TRIZ – Technology for Innovation

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Abstract

We will talk about HOW to use all modules of TRIZ as a complete and harmonic system in combination with other proven methods in the most effective way. TRIZ – Technology for Innovation is represented by TRIZ Innovation Roadmaps for Projects Creation & Problem Solving

We included in TRIZ Innovation Roadmap together with TRIZ modules other proven methods in order to create a complete (almost complete) set of tools for the Conceptual stage of Product/Process design (Fig. 1):

- Value Analysis & Value Engineering
- Root-cause analysis - RCA
- Failure Modes and Effects Analysis – FMEA
- Hybrid (alternative) system design
- Trimming
- Hybrid Concept Design
- Concept Scenario

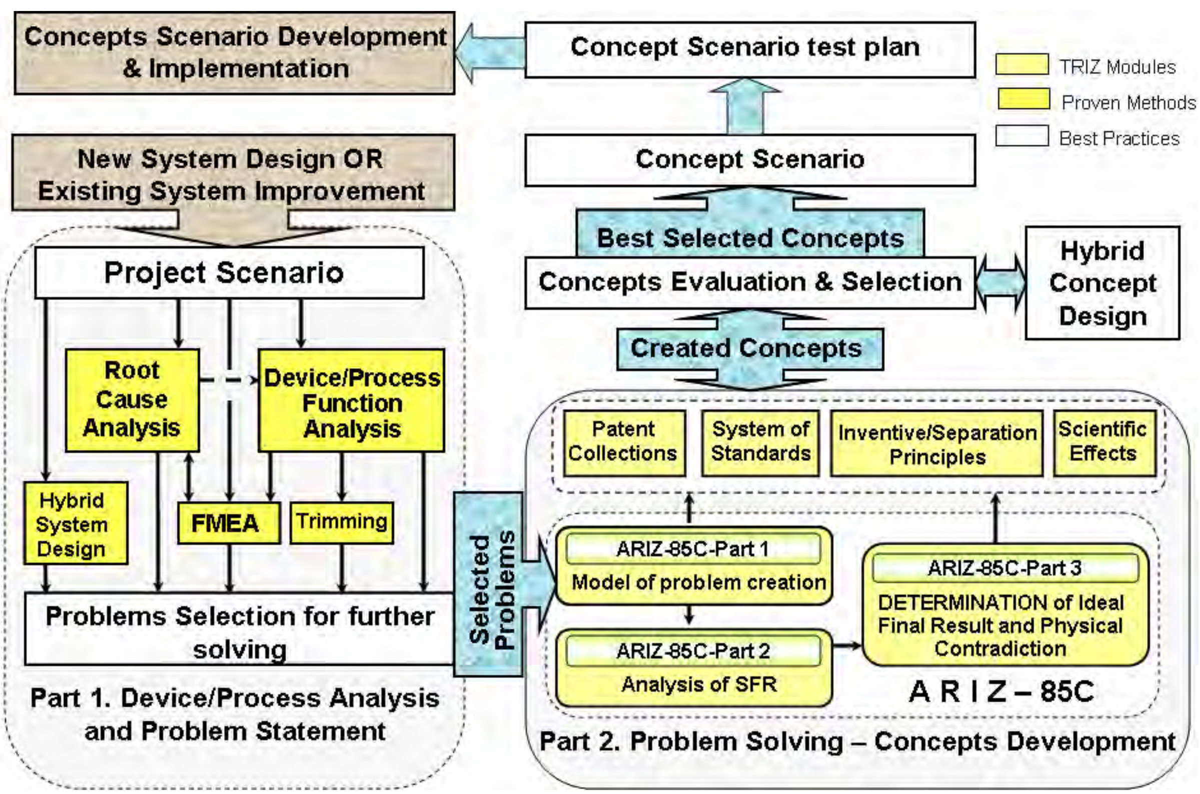

Fig. 1. TRIZ Innovation Roadmap (most complete variant) for Projects Creation & Problem Solving contains two parts: Part 1 - device/process analysis & problem statement (on the left) and Part 2 – TRIZ modules for problem solving and concepts development (on the right).

We will show you our experience and best practices of many innovative teams around the world in TRIZ application for different kinds of projects and problems including (but not limited to):

- Existing Product or Process Improvement
- New Product or Process Design
- Next generations of customer product and process
- Pre-specification research for new product and process
- Defects of components of a new product design -> to find available causes of these defects
- Burst/circumvent the competitor‟s patent
- Nature effect/phenomena application
- Quality/reliability improvement
- Manufacturing cost reduction
- Information preparation for R&D projects
- Six Sigma and DFSS projects
- New alternatives to achieve given function
- Improvement of interactions in product/process

Part 1 - System analysis and problem statement (Fig. 2)

Usually, the new system design or existing system improvement is an input to Part 1 - device/process analysis & problem statement. There are five modules of most proven methods of system analysis and problem statement. All problems, defined during RCA, Function Analysis, FMEA, Hybrid System Design, and Trimming, are collected in Problem Selection module.

Project scenario is a specially created module, based on experience of many project teams, for preparation the correct object of the project and for this object preparation for the further analysis. Some TRIZ modules are used for Project Scenario creation. Selected problems are an output product of Part1 and are an input to Part 2 – TRIZ modules for problem solving and concepts development.

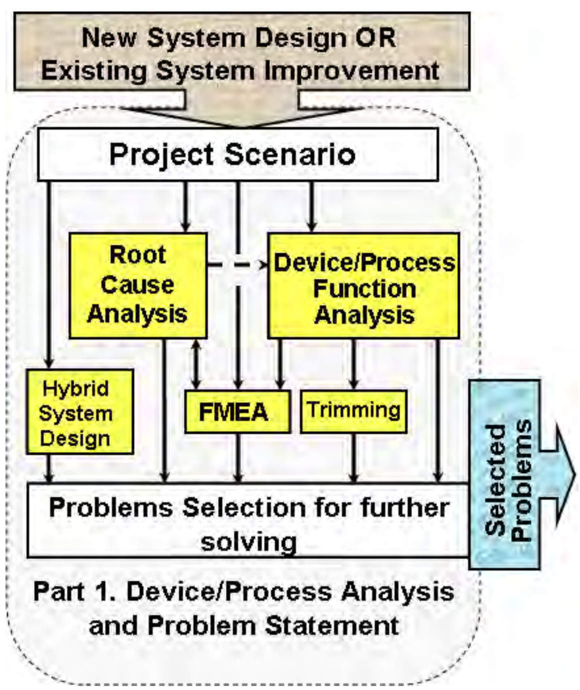

Fig. 2. TRIZ Innovation Roadmap for Projects Creation & Problem Solving: Part 1 - device/process analysis & problem statement

Project Scenario

Project Scenario is the first stage for any kind of projects. We strongly recommend you to have a complete Project Scenario at the end of the first Project session with the consultant. Project Scenario usually contains the following seven stages:

1. Project team report about Project initial situation, including requested information
2. Right project topic selection and right initial problems definition
3. Preparation of clear and "understandable" pictures/sketches of subject(s) of project
4. Creation of a list of expectations
5. Preparation of a list of time-space-substance-field resources and their parameters
6. Selection of most effective ways for concepts creation
7. Project innovation roadmap creation

Root-cause analysis

RCA is one of the main parts for many methods, including lean manufacturing; failure analysis; FMEA; risk management; accident analysis; DFSS; 6Sigma and so on. RCA is a systematic method that leads to the discovery of a fault's first or root cause. It is a definite progression of actions and consequences that leads to a failure or to a simpler problem.

An RCA investigation traces the cause and effect trail from the end failure back to the root cause. It is much like a deductive reasoning of Sherlock Holmes.

Example

A senior engineer of a manufacturing plant of one of the world leading companies urgently called the purchasing department located in Boston – we have problems with pipes in the ventilation system. We have to replace all pipes four times per year. It means we should buy two miles of pipes per year.

Accidentally a young engineer, who had recently completed RCA courses, listened to this conversation. He decided to use his knowledge for the pipe related problem. Let us follow him (Fig. 3). RCA of the pipes problem gave an excellent result – an instruction for the technician was created (to cover the solvent tank at the appropriate time) instead of buying miles of pipes.

RCA helps to define the right problem and simplify the initial stated problem.

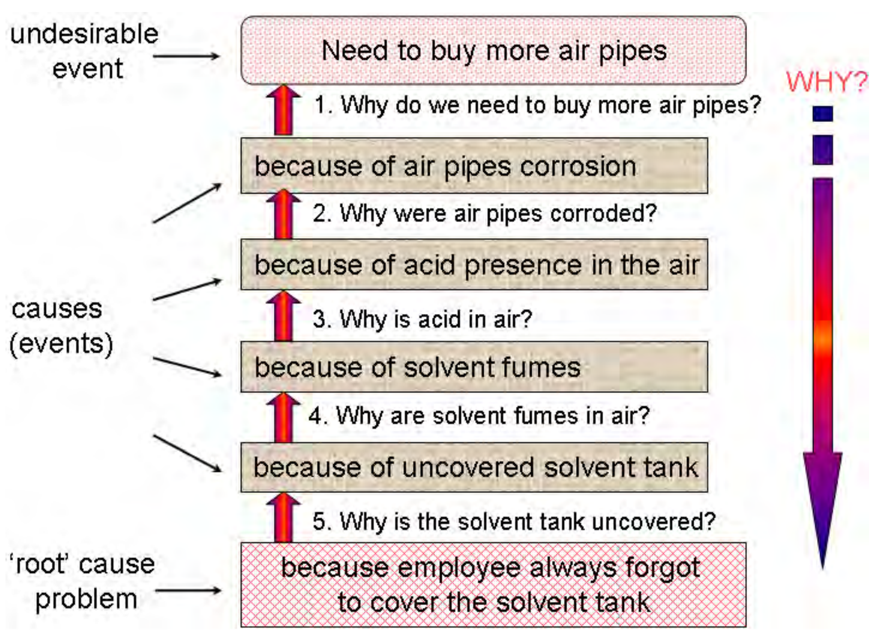

Fig. 3. The starting point for any RCA is the initially stated problem. In RCA, we often call it as the undesirable event. Now we ask for the first question – first WHY – Why do we need to buy more air pipes? An answer is –

because of air pipes corrosion. Second WHY – Why were air pipes corroded? An answer is – because of acid presence in the air. Third WHY – Why is acid in the air? An answer is – because of solvent fumes. Fourth WHY – Why are solvent fumes in the air? An answer is – because of uncovered solvent tank. Fifth WHY – Why is the solvent tank uncovered? An answer is – because an employee always forgot to cover the solvent tank.

System (Device/Process) functional modeling and analysis

Functional modeling and analysis is the main part of Value Methodology (Value Methodology is a system created to prevent unnecessary cost during the product/process design and to identify & remove unnecessary cost during product manufacturing in the most profitable manner).

A functional model of a system defines and describes the functions of each system component and super-system elements - it describes how the given system works. Functional analysis analyses these functions as interactions between components and helps to define almost any existing problem in the analyzed system.

Example

Ampoules are commonly used to store medicines. During the packaging process, the ampoule neck is exposed to a very intense flame. High temperature of welding causes a problem – it overheats the medicine and damages it. Let us create a functional model (Fig. 4) of the described system and provide the functional analysis (Fig. 5) of the created model.

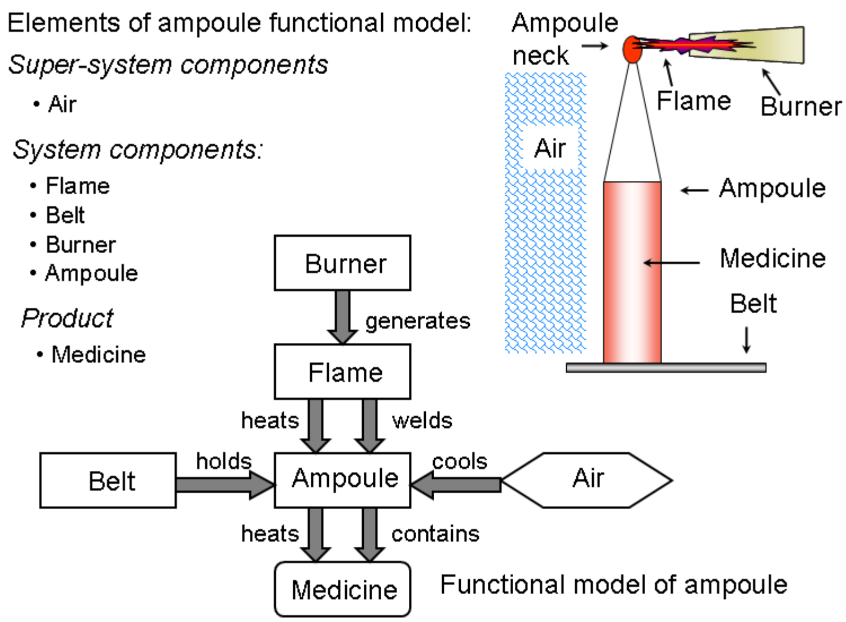

Fig. 4. Functional model of ampoule – contains one super-system component: air; system components: flame, belt, burner, and ampoule; product: medicine. There are seven functions/interactions in the functional model: burner generates flame; flame welds ampoule (neck of ampoule); flame heats ampoule; ampoule heats medicine; ampoule contains medicine; air cools ampoule; belt holds ampoule.

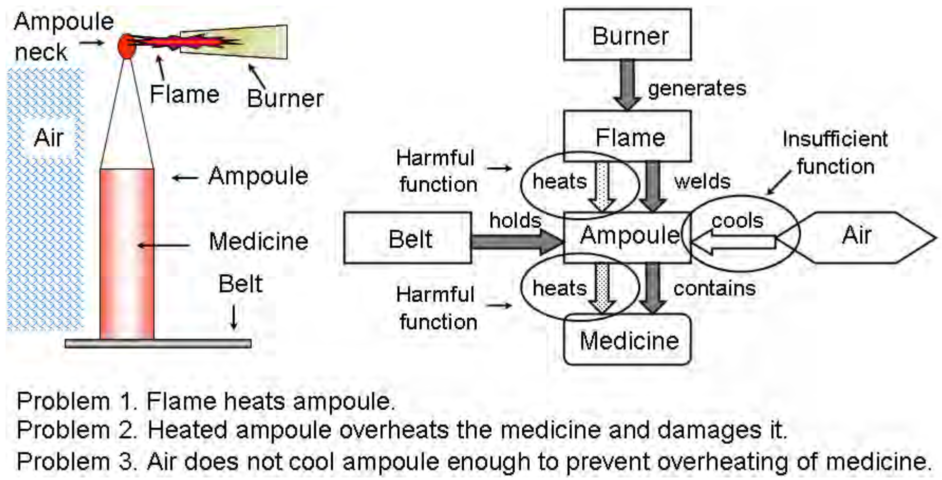

Fig. 5. Functional analysis of the functional model of ampoule – three problematic functions were found: „flame heats ampoule" and „ampoule heats medicine" are harmful functions for medicine; „air cools ampoule" is an insufficient function. These three functions cause three problems.

Hybrid (alternative) system design

Hybrid System Design allows you to compare several systems that perform similar function and to combine the best features of these systems into one hybrid system.

Failure Mode and Effects Analysis (FMEA)

FMEA is a procedure for analysis of potential failure modes within a system for the classification by severity or determination of the failure's effect upon the system.

It is widely used in the manufacturing industries in various phases of the product life cycle. Failure causes are any errors or defects in process, design, or item especially those that affect the customer, and can be potential or actual.

Modules of the TRIZ Innovation Roadmap perform the tasks of FMEA and help to populate the main five columns of the FMEA table (Fig. 6).

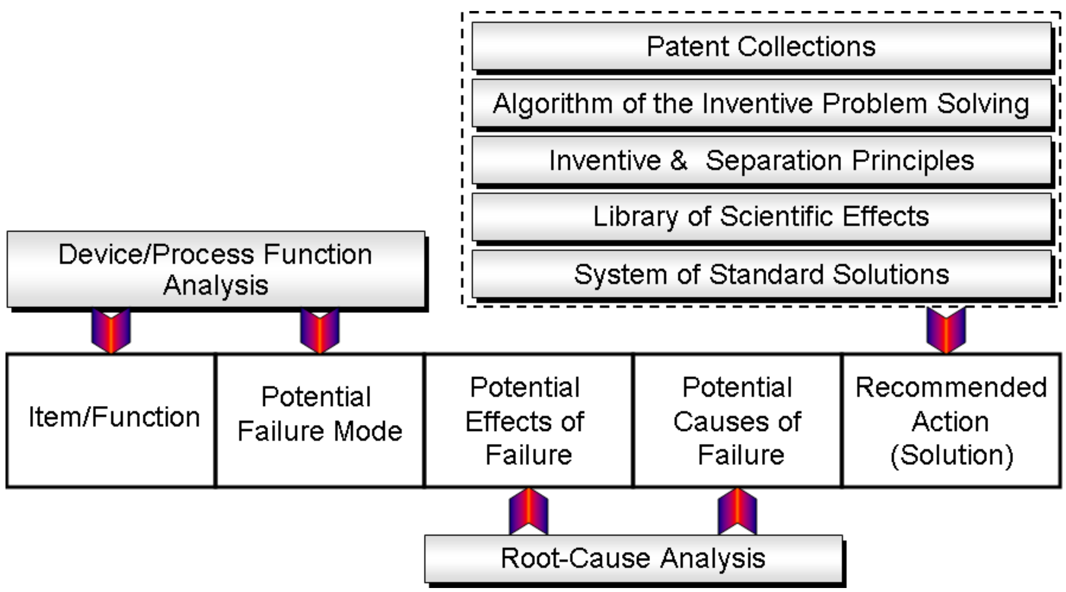

Fig. 6. Modules of the TRIZ Innovation Roadmap help to populate the main five columns of the FMEA table: device/process function analysis populates two columns – Item/Function and Potential Failure Mode; Root-

Cause Analysis populates two columns – Potential Effects of Failure and Potential Causes of Failure; all five TRIZ modules for problem solving populate the Recommended Action (Solution) column.

Trimming: Design Simplification Strategy - Radical product/process changes

Trimming improves a product/process by eliminating low value (problematic) components and redistributing their useful functions among other components.

The trimming process simplifies and reduces the cost of user product/process, while preserving the essential functionality.

In the trimming process, the most problematic (high cost, does not perform useful functions properly, sources of harmful functions and so on) components are the first candidates for trimming.

The design variants that result from trimming will generate different problem statements, which if solved, can lead to highly innovative solutions.

Problem selection for further solving

It is the final and a very important stage of Part 1 - Device/Process Analysis and Problem Statement. The team should select the most critical problems from the large list of problems defined by using all the modules of the first part of TRIZ project innovative roadmap.

Part 2 - Problem solving, concepts development

Selected problems are an input to Part 2 – TRIZ modules for problem solving and concepts development. Created concepts are the output of Part 2 (Fig. 7).

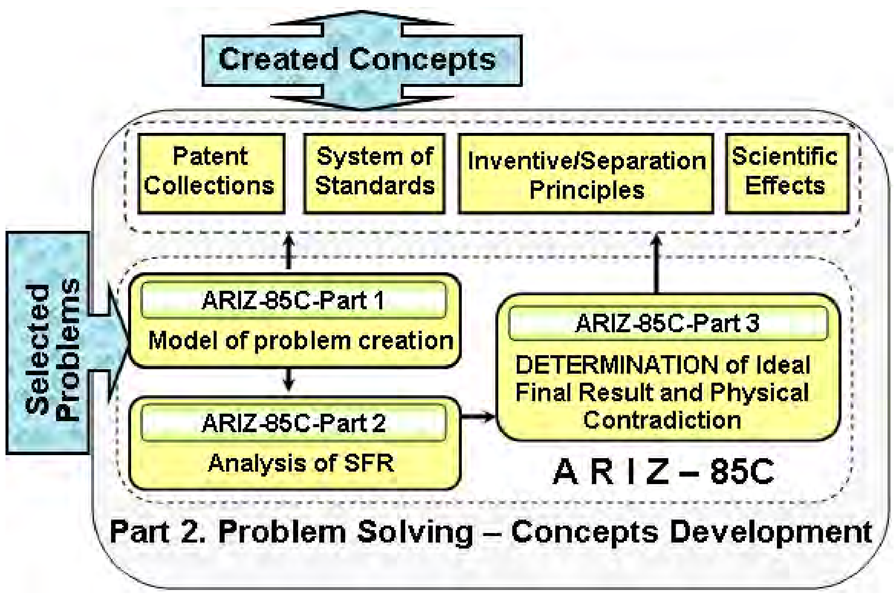

Fig. 7. TRIZ Innovation Roadmap for Projects Creation & Problem Solving: Part 2 – problem solving, concept development

Summary

- The most effective way of using TRIZ together with other proven methods like VM, Six Sigma, DFSS, QFD, RCA, and FMEA is to use **TRIZ Value Innovation Roadmaps.**
- We recommend you to use TRIZ Value Innovation Roadmap as the basic source for individual Project Innovation Roadmap creation.
- We should include in each individual roadmap any methods or modules of these methods that is nessessary for succesful project completion. Modules of TRIZ are the "center of gravity" in most of such roadmaps.

About the Author:

Isak Bukhman, TRIZ Master & 6σ BB, President & Global Consultant of TRIZ Solutions LLC,
Vice President of Altshuller Institute for TRIZ Studies

Isak is a TRIZ, Value Methodology (VM), and Six Sigma specialist with more then 35-year practice in the product/process development and manufacturing areas.

Isak has spent 7 years at IMC (Invention Machine Corporation) as their chief methodology specialist and now works as independent global consultant (owner of TRIZ Solutions, LLC).

During the last six years he guided development of 78 innovation projects in 11 countries for 39 world leading companies such as Philips, Mattel/Fisher-Price, Microsoft, Shell, Samsung, POSCO, Masco-Behr, Medtronic, Xinetics, Henkel, Delphi, Baker Hughes, J&J, BaoSteel, NXP, Intel, Savannah River Site, etc.

Isak has delivered numerous basic and advanced training seminars (some of them together with Mr.Genrich Altshuller), and educated and trained thousands of Managers, Engineers, and Researchers in TRIZ/Value Methodology, and in Product/Process Evolution and Development.

In 80's Isak dedicated about 7 years for children/juniors education of creativity (TRIZ) in his native country Latvia.

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