Full Immersion TRIZ in Education

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Full Immersion TRIZ in Education

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Abstract

Within the University of Twente, the Netherlands, TRIZ is seen as a powerful methodology that stimulates students in investigating innovative solutions during the product development process. The TRIZ methodology has been part of the Twente curriculum for many years, mainly as small parts of courses and projects. In 2009, TRIZ was presented as an 84 or 140 hour master course for the first time. The course organisation differs from regular university courses both by subject, timing and intensity. The course was offered during the summer break within two weeks, with a workload reaching 10+ hours a day. This paper describes the course itself, course results and the student evaluation of the course.

Keywords

TRIZ, TRIZ in education, TRIZ fundamentals and assignments

1 INTRODUCTION

This paper discusses the educational TRIZ programme as taught at the University of Twente. Until recently TRIZ was not taught extensively within our engineering curriculum. Although, small parts of TRIZ focussing primarily on the creative process were presented to the students as part of other courses.

The abstract notion of the "design aspects" of the engineering curriculum has traditionally been on structuring of the problem under design, breaking it down into manageable sub-problems and providing a stepwise approach to go from basic requirements to a final product or solution. In other words, a structured academic problem solving approach is taught. Examples of globally accepted design tools are amongst others: the systematic approach of Pahl and Beitz [1], Total Design by Pugh [2], Axiomatic Design by Suh [3], Quality Function Deployment (QFD) [4] and robustness techniques as Taguchi's methodology [5]. Especially at the Bachelor's level, engineering exercises, where these tools must be applied repeatedly, are practised by the students mostly in project groups. Undoubtedly, this will remain an important aspect of an engineering curriculum.

Today, however, nobody would argue against the fact that knowledge of innovation and the ability to innovate have also become key competencies of a technology specialist. Especially with the continuous globalization and potential competitors emerging worldwide, being one step ahead of the competition is essential to survive as a business.

Rapid dissemination of TRIZ – supporting the innovation process based on best practices – among world-leading industrial companies has demonstrated a higher effectiveness compared to other innovation methods. Perhaps, the main advantage of TRIZ is that while other methods are limited to answering the question: "What to do?" TRIZ targets answering both questions: "What to do?" and "How to do it?" This is possible due to the knowledge-based nature of TRIZ. Other publications have also considered the synergy between TRIZ, QFD and Taguchi's robustness methodology as *the* ideal design process [6, 7]. This synergy combines specific characteristics needed in product design: customer orientation (QFD), engineering (TRIZ) and optimization of parameters (Taguchi). In [7] this interaction was artistically represented as shown in Figure 1: TRIZ, Taguchi and QFD together present the solution to the "design" puzzle.

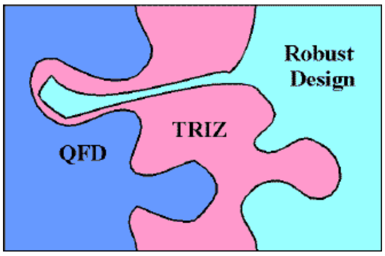


Figure 1: Synergy between QFD, TRIZ and Robust Design techniques [7].

1.1 Development of TRIZ education

The growing interest in TRIZ is generating a market demand for professionals skilled in TRIZ techniques. Today most of TRIZ education is provided in-house, usually at companies of relatively large size. However due to numerous constraints imposed by the industry (especially regarding time) the capacity of such education is rather low. A solution to meet the expected demand is to introduce formal TRIZ education at the higher education level. This primarily concerns those countries that are urging to remain competitive in the areas of technological innovation and innovative business services. Therefore an adequate level of TRIZ education should be provided at the academic institutes of such countries.

Modern TRIZ is a complex discipline, which in fact consists of two major areas: (1) a theory explaining how inventive problems are solved and (2) a theory explaining how technical systems evolve. Each of these theories has been used to introduce a number of methods and tools to support the execution of various innovative tasks ranging from solving a specific narrow problem to technology forecasting and road mapping projects within interdisciplinary fields. Although many inventive problems can be solved with the use of relatively simple TRIZ tools (e.g. Contradiction Matrix and 40 Inventive Principles), a broad class of more difficult, non-typical problems requires a deeper understanding of the driving forces and mechanisms of innovation that were uncovered by TRIZ research.

Therefore, if one sets up a goal to study (or teach) TRIZ comprehensively, it is clear that the learning process will take considerable time. For instance, obtaining a Level 3 certificate from the International TRIZ Association (MATRIZ) requires on average 120-160 hours of study. The MATRIZ Level 3 certificate certifies the knowledge of classical TRIZ tools and some modern tools [8]. In addition, as TRIZ is also evolving and its body of knowledge increases continuously, static training is not sufficient; rather continued education and training should be practiced.

1.2 Set-up of traditional TRIZ programmes

Traditionally, in the countries of the former USSR, where classical TRIZ was developed, it was taught mostly at workshops delivered by independent vendors and TRIZ experts (the period of 1970-1990 [9]). A typical face-to-face TRIZ workshop lasted from three to four weeks (approximately 160 hours) and was intended for professional engineers and scientists. Although the workshops included some practical work (usually given as an evening work after 8 hours of daily training), the workshops were mostly performed in a purely lecturing format. It helped to understand the evolution of TRIZ, its basic principles and learn a TRIZ approach to inventive problem solving rather well. It did however not really develop practical skills with the different TRIZ tools. Practice was supposed to be gained at the personal workplace after the workshop. In reality, after trainees had left the training workshop and returned to their regular tasks, they did not have much time to practice TRIZ and therefore their knowledge did not turn into active use. TRIZ education in the former USSR was not part of the formal university curricula except for some short facultative courses. As aforementioned, this is comparable to our recent engineering curriculum.

After TRIZ became recognized outside the former USSR, the first TRIZ training workshops in the USA and Western Europe were introduced (the period of 1990-2000). They were given mostly on a commercial basis and inherited a similar, lecture-based format. The target audience consisted of working professionals as well (e.g. engineers, innovation specialists and consultants). Despite the excitement of trainees during the workshops, when left alone they often experienced serious difficulties when applying TRIZ to real-life problems, especially problems that required solutions of high levels of the TRIZ classification of solutions. Gradually, it became clear that to increase the degree of practical effectiveness, TRIZ lectures had to be complemented with a sufficient load of practical work performed by the trainees in a training class under monitoring and supervision of a TRIZ teacher (trainer). However this solution raised another problem: teaching such a full-length TRIZ course for a professional audience appeared to be almost impossible due to the large number of hours which must be invested. This contradiction – the invested time of education versus the degree of quality of education – has to be resolved.

1.3 Solving the contradiction: state-of-the-art

Until now, the contradiction mentioned in the previous section has been solved by various TRIZ vendors in three ways:

1. Reduction of TRIZ to "stripped" versions that contain only a few TRIZ tools or even only some generalized parts of the tools. These tools can be easily taught (e.g. SIT, ASIT). The versions can be learned rather fast: within 4 to 16 hour programs. However their problem solving and idea generation power is also reduced proportionally. In fact, the stripped versions do not eliminate the contradiction; instead they try to compromise with a foreseen lack of desired result.
2. Introducing modular TRIZ trainings and developing new supporting tools and processes that accelerate the learning process. At the same time, due to the modular approach, the existing power of TRIZ is not impeded and several short trainings can be set up consecutively. This direction seems to be more promising, but it also demands further research on better structuring of the TRIZ body of knowledge.
3. Introducing TRIZ within educational environments as schools, colleges and universities. Here, relative long training programs are acceptable. However, problems are often solved in a simulated environment.

To us, a combination of directions 2 and 3 seems to be most promising, as these do not impede on the level of educated knowledge.

During the last decade, the use of TRIZ worldwide has increased manifold, especially in Asian-Pacific countries due to the heavy use of TRIZ in their hi-tech industries. Nevertheless, academic organizations and universities have been quite slow in introducing TRIZ into their curricula and tend to leave innovation to the students creative talents [10].

1.4 Current TRIZ education in academia

As reported by the European TRIZ Association (ETRIA) [11], today approximately 50 universities worldwide offer some form of TRIZ education at various levels. The majority of them focus either on several awareness-level lectures on TRIZ (2-4 hours, e.g. the University of Groningen, The Netherlands) or they offer introductory TRIZ learning with two or three classical TRIZ tools (up to 30 hours, e.g. the Technical University of Liberec, Czech Republic). The most extensive program reported is available at the National Institute of Applied Sciences (INSA) in Strasbourg, France. It covers 175 hours of TRIZ training [12]. However, as INSA's TRIZ program is part of a specific master programme, it is not available to other students.

A worldwide survey of TRIZ perception and usage conducted in 2009 [13] indicated that the vast majority of college and university education of TRIZ is based on programmes ranging from 0 to 40 hours. The dispersion of the hours is shown in Figure 2. According to what has been said above, this is certainly not enough to develop a sufficient level of TRIZ knowledge and skills.

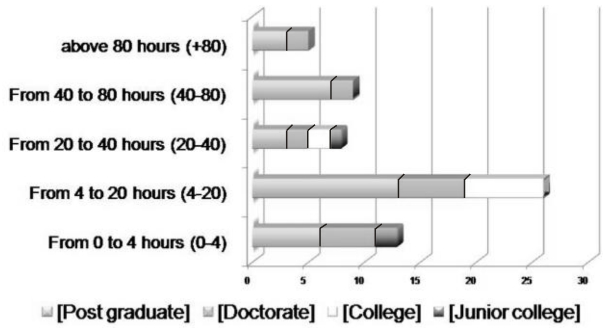


Figure 2: Hours of TRIZ training available worldwide for several educational levels [13].

1.5 TRIZ education and psychological inertia

The difficulty of teaching TRIZ is increased by the fact that knowledge of TRIZ tools and processes alone is not enough to create new effective ideas. All idea generation tools in TRIZ require creativity. While TRIZ provides guidelines towards obtaining abstract solutions, specific solutions have to be generated by people and this step requires the application of their creative thinking skills. As pointed out by Altshuller, creativity is obstructed by a certain barrier and the older (and more experienced) people are, the more difficult it is for them to stay open minded and think outside the box. The best time to develop our creative thinking skills is in fact when we are still young. This was also concluded by psychological studies done at the beginning of the previous century [14]. At that time, studies already indicated that the peak of our creative imagination is when we are between 12 to 16 years old.

The major reason why our creative skills decrease rapidly after our juvenility is that we gain too much so-called "psychological inertia" or fixed mental associations and other mental barriers. This is partly due to our standardized educational system preventing us from thinking beyond known things, ideas and concepts. Creativity is a skill which can – and must – be developed. A conclusion is that, as also noted by Altshuller, the earlier a person starts learning TRIZ and develops creative thinking skills, the higher the chance that this person will be able to resist psychological inertia during his or her lifetime [9].

Within this paradigm introducing TRIZ at universities, especially within the context of a specific study subject, seems to be a right direction. On a side note, there is also work being conducted that is dedicated to teaching principles of strong thinking based on TRIZ and OTSM-TRIZ to adolescents. The Jonathan Livingston project [15] focuses in TRIZ education from preschool to post graduate students, while the TETRIS project [16] focuses on secondary schools, universities and also companies. These projects are however not the subject of this paper.

Learning TRIZ within the university environment appears to be useful not only for acquiring knowledge and skills on how to deal with technical innovation, but also on improving general problem solving skills. As mentioned by Belski [17], 97% of students who completed the TRIZ course at the Melbourne University in Australia reported that their confidence in the ability to solve any problem had grown after the course (versus only 9% of the students that were confident in their problem solving capabilities before the course).

2 TRIZ PROGRAMME AT TWENTE UNIVERSITY

The decision to introduce the “TRIZ for Technology and Engineering” course at the University of Twente was made in the spring of 2009. The target audience consisted of primarily B.Sc. and M.Sc engineering students, primarily from our university, but the course was open to students from other European universities as well.

2.1 Set-up of the programme

Formally, the programme is split up into two independent courses. The first course – TRIZ fundamentals – is to educate and familiarize students with general TRIZ methods and techniques. This course ranges from classical problem solving techniques to innovation management and forecasting of next-generation products. The second course – TRIZ assignments – forces students to apply their TRIZ knowledge on an industrial application. We believe that this latter course is a unique part of our full immersion TRIZ experience.

Since one of the authors of this paper has extensive experience with the development and delivery of TRIZ courses for industry and public organizations (more than 100 training courses have been given), it was decided to license and adapt the existing professional courses and courseware developed for intensive learning of basic and advanced TRIZ. To accelerate the learning process, a number of techniques developed by the author were included into the program in addition to classical TRIZ techniques.

2.2 TRIZ fundamentals

The first course offers a two-week “full immersion” study in an auditorium (lectures plus educational practice) as shown in Figure 3. The second course is complementary and demands the students to perform a project for an industrial organization by applying the knowledge and skills acquired during the first course. A result of the second course must be a real inventive solution for the industrial partner organization.

The first course of the TRIZ programme was set-up such that students understand and comprehend the logical links between the various parts that TRIZ encompasses. After finishing the programme the students should have an overview of the overall structure of TRIZ and on innovation in general. Focus is put on classical TRIZ tools as well as recent developed TRIZ tools. In this way, students have a complete toolset for problem solving and innovation forecasting activities. The entire course programme is shown in Appendix A.

Figure 3: Two-week “full immersion” TRIZ at the University of Twente.

The course is performed in the beginning of the summer period. It lasts for two weeks in a row with a break on the weekend. This allows the students to fully concentrate on learning TRIZ and avoids any other (academic) distracting factors. Each day of the course (except for the first day) is split into three parts:

1. Presentation of the results of the student assignments of the previous day (10-15% of the day).
2. Lectures, introducing new material (40-50% of the day).
3. Execution of a new student assignment (40-50% of the day).

In practice however “working days” lasted much longer than the 8 hour minimum.

2.3 TRIZ assignments

In 2009, the TRIZ assignments part of the course used a worldwide design competition as the design problem handed to the students. The Staples® Global Ecoeasy Challenge [18] focuses on design teams from universities and challenges the students to design an environmentally preferable business or home office product that meets one of the following criteria:

1. A new design for an existing product that represents greater sustainability.
2. A product or product line that uses an eco-innovative material.
3. A completely new type of product that promotes sustainability.

Students were left free in their choice of product, TRIZ tools and TRIZ methods. The results of the student teams' efforts are discussed in Section 3.

3 EXAMPLES: PRACTICAL STUDENT WORK

This section will give a brief summary of the practical work the students performed. The students worked in groups of three and each group could choose the subject of their work themselves. Hence, most problems lay in the interest areas of the students.

This summary of results of practical work can also be used to create reference material for TRIZ development and future education. As TRIZ is often used for industrial cases, reference material is often company restricted; however, classroom material can well be presented. Obviously not all student work can be addressed in this section. It will however be an initiative to gather such information and manage it in a presentable form.

3.1 Root conflict analysis (RCA+)

The root conflict analysis is a tool that helps managing complexity of inventive problems by identifying all contradictions composing the problem. Also relations between the contradictions should be identified. Students were asked to formulate a general negative effect and build their RCA+ diagram from this negative effect. Finding underlying causes of the negative effect can generally be found by asking yourself: "What causes this effect to occur?"

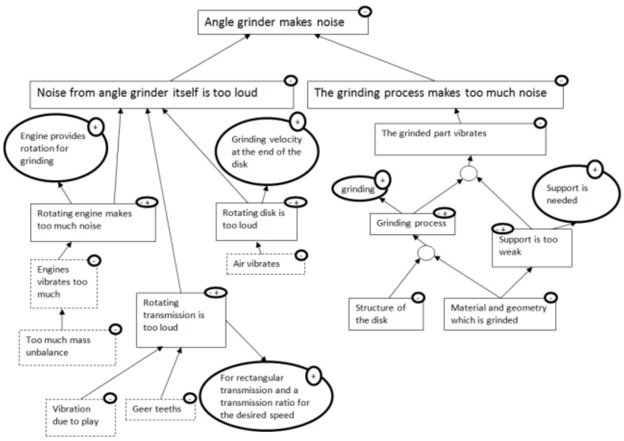


Figure 4: Symbolic illustration of a root conflict analysis as executed by the students.

Figure 4 presents one the constructed diagrams. This group focused on the fact that angle grinders produce a lot of noise during operation. According to their findings the negative effect could be caused by two underlying negative effects, namely the fact that either the angle grinder itself is too loud or the grinding process makes too much noise. Moving down the diagram, students realize that there are many contradictions (or trade-offs) to be found in almost any product.

Forcing yourself to fully construct such a diagram first, helps to get a comprehensive overview of the problem space. The danger of jumping to solutions is that you might not be focussing on the right part of your problem. This is also referred to as "cut and run" engineering in Pugh's Total Design theory [2]. As a result usually solutions still consist of trade-offs.

3.2 40 Inventive Principles

Any of the technical contradictions identified by the RCA+ diagram can be resolved by applying one of the 40 Inventive Principles. These are the principles that were identified by Altshuller's patent research [19].

Both the positive and negative effects of the technical contradiction should be mapped onto the contradiction matrix. This requires some form of abstraction as only 39 generalized technical parameters are possible. Finally, the intersection will give the most likely inventive principles.

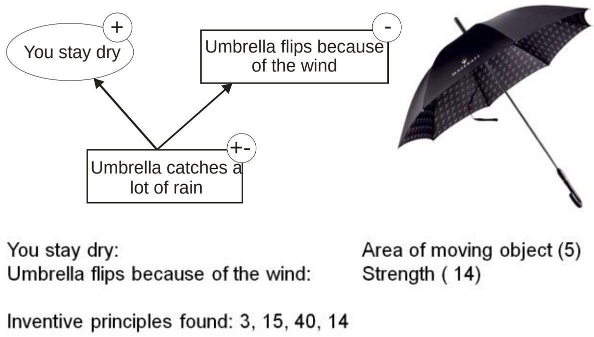


Figure 5: Applying Inventive Principles to find abstract solutions for the problem.

Figure 5 shows one of the contradictions the students tried to resolve. In this case, they concentrated on the fact that umbrellas tend to invert due to the wind (negative effect). On the positive side, the umbrella keeps you dry when it rains. After applying the inventive principles, the students were able to find several solutions. For instance, for Inventive Principle 3 (local quality), wind flaps could be added or the umbrella could be able to rotate in the direction of the wind. These solutions share in fact ideas with the Senz umbrella developed and patented by 3 Delft engineering students in 2005 [20].

3.3 Function analysis

Another method to gain insight into the problem space is to perform a function analysis. Each component of a system should be put in a diagram. Then between all components both existing and possible interactions should be identified. Each interaction can be labelled as either useful, harmful, insufficient, poorly controlled, excessive or missing. Even for a relatively simple device, for instance a coffee cup, already many interactions can be described.

The resulting function diagram is very useful when redesigning a product. Harmful, insufficient, excessive or poorly controlled interactions could be removed from the diagram to improve the system or interactions can be trimmed from the diagram to remove superfluous functionality. As the RCA+ diagram, making a complete function analysis also prevents you from jumping to solutions without over viewing the entire system.

3.4 76 Inventive Standards

Next to the 40 Inventive Principles, also the 76 Inventive Standards help to find abstract solutions for problems. They suggest system improvements by introducing or replacing a component of the system. Hence, for this it is helpful to perform a function analysis first since substance-field models used in the 76 Inventive Standards can be drawn directly from function models. The 76 Inventive Standards are generic solution patterns that indicate how to change the physical structure of the system in order to improve it.

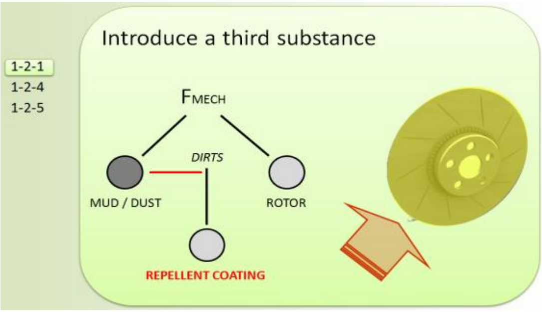


Figure 6: Application of Inventive Standard 1-2-1 to prevent a rotor from getting dirty.

The solution patterns are presented as substance field (Su-Field) models. Basic Su-Field models consist of three components that form a minimal model of a technical system. Figure 6 presents an example of such a Su-Field model. The model graphically explains the reasoning of Inventive Standard 1-2-1. In this case the students tried to find solutions to prevent the rotor of a braking system from getting dirty; for instance by applying a repellent coating.

3.5 Trends and lines of evolution

During the TRIZ course also two days were dedicated to describing the technical evolution of systems. Several tools were discussed, for instance S-curves, evolutionary potential analysis and value-conflict mapping.

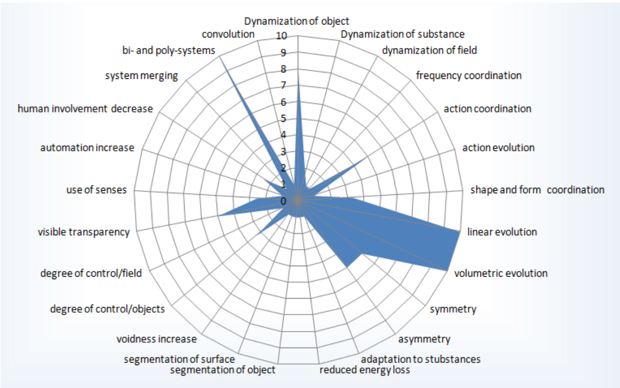


Figure 7: Radar plot of the line of evolution for a tent.

The students were challenged to invent a next generation product by applying the presented tools. For instance Figure 7 presents a radar plot for a camping tent. From this plot it was concluded that viable areas for improvement lay in the area of shape and form coordination, action evolution and asymmetry. Several drawings and ideas were generated; for instance “cylinder tents”, “360° entrance tents” or “high ventilation tents” amongst others.

As the radar plot only gives hints to possible improvement areas, students are really forced to be creative. During the course they also expressed this and thought this should be done in other (regular) courses more often.

3.6 ARIZ

The last portion of the programme was dedicated to teaching ARIZ, the algorithm of solving inventive problems. ARIZ should be applied when both the 40 Inventive Principles and the 76 Inventive Standards have not resulted in an acceptable solution. The algorithm describes several steps that must be taken to move from an ill-defined situation to a specific problem and finally towards to generation of solution ideas.

An important aspect of ARIZ is to free yourself of barriers caused by your psychological inertia. One of the steps, involving the method of the miniature dwarfs as shown in Figure 8, was welcomed with much enthusiasm by the students. Again this step forces students to be creative.

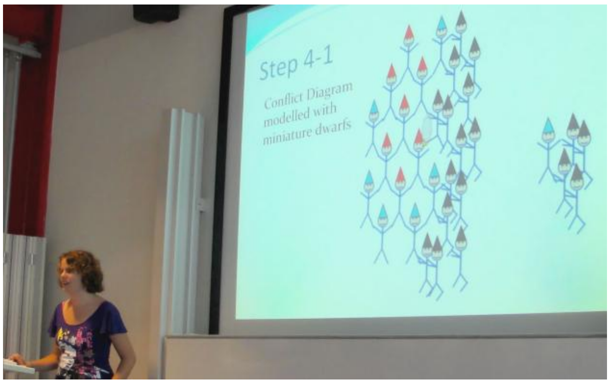
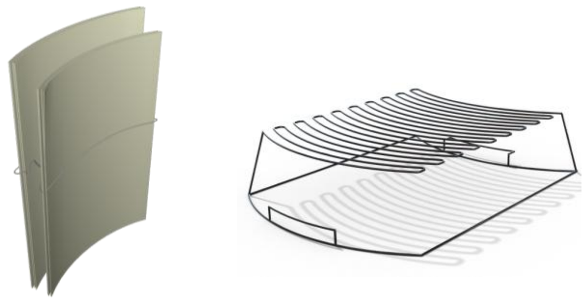


Figure 8: Student presentation of ARIZ: Step 4-1.

3.7 TRIZ assignments

Two teams entered the Staples ® Global Ecoeasy Challenge [18]. Team 1 focused on functional analysis, trimming, Su-Field modelling and the 76 Inventive Standards. In combination with 8 eco-efficiency rules, they identified 3 potential products to improve. The final product they analyzed and improved was the plastic trays for storing papers. The principle “another dimension” led to using a metal clip to bend the paper so the paper could both be bundled and stand upright. Their concept solution is presented in Figure 9. The idea was further developed into a product that scored well on 5 of the 8 eco-efficiency rules.



a) solution principle b) final product

Figure 9: Concept of student team 1.

Team 2 had a less structured approach. They focused on products where human movement and mass could be used to generate and/or replace electrical energy. Two products were defined in more detail: (1) a mat to put on staircases that would utilize piezoelectric components to generate electricity and (2) a human powered paper shredder that was also used in combination with the staircase.

4 COURSE EVALUATION

Since this paper discusses mostly the first course “TRIZ Fundamentals”, we will limit ourselves to presenting the results of this particular module. The results of the student evaluation of the course were rather positive, especially if you compare them to regular course evaluations. This also led to the decision to repeat the course the following year. One of the after-course comments by the students was: “On average, we were busy until 22:30h”. This certainly indicates a high degree of engagement of the students with the course. Officially the training day was finishing at 17:30h. In general, also almost every student showed a lot of interest and motivation during the course and each group of students was capable of generating effective inventive solutions throughout the course.

As a result of the course, the students have acquired the following:

- Understanding TRIZ, its structure, the general picture and directions of its evolution
- Understanding the nature and driving forces of innovation
- Learning a systematic approach to the front-end of innovation
- Ability to apply analytical TRIZ tools to analyze systems and correctly formulate problems in terms of functions and contradictions
- Ability to apply analytical TRIZ tools to create maps of complex problems
- Ability to use TRIZ problem solving tools to solve inventive problems
- Ability to apply TRIZ tools for systems evolution analysis and forecasting next steps in evolution
- Ability to tackle mental (psychological) inertia and stimulate creativity.

Despite a good level of TRIZ knowledge, a lot of practice is required to achieve the level of a confident TRIZ specialist. This task is partly covered by the second “TRIZ Assignments” course, as well as other types of student projects where they will be able to use TRIZ.

Interesting to note is also the fact that some of the students who completed the course are now interested in internships, master assignments and even jobs after graduation related to innovation and TRIZ. They feel that TRIZ also strengthens their personal career.

At the moment of writing this paper the course has been executed for the second time with double the number of students participating.

5 CONCLUSIONS

This paper describes the theoretical and practical course on TRIZ, currently being taught at the University of Twente, the Netherlands. Both the course goals, structure and student results have been presented. The course evaluation showed that the students were very satisfied with the current set-up. This conclusion is also supported by the growing interest in the course. Most importantly however, students have indicated that the set of TRIZ tools and TRIZ methods helps them to find solutions of which the originality surprised the students themselves.

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APPENDIX A

The entire two-week “full immersion” course programme.

DAY 1	DAY 2	DAY 3	DAY 4	DAY 5
GOAL: Understand basics and key principles of TRIZ: evolution, contradictions, ideality, problem solving.	**GOAL:** Understand and learn RCA+ (Root Conflict Analysis)	**GOAL:** Understand, learn and practice Contradiction Matrix and 40 principles, Ranking and Evaluation techniques.	**GOAL:** Understand, learn and practice with Function Analysis	**GOAL:** Understand, learn and practice Substance-Field Modeling, and a System of 76 Inventive Standards
CONTENT: • Inventive problems and innovative situations. • Psychological inertia and barriers to strong solutions. • Triggers of innovation. • Systematic approach to idea generation. • Introduction to the TRIZ background and key principles of Systematic Innovation. • Systems evolution via contradictions resolution. • Key principles of problem solving; criteria of “right” solutions. • Ideal Final Result and Ideality-Value Formula.	**CONTENT:** • xTRIZ Roadmap. • xTRIZ Basic Problem Solving and Conflict elimination Process. • General innovative principles and patterns for contradiction elimination. • **Root Conflict Analysis (RCA+):** problem modeling and building contradiction maps. • Rules of selection of contradictions from RCA+ models.	**CONTENT:** • Use of Resources. • **40 Inventive Principles** • **Contradiction Matrix** for systematic access to 40 Inventive Principles. • Generating ideas with 40 Inventive Principles. • Idea combinations and building an Ideas Portfolio. • Different versions of Contradiction Matrix. • Ranking and landscaping ideas	**CONTENT:** • **Function Analysis:** system modeling on the basis of functional interactions. • Discovering existing and potential problems and challenges from functional system models. • Comparative Ranking and selecting problems to solve. • Catalogues to Scientific Effects • Functional hierarchy and Rules of Functional Idealization.	**CONTENT:** • **Substance-Field Modeling and Analysis** • Substance-Field Resources • System of **76 Inventive Standards** • Evolutionary structure of the system of 76 Inventive Standards: link with Trends of Technology Evolution • A tree and navigation among 76 Standards • Problem Solving with Inventive Standards
PRACTICE: Exercises: kick-off exercises; generating ideas with a morphological matrix; fighting mental inertia; recognition and formulation of innovative problems.	**PRACTICE:** Practice with selecting a problem, building RCA+ diagram of the problem, identifying contradictions with RCA+, ranking contradictions.	**PRACTICE:** Practice with customer projects: solving specific problems extracted from RCA+ with 40 Inventive Principles, and generating Idea Portfolios.	**PRACTICE:** Practice with building functional models of systems, identifying problems and challenges, selecting problems to solve	**PRACTICE:** Practice with application of a system of inventive standards to solve problems and generate new ideas to innovatively improve systems.

DAY 6	DAY 7	DAY 8	DAY 9	DAY 10
GOAL: Understand and getting an overview of a system of TRIZ Laws and Trends of Evolution	**GOAL:** Learn Value-Conflict Mapping	**GOAL:** Understand and learn the first parts of ARIZ-85C (Algorithm of Solving Inventive Problems)	**GOAL:** Continue learning and practicing with ARIZ-85C (Algorithm of Solving Inventive Problems).	**GOAL:** Getting an overview of a contemporary TRIZ, TRIZ software, how TRIZ is used in real projects.
CONTENT: • Technology Evolution models: S-curve, Bell-Curve, change of parameters of value, investment decisions. • Evolution towards local ideality and adaptive variation of technologies and products. • **Technology Evolution Laws, Trends and Lines** • Strategies of Technology Evolution • Process of Evolution Forecast • **Evolutionary Potential Analysis** and radar plots to explore product’s evolutionary potential.	**CONTENT:** • **Value-Conflict Mapping:** linking customers, market, and technology demands, identification of Contradiction Trees and system parts to evolve • Assessment of Contradiction Trees and selection of best candidates for further development and improvement	**CONTENT:** • Introduction to the logic and philosophy of **ARIZ** (Algorithm of Solving Inventive Problems) • Use of RCA+ with ARIZ. • Explanation of first parts of ARIZ: Problem modeling, Mini-problem, Conflict Diagrams, Dealing with psychological inertia, Resource Analysis, Technical and physical contradictions, types of Ideal Final Result (Parts 1-3 of ARIZ-85C).	**CONTENT:** • Explanation and process with further parts of **ARIZ**: • Macro- and micro-physical contradictions • Modeling with miniature dwarfs, • Principles of physical contradiction elimination • Obtaining most ideal solutions • Analysis of a problem solving path. (Parts 4-6 of ARIZ 85-C)	**CONTENT:** • Contemporary TRIZ, versions of TRIZ • TRIZ Supporting Software • TRIZ for creating patent portfolios, patent umbrellas, and patent circumvention • **Creative Imagination Development** techniques (video course) • Aspects of TRIZ use and implementation • Integration of TRIZ with other methods (QFD, DFSS) • Discussions, questions and answers.
PRACTICE: Practice exploring its evolutionary potential and generating radically new ideas.	**PRACTICE:** Practice with Value-Conflict Mapping. Selection of a subsystem to evolve. Application of lines of evolution to a selected subsystem.	**PRACTICE:** Practice with the first parts of ARIZ.	**PRACTICE:** Practice with ARIZ and the principles of physical conflict elimination to find most ideal solutions to problems.	