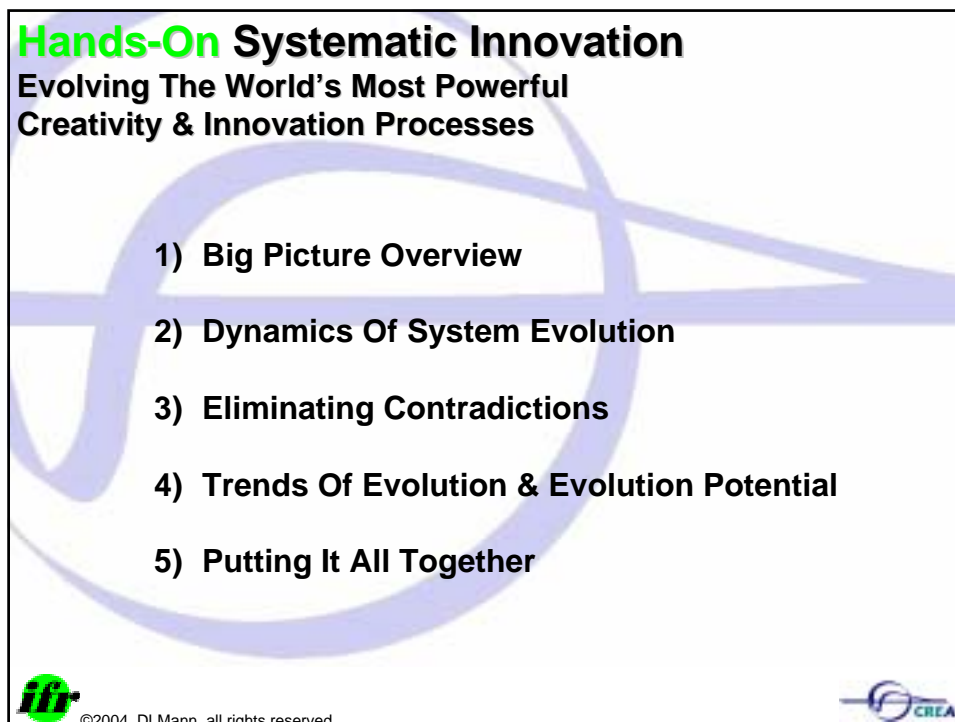




Hands-On
Systematic Innovation
Evolving The World's Most Powerful
Creativity & Innovation Processes



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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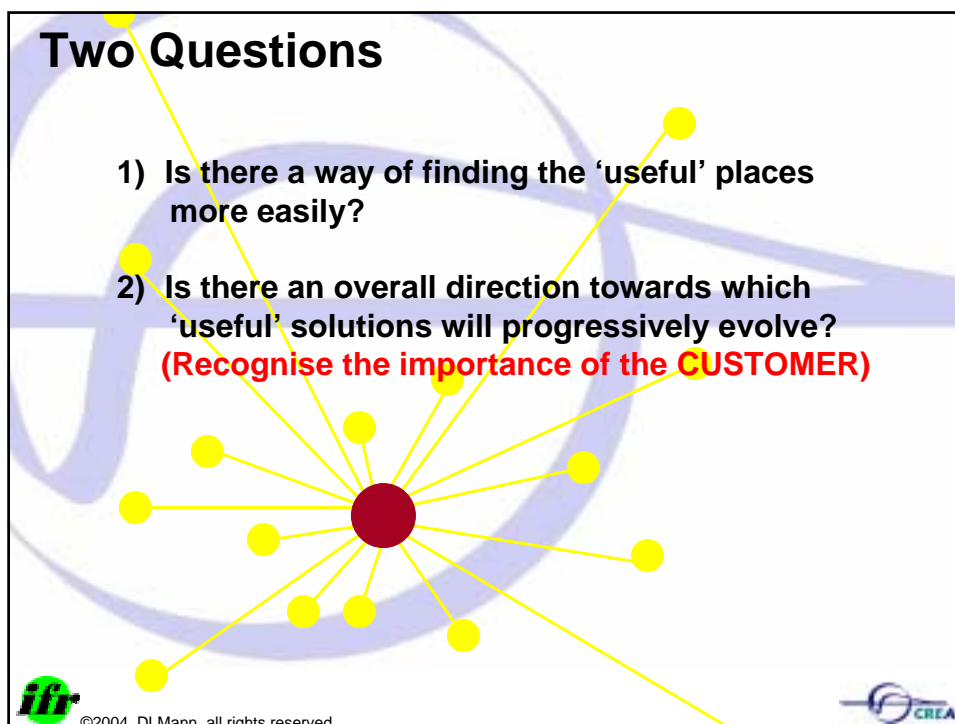
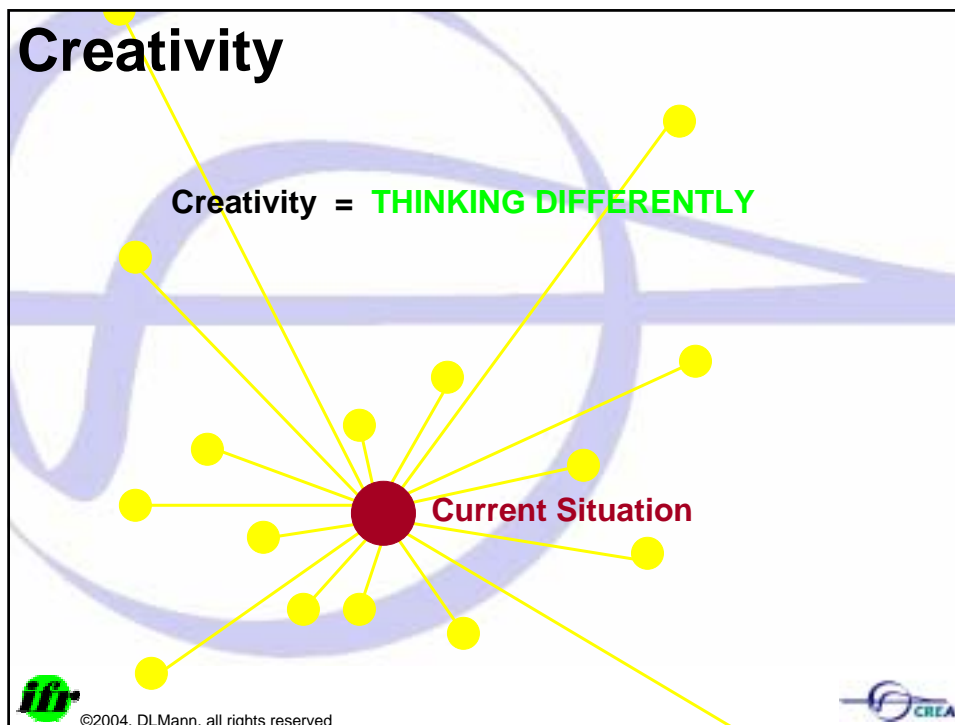
Innovation

Innovation = **DOING THINGS BETTER**

Innovation = **ACTIONxKNOWLEDGExCREATIVITY**



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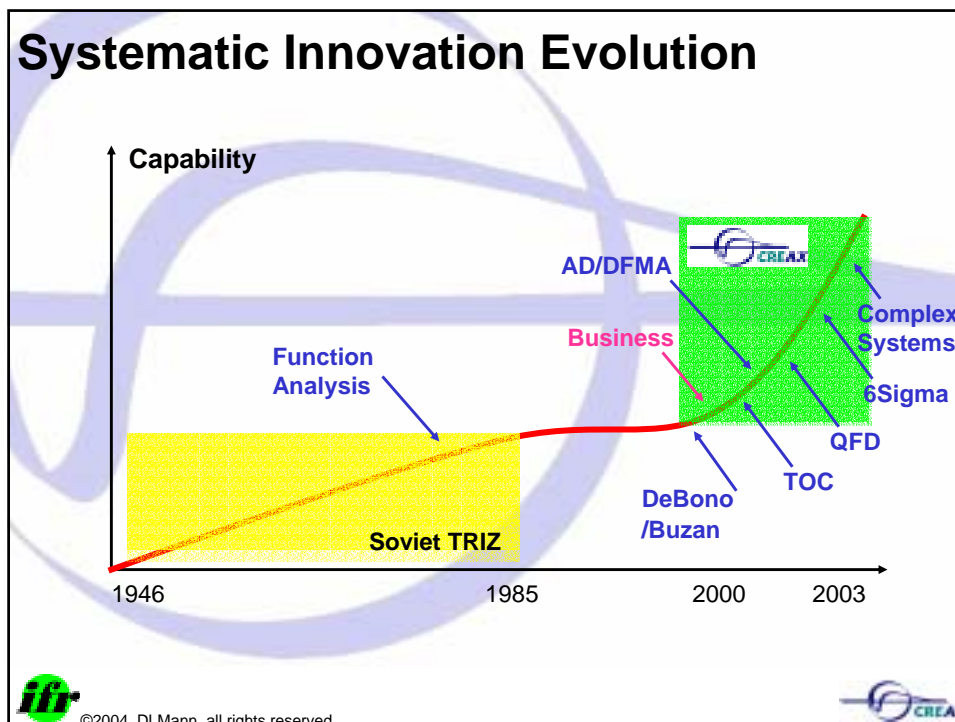


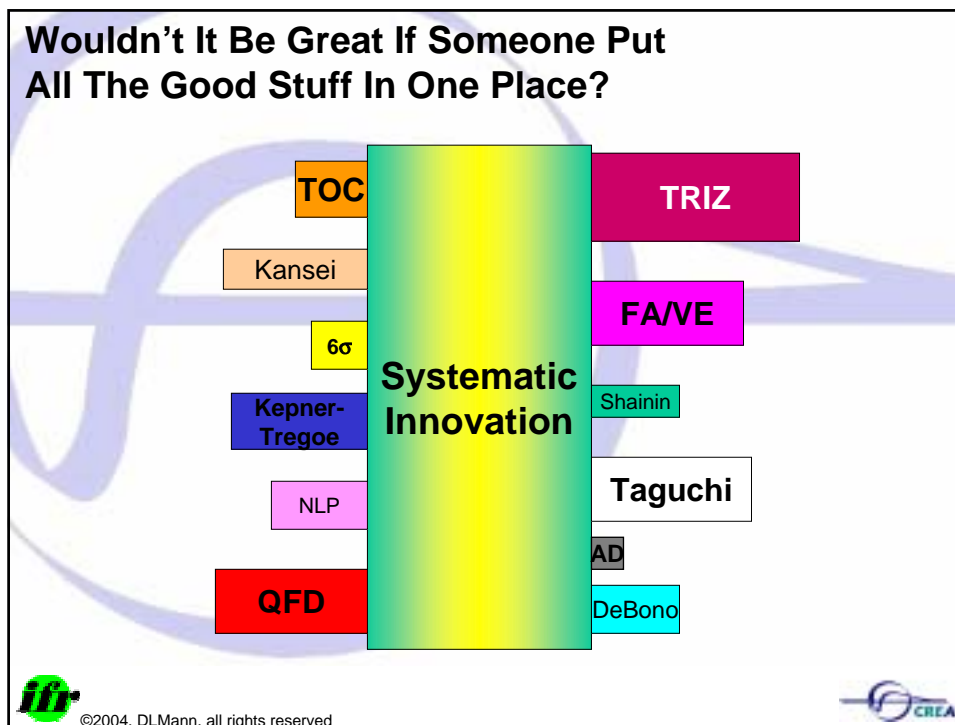
TRIZ

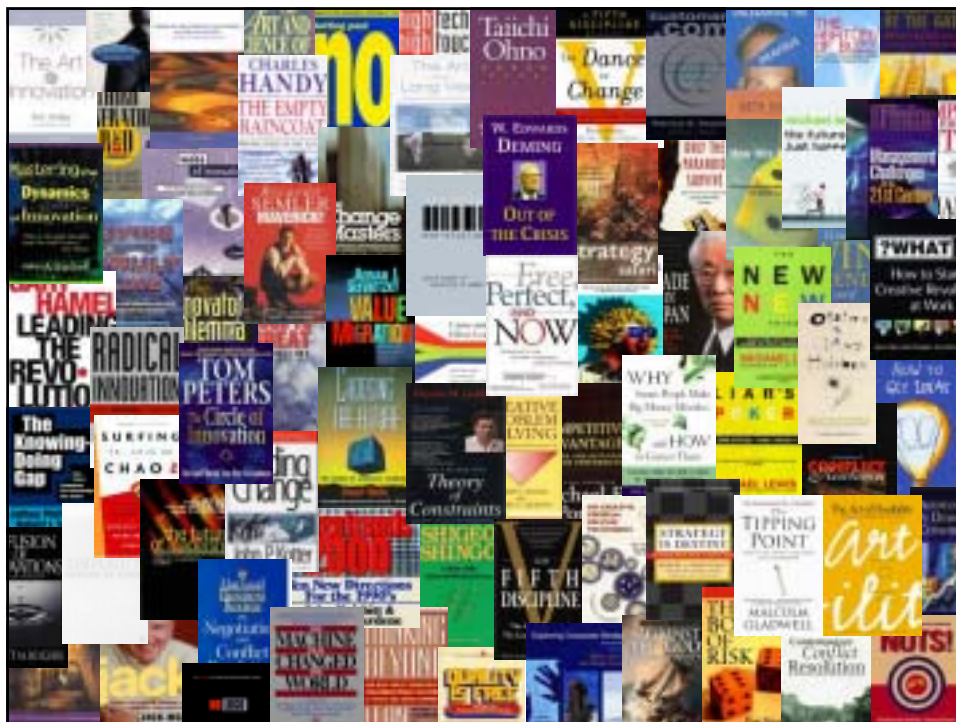
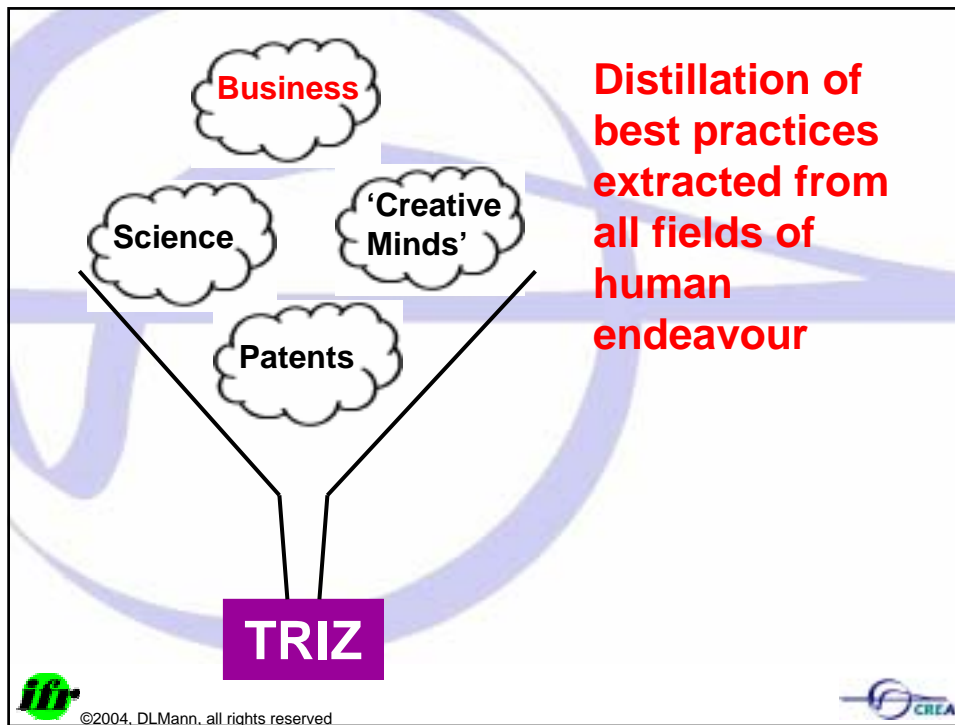
Teoriya Resheniya Izobreatatelskikh Zadatch
Теория Решения Изобретательских Задач
Theory of Inventive Problem Solving



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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?

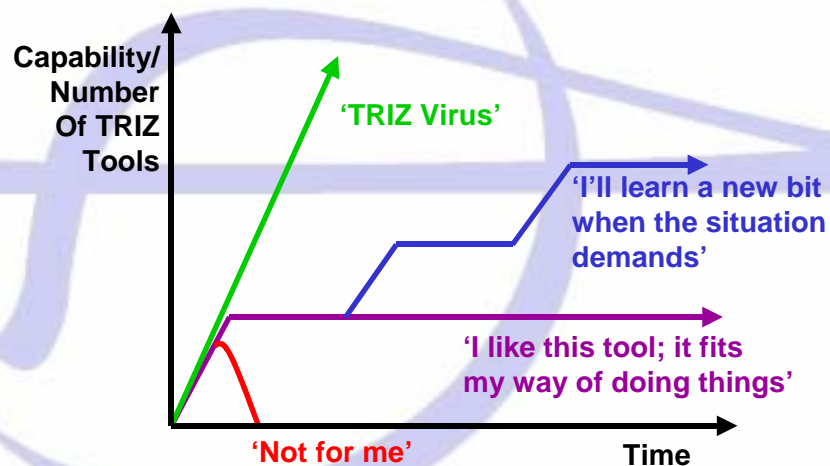


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TOP 10 Teaching TRIZ Issues


- 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?




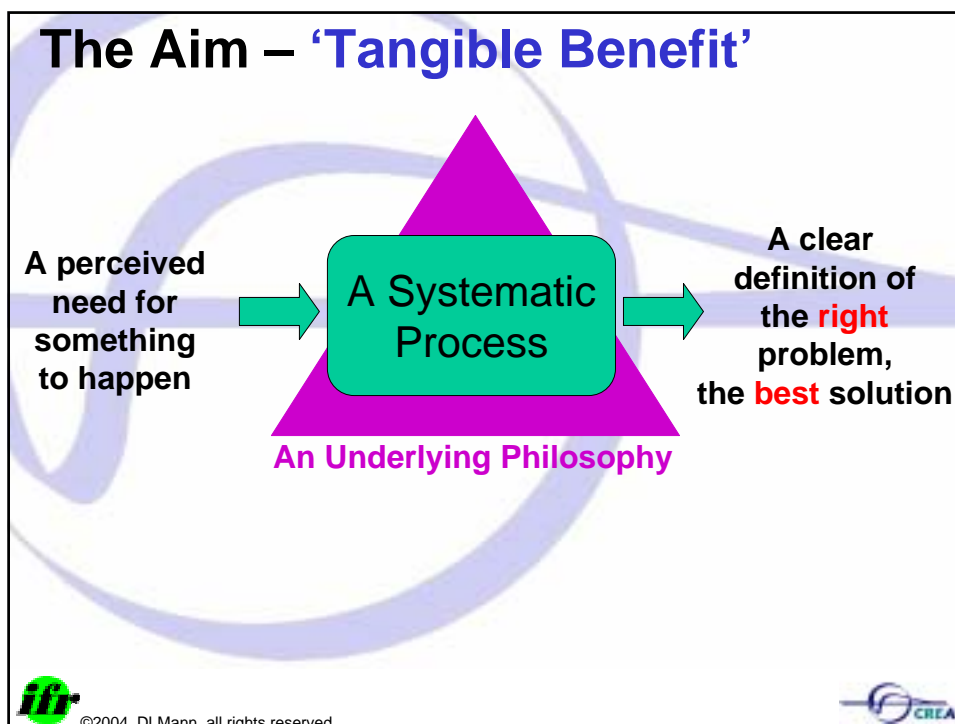
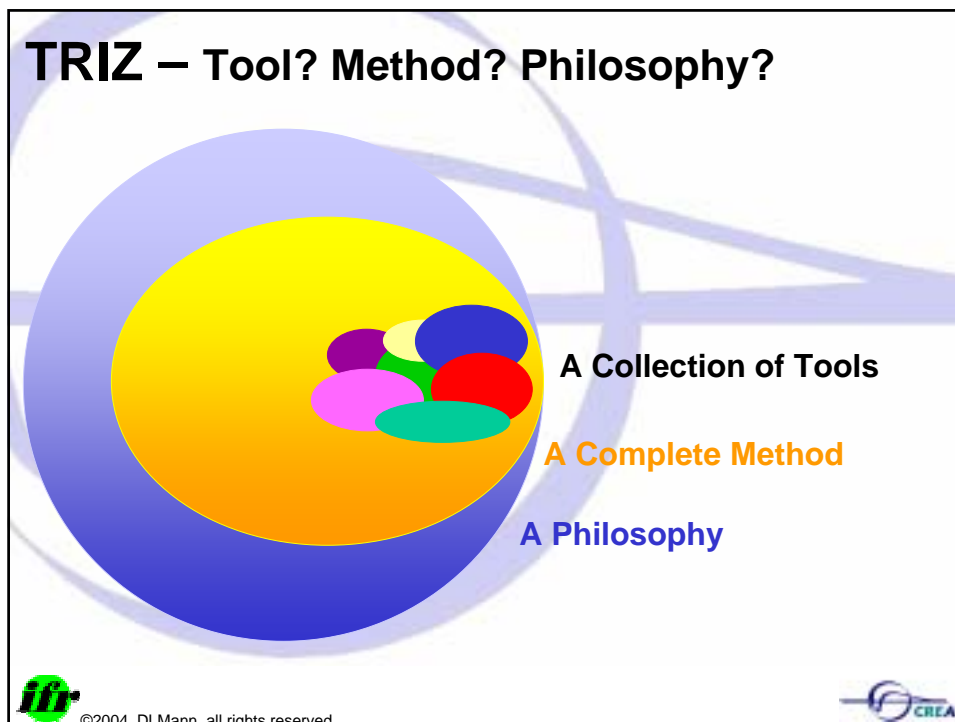
A Collection of Tools

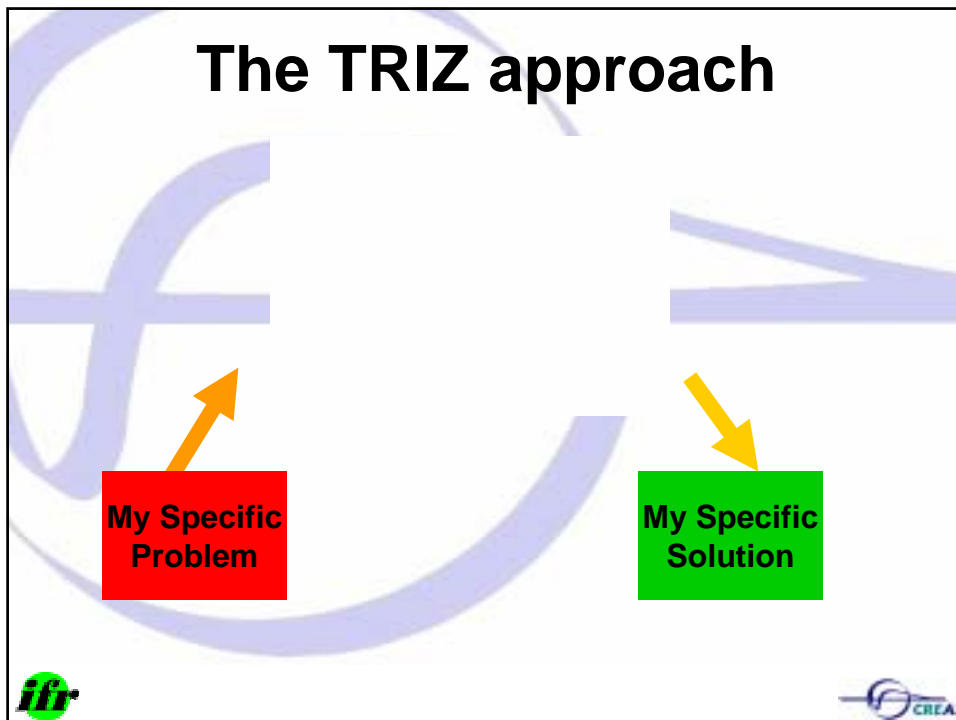
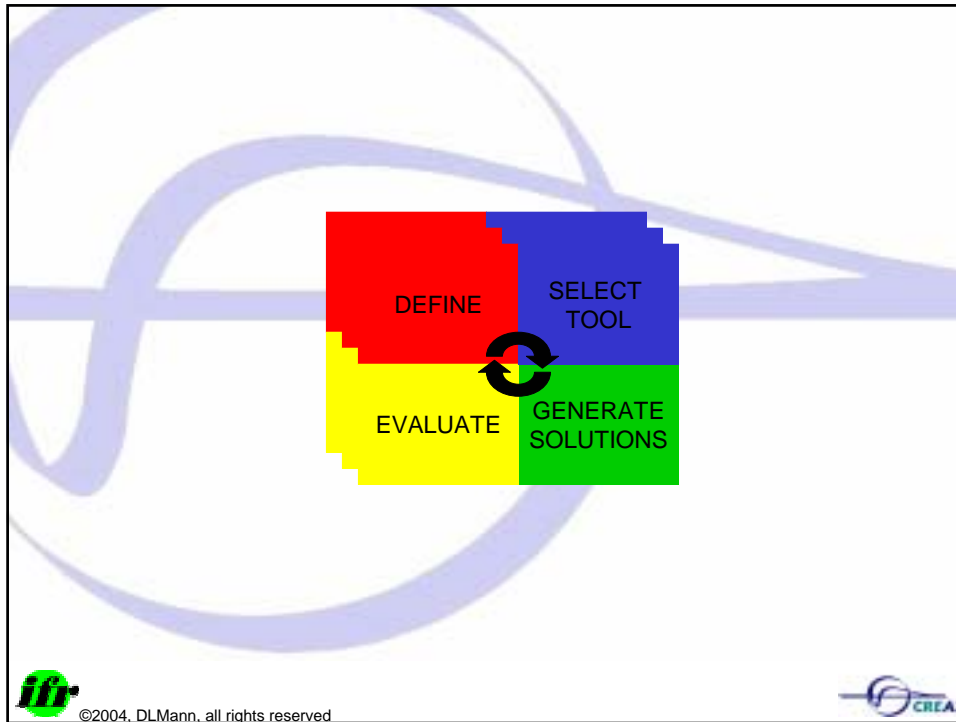
A Complete Method

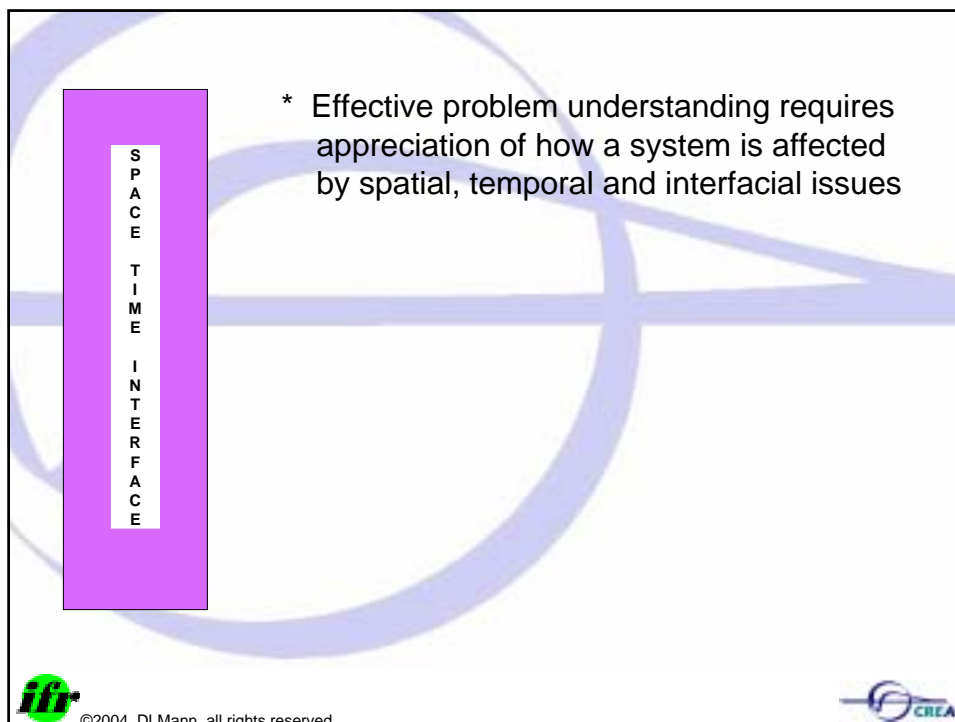
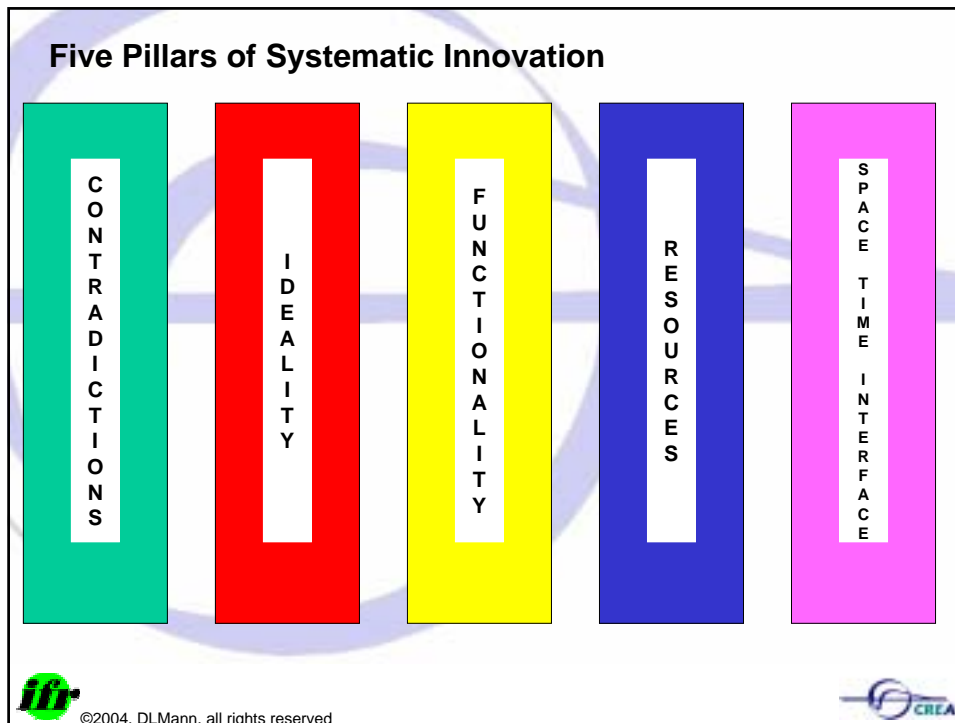


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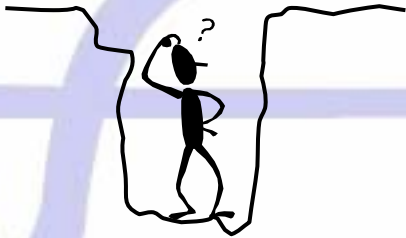










Systematic Creativity



- * 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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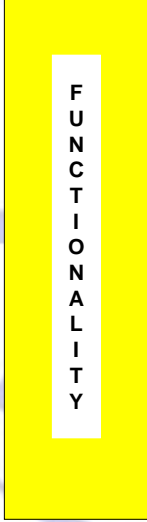


CONTRADICTIONS



- * **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**

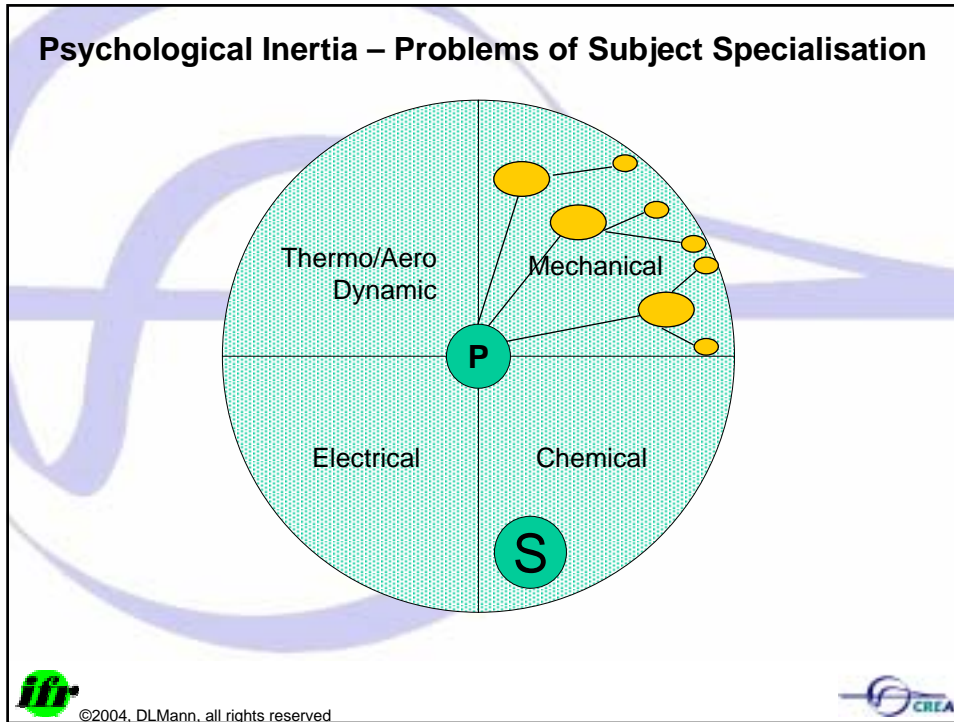
Rolls-Royce
Jet Engine Business → **'Power-by-the-Hour'**

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

www.creax.com

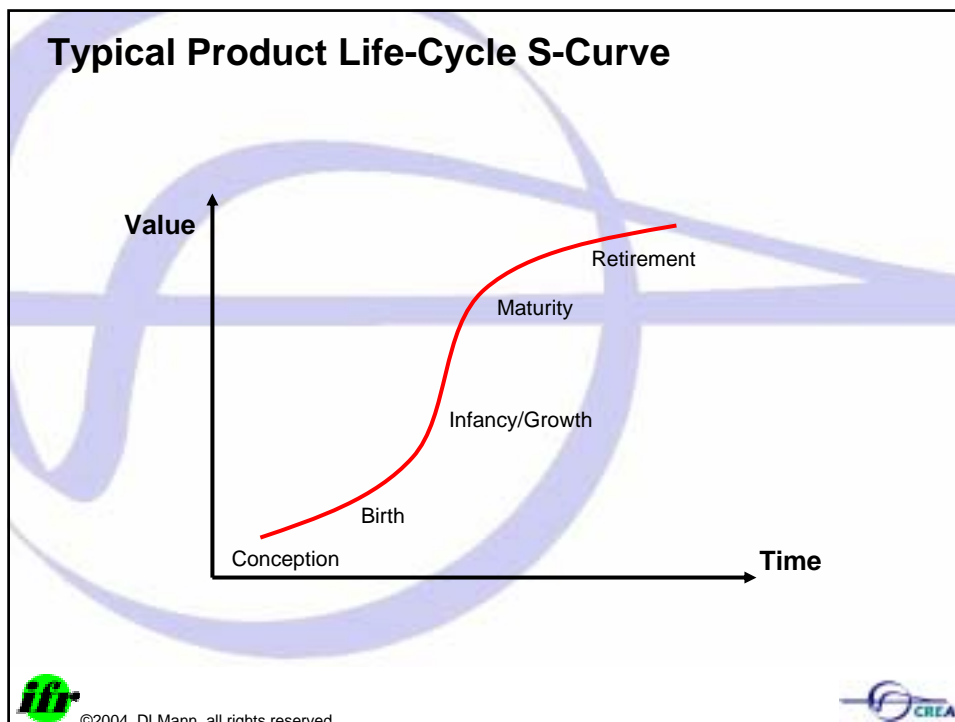
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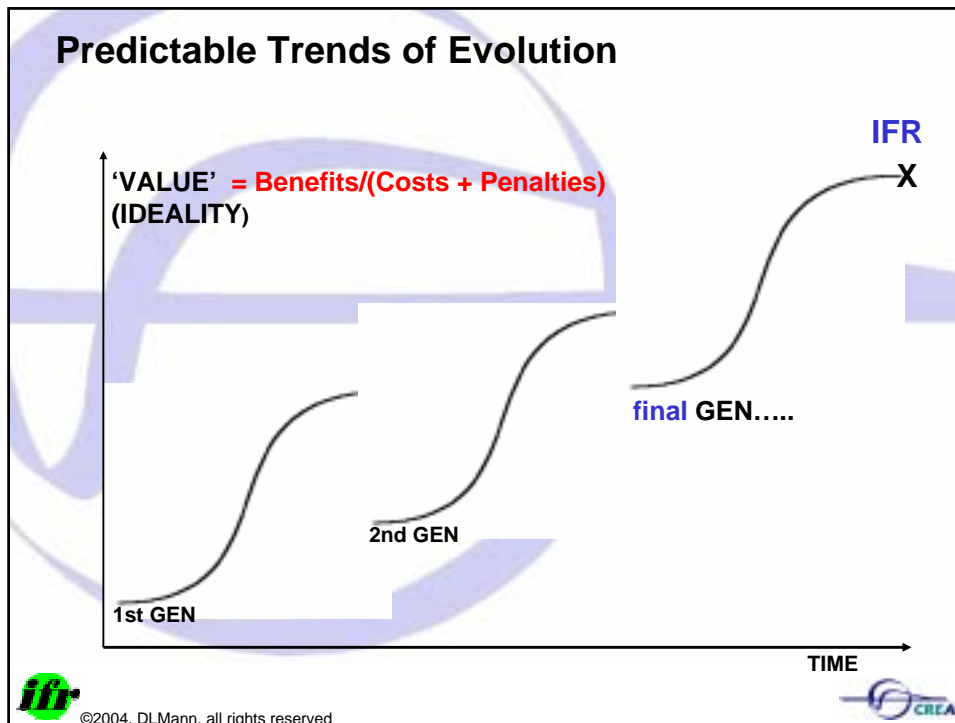


- * Ideality is the over-riding driver for system evolution
- * Ideality is about increasing the good, decreasing the bad
- * Ideality = 'Value' = $\frac{\text{Benefits}}{(\text{Cost} + \text{Harm})}$
- * IDEAL FINAL RESULT – all the benefits, none of the cost or harm
- * *'free, perfect & now'*
- *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





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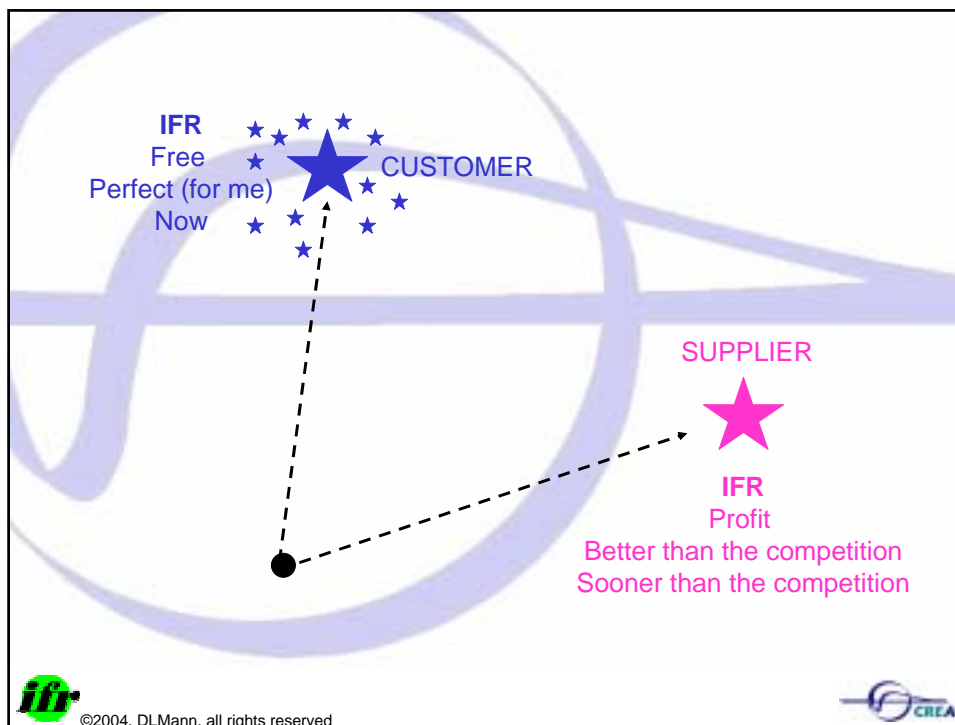


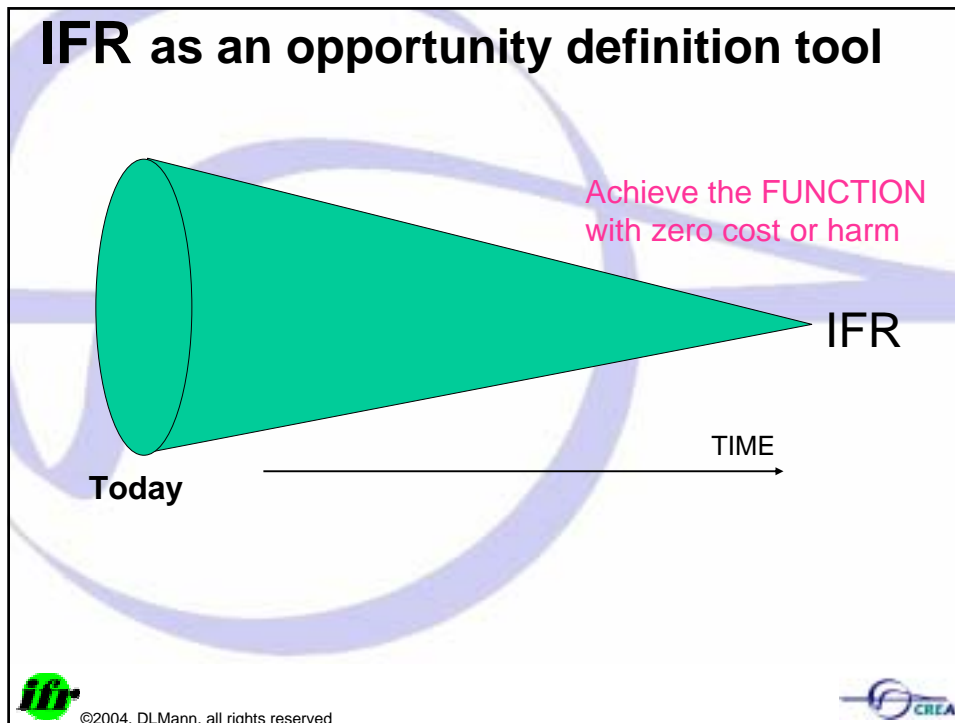


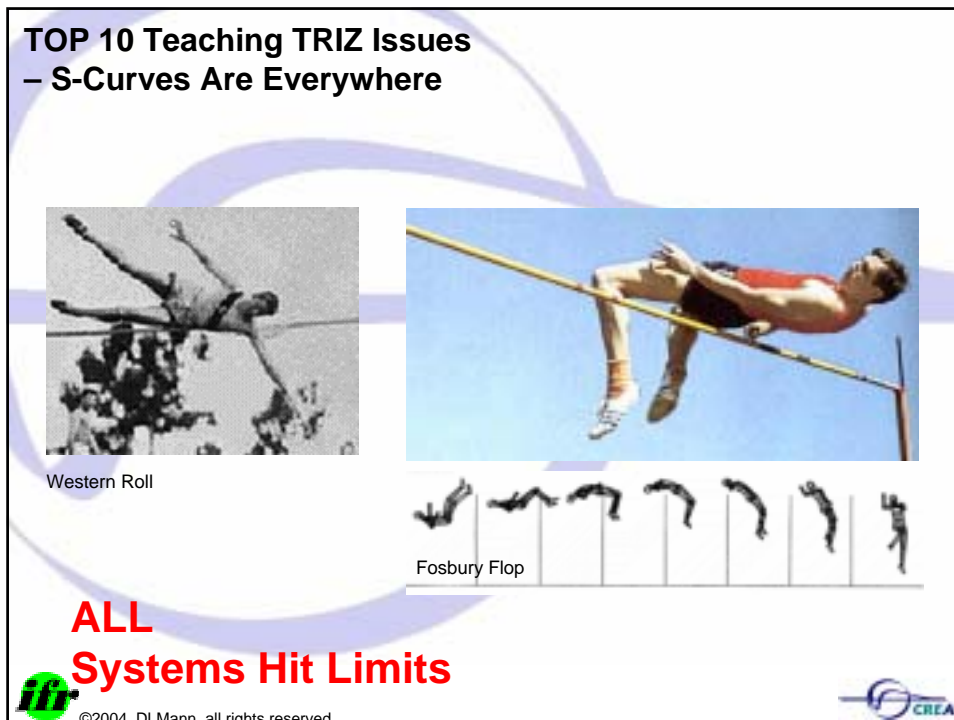
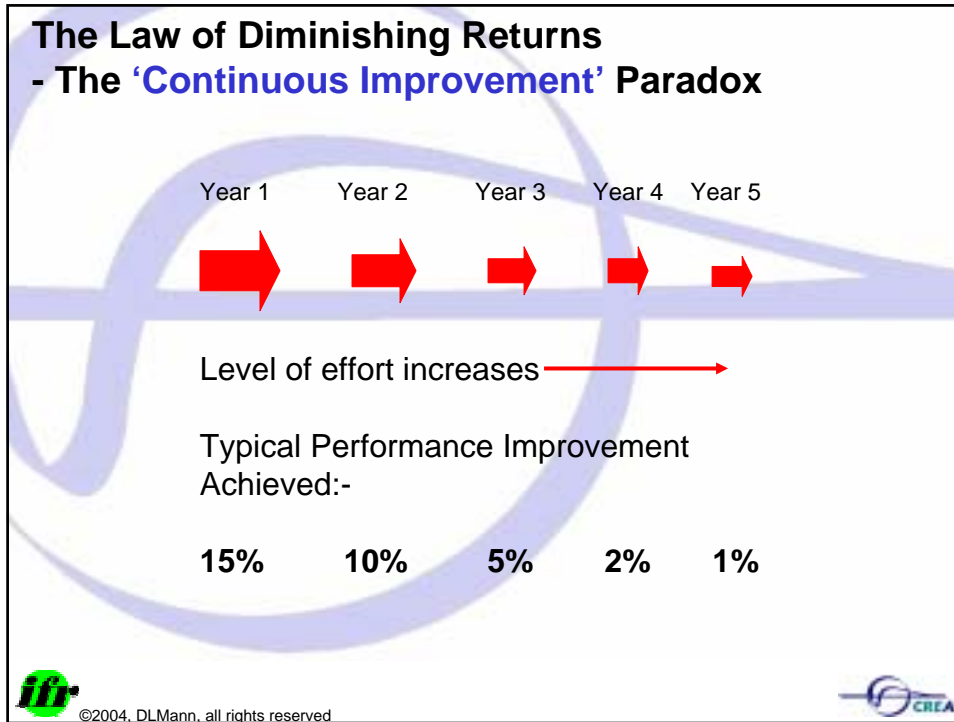
WHOSE IDEAL FINAL RESULT ?

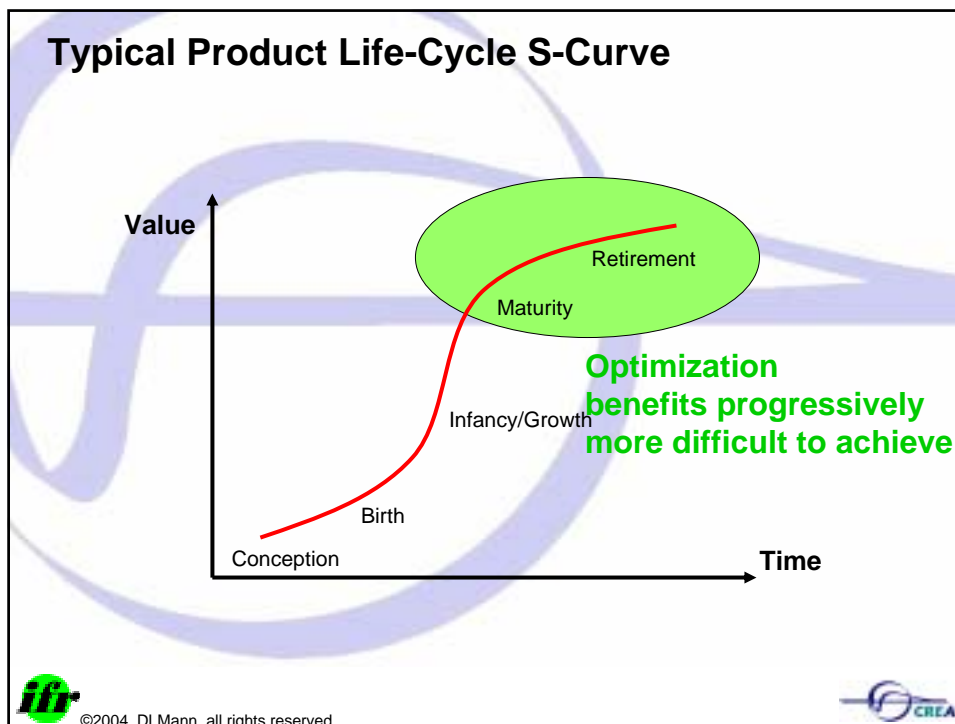
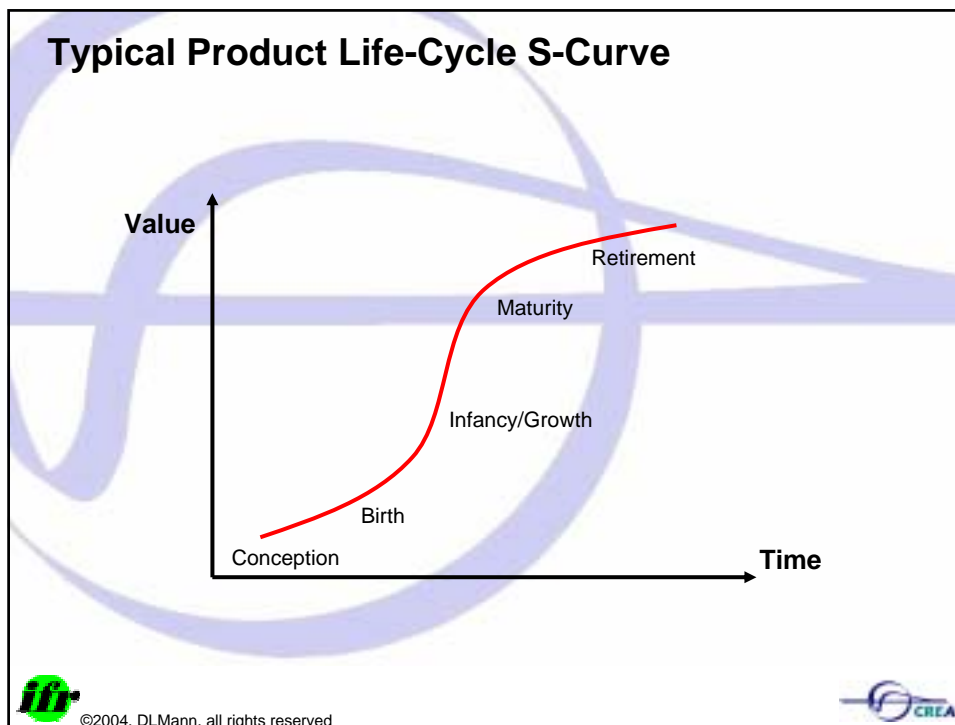
Customer ? Supplier ?

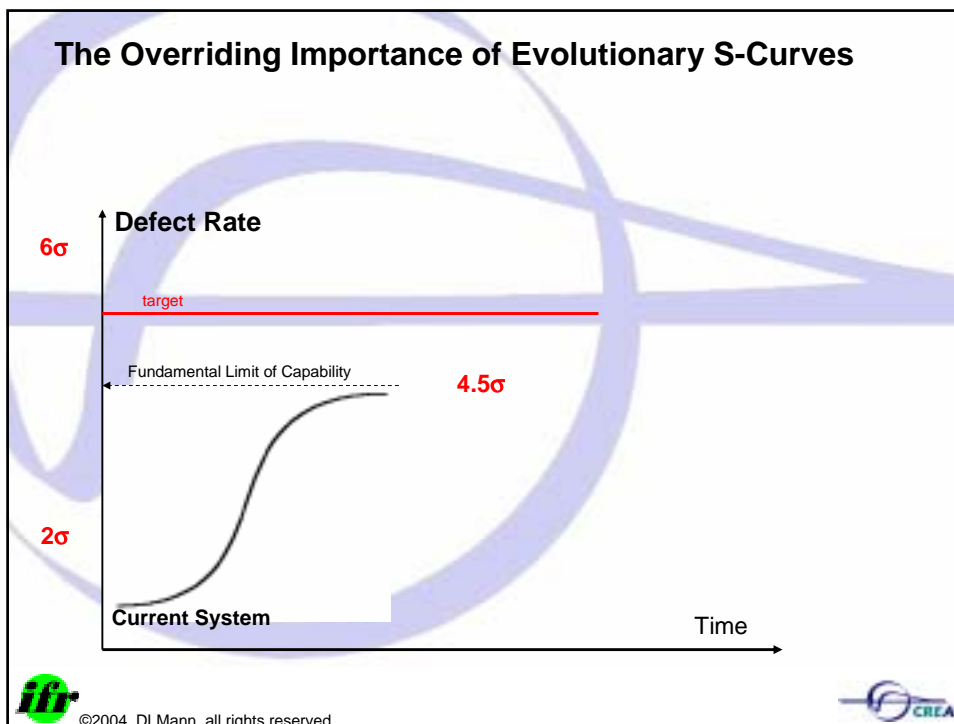
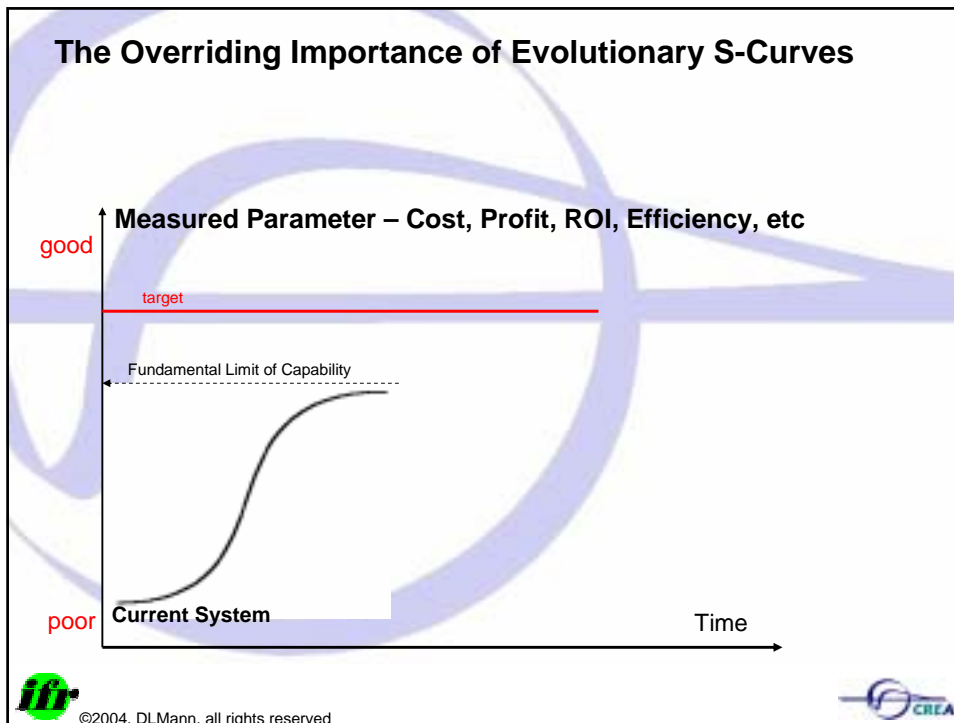
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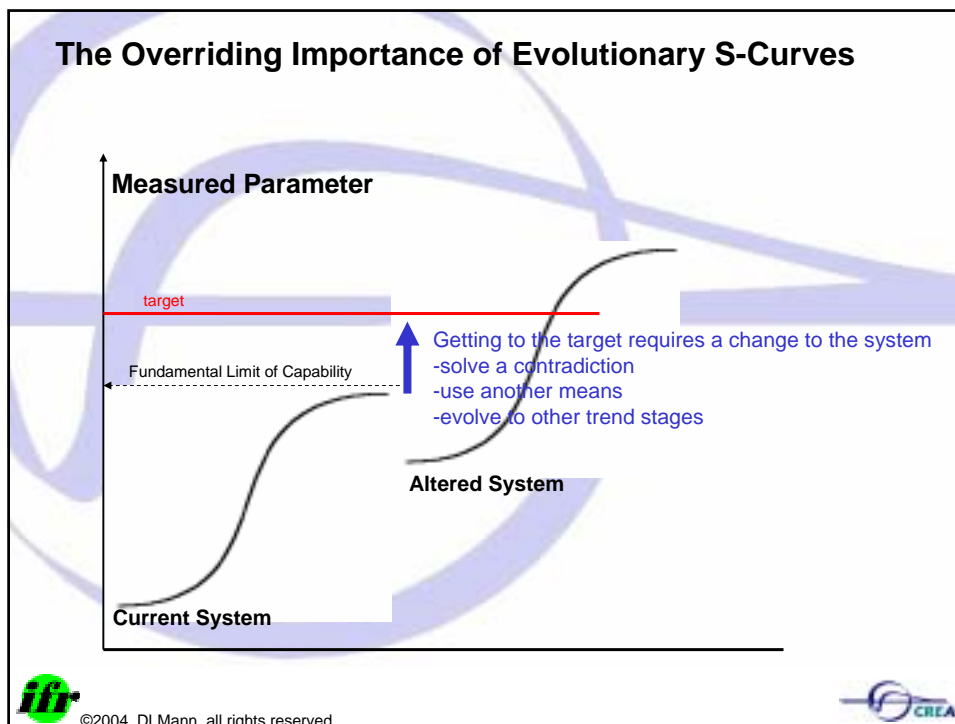
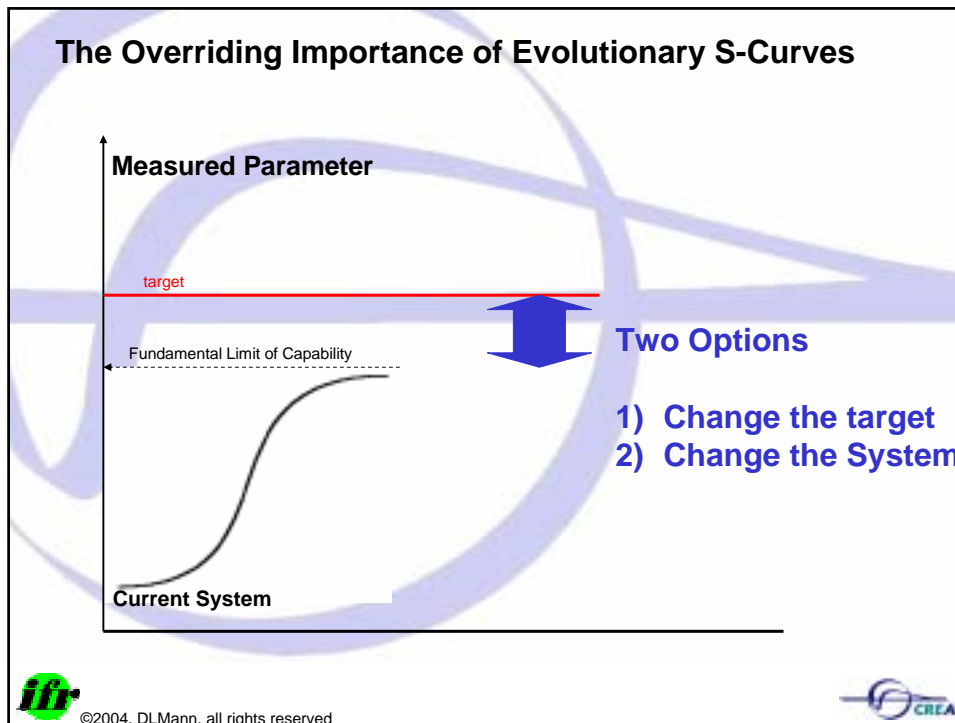




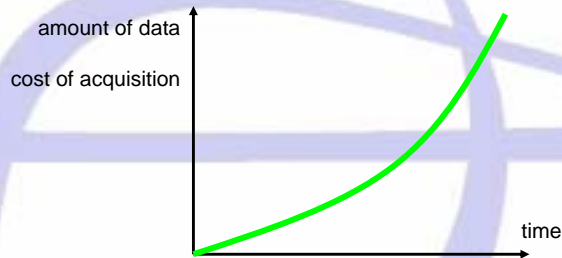








Root Cause Analysis Paralysis (How do I know when to stop?)



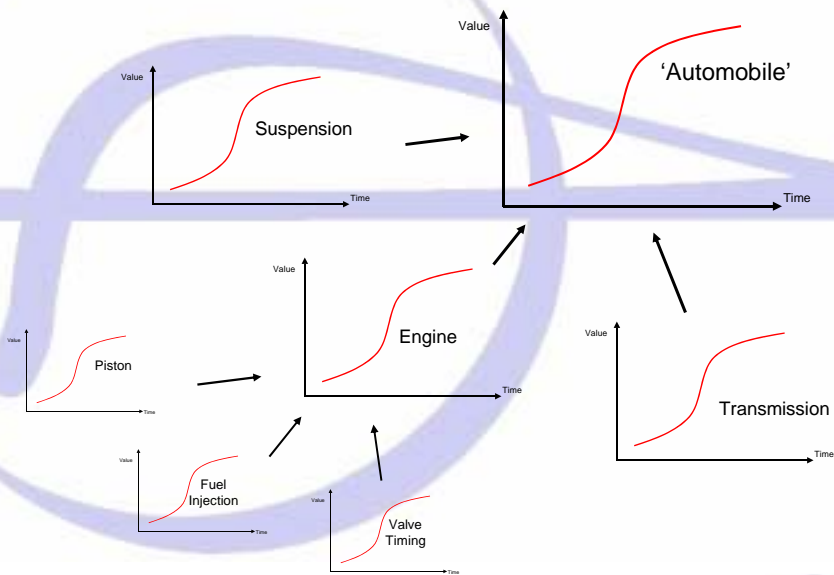
If you have spent a week looking for a root cause without success, perhaps the actual root cause is that your system has simply hit a **fundamental limit**?



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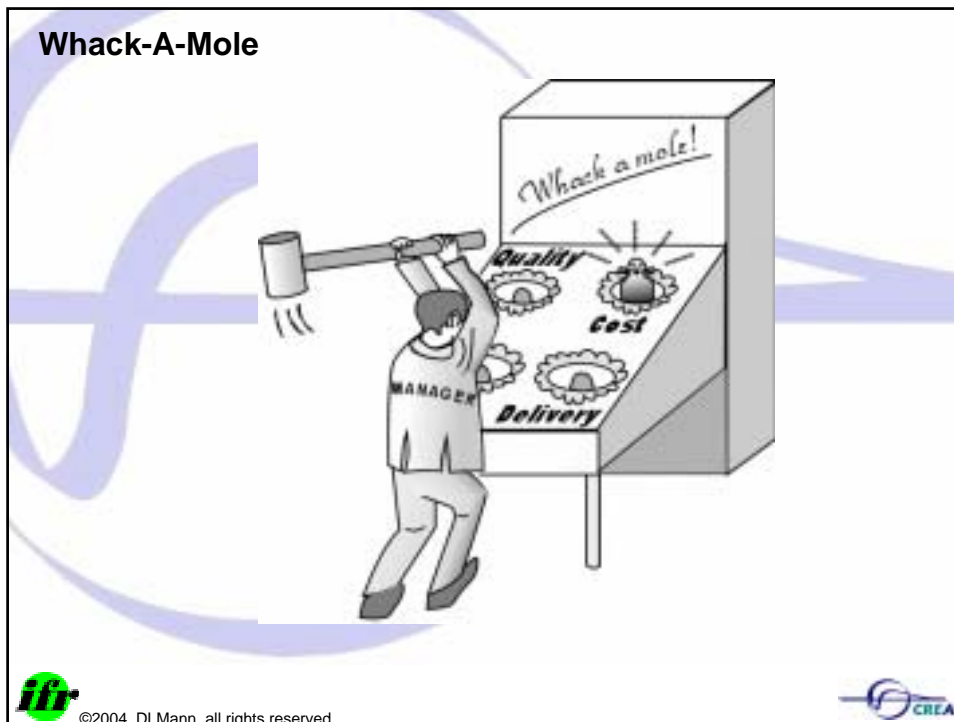


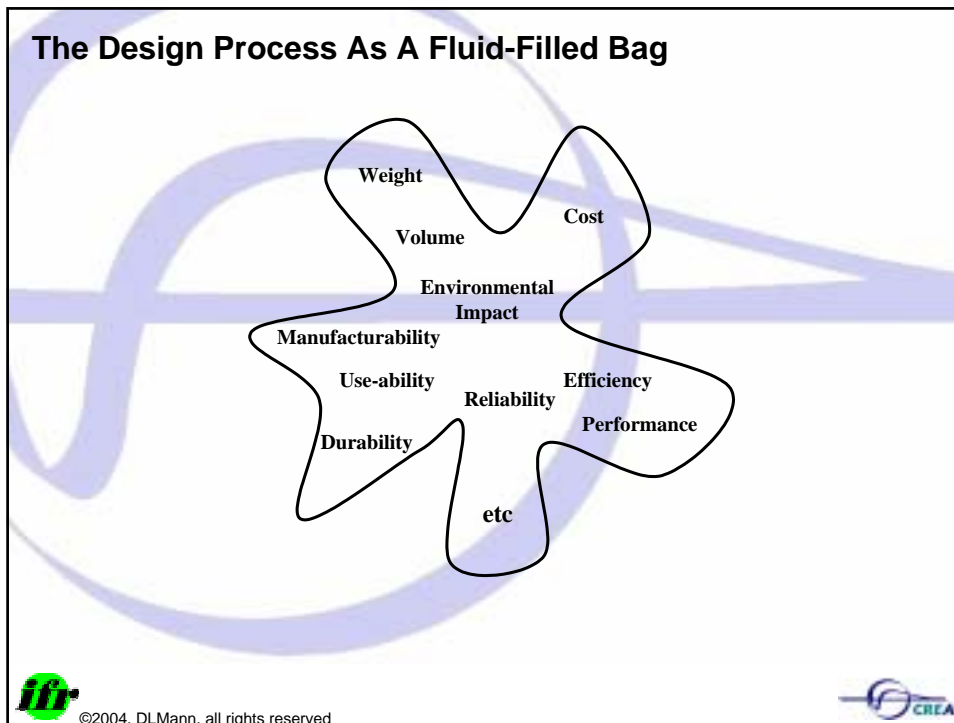
S-Curve Families



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




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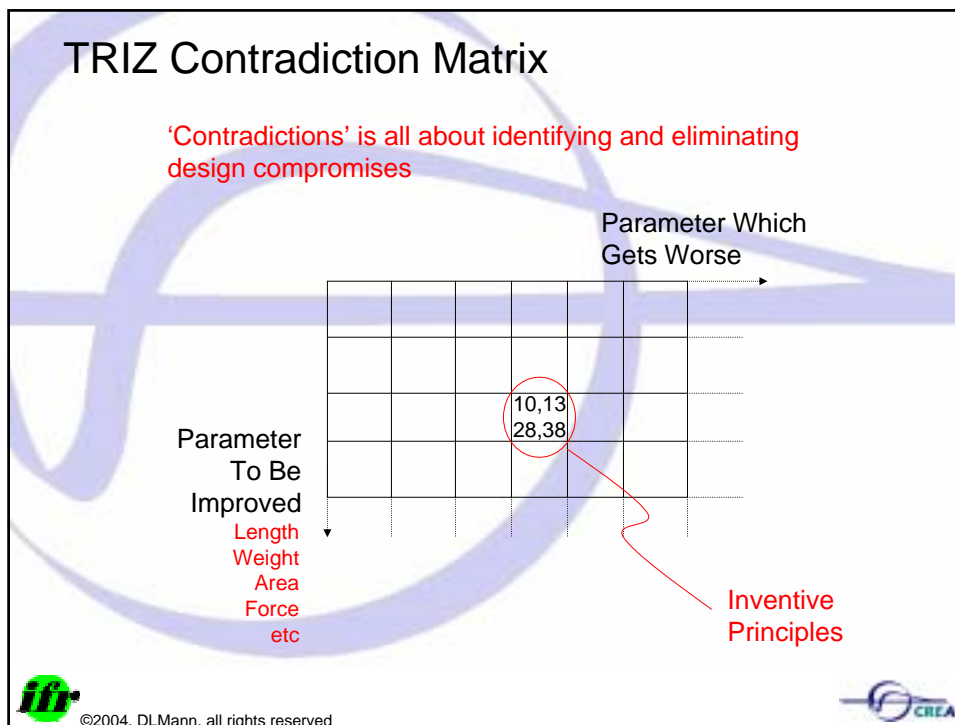
TRIZ - Contradiction Matrix Elements



<ol style="list-style-type: none"> 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. Speed 10. Force 11. Tension, pressure 12. Shape 13. Stability of object 14. Strength 15. Duration of action - moving object 16. Duration of action - stationary object 17. Temperature 18. Brightness 19. Use of energy by moving object 20. Use of energy by stationary object 	<ol style="list-style-type: none"> 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. Object affected harmful effects 31. Object generated 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
---	--



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

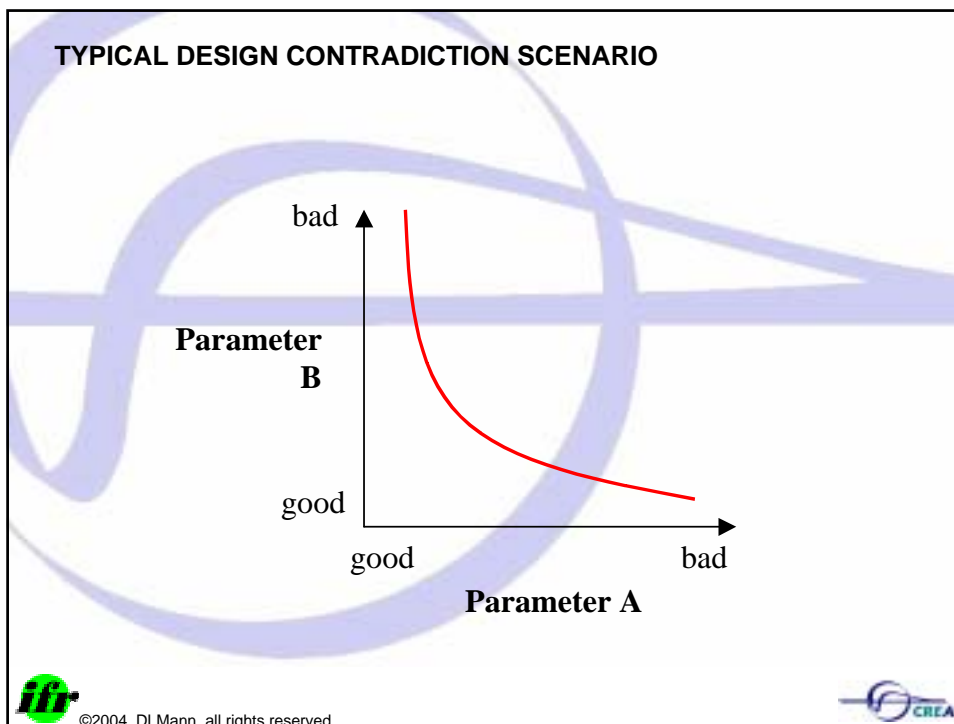
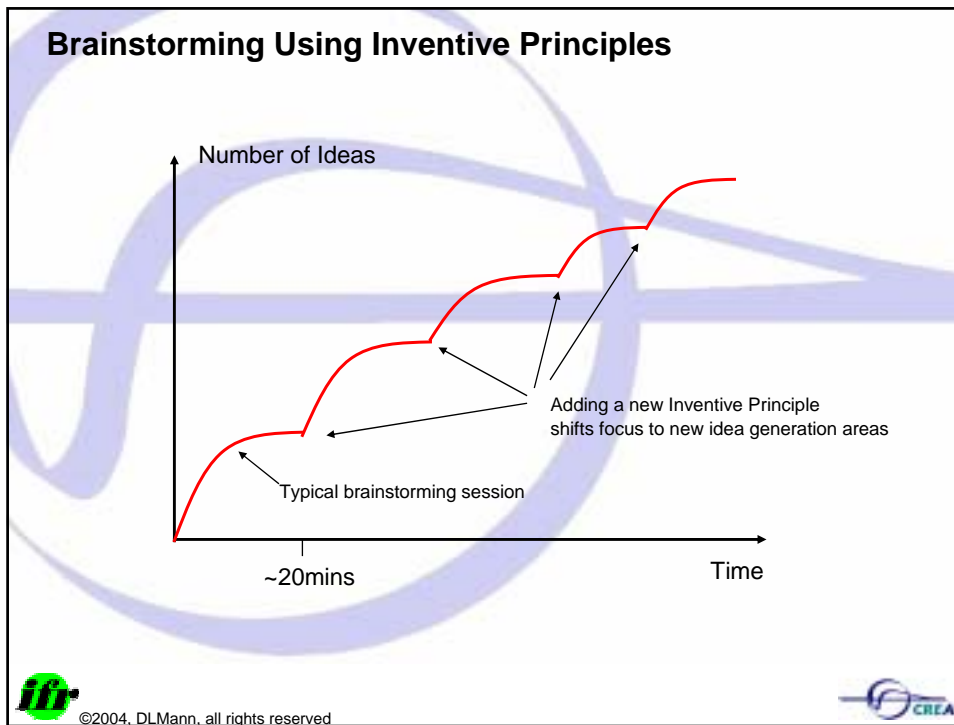
C. Increase the degree of fragmentation or segmentation.

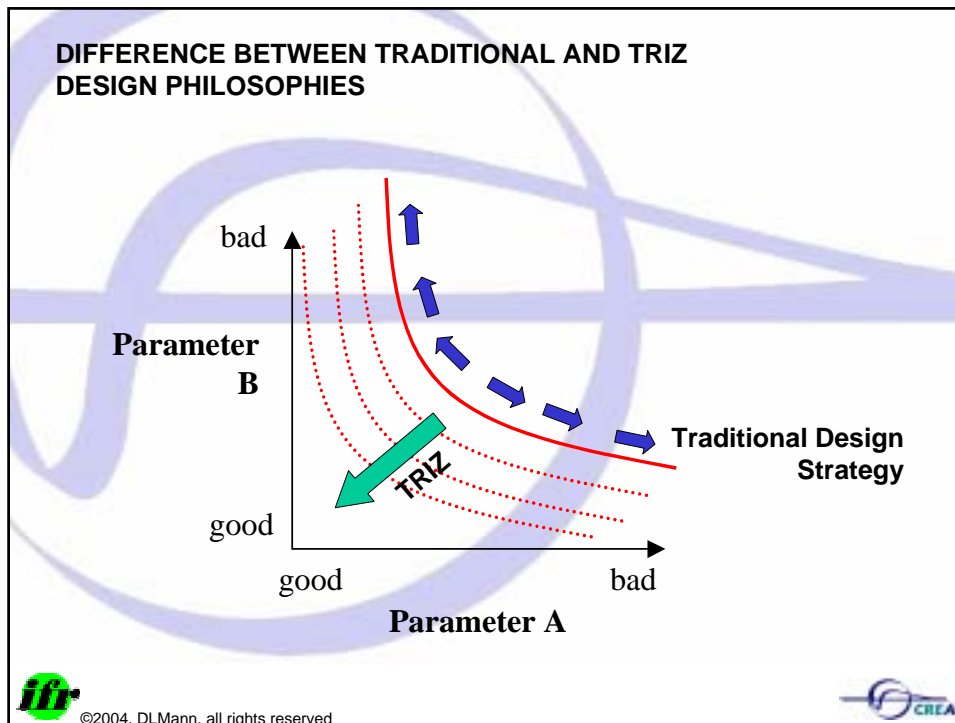
- Quality Circles.
- 'Empowerment' – segmentation of decision making.
- Distance learning (also 'Taking Out')
- Virtual office/remote working (also 'Taking Out')
- 'Creative Segmentation' – 'high performance small car', 'easy to use SLR', 'cordless power tool'



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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



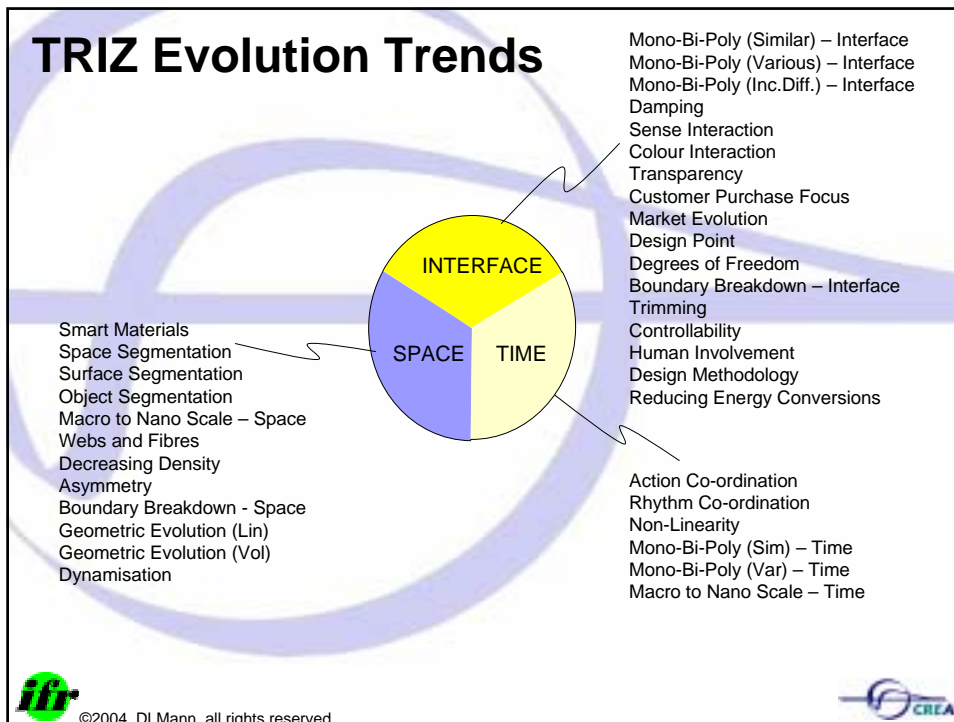
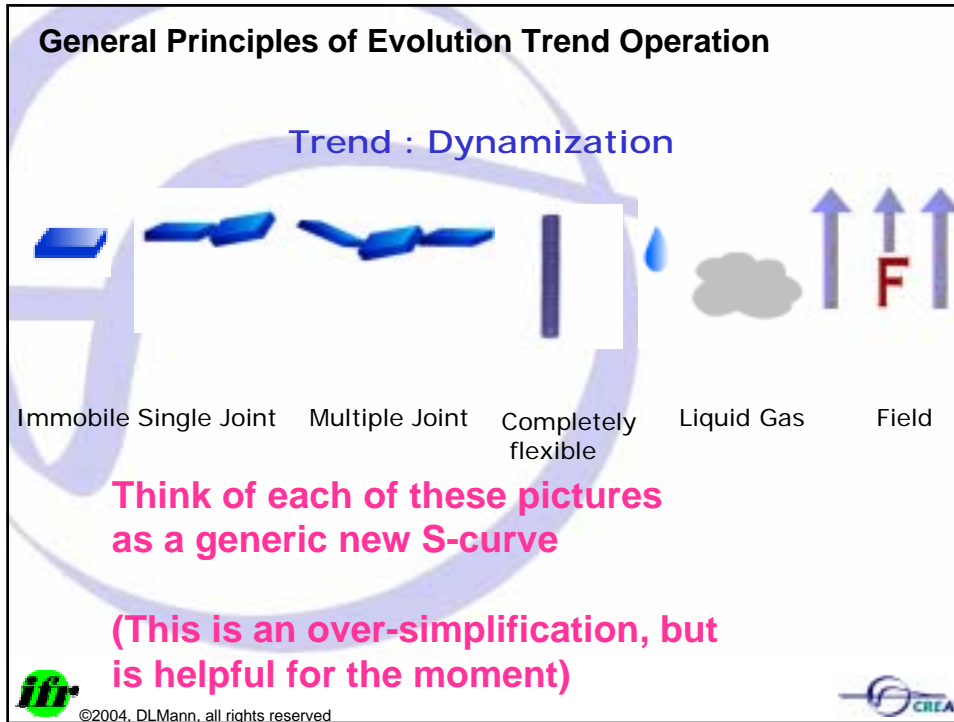
Business/
Commercial

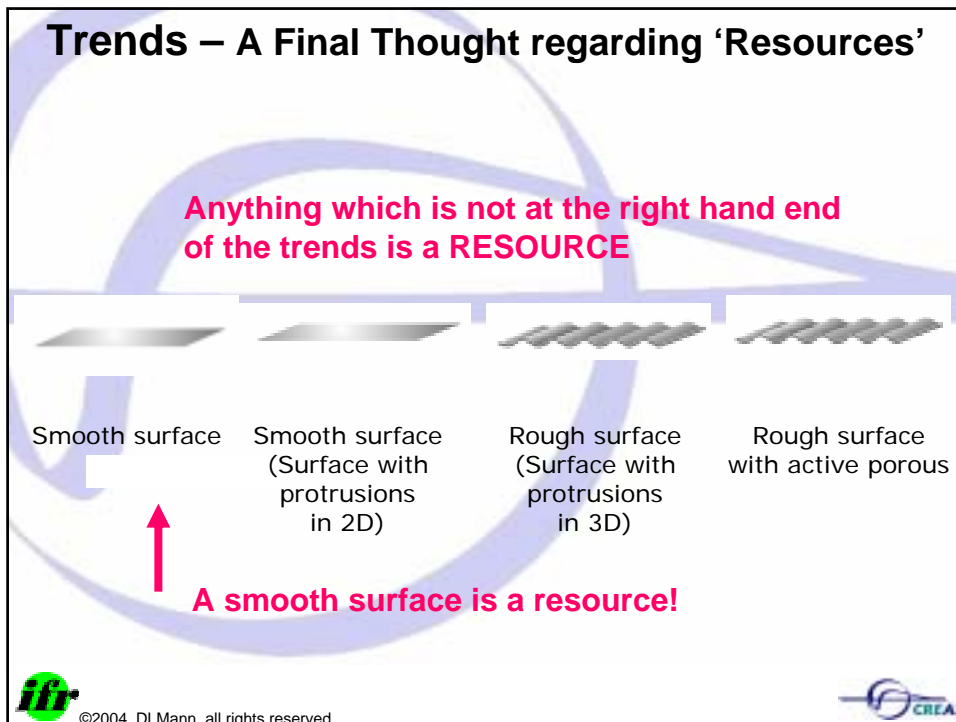
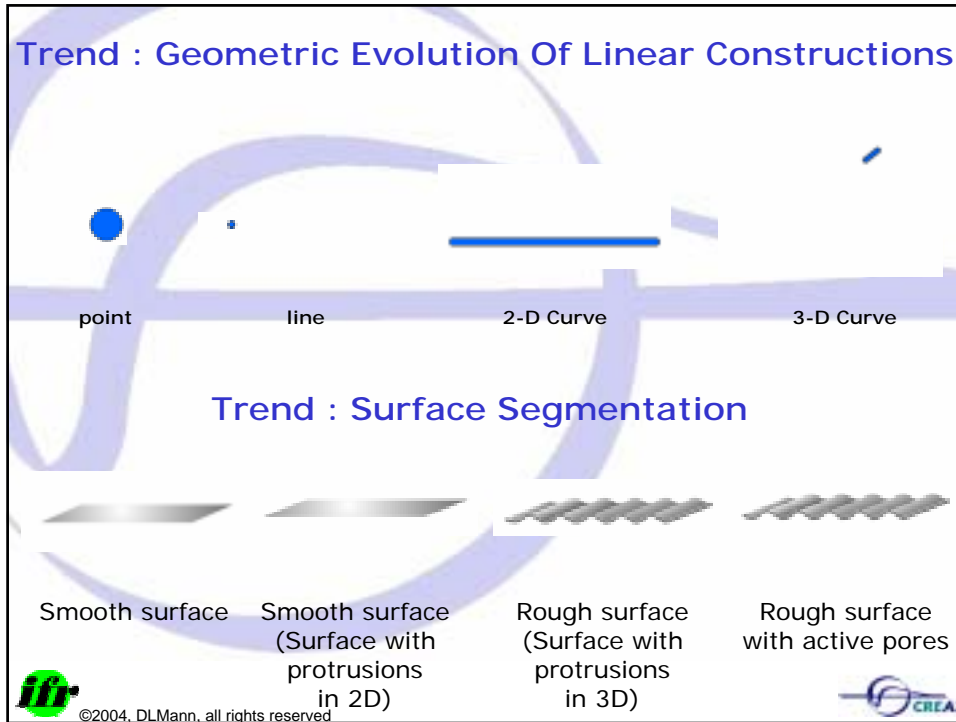
New opportunities
Limits of existing systems
Maximisation of R&D benefit

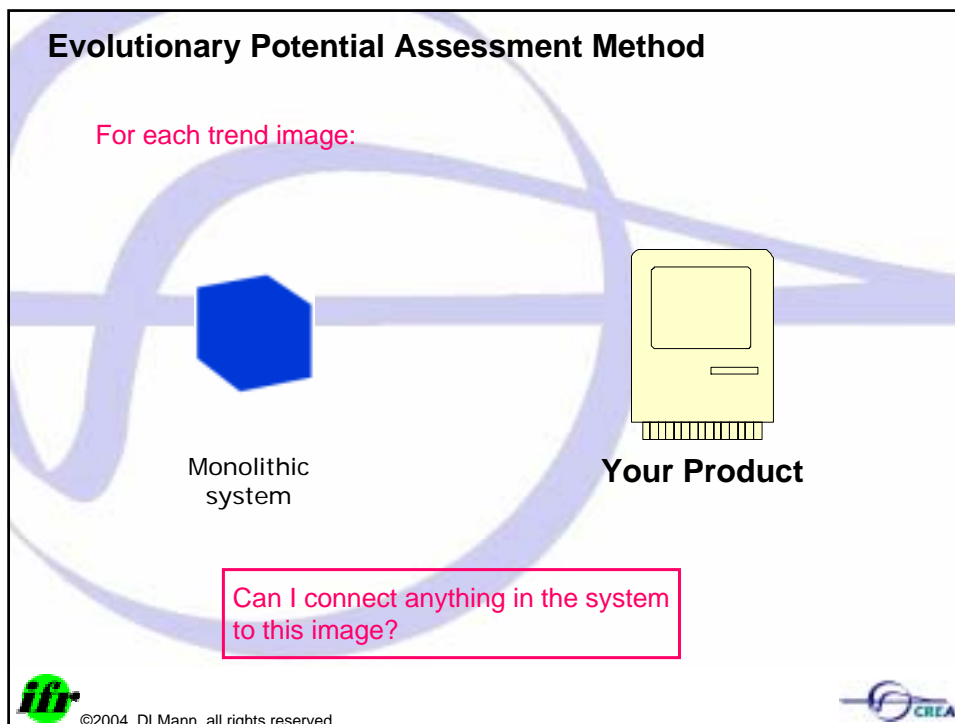
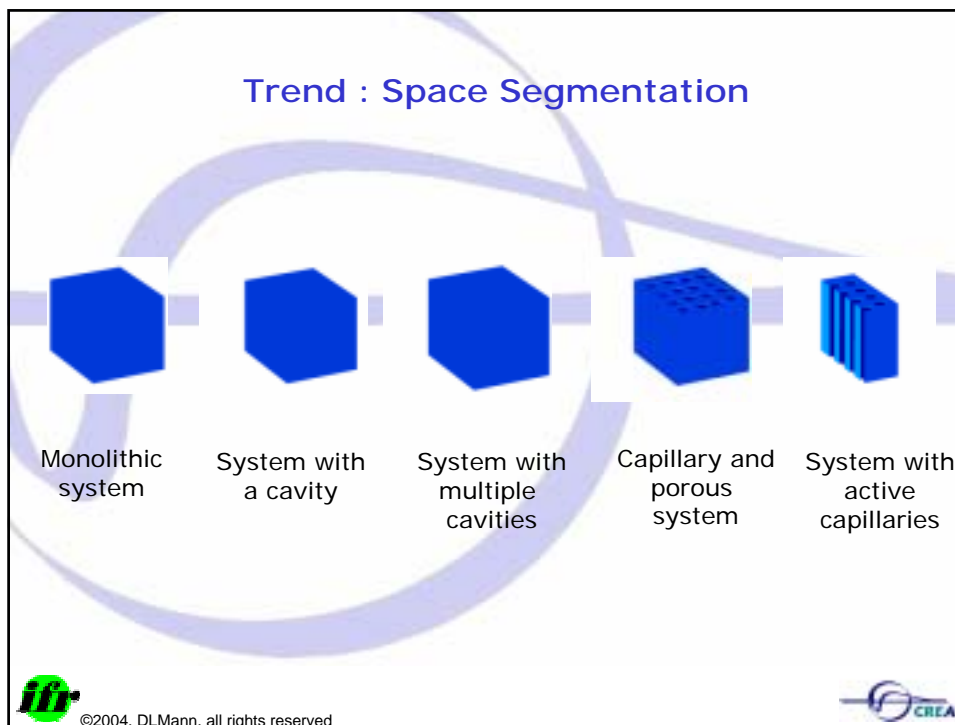


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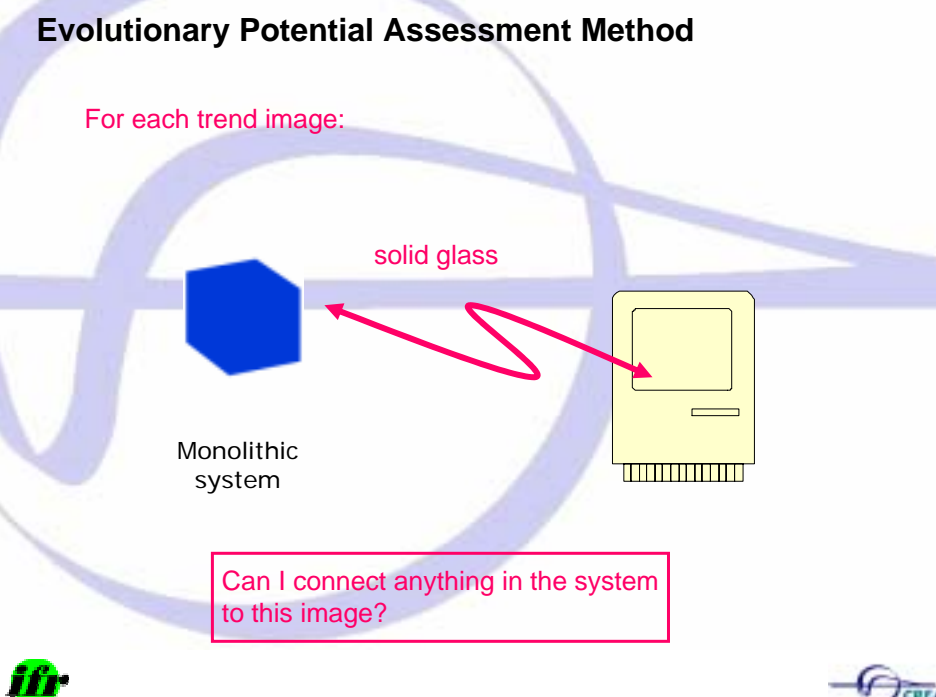






Evolutionary Potential Assessment Method



For each trend image:



solid glass

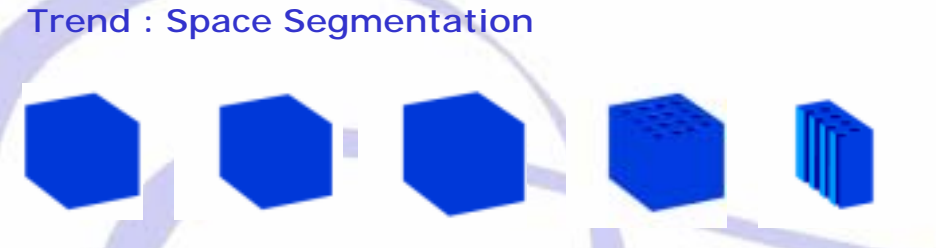
Monolithic system

Can I connect anything in the system to this image?






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Trend : Space Segmentation

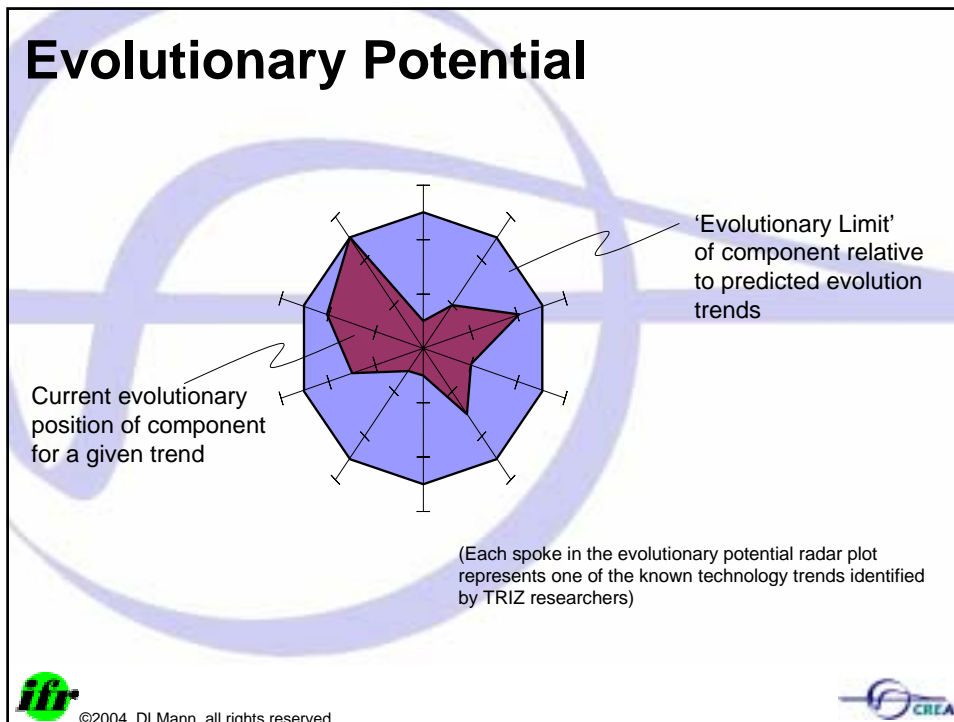
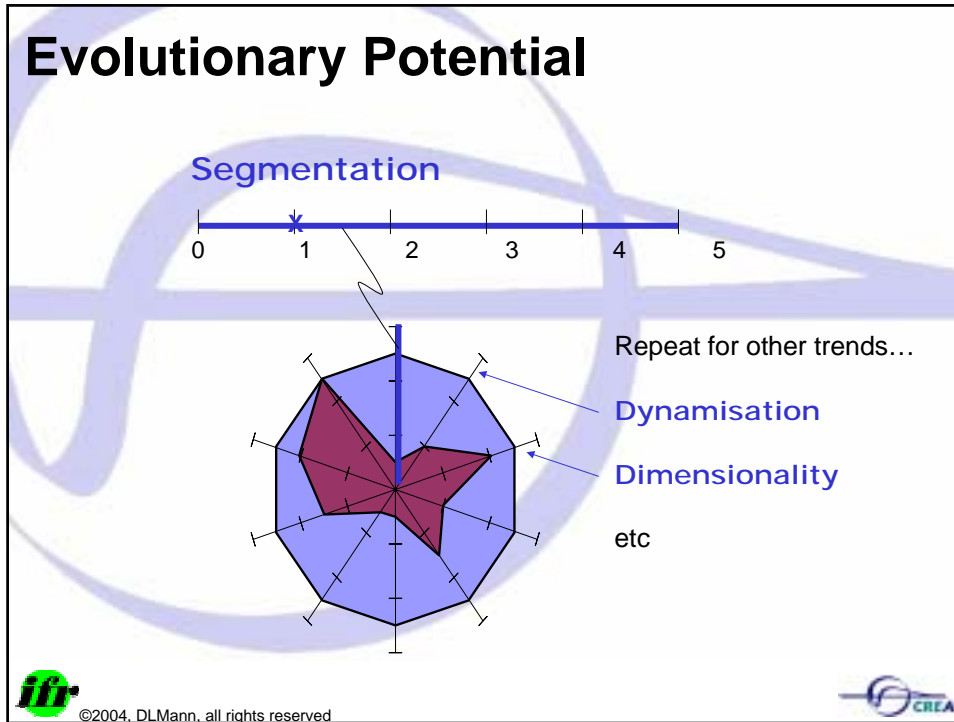


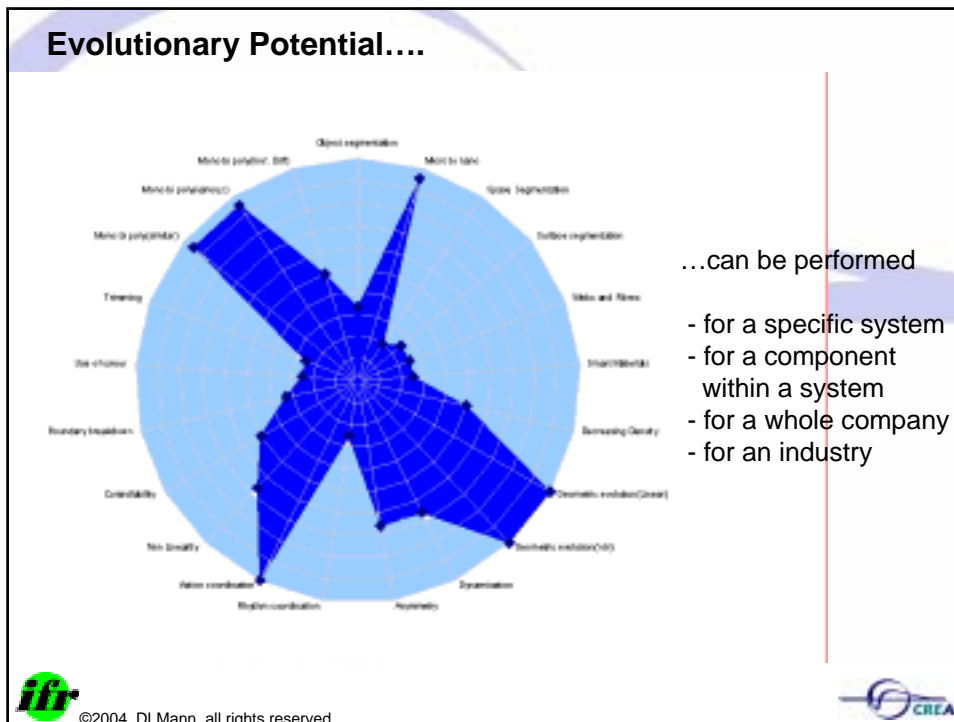
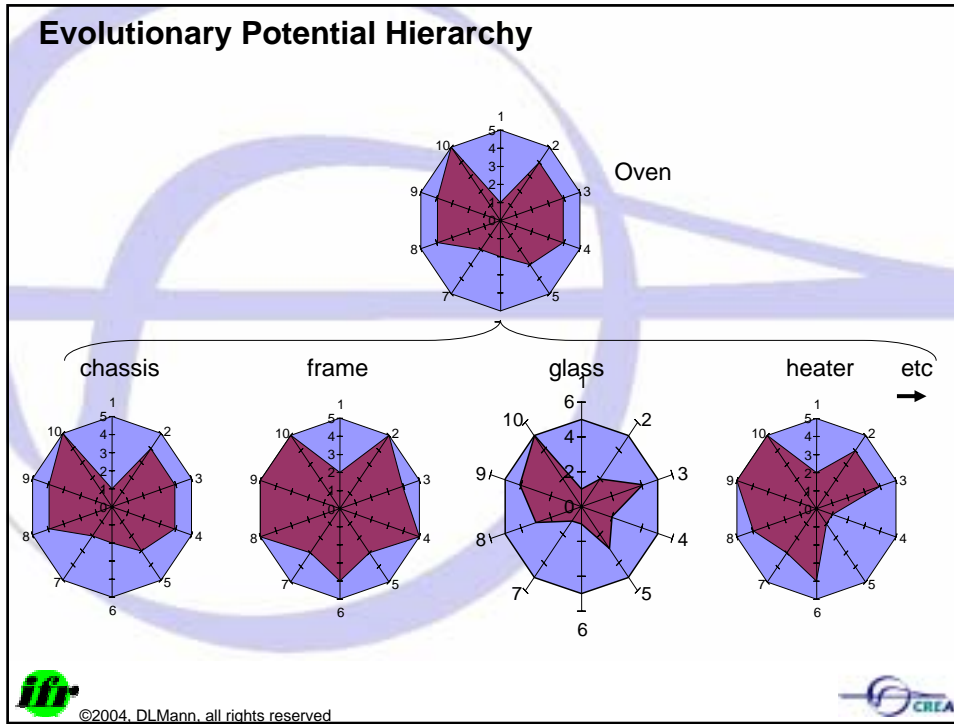
Monolithic system System with a cavity System with multiple cavities Capillary and porous system System with active capillaries

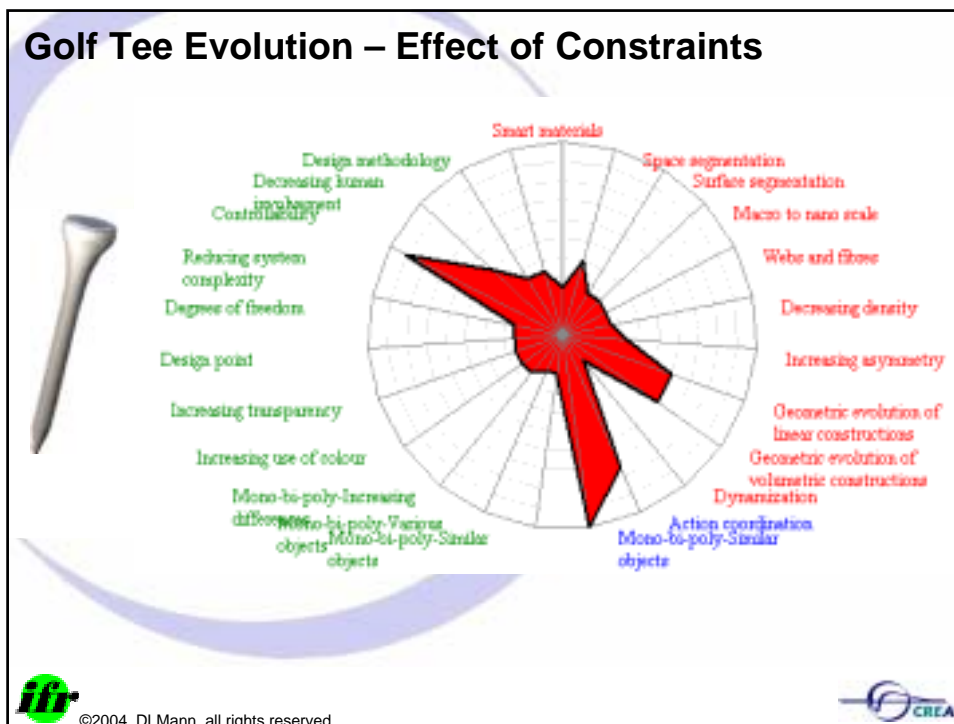
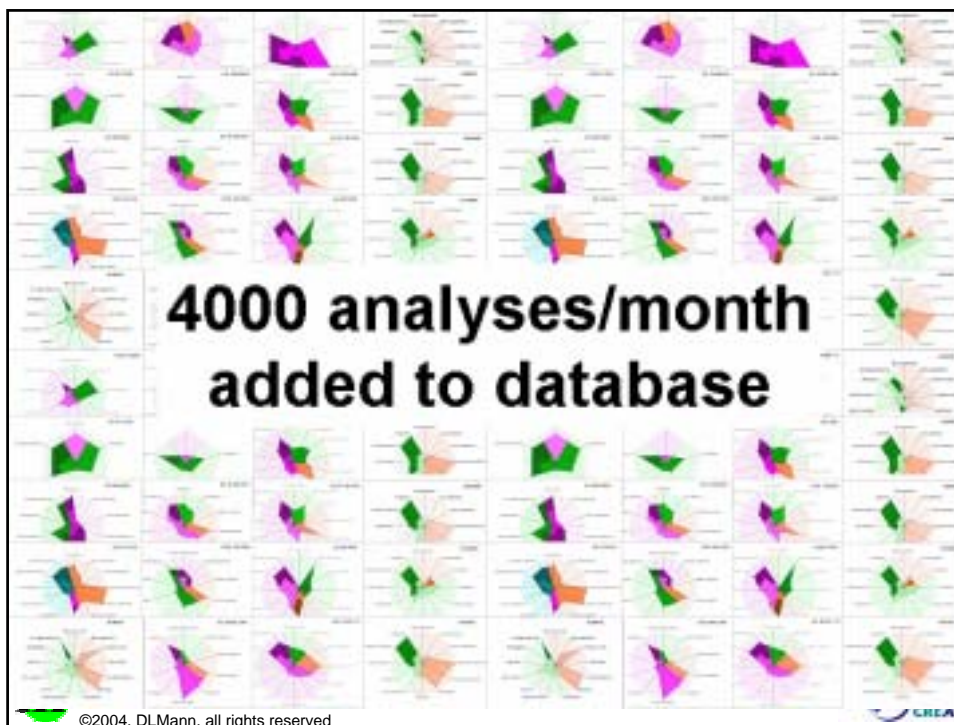
Evolutionary Potential:

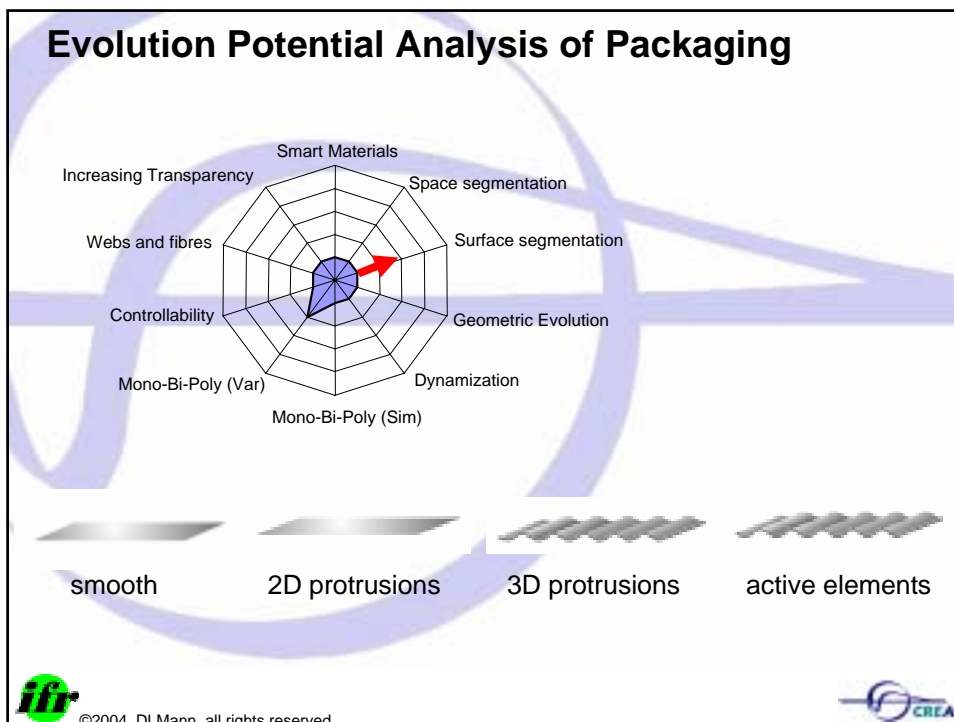
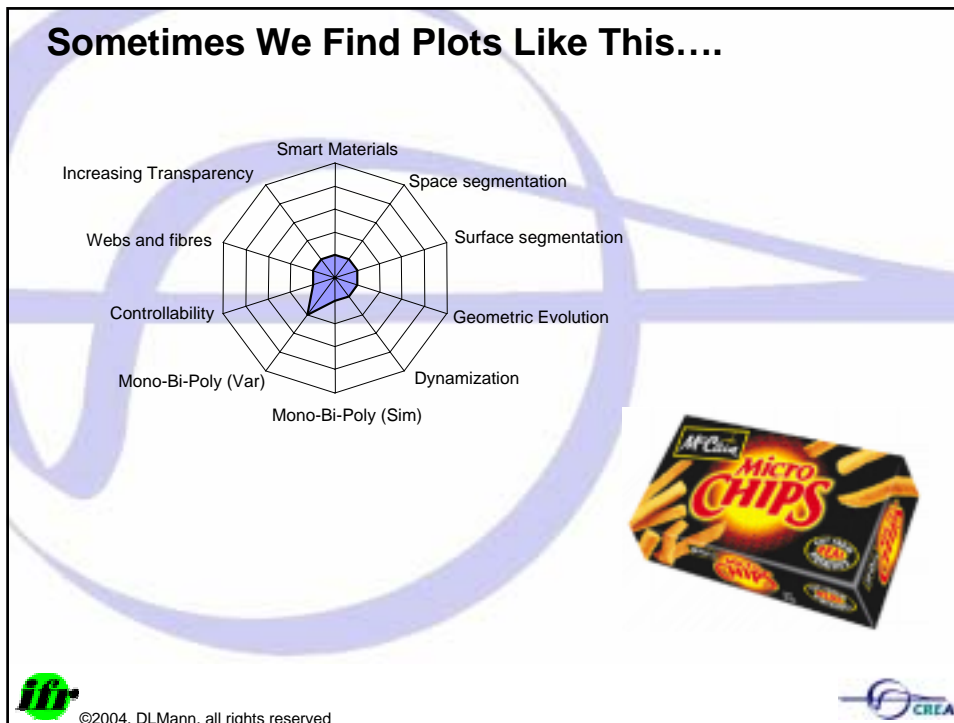


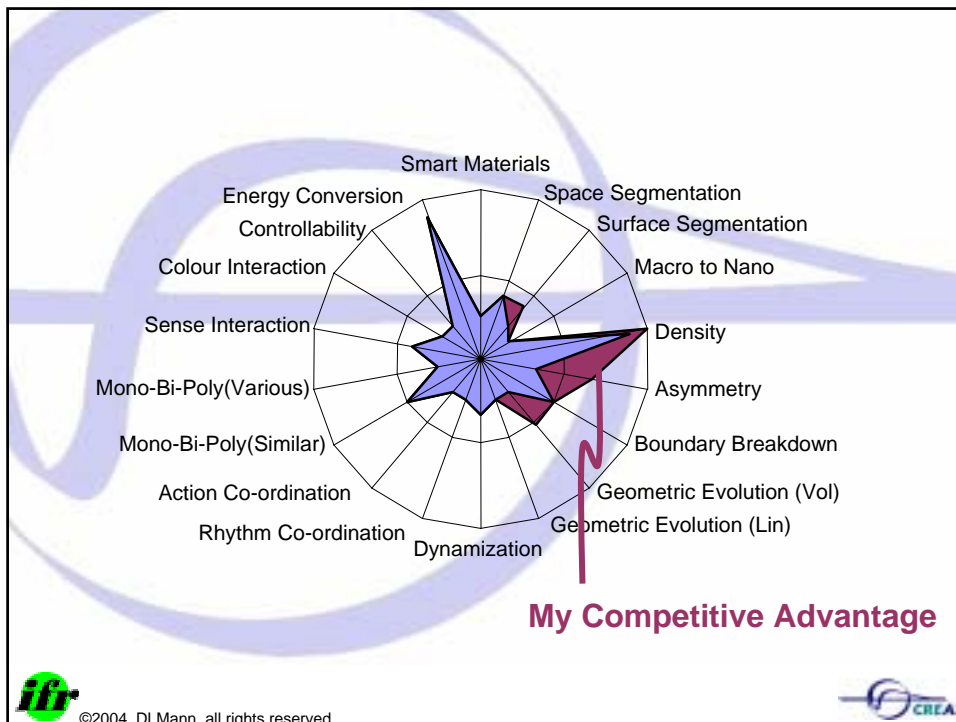
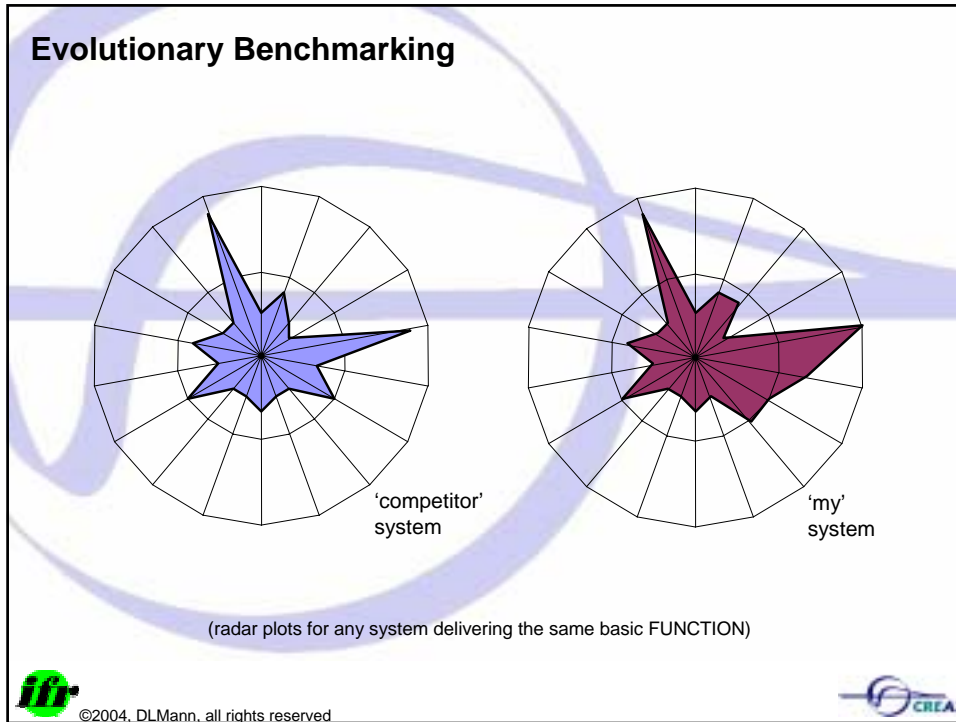
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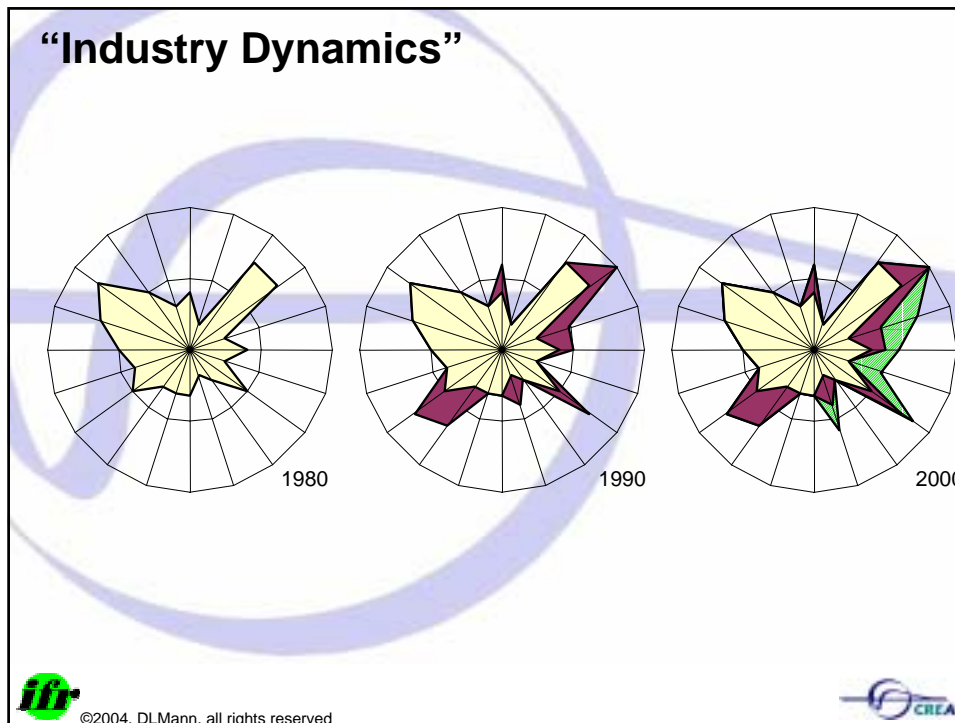






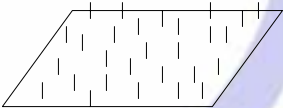








Trends of Evolution - Example

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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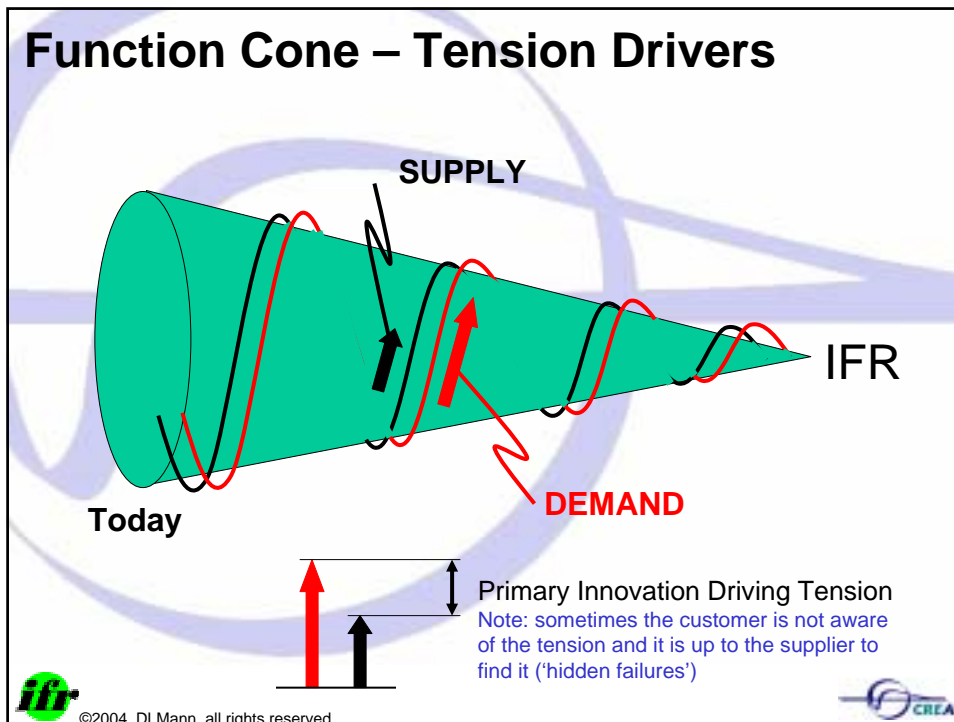
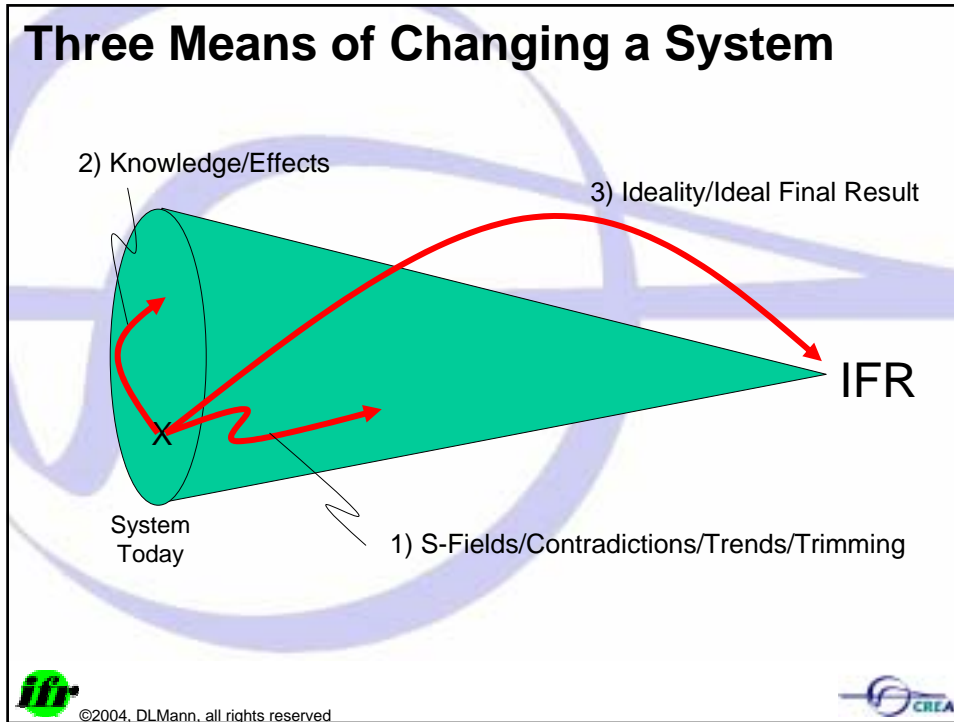


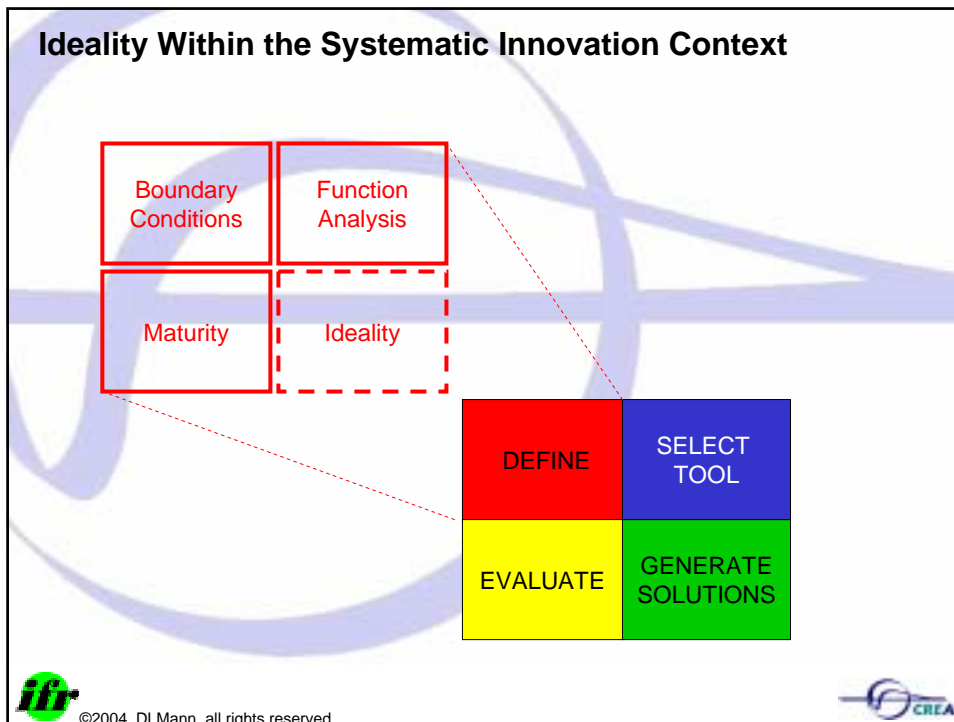
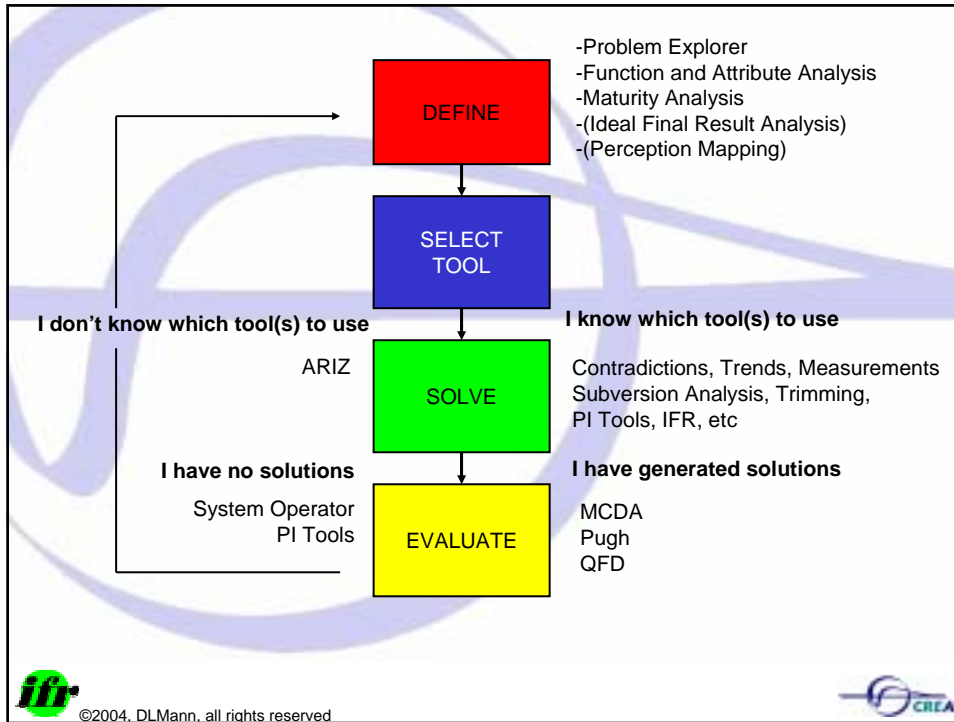
Putting It All Together Summary



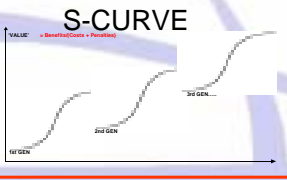
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3 Essentials of Problem Definition:

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

+ 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.

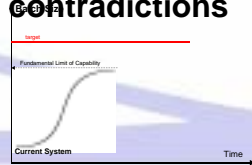
Print the sheets out, or fill them in electronically.
If you need more space, make copies or use blank pieces of paper.

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. The grid is mostly empty, with some faint markings in the top-left corner.

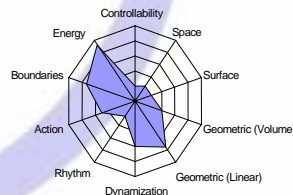


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TRIZ Short-Cuts 2) Resources

- 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

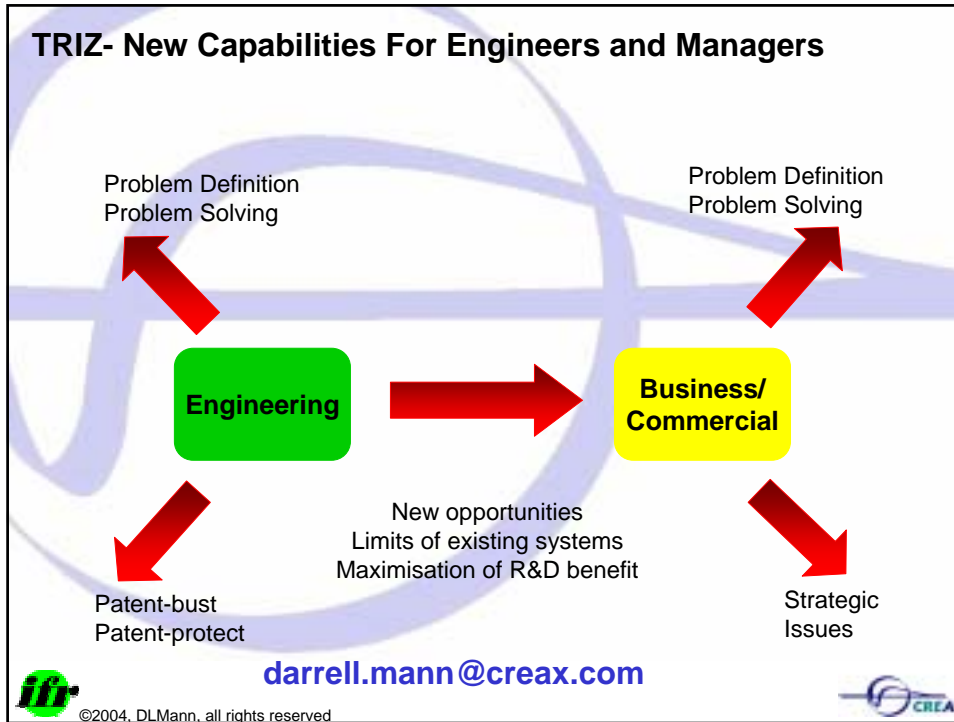
Successes with the right people will breed success everywhere (find the connectors)

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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