Multi-Scenario Planning

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Scenario Planning

- **Scenario planning**, also called **scenario thinking** or **scenario analysis**, is a strategic planning method that some organizations use to make flexible long-term plans.

- The original method was that a group of analysts would generate simulation games for policy makers. The games combine known facts about the future (such as demographics) with plausible alternative social, technical, economic, environmental, educational, political and aesthetic trends which are deemed to be key driving forces.

- Above all, scenario planning is a tool for collective learning, reframing perceptions and preserving uncertainty when the latter is pervasive.

Multi-Scenario Planning

- Too many decision makers want to bet on one future scenario, falling prey to the seductive temptation of trying to predict the future rather than to entertain multiple futures. The issue should not be which are the "right" scenarios but rather whether they delineate the range of possible futures appropriately.

- Therefore it is desirable to create multiple scenarios to insure the future actual reality fits within the boundaries set by the scenarios.

- One challenge associated with the multi-scenario methodology is the high probability that one or more contradictions (or conflicts) will be represented between the various scenario variants.

Conflicting Requirements

- Definition –

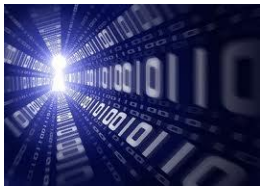
  conflict *n* - a state of opposition between ideas, interests, requirements etc.

- Sources of Conflicts
  - Between scenario variants
  - Between a scenario and the present state
  - Between customer needs and supplier needs
  - Between market needs and technical capabilities
  - Etc.

- Example
  - Scenario A states that additional manufacturing capacity will be required to keep up with customer demands and Scenario B states that disruptive technology will relegate the current product line to a lower market segment offering.

Resolving Conflicts

- **Systematic Innovation = Conflict Resolution**
  - Innovative Problem
    - A problem or challenge where a fundamental contradiction exists within or between system components that establishes a maximum performance level of the system



  - Engineering Systems Examples – Automobile fuel economy versus engine power, Freezer minimum temperature versus thickness of insulation, Smart phone data transfer rates versus i/o clock speed, Pharmaceutical product absorption rate versus product stability
  - Business System Examples – Insurance claim processing time versus standardized data gathering, Time required for new product introduction versus responsiveness to changing market demands, Customer throughput (customers per hour) versus number of check-out registers, Customer service quality (service defects per million) versus employee training requirements
  - Computing System Examples – Mobile application power requirements versus platform battery power, User interface ease of operation versus application flexibility, Firmware development resource requirements versus headcount limitations, Software code capability versus system resource requirements

Inventive Problem Solving

- Innovative Problems – a problem or challenge where a fundamental contradiction exists within or between system components that establishes a maximum performance level of the system

- Innovative Solution – a solution which simultaneously meets the contradictory requirements existing within or between system components thus creating an advanced system capable of achieving a new and accelerated level of performance

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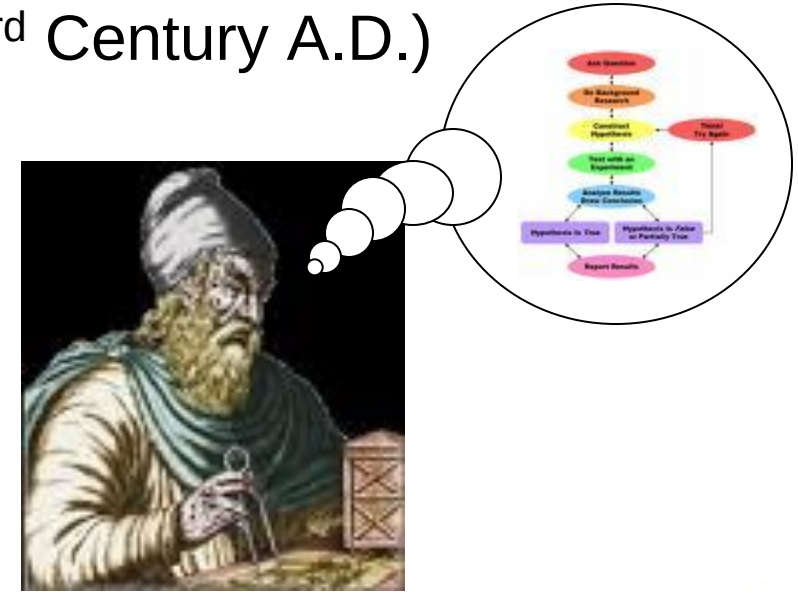
Resolving Conflicts

- Modeling Contradictions –
  - Brief History
- Heuristics – A science for solving creative problems
  - First appeared in the work of Greek mathematician, Euclid of Alexandria (3rd Century A.D.)



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Resolving Conflicts

- Modeling Contradictions –
  - Brief History
- Heuristics – A science for solving creative problems
  - First appeared in the work of Greek mathematician, Euclid of Alexandria (3rd Century A.D.)
  - Seventeen hundred years later most are still utilizing the trial-and-error method for solving creative problems

Resolving Conflicts

- Modeling Contradictions –
  - Brief History

• 1946 – Soviet Naval Officer Genrich Altshuller, began developing the Theory of Inventive Problem Solving (TRIZ) through analysis of the world wide patent database

  - Inventing is based on understanding and resolving contradictions
  - Every method used to solve contradictions can be summarized into a set of Inventive Principles

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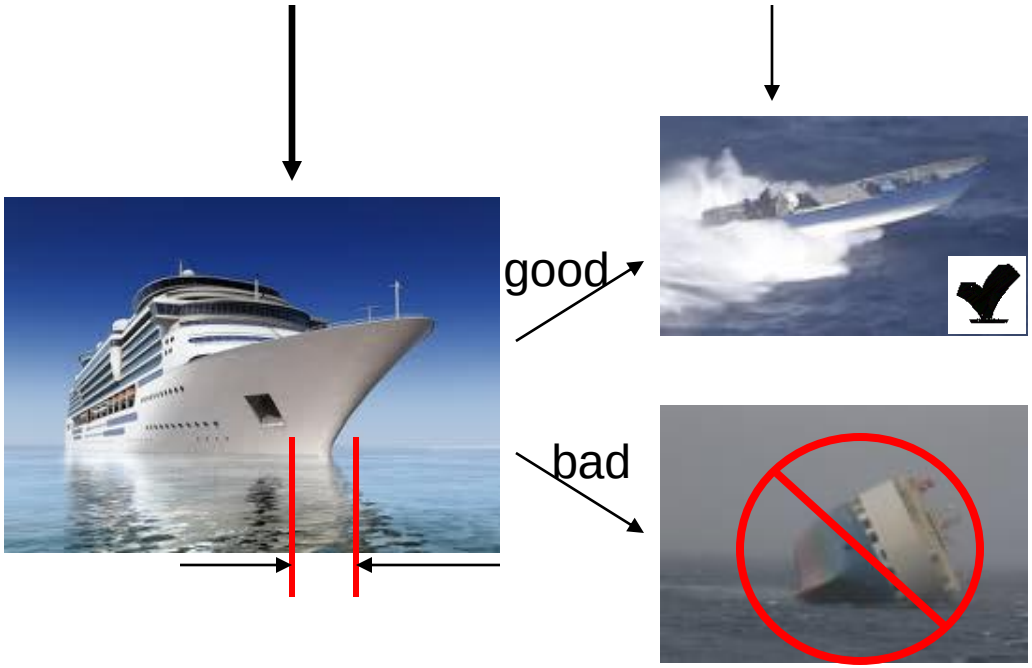
Resolving Conflicts

- Modeling Contradictions – Example
  - If, Then, But
    - If (a stated situation) Then (a positive effect) But (a negative effect)

If the hull is narrow Then the ship is fast But it is also unstable

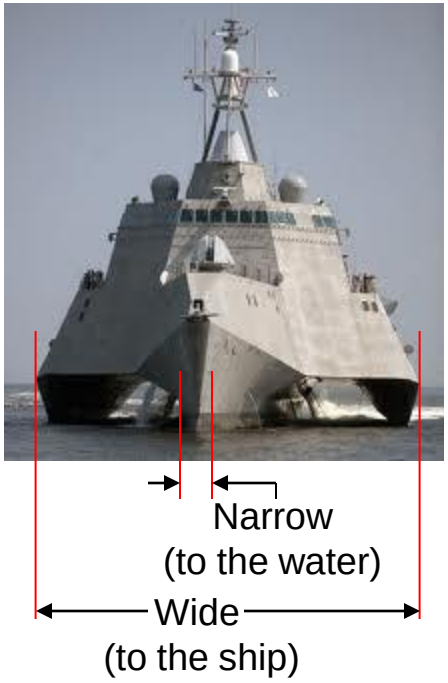


Resolving Conflicts

- Solving Contradictions – Example

If the hull is narrow Then the ship is fast But it is also unstable

One solution – separate requirements in relation to the ship and the water



Resolving Conflicts

- **Solving Contradictions – Formal Method**
  1. Represent contradiction by way of the 39 standardized Parameters
  2. Locate the representative parameters on Altshuller's Contradiction Matrix
  3. Identify the specific 40 Principles associated with solving similar contradictions
  4. Apply the selected Principles in resolving the contradiction

Engineering Contradiction Parameter Definitions

1.) **Weight of a Moving Object** – The mass of or gravitational force exerted by a moving or mobile object. 'Moving' includes any situations where there is any degree of relative motion or mobility between two or more parts related to the problem. This may be linear or rotational, a few microns or a considerable distance.

2.) **Weight of Stationary Object** – The mass of or gravitational force exerted by a stationary object. 'Stationary' includes any situations where there is no form of relative motion between two or more parts related to the problem.

3.) **Length (or Angle) of Moving Object** – linear or angular dimension relating to a moving or mobile object. 'Moving' includes any situations where there is any degree of relative motion or mobility between two or more parts related to the problem. This may be linear or rotational, a few microns or a considerable distance.

4.) **Length (or Angle) of Stationary Object** – Any linear or angular dimension relating to a stationary object. "Stationary" includes any situations where there is no form of relative motion between two or more parts related to the problem.

5.) **Area of a Moving Object** – Any dimension related to surfaces or surface area. These may be internal or external. They may also include contact area as well as actual surface area. 'Moving' includes any situations where there is any degree of relative motion or mobility between two or more parts related to the problem. The relative motion may be a few microns or considerable amounts.

6.) **Area of Stationary Object** – Any dimension relating to surfaces or surface area. These may be internal or external. They may also include contact area as well as actual surface area. 'Stationary' includes any situations where there is no form of relative motion between two or more parts related to the problem.

7.) **Volume of Moving Object** – Anything related to the cubic measure of space occupied by an object or the space around it. 'Moving' includes any situations where there is any degree of relative motion or mobility between two or more parts related to the problem. This relative motion may be a few microns or a considerable distance.

8.) **Volume of Stationary Object** – Anything related to the cubic measure of space occupied by an object or the space around it. 'Stationary' includes any situations where there is no form of relative motion between two or more parts related to the problem.

9.) **Speed** – The velocity or speed of an object or the rate of any kind of process or action. The speed may be relative or absolute, linear or rotational.

40 Inventive Principles

Principle 1. Segmentation
A.) Divide an object into independent parts.
B.) Make an object easy to disassemble.
C.) Increase the degree of fragmentation

Principle 2. Taking out
A.) Separate an interfering part or property from an object, or single out the only necessary part (or property) of an object.

Principle 3. Local quality
A.) Change an object's structure from uniform to non-uniform, change an external environment (or external influence) from uniform to non-uniform.
B.) Make each part of an object function in conditions most suitable for its operation.
C.) Make each part of an object fulfill a different and useful function.

Principle 4. Asymmetry
A.) Change the shape of an object from symmetrical to asymmetrical.
B.) If an object is asymmetrical, increase its degree of asymmetry.

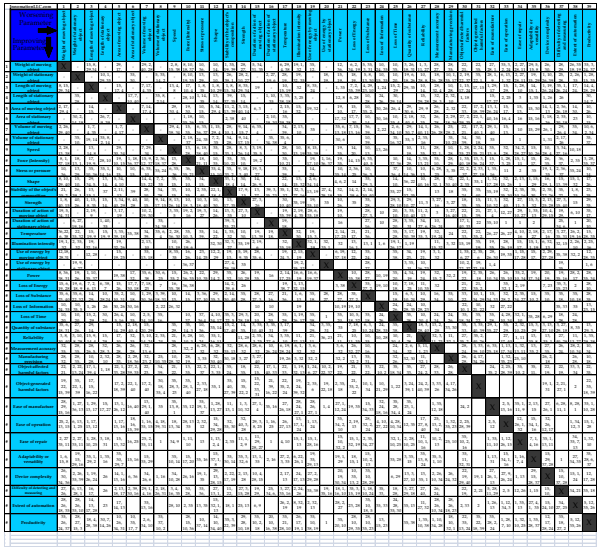
Principle 5. Merging
A.) Bring closer together (or merge) identical or similar objects, assemble identical or similar parts to perform parallel operations.
B.) Make operations contiguous or parallel; bring them together in time.

Principle 6. Universality
A.) Make a part or object perform multiple functions; eliminate the need for other parts.

Principle 7. "Nested doll"
A.) Place one object inside another; place each object, in turn, inside the other.
B.) Make one part pass through a cavity in the other.

Principle 8. Anti-weight
A.) To compensate for the weight of an object, merge it with other objects that provide lift.
B.) To compensate for the weight of an object, make it interact with the environment (e.g. use aerodynamic, hydrodynamic, and other forces).

Principle 9. Preliminary anti-action
A.) If it will be necessary to do an action with both harmful and useful effects, this action should be replaced with anti-actions to control harmful effects.
B.) Create beforehand stresses in an object that will oppose known undesirable working stresses later on.



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Contradiction Modeling

- Contradiction Matrix (Altshuller's Matrix)
  - One TRIZ tool that relates the parameters associated with contradictions to the 40 Principles

Improving Parameter

Worsening Parameter

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	Worsening Parameter → / Improving Parameter ↓	Weight of moving object	Weight of stationary object	Length of moving object
1	Weight of moving object	X	-	15, 8, 29,34
2	Weight of stationary object	-	X	-
3	Length of moving object	8, 15, 29, 34	-	X

Inventive principles

Case Study 1

Sources of Conflicts - between scenario variants

- **Future Models for Wireless Services (Business/Engineering)**
  - A wireless service provider wanted to model and prepare for potential future states of the wireless market. Their scenario planning resulted in the following conflicting future states:

  - State 1 – projection of current service provider model (mobile hand units with stationary cell towers) into the future with expected "normal" growth of requirements regarding bandwidth, #s of customers and their data usage

  - State 2 – shift to mobile (automobile, buses, aircraft) and stationary (home) high powered base stations which act as signal repeaters reducing the power requirements of the hand unit and the number of cell towers required

- Contradiction – If the current trend of cell tower installation is continued Then the required bandwidth and capacity will be in place for expanded customer requirements (State 1) But the new cell tower infrastructure will be excessive for the new base station/terminal hand sets (State 2)

Case Study 1

- Contradiction – If the current trend of cell tower installation is continued Then the required bandwidth and capacity will be in place for expanded customer requirements (State 1) But the new cell tower infrastructure will be excessive for the new base station/terminal hand sets (State 2)

Improving Parameter – Duration of Action by Moving Object
Worsening Parameter – Use of Energy by a Moving Object

- **Principles – 28, 6, 35, 18**

Case Study 1

- **Principles – 28, 6, 35, 18**

- **Principle 28 Mechanics substitution**
- A.) Replace a mechanical means with a sensory (optical, acoustic, taste or smell) means.
- B.) Use electric, magnetic and electromagnetic fields to interact with the object.
- C.) Change from static to movable fields, from unstructured fields to those having structure.
- D.) Use fields in conjunction with field activated (i.e., ferromagnetic) particles.

- **Principle 6. Universality**
- Make a part or object perform multiple functions; eliminate the need for other parts.

- **Principle 35. Parameter changes**
- A.) Change an object's physical state (e.g. to a gas, liquid, or solid).
- B.) Change the concentration or consistency.
- C.) Change the degree of flexibility.
- D.) Change the temperature.

- **Principle 18. Mechanical vibration**
- A.) Cause an object to oscillate or vibrate.
- B.) Increase its frequency (even up to the ultrasonic).
- C.) Use an object's resonant frequency.
- D.) Use piezoelectric vibrators instead of mechanical ones.
- E.) Use combined ultrasonic and electromagnetic field oscillations.

Install mobile cell towers that can be relocated as the base station concepts begins its proliferating

Case Study 2

Sources of Conflicts - between customer needs and supplier needs

- **Future of Personal Banking (Business/Computing)**
  - A national bank wanted to model and prepare for potential futures states of the banking industry. Their scenario planning resulted in the following scenario (State) that conflicts with the current state:
    - Future State – rapid and high volume shift to on-line banking and away from brick and mortar locations but with a continued customer desire for personal services

- Contradiction – If web based banking services and capabilities are greatly expanded (Future State) Then bank's operations costs can be reduced But customers will have little to no personal services available to them during their banking transactions

Versus

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Case Study 2

- Contradiction – If web based banking services and capabilities are greatly expanded (Future State) Then bank's operations costs can be reduced But customers will have little to no personal services available to them during their banking transactions

  Improving Parameter – Productivity
  Worsening Parameter – Adaptability or Versatility

- **Principles – 1, 35, 28, 37**

Versus

Case Study 2

- **Principles – 1, 35, 28, 37**

- **Principle 1. Segmentation**
- A.) Divide an object into independent parts.
- B.) Make an object easy to disassemble.
- C.) Increase the degree of fragmentation

- **Principle 35. Parameter changes**
- A.) Change an object's physical state (e.g. to a gas, liquid, or solid.
- B.) Change the concentration or consistency.
- C.) Change the degree of flexibility.
- D.) Change the temperature.

Sense if a customer is having difficulty with web based transactions and provide customized help (electronic or personal)

- **Principle 28 Mechanics substitution**
- A.) Replace a mechanical means with a sensory (optical, acoustic, taste or smell) means.
- B.) Use electric, magnetic and electromagnetic fields to interact with the object.
- C.) Change from static to movable fields, from unstructured fields to those having structure.
- D.) Use fields in conjunction with field activated (i.e., ferromagnetic) particles.

Provide on-line face to face banking as requested by customer

- **Principle 37. Thermal expansion**
- A.) Use thermal expansion (or contraction) of materials.
- B.) If thermal expansion is being used, use multiple materials with different coefficients of thermal expansion.

Current Usage in Industry

- **Systematic Innovation for Technology (TRIZ)**
  - Competitive Analysis and Positioning
  - Product Development / Improvement / Revolution
  - Technical Problem Resolution
  - Wide Spread Usage:
    - Kodak, GE, Airbus, Samsung, Intel, Ford, NASA, many Chinese companies, P&G, Rolls-Royce, Telekom Malaysia, Hilti, ……

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Current Usage in Industry

- Samsung
  - Thousands of engineers trained
  - Most at MATRIZ L-1, Few at MATRIZ L-2 and L-3
  - Hand full of L-4s
  - Substantial focus on product development
- Intel
  - 2500+ trained
  - 80% at MATRIZ L-1
  - 10% at MATRIZ L-2
  - 10% at MATRIZ L-3
  - 1 at MATRIZ L-4
  - Mostly focused on manufacturing process improvement (90%)
  - Some new product development (and growing)
  - Some business process development (and growing)

David W. Conley

- Education – BS Nuclear Engineering, MBA Finance, TRIZ L4
- Work Experience
  - USAF Philips Lab – R&D Officer
    - Plasma Physical
    - Space Based Nuclear Propulsion
  - Johnson and Johnson – Process Engineer
  - Phillips – Facilities Engineer
  - Lockwood Greene – Engineering Consulting
  - Intel Corporation – Engineering, Automation, Manufacturing, Finance, Management
  - Innomation LLC – Technical and Business Innovation Consulting

Back-Up

- System Thinking

System Thinking

- Scenario planning may involve aspects of System thinking, specifically the recognition that many factors may combine in complex ways to create sometime surprising futures (due to non-linear feedback loops). The method also allows the inclusion of factors that are difficult to formalize, such as novel insights about the future, deep shifts in values, unprecedented regulations or inventions. Systems thinking used in conjunction with scenario planning leads to plausible scenario story lines because the causal relationship between factors can be demonstrated. In these cases when scenario planning is integrated with a systems thinking approach to scenario development, it is sometimes referred to as structural dynamics.