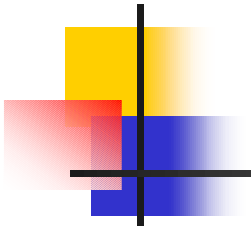
Inventive Problem Solving for Business

Empowering Employees with Innovation Skills for Improving Business Processes



Agenda

- Empowerment Process for Business Process Improvement
- Methods and Tools
  - Introduction to I-TRIZ
  - Basic Premises
- Introduction to Knowledge Wizard™ Software
  - Analytical and Knowledge Base Tools
  - Software demo

Empowerment

When you empower people, you're not influencing just them; you're influencing all the people they influence.

Qualifications of an Empowerer

- Position
- Relationship
- Respect
- Commitment

How to Empower Others to Their Potential

- Evaluate them
  - Do they have knowledge, skill, desire
- Model them
  - Show them the attitude and work ethic you would like them to embrace
- Give them permission to succeed
  - Expect it, verbalize it, reinforce it
- Transfer authority to them
  - Share power and ability to get things done

How to Empower Others to Their Potential

- Publicly show your confidence in them
  - Let them know you believe in them
- Supply them with feedback
  - Coach them through mistakes, miscues, misjudgments
- Release them to continue on their own
  - Give authority and responsibility, and offer assistance as needed

Results of Empowering People

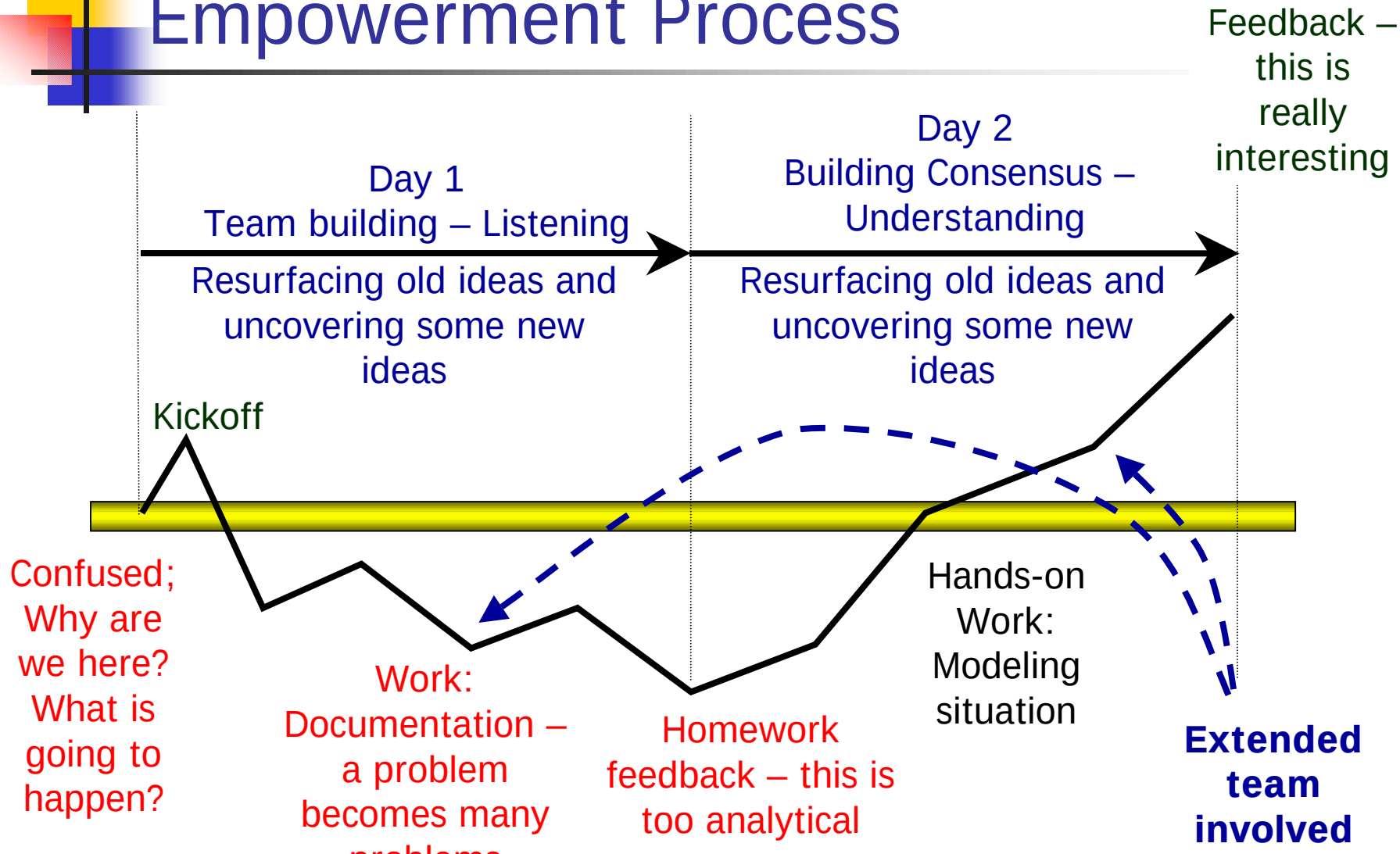
High return – raises people up by making them more confident, energetic and productive

Empowerment Process

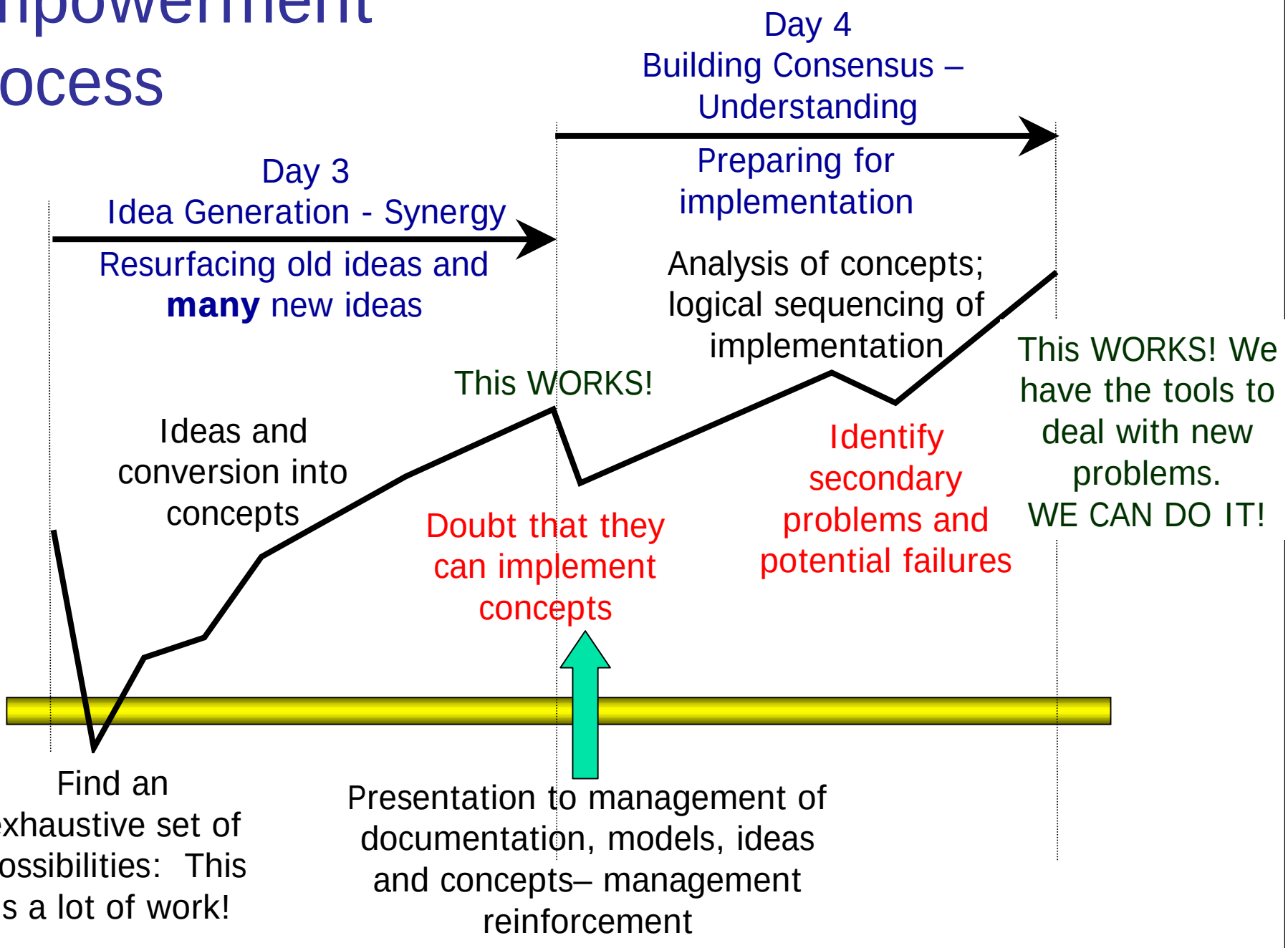
- Commitment from management
  - Select a problem in need of a solution
  - Select a team
  - Establish criteria for success
  - Provide resources for follow-through
- Position employees for success
  - Document their knowledge of the situation
  - Change their beliefs
  - Develop consensus
  - Capture their ideas
  - Help them convert their ideas into solutions
  - Provide them with a means to reduce risk
  - Prepare them to pursue their solutions
  - End on a high – “WE CAN DO IT!”
- Support implementation

Leverage employees emotional involvement in their job.

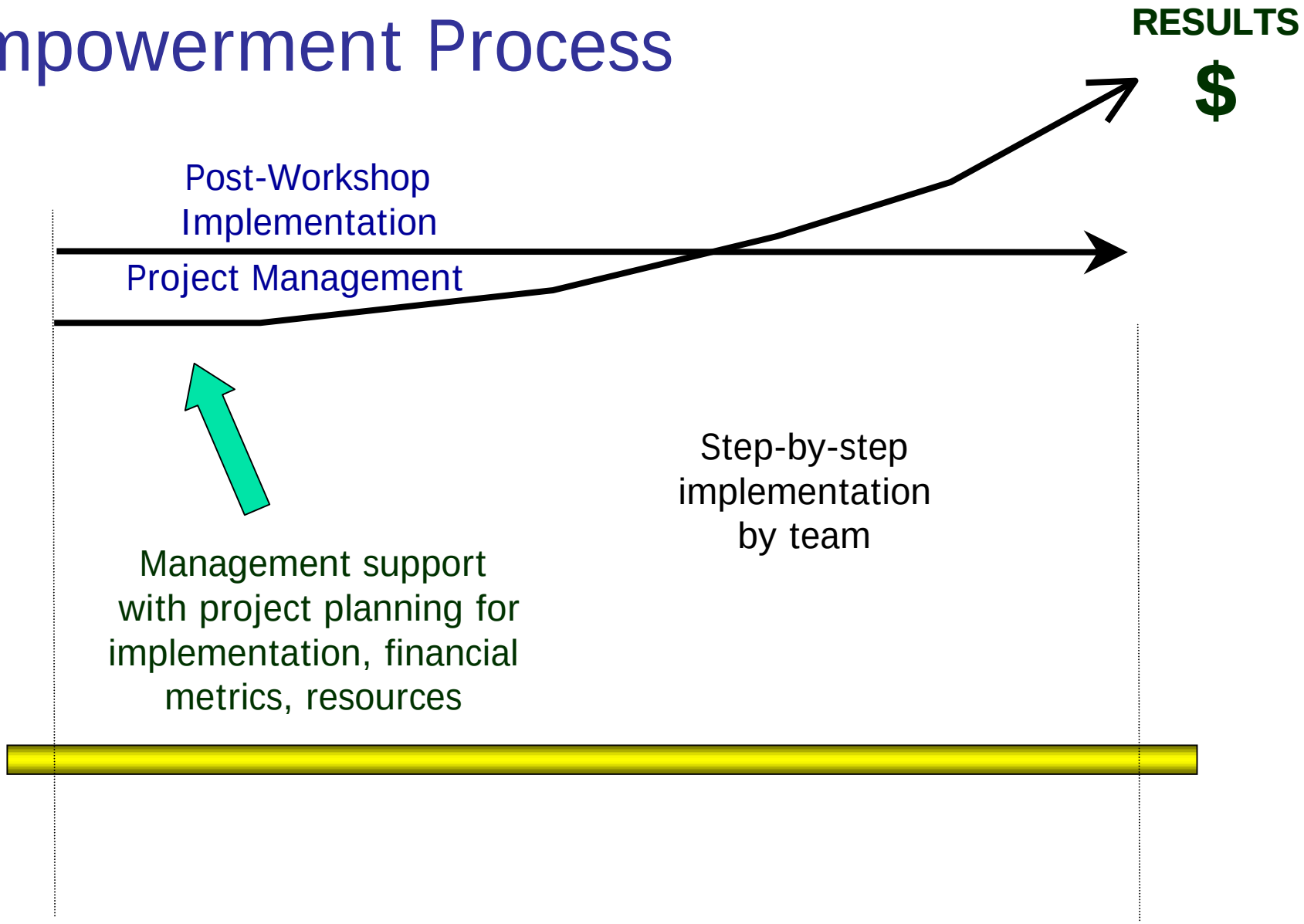
Empowerment Process



Empowerment Process



Empowerment Process



Introduction to I-TRIZ

Problem Solving: Mathematics

A Science

Calculators & Computers

Theoretical Foundation, Algorithms, Operators, etc.

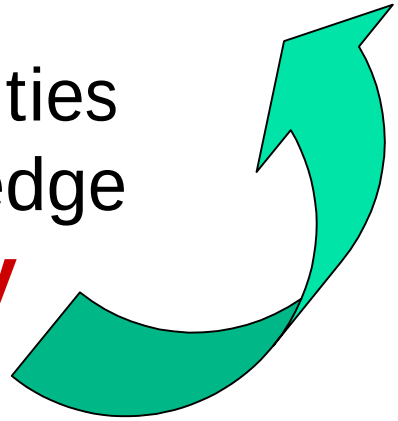
$$\text{Results} = P_c \times P_{kn} \times (1+M) \times (1+T)$$

P_c = Personal Capabilities

P_{kn} = Personal Knowledge

M = Methodology

T = Tools



What about Creative Problem Solving and Innovation?

Who was your teacher?

What courses did you take?

What are your structured methods and tools?

Step-by-step, how do you invent / innovate?

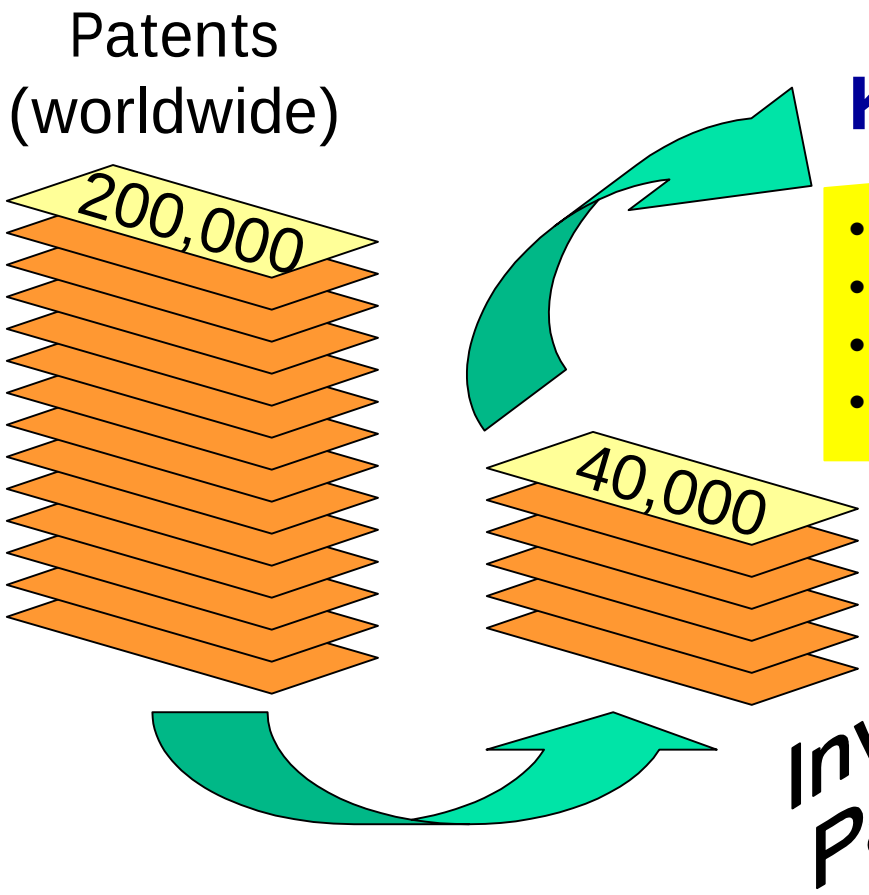
Creative problem solving lies at the root of business innovation. Its importance demands that we have and use structured methods and tools.

Foundation: TRIZ, the Theory of Inventive Problem Solving

- Systematic, structured way of thinking
- Science
- Results of over 55 years of research analyzing over 2 ½ million worldwide patents within all engineering disciplines

This is important because it is the foundation for structuring innovation-based knowledge.

TRIZ is Based on Abstraction of Knowledge Rather than Guesswork



Key Findings

- Definition of inventive problem
- Levels of invention
- Patterns of evolution
- Patterns of invention

TRANSFERABLE

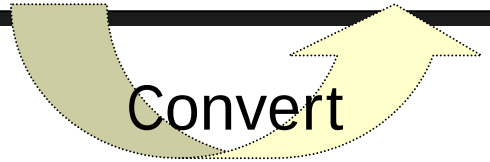
General Purpose Principles

Discovery: Common thread between great innovations.

What is an Inventive Problem?

- Involves one or more contradictions
- Suggests no known ways or means of solution

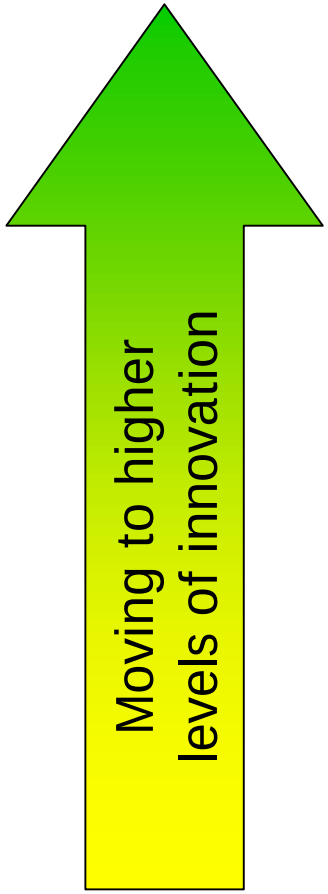
There are two types of contradictions: technical and physical



Apply 4 principles
- Separation in time
- Separation in space
- Separation between the parts & the whole
- Separation upon conditions

Classification of Solutions:
We need to raise innovation skills via methods and tools.

Levels of Invention (Solution)



Level 5: Discovery

Level 4: Invention outside the paradigm

Level 3: Invention inside the paradigm

Level 2: Improvement

Level 1: Apparent solution (no innovation)

Discovery: There is repetition in the way people solve creative problems.

Patterns of Invention

- Realization that the same fundamental problem (contradiction) had been addressed by a number of inventions in different areas of technology
- Observation that the same fundamental solutions were used over and over again, often separated by many years
- Reasoning that if the latter innovator had had knowledge of the earlier solution, their task would have been straightforward
- Sought to extract, compile, and organize such information

Patterns of Evolution: The Primary TRIZ Postulate

- Systems evolve not randomly, but according to objective patterns
- These patterns can be revealed from the research of the history of technology, markets and society and purposefully used for systems development without numerous blind trials

Patterns of Evolution: Common threads between evolving systems.

Patterns of Evolution: Common threads between evolving systems.

Patterns of Evolution

1. Stages of Evolution
2. Evolution toward Increased Ideality
3. Non-Uniform Development of System Elements
4. Evolution toward Increased Dynamism and Controllability
5. Increased Complexity Then Simplification
6. Evolution with Matching and Mismatching Elements
7. Evolution toward Micro-level and Increased Use of Fields
8. Evolution toward Decreased Human Involvement

Approach:
Leveraging Existing Knowledge

Abstraction of knowledge from the human experience and structuring of that knowledge for efficient and effective use.

54 years of research:
Abstraction of knowledge from worldwide patents, history of technology, markets and society.

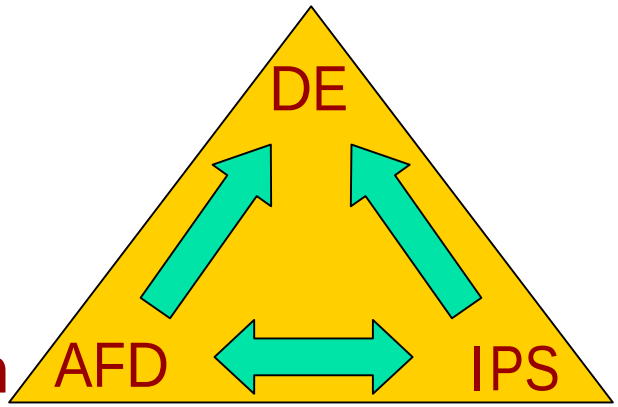
Movement Beyond the Theory: Evolution of TRIZ to I-TRIZ

- Structured ideation, invention and innovation
  - Development of analytical and knowledge base tools
- Expansion of research
  - Inclusion of market and society
- Development of new applications
  - Enhancement of Inventive Problem Solving
  - Invention-Based Failure Analysis and Prediction
  - Directed Evolution of Technological Systems

Scientifically-Based Applications: Systematic, Structured Innovation

Directed Evolution → Strategically evolving future generations of Systems

Healthcare for the Future



Anticipatory Failure Determination

Failure Analysis

Failure Prediction

Invention of Failure Modes

Medical Errors

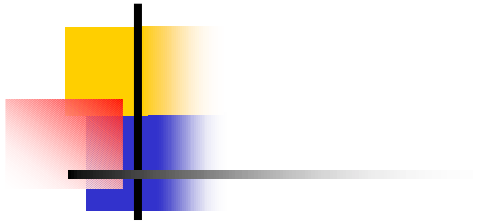
Inventive Problem Solving

Surgical removal of tough technological problems

Elimination of contradictions

Improved Business Processes

Inventive Problem Selection Guide (Non-Technical & Technical)



Knowledge Wizard Contains non-technical problem solving support ONLY

I-TRIZ: Ideation/Invention/Innovation

The Science of Innovation: Structured like mathematics with methods and tools.

Computers & Software

Theoretical Foundation, Algorithms, Operators, etc.

$$\text{Results} = P_c \times P_{kn} \times (1+M) \times (1+T)$$

P_c = Personal Capabilities

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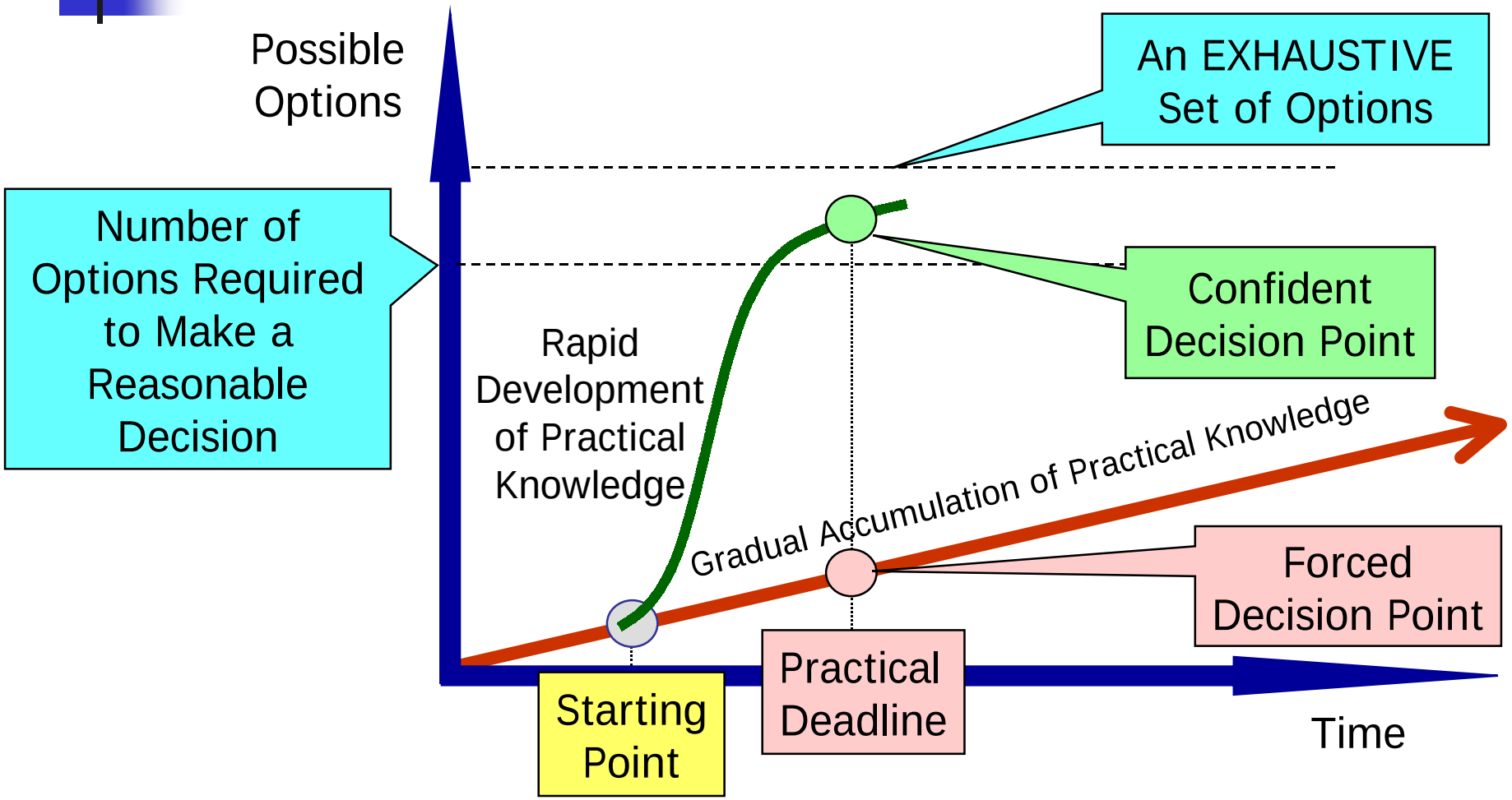
M = Methodology

T = Tools

I-TRIZ Applications: What Do They Do?



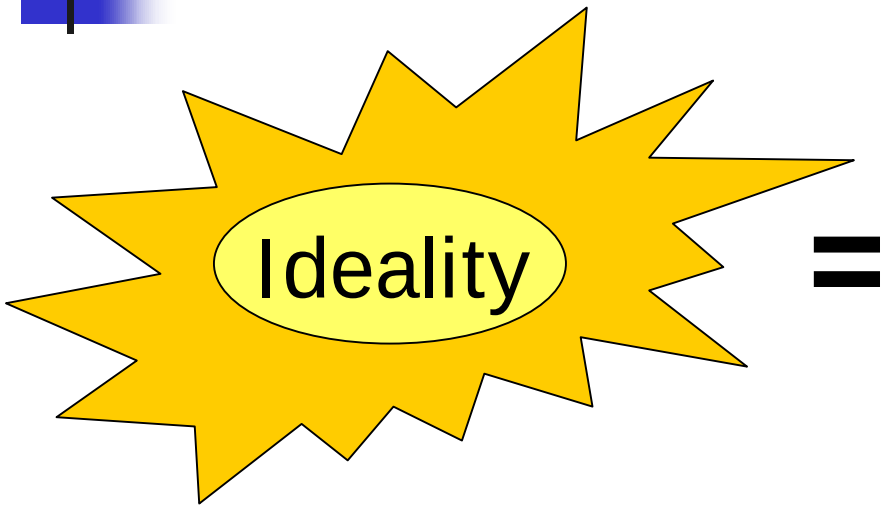
Basic Premises of I-TRIZ

Basic Premises of TRIZ

- Ideality
- Contradictions
- System Approach

I-TRIZ Thinking: Ideality Approach

Think of the end before the beginning.
Leonardo da Vinci



$$\text{Ideality} = \frac{\text{All } \textbf{\textit{Useful}} \text{ Functions}}{\text{All } \textbf{\textit{Harmful}} \text{ Functions}}$$

- The ideal system performs a required function without actually existing. The function is often performed using existing resources.
- Nothing changes; everything remains the same and the problem is resolved.

Ideality Approach:
A Different Set of Opportunities

Strategic understanding is valuable

The Objective of Inventive Problem Solving:
Striving for - - - - → Ideality

Zone of Incremental or Continuous Improvement

Zone of Near Ideality

(High-Level Innovation)

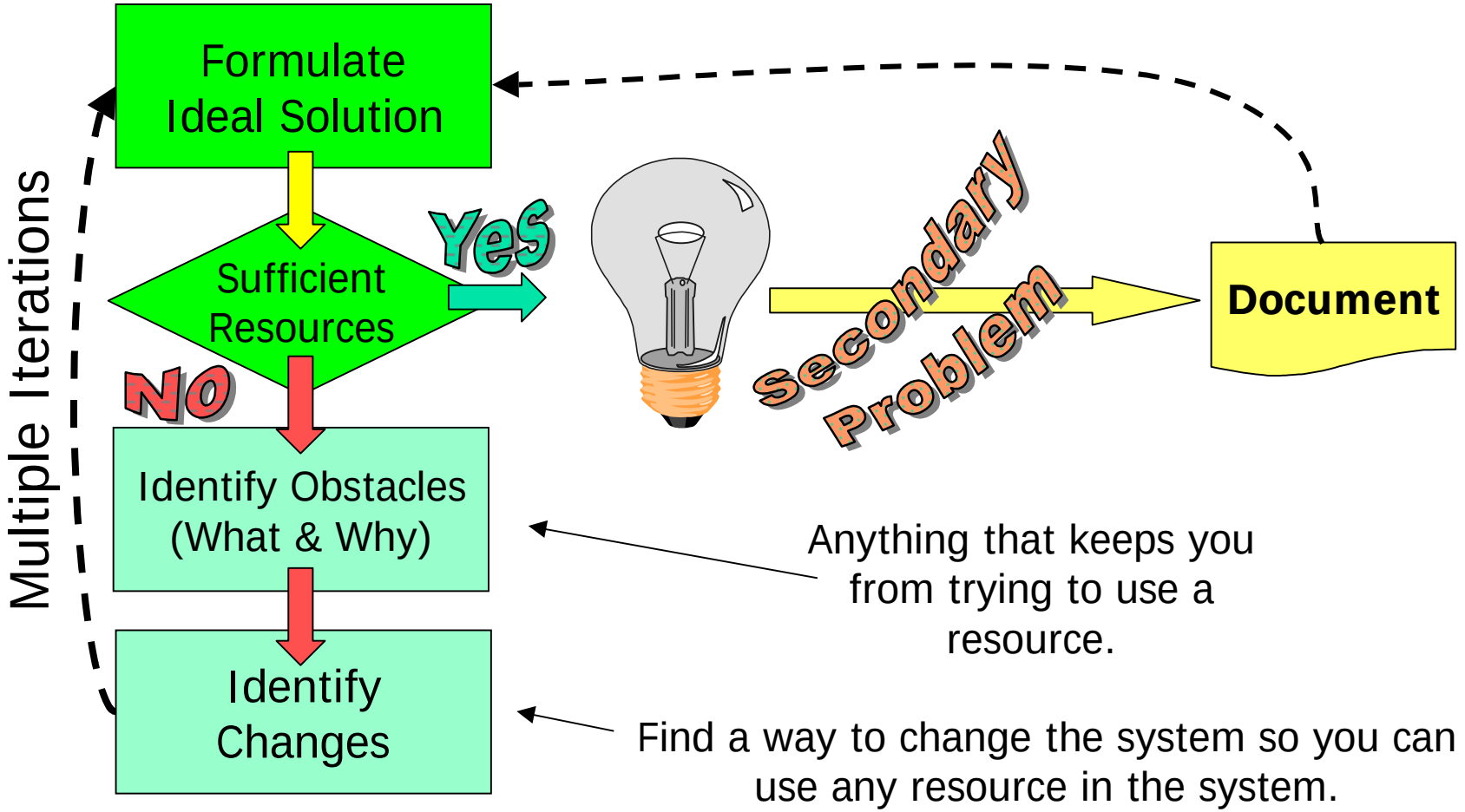
Ideality Approach

- I-TRIZ provides two interlinked approaches for achieving close-to-ideal solutions (that is, solutions which do not increase system complexity):
  - Use of resources
  - Use of effects (psychological, emotional, etc.)

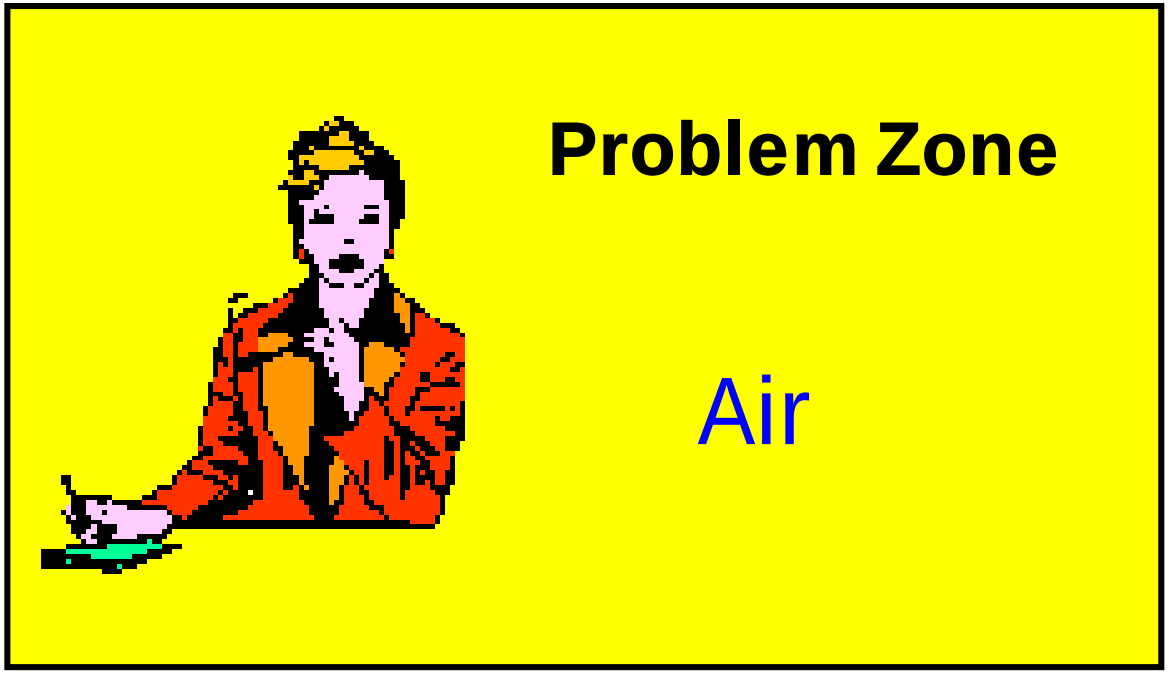
Using Resources to Increase Ideality

- A resource:
  - is any substance or anything of substance (including waste) available in the system or its environment
  - has the functional and technological ability to jointly perform additional functions
  - is an energy reserve, free time, unoccupied space, information, etc.

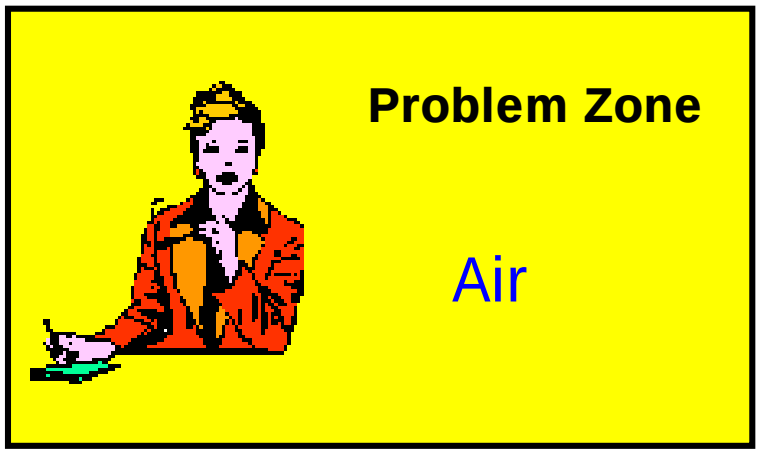
Simple Structured Approach



What Resources Are Available to Solve an Undefined Problem?

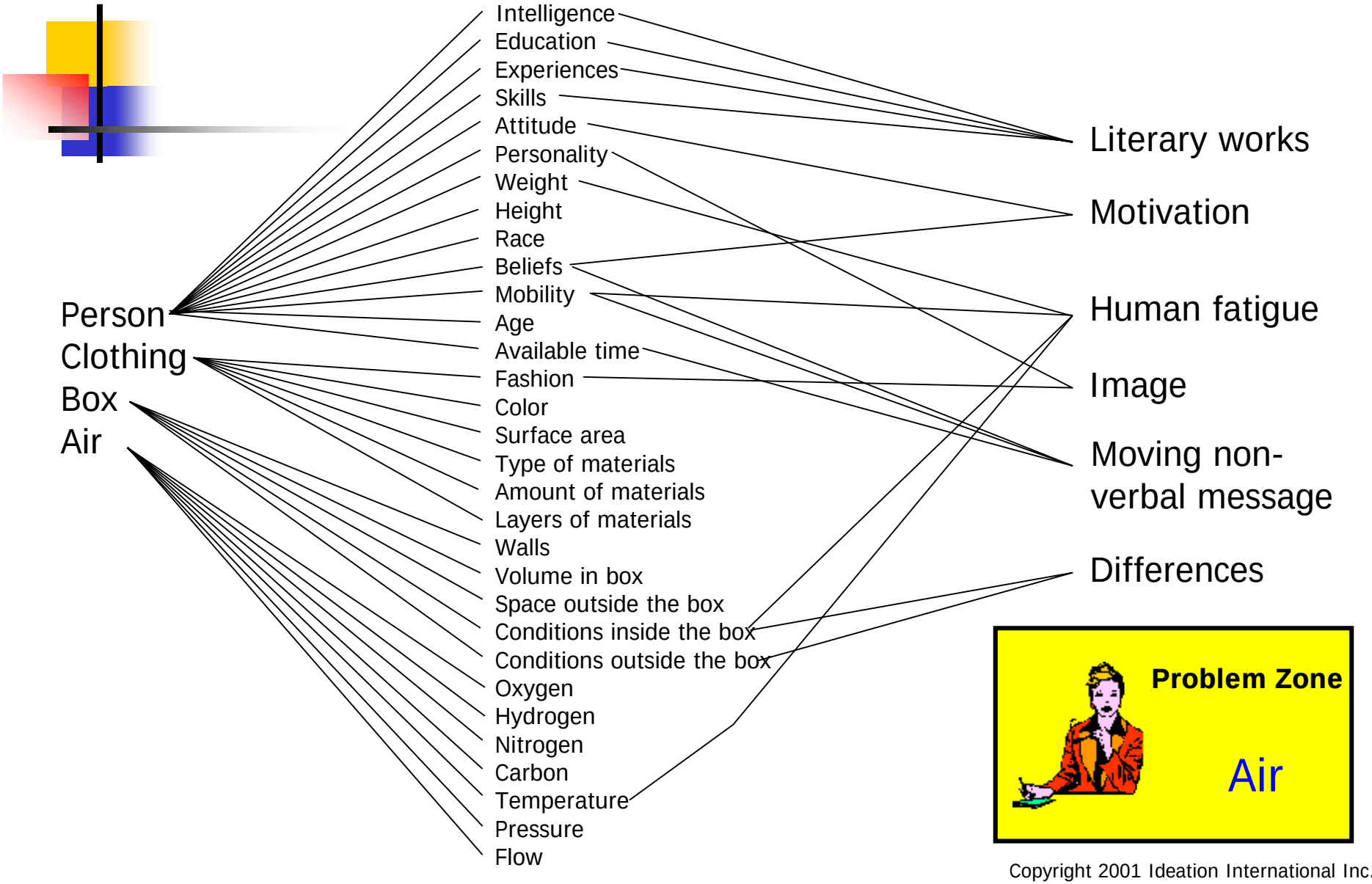


“Ready” Resources: Person Example



- Person
  - Intelligence
  - Education
  - Experiences
  - Skills
  - Attitude
  - Personality
  - Weight
  - Height
  - Race
  - Beliefs
  - Mobility
  - Age
  - Available time
- Clothing
  - Fashion
  - Color
  - Surface area
  - Type of materials
  - Amount of materials
  - Layers of materials
- Box
  - Walls
  - Volume in box
  - Space outside the box
  - Conditions inside the box
  - Conditions outside the box
- Air
  - Oxygen
  - Hydrogen
  - Nitrogen
  - Carbon
  - Temperature
  - Pressure
  - Flow

“Derived” Resources: Person Example



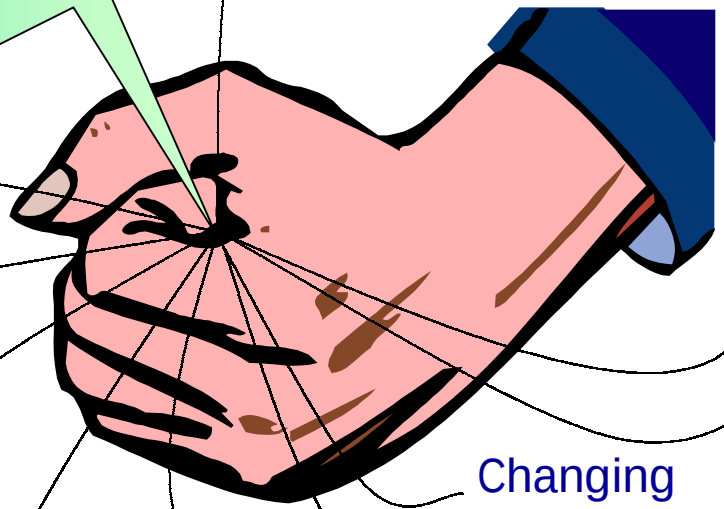
Moving toward Ideality with A "FFIISST" Full of Resources

Functional
Field (energy)
Information
Ideas (evolutionary)
Substance
Space
Time

Readily Available
- Visible
- Hidden

Useful

Harmful
- Harmful Energy
- Harmful Objects
- Space Resources of Harmful Functions
- Informational Resources of Harmful Functions
- Time Resources of Harmful Functions
- Resources of Harmful Functions



Accumulation

Concentration

Leveraging the Combination of Ideas, Concepts, Systems

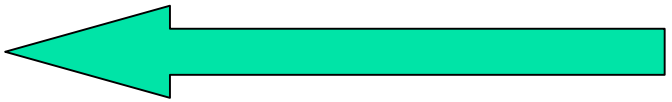
Natural Use via Psycological, Emotional Effects

Combination of resources

Changing (Scaling)

Resources of Change

Basic Premises of TRIZ

- Ideality
- Contradictions 
- System Approach

Contradiction

One of the basic premises of the Ideation/TRIZ Methodology

There are two types of contradictions: technical and physical

Technical Contradiction

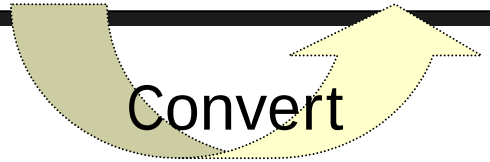
- An improvement in one system characteristic results in the deterioration of another
  - Example: Cost of service vs. accuracy of work
  - Example: Size of company and ease of change
- Traditionally, technical contradictions are resolved by trade-off or compromise
- TRIZ seeks to eliminate the contradiction without the use of trade-offs

Discovery: Common thread between great innovations.

What is an Inventive Problem?

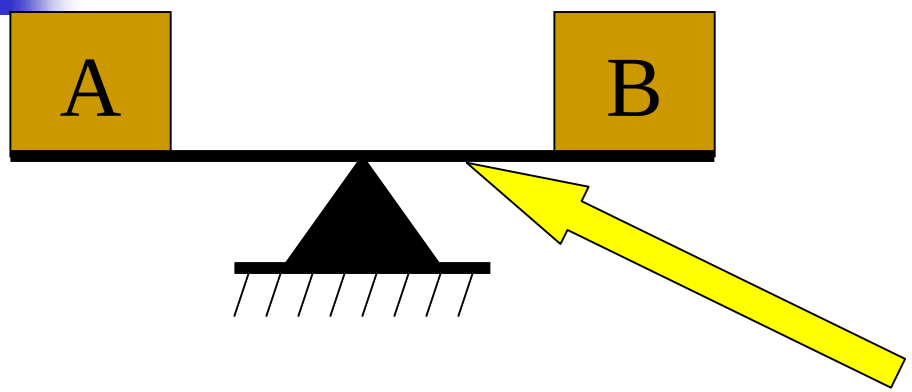
- Involves one or more contradictions
- Suggests no known ways or means of solution

There are two types of contradictions: technical and physical



Apply 4 principles
- Separation in time
- Separation in space
- Separation between the parts & the whole
- Separation upon conditions

Contradictions



Technical Contradiction

Control Parameter, **C**

So:

C should be high, and
C should be low

} **Physical Contradiction**

Controlling Characteristics

A mixture of technical and non-technical characteristics.

Physical Characteristics -- Micro

Micro refers to small particles on the molecular level. These parameters are typically measured in degrees of the parameter, such as: light is not necessarily on or off (light or dark) but has degrees of brightness.

Density
Light
Pressure
Weight
Volume
Hardness
Temperature
Conductivity
Speed
Mechanical Strength
Resistance
Width
Friction
Mass
Time
Power
Force
Area

Geometric Characteristics

Big Vs. Small
Thick Vs. Thin
Round Vs. Non Round
Parallel Vs. Intersecting
Long Vs. Short
Wide Vs. Narrow
Vertical Vs. Horizontal
Sharp Vs. Dull

Physical Characteristics -- Macro

Penetrable Vs. Non-Penetrable
High Density Vs. Low Density
Strong Vs. Weak
Hot Vs. Cold
Free Vs. Busy
Electrically Conductive Vs. Non-Conductive
Fast Vs. Slow
Hard Vs. Soft
Solid Vs. Some Porosity
Smooth Vs. Rough
Slippery Vs. With Friction
Moveable Vs. Stationary
Dark Vs. Light

Functional Characteristics

Push Vs. Pull
Catch Vs. Throw
Let Go Through Vs. Block

Physical Contradiction

- A characteristic must be higher and lower (self-opposing)
  - Example: An organization must be large so it has resources but must be small so it has agility.
- A characteristic must be present and absent
  - Example: A purchasing department must be present to provide a function that is vital to the company but should not be present because it increases the cost of overhead.

Principles of Separation

- TRIZ seeks to eliminate the physical contradiction by separating the two contradictory requirements
  - Separation in space
  - Separation in time
  - Separation between the parts and the whole
  - Separation upon condition

Separation in Space

- A characteristic is made larger in one place and smaller in another
- A characteristic is present in one place and absent in another
  - Pricing Strategy Example: High-end stores (space); you can buy a product at a high price; go to a low-end store (different space) and you can purchase the same product at a lower price.
  - Pricing Strategy Example: Pricing for products, like a car, in one region of the country or world (space) may can be high; and pricing for the same car in another region (different space) can be lower.

Separation in Time

- A characteristic is made larger at one time and smaller at another
- A characteristic is present at one time and absent at another
  - Pricing Strategy Example: When (time) a new exciting product is released into the marketplace the price is higher; after is has been in the marketplace for some period (different time) the price drops.
  - Pricing Strategy Example: During non-peak buying seasons (time) prices are higher; during off-peak seasons (different time) prices are lower.

Separation Between the Parts and the Whole

- A characteristic has one value at the system level and the opposite value at the component level
- A characteristic exists at the system level but not at the component level (or vice versa)
  - Pricing Strategy Example: Purchase a single wrench (part) for a lower price than when purchasing a complete set of wrenches (whole).
  - Pricing Strategy Example: Purchase individual components (part) of a bigger set of products (whole) to collect the entire set one piece at a time.

Separation upon Condition

- A characteristic is high under one condition and low under another
- A characteristic is present under one condition and absent under another
  - Pricing Strategy Example: Without a coupon (condition) for a specific product you will pay a higher price than if you do not have a coupon (different condition).
  - Pricing Strategy Example: If you are buying one product at a time (condition) you will pay more than if buying in bulk (different condition).

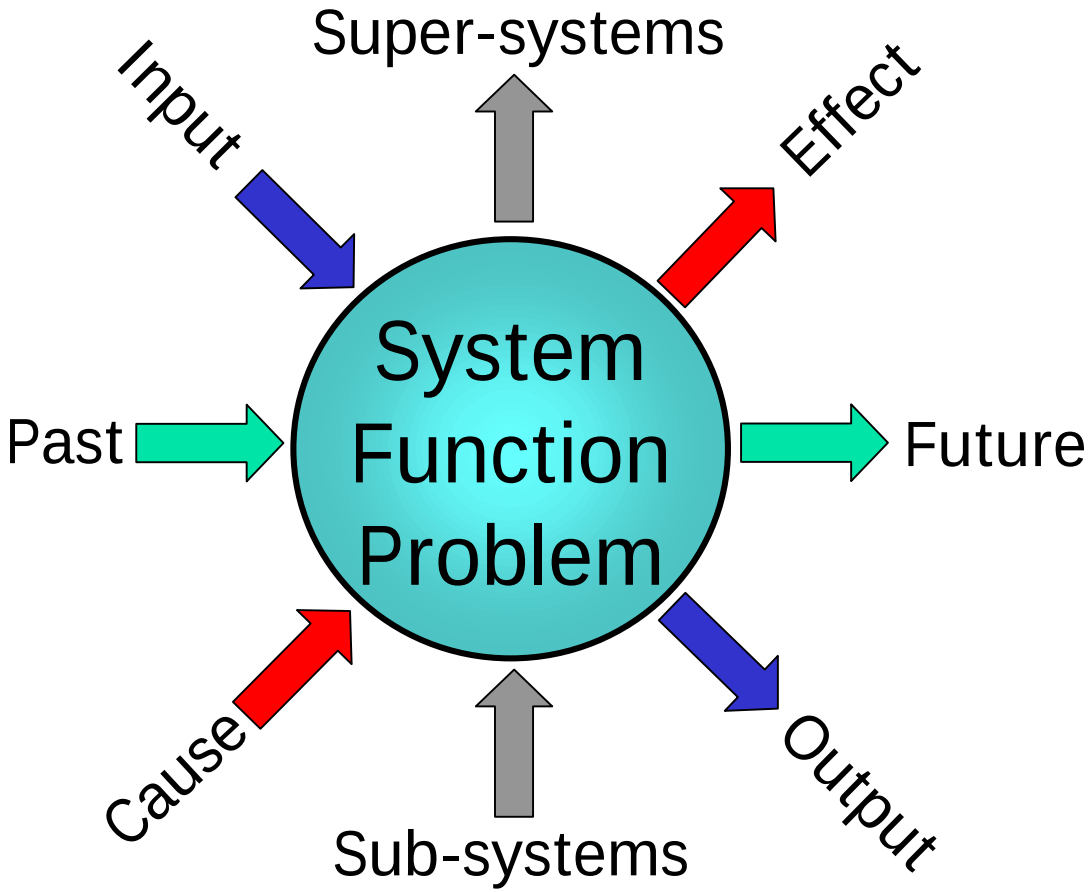
Basic Premises of TRIZ

- Ideality
- Contradictions
- System Approach

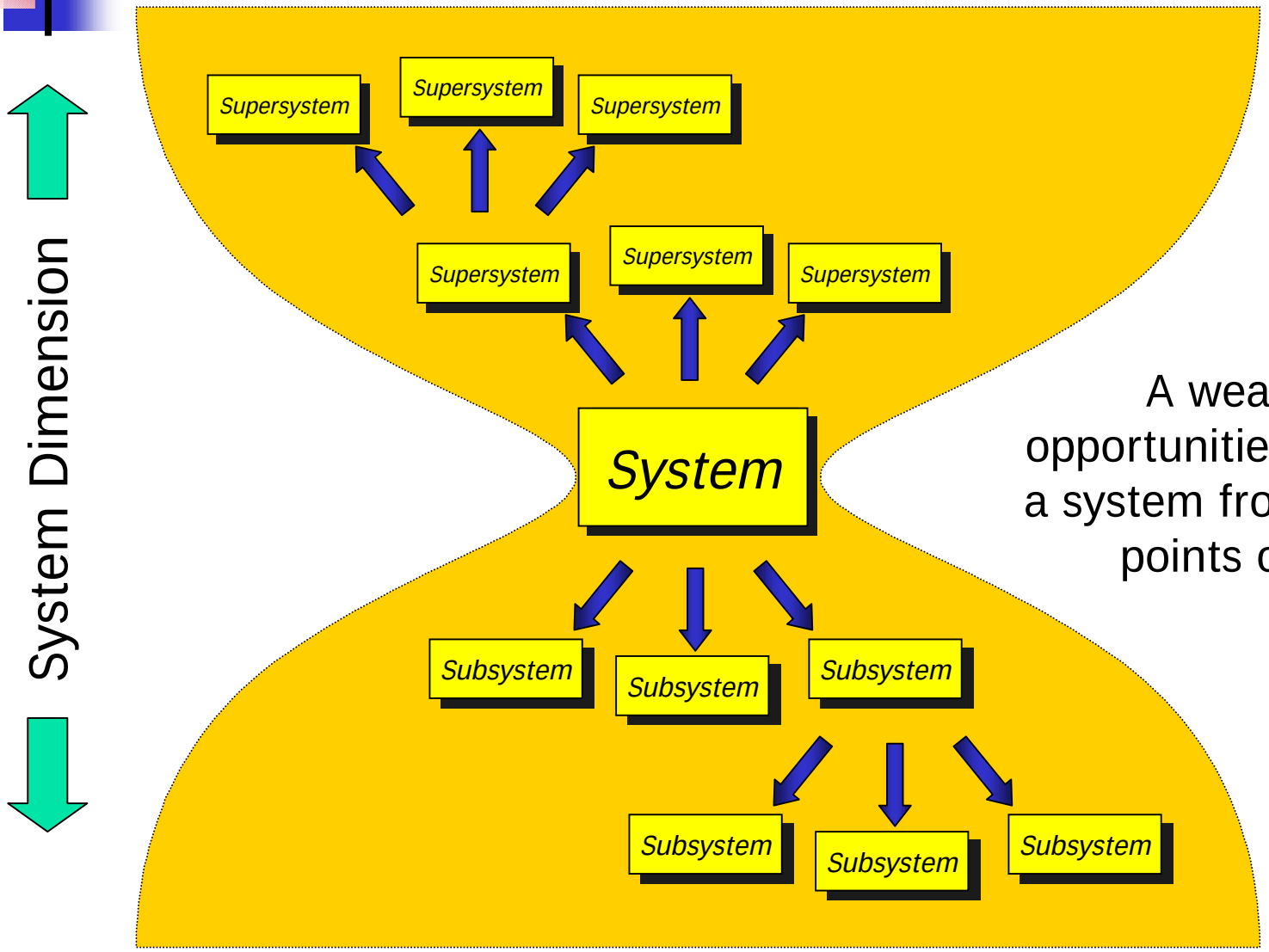
What is the System Approach?

- Multi-dimensional creative thinking
  - The unique ability of an inventor to look beyond the system as an object
- A tool for changing the way you think
  - Enhances understanding
  - Expands your vision

System Approach

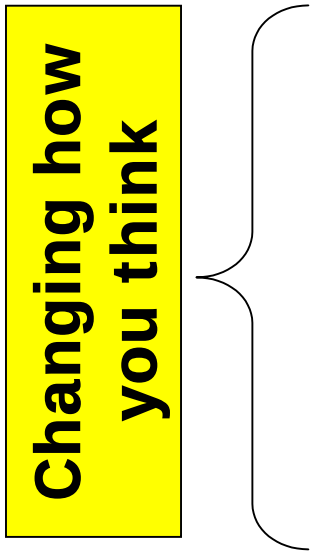


Hour-Glass Model



A wealth of opportunities to look at a system from different points of view

How Can the System Approach be Used?



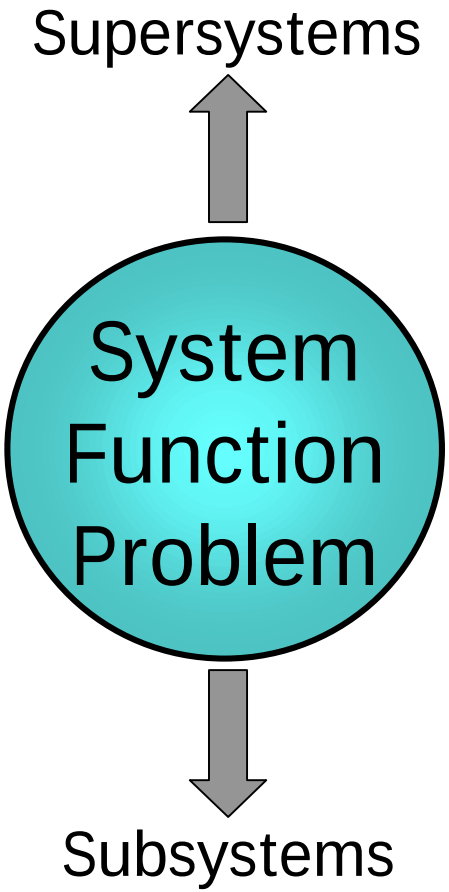
- Provides a means of organizing your thinking about the problem or situation
- Reduces psychological inertia by changing your “vision” of the problem or situation
- Starts you thinking from a TRIZ perspective by expanding the solution space

Bonus

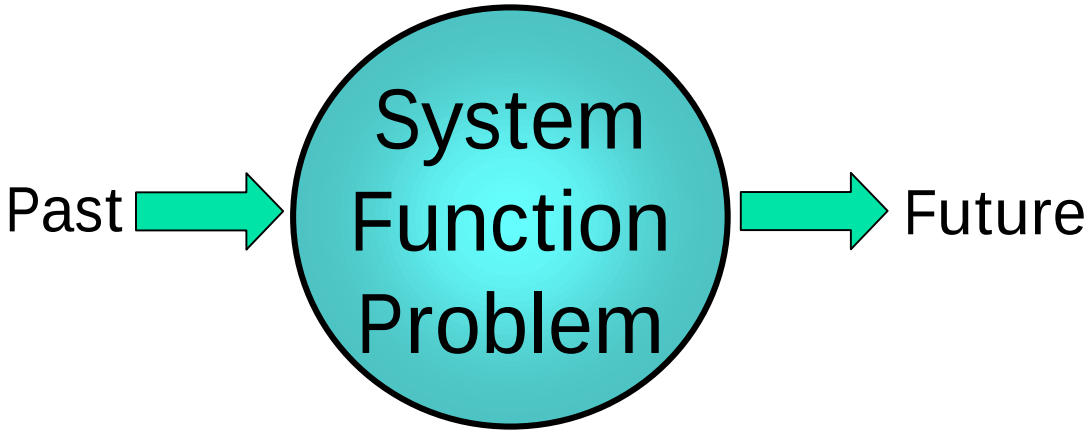
- Allows you to create modifications of your problem statement

Modifying a Problem Statement: System Dimension

- System
  - Step up to the supersystem
    - What changes to the supersystem might be made to resolve the situation?
  - Step down to the subsystem
    - What changes to a subsystem might be made to resolve the situation?



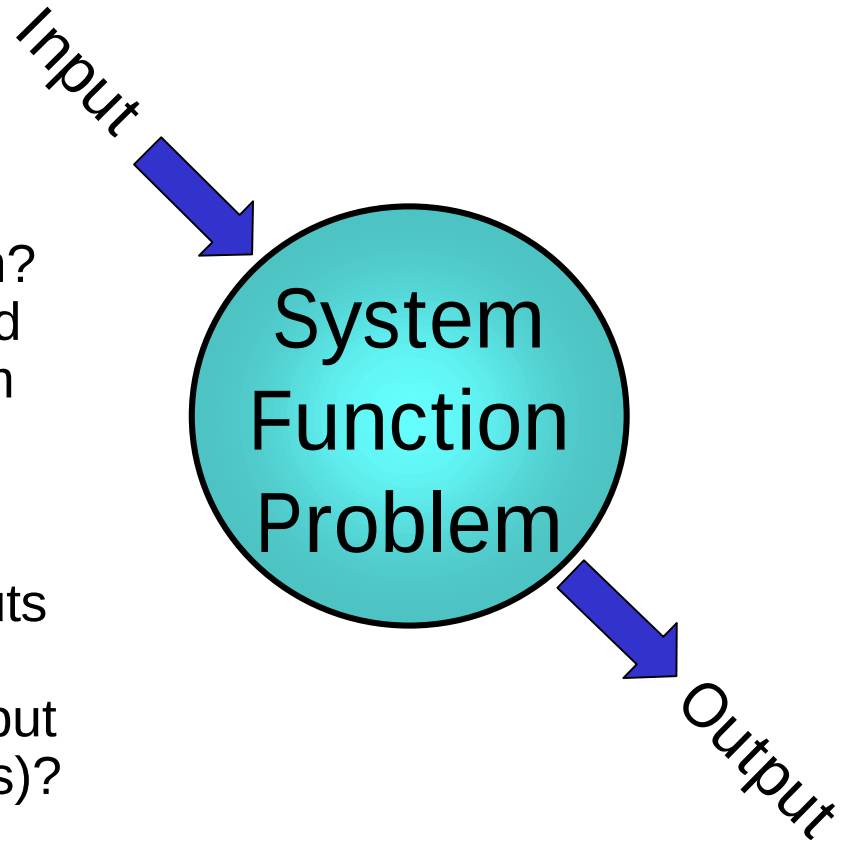
Modifying a Problem Statement: Time Dimension



- Time
  - Step into the past
    - What happened in the past to initiate the problem? Is it possible to return and change this critical event?
  - Step into the future
    - Think about the next generation of your system. Will the problem you are facing today continue or will it disappear?

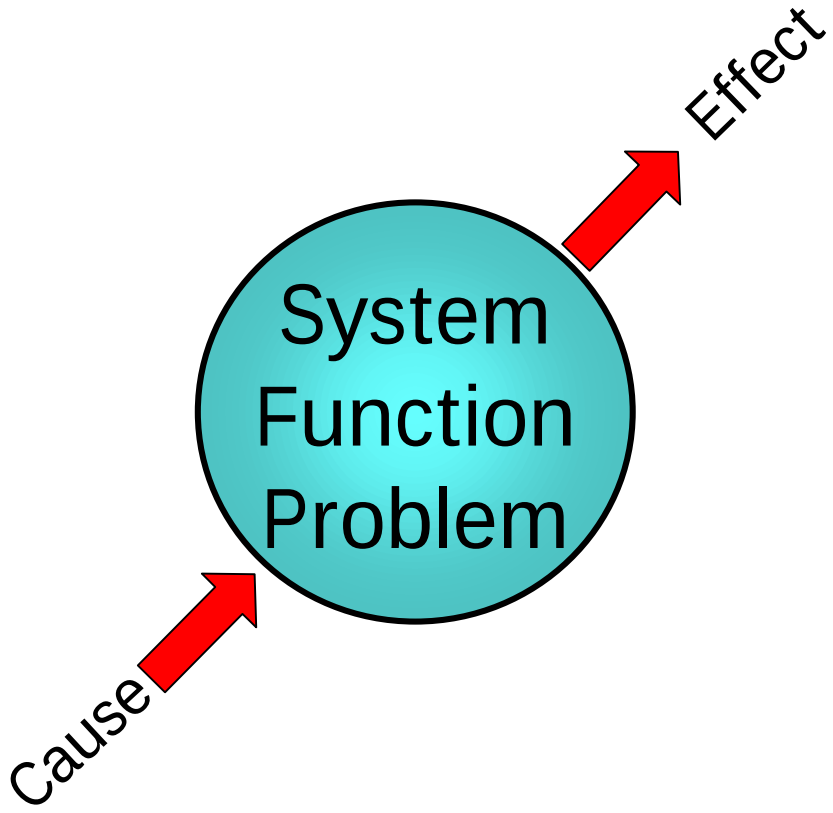
Modifying a Problem Statement: Input – Output Dimension

- Input - output
  - Step back
    - What are the inputs responsible for the problem? How might they be changed to prevent the problem from occurring?
  - Step forward
    - What are the harmful outputs leaving the system? Is it possible to change the output to block the harmful effect(s)?

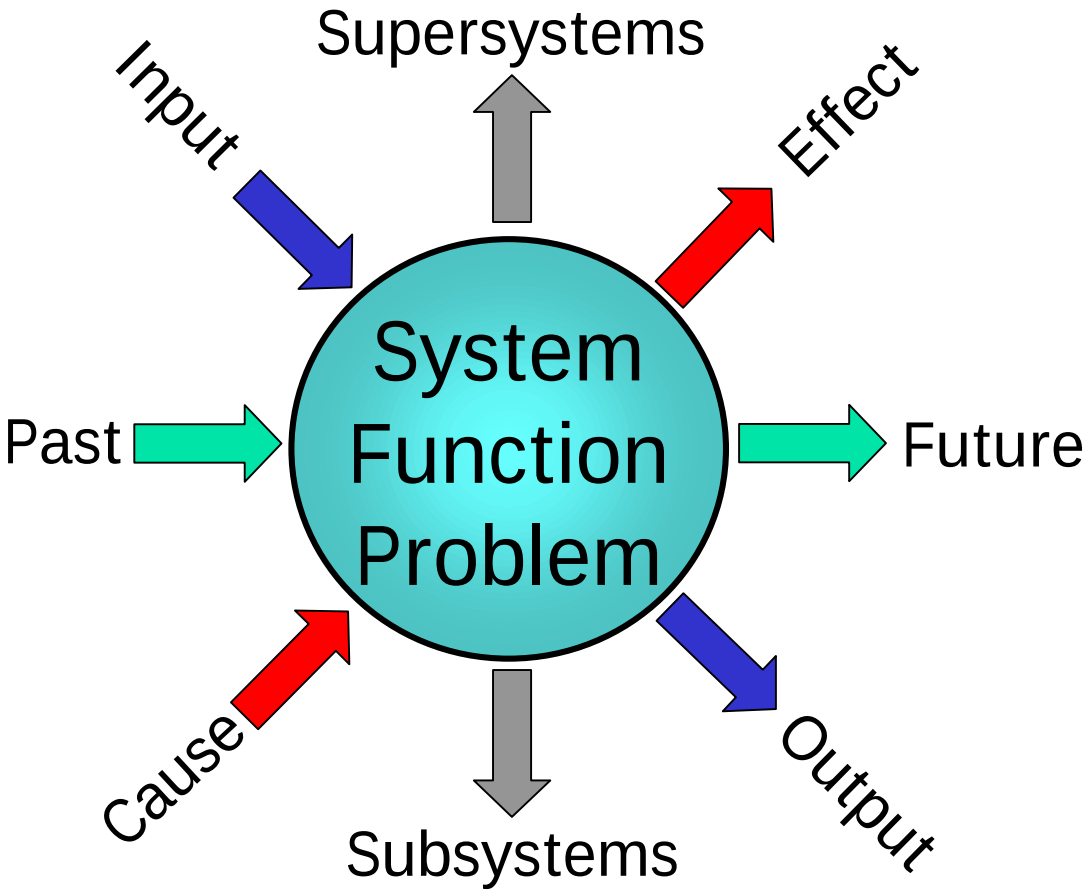


Modifying a Problem Statement: Cause – Effect Dimension

- Cause - effect
  - Step back
    - Is it possible to eliminate the cause of the problem?
  - Step forward
    - Is it possible to eliminate (or compensate for) the undesired results caused by the problem?



System Approach



Complete coverage of the system, function(s) and problem(s)

Changes the way you think about a system, it's functions and it's problems.

Inventive Problem Solving

Workshop Process –

Using the Knowledge Wizard™

Software

Inventive Problem Solving: Ideation Process

Enhancement: Structured methods and tools.

Step	Action	Contents
1	Document the problem	Complete and analyze the Innovation Situation Questionnaire (ISQ)
2	Formulate the problem	Develop exhaustive set of Directions for Innovation
3	Prioritize Directions for Innovation	
4	Develop Concepts	Develop an exhaustive set of Solution Concepts utilizing various knowledge- base tools
5	Evaluate Results & Plan Implementation	Select Solution Concepts and develop an implementation plan

Knowledge Wizard™ ME Software What Does It Do?

- Directs the user through the Ideation Process
- Models the successful techniques of experienced innovators
- Stimulates and directs your thinking in solving inventive problems
- Allows you to synthesize your own unique solutions

Knowledge Wizard™: How Does It Do It?

- Ideation Process
  - Analytical Tools
    - Innovation Situation Questionnaire (ISQ)
    - Problem Formulator
  - Knowledge Base Tools
    - Operators
      - Principles, Methods, Standard Solutions
    - Algorithm of Inventive Problem Solving

Guided Step-by-Step

Psychological inertia: Where does it come from?

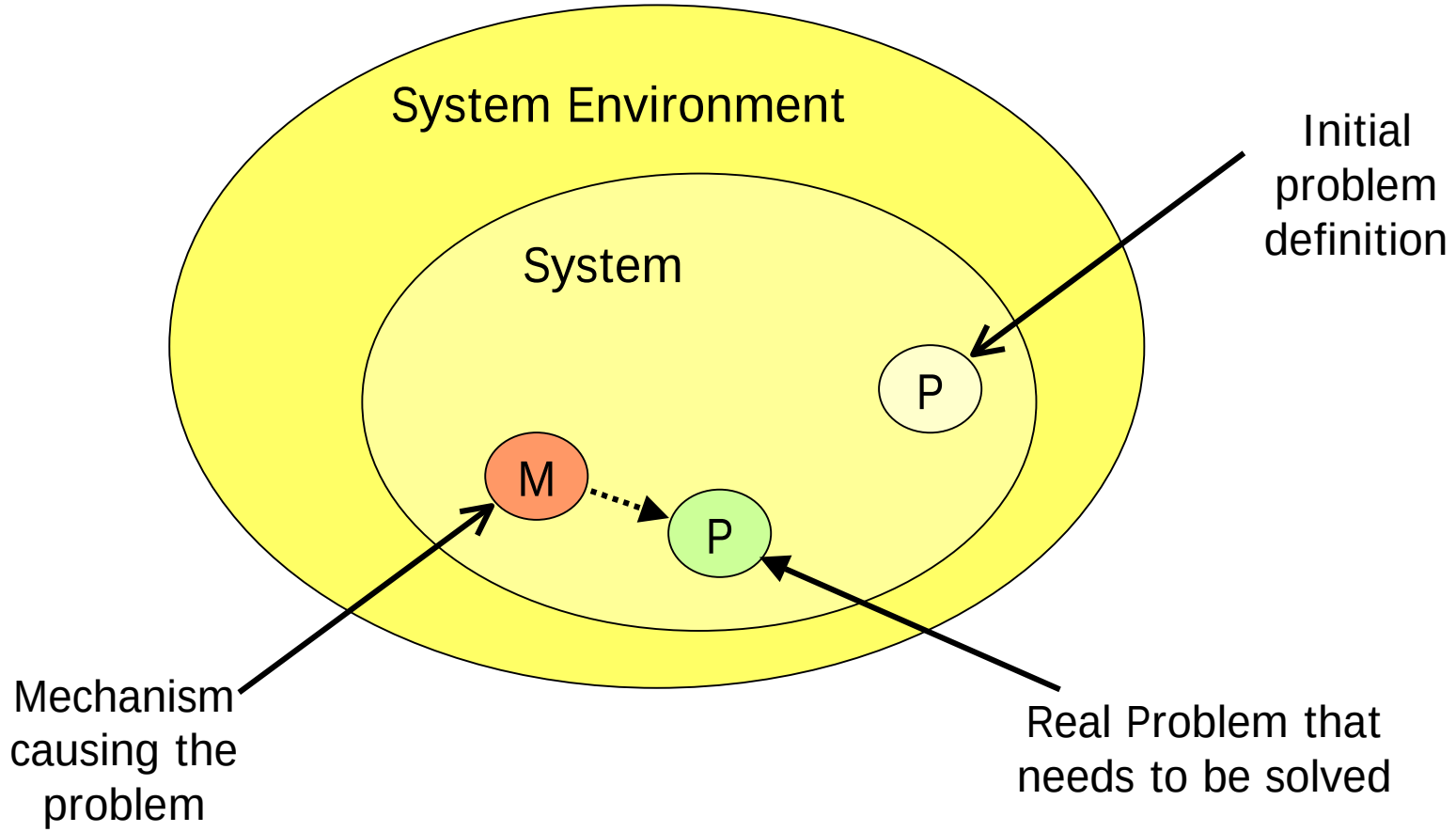
- Habits
- Beliefs
- History/Tradition
- Policies/Procedures
- Rules/Guidelines
- Education
- Past experiences

Psychological Inertia: How Strong Is It?

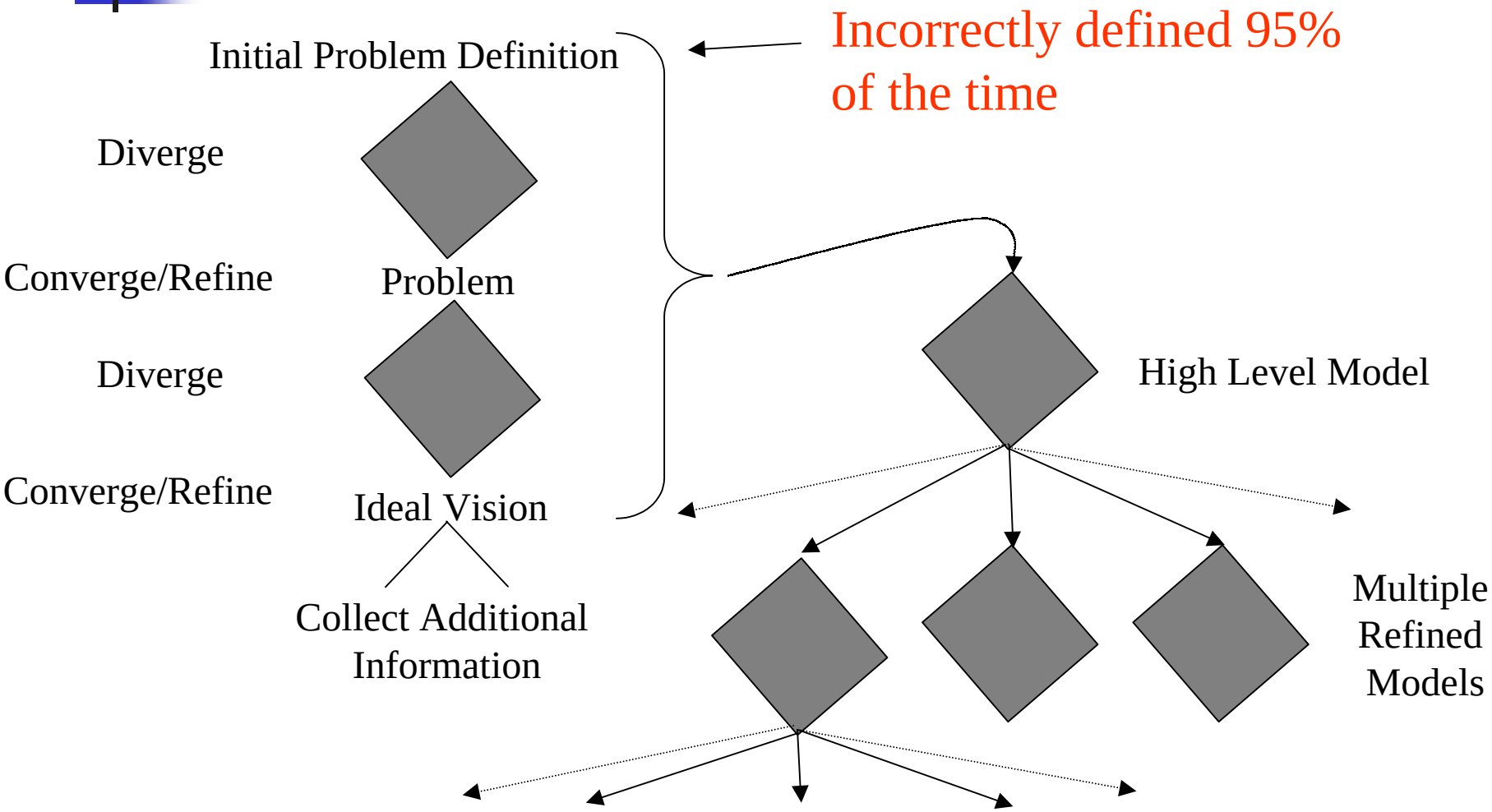
Strong enough to keep problems from being solved for years.

95% of the time a problem cannot be solved it is because it has been defined incorrectly or the mechanism (means, method, process, etc.) causing the problem is not understood.

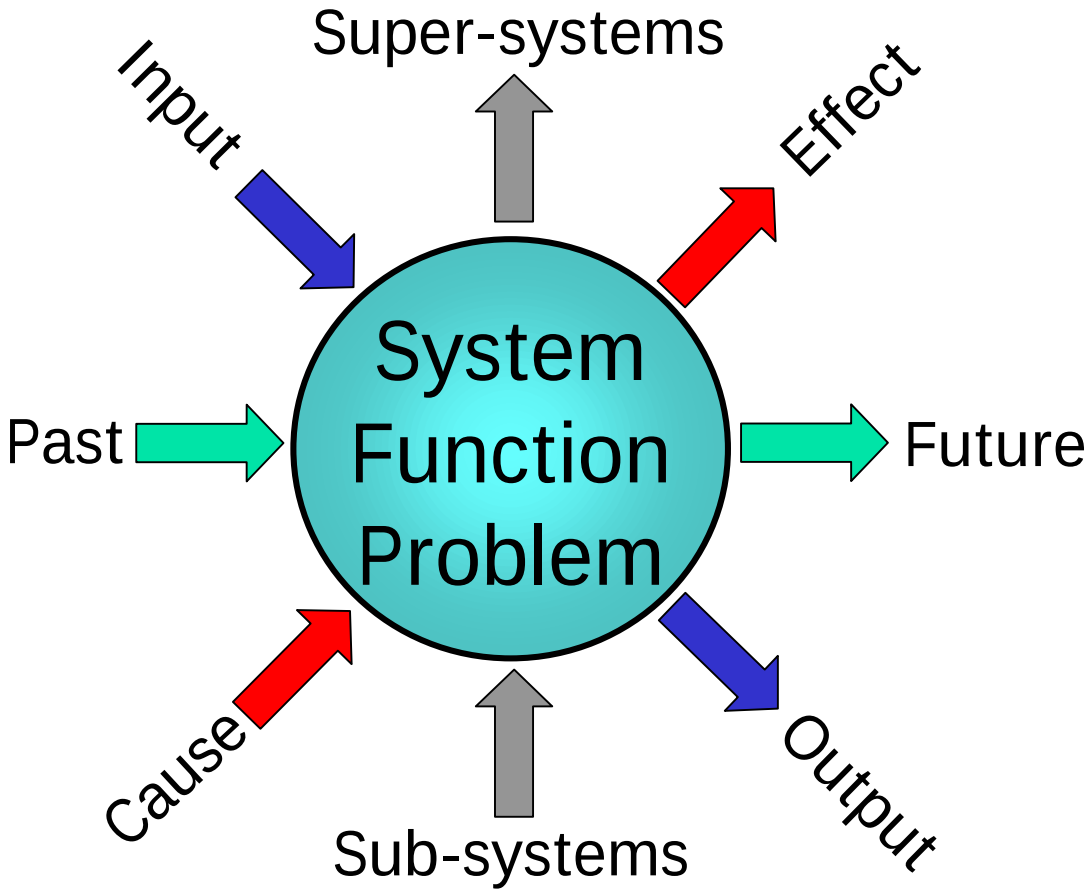
Innovation Situation Questionnaire: Where Are We Going?



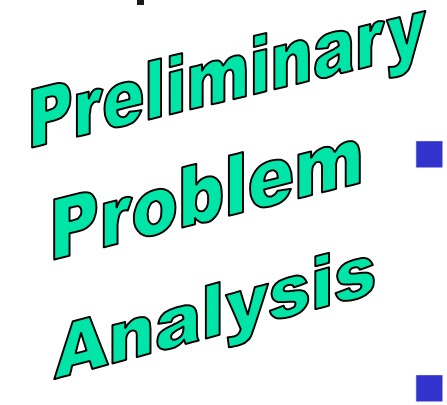
Discovering the Real Problem



ISQ's Underlying Structure: System Approach

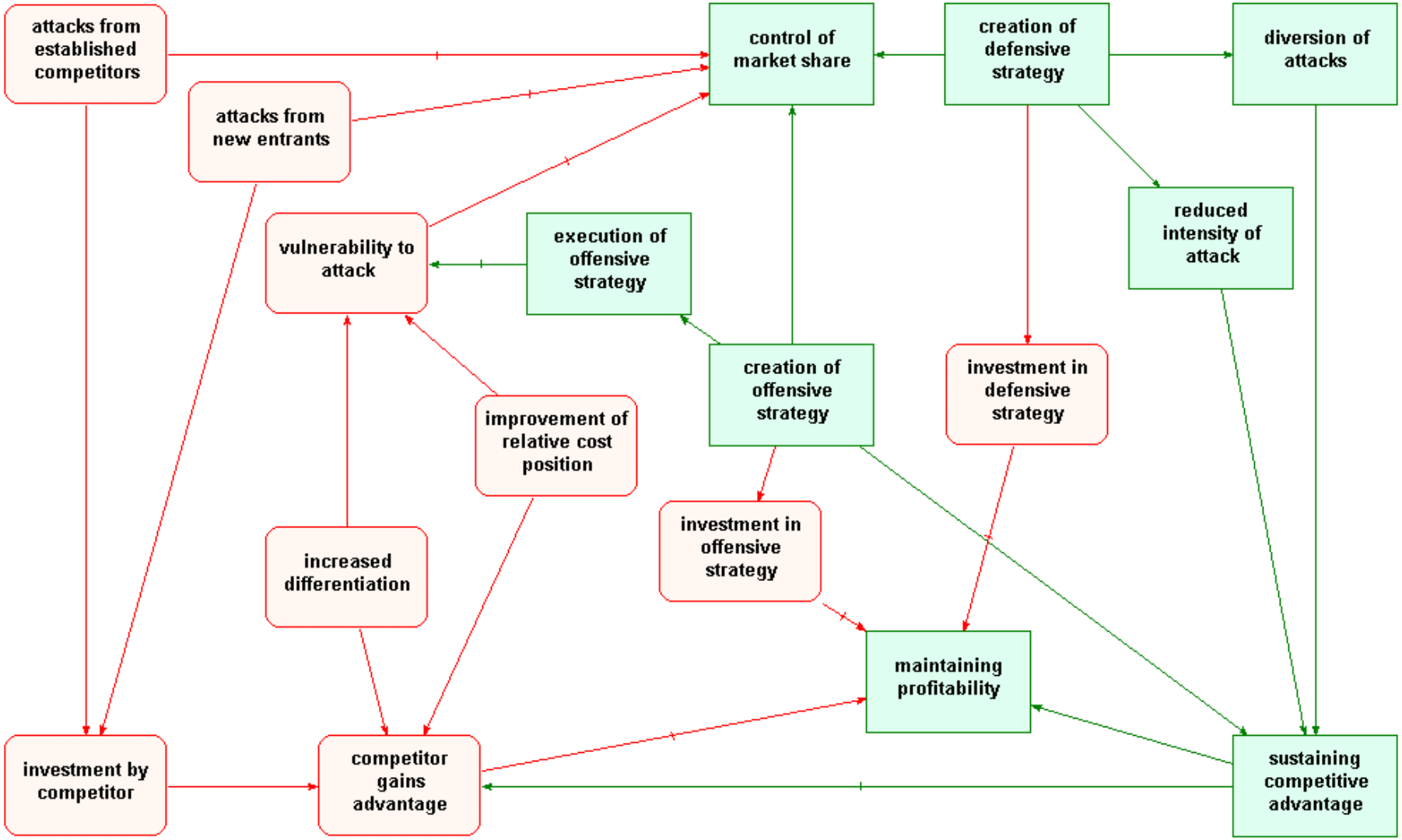


Innovation Situation Questionnaire: What Does It Do?



- Organizes your knowledge about the problem situation
- Starts you thinking from a TRIZ perspective
- Reduces psychological inertia
- Changes your “vision” of the problem

Problem Formulation Model



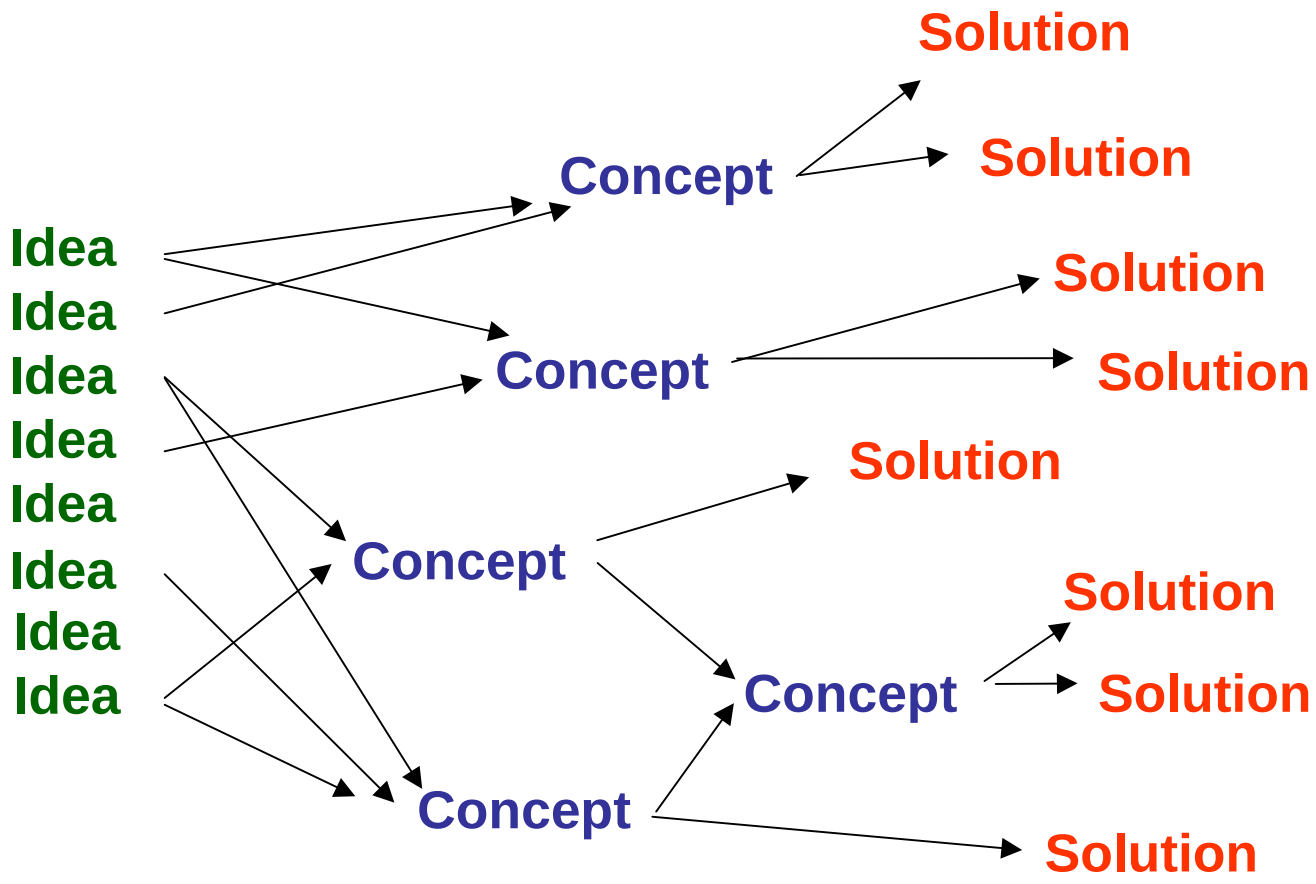
Problem Formulator Output: Slices a problem into its basic elements

1. Find a way to eliminate, reduce, or prevent [the] (vulnerability to attack) under the conditions of [the] (improvement of relative cost position) and (increased differentiation).
   - 1.1. Isolate the system or its part from the harmful effect of [the] (vulnerability to attack).
   - 1.2. Counteract the harmful effect of [the] (vulnerability to attack).
   - 1.3. Impact on the harmful action of [the] (vulnerability to attack).
   - 1.4. Reduce sensitivity of the system or its part to the harmful effect of [the] (vulnerability to attack).
   - 1.5. Eliminate the cause of the undesired action of [the] (vulnerability to attack).
   - 1.6. Reduce the harmful results produced by [the] (vulnerability to attack).
   - 1.7. Apply universal Operators to reduce the undesired factor (vulnerability to attack).
   - 1.8. Consider resources to reduce the undesired factor (vulnerability to attack).
   - 1.9. Try to benefit from the undesired factor (vulnerability to attack).

Directions for Innovation

- Guided entry into knowledge base
- Facilitates systematic generation of ideas
- Ensures breadth of ideas

Ideas to Concepts to Products



Evaluation of Results

- Identify and eliminate secondary problems
- Reveal and prevent potential failures
- Prepare for implementation

Software Demo / Case Study

Customer Service Representatives
– Health Care

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