What is TRIZ? From Conceptual Basics to a Framework for Research

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This paper introduces six aspects of the theory of inventive problem solving (TRIZ), from conceptual basics to a framework for interdisciplinary research, and explains some of the specific terminology, such as inventive principles, standard solutions, substance-field-systems or contradictions. The conceptual approach of TRIZ comprises the way from a concrete problem over an abstract problem to an abstract solution and from there to a concrete solution. This is supported by a toolkit, which helps the problem-solver analysing and solving problems in different perspectives. The 'power supply for notebook computers' example demonstrates a problem-solving process with TRIZ using contradiction thinking, the contradiction matrix and the inventive principles as tools. The TRIZ tools may be combined within a comprehensive process model such as ARIS or WOIS, which are briefly discussed. A framework for further research suggests five fields: the tools and their combination as the core, inspiration by new knowledge domains, adaptation to new fields of usage, psycho- and sociological contingency and integration with other creativity tools. The paper concludes with an overview of cornerstones in the history of TRIZ and suggests some introductory books and informative websites.

TRIZ – Using Knowledge from Former Inventors

The theory of inventive problem solving (usually abbreviated TRIZ for the Russian term 'Teoriya Resheniya Izobreatatelskikh Zadatch' and pronounced 'treez') was developed to support engineers and natural scientists solving inventive problems by using the knowledge of former inventors. For this purpose, TRIZ offers a comprehensive set of tools to analyse and solve problems in different perspectives. It also has established some specific terms like inventive principles, standard solutions, substance-field-systems, or contradictions.

TRIZ was introduced in the period 1950s to the 1980s, primarily in the former USSR. This period of time, together with the parts of the theory developed in this period, are sometimes referred to as 'classical TRIZ'. Since the 1990s, several members of European and American companies have recognized the benefits of TRIZ. One reason for this is the development of a number of TRIZ-based software applications, such as TechOptimizer (Invention Machine, Inc.) and Innovation WorkBench (Ideation International, Inc.), to provide the problem-solver with more or less easy to handle access to TRIZ tools. A second reason is the publication of reports of successful applications, in journals such as the *TRIZ Journal* (see the Appendix for website recommendations).

This paper addresses the fundamentals of TRIZ, and provides a general survey of the methodology. The key questions to be answered are:

- What benefits can TRIZ provide for creativity management?
- What are the fundamental ideas of TRIZ?
- Which tools are offered for problem solving?
- Which comprehensive process models are offered to combine several TRIZ tools?

Two examples using combinations of tools demonstrate the use of TRIZ. A research agenda and some historical aspects of TRIZ will close the paper.

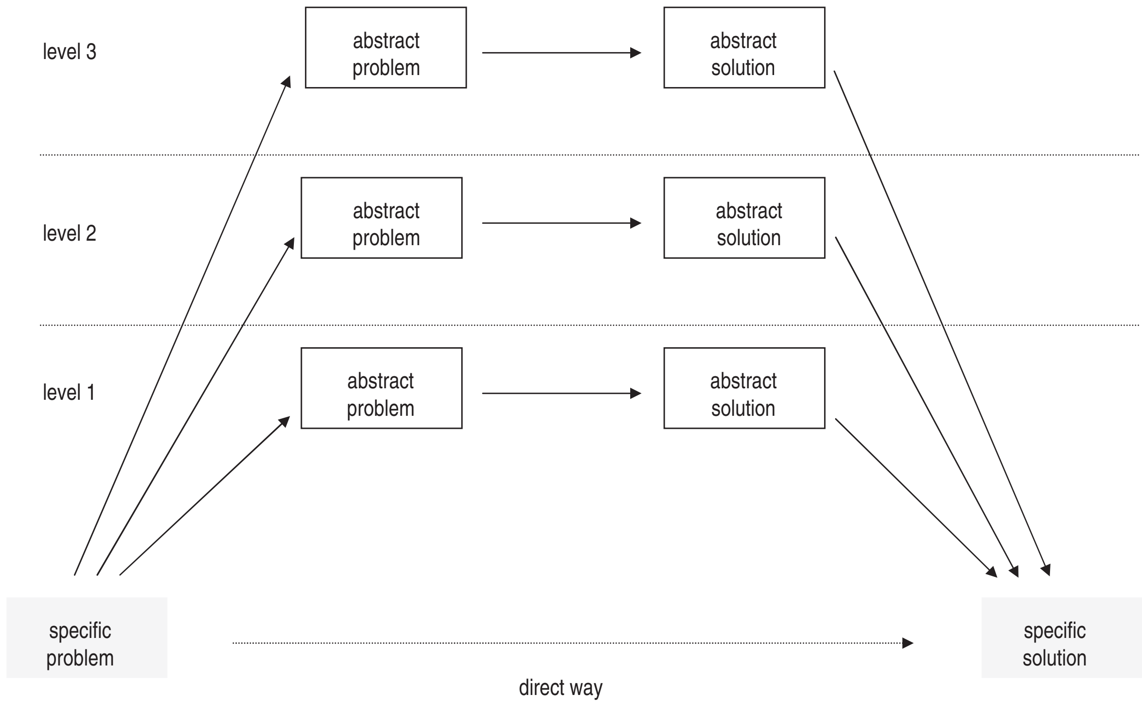

Figure 1. Problem solving with TRIZ tools at different levels of abstraction
Source: Adapted from Pannenbäcker 2001; Terninko, Zusman and Zlotin 1998.

Conceptual Basics of TRIZ

The goal of TRIZ, as it is known today, is to support inventors when they have to solve primarily technical or technical-economical problems. The fundamental idea of TRIZ is to provide them with easy access to a wide range of experiences and knowledge of former inventors, and thus use previous solutions for solving new inventive problems (Figure 1). Problem solving within TRIZ can be described using a four-element model:

1. The problem-solver should analyse his specific problem in detail. This is similar to many other creative problem-solving approaches.
2. He should match his specific problem to an abstract problem.
3. On an abstract level, the problem-solver should search for an abstract solution.
4. If the problem-solver has found an abstract solution, he should transform this solution into a specific solution for his specific problem.

During this process, TRIZ can support the problem-solver by accumulating innovative experiences and providing access to effective solutions independent of application area. For each step the problem-solver can resort to specific TRIZ tools:

- The specific problem can be analysed and transformed into an abstract solution, for example, through the tool function analysis.
- The tool contradiction can help to formulate the problem on an abstract level.
- Afterwards, the inventor can find abstract solutions for the formulated abstract problem, for instance using the tools inventive principles, separation principles or substance-field-modulation.
- Lastly, the problem-solver can use the tool ideal machine for assessing the found solution concepts and transfer the selected solution concept into a specific solution.

As there are different TRIZ tools corresponding with different levels of abstraction (see Figure 1), this process may vary in the heights of abstraction, and also in the number of loops, which the problem-solver is passing through.

Survey of TRIZ Tools

As mentioned above, TRIZ offers a comprehensive toolkit. A framework of five fields can help to structure the tools within this toolkit. The five fields represent all the relevant aspects that have to be addressed while problem analysing and solving:

- *current state* – what does the current state situation look like?
- *resources* – which resources are available?
- *goals* – which goals shall be fulfilled, to what degree?
- *intended state* – how is the future situation supposed to look like?
- *transformation* – in what way can the current state be transformed into the intended state?

A survey of the tools is given to help with a better understanding of the published contributions in this Special Issue (Table 1). For all TRIZ tools, the table contains a brief description, supplemented with its main application, the kind of tool and the connections to other tools. For a more detailed view see the recommended literature at the end of this paper.

All presented TRIZ tools have been well proven. Some are distinguished by characterized terms like 'contradiction'. By using the various tools, the problem solver can view a problem from different perspectives, because they work in different ways. Some tools are based on the application of concentrated knowledge. For example, lists and samples may stimulate the inventor to new ideas, and other tools represent special techniques for directing creativity by structuring the process of inventing. Different tools can lead to identical as well as to diverse solutions. Furthermore, some tools correspond to other tools, particularly if they (can) work on the results of another tool, e.g. the tool substance-field-modulation on the tool substance-field-analysis. Nevertheless, all tools are can be applied in isolation by a problem-solver individual or a team.

Example for Problem Solving with TRIZ Tools

Problem solving with TRIZ and its tools will now be demonstrated with an example. In almost all cases, notebook computers have a power supply, which consists of two interconnected systems (Figure 2). One system is the battery pack; the other is powered by the home power-supply system with a mains adaptor and two cables, one reaching from the socket to the mains adaptor, the other reaching from the mains adaptor to the notebook computer. If connected to the home power-supply system, the mains adaptor not only supplies the notebook with energy, but also recharges the batteries. For the user of the notebook it is not very convenient to assemble the mains adaptor when near a socket, dismantle it when leaving with the notebook, and to pack and carry all the components while on journey.

Figure 2. Notebook computer with two systems of power supply

Given this situation, TRIZ tools will be applied according to the process defined before. The contradictions tool will be used first to help to analyse the problem. Second – in the form of a contradiction matrix – it will help to transform the concrete problem into an abstract problem. Third, inventive principles will be identified as solutions for the abstract problem, and fourth, they will be specified for the concrete problem.

Contradiction Thinking

Contradictions represent the core of a problem, where an invention has to deliver a convincing solution. Contradictions are very characteristic for TRIZ. Uncovering contradictions requires paradox thinking and leads the problem to extremes, whereby the problem becomes evident. But does the term contradiction in TRIZ mean the same as when used in colloquial language? In TRIZ terminology, the word 'contradiction' is used more precisely – a contradiction is present when three conditions are fulfilled:

(i) there is a desired function in a system
(ii) there is a conventional mean to realize this function and
(iii) the realization is opposed by harmful factors (Figure 3).

To be more precise, the defined type of contradiction will be referred to as a technical

Table 1. Survey of tools in the field of TRIZ

tools in the field of TRIZ					
			procedure		
main field of application	**tool**	**remarkable issues**	**SP**	**CK**	**referring to**
current state	function analysis (system analysis)	modeling of positive and negative functions of a system	×		• substance-field-analysis • resource analysis
	object analysis (system analysis)	modeling of objects (represent components or products) of a system	×		• substance-field-analysis • resource analysis
	contradiction	confronting desired functions with harmful factors	×		• system analysis • ideality
	substance-field-analysis	modeling of substances and fields of a problem	×		• system analysis • resource analysis
	evolution analysis	analyzing of the previous evolution of a system	×		• evolution prediction
resource analysis	resource analysis	making aware of all available resources in and around a system	×		• system analysis • substance-field-analysis
transformation	inventive principles (IP) in independent form	direct applying of abstract inventive principles		×	• contradiction
	IP with contradiction matrix	transferring the desired function and the harmful factor of a problem to the contradiction matrix and applying of recommended abstract inventive principles		×	• contradiction
	separation principles	separating of conflicting system requirements	×		• contradiction
	substance-field-modulation	applying of standard operations		×	• substance-field-analysis
	evolution prediction	anticipating of the further development of a system		×	• evolution analysis
	resource variation	applying of the available resources	×		• resource analysis
	scientific effects and phenomena	making use of scientific effects and phenomena of different disciplines		×	• system analysis
goals	idealty	radical asking for the best possible solution	×		• contradiction • evolution prediction
	fitting	considering of restricting basic conditions	×		• contradiction
intended state	strong solution	balancing between ideality and fitting	×		• ideality • fitting

Source: Pannenbäcker 2001.
Notes: In the column 'procedure' SP stands for 'special technique' and CK for 'concentrated knowledge'.

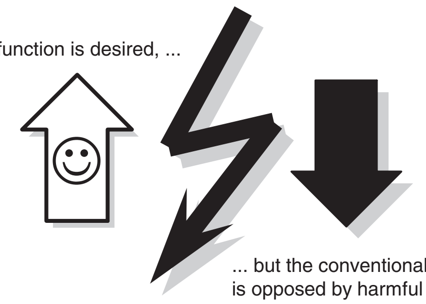

Figure 3. Definition of a technical contradiction

(or two-parametrical) contradiction, as opposed to a physical (or one-parametrical) contradiction.

It is useful to apply contradiction thinking in order to analyse the example.

(i) What function is desired? Perhaps the user wants to get rid of the inconvenience. He wants to take the notebook away on a journey, but not the mains adaptor and the different cables.
(ii) Is there a conventional mean to achieve this function? The answer is yes, the user can just leave the mains adaptor and the different cables at home.
(iii) The user will be able to work with the notebook computer as long as there is energy in the battery – then the operating system will run the notebook computer down. Therefore, if the user wants to work for a longer period of time, a harmful condition occurs, which opposes the conventional mean for solving the problem.

Contradiction Matrix

Using contradiction thinking, the concrete problem can be analysed. Afterwards, it is useful to transform the concrete problem into an abstract problem. For this purpose, the contradiction matrix can be applied. The contradiction matrix consists of 39 rows and 39 columns. Rows and columns represent parameters of technical systems, which can be changed in different directions, such as volume, mass, energy supply or user friendliness of a system. The rows of the matrix contain desired functions of a system, and the columns contain harmful factors of a system.

To use the contradiction matrix, the problem-solver has to proceed in three steps. First, the desired function is transformed into one (or more) of the parameters of the contradiction matrix' rows. Second, the harmful factor is transformed into one (or more) parameters of the contradiction matrix' columns. After the second step, the conrete problem has been assigned to one of $39 \times 39 - 39 = 1.482$ abstract problems. Third, the problem-solver will find in the cross-field, defined by the selected row and the selected column of the contradiction matrix, up to four of forty inventive principles (see below), which are recommended for overcoming the technical contradiction.

The three steps will now be applied to the power-supply example (Figure 4). The desired function may be related to parameter 'waste of energy' (which should be reduced), row 22 of the contradiction matrix. The harmful factor may be transformed to 'weight of moving object' (which rises, if the desired function is achieved by a conventional mean), column 1 of the contradiction matrix. In the cross-field, four inventive principles are recommended (see below for an explanation).

Inventive Principles

One important result of Altshuller's comprehensive patent analysis is the so-called inventive principles. He found that a large number of inventions were based on a small number of principles, which the inventors used intuitively. In addition, he developed the contradiction matrix mentioned above, which allows the connection of abstract problems with abstract solutions – in this case the inventive principles (Table 2).

The inventive principles offer a different degree of abstraction, and various of them are divided into two to five sub-principles. The problem-solver can apply them by looking over them and using his intuition for the best fitting principle, or he can use the contradiction matrix to lead him to inventive principles, which had been applied in similar abstract problems. In the example, inventive principles 15, 6, 19 and 28 are proposed by the contradiction matrix (Table 3).

Solution Concepts

Having identified the inventive principles as abstract solutions of the abstract problem, it is now necessary to find concrete solution concepts. The problem-solver therefore applies the inventive principles. At this point it should be noted that TRIZ does not replace an inventor's natural creativity, but leads it in some predefined direction. This will be demonstrated with the help of two inventive principles.

For instance, inventive principle 6, 'universality', could be applied: 'Have the object perform multiple functions, thereby eliminating the need for some other object(s)'. To apply the

HARMFUL FACTOR / PARAMETER II

USEFUL FUNCTION / PARAMETER I	1. Weight of moving object	…	22. Waste of energy	…	38. Level of automation	39. Productivity
1. Weight of moving object			6, 2, 34, 19		26, 35, 18, 19	35, 3, 24, 37
⋮						
22. Waste of energy	15, 6, 19, 28				2	28, 10, 29, 35
⋮						
38. Level of automation	28, 26, 18, 35		23, 28			5, 12, 35, 26
39. Productivity	35, 26, 24, 37		28, 10, 29, 35		5, 12, 35, 26	

Figure 4. Selecting inventive principles by applying the contradiction matrix

Table 2. Forty inventive principles

1. Segmentation	21. Rushing through
2. Extraction	22. Convert harm into benefit
3. Local conditions	23. Feedback
4. Asymmetry	24. Mediator
5. Consolidation	25. Self-service
6. Universality	26. Copying
7. Nesting	27. Disposable object
8. Anti-weight	28. Replacement of a mechanical system
9. Prior counteraction	29. Pneumatic or hydraulic construction
10. Prior action	30. Flexible ‘shells’ or thin films
11. Cushion in advance	31. Porous material
12. Equipotentiality	32. Change the color
13. Inversion	33. Homogeneity
14. Spheroidality	34. Rejecting or regenerating parts
15. Dynamicity	35. Transforming the physical/chemical state
16. Partial or excessive action	36. Phase transition
17. Shift to a new dimension	37. Thermal expansion
18. Mechanical vibration	38. Strengthen oxidation
19. Periodic action	39. Inert environment
20. Continuity of useful action	40. Composite materials

Source: Ideation International, 1999

principle, the problem-solver could use the inventive principle like an equation with some variables. What could the ‘object’ mentioned in the inventive principle be? The problem-solver considers the situation of a human using a notebook computer with several elements:

- the notebook computer itself and its parts – display, keyboard, motherboard, expansion units, network connectors, etc;
- around the system: the table, the chair, illumination, panel lighting, pens, electric sockets etc.;
- last, but not least, the person using the notebook computer, who, in the sense of the inventive principle, is also considered as an object.

All these objects have functions. Now the problem-solver should think about new func-

Table 3. Four selected inventive principles with descriptions/sub principles

Principle	Description/Sub principles
Dynamicity (inventive principle no. 15)	a. Make an object or its environment automatically adjust for optimal performance at each stage of operation b. Divide an object into elements which can change position relative to each other c. If an object is immovable, make it movable or interchangeable
Universality (inventive principle no. 6)	Have the object perform multiple functions, thereby eliminating the need for some other object(s)
Periodic action (inventive principle no. 19)	a. Replace a continuous action with a periodic (pulsed) one b. If an action is already periodic, change its frequency c. Use pulsed between impulses to provide additional action
	a. Replace a mechanical system by an optical, acoustical or olfactory (odor) system b. Use an electrical, magnetic or electromagnetic field for interaction with the object c. Replace fields 1. Stationary fields with moving fields 2. Fixed fields with those which change in time 3. Random fields with structured fields
Replacement of a mechanical system (inventive principle no. 28)	d. Use a field in conjunction with ferromagnetic particles

Source: Ideation International, 1999.

tions for those objects, especially the function of supplying energy. In a number of seminars with managers from a large power-supplying company some ideas arose:

- new function for the table: it may provide low voltage access;
- new function for the display and the illumination: there could be photovoltaic elements on the backside of the display and focused lighting in the rooms;
- new function for the keyboard: with piezo elements the keystrokes could be used for supplying power (to a very limited extent);
- new function for network connectors: with additional cores they may be used for low-voltage power supply;
- new function for the room: under supposition of standardized battery packs there may be battery-pack exchanger units (put a battery pack in, add some money, get a charged battery pack);
- new function for the human and the expansion slot: with a small generator, which fits into the expansion slot, and a crank handle the user could supply the battery pack with energy.

After having applied inventive principle of universality, the problem-solver may like to apply another inventive principle and lead his creativity to a new direction. For example, inventive principle 28, 'replacement of a mechanical system', could be applied next (see Table 3 above for sub-principles). Again, the problem-solver could use the inventive principle like an equation with variables. The problem-solver should now consider all mechanical or electrical systems. Some ideas:

- replacement of cable connection with induction: there could be induction loops in the table or in specific mats, which send

electrical energy to an induction loop in the notebook computer (sub-principle b);
- replacement of the battery pack with a fuel cell (sub-principle using a wide interpretation);
- replacement of the electrical system with an optical system: there could be photovoltaic elements on the backside of the display and focused lighting or even laser beams in the rooms (sub-principle a).

Comparing the ideas that have been found by applying inventive principle universality with those that have been found by using inventive principle mechanical systems, two findings come out:

- In some cases, the same ideas come up when applying different inventive principles. This shows that there are different roads leading to Rome.
- The inventive principles led the problem-solver into specific directions, but the concrete solution concepts had to be found by combining inventive principle with knowledge and human creativity. This is not only that case in this example: TRIZ helps humans to be creative, but it does not replace human creativity (like one could think when reading advertisements of some companies like 'invention machine' – *nomen est omen*).

Comprehensive Process Models: ARIS, WOIS, I-TRIZ and PI

A number of comprehensive process models have been introduced to provide a more specific way through the TRIZ tools; for example, ARIS, WOIS, I-TRIZ and PI.

ARIS

Altshuller propagated an 'Algorithm for Inventive Problem Solving' (1973, 1984; Ideation International, 1999) according to a determined sequence of mathematical operations. ARIS was improved a number of times between 1961 and 1985 (ARIS-61, ARIS-77, ARIS-85). The recent version comprises nine sections with 40 steps, which the problem-solver has to process sequentially. This makes an entire application of ARIS very ambitious. According to Terninko, Zusman and Zlotin (1998), only 5 per cent of all problem-solvers apply ARIS.

WOIS

The 'Inventive Product Development Strategy Focusing On Contradictions' (abbreviation derived from the German title: Widerspruchsorientierte Innovationsstrategie) was generated by Linde and Hill (1993). It is geared to the metaphor of the evolution spiral of a technical system. The problem-solving process using WOIS is divided into three phases: (i) orientation; (ii) evolution barrier; and (iii) solution finding, in which various TRIZ-based tools can be used. In contrast to ARIS, iterations and parallel operations are explicitly permitted. Furthermore, WOIS uses elements of design and bionics and can be combined with other methods, such as QFD.

I-TRIZ

The software Innovation WorkBench, by Ideation International (1995) is based on a methodology that is in many, but not all aspects similar to ARIS. Characteristic sections are the Innovation Situation Questionnaire to define a problem and the Problem Formulator to develop a function model of the problem. Although the sections are arranged sequentially in the software, the problem-solver can decide whether or not all steps should be processed.

PI

Moehrle and Pannenbaecker (1997) have proposed a 'Concept of Problem-Driven Inventing' (abbreviation: PI). In the framework of the Five-Field-Analysis, all TRIZ tools are integrated. This concept suggests a flexible approach to the process of inventive problem-solving. It leaves the decisions – which tools should be processed in which sequence – to the problem-solvers' experience and intuition, with only a weak suggestion to start from the outside fields. PI is designed to be open in the same way as WOIS; therefore other tools may supplement it.

Although the comprehensive process models have been known since a long time, other combinations of TRIZ tools are not unusually in companies. In an empirical study, Moehrle (2003) reports three cluster types of tool configuration: (i) basic TRIZ, (ii) resource and ideality-based TRIZ; and (iii) substance-field based TRIZ.

Framework for Interdisciplinary Research

Although TRIZ has been discussed in several books and articles, there is still a lot of research to be carried out. To structure these research aspects, a framework for interdisciplinary research is suggested in Figure 5.

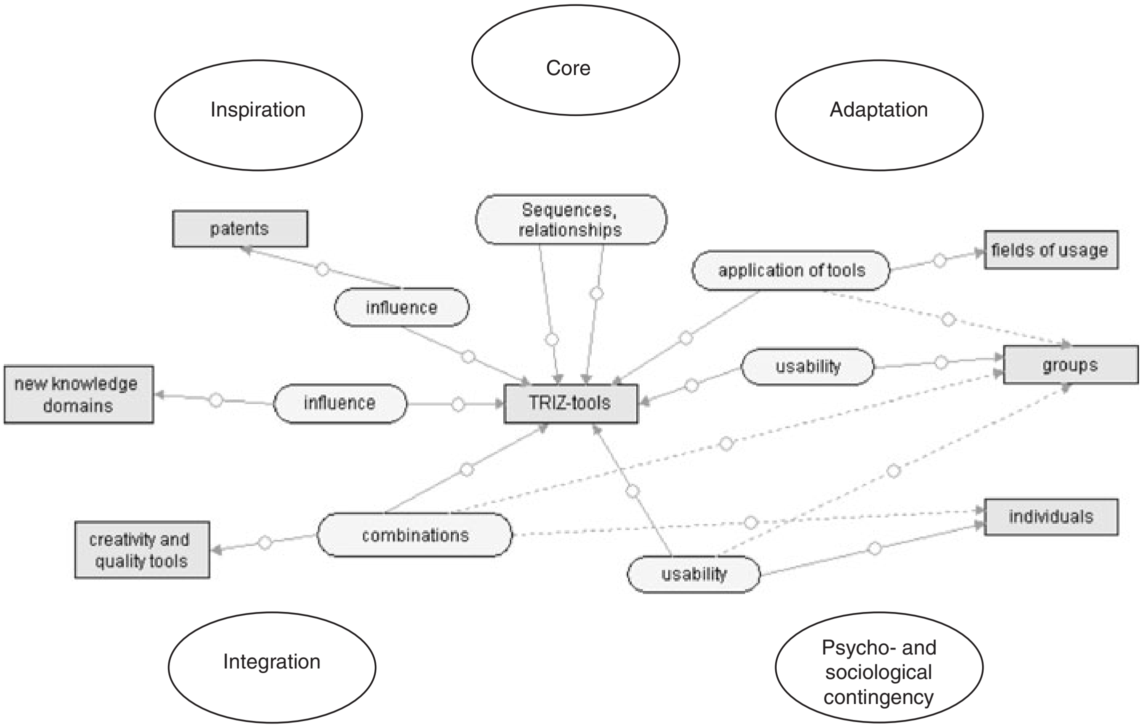

Figure 5. Framework for interdisciplinary TRIZ research

The framework has been modelled with the help of the entity-relationship-approach as a mean of structuring knowledge networks (see Chen, 1976). It will be presented in five aspects:

- *Core* – the various TRIZ tools are located in the centre of the framework. How effective and efficient are those tools? What combinations of them are particularly helpful? What theoretical background can be found to enhance the toolkit? What comprehensive process models (see above) should be used under what conditions?
- *Inspiration* – some aspects may inspire the development of TRIZ. New scientific knowledge domains, and new patented inventions may be assigned to this field of research. What findings, for example, from the field of bionics can be integrated into TRIZ and its tools? Which new inventive principles can be found in patents covering newer technologies like photovoltaics or nanotechnology?
- *Adaptation* – TRIZ may be applied in different fields. In a narrow sense, one can think of different technical fields, reaching from classical engineering to software and gentechnology. In a broader sense, other fields of application like management, sociological or even psychological problems can be considered (bearing in mind that people are not technical systems).
- *Psychological and sociological contingency* – the application of TRIZ and its tools is embedded in psychological and sociological factors. Which personnel types prefer which TRIZ tools? How is this related to the qualification of the people? How should group members be assigned to reach acceptable results with TRIZ tools?
- *Integration* – several creativity techniques, such as lateral thinking, morphology, CPS and synectics have been developed. Furthermore, a lot of quality tools such ase FMEA or QFD are being discussed. How could these techniques and tools be combined with TRIZ tools?

This framework shows a number of basic research questions. It may be stretched by combinations of research areas and questions. Some examples for this are marked in Figure 5 (above), with dotted lines. Furthermore, interdisciplinary research is needed, as there are technical, biological, chemical, physical, managerial, psychological and sociological aspects, which have to be combined.

Having the framework for research in mind, it is easy to assign the six TRIZ papers of this special issue. Mann can be assigned to the core field, Hipple to the field of psychological and sociological contingency, Hill and Vincent et al. belong to the field inspiration, Zhang et al. and Mueller to the field of adaptation.

History of TRIZ

TRIZ has an interesting history (see Terninko, Zusman & Zlotin, 1998). After World War II Genrich Saulowitsch Altshuller (1926–1998), at that time a young and talented inventor in the former Soviet Union and a patent examiner for the Russian navy, started to develop TRIZ as a methodology to create systematic innovations. His research began with comparing patents to analyse how inventors invent. Because of his criticism of the Soviet system, Stalin banished Altshuller to Siberia, where he spent a number years in a labour camp. During this time, he worked intensively on the patent analysis and discovered cohesions between inventions. For instance, Altshuller extracted the 40 inventive principles, which were mentioned above and on which many technical solutions are based on. Furthermore, in the labour camp he met like-minded researchers who were interested in his research, and with them he discussed his ideas. In the following years, Altshuller developed successively TRIZ tools and characteristic terms.

Later, as a consequence of *glasnost*, several of Altshuller's students emmigrated to the USA, Scandinavia, Israel and Germany, so that TRIZ has been introduced in the Western hemisphere. Some of the TRIZ experts have worked on the development of software applications. Since this time TRIZ has spread out to several countries all over the world.

Conclusions

Based on the thorough analysis of former inventions, TRIZ enriches the theory of creativity in multiple ways. It serves with many interesting tools and comprehensive process models, both having several connections to traditional creative methods. Furthermore, the basic idea of TRIZ – using knowledge from former inventions – gives starting points for similar research in other fields: what principles and abstract contradictions may be found in biology, in management, in psychology? In addition, there is still a lot of research work to do, as it is specified in the framework for research mentioned above.

TRIZ will not only influence science and research, but also applications in companies. R&D Managers and service designers have the opportunity to organize creativity workshops with TRIZ tools, stimulating the creativity of individual problem-solvers as well as problem-solving groups. For successful implementation, the recommendation of the author is to search for an interesting inventive task, work on it with an interdisciplinary team and deploy experienced consultants directly in the problem-solving process.

Appendix – Recommendations for Resources

Recommended Reading

There are nine recommendations for introductory books about TRIZ; six in English, and three in German.

Altshuller's *Creativity as an Exact Science* (1984) is an original book by the father of TRIZ. It gives insight into the goals that Altshuller expected to reach with TRIZ, and many tools. As the book was published in 1984 and there are newer, more tool-oriented introductions, this book is not recommended for the first reading about TRIZ, but for the experienced TRIZ user.

As mentioned above, Terninko, Zusman and Zlotin provide a tool-oriented introduction to TRIZ together with improvements to the tools in *Systematic Innovation: An Introduction to TRIZ* (1998). A similar introduction, but with some newer tools like the nine fields analysis is offered by Mann, *Hands-on Systematic Innovation* (2002). In *Inventive Thinking Through TRIZ: A Practical Introduction,* Orloff (2003) links classical TRIZ with newer developments made in Russia. Many creative aspects may be found in his book. Savransky, in *Engineering of Creativity: Introduction to TRIZ Methodology of Inventive Problem Solving* (2000), gives an introduction with some case studies. A simplified introduction with only few tools has been written by Rantanen and Domb, *Simplified TRIZ: New Problem Solving Applications for Engineers & Manufacturing Professionals* (2002).

In addition to the above books in English, three books in the German language are recommended. A very solid book has been written by Zobel, *Systematisches Erfinden* (2004), which combines theory with humor in a very pleasant way. In *Methodisches Erfinden in Unternehmen: Bedarf, Konzept, Perspektiven für TRIZ-basierte Erfolge*, Pannenbaecker (2001) shows how TRIZ tools are assigned within the concept of problem-driven invention and adds empirical findings about problem-solving processes in industry. Linde and Hill, in *Erfolgreich erfinden. Widerspruchsorientierte Innovationsstrategie für Entwickler und Konstrukteure* (1993), suggest TRIZ tools arranged within the 'Inventive Product Development Strategy Focusing On Contradictions'.

Recommended Websites

There are two types of interesting website for TRIZ; one giving access to discussions of TRIZ topics, the other providing information about software tools for TRIZ. For the first type, five websites are recommended:

- http://www.aitriz.org (Altshuller Institute for TRIZ Studies)
- http://www.altshuller.ru/world/eng (source for all articles published by Altshuller)
- http://www.triz-journal.com (international, moderated, but unreferreed web journal)
- http://www.triz-online.de (international, moderated, but unreferreed web journal in German)
- http://www.trizexperts.net

For the second type, three websites are recommended, which are all provided by producers of TRIZ-related software:

- http://www.creax.com
- http://www.ideationtriz.com
- http://www.invention-machine.com

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