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TRIZ for CIOs – The Theory of Inventive Problem Solving

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24 May 2005

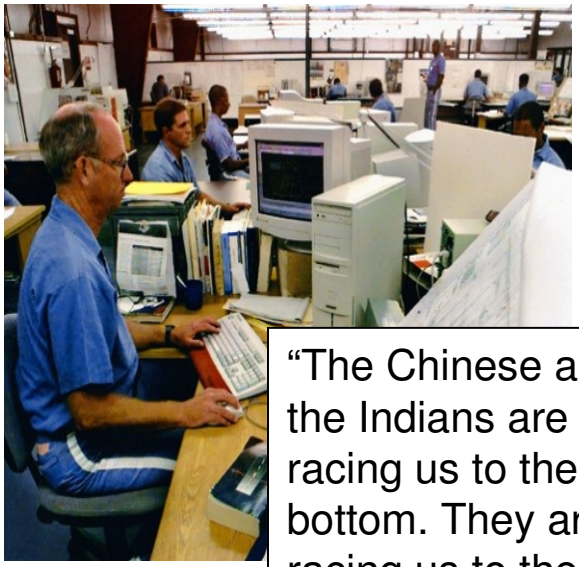
CSC
EXPERIENCE. RESULTS.

Twin drivers of innovation in 2005 and beyond

"We are all just a moment of complacency away from an abyss called **commodity hell**, where you compete only on price, where share goes to the least common denominator …" Jeff Immelt, GE

Globalization

- Lower growth, higher risk
- Excess capacity – getting that order
- Strong competitors in emerging economies
- Outsourcing options and multi-sourcing
- Better educated, cheaper, global, labour
- Price transparency – perfect information
- Fleeting value from new product launches
- Distribution-oriented, consolidating channels



"The Chinese and the Indians are not racing us to the bottom. They are racing us to the top." Thomas Friedman, NYT

The innovator is a problem solver

- A special place in the mind or just plain old-fashioned hard work?

Directed Evolution

Process Improvement

Problem Solving

IQ test: tick the boxes that apply to your company

- ❑ The value in your industry is shifting from perfecting the old, towards inventing the new, in processes, products and services.
- ❑ Even when you take on significant new contracts, vast amounts of new work or hundreds of new orders, your share price won't budge.
- ❑ You are certain that reducing development time, production costs, and product price by 15 per cent would make your firm and your product a winner.
- ❑ It seems that the innovation efforts in your organization are not systematic enough, and are based on chance flashes of genius or ad-hoc ideas raised by individuals in skunk works projects.

(I.Q. = Innovation Quotient)

- ❑ You sense that your R&D staff members are sated and have settled into complacency, and the flow of ideas is not what it was.
- ❑ Your company has an excellent product that, "if we could only solve that problem", would conquer the world.
- ❑ You feel you are nearing the end of a long and expensive development race and your competitors are about to pass you by and win a valuable brand name and profitable chunks of the market before you are able to act.
- ❑ Despite all the consultants, ISO standards and best practices you deploy, the cancer of "it'll be okay", and of undirected improvisation, has taken a grip on your firm, and this is something you are unwilling to accept.

More ticks means more need to improve your operating system for innovation

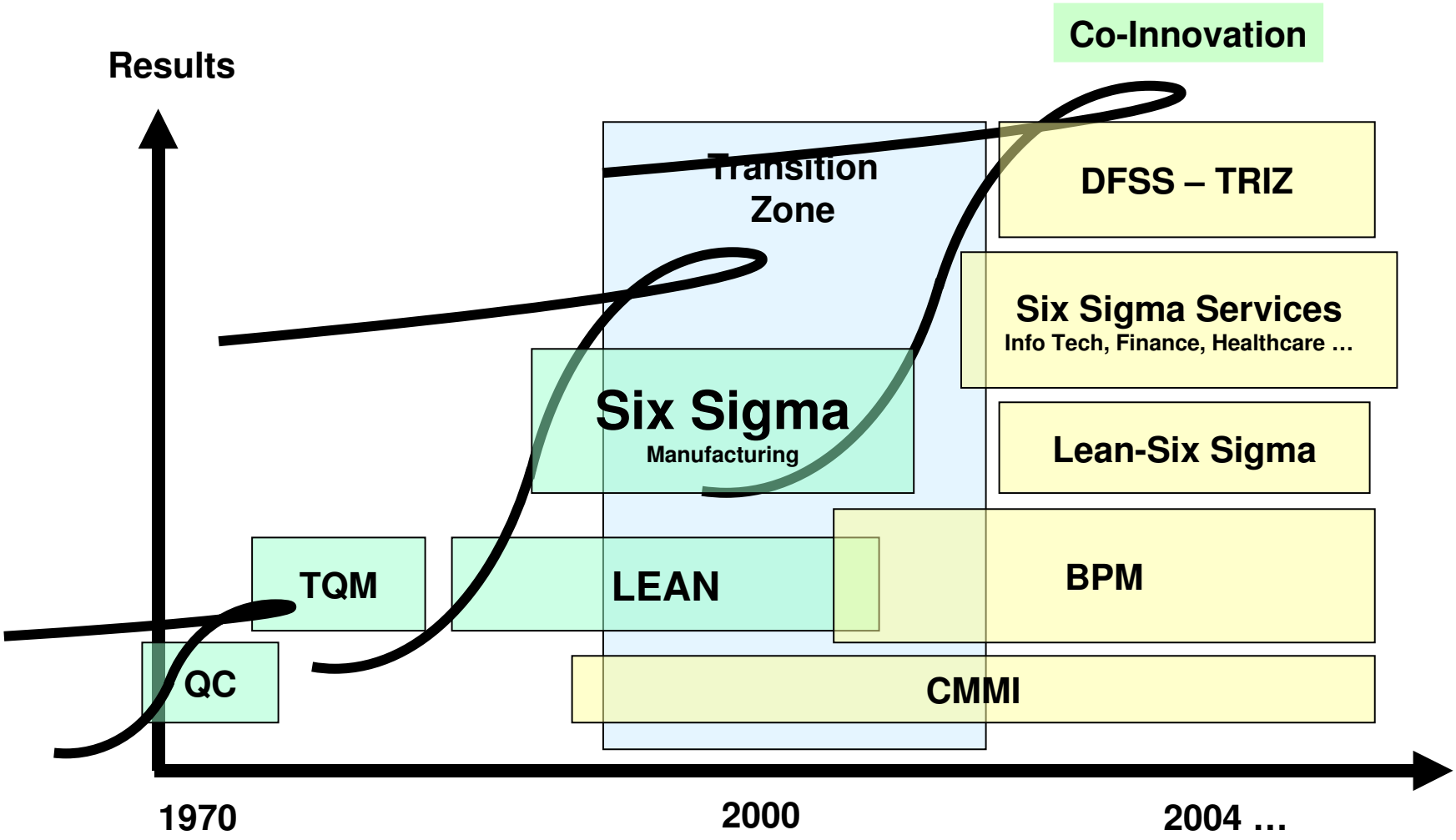
Roots of business innovation

- J M Juran
- Father of Quality Movement
- Conceptualized the Pareto principle
- Born 24 December 1904

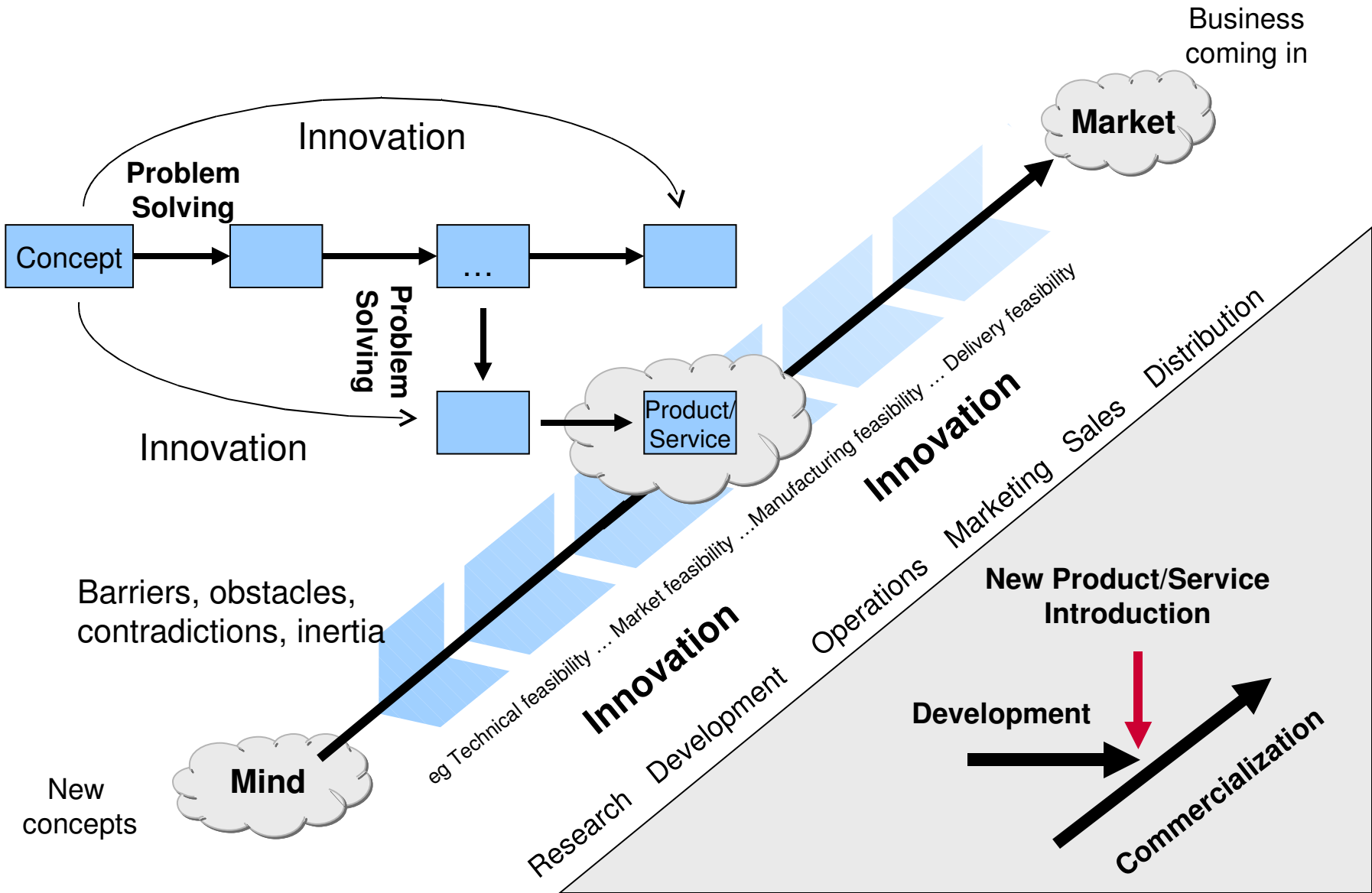
- Genrich Saulovich Altshuller
- Father of TRIZ
- Controlling and predicting innovation
- 15 October 1926 – 24 September 1998

6Σ
Lean
DFSS
TRIZ

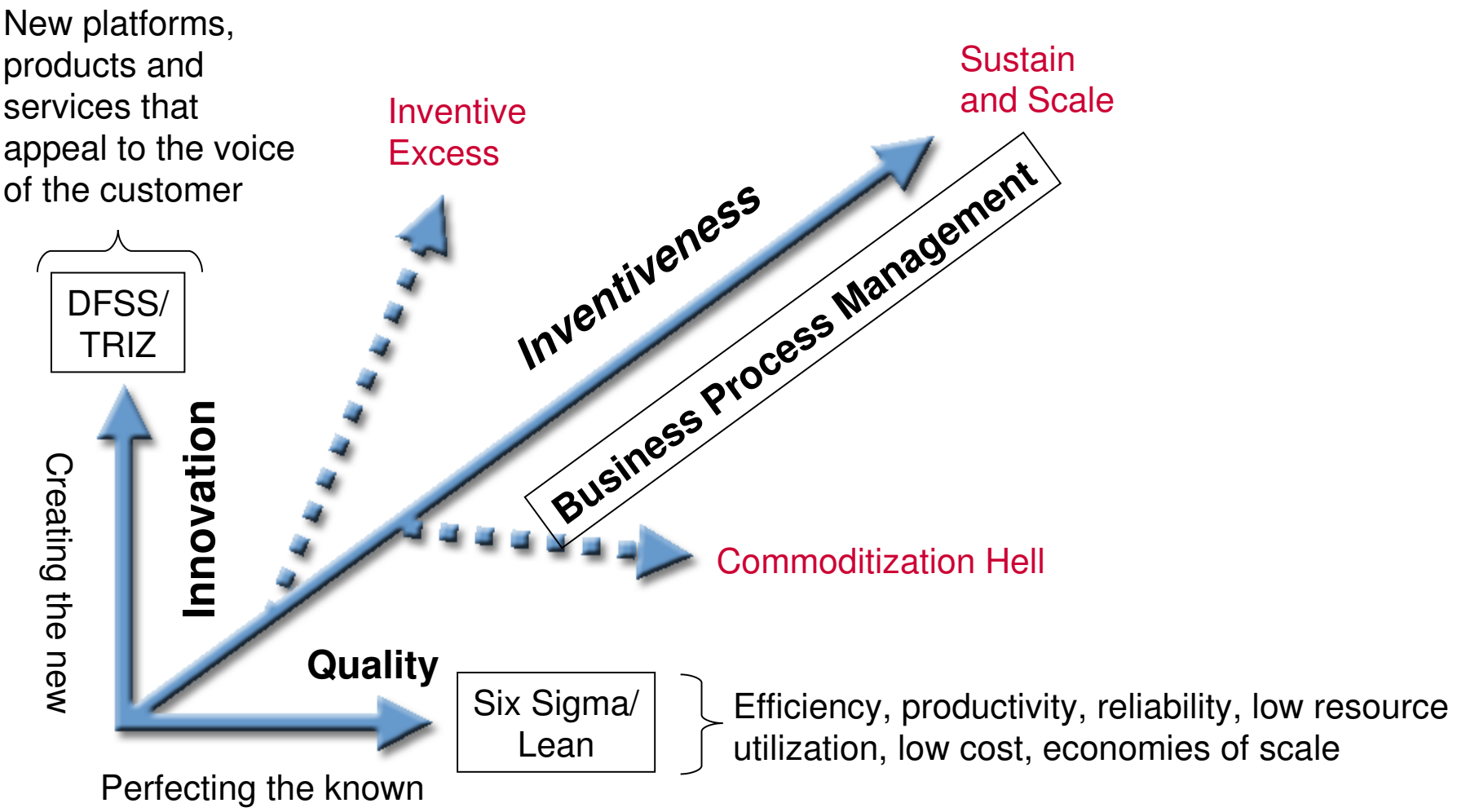
Where we are heading, methodologically speaking



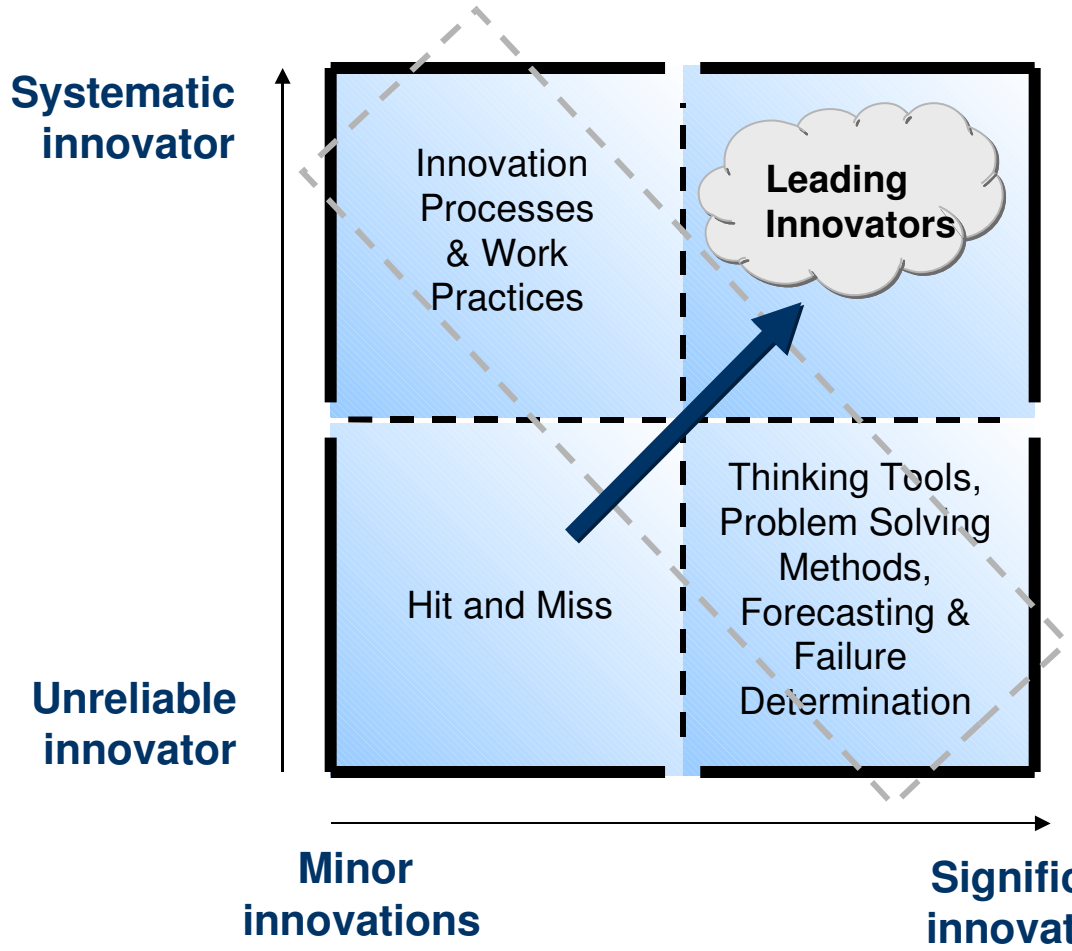
Innovation is more than a good idea



Balancing innovation and quality



Leading innovators apply processes and methods

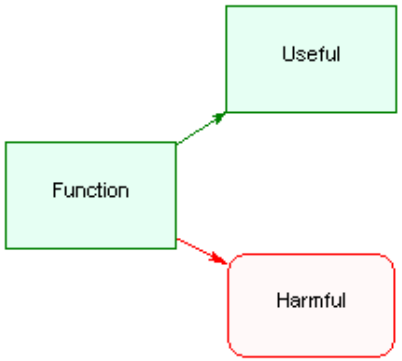


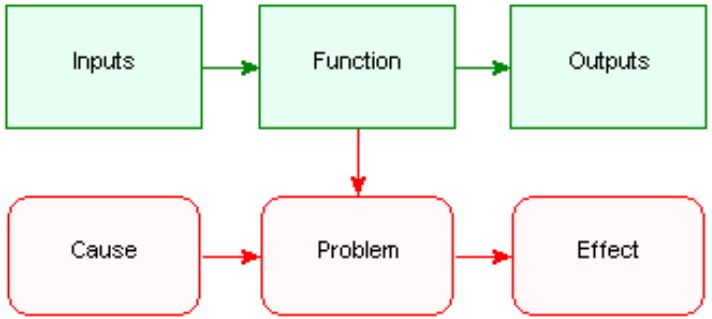
- **Idea Management**
- **Innovation Process Management**
- **DFSS, TRIZ …**

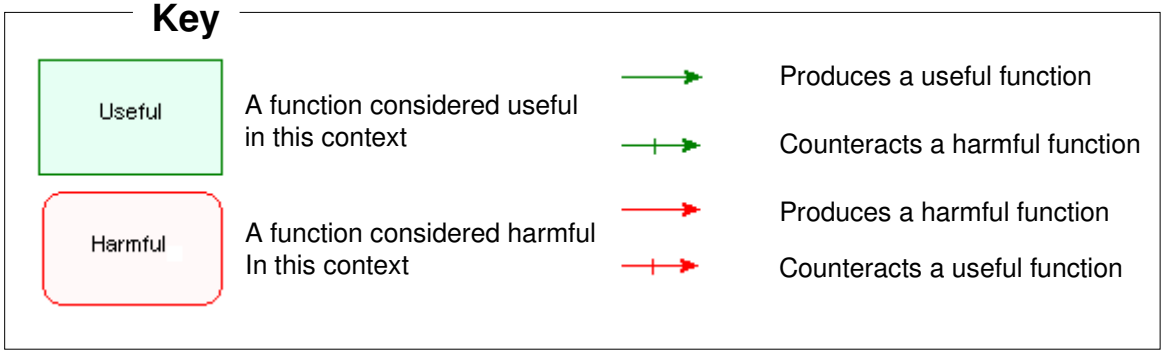
The Operating System for Innovation

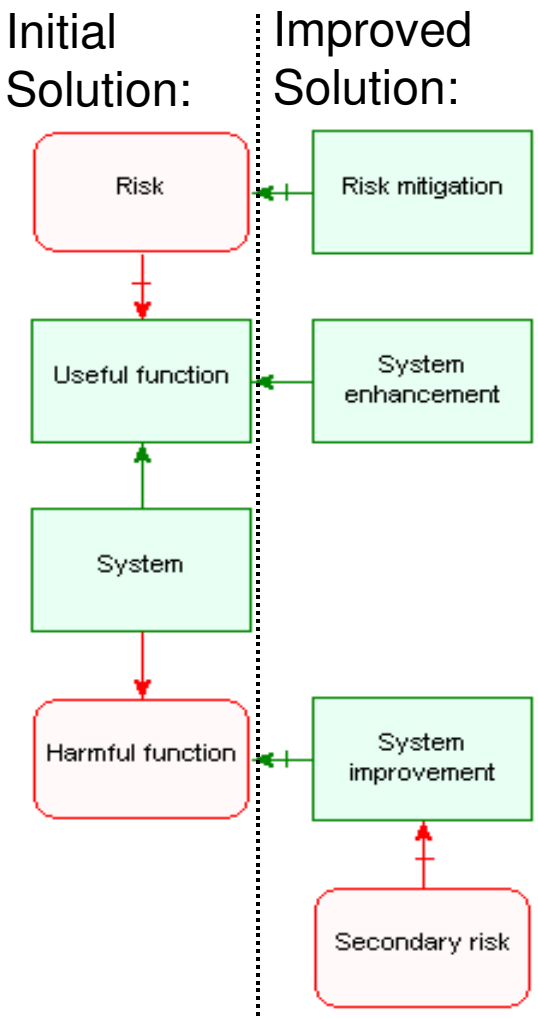
TRIZ from 50,000 feet

- TRIZ is a methodology for **iterative improvement**
- All elements of a system are considered **useful** **or** **harmful**
- Arrows indicate **causal relationships** between elements
- The models shown here are standard **TRIZ patterns**





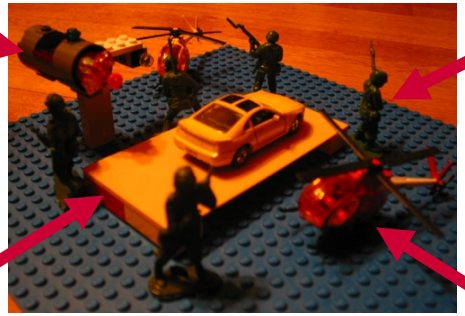




Oliver's garage

Laser cannon

Commandoes



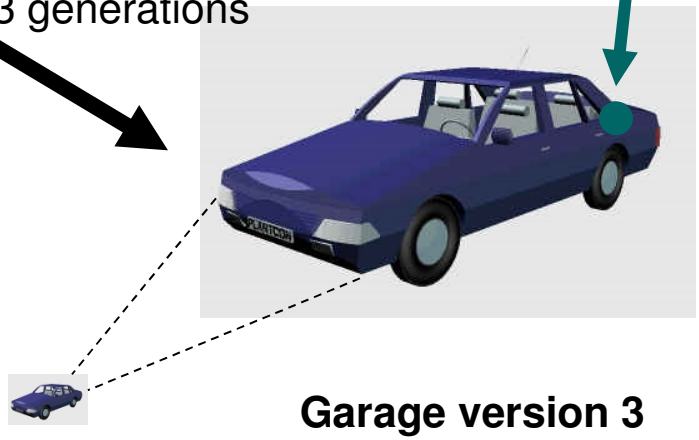
Infrared detector

Helicopters

Garage version 1

Shrink button

3 generations



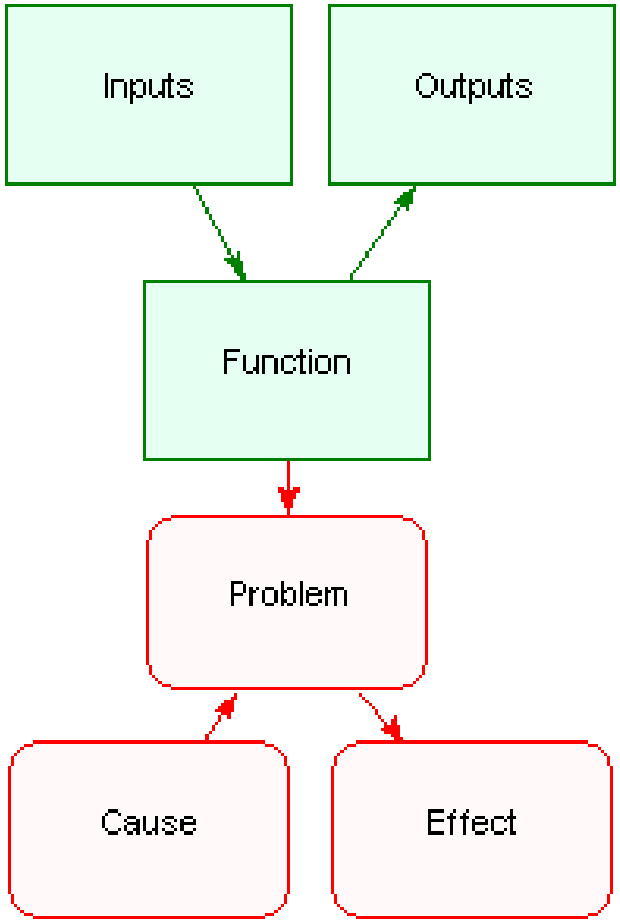
Garage version 3

In the beginning, Oliver ignored **harmful** functions

Only by modelling **causes and effects** among **useful and harmful functions** can innovation proceed

Instant innovation?

One TRIZ model pattern

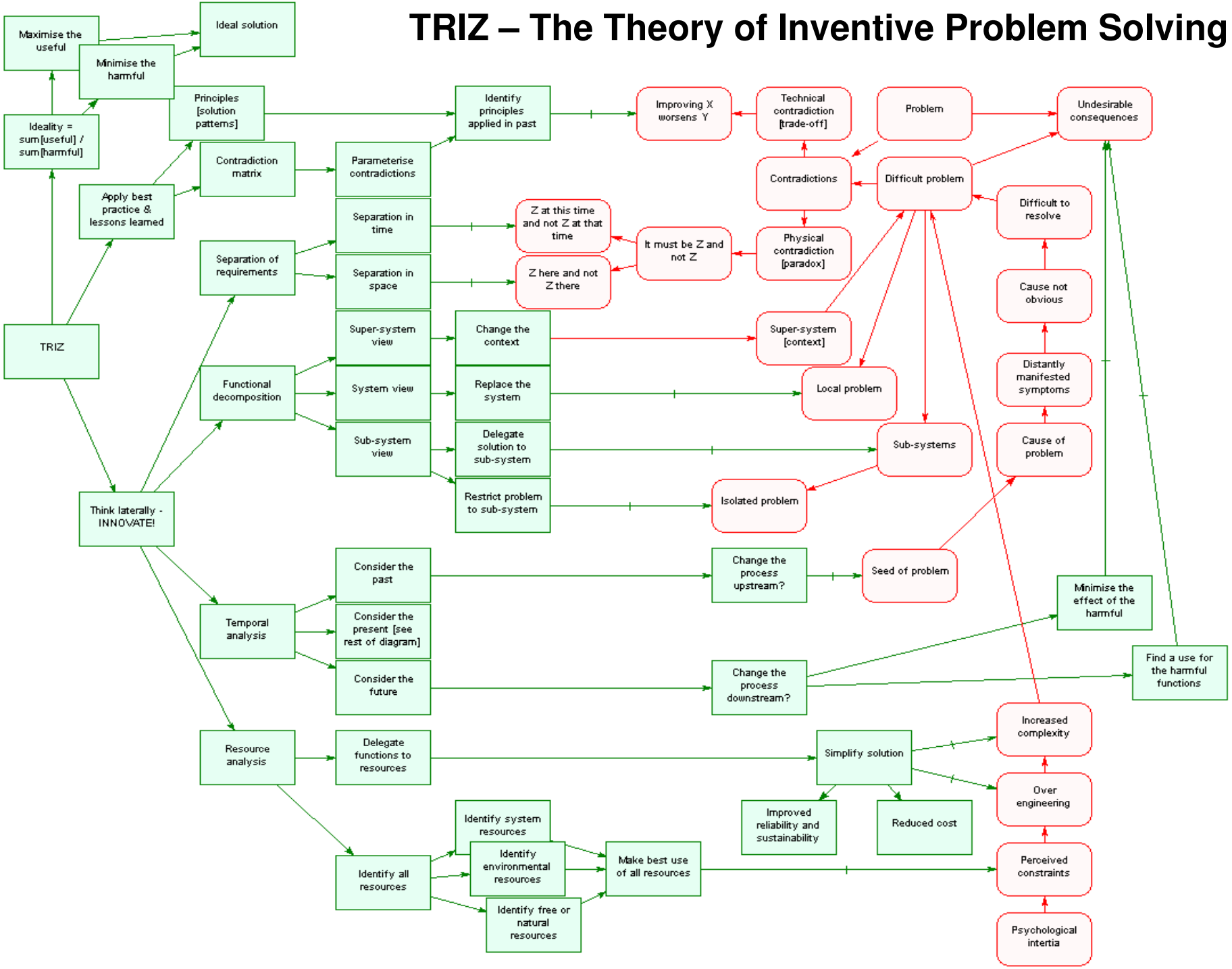


Generated solution pathways

- 1. Find an alternative way to obtain [the] (Function) that offers the following: provides or enhances [the] (Outputs), does not cause [the] (Problem), does not require [the] (Inputs).
- 2. Try to resolve the following contradiction: the useful factor [the] (Function) should be in place in order to provide or enhance [the] (Outputs), and should not exist in order to avoid [the] (Problem).
- 3. Find an alternative way to obtain [the] (Inputs) that provides or enhances [the] (Function).
- 4. Find an alternative way to obtain [the] (Outputs) that does not require [the] (Function).
- 5. Consider replacing the entire system with an alternative one that will provide [the] (Outputs).
- 6. Find a way to eliminate, reduce, or prevent [the] (Problem) in order to avoid [the] (Effect), under the conditions of [the] (Cause) and (Function).
- 7. Find a way to eliminate, reduce, or prevent [the] (Cause) in order to avoid [the] (Problem).
- 8. Find a way to eliminate, reduce, or prevent [the] (Effect) under the conditions of [the] (Problem).

Note: These solution directions were generated by a TRIZ formulator

TRIZ – The Theory of Inventive Problem Solving



TRIZ Modeling Guide

Overview

- TRIZ models depict functions of a system
- Each function is considered either Useful or Harmful
- Each model is done from a particular perspective
- Arrows show causal relationships between functions
- Crossed arrows show counteraction
- It is valid to model the same scenario from different perspectives. This can often help to identify contradictory requirements

How to start

- Decide from what perspective you are creating this model
- What is the system?
  - Is it considered to be useful overall?
    - Add as a useful function
  - Or harmful?
    - Add as a harmful function
- What is its primary useful function?
- What is its primary harmful function?

Extending the model

- (Adding functions onto the end of chains)
- For each function
  - 1. Ask yourself the following questions
  - 2. Add an arrow and function for each answer
  - Or just add an arrow if the function is already in the model
  - Then for each arrow, elaborate the model
- What are the useful consequences?
- What are the harmful consequences?
- What counteracts this function?
- What functions does this counteract?
- What [else] could lead to this?

Elaborating the model

- (Adding functions between existing functions)
- For each arrow
  - 1. Ask yourself one or all of the following questions
  - 2. Add a function in place of the arrow
  - So A -> B becomes A -> E -> B
  - Where E is the elaboration of why A -> B
  - Then for each new elaboration added, Extend the model
- Why does this lead to that?
- Why does this counteract that?

Decomposing functions

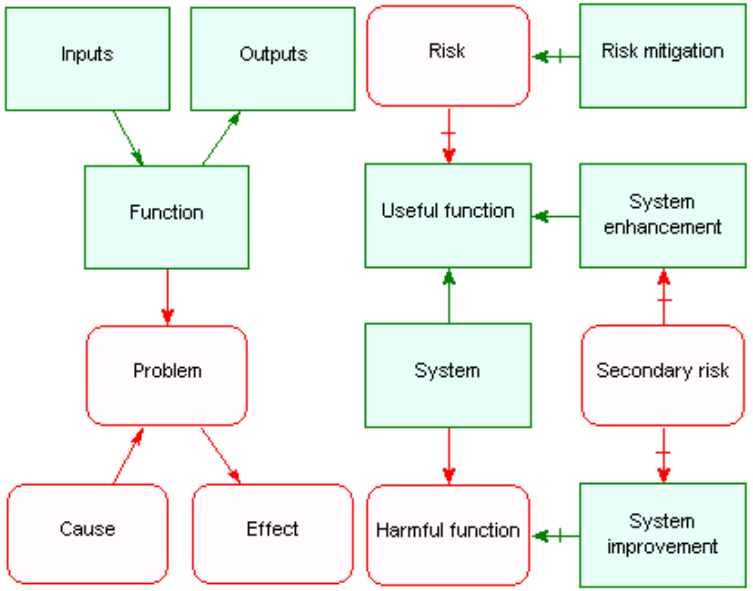
- (Replacing single functions with multiple functions)
- For complex functions
  - 1. Ask yourself the following questions
  - 2a. Add multiple functions in place of the function
  - 2b. or create an additional model just for that function
  - Then for each added function, elaborate the model
- If I decompose this function into multiple functions:
- Will it yield more functions that can be independently changed?
- Will it improve the clarity of the model?
- Will it lead to additional detailed knowledge being harvested from SMEs?
- Could it reveal why this function is harmful?
- Could it reveal how to turn this into a useful function?

Reviewing the model

- Model all important contradictions (paradoxes and compromises)
- Model all key functions that if changed, could improve the system
- Ensure that the model is as simple as possible
- Consider breaking large models into multiple sub-models
- Ensure that the model accurately represents the current problem
- Ensure that the emphasis of the model is correct

Example System

Principle model pattern

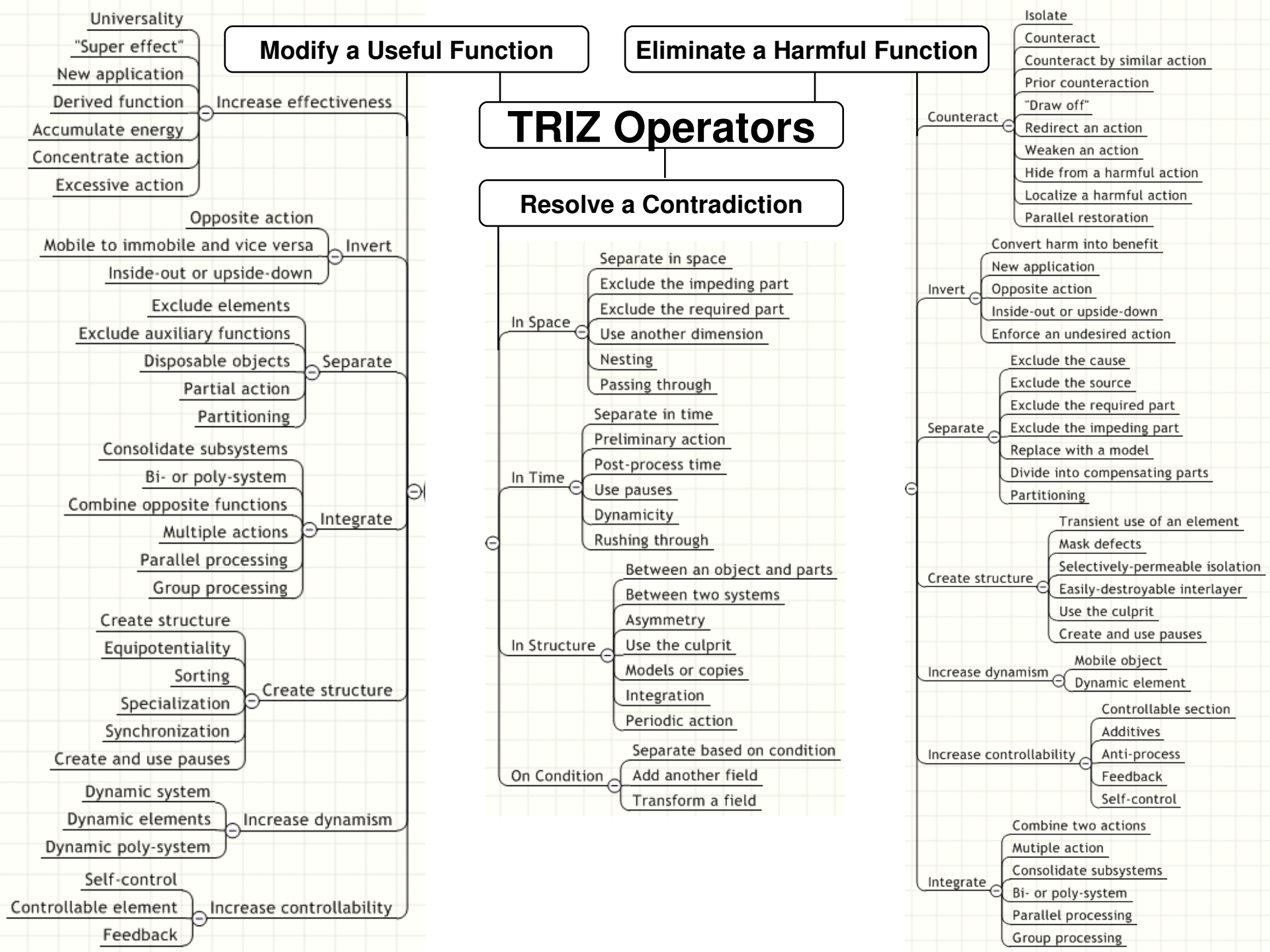


1st Generation

2nd Generation

Tips

- Model requirements of the system as useful functions, even if you have not yet achieved them!
- Model reasons requirements have not been met as harmful counteractions of the useful functions
- Keep the model concise; only model functions that could play a part in solving the problem or improving the system


TRIZ Operators
Modify a Useful Function
Universality
"Super effect"
New application
Derived function
Increase effectiveness
Accumulate energy
Concentrate action
Excessive action
Opposite action
Mobile to immobile and vice versa
Invert
Inside-out or upside-down
Exclude elements
Exclude auxiliary functions
Disposable objects
Separate
Partial action
Partitioning
Consolidate subsystems
Bi- or poly-system
Combine opposite functions
Integrate
Multiple actions
Parallel processing
Group processing
Create structure
Equipotentiality
Sorting
Specialization
Create structure
Synchronization
Create and use pauses
Dynamic system
Dynamic elements
Increase dynamism
Dynamic poly-system
Self-control
Controllable element
Increase controllability
Feedback
Resolve a Contradiction
Separate in space
Exclude the impeding part
Exclude the required part
In Space
Use another dimension
Nesting
Passing through
Separate in time
Preliminary action
Post-process time
In Time
Use pauses
Dynamicity
Rushing through
Between an object and parts
Between two systems
Asymmetry
In Structure
Use the culprit
Models or copies
Integration
Periodic action
Separate based on condition
On Condition
Add another field
Transform a field
Eliminate a Harmful Function
Isolate
Counteract
Counteract by similar action
Prior counteraction
"Draw off"
Counteract
Redirect an action
Weaken an action
Hide from a harmful action
Localize a harmful action
Parallel restoration
Convert harm into benefit
New application
Invert
Opposite action
Inside-out or upside-down
Enforce an undesired action
Exclude the cause
Exclude the source
Exclude the required part
Separate
Exclude the impeding part
Replace with a model
Divide into compensating parts
Partitioning
Transient use of an element
Mask defects
Create structure
Selectively-permeable isolation
Easily-destroyable interlayer
Use the culprit
Create and use pauses
Mobile object
Increase dynamism
Dynamic element
Controllable section
Additives
Increase controllability
Anti-process
Feedback
Self-control
Combine two actions
Mutiple action
Integrate
Consolidate subsystems
Bi- or poly-system
Parallel processing
Group processing

Where did TRIZ come from?

Practical experience of thousands of scientists, inventors, engineers, managers, businessmen, etc

More than 3,000,000 worldwide patents

History of evolution in different areas of technology and science, social systems, business, management, art, languages, etc

TRIZ was conceived in Russia in 1946 by Genrich Altshuller.
Initially used by engineers and inventors, it is now used across many disciplines.

The scope of TRIZ: Systems

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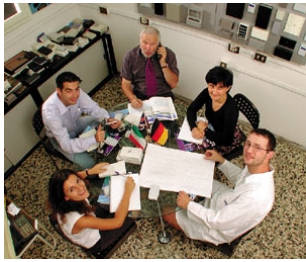
Darwinian analogy: Artificial Systems created by humans are subject to selections: buyer preferences, competition, consumerism etc

Technical Systems: Machine, device, equipment, manufacturing process, process related to design, utilization of materials, etc

Intellectual Systems: Religious and philosophical concepts, scientific theories and hypotheses, arts, etc



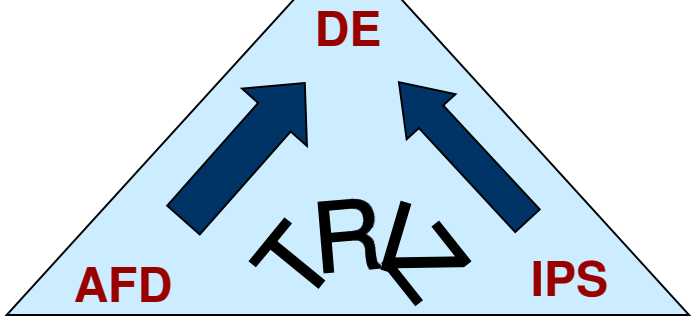
Social Systems: Various groups of people, organizations and associations, management systems, business processes, legal systems, etc

Service Systems: Education, medicine, information technology, entertainment and related processes

Science, Engineering, Products, Services, Processes, Business, IT, Finance

Modern TRIZ applications

Emerging in Global 1,000



Directed Evolution
Systematic procedure for strategically evolving future generations of business or technological systems

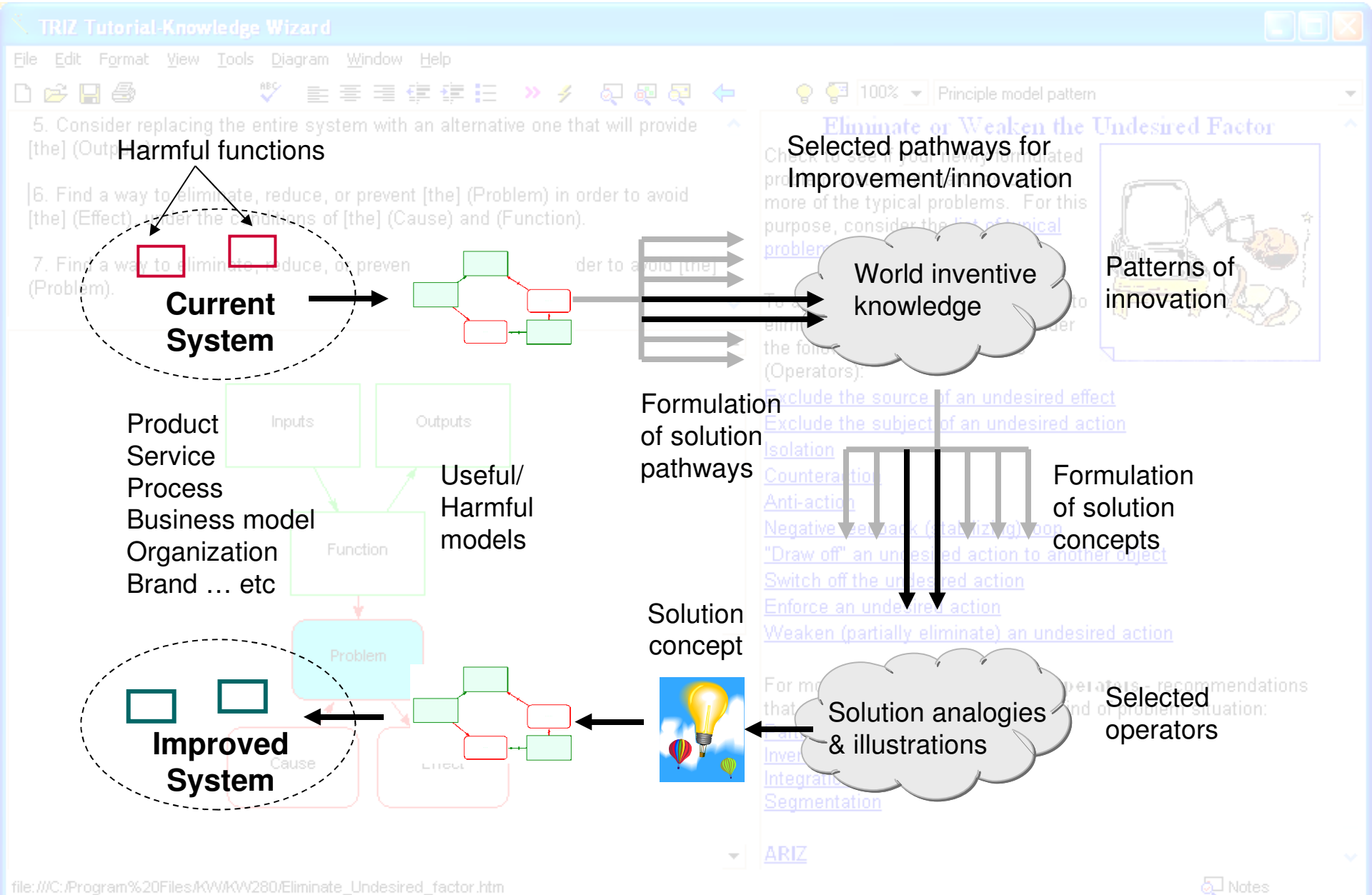
Anticipatory Failure Determination

Failure Analysis
Systematic procedure for identifying the root causes of a failure or other undesired phenomenon occurring in a system, and for correcting it in a timely manner

Failure Prediction
Systematic procedure for identifying beforehand – and then preventing – all dangerous or harmful events that could cause the system to fail

Inventive Problem Solving
Systematic procedure for surgical removal of tough technological problems, improvement, cost reduction etc, for current product and/or technology generation

Typical steps in a TRIZ application



TRIZ @ stories

Computer Sciences Corporation

IT Solutions Innovation
Business Process Innovation

Samsung

Engineering Research
e.g. Next Gen Displays

Procter & Gamble

Consumer Products
Innovation

The Boeing Company

Aeronautical Engineering

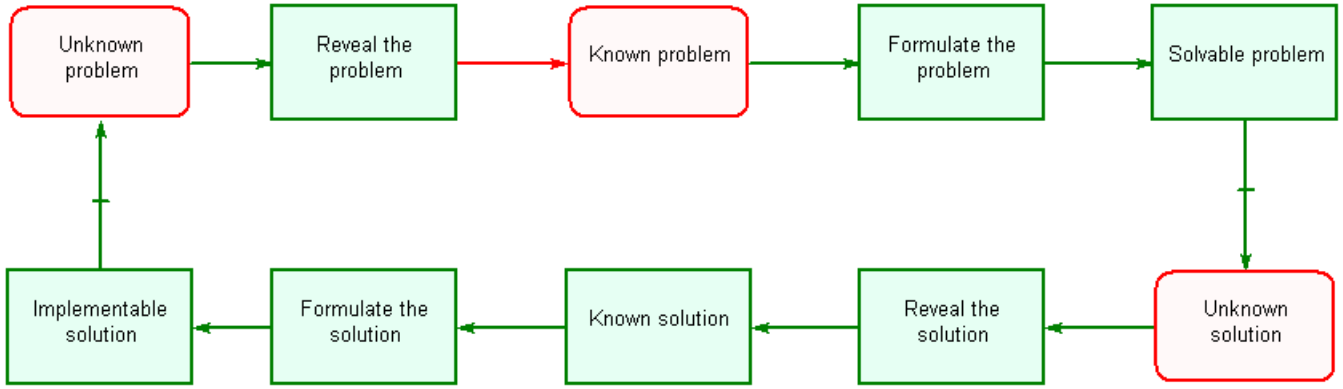
Ford?

Improving Driving
Cradle-To-Cradle

IBM

Software Development

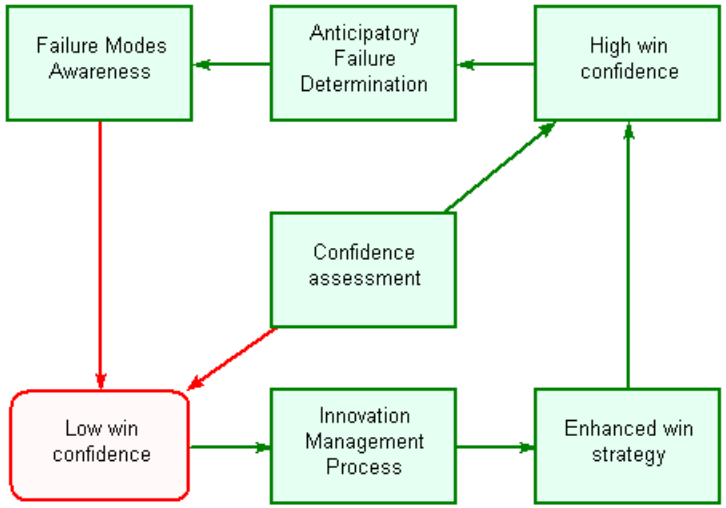
TRIZ is extensible



Inventive Problem Solving (IPS)

- TRIZ can be used to define, improve and extend innovation process:
  - Core TRIZ provides the 'engine'
  - **TRIZ Applications** provide the 'car'

    (Few people buy engines, everyone buys cars)
- CSC is contributing to the development of the next generation of TRIZ:
  - TRIZ for business development
  - TRIZ for architecture and solution innovation
  - TRIZ for process innovation (P-TRIZ)
  - etc



Win Strategy Enhancement (WSE)

Read about TRIZ and innovation

"Taking an idea and turning it into cash is an effort that involves almost every part of a company and the participation of all employees."

"What is innovative about innovation today is the realization that it can be done systematically, and that the innovator is an obsessive problem solver."

The Innovator Is A Problem Solver

http://www.csc.com/cscworld/042005/fa/fa005c.shtml

http://www.csc.com/cscworld/042005/uploads/cscworld_apr_jun_2005.pdf

White paper
38 pages

What Innovation Is

How Companies Develop Operating Systems For Innovation

http://www.csc.com/features/2004/57.shtml

"TRIZ looks at innovation as the result of systematic patterns in the past evolution of systems, and includes descriptions of hundreds of such patterns."

"A fool with a tool may still be a fool, but talent without the means for execution lies dormant. Unless the individual, team, or company is solving problems, they are not innovating."

A fool with a tool is still a fool

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TRIZ Tutorial-Knowledge Wizard

File Edit Format View Tools Diagram Window Help

100% Principle model pattern

5. Consider replacing the entire system with an alternative one that will provide [the] (Outputs).

6. Find a way to eliminate, reduce, or prevent [the] (Problem) in order to avoid [the] (Effect), under the conditions of [the] (Cause) and (Function).

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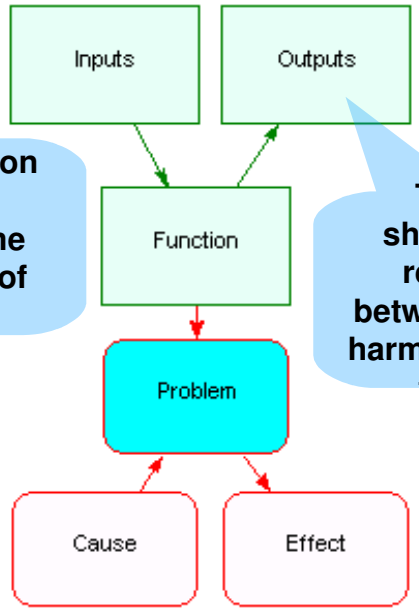

'Inventive solution directions' generated by the tool's analysis of the model

TRIZ model showing causal relationships between useful and harmful functions of the system

Eliminate or Weaken the Undesired Factor

Check to see if your newly formulated problem statement matches one or more of the typical problems. For this purpose, consider the list of typical problems.

To apply the I-TRIZ knowledge base to eliminate undesired effects, consider the following recommendations (Operators):

Exclude the source of an undesired effect
Exclude the subject of an undesired action
Isolation
Counteraction
Anti-action
Negative feedback (stabilizing) loop
"Draw off" an undesired action to another object
Switch off the undesired action
Enforce an undesired action
Weaken (partially eliminate) an undesired action

For more ideas, apply **Universal Operators** - recommendations that can be applied to resolve any kind of problem situation:

Partial/excessive action
Inversion
Integration
Segmentation

ARIZ

Knowledge base of 'TRIZ operators' (solution patterns) with examples

'Knowledge Wizard' – A basic TRIZ support tool

file:///C:/Program%20Files/KVV/KVV280/Eliminate_Undesired_factor.htm

Notes

Do you have problems?

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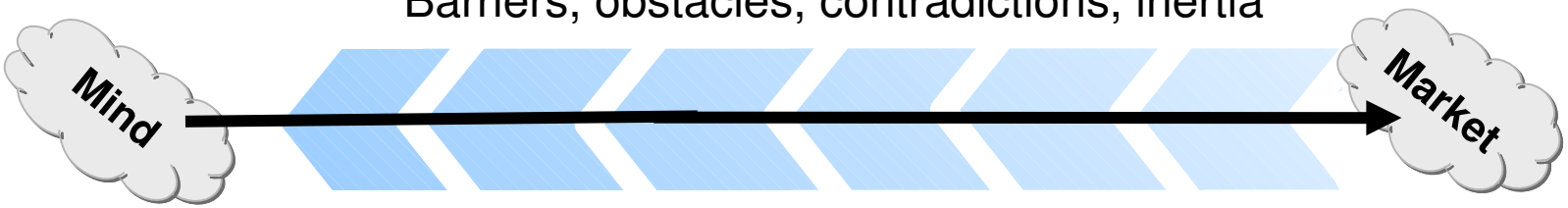
May 2005 Issue of Journal

Known Problems
you must solve and for which you have no known solution

Unknown Problems
preventing progress that must be revealed, and subsequently solved

Barriers, obstacles, contradictions, inertia



Technical feasibility … Market feasibility … Manufacturing feasibility … Delivery feasibility

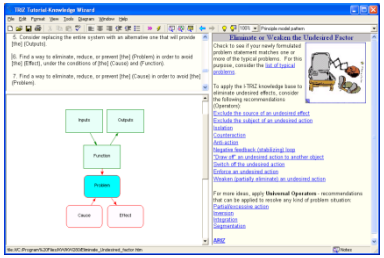
Research … Development … Operations … Marketing … Sales … Distribution

Let us TRIZ you …

TRIZ facilitator

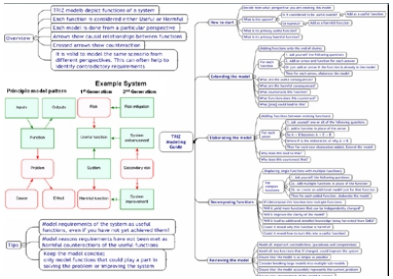
Co-Innovation

Domain experts

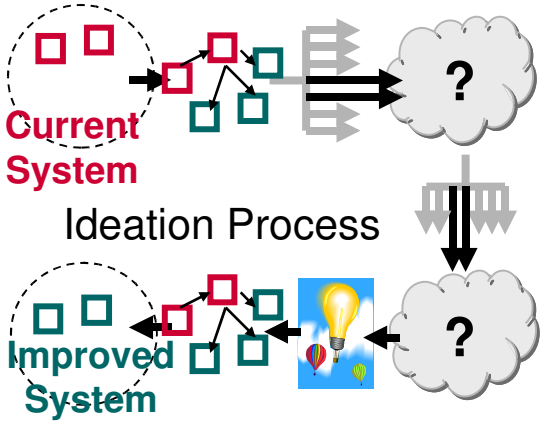


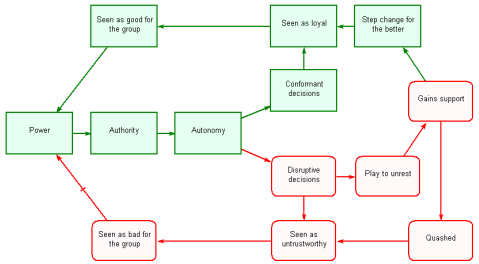
TRIZ software

Useful - Harmful



TRIZ modelling guides





TRIZ models

Next steps

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- *To discuss today's web conference, contact:*

  Howard N Smith – hsmith23@csc.com

- *Presentation available at:*

  http://lef.csc.com/events/listings/webconference/24_05_05/

- *Leading Edge Forum web site:* **http://lef.csc.com/**

- *Next global web conference – 28 June 2005: The Future of the IT Organization – Findings from the March 2005 Executive Forum*