Three stages of classical TRIZ

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Basic problem statement

- Foundation of TRIZ validity
  - Most arguments for TRIZ promotion are based on its successful application
    - However, successful applications do not prove TRIZ validity. Possibility of lucky chance cannot be denied.
  - Basic postulate of TRIZ

"Technical systems do not evolve at random, but they evolve in accordance with certain objective laws. It is possible to discover the laws and use them for further improvement of systems."

- There is no common definition of "Technical systems" or "Laws" even among a limited number of leading TRIZ masters.

Ultimate object of the study

- Because the present TRIZ theory does not serve as the foundation of TRIZ validity, it is required to set the foundation on the basis of validly used TRIZ contents.
- It is necessary to reveal specific common nature of different types of TRIZ.

Targets of the study

- To set foundations of TRIZ validity on the followings:
  - specific features of TRIZ which other disciplines lack and
  - their practical merits.
- To reveal the TRIZ specific features in
  - existing variety of TRIZ and
  - dynamism of TRIZ development.

Existing variety of TRIZ

∗ Classical TRIZ

TRIZ developed under Altshuller's direct leadership up to around 1985

∗ TRIZ development without Altshuller

By students of Altshuller

Development according to inherent logics of classical TRIZ

Development of TRIZ application based on classical TRIZ

Management of failures, Business planning, Patent strategy

Education, Advertisement, Designing, Business

European universities

Partial use of Classical TRIZ and its development (Especially in combination with existing methods of academic and/or practical origins)

Others

Auxiliary modifications of limited tools of Classical TRIZ

Plan: the Present presentation

- To reveal steps of the TRIZ development during the classical era in order to set bases to understand dynamism of TRIZ development.
- To study 3 stages of TRIZ development at the interval of some 15 years in between documented in the following documents:
  - “On Psychology of Inventive Creativity”, Problems of Psychology, Vol.6, 1956
  - ARIZ-71, 1971
  - ARIZ-85C, 1985

Nature of the 3 documents

	1956	1971	1985
Aims	Creative problem solving is a thinking process consisting of Analytic, Operational and Synthetic parts	Presentation of a scientific method for creative solution of difficult technical problems	Presentation of an indisputable thinking process to solve difficult problems new to the TRIZ community
Role	Presentation of the steps which respond to the requirements of each part of the process	An all-round technical problem solving process	* Easy problems: Traditional tools developed by TRIZ (Inventive principles, etc.) * Standard problems: Standards * Non standard problems: ARIZ-85C
Historic position	Prototype of ARIZ	ARIZ as the Keystone of TRIZ	ARIZ as a specialized problem solving tool for new types of technical problems and a tool for TRIZ development

Comparison of Basic steps

	1956	1971	1985
	Selection of problem	Selection of problem	
	Identification of principal links of the problem	Evaluation of problem situation	
	Identification of the critical conflict	Analytic stage	Analysis of problem
	Identification of cause of the conflict	Preliminary evaluation of solutions	Identification of resources
			Ideality / Physical conflict
	Search for prototypes of solution	Operational stage	Application of resources
	Search for changes as solution		Application of knowledge bank
	Identification of related changes	Synthetic stage	Alternative problem
	Application of changed system		Analysis of process of solving physical conflict
Synthesis (Idea application)	Application of solution		Practical application of the solution
	Evaluation of invention		Analysis of problem solving process

Three parts of Problem solving Contents

- Problem solving as a human thinking activity is composed of 3 parts with different natures
  - Analytic part
    - To extract the essence of the situation with a problem
    - Altshuller and Shapiro discovered the essence to be a conflict
  - Operational part
    - To change the representation of the situation for the solution
    - Altshuller and Shapiro discovered the change to be the solution of the conflict
  - Synthetic part
    - To identify related changes required in connection with the solution
      - It is the root of “Secondary problem”, “Failure prediction” (Ideation), “Problem Flow Network” (OTSM) and other TRIZ steps and tools.
    - Capitalization of the solution

Three parts of Problem solving Comments

- One of the discoveries that put TRIZ on a new dimension of problem solving methods
- Similar understandings are consistent throughout different schools of contemporary TRIZ

Analysis: Prototype in 1956

- Tasks of the analytic part are as follows in 1956
  - To identify the true problem to be solved
  - To extract the essence of the problem
  - To formalize the essence as a conflict
  - To reveal the cause of the conflict
- However, it was not more than a list of required tasks at this stage

Analysis: Development in 1971

- Tasks in 1956 have developed into 4 sets of steps in 1971 in a new structure
  - Selection of problem
    - Comparison of different approaches to achieve the same target. Numeric expression of the target. Adjustment of the target based on pragmatic consideration
  - Evaluation of problem situation
    - Analysis of patents, Changes of problem representation by psychological methods, Division of elements of the problem into changeable and non-changeable groups
  - Analytic stage
    - Ideality, Operational zone, Prototype of physical conflict, List of possible methods to solve the conflict, Priority of the solutions
  - Preliminary evaluation of solutions
    - Secondary problem, Solution, Evaluation of solution for secondary problem
- Later in 1975 (“Present situation of TRIZ”) Altshuller stated that the analytic steps including the preliminary evaluation made the ContradictionTable superfluous.

Analysis: Elimination in ARIZ-85C

- Elimination of “Selection of problem” step in the preceding ARIZ (refer to slide 7)
- One of the tasks of the analytic step, now, is the purification of the “Mini Problem” (= Essence of problem) into a physical conflict
- A new important task of the analytic step, identification of substance / filed resources, was introduced

Operation: Conflict

	1956	1971	1985
Types of conflicts	Technical conflict	Main: Technical conflict Additional: Prototype of Physical conflict (Identification of the operational zone and analysis of two contradictory requirements for the zone)	Main: Physical conflict (Technical conflict is treated as a mere step to the physical conflict)
Methods for solving conflicts	* Analogy in nature and other fields of technology * Possible changes in the system	* Contradiction Table * Analytic steps	* Application of resources * Standards * Experiences of TRIZ application * Eleven heuristics for physical conflicts * Physical effects

Synthesis

	1956	1971	1985
Contents	List of steps * Changes required by introduction of solution * New applications of improved system * Application of solution to other fields * Evaluation of invention	List of steps * Required changes in the super system * New applications of improved system * Application of solution to other fields	Detailed steps for evaluation and pragmatic application of solution were introduced * Traditional contents of synthetic part * Detailed instruction for capitalization of ARIZ application cases
Secondary problem	Necessity of related changes was realized	Reference to secondary problems in the new steps for preliminary evaluation of solution	A step was introduced to list different types of secondary problems

Laws of technical systems evolution 1956

- 1956
  - The following laws were listed as the presupposition of the inventive problem solving process
    1. There are always close co-relationships between elements of equipment, mechanism and/or technical process.
    2. Evolution of elements proceeds disproportionally. Some elements evolve ahead of others.
    3. It is possible to control the evolution of a system (equipment, mechanism and/or technical process) while a conflict between elements with advanced and delayed evolution does not materialize and intensify.
    4. A conflict prevents the evolution of a system as a whole. Invention is elimination of the conflict itself.
    5. Introduction of a change to a certain part of a system inevitably leads to the necessity of introduction of a set of changes in different parts of the system in accordance with the requirement of the original change.

Laws of technical systems evolution1971/1985

- 1971
  - No change from 1956
- 1985
  - Laws for this ARIZ assumed to be those mentioned in “The laws of systems evolution” (Altshuller, 1975)
  - Reference to “the standards” in every step of ARIZ and reference in several steps to “Shift to a super system” and “Change to micro level” witness the close ties between ARIZ-85C and the laws.

Ideality: 1956 / 1971

- 1956
  - Concept of “Ideality” was yet to be established
- 1971
  - A step was introduced at the beginning of Analytic part for formulation of Ideal Final Result, as follows:

  a) Think about (the selected) substance;

  b) What does it do?

  c) How does it work?

  d) When does it work?

  e) Under what conditions (limitation, requirements and so on)?

Ideality: 1985

- Based on the understanding that a physical conflict is a situation that prevents the realization of the Ideal Final Result, the concept of IFR is used twice in combination with two levels of physical conflict.
  - 1
    - X-element does not complicate the system or cause harmful effects itself,

    while eliminating harmful effects and/or retaining the ability of tools to achieve useful effects during a certain operational time within a certain operational zone.
  - 2
    - Certain operational zone should

    during a certain operational time

    provide two conflicting requirements on the macro or micro level on its own.
- This ARIZ requires (in the step to evaluate the solution) to further improve the ideality of (or trim) the solution.

Emphasis in each “ARIZ”

	1956	1971	1985
Emphasis	Conflict	Analysis	Analysis and synthesis
Back-ground	First introduction of the TRIZ concept of Conflict	Intention to guarantee better results from ARIZ application	ARIZ as a tool for TRIZ development

Prospect of further ARIZ development at 1985

- A quotation from “History of ARIZ development” (Altshuller, 1986)

1. The traditional trend of ARIZ evolution - overall improvement of its quality as an algorithm through more complete and more in-depth use of objective laws of technical systems evolution.
2. A substantial strengthening of the "bridge" between Physical Conflict and the methods of its resolution.
3. Further enrichment of informational data base, reinforcement of ties between ARIZ and Standards.
4. Separation of the second half of ARIZ (further development and use of discovered ideas) into an independent algorithm.
5. Development of a new beginning part (or a separate algorithm) for identification of new problems.
6. Strengthening of the function as a means of public education. ARIZ should vigorously develop strong thinking skills.
7. Gradual universalization of ARIZ.

Preliminary conclusions

- History of TRIZ in classical era witnesses its constant improvement. Major TRIZ concepts are not exceptions. They have gradually changed to those we understand today.
- On the other hand, emphasis of ARIZ remained on certain and rightful extraction of conflict as the focus of problems.
- By studying 3 stages of classical TRIZ we can notice that the aim of TRIZ as a system also gradually shifted. The change could be characterized as follows:
  - Method of invention → Science of invention → Science for effective thinking
- The change of TRIZ did not end with the Classical TRIZ, but continues today.
- It is required to identify defects of Classical TRIZ as the basis of the development of contemporary TRIZ.

References:

All by Altshuller:
“On Psychology of Inventive Creativity”, Problems of Psychology, Vol.6, 1956, (co-author Rafael Shapiro)
“ARIZ-71”, 1971
“ARIZ-85C”, 1985
“History of ARIZ development”, 1986
“TRIZ application”, 1986
'Introduction' to “Standards for Inventive Problem Solving (76 standards)”, 1988
All from the site of Altshuller Foundation
http://www.altshuller.ru/triz/