## SPECIAL NOTE TO USERS OF EZZE TRIZ

### WARRANTY

The author is not liable for errors contained herein or for incidental or consequential damages in connection with the furnishing, performance or use of this material. All technical application software is inherently complex and users are cautioned to verify the results.

### TECHNOLOGY

This program (EZZE TRIZ) uses the UFIPS (User Friendly Innovative Problem Solving) method which is a simple "cook book recipe" for Innovative Problem Solving. It was developed from ASIT (Advanced Systematic Inventive Thinking) and USIT ( unified structured inventive thinking) both of which are simplified TRIZ techniques used by Industry. The tutorial page contains a brief description of TRIZ and the  UFIPS method.

### COPYRIGHT



**R. Cuthbert - bb646@yahoo.ca**
**Hamlton Ontario Canada - 01/25/2005**

**TRIZ+USIT+ASIT = UFIPS (USER FRIENDLY INNOVATIVE PROBLEM SOLVER)**
**TUTORIAL AND USER GUIDE**

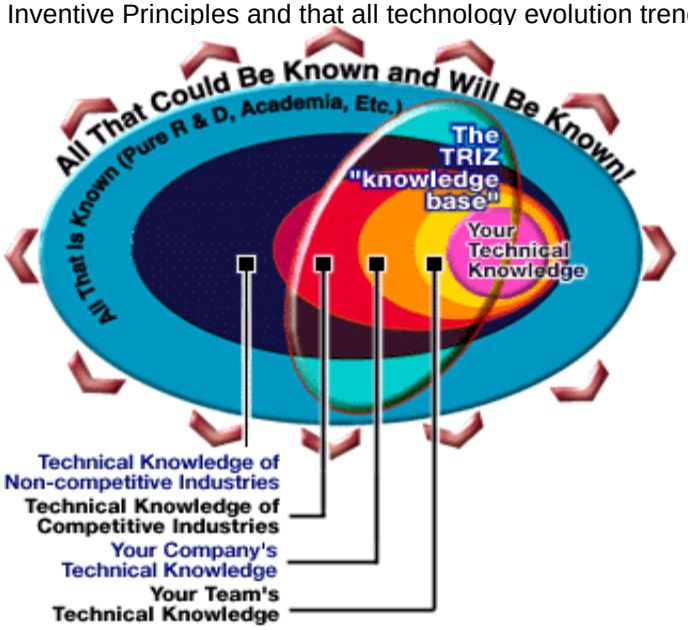
## BACKGROUND

There are two types of problems people face: those with known solutions and those with unknown solutions. Those with known solutions can usually be solved by information found in books, technical journals, or by using a consultant. These solutions follow the general pattern of problem solving where the particular problem is elevated to a standard problem of a similar or analogous nature. A standard solution is known and from that standard solution comes a particular solution to the problem.

The other type of problem is one with no known solution. It is called an inventive problem and may contain contradictory requirements. Innovative (inventive) problem solving has until recently fallen into the field of psychology where the links between the brain and insight and innovation are studied. Methods such as brainstorming and trial-and-error are commonly suggested. Depending on the complexity of the problem, the number of trials will vary. If the solution lies within one's experience or field, such as mechanical engineering, than the number of trials will be fewer. If the solution is not forthcoming, then the inventor must look beyond his experience and knowledge to new fields such as chemistry or electronics. Then the number of trials will grow large depending on how well the inventor can master psychological tools like brainstorming, intuition, and creativity. A further problem is that psychological tools like experience and intuition are difficult to transfer to other people in the organization

* 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 first set of principles to prove extremely useful was developed by Genrich Altshuller in the 1950s and 60s. Altshuller analyzed thousands of inventions documented in patents throughout the world, and selected those that represented the repeated application of the same inventions. He recognized that the same fundamental problem had been addressed by a number of inventions -- in different areas of technology. In summary, TRIZ research of the global patent database found that the same fundamentals solutions were used over and over again, often separated by many years and the world currently contains a very small number (40) of Inventive Principles and that all technology evolution trends are predictable.



By using the global patent database as the foundation for the method, TRIZ effectively overcomes all the boundaries that exist between different industry sectors. The generic problem-solving framework thus allows engineers and scientists working in any field, to access the good practices of any other field of science and engineering.

**Patents on the world data base have been categorized into 5 levels of innovation as follows:**

**Level 1 represented 32 % of the patent inventions and employs obvious solutions drawn from only a few clear options. Level 1 innovations are not inventions but narrow extensions or improvements of the existing system, which is not substantially changed.**

**Level 2 inventions offer small improvements to an existing system by reducing a contradiction inherent in the system but requiring obvious compromise. These solutions represented 45% of the inventions.**

**Level 3 Fundamental improvement to an existing system, by mrthods known outside the industry. Contradictions resolved. About 18% of the solutions fell into this category.**

**Level 4 solutions are found in science, not in technology. Such breakthroughs represented about 4% of inventions.**

**Level 5 solutions exist outside the confines of contemporary scientific knowledge. Such pioneering work represented less than 1% of inventions.**

**Once a Level 5 discovery becomes known, subsequent application or invention occurs at one of the four lower levels. For instance, the laser, technological wonder of the 1960s, is now used routinely as a lecturer's pointer and a land surveyor's measuring instrument**

**In working toward his goal of developing the "science" of creativity, Altshuller's central questions were:**

**How can the time required to invent be reduced?**

**How can a process be structured to enhance breakthrough thinking?**

**Altshuller initiated a renaissance in heuristics through his process for systematic innovation.**

Why call the process TRIZ ?
**TRIZ is the Russian acronym for the Cyrillic words:**

TEORIYA RESHENIYA IZOBREATATELSKIKH ZADATCH

**Теория Решения Изобретательских Задач**

(THEORY of INVENTIVE PROBLEM SOLVING)

In recent years TRIZ has gained increasing interest in the manufacturing industry in the Western world. This interest is driven by different factors
including:

1. Companies introduce product innovations faster and on the other hand have more difficulty to attract skilled R&D professionals.

2. The availability of state-of-the-art software supporting the TRIZ methodology.

**TRIZ METHODOLOGY**

A basic principle of TRIZ is that a technical problem is defined by contradictions. That is, if there are no contradictions, there are no problems. This radical-sounding statement forms the basis for the TRIZ problem solving methods that are fastest and easiest to learn

1. IDENTIFY MY PROBLEM

But the Central idea common to TRIZ and other problem solving techniques is the need to be able to clearly define and understand the problem to be solved. If you can't do this how can you solve the problem.

***Being able to identify your problem is one of the key ingredients to problem solving.***

2. FORMULATE THE PROBLEM

Restate the problem in terms of physical contradictions. Identify problems that could occur. Could improving one technical characteristic to solve a problem cause other technical characteristics to worsen, resulting in secondary problems arising? Are there technical conflicts that might force a trade-off?

3. SEARCH FOR PREVIOUSLY WELL-SOLVED PROBLEMS

Altshuller extracted from over 1,500,000 world-wide patents these 39 standard technical characteristics that cause conflict. These are called the 39 Engineering Parameters shown in Contradiction Tables below. Find the contradicting engineering principles. First find the principle that needs to be changed. Then find the principle that is an undesirable secondary effect. State the standard technical conflict. Are there any trade-offs to be made?

4. LOOK FOR ANALOGOUS SOLUTIONS AND ADAPT TO MY SOLUTION

Altshuller also extracted from the world wide patents 40 inventive principles. These are hints that will help an engineer find a highly inventive (and patentable) solution to the problem. Examples from patents are also suggested with these 40 inventive principles. See Table 3. To find which inventive principles to use, Altshuller created the Table of Contradictions, Table 4. The Table of Contradictions lists the 39 Engineering Parameters on the X-axis (undesired secondary effect) and Y-axis (feature to improve). In the intersecting cells, are listed the appropriate Inventive Principles to use for a solution.•(Use Matrix to identify 4-6 ‘most likely’ Principles)

# TRIZ 40 Principles

Creative tools > TRIZ Contradiction Analysis > TRIZ 40 Principles

These are the 40 inventive principles that have been used in hundreds of thousands of patents. You can use them via TRIZ Contradiction Analysis or standalone, as stimuli to prod your thinking forward.

1. Segmentation
2. Extraction

2. Extraction
3. Local Quality
4. Asymmetry
5. Combination
6. Universality
7. Nesting
8. Counterweight
9. Prior Counteraction
10. Prior Action
11. Cushion in Advance
12. Equipotentiality
13. Inversion
14. Spheroidality
15. Dynamicity
16. Partial, overdone or excessive action
17. Moving to a new dimension
18. Mechanical vibration
19. Periodic action
20. Continuity of useful action
21. Rushing through
22. Convert harm into benefit
23. Feedback
24. Mediator
25. Self-service
26. Copying
27. Inexpensive short life
28. Replacement of a mechanical system
29. Use pneumatic or hydraulic systems
30. Flexible film or thin membranes
31. Use of porous materials
32. Changing the colour
33. Homogeneity
34. Rejecting and regenerating parts
35. Transforming physical or chemical states
36. Phase transition
37. Thermal expansion
38. Use strong oxidisers
39. Inert environment
40. Composite materials

For definitions of each of the 40 TRIZ PRINCIPLES go to sheet 40

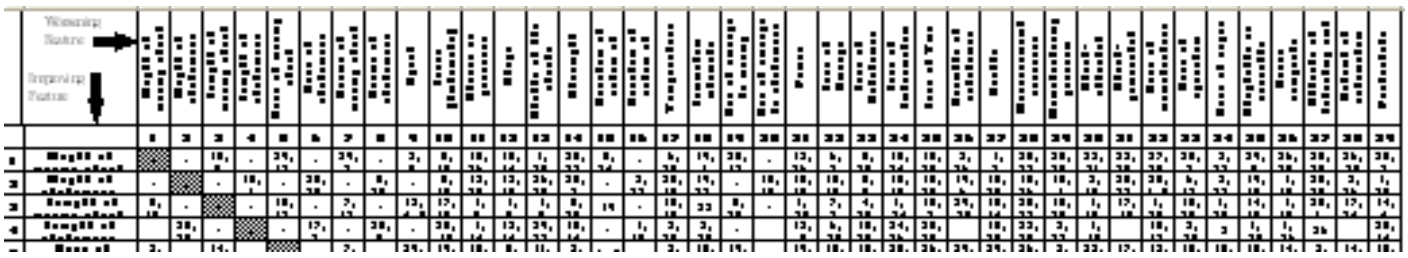
**Table 2. The 39 Engineering Parameters**

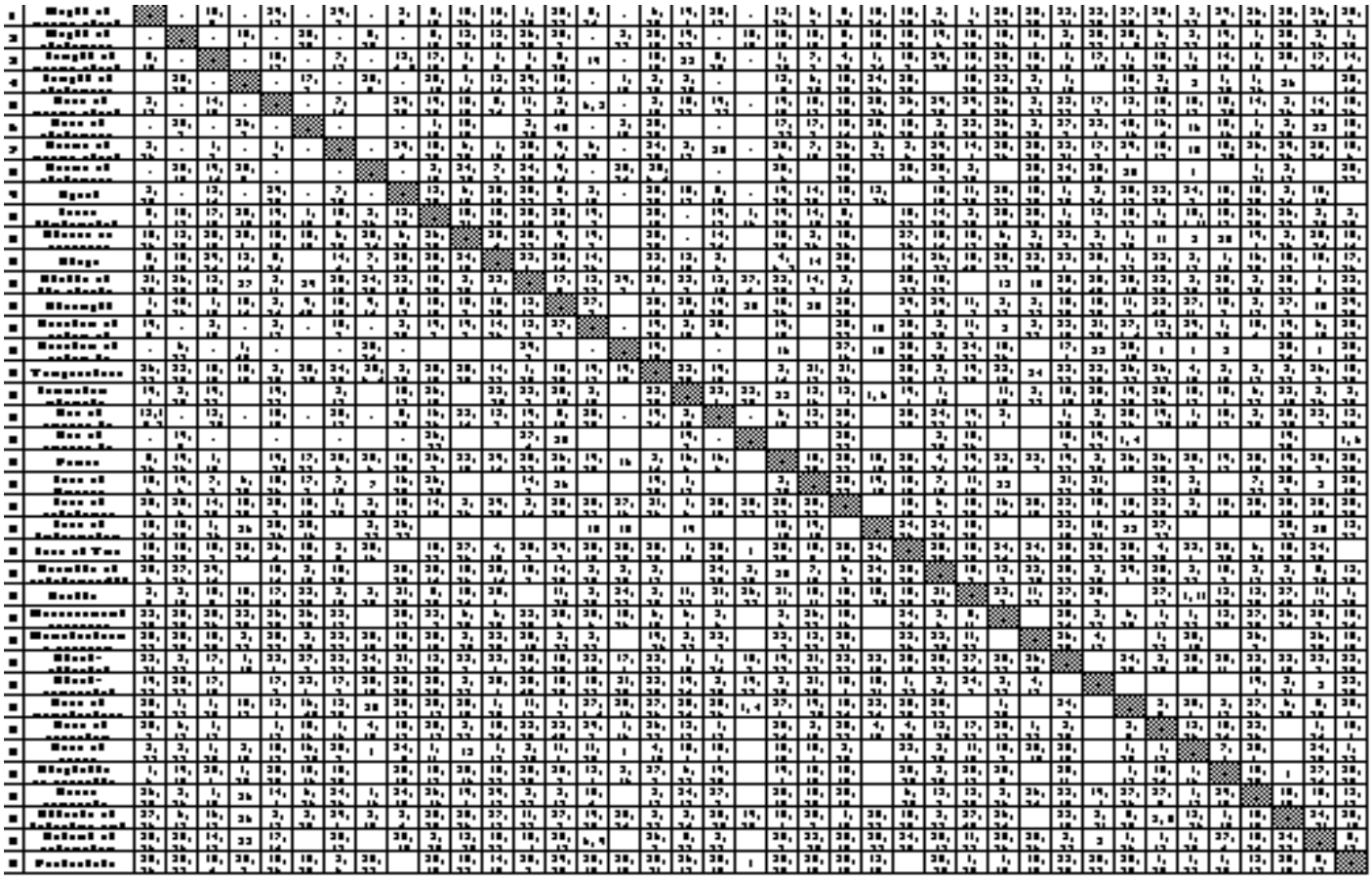
1. Weight of moving object
2. Weight of nonmoving object
3. Length of moving object
4. Length of nonmoving object
5. Area of moving object

3. Length of moving object
4. Length of nonmoving object
5. Area of moving object
6. Area of nonmoving object
7. Volume of moving object
8. Volume of nonmoving object
9. Speed
10. Force
11. Tension, pressure
12. Shape
13. Stability of object
14. Strength
15. Durability of moving object
16. Durability of nonmoving object
17. Temperature
18. Brightness
19. Energy spent by moving object
20. Energy spent by nonmoving object
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. Harmful factors acting on object
31. Harmful 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

The 39 Engineering Parameters form the basis for the CONTRADICTIONS MATRIX below. The matrix may be viewed in more detail on sheet CM4.

**CONTRADICTION MATRIX FOR TRIZ**





This technique is very comprehensive and complete but requires a great deal of experience and practice to fully exploit its potential. This richness of information and complexity is perhaps why TRIZ is not widely used in the West where we want instant results and 'never read the manual.'

THE THEORY BEHIND TRIZ IS VALID. THE APPLICATION OF THE THEORY NEEDS TO BE USER FRIENDLY!

## UFIPS USER'S GUIDE

USER FRIENDLY (AKA 'DON'T NEED TO READ THE MANUAL') is part of UFIPS's name. "The manual is integrated into the TRIZ WORKSHEETS TRIZ1 to TRIZ19. UFIPS is essentially "cook book" problem solving. If Betty Crocker and I can make a 'killer' Angel Food Cake then you and I can succeed using the UFIPS recipe for innovative problem solving.
UFIPS has as an integral part of its methodology a questionaire - a recipe to folllow in your search for an innovative solution to a particular problem. That methodology follows that of TRIZ in the problem identification and formulation stages in that a Problem is defined using structured procedures and analytical tools developed from common principles found in the worldwide patent database. but departs slightly in the analysis and solution phases.

**PROBLEM DEFINITION** Before you can solve a problem you need to know what the problem is. This is the key step in that if you cannot clearly and concisely describe the problem how can you solve it. Simply fill in the information requested in pages TRIZ1 to TRIZ4 (equipment, resources, primary process benefit,harmful effects and their probable root cause). The following Guidelines should give you insight into the information required at this stage. At this stage its better to have too much information rather then too little!

### Guidelines:

Consider a hierarchical system of problems, and set your focus.
Set a problem (i.e., a goal) as meaningful as possible.

Set a problem (i.e., a goal) as meaningful as possible.
Consider the (physical) mechanism of the problem.
Set your root causes at the level you can handle.
Examine your plausible root causes by experiments
(beforehand or afterwards).
Should be prepared for shifting your focus, if appropriate.
Set technical details and constraints aside, to get wider scope.

**This stage is found critical, because it determines the whole direction of problem solving.**

**Advised criteria:**
**Significance of the problem** (foreseeable merit/profit);
**Clearness in the problem definition**
(i.e., not vague, not open-ended);

**PROBLEM ANALYSIS** ASIT reduced TRIZ's 40 principles to five idea-provoking tools by: eliminating principles that are too problem-specific; eliminating principles that are not used very often; grouping similar principles together. TRIZ principles modified by the ASIT method were further refined into UFIPS factors for use in the cookbook recipe format used on pages TRIZ5 - TRIZ19. The factors, their relationship to the original 40 TRIZ principles and a brief description of how they are used in problem solving situations follows:

## THE FIVE PROBLEM SOLVING FACTORS(UFIPS)

**1. Reassign** Solve a problem by assigning a new use to an existing component

***2. Modification Solve a problem by using a slightly modified copy of an existing object***

**3. Division Solve a problem by dividing an object and reorganizing it parts**

4. Uniformity: Solve a problem by turning a symmetrical situation into an asymmetrical one.

**5. Physchemical** Changes of an object or system due to Chemical reaction, form (gas, liquid, solid) or physical action/reaction of component or system

**In order to use the problem solving factors one must understand how the factors are related to the original TRIZ 40 principles which are the keystone of this method. This relationship is tabulated in worksheet "FACTORS".**

**Whether you group the principles and problem solving factors the same as I do is not important. What is important is you follow the recipe using the factors as ingredients modified to suit your taste when solving a problem.**

### APPLICATION OF PROBLEM SOLVING FACTORS

Applying each factor is a five-step process. In the first step we define the problem world by listing the problem objects and the objects in the environment. In the second step we prepare for the application of the factor by collecting relevant data and making a few simple decisions. The third step is where we actually apply the factor and where the idea is born. In the fourth step the idea is captured in one sentence, and in the fifth step it is expanded and elaborated into 4 - 5 sentences.

## APPLICATION OF UFIPS FOR NEW PRODUCTS

UFIPS uses the KISS (KEEP It Simple Stupid) principle - it is easier to build upon success than to start from SQUARE ONE. One starts the product development stage with the existing product and modifies it using the UFIPS FACTORS.

In the second stage the new (virtual) product is matched with a possible market. The market is identified (or invented) by answering the question, "Who may benefit from our modified product and under what circumstances?" The market is invented instead of the product.

The advantage of this approach over the conventional approach is that we can get ahead of our competition and come up with exciting new products which satisfy needs that may have been overlooked because our customers have not communicate these needs.

Developing ideas by creating a form before determining its function has been described as 'function follows form' thinking. It has been showed experimently, that individuals become more creative when they are constrained to determine the form before its function.

### The UFIPS process for New Product Development (NPD)

1. Determine the market environment in which the product is situated.
2. Determine the new form: select an UFIPS factor and apply it to modify the product.
3. Determine the new function: try to conceive new functions, new values or new benefits for the modified product.

Here is a short description of the five UFIPS factors as they apply to new product development:

**1. Assign** Scan the product's world to find other products whose functioning can be fully or partially integrated into the existing product.

***2. Modification: modify a component of the product.***

**3. Division: Divide the products into its basic parts then reorganize the parts in space or time**

4. Uniformity: change appearance by turning a symmetrical part of the product into something asymmetrical

**5. Physchemical** Changes of an object or system due to Chemical reaction, form (gas, liquid, solid) or physical action/reaction of component or system

Notice the slight change in emphasis for the five factors

### APPLICATION OF PROBLEM SOLVING FACTORS

Applying each factor is a five-step process. In the first step we define the problem world by listing the problem objects and the objects in the environment. In the second step we prepare for the application of the factor by collecting relevant data and making a few simple decisions. The third step is where we actually apply the factor and where the idea is born. In the fourth step the idea is captured in one sentence, and in the fifth step it is expanded and elaborated into 4 - 5 sentences.

**UNIQUENESS ANALYSIS**

Among the TRIZ techniques, the derivation and elimination of "Physical Contradictions" are most important. Physical Contradiction is a conflicting situation where one parameter of a system is requested to be made in one direction and at the same time in its reverse direction. When we face with such a contradictory requirement, we very often think "It's impossible!" Whereas TRIZ gives us amazing solutions in such a case. TRIZ' solutions are derived with the Principle of Separation with respect to space, time, or some other conditions. The space - time characteristics analysis in the "Uniqueness Analysis" forms the basis of using this Separation Principles in TRIZ.

After analyzing with the UFIPS Factors. carry out the Analysis of Space - Time characteristics. Taking the (harmful) problem effect (or else the system's performance) as the problem with respect to space - time in qualitative terms.

## PROBLEM SOLVING

After completing the problem definition and analysis exercise(TRIZ1 - TRIZ19), solving the problem and summarizing it in the Solution Report follows. This is a two page report where you report the solutions evaluated, rate them and the solution selected to solve the problem.

Reporting the top 2+ solutions and not just the one selected is done to have a second look at all of the options because the actual solution to the problem maybe a combination of 2 or more solutions.

## SUMMARY

TO USE UFIPS JUST FOLLOW 'UFIPS RECIPE' COMPLETE THE TRIZ WORKBOOK (TRIZ1 TO TRIZ19) THEN FINISH WITH THE SOLUTION (1 & 2).

Using the Betty Crocker analogy the TRIZ Workbook is where you add and mix the incredients and the Solution is 'baking the Cake.' Just like baking a cake, before you take it out of the oven. You check a few times before you are satisfied that its done.