Annotated List of Key TRIZ Components

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November 2006

Below is an annotated list of key TRIZ concepts and techniques, including complementary techniques developed, used or recommended by ICG T&C.

The table presents those components which have proven to be successful in our practice. Although there are several TRIZ schools worldwide which recently developed their own modifications of original Altshuller's works or introduced their own techniques, they were not included to the table.

Theory of Technical Systems Evolution	Main theoretical foundation of TRIZ. A philosophy behind the theory of technology evolution is that every man-made product (or a technical system) which was designed to deliver certain functional value tends to evolve in a systematic way according to generic patterns and trends of evolution. Altshuller made this conclusion on the basis of comprehensive studies of hundreds of thousands of patents, books and articles presenting the history of technological products evolution. The TRIZ laws and trends of evolution are claimed to be independent of any specific technological area.
Laws and Trends of Technology Evolution	Specific laws and trends of the technology evolution. In total, TRIZ presents nine laws and trends of evolution. A number of trends include more specific lines and patterns indicating how a system or its parts evolve over the time. The TRIZ trends and laws are very powerful knowledge which provides the basis to predict what will happen next with a selected product or a technology from the perspective of internal evolutionary potential of a system.
Multi-Screen Diagram (also known as 9 Windows, or 9 Screens, or System Operator)	The multi-screen diagram of thinking specifies that any specific system (product, technology, organization, etc.) can be viewed at least from three layers: system (the system itself within its boundaries), its subsystems and supersystem. Besides, at each layer, the past and the future of the system, subsystems or supersystem are considered to understand what factors drive evolution of the system. This approach helps to analyze the product evolution deeper by taking into account relationships of the product with an outer world, as well as predict further evolution of each layer. According to Altshuller, this way of thinking is a feature of outstanding inventors, artists, musicians – those who used to create new breakthrough ideas by seeing the world through the prism of system thinking. Although not easy to use, the multi-screen diagram of thinking is a very powerful tool of system analysis and forecast.

Ideality	As claimed by TRIZ, ideality if a major trend of man-made systems evolution. The degree of ideality is defined as a ratio between the overall performance of a system (everything that creates value) minus harmful effects produced by the system (everything that diminishes its value) and costs necessary to achieve its performance (everything which is needed to create value). Ideality in TRIZ is a qualitative measure which is not directly calculated but serves as a major guideline during processes of problem solving and new idea generation.
Ideal Final Result (IFR)	Enables formulating target solutions in terms of ideality. Formulation of the Ideal Final Result helps to correctly set up goals, fight mental inertia and design costs-effective products and services.
Contradiction	A contradiction in TRIZ is a primary problem model which is used to formulate inventive problems. As stated by Altshuller, emergence of a contradiction is a main feature which distinguishes an ordinary problem from an inventive problem. Contradictions arise when two mutually exclusive demands are put on the same system or object and there is no known way to meet them. TRIZ introduces three types of contradictions: a) Administrative, b) Technical, c) Physical. TRIZ states that to obtain an inventive (breakthrough) solution, a contradiction has to be eliminated rather than optimized.
Resource Analysis	During problem solving, resources play a major role in TRIZ. The proper use of available resources helps to obtain more cost-effective and ideal solutions without complicating a system and introducing new expensive components and materials. Resources are available at both system and supersystem levels and can be material (e.g. substances, fields) and immaterial (e.g. information). Although originally Resource Analysis was a part of ARIZ, today Resource Analysis is also used together with other TRIZ techniques.
Function Analysis (also known as Function-Attribute Analysis).	Function Analysis is a modification of original Value-Engineering Analysis (VEA). Utilizing the same basic approach to modeling existing products in terms of components and functions delivered by the components, FA differs from VEA in a way of how function is defined. In FA, the function is regarded as an effect of a physical interaction between two system components. Besides, FA has algorithms for ranking functions and problems. FA is very useful to conduct a systematic analysis of products and formulate problems in terms required by the other TRIZ problem solving techniques.
Ideation Problem Formulator	Developed by Ideation International, it is an analytical tool which gives users the ability to model systems or problem situations in terms of cause and effect relationships, and attacks the overall problem more effectively by slicing it into a subset of simpler (typical) engineering dilemmas.
Root Conflict Analysis (RCA+)	A technique for casual decomposition of complex problems and invention situations to effects and causing conflicts (contradictions). Helps to map and visualize all system conflicts as well as reveal hidden conflicts. Although based on a similar

	approach introduced in Theory of Constraints (TOC) and Root Cause Analysis, RCA+ focuses on revealing conflicts which can be further resolved with other TRIZ techniques. Note: RCA+ was developed by ICG T&C. Some other TRIZ vendors use Root Cause Analysis to identify root problems in inventive situations.
40 Inventive Principles for Resolving Technical Contradictions	Inventive Principles for technical contradiction elimination are used to eliminate problems represented in terms of technical contradictions. Inventive Principles describe either solution pattern which can be applied to resolve the contradiction, or a direction in which a problem has to be solved. There are 40 inventive principles for resolving technical contradictions available in TRIZ (some TRIZ extensions present 50 principles).
Matrix for Resolving Technical Contradictions (also known as Contradiction Matrix, or Altshuller Matrix)	The first technique and still the most popular, developed by Altshuller in the sixties. Based on the analysis of over 400.000 patents intentionally drawn from different areas of technology, the matrix helps to identify which of 40 Inventive Principles are most relevant to solve problems represented as contradictions: a technical parameter to be improved versus another parameter of the system that gets worse when implementing such an improvement. TRIZ states, that to obtain inventive solution the contradiction has to be eliminated while no compromising is allowed. The necessity to eliminate contradictions is the driving force of technological progress. Altshuller Matrix allows the principles for technical contradiction elimination to be used in a systematic way. The matrix was designed on the basis of 39 generalized parameters any specific parameter is claimed to be possible to associate with. The same lists of parameters are placed along vertical and horizontal axes of the matrix. A point of intersection of two generalized parameters indicates which inventive principle(s) is to be used in each particular situation.
11 Principles for Physical Contradiction Elimination	The Principles for Physical Conflict Elimination indicate how to change a physical structure of a system to eliminate physical contradictions (conflicts). There are 11 principles for Physical Conflict Elimination presented in TRIZ. Although this technique can be used independently, formulation of a correct physical conflict is a non-trivial task. For this reason, the use of ARIZ to formulate physical conflicts is recommended. The aim of using ARIZ is to formulate and eliminate physical conflicts in the most ideal way.
Substance-Field Analysis (also known as Su-Fi or S-Field Analysis)	Any technical system (product, machinery, technology) or its part can be modeled as a number of substance components interacting with each other via fields. Unlike physics, TRIZ introduces 6 types of fields: mechanical, acoustic, thermal, chemical, electric, magnetic, and electromagnetic. Abstract physical modeling of the system's part which causes a problem helps to identify and classify a specific interaction which does not meet the required specifications. The unsatisfactory interaction might be of four types: i) insufficient or poorly-controllable to obtain the desired result, ii) excessive and produces more action than required, iii) harmful, when the interaction is necessary to obtain a positive effect but results in a side negative effect, and iv) missing – an interaction is necessary in the system but we do not know how to introduce it.

	Substance-Field Modeling and Analysis are used for problem modeling and further solving with 76 Inventive Standards.
76 Inventive Standards	In case a system was modeled in terms of physical components and interactions via Substance-Field Modeling, and a problem is represented as an unsatisfactory interaction, TRIZ recommends to use special rules which contain abstract patterns indicating how the physical model given has to be modified by: a) replacing the existing components with other components, b) introducing new components; c) modifying the existing components; d) changing a system structure. The term "inventive standard" means that there is a typical, or a "standard" pattern of solving those groups of problems which result in identical substance-field models. There are 76 inventive standards available. Although inventive standards are more specific than 40 Inventive Principles, their application requires more learning and practice.
Algorithm of Solving Inventive Problems (ARIZ)	One of the most powerful and complex analytical TRIZ technique which helps solving those problems that can not be solved with the use of the other TRIZ techniques. Since the above mentioned TRIZ techniques operate with direct modeling of a problem and finding a relevant solution pattern or a principle from the TRIZ databases, it is not always possible to formulate the problem directly in the right way. ARIZ helps to extract a core problem through comprehensive analysis of the problem conditions and fighting mental inertia. ARIZ consists of a number of operators specifying how to perform the steps of analysis. However, learning ARIZ and mastering skills with ARIZ is not an easy process and can not be done within a short time. Being more analytical tool rather than the tool for synthesis, ARIZ requires a problem solver to restructure and reorganize his thinking process that might be found time-consuming but necessary. Although there are several versions of ARIZ proposed by different TRIZ schools which are claimed by authors to be more effective than the original Altshuller's ARIZ, we, however, recommend the Altshuller's version of ARIZ due to its proven efficiency. The latest official version of ARIZ is ARIZ-85C.
Trimming (also known as Idealization)	A technique which helps to make existing systems and products more ideal by eliminating their components without impairing overall system's performance, functionality, and quality. Usually performed after a system is represented as a function model with the help of Function Analysis.
Alternative System Merging (also known as Feature Transfer, Hybridization)	A technique which helps to develop new products on the basis of combining features of two competitive products. Usually competitive products are featured by different sets of advantages and disadvantages. The technique helps to design a new product that inherits advantages of the competitive products while disadvantages are eliminated. However, direct merging of features might be difficult due to a number of contradictions arising when we attempt to develop such the product. For this reason, the TRIZ techniques are recommended to use after the contradictions were identified.

Catalogs of Physical, Chemical and Geometrical Effects	Resulted from large-scale studies of hundreds of thousands of patents to determine which technical function is delivered by which physical effect (principle, phenomenon). Specific technical functions and effects then were generalized, categorized, and presented in the catalogue. In many cases, scientific knowledge we possess is not enough to find a required solution, especially in cases when we need to find a new solution principle outside of our area of knowledge. Encyclopedia and handbooks usually do not provide fast access to the needed information since they are not developed with respect to technological diversity. For these reasons, the use of the TRIZ Catalogues of effects helps to bridge the gap between physics and technology by mapping technical functions to physical effects, principles and phenomena. Similar catalogs are available for chemistry and geometry.
Modeling with Miniature Dwarfs (also known as "Little Men Method")	Complementary technique, mostly used in combination with ARIZ (included to ARIZ-85C). The technique helps to represent physical interactions within a system in terms of "controllable dwarfs" which can be associated with system parts, molecules, elementary particles, etc. The technique is directly aimed at tackling the mental inertia and better understanding the problem.
Demand/Trend Matrix	A technique for generating new ideas for products and services by using correlation between Evolutionary Potential Analysis, Market needs and demands, and TRIZ Trends of System Evolution. Note: Demand/Trend Matrix was developed by ICG T&C
Problem Flow Technology	A technique for solving most difficult problems which can not be directly solved by other TRIZ techniques. Enables designing a final desired solution from a number of "partial" intermediary solutions. Was developed as a part of OTSM-TRIZ, the latest TRIZ development by G. Altshuller and N. Khomenko, where OTSM is a Russian abbreviation for the "General Theory of Advanced Thinking".
Radar Plotting and Evolutionary Potential Analysis	Enables mapping of any technical or business system to a radar plot in which spokes represent TRIZ lines of systems evolution, thus visualizing current state-of-the-art of a system with respect to its evolution from TRIZ perspective.
Evaluation Techniques	Although these techniques were not developed as a part of TRIZ, they have been used together with TRIZ to help with making decisions related to selection and evaluation of problems and generated ideas. Among the used techniques are Comparative Ranking and Multi-Criteria Decision Matrix.
Subversion Analysis (there is a version known as Anticipatory Failure Determination)	Helps to analyze a system against potential failures that might emerge in the system during its operation and exploitation.
Creative Imagination Development Techniques	A number of techniques aimed at the improving personal creative imagination skills and foster generation of the "out-of-the-box" ideas. For example, replacement of specific terms that describe a problem with abstract terms helps to broaden the

	search space of possible solutions. Among the techniques are the method of Focal Objects, Creativity Principles, 4-Stories Modeling, Fantogramma, etc. The most popular technique is "Size-Time-Cost Operator" which suggests to imagine what would happen with an object and its environment if we increase or decrease values of parameters many times. Today Creative Imagination Development Techniques are used in both adult and children education. In Russia, special programs were developed for teaching creativity to kids starting at age of 3.
Theory of Creative Personality Development	A theory which was developed by Altshuller based on his extensive studies of over 1000 biographies of outstanding creative people – inventors, writers, artists, scientists – and introducing generic patterns which indicate how these people were able to resolve social contradictions to achieve their goals.
TRIZ for Business and Management	A number of original TRIZ and additional techniques which were adapted and developed for business and management innovation to improve and create new business products, processes, and services.

