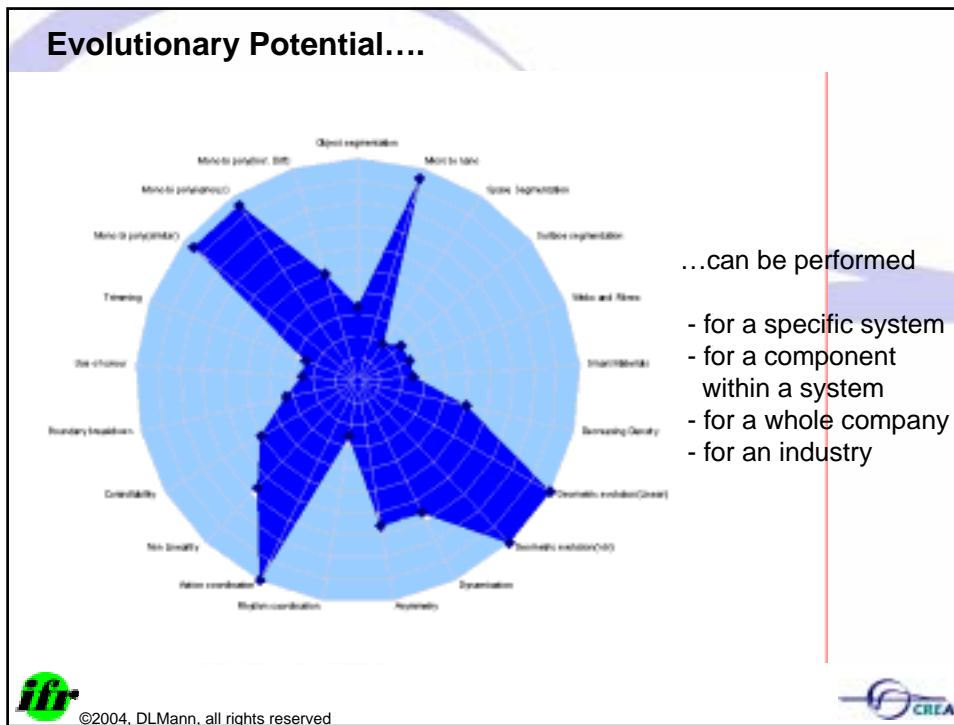
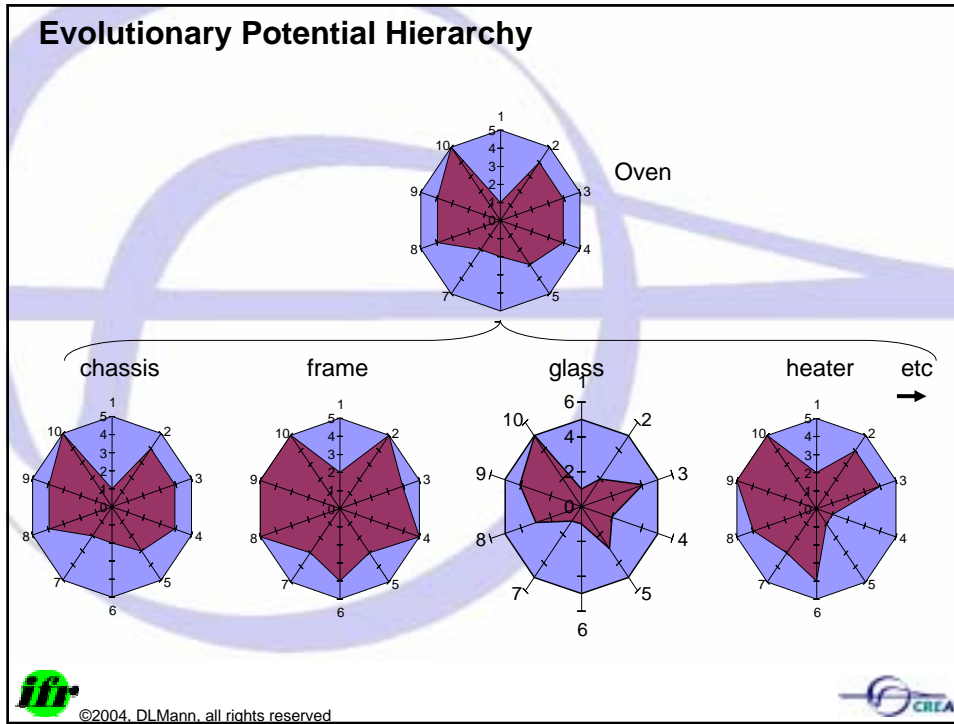
Monolithic system    System with a cavity    System with multiple cavities    Capillary and porous system    System with active capillaries

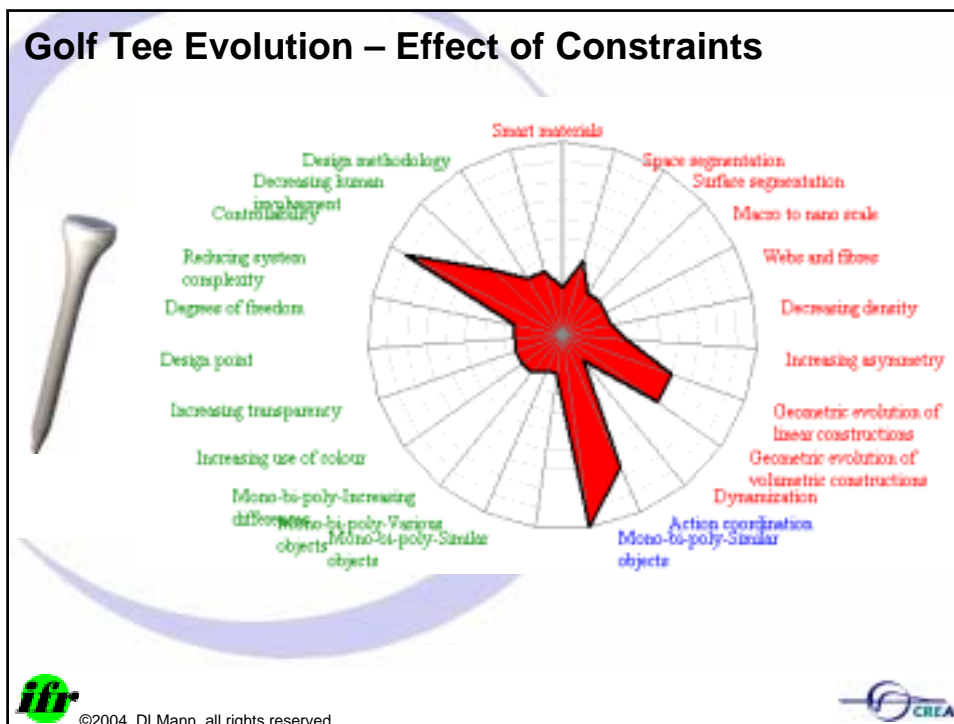
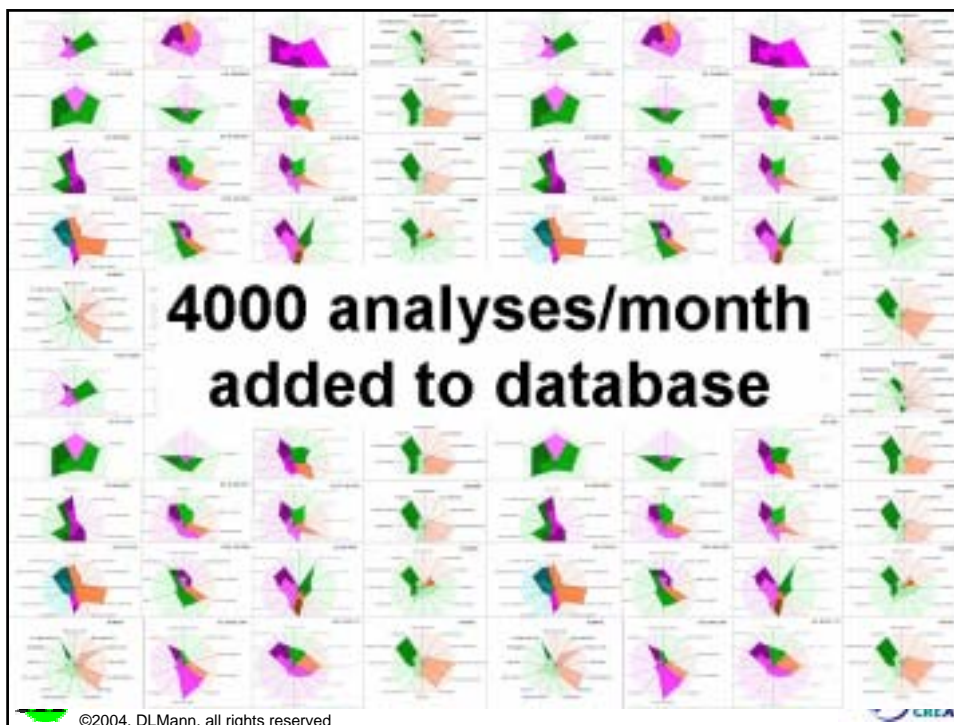
Evolutionary Potential:

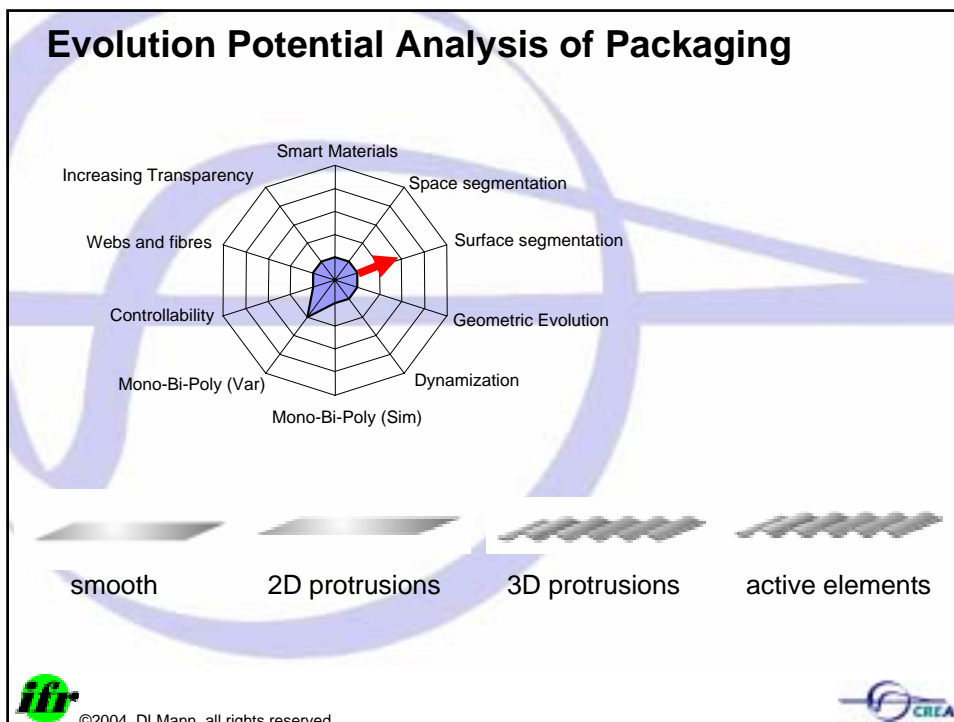
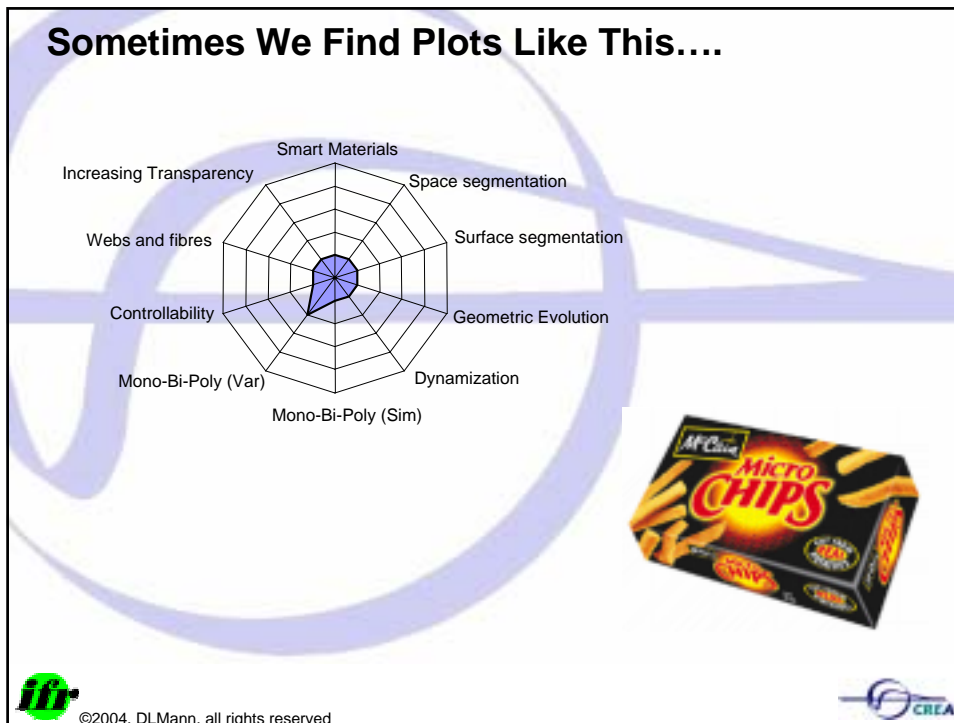


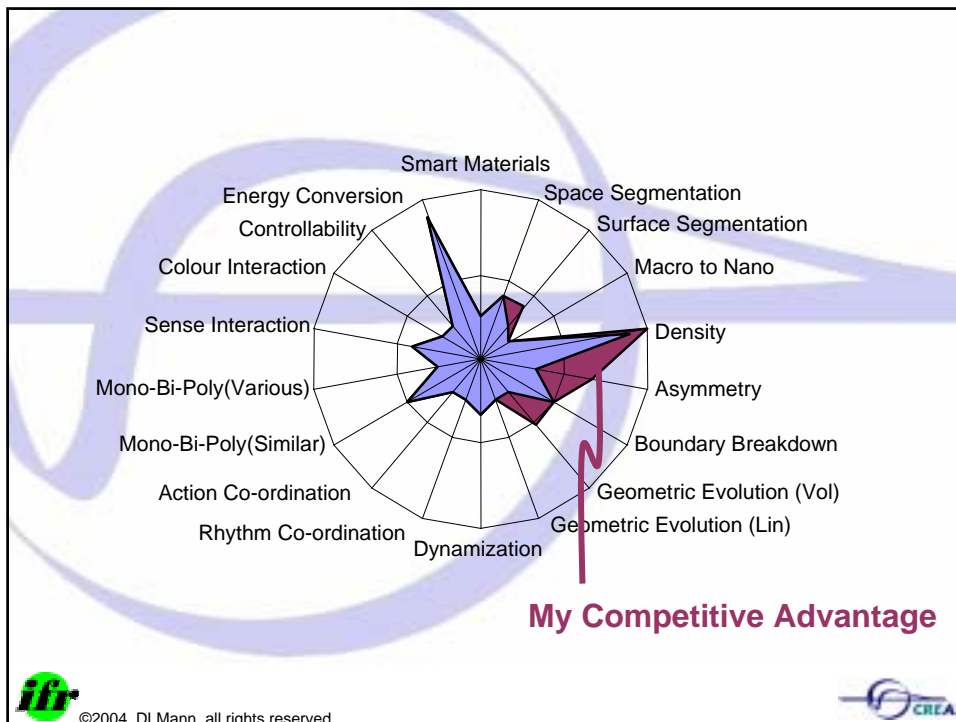
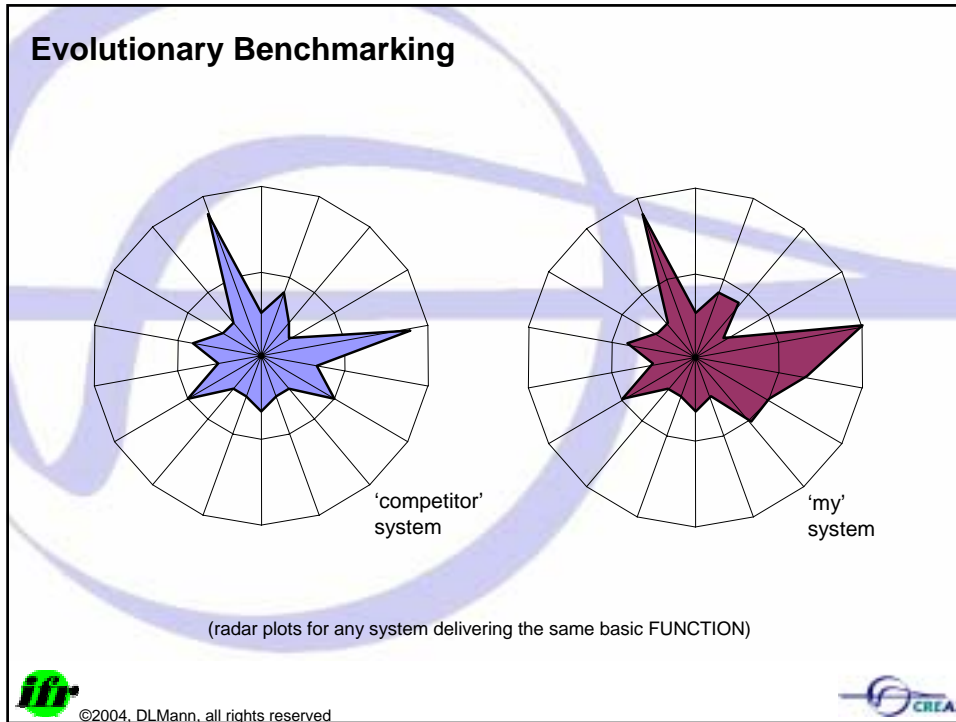
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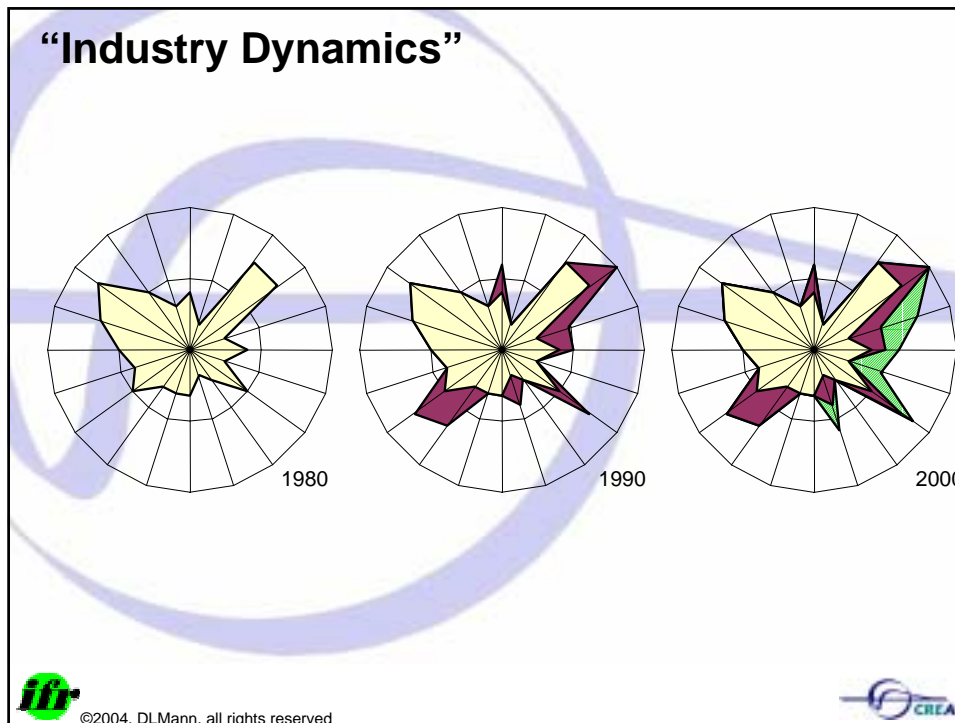






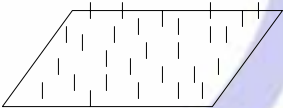








### Trends of Evolution - Example

I discover that as well as having excellent structural properties, carbon fibres also have very good heat conduction characteristics. I put one and one together and decide that I would like to patent a heat exchanger constructed from woven carbon fibres, in which I seek to maximise heat transfer by weaving the fibres such that I achieve fibre ends which protrude into the heat exchange passages:



Suggest ways of incorporating knowledge from the TRIZ trends to strengthen any IPR which may result from this idea.

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“The surface and structure of fibre members... may be fabricated in order to control heat transfer features on macro and micro levels: 1) with different roughness and 2) different porosity and size of pores and 3) different directions of pore channels pores on micro-level and on macro-level - fibre members may include surface perforations, depressions, grooves, outstanding fibres, etc

“One or more of the fibre members may be adapted to form at least one capillary channel... (to) form a wick structure...

“The fibres must be adapted to move relative to the substrate... the fibres need not be completely flexible, and may comprise both rigid and flexible portions.

“The fibres may be oriented at a range of different angles to the substrate

“The distribution of fibres may be uneven

“Fibres may be bundled...



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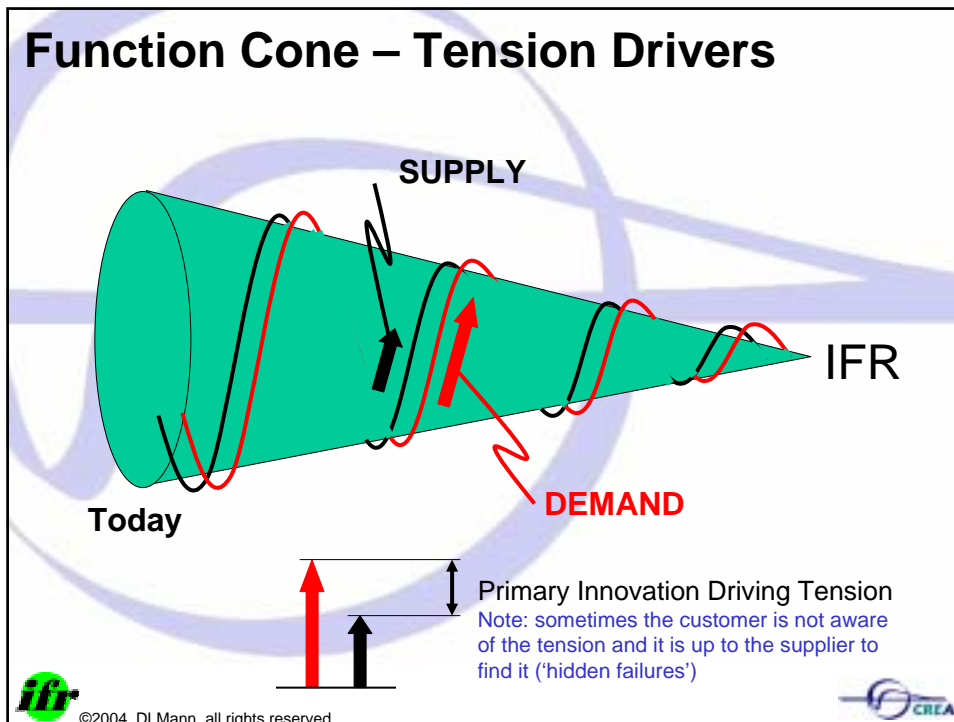
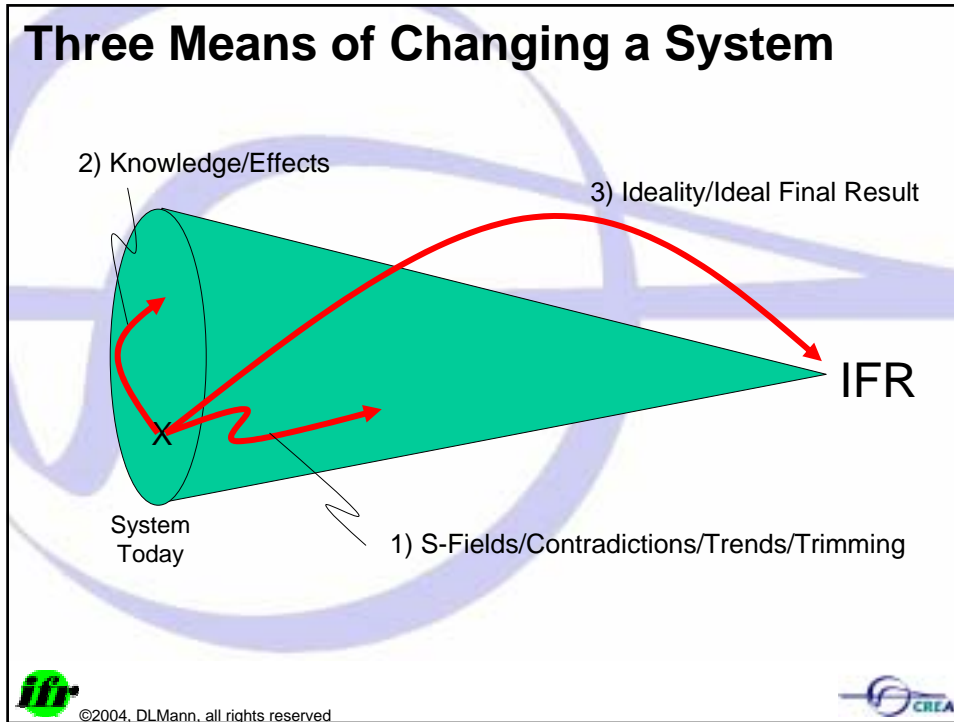


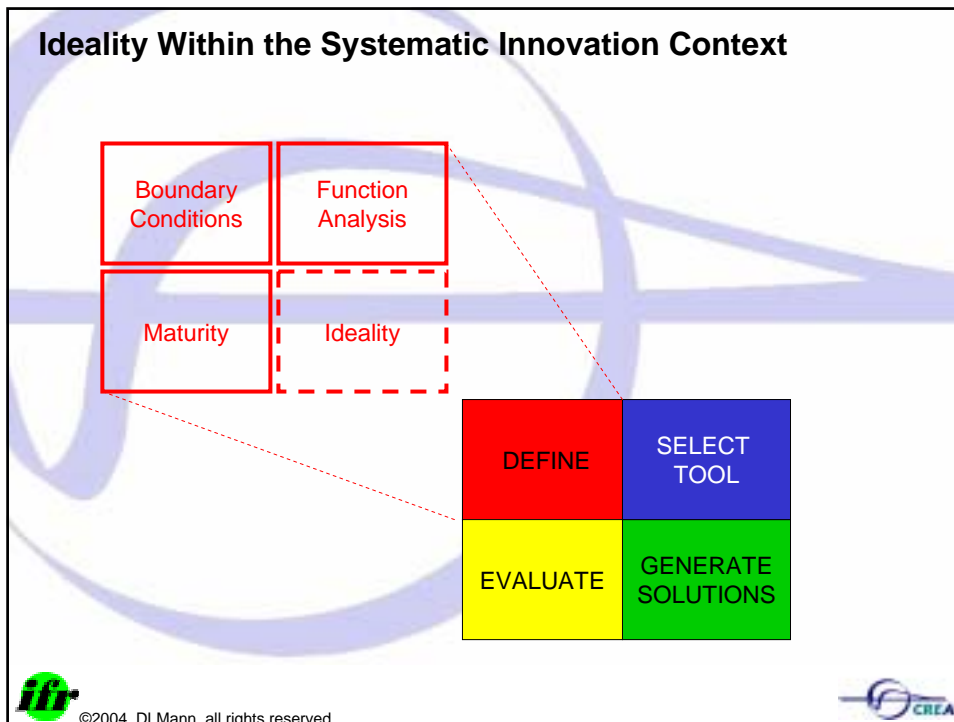
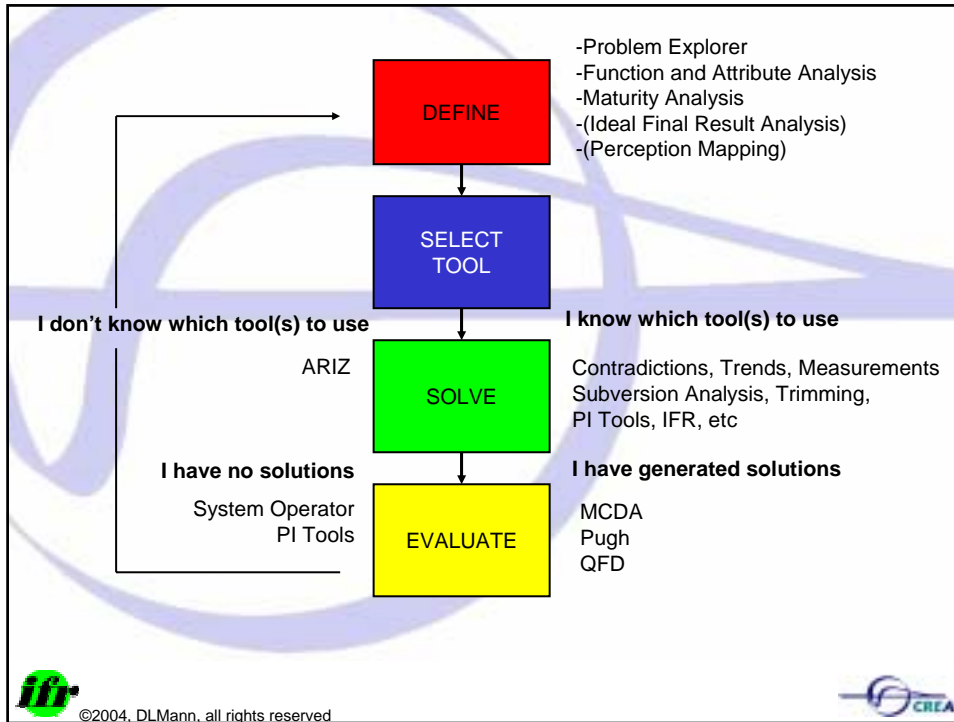
## Putting It All Together Summary



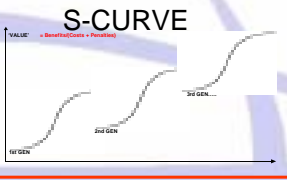
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### 3 Essentials of Problem Definition:

<b>BOUNDARY CONDITIONS</b> <ul style="list-style-type: none"><li>- Benefits</li><li>- Resources</li><li>- Constraints</li><li>- ('Sore Point')</li></ul>	<b>S-CURVE</b> 	<b>FUNCTION ANALYSIS</b>
--	--	--------------------------

**+ 1 'Highly Recommended'**

Ideality/ Ideal Final Result
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## 'DEFINE' PACK

This pack offers a series of questions you should be asking during the DEFINE stage of a problem or opportunity. The main aim is to get you to think about your situation in terms of how it is affected by TIME and SPACE. You may not be able to answer all of the questions. The important thing is that you ask them.

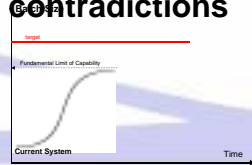
Print the sheets out, or fill them in electronically.  
If you need more space, make copies or use blank pieces of paper.

Although the pack gives you a structured way of communicating your situation to others it is up to you to use the sheets in a way that best suits the way you work.

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## TRIZ Short-Cuts 1) Contradictions

- Many systems are at or close to limiting contradictions (80+%)



- Finding a good unresolved contradiction offers an effective short-cut
- Use 40 Principles to systematically brainstorm solutions
- (Use Matrix to identify 4-6 'most likely' Principles)

A 40x40 matrix grid used for identifying TRIZ principles based on contradictions. The grid is used to map specific contradictions to the most effective TRIZ principles.

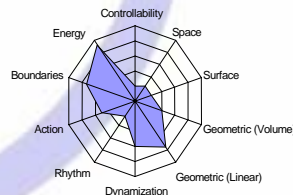


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## TRIZ Short-Cuts 2) Resources

- Find a good under-utilised resource in or around the system and find a way of making use of it
- (Resource trigger sheets can help to identify resources)
- (Unused trend stages are resources)



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**Strong solutions eliminate contradictions**

**Predictable evolution presents many new opportunities**


**Free, Perfect and Now as an evolutionary end-point**

**Perception Mapping as a means of Organising and managing complexity**



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**TOP 10 Teaching TRIZ Issues**  
**-The Importance of Self-Re-enforcing versus Self Destroying Systems**





**Win-Win Spiral**

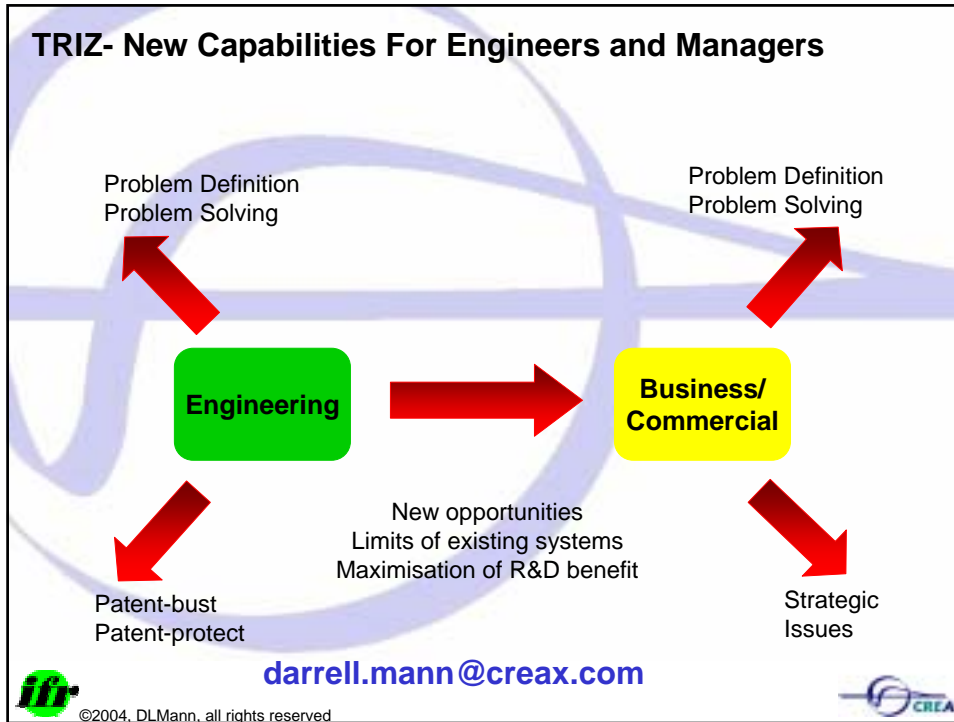
Successes with the right people will breed success everywhere (find the connectors)

People are 2-7 times more likely to tell others about a bad experience than a good one

**Lose-Lose Spiral**



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