Quality Guideline

Quality guidelines
for the
TRIZ Certification Training and Examination

EUROPEAN
TRIZ-CAMPUS

Content:

1 Introduction

1.1 Backgrounds and origins

For a long time, the European TRIZ Campus (ETC) has exclusively followed the quality standards of the International TRIZ Association (MATRIZ / MATRIZ Official) in education and training in TRIZ (Theory of Inventive Problem Solving).
These quality guidelines have been developed to better and more clearly describe the necessary training content for each quality level and thus provide trainers who want to certify according to the MATRIZ / MATRIZ Official and/or an ETC standard with a guideline according to which they can do so. This guideline defines the minimum requirements for the training and certification of TRIZ users and TRIZ experts. It also builds a bridge to the modern requirements of TRIZ application and teaching methods.
This guideline is primarily intended for trainers.

1.2 Changes in this version

In Version 2, the course content "Ideality, Ideal Technical System, Ideal Final Result," "MPV Discovery (Main Parameter of Value)," and "FOS (Function-Oriented Search)" were added to the curriculum. References 50–52 were added.

1.3 Older versions

Version 1 of the guideline: Published in January 2023.

1.4 Abbreviations

ETC	**E**uropean **T**RIZ **C**ampus
MATRIZ Official	The International TRIZ Official Association
MATRIZ	Russian acronym for **I**nternational **TRIZ A**ssociation: International TRIZ Association
TRIZ	Russian acronym for **T**heory of **I**nventive **P**roblem **S**olving

2 Use of the Quality Guide

The guidelines describe the minimum requirements for each certification level in the TRIZ training concept of the ETC. They describe the knowledge that should be acquired by learners for each training level. Therefore, the guidelines are intended to help trainers structure their training content.

3 Duration of the training

In order to promote learning concepts such as e-learning or blended learning, up to 100% of the training can be completed as distance learning or self-study. Trainers must ensure that trainees have received the necessary knowledge according to the standards for the content of the training. Suitable ways are for example

- questionnaires,
- telephone calls and / or
- project work,

to check the trainees' knowledge before they are admitted to an examination.

3.1 TRIZ Basic Course (TRIZ Level 1)

The required minimum duration of the training is 24 hours. As a rule, these 24 hours are completed within three days.

3.2 TRIZ Advanced Course (TRIZ Level 2)

The required minimum duration of the training is 40 hours.
Trainees must have a Level 1 certificate that meets these guidelines in order to take a Level 2 exam.

3.3 TRIZ Expert Course (TRIZ Level 3)

The required minimum duration of the training is 80 hours. In addition, time must be planned for working on one's own project.
Trainees must have a Level 2 certificate that meets these guidelines in order to take a Level 3 exam.
Trainees should be confident in problem solving skills and the application of their TRIZ knowledge.

4 Content of the training

4.1 Classification of the training content

In the following, the methods to be taught are assigned to the different training levels according to the classification below, which describes the scope of the training and depth of understanding.

Class	Meaning
A	Knowledge and purpose: method/tool has been briefly introduced and trainees know what the method/tool is used for
B	Simple applications and purpose: method/tool has been explained and trainees can apply the method/tool to simple problems (out-of-the-box examples, training examples)
C	Complex and/or complicated applications and purpose: Method/tool has been taught in detail using an example. Trainees know the method/tool very well and can apply it/it to complicated and complex problems (own project)

We understand that for people who are not employed by a company or who work in companies with very strict confidentiality policies, a project from the professional activity cannot be used. In these cases, participants may choose their own private project, or the instructor may assign a suitable project to them.

4.2 Training contents of levels 1 to 3

Content	Level 1	Level 2	Level 3
Creative thinking methods	A	A	A
History and development of TRIZ	A	-	-
Function analysis for products	B	C	-
Trimming for products	B	C	-
Cause-effect chains analysis	B	C	-
Ideality, Ideal Technical System, Ideal Final Result	B	C	-
Resources and resource analysis	B	C	-
Engineering contradiction, inventive principles, contradiction matrix	B	C	-
Physical contradictions and principles of separating contradictory demands	B	C	-
Catalogue of effects	B	C	-
System Operator (Nine Fields Thinking)	B	C	-
Innovation Checklist (ISQ)	A	B	C
MPV Discovery (Main Parameters of Value)	A	-	-
FOS (Function-Oriented Search)	-	B	C
Feature Transfer	-	B	C
Function analysis for processes	-	B	C
Trimming for processes	-	B	C
Substance-field analysis and 76 inventive standards	-	B	C
ARIZ-85C	-	A	C
S-curve analysis	-	A	B
Flow analysis	-	-	B
Application of analogy problems (clone problems)	-	-	B
Super Effect Analysis	-	-	B
Trends of Engineering System Evolution	-	-	B
TRIZ-based forecasting	-	-	B
Anticipatory Failure Determination (AFD)	-	-	B
Patent circumvention	-	-	B

4.3 The training contents lead to the following acquisition of competences by the participants

4.3.1 Creative thinking methods

As described in Section 3 in [2], a creative mind is necessary to overcome psychological barriers. In every level of TRIZ training, one should therefore not forget to look beyond TRIZ. Other creativity techniques and their frameworks should be explained, which can be used in the work on technical problems.
Examples of these techniques would be

- Brainstorming,
- Random word method,
- Analogy techniques,

- Synectics,
- Gallery method,
- Provocation techniques and
- Card query.

In [36] there is a good overview of a variety of such methods.

4.3.2 History and development of TRIZ

The trainees are familiar with the development of the TRIZ toolbox and the emergence of TRIZ, as presented for example in [1][6][49]. It is explained what classical TRIZ and modern TRIZ understanding is.
This topic can only be trained at A-level, as there is no method that could be trained. In any case, an overview of the TRIZ methods mentioned in this guideline [45] should be given.

4.3.3 Function analysis for products

Trainees develop a basic understanding of the concept of a function according to TRIZ. The trainees understand how to analyse a product with the function analysis. The three steps

- component analysis,
- interaction analysis,
- and function modelling

are distinguish. They understand how to derive tasks by assigning categories (harmful, useful) and performance levels (insufficient, normal, excessive) to functions. They are able to calculate the normalised functionality and normalised costs of components, compare them using a functionality-over-cost diagram and derive tasks from the comparison.
After level 1, trainees are able to apply the method to practice examples. From level 2 on they have to apply it at least once on a case. From level 3 on they have the ability to link this analysis tool to a problem-solving tool. This type of function analysis is presented in the books [6], [49] and [32].

If function analysis is taught according to [8] or [38], the differences should be pointed out.

Extensions of function analysis, for example the application of function analysis to information-heavy systems, can be introduced to the trainees. Furthermore, complementary approaches to function analysis such as problem formulation can be taught ([46], [48], [29]).

4.3.4 Trimming for products

Trainees know the three trimming rules and the conditions for trimming rule C. They are able to recall tasks from a trimming scenario ([46], [6], [49], [32]).
After level 1, trainees are able to apply the method to practice examples. From level 2 on they have to apply it at least once in a project.

4.3.5 Cause-effect chains analysis

After Level 1, the trainees know what a Cause-effect chains analysis is and what the result of such an analysis should be, namely breaking down the initial problems to the main causes/disadvantages. They know how to select the main disadvantages and what the link

between function analysis and cause-effect chains analysis is. They know how to reformulate a disadvantage from a cause or a root cause into a task.
From level 2 [33] on, the finer points of cause-effect chains analysis are learned. This includes dealing with the operators AND and OR, vicious circles and the use of parameters and formulas.
As a cause-effect chains analysis, the Cause-Effect Chains Analysis (CECA) ([46], [6], [49], [32], [33]), a Root Cause Analysis, 5xWhy, the Cause-Effect Chain Model ([46], [29], [48]) or the RCA+ ([46], [38]) can be introduced to the participants.

4.3.6 Ideality, Ideal Technical System, Ideal Final Result

Participants understand the concept of ideality as a central guiding principle of TRIZ. Ideality describes the relationship between the benefits, costs, and harmful effects of a system. The ideal technical system represents an extreme interpretation of this formula, to the point where only the benefits remain without the system itself existing. In the form of the Ideal Final Result, ideality is used to solve problems ([2], [5], [8], [32], [37]).
In Level 1, ideality is taught as a formula, along with the concepts of the Ideal Technical System and the Ideal Final Result (IFR). Participants understand that the ideal system fulfills its function without existing, and that the IFR serves as the target state for problem-solving.
Starting at Level 2, ideality is actively used to evaluate and improve concepts. It is systematically integrated into problem-solving processes and combined with other TRIZ tools.

4.3.7 Resources and resource analysis

Participants understand what the term resource means. The types of resources and how they are identified using resource analysis should be addressed ([47], [6], [49]). Resource analysis is also used within the ARIZ-85C in Step 2. Therefore, it can also be used as a source ([7], [4], [26]).
After Level 1, participants should know how to use resources for finding solutions, e.g. for trimming and resolving contradictions.
From level 2 on, participants can apply resource analysis in a project.

4.3.8 Engineering contradiction, inventive principles, contradiction matrix

The complete understanding of the engineering contradiction and its solution should be developed in Level 1 ([47], [6], [49], [32]). This includes the creation of engineering contradictions (EC) and how the 40 inventive principles [1] are used to solve them. The EC is set up in an if-then-but format.
The contradiction matrix according to Altshuller or the current extensions of the matrix 2003 [11][42] and 2010 [12][43] can be taught as a contradiction matrix. The participants know all 40 inventive principles and know how to use them. They know how to convert concrete parameters into abstract technical parameters.

4.3.9 Physical contradictions and principles of separating contradictory demands

Level 1 is to learn how to set up a physical contradiction (PC) and the procedure for resolving physical contradictions [47].
According to [6], [49], [32], PC is resolved by separation, satisfaction and circumvention. Under separation, a distinction is made between separation in time, in space, in relation or in system level. Each of these methods of resolving is assigned a set of inventive principles as preference principles.
Other ways of resolving the physical contradiction (e.g. [42], [43], [26]) can also be taught.

The connection between technical and physical contradictions is understood and the two types of contradiction can be transformed into each other.

4.3.10 Catalogue of effects

Already in Level 1, the trainees learn the procedure for using the effects databases ([47], [32]). From level 2 they can apply this to the work in projects.
First effects databases can be found in [26] and [31]. More modern free versions can be found on the web at http://wbam2244.dns-systems.net/EDB/ (Oxford Creativity, [8], [37]) and http://www.productioninspiration.com (AULIVE).

4.3.11 System Operator (Nine Screen Approach)

The system operator, in the simplest case nine screen approach, is learned in level 1 ([47], [3, 30ff], [8], [37], [32], [6], [49]). Subsystem, system and supersystem are to be explained as the different rows of the system operator and past, present and future as columns of the same.

4.3.12 Innovation Checklist (ISQ)

The innovation checklist (ISQ, Innovation Situation Questionaire ®) ([46], [24], [38]) is learned as a basic tool for describing inventive problems in Level 1. From level 2 onwards, the procedure is applied and then mastered in the project in level 3.

4.3.13 MPV Discovery (Main Parameters of Value)

Trainees understand the purpose of MPV discovery [50] in identifying the main value-determining parameters of a system from the perspective of customers and stakeholders. They understand the relationship between customer value, system parameters, and technical solutions.
At Level 1, participants should know how to identify Main Parameters of Value (MPV) and how these serve as target metrics for innovation tasks.

4.3.14 FOS (Function-Oriented Search)

Participants understand the concept of function-oriented search as an extension of classical effect databases for the systematic search for solution principles based on functions [51].
Level 2 covers how to abstract functions, derive suitable search terms, and identify relevant solution principles from various technical domains. Participants are able to apply FOS to generate solution approaches in projects and evaluate the results.

4.3.15 Feature Transfer

From level 2, the Feature Transfer procedure is learned ([47], [33]). Competing and alternative systems are to be distinguished. Different types of feature transfer are understood: Transfer with a physical component, mixtures and pure feature transfer. Feature transfer in multiple loops/passes is to be understood ([33]).

4.3.16 Function analysis for processes

Component analysis for processes should address the difference between component analysis of products and processes ([47], [33]). It is necessary to understand what process steps are and how the boundaries of a process are identified.
In the functional modelling of processes, the classification of the functions of a process not only by category and function ranks, but also by their types must be addressed and defined: productive, providing and corrective functions. In the case of providing functions, the division into supportive, transportation and measurement functions should be understood.

The concept of defect is known and understood.
Understand how function-over-cost diagrams are created. Other target parameters can be applied instead of costs.

4.3.17 Trimming for processes

What needs to be understood is how to apply the rules for trimming in processes to the different types of functions productive, providing (all types) and corrective functions [33].

4.3.18 Substance-field analysis and 76 inventive standards

To understand what is the basic idea behind modelling problems and solutions as a substance-field model. The trainees will be able to distinguish the types of substance-field models: incomplete, harmful, complex, chain, double or measurement substance-field models.
The participants know the 76 inventive standards. The division into classes of inventive standards is to be understood and for which type of substance-field models the respective class is designed.
The best and most frequently used inventive standards from each class (at least 2-3 from each class should be known to the trainee) are to be thematised
([35], [47], [4], [9], [5], [40], [39], [33], [16]).

Building on the understanding of the classic 76 inventive standards, further developments such as [30] can also be part of the training.

4.3.19 ARIZ-85C

In Level 2, the history of the ARIZ will be briefly discussed. The main objectives pursued with it and its strong points (going through all possible problem models offered by TRIZ, use of resources, formulation of new PC with resources) should be known.
The concept of the mini problem and the ideal final result (IFR) is to be understood and also the difference between ideal system (ideal machine) and IFR.
Know the ARIZ structure and the main components (steps 1-3).
For Level 3, all ARIZ parts (steps 1-9) have to be known with their details and nuances. Trainees have developed the ability to apply the ARIZ to a project ([47], [26], [7], [4], [34], [5], [17]).

4.3.20 S-curve analysis

The S-curve analysis is a component of the "Trends of Engineering System Evolution" [47].
Level 2 is to understand the concept of S-curve development and its origin. The trainees know how a technical system develops through the phases of the S-curve ([41], [10], chapter 2).
The most important indicators for the four stages of the S-curve are to be understood.
Important recommendations for the four stages of the S-curve can be derived from this ([26], [39]).
From level 3 onwards, trainees know the detailed indicators and recommendations as well as the transition stage and the "reincarnation" of technical systems ([38, 9]).
Additional variants of the S-curve analysis can also be learned ([29], [48]).

4.3.21 Flow analysis

Participants know what a flow analysis is and what types of flows it examines: substance, energy and information. These flows are divided into the following categories of flows: useful, harmful, neutral and wasted. The types of flow disadvantages are known that can be

identified with flow analysis: Grey zones, stagnant zones, low flow density, bottlenecks, long channels, etc. ([47], [34]).
Once the trainees have identified these disadvantages, they can deal with the suggestions to remedy these flow disadvantages: Increasing the conductivity of useful flows, increasing the utilisation of useful flows, decreasing the conductivity of harmful flows and decreasing the impact of harmful flows ([10], [41]).
It should be understood how the link between flow analysis and cause-effect chains analysis is.

4.3.22 Application of analogy problems (clone problems)

A definition for analogy problems (clone problems) and the procedure for their application are known ([47], [34]).

4.3.23 Super Effect Analysis

A definition of super-effect analysis and the procedure for its application are known [34]. Since the super-effect analysis is included as step 8 in the ARIZ-85C, the super-effect analysis can also be addressed within it [26][7][4] [5].

4.3.24 Trends of Engineering System Evolution

The Trends of Engineering System Evolution are to be understood in depth. Reference is made to [10] and [41] with the following scope:

- Trend of increasing ideality (value)
- Trend of increasing completeness of system components
- Trend of transition to the super system
- Trend of increasing trimming
- Trend of increasing coordination
- Trend of increasing controllability
- Trend of increasing flow enhancement
- Trend of increasing dynamisation
- Trend of decreasing human involvement
- Trend of uneven development of system components
- S-curve trend of evolution - advanced application: Transitional stage of the S-curve, Detailed indicators and recommendations for each stage of the S-curve, Possibility of reincarnation of the technical system. Scenarios for the return from stage 4 to earlier stages of the S-curve, pragmatic S-curve analysis. (see 4.3.17)

Further or other trends according to the following sources are also possible: [4], [29], [46], [14], [18], [19], [20], [21], [22] as well as the trend of incorporating human senses [13].

These technical trends or trends in the evolution of technical systems must be distinguished from other trends such as megatrends, trends in TrenDNA or trends in society. These do not aim at the higher development of technology and are therefore outside the trends trained in TRIZ education. These trends can be learned as a supplement, but they should not replace the above-mentioned trends.

4.3.25 TRIZ-based forecasting

Specifics of the use of TRIZ tools (FA, CECA, Trimming, FT, etc.) in TRIZ Forecast projects [34].
Further or other procedures according to the sources [29], [48] or [23] are also possible.

4.3.26 Anticipatory Failure Determination (AFD)

Anticipatory Failure Determination (AFD) [44], [47], [27], [28], is also known as Inversion Analysis or Subversion Analysis. Elsewhere it is known as Failure Anticipation Analysis (FAA) [34].

4.3.27 Patent circumvention

Level 3 teaches how patents can be technically circumvented using TRIZ methods ([46], [34]).

5 Requirements for the examination

It is the responsibility of the trainer to ensure that participants achieve the above level of understanding of the required training content. If the European TRIZ Campus learns that the trainer does not fulfil this responsibility, the trainer's certification rights will be withdrawn. Trainers must keep the tests for at least one year in case of doubts about the candidate's or trainer's abilities. Upon request, the trainer shall make the entire test available to the European TRIZ Campus.

5.1 Level of knowledge and skills for the exam

Content	Level 1	Level 2	Level 3
Creative thinking methods	A	A	A
History and development of TRIZ	A	A	A
Function analysis for products	B	C	C
Trimming for products	B	C	C
Cause-effect chains analysis	B	C	C
Ideality, Ideal Technical System, Ideal Final Result	B	C	C
Resources and resource analysis	B	C	C
Engineering contradiction, inventive principles, contradiction matrix	B	C	C
Physical contradictions and principles of separating contradictory demands	B	C	C
Catalogue of effects	B	C	C
System Operator (Nine Fields Thinking)	B	C	C
Innovation Checklist (ISQ)	A	B	C
MPV Discovery (Main Parameters of Value)	A	A	A
FOS (Function-Oriented Search)	-	B	C
Feature Transfer	-	B	C
Function analysis for processes	-	B	C
Trimming for processes	-	B	C
Substance-field analysis and 76 inventive standards	-	B	C
ARIZ-85C	-	A	C
S-curve analysis	-	A	B
Flow analysis	-	-	B
Application of analogy problems (clone problems)	-	-	B
Super Effect Analysis	-	-	B
Trends of Engineering System Evolution	-	-	B
TRIZ-based forecasting	-	-	B
Anticipatory Failure Determination (AFD)	-	-	B
Patent circumvention	-	-	B

5.2 TRIZ Basic Course (TRIZ Level 1)

5.2.1 Format

The TRIZ Level 1 test is taken as a written examination.
The test can be conducted as a presence test or as an online test. If an online test is conducted, the trainers must ensure at least by means of a written declaration by the trainees that they have conducted the test without outside help.
The test is administered in open-ended question format or in a mixture of multiple-choice and open-ended questions.
It is advised to design the test as an open-book test. This means that the examinees may use all their written, printed training materials in the test as well. The test is not intended to test rote learning, but practical application.

5.2.2 Duration

The test should take at least one hour.

5.2.3 Content

The test must ensure through its questions that the test candidate knows and can apply the content learned for the "B" classification.

5.3 TRIZ Advanced Course (TRIZ Level 2)

5.3.1 Format

The TRIZ Level 2 test is taken as a written examination.
The test can be conducted as a presence test or as an online test. If an online test is conducted, the trainers must ensure at least by means of a written declaration by the trainees that they have conducted the test without outside help.
The test is administered in open-ended question format or in a mixture of multiple-choice and open-ended questions.
It is advised to design the test as an open-book test. This means that the examinees may use all their written, printed training materials in the test as well. The test is not intended to test rote learning, but practical application.

5.3.2 Duration

The test should take at least one and a half hours.

5.3.3 Content

The test must ensure through its questions that content learned up to a rating of "B" or "C" is known to the test candidates and can be used. This includes questions from Level 1 of the training.

5.4 TRIZ Expert Course (TRIZ Level 3)

5.4.1 Format

In addition to the written test, the Level 3 test also includes a project work.
The written test can be conducted as a presence test or as an online test. If an online test is conducted, the trainers must ensure, at least by means of a written declaration by the trainees, that they have conducted the test without outside help.

The test is administered in open-ended question format or in a mixture of multiple-choice and open-ended questions.
It is advised to design the test as an open-book test. This means that the examinees may use all their written, printed training materials in the test as well. The test is not intended to test rote learning, but practical application.
The project work is a project in which the candidate selects and applies the methods learned in a meaningful way for the problem worked on. The selection is to be checked and approved by the trainer. The trainer's focus is on the methodologically correct application of the tools AND on the outcome of the project. This work should provide candidates with good solutions to their chosen problem that can be implemented. Level 3 candidates must be able to analyse and solve problems using the TRIZ methods they have learned.

5.4.2 Duration

The test should take at least two hours. The project work is best completed during the training period, but should be handed in no later than one month after the written test.

5.4.3 Content

The test must ensure through its questions that content learned up to a rating of "B" is known to the test candidates and can be used. This also includes questions from training levels 1 and 2.
The project work must show that the candidates are able to use the methods in a meaningful way to solve practical problems.

6 List of sources, references

6.1 English Literature

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