HOT TO USE TETRIS HANDBOOK

STARTING POINT

This handbook is one of the outcomes of the TETRIS Project, an initiative within the European Lifelong Learning Programme aiming at:

- identifying the educational requirements of upper-secondary schools, universities and industries from different European countries interested in the introduction of TRIZ (Theory of Inventive Problem Solving) in their curricula/training programs;
- attracting secondary school students to the study of methods and tools enhancing their creativity and supporting their problem solving skills with systematic means;
- defining an educational model suitable for addressing the heterogeneous demands of TRIZ education;
- producing and validating educational materials adaptable to heterogeneous specific situations , that can be used in a wide variety of different contexts.

The structure of the handbook has been conceived to guarantee the maximum adaptability to the heterogeneous requirements of TRIZ learners: a selected portion of the classical TRIZ Body of Knowledge has been divided into independent items, to be assembled according to specific needs and contexts of teachers, students, newcomers, practitioners.

Therefore, different readers might opt for selecting different subsets of chapters and paragraphs as described below.

The whole volume is divided into 5 main chapters related to the following topics:

1. Introduction(s)
2. Laws of Engineering Systems Evolution
3. Algorithm of Inventive Problem Solving
4. Su-Field Analysis and System of Inventive Standards
5. Tools and Principles for solving contradictions

Moreover the handbook is accompanied by an appendix with a set of exemplary inventive problems with solutions and 5 animations.

Structure of the chapters

Each chapter is related to a specific topic as detailed below; moreover, the chapters are divided into paragraphs dealing with more detailed subtopics. For example, readers interested in a general overview of the TRIZ Body of Knowledge can limit their reading to the first sections of each chapter, highlighted by means of a red bar on the side of the page. Besides, those who want to go deeper into a specific topic can study the related chapter, discarding the rest of the handbook.

Whatever is the level of detail of a topic, the related paragraph is divided into the following subsections:

- Definition: short definition of the selected Topic (hereafter referred as “T”);
- Theory: theoretical aspects related to T;
- Model: conceptual model and graphical representation of T;
- Method/Tool: operative instructions about how to use/implement T;
- Example: exemplary application of T;
- Self-Assessment: exercises to assess the reader’s level of understanding about T;
- References: further reading about T.

Education and Culture DG
Lifelong Learning Programme

Topics of the handbook chapters and related scope

Chapter 1: Introduction(s)

- The first paragraph introduces teachers and adult readers to TRIZ, explaining its rationale and expected benefits;
- The second paragraph is an introduction for students that is aimed at motivating younger readers into TRIZ study;
- The third paragraph introduces some reference concepts supporting the comprehension that can be helpful in understanding the following chapters.

Chapter 2: Laws of Engineering Systems Evolution

- The observation of the history of technical systems has demonstrated that any human artifact evolves by following repeatable patterns, despite the specific goal of such transformations. In other terms: Technical Systems evolve according to objective laws which are not dependent on the field of application or the function that the technical system is supposed to deliver. These laws govern the development of technical systems just like natural laws regulate the development of biological systems. The knowledge of genetics allows to predict the characteristics of a living organism; just like the Laws of Engineering Systems Evolution allow to anticipate future developments of technical systems.
- The second Chapter describes the 8 general Laws of Engineering Systems Evolution which can be used to analyse the level of maturity of a certain technical system and/or to guide the development of inventive solutions with an efficiently focused approach.

Chapter 3: Algorithm of Inventive Problem Solving

- System evolution implies the resolution of contradictions, i.e., conflicts between a system and its environment or between the constituting elements of the system itself. According to TRIZ research, the inventive solutions bringing a major contribution to the development of a technical system don't compromise opposite requirements. Overcoming contradictions is thus a driving force behind technology evolution and their identification is the first step of any invention process.
- The third Chapter introduces the readers to the TRIZ approach for analysing and reformulating a problem in the form of conflicting pairs of parameters (in TRIZ terms, contradictions); the step-by-step algorithm embeds the TRIZ logic and its practice progressively increases individual's problem-solving skills.

Chapter 4: Su-Field Analysis and System of Inventive Standards

- The Inventive Standard Solutions (sometimes briefly named Standards) are a system of 76 models of synthesis and transformations of technical systems in agreement with the Laws of Evolution of Engineering Systems. Together with the database of Scientific Effects and the Inventive Principles, they constitute the Classical TRIZ Knowledge Base.
- The fourth Chapter details the Substance-Field modelling approach, which is the standard TRIZ tool for modelling problematic situations; then, a selection of Inventive Standard Solutions is presented with the aim of constituting a reference list of solving techniques.

Chapter 5: Tools and Principles for solving contradictions

- Any inventive problem should be analysed according to the ARIZ logic and once that the underlying physical contradictions have been identified, and the ideal solution has been depicted, a new concept can be generated by means of the separation principles.
- The fifth Chapter describes the TRIZ principles providing the directions to overcome the contradictions of a problem modeled according to the ARIZ logic.

Appendix: Collection of examples

- The appendix contains a set of exemplary "inventive" problems with a detailed step-by-step description of the solving process until the generation of a possible solution.

Education and Culture DG
Lifelong Learning Programme

Content of the animations

The TETRIS educational material also includes a set of five animations which can be used both for attracting to the study of TRIZ and to support the explanation of the main models of TRIZ (teachers can stop the animations on the appropriate frame to describe with further details the concepts behind the short stories). The content of the animations is briefly summarized below:

<u>Animation 1: History of TRIZ</u>

- The short story shows the origin of TRIZ as a theory developed through an extensive experimental activity (fig. 1), just like other well established sciences.
- The animation also introduces the existence of Laws describing the evolution of Engineering Systems.

Fig. 1: Animation 1 – History of TRIZ

<u>Animations 2-4: Nina at school/university/work</u>

- The stories represent Nina at different ages; the main goal of the stories is to show how a systematic approach to problem solving can support the generation of effective solutions in any situation, in private life as well as at school/work. All the three problems proposed in these animations are approached by means of the same inventive principles in order to show that the same model of solution can be efficiently applied to a variety of problematic situations.
- These animations also constitute a practical support to help teachers in the introduction of some TRIZ fundamentals, as detailed below.
- Animation 2 presents the concept of contradiction (fig. 2) and the importance of rejecting any compromise solution by formulating the Most Desirable Result.
- Animation 2 also introduces the Tongs model (fig. 3): to identify the underlying contradictions it is necessary to compare the most desirable result with the currently available resources. TRIZ teaches that the identification of contradictions is a crucial step to generate inventive solutions.

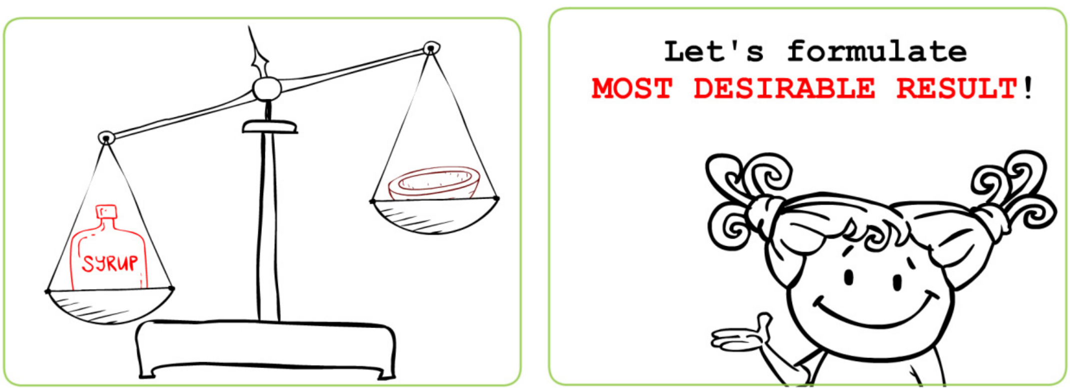

Fig. 2: Animation 2 – The concept of contradiction and the formulation of the Most Desirable Result

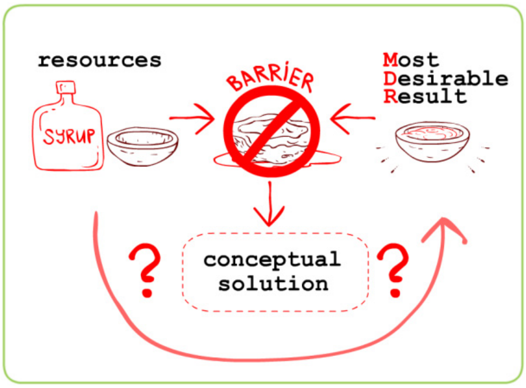

Fig. 3: Animation 2 – The Tongs model: a comparison between the current situation and the Most Desirable Result allows to identify the obstacle in the form of contradictions.

- Animation 3 adds further details to the concepts introduced in the first episode about Nina: in order to avoid the psychological inertia it is suggested to intensify the contradictions. As a consequence, radical modifications can be made as a result of adopting different perspectives (fig. 4).

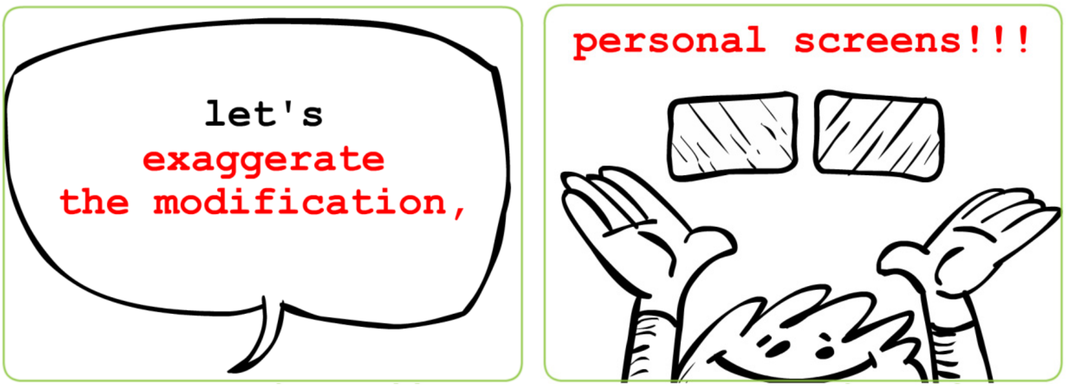

Fig. 4: Animation 3 – Exaggeration of contradictions helps overcoming psychological inertia.

- Animation 4 highlights another extremely important feature of the formulation of the Most Desirable Result: ideality suggests formulating the concept of an object of a function self-delivering the function itself, as a means to reduce the consumption of resources and to avoid harmful effects (fig. 5).
- Animation 4 provides also an extended list of products that can be associated with the Inventive Principle adopted by Nina to solve the problems described in these short stories.

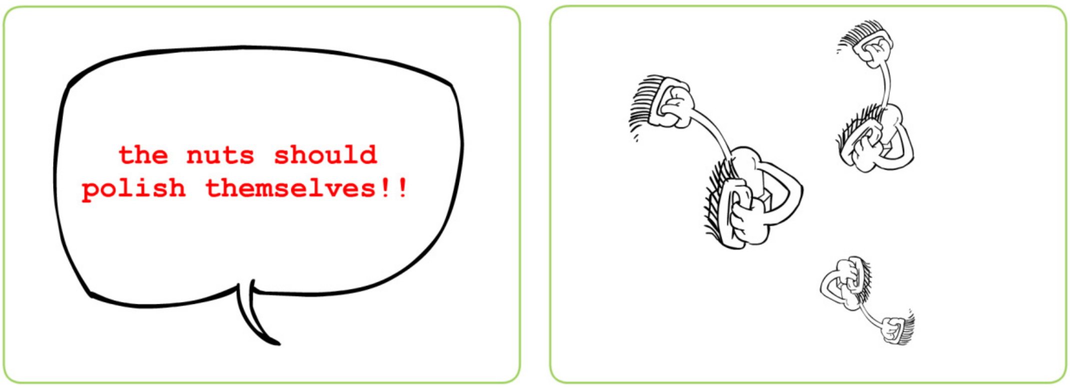

Fig. 5: Animation 4 – Ideality helps overcoming the psychological inertia and draws the attention to the cheapest and most efective solution.

Animations 5: Theory of Inventive Problem Solving

- The last animation summarises the concepts introduced in the previous ones and introduces some further elements of the TRIZ Body of Knowledge.
- The first part continues the analogy between TRIZ and other sciences proposed in the first animation; just like genetics allows to predict the evolution of a living organism, TRIZ helps anticipate the evolution of technical systems (fig. 6).
- The animation can also support teachers when introducing the System Operator (fig. 7) as well as Su-Field Modeling and Inventive Standards (fig. 8).

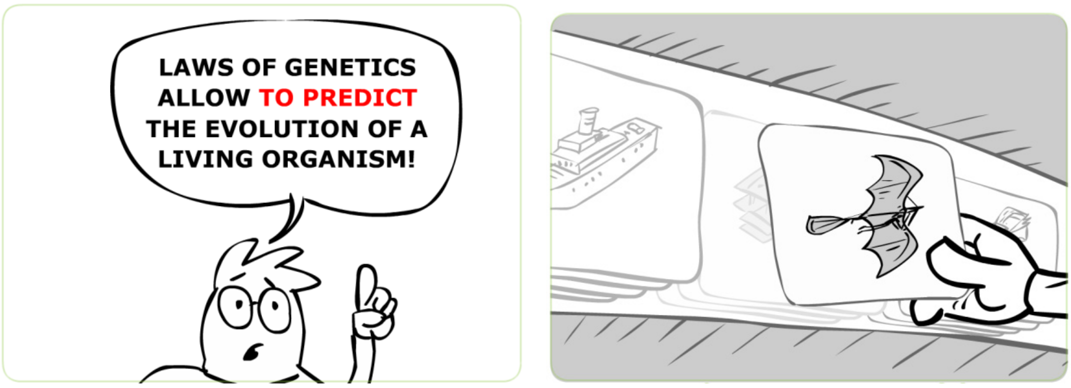

Fig. 6: Animation 5 – Ideality helps overcoming the psychological inertia and draws the attention to the cheapest and most efective solution.

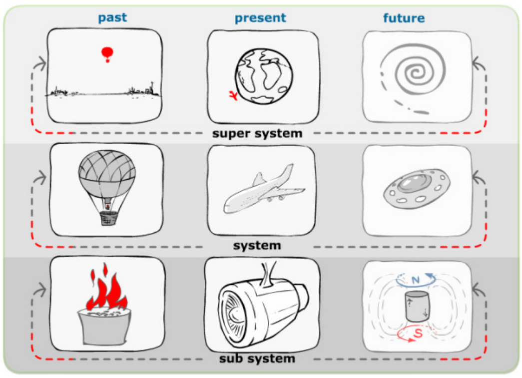

Fig. 7: Animation 5 – System operator: the TRIZ approach to system thinking.

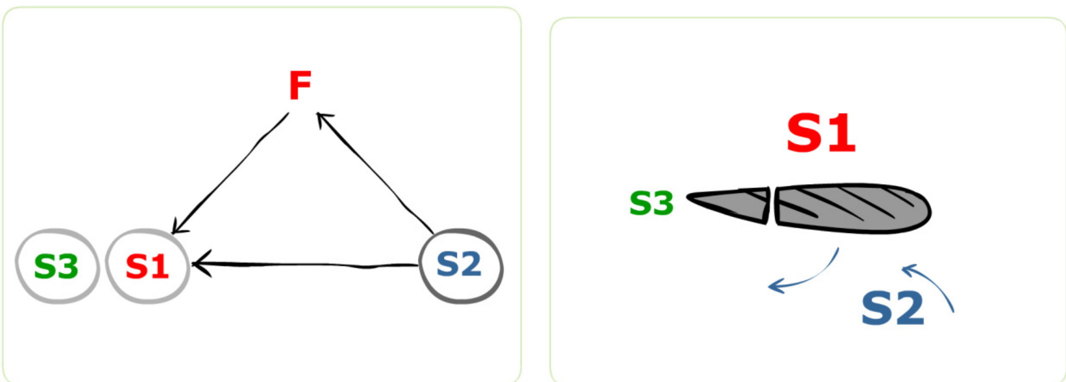

Fig. 8: Animation 5 – Su-Field modeling and Inventive Standard Solutions.

Education and Culture DG
Lifelong Learning Programme

Future of TETRIS Project

The TETRIS project is the first attempt to create a unified multi-language training material to be used by teachers, students, trainers, professionals and interested readers as an alternative to multiple fragmented TRIZ education materials today available.

It is worth noting that all these materials can be freely copied and distributed provided the copyright notice remains intact. This also applies to the partial use of the handbook.

The TETRIS project team has not aimed at the development of a comprehensive set of materials to cover the whole Classical TRIZ Body of Knowledge, thus the TETRIS materials can be supplemented and improved. Those who would like to contribute to the translations into other languages, as well as to the improvement or integration of the present materials are invited to contact the project coordinator.

Education and Culture DG
Lifelong Learning Programme